STANDARD SPECIFICATIONS

FOR

MUNICIPAL PUBLIC WORKS CONSTRUCTION

Prepared By

WASHINGTON STATE CHAPTER

AMERICAN PUBLIC WORKS ASSOCIATION

1969

ENGR. DEPT. C & R/W

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FOREWORD

This, the second edition of Standard Specifications for Municipal Public Works, is a consolidation of the 1963 edition and the 1964 separate edition of Structural Specifications. This 1969 edition has been prepared by the Washington State Chapter of American Public Works Association (APWA). It is financed and published by authority of the Washington State Highway Commission with funds allocated by law for cooperative endeavors by the State with the counties and cities.

Following the publication and use of the 1963 edition, a number of engineering departments of the principal cities prepared supplements wherein were incorporated certain revisions and additions found advisable from their local engineering and construction experiences. Principally, upon basis of these supplements a considerable number of revisions have been incorporated with the original text to make the specifications more responsive to present practices. Some of the changes reflect revisions since made by the Department of Highways in specifications common to highway and municipal construction. A number of engineers of the Department of Highways collaborated with the committees in this work.

The work of compiling the new edition was directed by the Construction Standardization Committee of the Washington State Chapter APWA. Nine separate subcommittees involving 76 engineers, consultants, contractors, and materials suppliers were actively engaged in conferences for several months in reviewing the text of the 1963 edition and the proposed revisional drafts in the above-mentioned supplements. Each subcommittee was assigned a particular sphere, such as asphalt pavement, cement concrete pavement, sewers, watermains, et cetera, and each subcommittee made its determinations, subject to consistence with the work of other committees.

Specifications and drawings will never become static, and it is not presumed that this edition is without some faults. This edition is, however, another step toward the goal of the Washington State Chapter APWA for uniformity of engineering and construction practices among municipalities in the State of Washington for the purpose of stretching public works funds.

This FOREWORD would be incomplete if we were not to express our appreciation to the 76 members of the committees who sacrificed time, and often personal expense, in attending the committee deliberations.

Special appreciation is due, also, to several public agencies for their exceptional contributions to the project. Among them are the following:

To the Office of City Engineer of Seattle, for assigning an engineer to attend all committee meetings, for circulating the committee determinations among the Chapter members for their information, and for otherwise assisting in the correlation of subject matter and drawings.

To the Office of City Engineer of Tacoma, for assuming the responsibility of distributing the copies of the new edition to the cities and towns and to other individuals and organizations who will have occasion to use them.

To the Office of City Engineer of Olympia, for providing office space and other facilities for the coordination and editing of the new edition.

EDITOR

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DIVISION I—GENERAL REQUIREMENTS AND COVENANTS

Section 1—Definitions and Terms

In the interpretation and construction of these specifications and the contract, or in any documents or instruments dealing with the construction operations governed by these specifications, the following words, terms and abbreviations, or pronouns in place of them shall each be construed as defined below.

1.01 OWNER

The city, or other municipality, acting through its legally constituted officials, officers, or employees.

1.02 ENGINEER

The city engineer, or an engineer of a municipality, including such assistants as are authorized to represent him.

1.03 CONSULTING ENGINEER

A licensed engineer or an authorized member of a licensed consulting firm or organization retained by the Owner for design and supervision of specific public work projects.

1.04 INSPECTOR

The inspector or inspectors of the Owner who are placed in supervision of any part of the inspecting or engineering work with authority limited to the particular duties entrusted by the Engineer.

1.05 SPECIFICATIONS

The directions and requirements of the standard specifications as contained herein, as supplemented by such special provisions as may be provided, pertaining to the manner of performing the work or the quantities and quality of materials to be furnished under the contract.

1.06 SPECIAL PROVISIONS

The special provisions are contract requirements peculiar to the project and which are not otherwise thoroughly or satisfactorily detailed and set forth in the standard specifications.

1.07 SUPPLEMENTAL SPECIFICATIONS

Supplemental specifications are those adopted subsequent to the standard specifications and generally involve alterations and new construction items, or substantial changes in the standard specifications.

1.08 PLANS

The official drawings, plans, profiles, typical cross sections and supplemental drawings, or reproductions thereof, approved by the Engineer, which show the location, character, dimensions and details of work to be performed. All such documents are to be considered as a part of the plans whether attached to the specifications or separate therefrom.

The terms "standard drawing," generally used in the specification text, and "standard plan," generally appearing in the titles of drawings, are synonymous for reference purposes.

1.09 BIDDER

An individual, firm, copartnership or corporation, or combination thereof, submitting a proposal for the work contemplated and acting directly or through a duly authorized representative.

1.10 PROPOSAL

The written offer, or copy thereof, of the bidder to perform the work proposed, properly signed and guaranteed.

1.11 PROPOSAL GUARANTY, BID BOND

Cash, bid bond, cashier's or certified check accompanying the proposal submitted by the bidder as a guaranty that he will enter into contract with the Owner for performance of the work if the contract is awarded to him.

1.12 CONTRACT

The written agreement covering the performance of the work and the furnishing of labor, materials, tools, and equipment in the construction of the work. The contract shall include the notice to contractors, proposal, plans, specifications, special provisions and contract bonds; also any and all supplemental agreements amending or extending the work contemplated and which may be required to complete the work in a substantial and acceptable manner. Supplemental agreements are written agreements covering alterations, amendments or extensions to the contract and include contract change orders.

The contract documents are complementary and what is called for by one shall be as binding as if called for by all. In case of conflict between plans and specifications, the specifications shall govern.

1.13 AMOUNT OF CONTRACT

For the purpose of awarding the contract and determining the amount of the bond, the total amount of the bid and the full amount of the contract price will be the summation of the products of the quantities shown in the proposal by the unit bid prices, and state sales or use tax, whenever applicable. See Sec. 7.09.

1.14 CONTRACTOR

The individual, firm, copartnership or corporation, and his, their, or its heirs, executors, administrators, successors and assigns, or the lawful agent of any such individual, firm, partnership, covenantor or corporation, or his, their or its surety under the contract bond, constituting one of the principals to the contract and undertaking to perform the work herein specified. Where any pronoun is used as referring to the word "Contractor" it shall mean the Contractor as defined above.

1.15 SUBCONTRACTOR

The individual, firm, partnership or corporation to whom the Contractor, with written consent of the Owner, sublets any part of the work covered by the contract.

1.16 CONTRACT BOND, PERFORMANCE BOND

The approved form of security furnished by the Contractor and his surety, as required in the contract. It shall be conditioned that such person or persons who enter into contract with the Owner shall faithfully perform and fulfill all the provisions of the contract and complete the work in strict accordance with the plans and specifications including full payment for labor and materials used in the work.

1.17 SURETY

The surety (RCW 39.08.010) responsible for the bidder's acts in the execution of the contract, or which is bound with and for the Contractor to insure performance of the contract, the payment of all obligations pertaining to the work, and the fulfillment of such other conditions as may be specified or required by law.

1.18 WORK

All the work specified, indicated, shown or contemplated in the contract to construct the improvement, including all alterations, amendments or extensions thereto made by contract change order or other written orders of the Engineer.

1.19 DAYS

Unless otherwise designated, days as used in the specifications will be understood to mean calendar days.

1.20 LIQUIDATED DAMAGES

The amount prescribed in the specifications to be paid the Owner, or to be deducted from any payments due or to become due the Contractor, for each day's delay in completing the whole or any specified portion of the work beyond the time allowed in the specifications.

1.21 "OR EQUAL"

In order to establish a basis of quality for some things in the work, certain processes, types of machinery and equipment, or kind of material may be mentioned on the plans by designating a manufacturer by name and referring to his brand or model numbers. Such mention is not intended to exclude other processes, equipment or materials that will measure up to the designated standards of that mentioned. If the Contractor desires to use other products as equal thereto, he shall secure the approval of the Engineer before entering an order therefor. Wherever in the specifications a manufacturer's name, brand or model is mentioned, it is to be understood that the phrase "or equal" is assumed to follow thereafter whether or not it does in fact.

1.22 ABBREVIATIONS

A.S.T.M. (ASTM) American Society for Testing Materials.
A.W.W.A. (AWWA) American Water Works Association.
U.S.A.S.I. (USASI) United States of America Standards Institute.
A.A.S.H.O. (AASHO) American Association of State Highway Officials.
A.G.C. (AGC) Associated General Contractors of America.
A.P.W.A. (APWA) American Public Works Association.

1.23 HIGHWAY, STREET, ROAD, OR ALLEY

The whole area within the right of way which is reserved for and secured for use in constructing the roadway and its appurtenances.

1.24 ARTERIAL STREET

A general term denoting a highway primarily for through traffic, usually on a continuous route.

1.25 RIGHT OF WAY, EASEMENT

The land provided by the Owner upon which to construct the roadway or other work and appurtenances specified in the contract.

1.26 ROADWAY

That portion of the highway included between curbs, gutters, or ditches, intended primarily for vehicular traffic, and including all appertaining structures and other features necessary to proper drainage and protection.

1.27 SUBGRADE

That portion of the roadbed surface which has been prepared, as specified, and upon which a layer of specified roadbed material or base, or surfacing, or pavement is to be placed.

1.28 SURFACING

The uppermost layer of material placed on the traveled way or shoulders. This term is used interchangeably with pavement.

1.29 TRAVELED WAY

That portion of the roadway intended for movement of vehicles, exclusive of shoulders and auxiliary lanes.

1.30 PAVEMENT

The uppermost layer of material placed on the traveled way or shoulders for riding surface, generally rigid or flexible in composition. This term is used interchangeably with surfacing.

1.31 BRIDGE

A structure, other than a culvert, which carries traffic over a water course, highway or railroad, or railroad traffic over a highway or street.

1.32 CULVERT

A drainage structure which may or may not directly support traffic, extending across and beneath a highway, street, driveway or alley.

1.33 TRAFFIC CONTROL DEVICES

Fixed or portable signs, signals, street lights, barricades, guard rails, pavement markings, channelization and other equipment or materials used for the purpose of regulating, warning and guiding traffic.

Section 2—Proposal Requirements and Conditions

2.01 CONTENTS OF PROPOSAL FORMS

Prospective bidders will be furnished with proposal forms which will state the location and description of the contemplated construction and will show the approximate estimate of the various quantities and kind of work to be performed and/or materials to be furnished, with a schedule of items for which unit bid prices are asked.

2.02 EXAMINATION OF PLANS, SPECIFICATIONS AND SITE OF WORK

Before submitting his bid, the bidder shall examine the site of the work and ascertain for himself all the physical conditions in relation thereto. Failure to do this shall not relieve the bidder from entering into a contract nor excuse him from performing the work in strict accordance with the terms of the contract and specifications. He will not be entitled to additional compensation if he subsequently finds the conditions to require other methods or equipment that he did not anticipate in making his unit contract bid prices.

Any statement or representation made by an officer, agent or employee of the Owner with respect to the physical conditions appertaining to the site of the work shall not be binding upon the Owner.

2.03 INTERPRETATION OF CONTRACT DOCUMENTS

The documents forming the contract are complementary and what is called for by one shall be as binding as if it were called for by all. They are intended to include all detail of labor and material reasonably necessary for the proper execution of the work. Should there be any discrepancy between the specifications and the plans, the specifications shall have precedence.

If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the plans, specifications or other documents, he may submit to the Engineer a written request for an interpretation thereof. The person submitting the request will be responsible for its prompt delivery not less than five (5) days prior to the date set for opening bids. Any interpretation of the proposed documents will be made by an addendum duly issued, and a copy of such addendum will be mailed or delivered to each person receiving a set of the plans and specifications and each bidder shall acknowledge receipt of each such addendum received in order to have the bid considered. The Owner will not be responsible for any other explanations or interpretations of the proposed documents.

2.04 QUANTITIES AND UNIT PRICES

The quantities, for which unit prices are indicated in the proposal form, are approximate only, and do not constitute a warranty or guarantee by the Owner as to the actual quantities involved in the work. Such quantities are to be used for the purpose of comparison of bids and determining the amount of the performance bond. The Owner expressly reserves the right to increase or decrease the quantities during construction as outlined in Section 4.03 of the specifications; also to make reasonable changes in design, provided such changes do not materially change the intent of the basic contract. The amount of work to be paid for shall be upon the actual quantities performed.

2.05 QUALIFICATION OF BIDDERS

The bidder must be qualified by experience, financing and equipment to do the work called for in the plans and specifications. Whenever required in the special provisions, the bidder shall furnish upon a form for that purpose, a statement of his construction experience and his general ability to perform the work contemplated, and shall submit same along with his bid proposal.

The Owner shall have the right to take such action as he may deem necessary in determining the ability of the bidder to perform the work satisfactorily.

Upon request of the Owner, a bidder whose bid is under consideration for award of a contract, shall submit promptly to the Owner satisfactory evidence of financial resources, his construction experience and his organization available for performance of the proposed contract.

2.06 PREPARATION OF PROPOSAL

Each bid shall be made on the forms furnished by the Owner and shall be signed by the bidder with the signature in full. If the proposal is made by a partnership, it shall contain the name of each partner and shall be signed in the firm name, followed by the signature of the person authorized to sign. If the proposal is made by a corporation it shall be signed in the name of the corporation by the officer or officers having authority to sign contracts. The address and telephone number of the bidder shall be typed or printed on the proposal.

A unit or lump sum price, as required in the proposal, shall be submitted on each item of work included in the group or division for which bids are requested. Each unit or lump sum price shall be typed or written with ink in both words and figures.

In case of a discrepancy as between the words and the figures, the words shall govern. Any omission of prices on items shown in the proposal form or any addition in writing to the form of bid, or any condition, limitation or provision not officially invited in the proposal or special provisions may render the proposal as being incomplete or modified and may become cause for rejection of the bid.

2.07 DELIVERY OF PROPOSAL

Each proposal or bid shall be completely sealed in a separate envelope, properly addressed to the Owner at the address indicated on the proposal form, with the name and address of the bidder and the name of the project for which the bid is submitted, plainly written on the outside of the envelope.

Proposals will be received at the time and place stated in the Call for Bids. It is the sole responsibility of the bidder to see that his bid is delivered in time. Any bid received after the scheduled closing time for receipt of bids will be returned to the bidder unopened.

Bids shall be submitted intact, including all proposal documents and acknowledgment of all addenda received from the Owner.

2.08 WITHDRAWAL OR REVISION OF PROPOSAL

A bidder may, without prejudice to himself, withdraw, modify, or correct a proposal after it has been deposited with the Owner, provided the request for such withdrawal, modification, or correction is filed with the Owner, in writing or by telegrams, before the time set for opening proposals. The original proposal, as modified by such written or telegraphic communication, will be considered as the proposal submitted by the bidder.

No bidder will be permitted to withdraw his proposal between the closing time for receipt of proposals and the execution of contract, unless the award is delayed for a period exceeding thirty (30) calendar days.

2.09 SUPPLEMENTAL PROPOSALS

If supplemental proposals are required due to the character of the improvement and uncertainties which may be encountered during construction, bidders shall submit supplemental bids on all items as shown on the supplemental proposal. The bidder shall bid on all alternates on the proposal form as provided therein. When bidding on an alternate for which there is no charge, the bidder shall insert the words "No Charge" in the space provided on the proposal form. The unit contract price bid shall be full compensation for furnishing all labor, tools and equipment which may be required under the several items listed and shall be a basis for final settlement.

Only the proposal for the basic contract shall be considered in the determination of the lowest and best bid. The supplemental proposal shall not be considered in this determination unless it is so provided in the special provisions.

2.10 PROHIBITION OF ALTERATIONS

The proposal form invites bids on definite plans and specifications. Only the amounts and information asked for on the proposal form furnished by the Owner will be considered as the bid. Each bidder shall bid upon the work exactly as specified and as provided in the proposal form.

Proposals which are incomplete or which are conditioned in any way, or which contain unauthenticated erasures, alterations or items not called for in the proposal, or which are not in conformity with the law may be rejected.

No oral or telephone proposals or modifications will be considered.

2.11 OPENING OF PROPOSALS

At the time and place set for the opening and reading of the proposals as indicated in the call for bids, each and every proposal (except any which may have been withdrawn in accordance with Section 2.08) received prior to the scheduled closing time for receipt of proposals, will be publicly opened and read aloud.

All items and totals will be tabulated and, in event of error, the corrected totals will be considered the official totals. The low bid will be determined on the basis of the aggregate sum of items as carried in the proposal.

2.12 REJECTION OF PROPOSAL

The Owner reserves the right to reject any and all proposals. (See causes in Sections 2.09 and 2.10.)

2.13 PROPOSAL GUARANTY

A certified check, cashier's check, cash or proposal bond in an amount equal to at least five percent (5%) of the total amount bid must accompany each bid as evidence of good faith and as a guarantee that if awarded the contract, the bidder will execute the contract and give a performance bond as required. Checks shall be made payable to the fiscal officer of the Owner, such as the treasurer of a city, or other official designated in the specifications.

2.14 FAMILIARITY WITH LAWS AND ORDINANCES

The bidder is assumed to be familiar with all federal, state, and local laws, ordinances, and regulations, which in any manner affect those engaged or employed in the work or the materials or equipment used in the proposed construction, or which in any way affect the conduct of the work, and no plea of misunderstanding will be considered on account of ignorance thereof. If the bidder, or contractor, shall discover any provision in the plans, specifications, or contract which is contrary to or inconsistent with any law, ordinance, or regulation, he shall forthwith report it to the Owner in writing.

Section 3—Award and Execution of Contract

3.01 AWARD OF CONTRACT

The award of contract, if made, will be to the lowest bidder whose bid conforms to the requirements of these specifications.

3.01A Bidding Errors

When, after the opening and tabulation of bids a bidder claims error in his bid and requests to be relieved of the award, he will be required to promptly present certified work sheets. The Owner will review the work sheets to determine the validity of the claim of error. If the Owner is convinced that an honest, allowable (mathematically excusable) error or critical omission of costs has been made the bidder may be relieved and his bid bond may be returned. The award may then be made to the next low bidder, or the Owner may reject all bids and readvertise.

3.02 RETURN OF PROPOSAL GUARANTY

After the bids have been tabulated and compared, the Owner will return the guaranty deposits accompanying such of the proposals as in his judgment will not be considered in making the award. All other proposal guaranties will be held until the contract and bond have been executed and then be returned to the bidders who furnished them.

3.03 EXECUTION OF CONTRACT

Within ten (10) days after the date the bidder receives notification of award of contract, as evidenced by receipt from the Owner of properly prepared contract documents, the bidder to whom award is made shall execute and return the contract in the required number of copies, and shall furnish a performance bond and other required bonds and insurances satisfactory to the Owner. (See Section 8.05 for contract time.)

3.04 PERFORMANCE BOND, CONTRACT BOND

The Contractor shall, at the time of delivery of the executed contract, furnish to the Owner a corporate surety bond in the full amount of the contract price conditioned for the faithful performance of the contract, as conditioned in Section 7.02. The surety must be authorized to do business in the State of Washington and be satisfactory to the Owner. Each bond must be approved in writing by the legal representative of the Owner.

3.05 FAILURE TO EXECUTE CONTRACT

Upon failure to enter into the contract and furnish the necessary bond within the time specified in Section 3.03, the proposal guaranty which accompanied the bid, whether in form of a bond, check or cash deposit, shall be forfeited to the Owner. The award may then, at the discretion of the Owner, be made to the next lowest responsible bidder or the work may be readvertised, or may be constructed by the Owner in any legal manner.

Any contractor who refuses to enter into a contract and who forfeits his bid bond may be prohibited from bidding on other work of the Owner for a period of 24 months.

3.06 NONCOLLUSION AFFIDAVIT

Each bid shall be accompanied by a properly executed noncollusion affidavit on the form furnished therefor by the Owner.

3.07 CONTRACTOR'S INSURANCE

The Contractor shall not commence work under the contract or under any special condition until he has obtained all insurance and all necessary permits, as required under the following sub-paragraphs, and until such insurances have been approved by the Owner, nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar insurances required of the subcontractor have been obtained and approved.

3.07A Compensation Insurance

The Contractor shall take out and maintain during the life of this contract Workmen's Compensation Insurance for all of his employees employed at the site of the project and, in case any work is sublet, the Contractor shall require the subcontractor similarly to provide Workmen's Compensation Insurance for all the latter's employees unless such employees are covered by the protection afforded by the Contractor. In case any class of employees engaged in hazardous work under this contract at the site of the project is not protected under Workmen's Compensation statutes, the Contractor shall provide, and shall cause each subcontractor to provide compensation insurance with a private company in an amount equivalent to that provided by the Workmen's Compensation statute for the protection of his employees not otherwise protected.

3.07B Public Liability and Property Damage Insurance

The Contractor shall obtain and keep in force during the term of the contract, public liability and property damage insurance in companies and in form to be approved by the Owner. Said insurance shall provide coverage to the Contractor, any subcontractor performing work provided by this contract, and the Owner. The Owner shall be named as an additional insured on said policy insofar as the work and obligations performed under the contract are concerned. The coverage so provided shall protect against claims for personal injuries, including accidental death, as well as claims for property damages which may arise from any act or omission of the Contractor or the subcontractor, or by anyone directly or indirectly employed by either of them.

The minimum policy limits of such insurance shall be as follows:

Bodily injury liability coverage with limits of not less than $100,000 for bodily injury, including accidental death, to any one person, and subject to that limit for each person, in an amount not less than $300,000 for each accident; and property damage coverage in an amount of not less than $50,000 for each accident.

A copy of the insurance policy or a certificate of insurance, as required by the Owner, together with a copy of the endorsement naming the Owner as an additional insured, shall be provided to the Owner as specified in Section 3.03.

3.07C Indemnify Owner From Loss

The Contractor hereby agrees to save the Owner harmless from all loss or damage occasioned to it or to any third person or property by reason of any acts or omissions on the part of the Contractor, subcontractors, agents, and employees in the performance of the contract and will, after reasonable notice thereof, defend and pay the expense of defending any suit which may be commenced against the Owner by any third person alleging injury by reason of such acts or omissions and will pay any judgment which may be obtained against the Owner in such suit.

3.07D Street Obstruction Bond

Where required by law or by municipal procedures, the Contractor shall furnish the Owner a Street Obstruction bond in the amount required by ordinance prior to commencement of any work covered by the contract. The award of the contract shall be considered to be the permit to work upon the roads, streets, alleys, easements or public places as specified in the contract.

3.08 PROOF OF CARRIAGE OF INSURANCE

Refer to Sections 3.07B and 3.07D.

Section 4—Scope of Work

4.01 INTENT OF CONTRACT

The intent of the contract is to prescribe a complete work or improvement which the Contractor undertakes to do, in full compliance with the provisions and requirements of the contract. The Contractor for all or any part shall furnish all labor, materials, tools, equipment, transportation, necessary supplies and incidentals required to make each and every item complete as contemplated by the contract. Any deviation from these requirements must be stipulated in the special provisions.

4.02 ADDITIONAL INSTRUCTIONS

In the event it is found that the instructions and drawings contained in the contract documents are not sufficiently clear to permit the Contractor to proceed with the work, the Engineer shall, either upon his own initiative or upon the request from the Contractor, furnish such additional written instructions, together with such additional drawings as may be necessary. When such request is made by the Contractor, it must be in ample time to permit the preparation of the instructions and drawings by the Engineer before the construction of the work covered by them is undertaken. Such additional instructions and drawings shall be consistent with the contract documents and shall have the same force and effect as if contained in the contract documents.

For the purpose of avoiding delays in the preparation of such additional instructions and drawings, the Engineer and the Contractor shall jointly prepare a schedule showing the time for the commencement of the work to be included in them and the time the Contractor shall furnish the necessary shop drawings, which may be necessary for their preparation. The Contractor shall do no work without proper drawings or instructions and shall at his own expense, replace any work wrongly executed.

4.03 INCREASE OR DECREASE OF WORK

The Owner reserves the right to make such alterations in the plans or in the quantities of work as may be considered necessary. Such alterations shall be submitted in writing to the Contractor by the Engineer and shall not be considered as a waiver of any conditions of the contract nor to invalidate any of the provisions thereof; provided, however, that the execution of a supplemental agreement acceptable to both parties of the contract will be necessary before any alteration is made which involves (1) an extension or shortening of the length of the project by more than 25%, (2) an increase or decrease of more than 25% of the total cost of the work calculated from the original proposal quantities and the unit contract prices, or (3) an increase or decrease of more than 25% in the quantity of any one major contract item.

For condition (3) above, a major item is defined as any item, unless otherwise indicated on the plans or designated in the special provisions, the contract price for which amounts to 5% or more of the total contract price as determined by the original quantities and the unit contract prices.

When an alteration requires the execution of a supplemental agreement, the agreement shall be fully executed before any work on the alteration is started. Alterations involving an increase of more than 25% in the net of any one minor contract item will not require a supplemental agreement.

4.04 EXTRA WORK

Any extra work made necessary by alteration of or additions to the plans or by other reasons for which no price is provided in the contract, shall be performed by the Contractor as directed by the Engineer and he shall be compensated therefor as elsewhere provided herein.

Extra work which by reason of its character or extent is covered by a supplemental agreement between the Owner and the Contractor, must have the written consent of the surety on the bond, but extra work and change orders not covered by a supplemental agreement will not require the consent of the surety.

4.05 CHANGED CONDITIONS

Should the Contractor encounter subsurface or latent physical conditions at the site differing materially from those indicated in the contract, or unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract, which changed or unusual conditions will be considered by the Contractor as the basis for a claim for extra compensation, the Contractor shall promptly notify the Engineer of the alleged conditions in writing.

If the Engineer is not given written notice, the Contractor will be deemed to have waived any claim or claims for extra compensation in any manner arising out of the changed or unusual conditions.

If the Owner shall determine the conditions to be such as to justify a claim for additional compensation, he may provide for additional payment as specified in Section 9.03 for the particular phase of work in question, or by any other equitable arrangement mutually agreed upon by the Owner and the Contractor and consented to in writing by the surety to the bond. In any event, the Contractor shall not be relieved, unless permitted to do so by the Owner, from his obligation of resuming construction operations pending decision as to the validity of a claim, or pending the execution of a negotiated agreement to cover additional costs if a claim shall be recognized under the provisions of this section of the specifications.

4.06 WASTE SITES

The various sections of these specifications require three different types of waste sites which are: (1) private property abutting the improvement, (2) waste sites designated on construction plans, and (3) waste sites to be provided by the Contractor.

In all cases, all waste sites shall be operated in such a manner as to meet safety and health requirements of state, county, and city. Sites, operations, or the result of such operations, which create a definite nuisance problem, or which result in damage to public or private properties will not be permitted.

4.06A Private Property Abutting the Project

It shall be required that waste excavation not needed on the project shall be equitably distributed among those private properties abutting the project and desiring waste material. The Contractor will be required to haul and dump the excavated material at no expense to the property owner or to the Owner. The material shall be dumped as the Engineer may direct at the location designated by the property owner, except that no leveling or dressing will be performed under this contract other than as may be necessary to provide access for the material to be dumped. Where conditions are such as to require additional work such as clearing and grubbing, the providing of drainage, leveling and shaping (other than previously mentioned), the property owner shall make necessary arrangements with the Contractor for payment of such additional work. The Engineer shall make final determination of responsibility in event of controversy.

4.06B Waste Sites Designated on the Construction Plans

Where waste sites are designated on the plans, the operations shall be performed as the Engineer may direct, and upon completion, the area shall be uniformly cleaned and shaped as directed by the Engineer. Other requirements shall be as provided in the special provisions.

4.06C Waste Sites To Be Provided by the Contractor

Where there is additional waste excavation in excess of that needed for the project and that needed for compliance with requests of abutting properties, the Contrac-

tor shall, unless otherwise provided for in the special provisions, secure and operate his own waste site at his own expense. In such case, the Contractor shall meet the general requirements hereinbefore described.

4.07 SALVAGE

If indicated on the plans or in the special provisions, all castings, pipe and any other material taken from any of the discarded facilities shall be carefully salvaged and delivered to the Owner in good condition and in such order of storage as the Engineer may direct; otherwise, such material shall belong to the Contractor and be removed by him from the site.

4.08 FINISHING AND CLEAN

From time to time or as may be ordered by the Engineer and immediately after completion of the work, the Contractor shall at his own expense clean up and remove all refuse and unused materials of any kind resulting from the work. Upon failure to do so within twenty-four (24) hours after request by the Engineer, the work may be done by the Owner and the cost thereof be charged to the Contractor and deducted from his final estimate. Upon completion of the work, the Contractor shall remove all his equipment and put the area of the work in a neat and clean condition and do all other cleaning required to complete the work in a workmanlike manner, ready for use and satisfactory to the Engineer.

All cleanup shall be performed as specified in the various sections of these specifications, in the special provisions, or in Section 57.

If no bid item is included in the proposal for "Finishing and Cleanup," per lump sum, or for "Finishing and Cleanup," per station (100-foot), then all work of cleaning up as required shall be considered as incidental to the construction and the costs thereof shall be included in other items of the work.

Section 5—Control of Work

5.01 AUTHORITY OF ENGINEER

It is understood and agreed by and between the parties hereto that the work included in the contract is to be done in accordance with the plans and specifications and to the satisfaction of the Engineer. The Engineer shall determine the unit quantities and the classification of all work done and materials furnished under the provisions of the contract.

The Engineer may appoint assistants and inspectors to inspect the materials used and the work performed.

Nothing contained in the contract shall be construed as requiring the Engineer to direct the method or manner of performing the work.

5.02 AUTHORITY AND DUTIES OF INSPECTORS

The Engineer may appoint assistants to inspect all materials used and all work done. Such inspection may extend to any or all parts of the work and to the preparation or manufacture of the materials to be used. The assistants will not be authorized to revoke, alter, enlarge or relax the provisions of these specifications. An assistant is placed on the work to set the necessary lines and grades and to keep the Engineer informed as to the progress of the work and the manner in which it is being done; also to call the attention of the Contractor to any infringements upon plans, or specifications, but failure of the assistant or the Engineer to call the attention of the Contractor to faulty work or infringements upon the plans or specifications shall not constitute acceptance of said work.

An assistant will not be authorized to approve or accept any portion of the work or to issue instructions contrary to the plans and specifications. The assistant will have authority to reject defective material and to suspend any work that is being improperly done, subject to the final decision of the Engineer. The assistant will exercise such additional authority as may, from time to time, be especially delegated to him by the Engineer.

5.03 COOPERATION BY CONTRACTOR

A set of approved plans, specifications and any special provisions and authorized alterations will be supplied to the Contractor and these must be kept available on the job at all times. The Contractor shall be present either in person or by duly authorized representatives on the site of the work continually during its progress. The Contractor or his representative shall receive from the Engineer all explanations and directions necessary for the satisfactory prosecution and completion of the work. The Contractor shall not cause any unnecessary delay or hindrance to other Contractors on the work, but he shall cooperate with other Contractors to the fullest extent.

5.04 INTERFERENCE WITH OTHER CONTRACTORS

Bidders are required to inform themselves fully of the conditions relating to construction and labor under which the work will be or is now being performed, and the Contractor shall employ, as far as possible, such methods and means in the carrying out of his work as will not cause any interruption or interference with any other Contractor or agency.

If the performance of any contract for the project is likely to be interfered with by the simultaneous execution of some other contract or contracts, the Engineer shall decide which Contractor shall cease work temporarily and which Contractor shall continue, or whether the work under the contractors can be co-ordinated so that the Contractors may proceed simultaneously. The Owner shall not be responsible for any damages suffered or extra costs incurred by the Contractor, resulting directly or indirectly from the award or performance or attempted performance of any other contract or contracts on the project, or caused by any decision or omission of the Engineer respecting the order of precedence in the performance of the contracts other than for an extension of time.

5.05 NOTIFICATIONS RELATIVE TO CONTRACTOR'S ACTIVITIES

The Engineer will initially notify the agencies concerned as to the time bids will be called, and the approximate time of starting work. The Engineer will also define what the project consists of and will point out particular problems. The Contractor shall be responsible for making detailed notifications as follows.

The Contractor performing work in street and alley rights of way and easements shall notify all of the affected agencies in regard to his operations so as to properly co-ordinate and expedite his work in such a manner as to cause the least amount of conflict and interference between his operations and those of other agencies.

Notification may be verbal and must be in such detail as to give the time of commencement and completion of work, names of streets or location of alleys to be closed, schedule of operations, routes of detours where possible, etc. Those agencies usually concerned with construction activities will be as indicated elsewhere in the specifications under special provisions.

Notification of commencement shall be made sufficiently ahead of time to provide for proper rerouting of traffic and the erection of signs. On larger projects requiring extended periods of time to complete, the Contractor shall make such additional notifications as the conditions may require.

5.06 PROTECTION OF LINE AND GRADE STAKES

The work shall be done in strict conformity with the plans and specifications and to the lines and grades as fixed by the Engineer, and be according to such instructions as may be given by the Engineer. The Contractor shall protect and preserve in their original position all stakes, points, or marks set for the work by the Engineer. If such stakes and markings are carelessly destroyed or defaced by the Contractor operations before

their use is ended, the full cost of replacing them will be at the Contractor's expense by deduction from any money due him.

The Contractor shall provide sufficient and safe facilities to enable the Engineer to set the control points for structure work such as bridges, piers, towers, and similar works where control points need to be set above ground level.

Any claim by the Contractor for extra compensation by reason of alterations or reconstruction work allegedly due to error in the Engineer's line and grade, will not be allowed unless the original control points set by the Engineer still exist, or unless other satisfactory substantiating evidence to prove the error is furnished the Engineer.

The Contractor shall keep the Engineer informed in advance as to when and where he intends to work, thus enabling the Engineer to set the engineering control points, lines and grades with a minimum of delay and interference. If the schedule of work be such as to handicap the setting of necessary engineering control, the Contractor shall suspend his operations at the particular place in sufficient time for the Engineer to complete his urgent work. Any additional expense to the Contractor arising from the temporary suspension of work shall be considered as incidental to the construction and be included in various bid items of the contract.

5.07 REMOVAL OF DEFECTIVE OR UNAUTHORIZED WORK

Defective work or material may be condemned by the Engineer any time before the final acceptance of the work. Notice of such condemnation shall be given in writing by the Engineer. Such condemned work shall be immediately removed or disposed of to the satisfaction of the Engineer. Failure or neglect on the part of the Engineer to condemn unsatisfactory material or reject inferior workmanship will in no way release the Contractor, nor shall it be construed to mean the acceptance of such work, nor shall the final acceptance bar the Owner from recovering damages in case fraud was practiced, or for defective work resulting from the Contractor's dishonesty. No compensation will be made for defective work or materials.

Work done contrary to or regardless of the instructions of the Engineer, work done without lines, grade and/or cross section stakes and grades shown on the plans or has given by the Engineer, or any deviation made from the plans and specifications without written authority will be considered unauthorized and at the expense of the Contractor, and will not be measured or paid for by the Owner. Any and all work so done may be ordered removed and replaced immediately at the Contractor's expense.

5.08 MOVING OF PUBLIC AND PRIVATE UTILITIES

Prior to awarding the contract, the Owner will notify all affected utilities to move such of their installations as would be within the confines of the finished improvement. This kind of work by the utilities will normally have been accomplished in most instances before the Contractor is working at points affected. Under some circumstances, however, the work of the utilities may have to be performed during the construction. It shall be the responsibility of the Contractor to co-ordinate his work with that of the utilities in such manner as to cause the least possible interference, and as may be further provided in the special provisions.

It is provided that no utility, private or public, shall be moved to accommodate the Contractor's equipment or his method of operation when such utility does not interfere with the improvement under construction unless the costs of such removal shall be at the expense of the Contractor.

5.09 PROTECTION OF PUBLIC AND PRIVATE UTILITIES

The Contractor shall support and protect by timbers or otherwise, all pipes, conduits, poles, wires or other apparatus which may be in any way affected by the work, and do everything to support, sustain and protect the same, under, over, along or across said work. In case any of said pipes, conduits, poles, wires, or apparatus should be damaged they shall be repaired by the authorities having control of same, and the expense of such repairs shall be charged to the Contractor.

The Contractor shall further be responsible for any damage done to any street or other public property, or to any private property by reason of the breaking of any water pipe, sewer or gas pipe, electric conduit, or other utility by or through his negligence.

Specific requirements in other sections of these specifications or special provisions shall prevail over the foregoing requirements in case of conflict.

5.10 DAMAGE TO EXISTING IMPROVEMENTS AND UTILITIES

The Contractor's work shall be confined to the Owner's premises, including easements and construction permit limits, whenever possible. He shall not enter upon or place materials on other private premises except by written consent of the individual owners, and he shall save the Owner harmless from all suits and actions of every kind and description that might result from his use of private property.

Underground utilities of record will be shown on the construction plans insofar as it is possible to do so. These, however, are shown for convenience only and the Owner assumes no responsibility for improper locations or failure to show utility locations on the construction plans.

The Contractor shall take adequate precautions to protect existing lawns, trees and shrubs outside rights of way, sidewalk, curbs, pavements, utilities, adjoining property, and structures, and to avoid damage thereto. He shall at his own expense completely repair any damage thereto caused by his operations to the satisfaction of the Engineer, except as otherwise provided in other sections of these specifications.

5.11 INSPECTION BY ENGINEER

All materials furnished by the Contractor shall be subject to the inspection and approval of the Engineer at any time during the progress of the work and until final completion thereof. The materials shall be delivered by the Contractor sufficiently in advance of the work to enable the Engineer to make the proper tests and inspections. As soon as materials have been tested and inspected, the Contractor shall immediately remove all rejected materials from the work to such place distant therefrom as the Engineer may require, and shall arrange for replacement of rejected materials and things at his own expense. The neglect or failure on the part of the Engineer to condemn or reject inferior materials or work shall not be construed as an acceptance of the materials or work.

The Contractor shall furnish, at his own expense, such labor and facilities as may be required to enable the Engineer to make a thorough inspection and culling of the materials.

In lieu of inspection, the Owner may require certified statements from the producer as to quality.

5.12 MAINTENANCE OF WORK

The work occasionally involves such items as buildings, machinery or other mechanical equipment and/or the setting of same, or may otherwise be of such a nature that it is desirable to have the Contractor maintain or guarantee the work for a period of time after final acceptance by the Engineer. (Sec. 9.06.)

When such maintenance or guarantees are desired by the Owner and are not specifically provided for in these specifications, the requirements and terms shall be defined in the special provisions. Such maintenance or guarantees shall not affect the manufacturer's warranties.

The Contractor shall be responsible for the entire improvement and maintain it until it has been accepted by the Owner. The Owner reserves the right to utilize any portion of the improvement prior to final acceptance and in such event the Owner will assume responsibility for its use in case of damage.

When maintenance or guarantees are desired by the Owner and are not specifically provided for in these specifications, the requirements and terms shall be defined in the special provisions. Such maintenance or guarantees shall not affect the manufacturer's warranties. (See Section 9.06.)

5.13 WATER AND POWER

In instances, other than those specifically mentioned in the specifications or special provisions, the Contractor shall make all necessary arrangements for power and water. All costs thereof shall be borne by the Contractor.

5.14 METHOD OF SERVING NOTICE

Any written notice to the Contractor which may be requisite under these specifications may be served on him, either personally, by mailing, or by leaving at his last postoffice address known to the Owner.

5.15 VERBAL AGREEMENTS

No verbal agreement or conversation with any officer, agent, or employee of the Owner, either before or after execution of the contract, shall affect or modify any of the terms or obligations contained in any of the documents comprising the contract. Any such verbal contact shall be considered as unofficial information and in no way binding upon the Owner.

5.16 FINAL INSPECTION

As soon as practicable after the completion of the entire work, it will be examined thoroughly by the Engineer. The Contractor will be notified when the examination is to be made so that he or his representative may be present. When the work is found to be satisfactory, it will be accepted, subject to provisions of Section 5.12, and such final acceptance will not be reopened after having once been made, except on evidence of collusion, fraud, or obvious error.

If the inspection reveals any defects in the work as contemplated by the specifications, such defects shall be repaired or unsatisfactory work be replaced as the Engineer may direct before final acceptance. The cost of all such repairs and replacements shall be borne by the Contractor, and no extension of the contract time will be granted because of the time required to remedy such defects.

Section 6—Control of Materials

6.01 SOURCE OF SUPPLY AND QUALITY OF MATERIALS

Promptly after the approval of the award, the Contractor shall notify the Engineer of the proposed sources of supply of all materials to be furnished by him. At the option of the Engineer the source of supply of each of the materials shall be approved by the Engineer before the delivery is started. Representative preliminary samples of the character and quality prescribed shall be submitted by the Contractor or producer for examination and tests by the Engineer. Only materials conforming to the requirements of these specifications and approved by the Engineer shall be used in the work. Any of the materials proposed to be used may be inspected or tested at any time during their preparation and use. If, after trial, it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source proves unacceptable at any time, the Contractor shall furnish approved material from other approved sources. No material which, after approval, has in any way become unfit for use shall be used in the work.

6.02 SAMPLES AND TESTS

All tests of materials furnished by the Contractor shall be made by the Engineer in accordance with commonly recognized standards of national organizations, and such special methods and tests as are in use at the laboratory of the Department of Highways or as set forth in the special provisions.

Field tests of materials will also be made by the Engineer when deemed necessary and these tests shall be made in accordance with standard practices of the Department of Highways.

The Contractor shall furnish without charge such samples of all materials as may be requested by the Engineer. Materials shall not be used until they have been approved by the Engineer. Samples will be secured and tested whenever necessary to determine the quality of the material.

Materials shall be delivered on the work in advance, in such quantities as to afford the Engineer an opportunity to make tests before the materials are to be used.

The following shall apply in the use of specifications and methods of tests of the organizations named below:

ASTM—American Society for Testing Materials. The ASTM designation number refers to the latest adopted standard or tentative standard of this society. The standard or tentative standard in effect at the time of call for bids shall apply in each case. Revisions shall be considered as becoming effective on the first day of December in the year in which they are adopted.

USASI—United States of America Standards Institute. Specifications may be obtained from United States of America Standards Institute, 10 East 40th Street, New York 16, N.Y.

AASHO—American Association of State Highway Officials. The specifications or test method shown by number refers to the "Standard Specifications for Highway Materials and Methods of Sampling and Testing," currently published by the association, or to such revisions as may have been subsequently adopted by the association or to the "Interim Specifications and Methods adopted by the AASHO Committee on Materials." Revisions and Interim Standards in effect at the time of award of the Contract shall apply. Revisions shall be considered as becoming effective 60 days after announcement of adoption is published in the "Annual Reports of the Permanent Committees" of the Association. Interim Standards shall be considered as becoming effective on the first day of December of the year indicated in the Specification or test method designation number.

AWWA—American Water Works Association. The effective date of the AWWA specifications is on the first day of the second month after publication in the American Water Works Journal. The AWWA specifications and revisions thus in effect at the time of the call for bids shall apply whenever referenced in these specifications. Copies of AWWA specifications may be obtained from American Water Works Association, Inc., 2 Park Avenue, New York 16, N.Y.

Federal Specifications—U. S. Government Federal Stock Catalogue. The specification number refers to the latest revised specifications adopted by the Federal Specifications Board. Revisions in effect at the time of call for bids shall apply. Revisions shall be considered as becoming effective sixty days after adoption by the Board. Copies of Federal Specifications may be obtained from the Business Service Center, Room 101, Federal Office Building, Seattle 4, Washington.

PUBLICATIONS:

Copies of any separate ASTM specifications or method of test may be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia, Pa. 19103.

Copies of "Standard Specifications for Highway Materials and Methods of Sampling and Testing" may be obtained from the American Association of State Highway Officials, 917 National Press Building, Washington, D. C.

Copies of standard grading and dressing rules may be obtained from the West Coast Lumber Inspection Bureau, Seattle, Washington, or Portland, Oregon, and from the Western Pine Association, Portland, Oregon.

6.03 SPECIAL METHODS OF TEST

The methods of tests which follow shall apply when so designated elsewhere in these specifications or in the special provisions. Details of test methods are available from the Materials Laboratory of the Department of Highways, Olympia, Washington.

1. *Stabilometer Resistance Value and Swell Pressure Test:* The resistance value (R-value) is measured by the stabilometer test which is a form of triaxial test. The test is performed on untreated or treated soils or aggregates for use as subgrades, subbases, or bases. The test result is reported as an R-value on a scale from 0 to 100 which is a numerical index of the ability of the material to resist plastic deformation under vehicle loads.
2. *Test for Moisture Retaining Effectiveness of Concrete Curing Compounds:* This test measures the ability of concrete curing compounds to prevent loss of water from a fresh concrete mixture made under definite specified conditions.
3. *Modified Immersion-Compression Test:* The modified immersion-compression test measures the degree to which a compacted bituminous specimen resists the action of water. The test is performed by soaking a compacted briquette 4 inches in diameter and 2½ inches high in water at 140° F., for 24 hours. The ratio of the stabilometer value of the soaked specimen to the stabilometer value of a companion specimen that has not been soaked is the measure of the resistance of the material to water action.
4. *Mortar Strength Test:* The mortar strength test is a procedure to determine the strength developed by mortar using a given concrete sand in relation to that developed by mortar using Ottawa sand. The test indirectly measures the concrete making properties of the sand under test.
5. *Sand Equivalent Test:* The sand equivalent test indicates the proportion of detrimental fine dust or clay-like materials in soils or fine aggregates.
6. *Test for Effectiveness of Concrete Waterproofing Materials:* The test for effectiveness of concrete waterproofing materials measures the ability of those materials to prevent moisture absorption by concrete specimens under standardized test conditions.
7. *Stabilometer Test (Asphalt Concrete Mixtures):* The stabilometer test is a form of triaxial test employing compacted test specimens of asphalt concrete mixtures having a height-diameter ratio of approximately 0.6. The results are reported as stabilometer values in units on a scale ranging from 0 to 100, indicating the relative ability of the pavement to resist distortion under the action of traffic.
8. *Cohesiometer Test (Asphalt Concrete Mixtures):* The cohesiometer test is a measure of the cohesive resistance or tensile strength of a compacted asphalt concrete mixture.
9. *Thin Film Oven Test:* The thin film oven test is a method of determining the amount which an asphalt changes when subjected to prolonged, elevated temperature.
10. *Penetration Ratio:* The penetration ratio is the ratio of the penetration at 39.2° F. to that at 77° F., and is a means of determining the effect of low temperatures on the characteristics of the asphalt.

6.04 STORAGE OF MATERIALS

All materials intended for use in the work shall be stored by the Contractor by means that will prevent damage from exposure to the elements, from admixture of foreign material, or from any other cause. The Engineer will refuse to accept, or to sample for testing, any materials that are improperly stored.

6.05 DEFECTIVE MATERIALS

All materials not conforming to the requirements of these specifications will be rejected by the Engineer, and all such materials whether in place or not, shall be immediately removed from the site of the work by the Contractor.

6.06 SIEVES FOR TESTING PURPOSES

Sieves for testing purposes shall be woven wire cloth sieves or square hole perforated plates conforming to the requirements of AASHO Designation M92 or ASTM Designation E11.

Section 7—Legal Relations and Responsibility to the Public

7.01 LAWS AND REGULATIONS

The Contractor shall observe and comply with all federal and state laws and with the county, city and municipal resolutions, ordinances and regulations that will in any way affect the work; and he shall indemnify and save harmless the Owner against any claims arising from the violation of any such laws, resolutions, ordinances or regulations.

7.02 CONTRACT BOND, PERFORMANCE BOND

The contract bond or performance bond furnished by the Contractor, as provided in Section 3.04, shall be payable to the Owner in the full and just sum of the total amount of the contract, conditioned that all the provisions of the contract shall be faithfully performed by the Contractor, or the surety if so required, and shall indemnify the Owner against any direct or indirect damages that shall be suffered or claimed, for injuries to persons or property, during the carrying out of the work of the contract, and further conditioned as required by law for the payment of all laborers, mechanics, subcontractors and material men, and all persons who shall supply such person or persons or subcontractors with provisions or supplies for the carrying on of such work. If the Engineer shall have reason to believe that the security on said bond has become impaired since the execution thereof, or is insufficient, he may require the Contractor to furnish other or additional security.

7.03 ACCIDENT PREVENTION

Precaution shall be exercised at all times by the Contractor for the protection of persons, employees and property. The safety provisions of applicable laws and local building and construction codes shall be observed. The operations of the Contractor for the protection of persons, and for guarding against hazards of machinery and equipment, shall meet the requirements of state law and all safety regulations as set out in "Safety Standards for Construction" and "General Safety Standards," published and in effect at the time of call for bids. These publications may be obtained from the Department of Labor and Industries, Olympia, Washington.

7.04 PROTECTION OF WORKMEN AND PROPERTY

The Contractor shall erect and maintain good and sufficient guards, barricades and signals at all unsafe places at or near the work, and shall in all cases maintain safe passageways at all road crossings, crosswalks, street intersections, and shall do all other things necessary to prevent accident or loss of any kind.

When work is being performed below the standards established in the State Safety Code, or when the Engineer believes the condition endangers the safety of the general public and employees of the project, the Engineer may immediately issue a written stop-work order describing the substandard work and deliver same to the Contractor. The Contractor shall cease work and not resume work on the estopped portion of the project until acceptable remedial action has been taken. Such protective measures shall not be construed as releasing the Contractor of any obligation or liability arising under the contract.

7.05 LABOR

The Contractor shall at all times employ workmen who are skilled in their respective lines. The Contractor is restricted in his selection of labor and payment there-

for by certain legal requirements which must be observed for compliance with the public policy enunciated in RCW 49.28. This refers to the eight hour day, payment for overtime, cancellation of contract for violations, and penalties for violations of provisions therein. The Contractor should be thoroughly familiar with all provisions of this and other statutes that are subsequently noted herein before commencing work on his contract.

7.05A Non-Discrimination Certificate

"The Contractor hereby covenants, stipulates and agrees that during the performance of this contract, he will not discriminate against any person in hiring, discharging, compensating or in any other term or condition of employment, by reason of such person's race, color, religion, ancestry or national origin, and that the foregoing provision will be inserted in all subcontracts for work covered by this contract; provided that such provision shall not apply to contracts or subcontracts for standard commercial supplies or raw materials."

7.06 SELECTION OF LABOR (Chapter 246, Laws of 1943, RCW Chapter 39.16)

In all contracts awarded by the Owner for the erection, construction, alteration, demolition or repair of any public building, structure, bridge, highway, or any other kind of public work or improvement, the Contractor, subcontractor, or person in charge thereof, shall employ ninety-five (95) percent or more bona fide Washington residents as employees where more than fifty (50) persons are employed, and ninety (90) percent or more where fifty (50) or less are employed. The term "resident" as used in this act shall mean any person who has been a bona fide resident of the State of Washington for a period of ninety (90) days prior to such employment, *Provided,* That in contracts involving the expenditure of Federal-aid funds this act shall not be enforced in such a manner as to conflict with or be contrary to the Federal statutes, rules and regulations prescribing a labor preference to honorably discharged soldiers, sailors and marines, or prohibiting as unlawful any other preference or discrimination among the citizens of the United States.

In the event that a sufficient number of Washington residents shall not be available, the Contractor or subcontractor shall immediately notify the Owner and shall state the number of non-residents needed. The Engineer shall immediately investigate the facts and report to the Owner, and if the conditions are as stated the Owner may by written order designate the number of nonresidents and the period for which they may be employed, *Provided,* That should residents become available within the period such residents shall be immediately employed and the period shortened consistent with the supply of resident labor.

The provisions of this act shall be written into every such public contract including the following penalty: Any Contractor or subcontractor who shall employ a nonresident in excess of the percentage preferences, excepting as herein permitted, shall have deducted from the amount due him for every violation, the prevailing wages which should have been paid to a displaced resident. The money so deducted shall be retained by the public body for whom the contract is being performed.

Any person, firm or corporation violating any of the provisions of this act shall be guilty of a misdemeanor.

7.07 LEGAL WAGES ON PUBLIC WORKS

Under the provisions of RCW 39.12, as amended by the 1965 Legislature in extraordinary session, the hourly wages paid to laborers, workmen, or mechanics upon all public works of this State and upon work contemplated in this contract, shall be not less than the prevailing rate of wage for an hour's work in the same trade or occupation in the locality within the State where such labor and work herein contemplated is to be performed.

All laborers, workmen or mechanics shall be paid not less than the minimum hourly rate of wage hereinafter specified, *Provided, however,* That nothing herein contained shall be construed to prohibit the Contractor, subcontractor or other person doing or contracting to do the whole or any part of the work under this contract, from paying any such laborers, workmen or mechanics wages in excess of the hourly minimum rate above specified.

The "prevailing rate of wage," for the purposes of the contract, shall be the rate of hourly wage, usual benefits and overtime paid in this locality, as hereinafter defined, to the majority of workmen, laborers or mechanics, in the same trade or occupation. In the event that there is not a majority in the same trade or occupation paid at the same rate, then the average rate of hourly wage and overtime paid to such laborers, workmen, or mechanics in the same trade or occupation shall be the prevailing rate.

The usual benefits for the purpose of these specifications shall include the amount of:

(a) The rate of contribution irrevocably made by a contractor or subcontractor to a trustee or to a third person pursuant to a fund, plan, or program, and

(b) The rate of costs to a contractor or subcontractor which may be reasonably anticipated in providing benefits to laborers, workmen, or mechanics pursuant to an enforceable commitment to carry out a plan or program which was communicated in writing to laborers, workmen or mechanics affected for medical, pensions, workmen's compensation insurance to cover the above, vacation and holiday pay, for defrayment of costs of apprenticeship, or other bona fide fringe benefits, *but only* where the Contractor or subcontractor is not required by other federal, state or local law to so provide.

All determinations of the prevailing rate of wage shall be made by the industrial statistician of the Department of Labor and Industries.

The specifications for every contract for the construction, reconstruction, maintenance, or repair of any public work to which the State or any of its political subdivisions created by its laws is a party, shall contain a provision stating the hourly minimum rate of wage, not less than the prevailing wage, which may be paid to laborers, workmen, or mechanics in each trade or occupation required for such public work, employed in the performance of the contract either by the Contractor, subcontractor or other person doing, or contracting to do the whole or any part of the work contemplated by the contract; and the contract shall contain a stipulation that such laborers, workmen, or mechanics shall be paid not less than such specified hourly minimum rate of wage.

Before payment is made by or on behalf of the Owner of any sum or sums due on account of a contract for a public works improvement under these specifications, a certified statement of hourly wage paid shall be filed with the Owner's fiscal officer and with the Director of the Department of Labor and Industries by the Contractor and each subcontractor, and, further provided, that before any payment is made by or on behalf of the Owner, the Director of the Department of Labor and Industries shall issue a statement certifying that the prevailing wage requirements of this section have been satisfied.

The certified statement of hourly wage paid shall be in the following form:

State of Washington, }
County of ..... } ss.

I, the undersigned, having been duly sworn, depose, say and certify that in connection with the performance of the work, payment for which this voucher is submitted, I have paid the following rate per hour for each classification of laborers, workmen, or mechanics, as indicated upon the attached list, now referred to and by such reference incorporated in and made an integral part hereof, for all such employed in the performance of such work; and no laborer, workman or mechanic so employed upon such work has been paid less than the prevailing rate of wage or less than the minimum rate of wages as specified in the principal contract; that I have read the above and foregoing statement and certificate, known the contents thereof and the substance as set forth therein is true to my knowledge and belief.

Attention is called to RCW 39.12.050, which reads as follows:

"Any Contractor or subcontractor who shall, upon his oath, verify any statement required to be filed under this act which is known by him to be false, or is made without knowledge in reckless disregard of the truth, shall be guilty of perjury in second degree and shall be punished as provided in RCW 9.72.030."

In case any dispute arises as to what are the prevailing rates of wages for work of a similar nature to that contemplated under the contract and such dispute cannot be adjusted by the parties involved, the matter shall be referred for arbitration to the Director of the Department of Labor and Industries of the State of Washington, and his decision therein shall be final, conclusive, and binding on all parties involved in the dispute.

The hourly minimum rate of wage, not less than the prevailing rate of wage, which may be paid to laborers, workmen or mechanics in each trade or occupation required in the performance of this contract, either by the Contractor, subcontractor or person doing or contracting to do the whole or any part of the work contemplated by this contract, is shown in the special provisions.

The Owner does not guarantee that labor can be procured for the minimum wages set forth. The rates of wages listed are minimum only, below which the Contractor cannot pay and they do not constitute a representation that labor can be procured for the minimum listed. It will be the responsibility of the Contractor to ascertain for himself the wages above the minimum set forth he may have to pay.

7.08 FAILURE TO PAY FOR LABOR AND MATERIALS

If, at any time the Contractor fails to pay the subcontractor or the laborers employed upon the work, or fails to pay for the materials used therein, the Owner may withhold from the money which may be due the Contractor under this agreement such amount or amounts as may be necessary for the payment of such subcontractors, laborers, or materials, and may, acting as agent for the Contractor, deduct such amount or amounts from the final estimate and reserve the same, plus an amount sufficient to pay such claims, costs of action and attorney fees, for final disposition as provided by law. This provision is intended to protect the subcontractors and laborers employed upon the work and the parties who may be furnishing the materials to be used herein.

7.09 STATE SALES TAX

Pursuant to the existing laws of the State of Washington and rulings of the Tax Commission, certain activities relating to the building, repairing, or improving of public streets are not subject to a retail sales tax. Most other construction activities are deemed to be retail sales and hence subject to the sales tax.

The Owner will claim any exemption from the retail sales tax authorized by law, and the Contractor should determine which activities are subject to tax in order to properly evaluate the work. The Owner will furnish such information as it has available regarding the application of sales tax, but in no event shall the furnishing of such information constitute a representation or warranty and the Contractor shall be responsible for the correct interpretation of any laws or regulations relating to the application of the State sales tax.

7.10 PERMITS AND LICENSES

The Contractor shall procure all necessary permits, pay for the same, and obtain all official licenses for the construction of the work and for temporary obstructions, inclosures, opening of streets for pipes, walls, etc., arising from the construction and completion of the work described in the specifications. He shall be responsible for all violations of the law for any cause in connection with the construction of the work, or caused by obstruction of the work, or caused by obstructing streets, sidewalks, etc., and he shall give all requisite notice to public authorities.

7.11 ROYALTIES AND PATENTS

The Contractor shall be liable for all suits brought against the Owner by reason of infringement of patent rights on any material, machine or appliance that he may use on the work or incorporate in the finished job, except where specifically exempted by the special provisions. Unit prices named in the proposal shall include payment of royalties, if any.

7.12 USE OF PREMISES

The Contractor shall confine his equipment, storage of materials and operation of work to the limits indicated by law, ordinances, permits or direction of the Engineer, and shall not unreasonably encumber the premises with his materials. The Contractor shall comply with the Engineer's instructions regarding signs, advertisements, fires, and smoking.

7.13 CONFINE OPERATIONS WITHIN RIGHTS OF WAY AND EASEMENTS

Property lines, limits of easements, and limits of construction permits are indicated on the plans and it shall be the Contractor's responsibility to confine his construction activities within these limits, unless he makes arrangements for use of private property. Before using any private property adjoining the work, the Contractor shall file with the Engineer a written permission of the property owner, and upon vacating the premises the Contractor shall furnish the Engineer with a release from all damages, properly executed by the property owner.

7.14 SAFEGUARDS

The Contractor shall provide and maintain on a 24-hour basis all necessary safeguards such as watchmen, warning signs, barricades, and night lights at his own expense. Special care shall be exercised to prevent vehicles, pedestrians, and livestock from falling into open trenches or being otherwise harmed as a result of the work. The Contractor shall, in all cases, hold the Owner harmless for any and all damages resulting from any of his operations.

Any emergency safeguard or action which must be undertaken by the Owner for safety of the public shall be regarded as a legitimate charge against the Contractor.

7.15 MAINTENANCE OF TRAFFIC

7.15A Division of Responsibility

The Contractor shall be responsible for maintenance, control, and the safeguarding of traffic within and immediately abutting the project as further outlined herein, and as may otherwise be provided in the special provisions. The Owner will be responsible for maintenance, control, and safeguarding of traffic on all detours which do not lie within the project limits, unless otherwise required in the special provisions.

7.15B Street Closures or Partial Closures

Streets may be closed to through traffic unless otherwise provided for in the special provisions. Streets shall not be closed to traffic until such closure has been approved by the Engineer or an authorized traffic officer. Street closures shall be made in such a manner as to provide for maximum public safety and public convenience. They shall be opened to through traffic at such time as the work has been completed, or as the Engineer may direct.

7.15C Notifications

Notifications for street closures shall be made in accordance with Section 5.05.

7.15D Existing Traffic Signs and Facilities

The Owner will make all necessary adjustments to traffic signals and traffic signal activators at no cost to the Contractor. Existing traffic and street name signs which will interfere with construction shall be removed

by the Contractor and stored in a safe place. These signs shall not be removed until the Engineer has so directed and until the necessary measures have been taken to safeguard traffic after the signs have been removed. Preservation and maintenance of the signs shall be the sole responsibility of the Contractor. Upon completion of the project, the Owner will reset all such signs in their permanent location at no cost to the Contractor.

7.15E Detours

Detours outside the limits of the project shall be the sole responsibility of the Owner unless otherwise provided in the special provisions. Detours within the limits of the project such as side street crossings, temporary bridges over freshly placed concrete, utilization of one or more lanes of the construction area for maintenance of traffic, and such related facilities for the maintenance of traffic shall be the responsibility of the Contractor, the costs for which shall be included in the unit contract prices unless otherwise provided in the special provisions.

7.15F Local and Emergency Traffic

Local traffic shall be provided access to private properties at all times, except during some urgent stages of construction when it is impracticable to carry on the construction and maintain traffic simultaneously, such as for the placing of asphalt concrete pavement, placing and curing of portland cement concrete pavement, and deep sewer excavations which prohibit safe travel of vehicular traffic.

No private driveway may be closed without the approval of the Engineer unless written permission has been given the Contractor by the owner of the property affected.

Emergency traffic such as police, fire, and disaster units shall be provided reasonable access at all times. The Contractor shall be liable for any damages which may result from his failure to provide such reasonable access.

7.15G Protection of Pedestrian and Vehicular Traffic

The Contractor shall take every precaution to protect pedestrian and vehicular traffic. Wherever, in the opinion of the Engineer, the Contractor has not provided sufficient or proper safety precautions and safeguards, he shall do so immediately and to whatever extent the Engineer deems advisable.

7.15H Restriction of Parking

Where parking is a hazard to through traffic or to the construction work, it shall be restricted either entirely or during the time when it creates a hazard. Signs for this purpose will be initially furnished and placed by the Owner. The Contractor shall be responsible for and shall maintain the signs if they are used on any street which is directly involved in the construction work. If the parking signs are to be used beyond the confines of the work area such as another street being used as a detour, the signs will be the responsibility of the Owner.

7.15I Flagmen

The Contractor shall furnish at his own expense all flagmen who may be needed unless otherwise provided in the special provisions.

7.16 TRAFFIC CONTROL WITHIN AND ABUTTING THE PROJECT

The Contractor shall place and maintain all signs, barricades and warning lights within the limits of the project on all streets, alleys and driveways entering the project so that approaching traffic will turn right or left on existing undisturbed streets before reaching the warning signs and barriers immediately abutting the project. Signs which are required will, unless otherwise provided in the special provisions, be furnished by the Owner as provided in Section 7.17.

Barricades shall be furnished by the Contractor. The barricades shall be of a conventional design normally used in street construction work and painted a current traffic yellow with black stripes.

Unless otherwise provided in the special provisions, the Owner will assume responsibility for signs and traffic control devices beyond the limits hereinbefore described.

7.17 TRAFFIC CONTROL SIGNS

Standard traffic control signs required for construction will be furnished to the Contractor at no charge. He shall maintain them in a neat condition until the need for them has ceased, after when he shall carefully remove the signs and return them to the Engineer in good condition. All signs lost or destroyed shall be replaced in kind by the Contractor or else a deduction will be made on estimates due him to cover the value of signs not returned in acceptable condition.

All costs incurred by the Contractor in placing and maintaining the signs shall be considered as incidental to the cost of the construction and be included in the unit contract prices of the work.

7.18 PROCEDURE FOR PROCURING SIGNS

The Contractor shall call the Engineer for those signs the Owner is to furnish. Except in an emergency, the call shall not be less than eighteen (18) hours before signs are required. Where special signs are involved, the notification shall be not less than one (1) week before delivery.

The Contractor shall pick up the signs at the point designated by the Engineer and return them at such time as they are no longer needed on the particular project. At the time the Contractor picks up the signs, he or his representative shall sign an itemized receipt showing the number and types of signs delivered to him. Any signs not returned, or which have been damaged, will be charged against the Contractor at a rate to be determined by the Engineer, and the cost thereof shall be deducted from the pre-final estimate.

7.19 MAINTAINING POSTAL SERVICE

Postal service shall be maintained in accordance with the instructions of the U.S. Post Office Department. The Contractor shall be responsible for moving mail boxes to temporary locations designated by the Post Office Department, and at completion of the work he shall replace them in location and in condition satisfactory to the Post Office Department.

It will be the Contractor's responsibility to contact the U.S. Post Office Department for their requirements in maintenance of postal service and to follow the requirements.

In cases where the posts upon which the box or boxes are fastened are in such condition that they cannot be reset, the Contractor shall furnish posts for this purpose at his own expense unless payment therefor is otherwise provided in the proposal or special provisions.

All cost incurred in work outlined above shall be considered as incidental to the construction of the contract unless otherwise provided in the proposal or special provisions.

7.20 USE OF EXPLOSIVES

Blasting will not be permitted in any case without specific authority of the Owner, and then only under such restrictions as may be required by the proper authorities. Explosives shall be handled and used in strict compliance with "Safety Standards for Construction," by the Department of Labor and Industries, Olympia.

When the use of explosives is necessary for the prosecution of the work, the Contractor shall use the utmost care so as not to endanger life or property, cause slides or disturb the materials outside the neat lines of the cross section.

Blasting shall be completed in the vicinity of new structures before construction on such structures is undertaken. All explosives shall be stored in a secure manner and place in compliance with local laws and ordinances and all such storage places shall be clearly marked "Dangerous—Explosives". No explosive shall be left in an unprotected manner along or adjacent to any existing highway or public place.

7.21 RAILROAD CROSSINGS

Wherever a project is being constructed beneath, at grade or above railroad tracks, the permits for the construction will have previously been secured by the Owner. It shall be the Contractor's responsibility to conform to the terms and provisions of the permits as may be described in the special provisions.

The Contractor shall hold the Owner harmless from any and all damages resulting from the Contractor's construction operations at such railroad crossings.

7.22 SANITARY PROVISIONS

The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the State Department of Health and of other bodies or officers having jurisdiction thereover. He shall permit no public nuisance.

7.23 USE AND OCCUPANCY PRIOR TO COMPLETION OF CONTRACT

The Owner reserves the right to use and occupy any portion of this improvement which has been sufficiently completed, but such use and occupancy shall not be construed as an acceptance of any portion of the work, and any claims which the Owner may have against the Contractor shall not be deemed to have been waived by such occupancy.

7.24 PERSONAL LIABILITY OF PUBLIC OFFICIALS

Neither the Engineer nor any of his assistants, nor any other officer of the Owner shall be personally responsible for any liability arising under or growing out of the contract.

7.25 NO WAIVER OF LEGAL RIGHTS

Should an error be discovered in or payment of unauthorized work be made by the final estimate or should dishonesty on the part of the Contractor be discovered in the work, the Owner reserves the right, after the final payment has been made, to claim and recover by process of law such sums as may be sufficient to correct the error, to recover the overpayment, or to make good the defects in the work resulting from the Contractor's dishonesty.

Section 8—Prosecution and Progress

8.01 CONSTRUCTION SCHEDULE

After being awarded the contract and having been duly notified of the same, the Contractor, if requested by the Engineer, shall immediately prepare and submit to the Engineer for approval a progress schedule which will insure the completion of the project within the time specified. Adequate equipment and forces shall be made available by the Contractor to start work immediately upon order of the Engineer and to carry out the schedule to completion of the contract within the time specified.

8.02 NOTICE TO PROCEED AND PROSECUTION OF THE WORK

The Contractor shall begin work as specified in Section 8.05, and shall prosecute the work vigorously and continuously to completion except when it is physically impossible to do so on account of weather conditions or other unavoidable handicaps.

The necessity of discontinuing and resuming work on any portion of the contract shall be determined by the Engineer.

8.03 SUSPENSION OF WORK

When, in the judgment of the Engineer, unfavorable weather makes it impractical to secure first class results, or other conditions warrant the granting of a suspense order, he shall issue to the Contractor a written order to suspend work wholly or on any part of the contract. When conditions are again favorable for prosecution of the work the Engineer shall issue to the Contractor a written order to resume the suspended work. Orders to suspend work will not be written for intermittent shutdowns due to weather conditions unless the suspension of work is to be for an extended period of time. The Contractor shall take every precaution to prevent any damage or unreasonable deterioration of the work during the time it is closed down.

Suspension of the work by the Engineer shall not furnish any grounds for claims by the Contractor for damages or extra compensation, but the period of such suspensions shall be taken into consideration in determining the revised date for completion as hereinafter provided. The Contractor shall not suspend work under the contract without the written order of the Engineer as stated in the preceding paragraph. The Contractor will be required to work a sufficient number of hours per day in order to complete the project within the work days specified. The question as to the necessity of discontinuing any portion of the work by reason of unfavorable weather conditions shall be determined by the Engineer. Suspension orders will not be issued for the unavoidable delays mentioned in Section 8.07.

Upon failure of the Contractor to carry out the orders of the Engineer or to perform work under the contract in accordance with its provisions, the Engineer may suspend the work for such period as he may deem necessary. Time lost by reason of such failure or in replacing improper work or material shall not furnish any grounds to the Contractor for claiming an extension of time or extra compensation, and shall not release the Contractor from damages or liability from failure to complete the work within the time prescribed.

8.04 SUSPENSION OF WORK FOR AN EXTENDED PERIOD

In the event that a suspension of work is ordered in writing by the Engineer for an extended period of time due to unsuitable weather, which work in the opinion of the Engineer could have been performed prior to the occurrence of unsuitable weather conditions had the Contractor diligently prosecuted the work when conditions were suitable, the Contractor, at his own expense, shall do all work necessary to provide a safe, smooth and unobstructed roadway through the construction area for use by public traffic, and particularly for access to abutting property, during the period of suspension, or as provided in the special provisions. If the Contractor fails to do the work as above specified, the Owner will perform such work and deduct the cost thereof from any moneys due or to become due the Contractor.

In the event that a suspension of work for an extended period of time is ordered in writing by the Engineer due to unsuitable weather or unforeseen conditions and, in the opinion of the Engineer the Contractor has prosecuted the work with energy and diligence prior to the time of suspension of operations and has so constructed the temporary roadway or detour that it may be maintained by routine maintenance forces of the Owner during the period of suspension, the cost of maintaining a smooth and unobstructed roadway will be borne by the Owner at no cost to the Contractor.

In the event that a suspension of work for an extended period of time is ordered in writing by the Engineer on oiling or resurfacing projects, which do not require disturbing the existing traveled surface and on which the existing surface or shoulders have not been disturbed by the Contractor, the owner will maintain the roadway at no cost to the Contractor during the period of suspension.

If a suspension of work for an extended period, under which the Owner assumes the responsibility of maintenance, is granted in writing by the Engineer, the Owner will assume no responsibility except for routine mainte-

nance which shall include and be restricted to the following:

(a) Maintenance of the traveled roadway and/or detour surface.

(b) Maintenance of roadway surface drainage along the roadway and/or detour.

Any areas which are closed to traffic shall be maintained and safeguarded by the Contractor at his own expense.

In the event that the Owner has assumed maintenance of a project during a period of suspension, the Contractor agrees to accept the roadway or detour as it has been maintained by the Owner and no claim for extra payment shall be made on account of its condition or the manner in which the maintenance has been performed by the Owner. Such suspensions of work shall not relieve the Contractor of his responsibility of restoring the roadway and its slopes to the designated roadway section at his unit contract prices and for performing all other remaining work in accordance with the contract.

An extended period of time as expressed in these specifications is intended to mean shutdowns ordered in writing by the Engineer to cover extended shutdowns due to winter or seasonal weather, or extended shutdowns due to delays occasioned by the failure of another contractor to complete a portion of the work on which progress of the contract is dependent, or for other causes approved by the Engineer.

8.05 CONTRACT TIME

The improvement contemplated by the contract shall be completed in its entirety within the number of working days, or by definite completion date specified in the special provisions. The contract time shall commence ten (10) days after execution of the contract. The Contractor will be notified of the actual starting date by letter from the Owner.

A working day is defined as any day not otherwise defined herein as a non-working day. A non-working day is defined as Saturday, Sunday, a recognized holiday, a day on which the Contractor is specifically required by the special provisions to suspend construction operations, a day on which a suspension order is in effect, or a day on which work is not performed for reasons set forth in Section 8.07. Recognized holidays shall be: January 1st, February 22nd, May 30th, July 4th, Labor Day, Presidential Election Day, Thanksgiving Day, and December 25th. When any of the above days fall on Sunday, the following Monday shall be counted as a holiday. Lincoln's Birthday on February 12, Columbus Day on October 12 and Veterans' Day on November 11 are additional holidays for city and other political subdivision employees. When any of these holidays occur on Saturday or Sunday, the preceding Friday or the following Monday may be a legal holiday for these employees only; the three above named days are working days with respect to the contract time.

A suspension order covering a certain portion of the work only, will affect a working day by the percentage set forth on the suspension order, which percentage is intended to compensate for anticipated time lost in completing the contract on the time specified.

The Owner shall have the right at his discretion to extend the time for completion of the contract. Any extension of time requested by the Contractor for the consideration of the Owner shall be submitted in writing and shall be accompanied by the written consent to such extension by the surety on the bond.

8.06 DATE OF COMPLETION OF CONTRACT

Upon completion of all work and the incorporation of materials required under the provisions of the contract, the Engineer will inform the Contractor of the date on which all work and materials were considered as being completed. Further requirements shall be as outlined in Section 9.06, Acceptance of Construction.

Notification to the Contractor of the date of completion will not constitute acceptance of the work by the Owner. The acceptance of the work by the Owner is further outlined in Sections 9.05 and 9.06.

8.07 UNAVOIDABLE DELAYS

Should the Contractor be delayed in the prosecution or completion of the work by the act, neglect, or default of the Owner, any of its officers or employees, any other contractor employed by the Owner upon the work, or by any damage caused by fire or other casualty for which the Contractor is not responsible, or by combined action of workmen, in no way caused by or resulting from default or collusion on the part of the Contractor, then the time herein set for the completion of the work shall be extended for a period equivalent to the work time lost by reason of any or all of the causes aforesaid. The extended time period shall be determined and fixed by the Owner, which determination shall be final, but no such allowance shall be made unless a claim therefor is presented in writing to the Owner within ten (10) days after the occurrence of such delay.

The Contractor shall cooperate with the contractor of an adjoining or interdependent project to the fullest extent possible so that the operations of both will suffer a minimum of interference and delay. In case of disagreement between the Contractors, the decision of the Engineer shall be accepted as final. Any unavoidable delays to the Contractor resulting therefrom shall be adjusted as to contract time in accordance with specifications of this section.

In general, the number of working days allowed for completion of the project has been extended sufficiently to provide for the procurement of all materials necessary for construction and, unless otherwise noted in the special provisions, failure to procure the materials involved for any reason other than listed above will not be considered as an adequate reason for an extension of time.

8.08 FAILURE TO COMPLETE WORK ON TIME—LIQUIDATED DAMAGES

Time for completion of the work as provided by the contract is admitted to have been sufficiently advanced to allow resulting benefit to the Contractor from earlier completion of the work. Time, therefore, shall be of the essence of the contract.

If the Contractor shall fail to complete the work within the time specified in the contract, he shall pay the Owner as liquidated damages the amount per day (calendar or working day as specified) for each day that the work remains uncompleted beyond the specified completion date or time period, unless there shall have been an extension of time granted by the Owner. In the event of an extension of time, the Contractor shall pay the Owner as liquidated damages the specified amount per day for each day that the work remains uncompleted beyond the date or time period fixed by the extension of time.

The Contractor does hereby authorize the Owner to deduct such liquidated damages from the amount due, or to become due, the Contractor. The Contractor further agrees that any such deduction shall not in any degree release him from further obligations and liabilities in respect to the fulfillment of the entire contract.

Liquidated damages shall not be assessed the Contractor for unworkable days caused by weather conditions, or for any other days for which any extension of time will have been granted.

8.09 ASSIGNMENT OF CONTRACT AND SUBLETTING

The Contractor shall not assign this contract or any part thereof, or any moneys due or to become due thereunder, without the prior written approval of the Owner. The Contractor shall not sublet any part of this contract without first having obtained the written consent of the Engineer to do so.

Requests for permission to sublet, assign, or otherwise dispose of any portion of the contract shall be in writing and accompanied by the consent of the surety. In the event consent is given, it shall in no way release the Contractor from any responsibility, but he shall be held in all respects accountable for the same as if no consent had been given. The Contractor shall be required to give his personal attention to the work which is sublet.

8.10 FORFEITURE OF CONTRACT

Should the Contractor at any time refuse or neglect to supply a sufficiency of properly skilled workmen or of material of the proper quality, or fail in any respect to prosecute the work with promptness and diligence, or fail in the performance of any of the agreements herein contained, the Owner may at his option, after giving ten (10) days written notice to the Contractor, provide such sufficiency of labor or materials and deduct the cost thereof from any moneys due or thereafter to become due under this contract.

In the event of such refusal, neglect, or failure, the Owner may, by written notice to the Contractor and his surety or his representative, or, if the Contractor abandons the work undertaken under the contract, the Owner may, at his option with such written notice to the surety and without any written notice to the Contractor, transfer the employment of said work from the Contractor to the surety.

Upon receipt of such notice, the surety shall enter upon the premises and take possession of all materials, tools, and appliances thereon for the purpose of completing the work included under this contract, and employ by contract or otherwise, any person or persons to finish the work and provide the material therefor, without termination of the continuing full force and effect of the contract.

In case of such transfer of employment to the surety, the surety shall be paid in its own name on estimates covering the work subsequently performed under the terms of the contract and according to the terms hereof, without any right of the Contractor to make any claim for the same or any part thereof. In lieu of the foregoing, if the Owner so elects, he may terminate the employment of the Contractor for said work and enter upon the premises and take possession of all materials, tools and equipment thereon for the purpose of completing the work included under the contract, and employ by contract or otherwise, any person or persons to finish the work and provide the materials therefor.

In case of the discontinuance of employment by the Owner as aforesaid, the Contractor shall not be entitled to receive any further balance of the amount to be paid under this contract until the work shall have been fully finished. At this time, if the unpaid balance of the amount to be paid under this contract exceeds the expense incurred by the Owner in finishing the work, and all damages sustained or which may be sustained by the Owner by reason of such refusal, neglect, failure, or discontinuance of employment, such excess shall be paid by the Owner to the Contractor. If such expense and damages shall exceed the unpaid balance, the Contractor and his surety and each thereof shall be jointly and severally liable therefor to the Owner and shall pay the difference to the Owner.

8.11 CONTRACTOR ORGANIZATION, SUPERINTENDENCE AND EQUIPMENT

All machinery and equipment shall be adequate for the purpose used and shall be kept in good workable condition and be operated by experienced operators.

The Contractor shall provide at all times during the progress of the work, competent and necessary superintendence. During the Contractor's absence, the superintendent shall have full authority to execute the orders or directions of the Engineer without delay and to promptly supply such materials, tools, plant equipment and labor as may be required.

All work under the contract shall be performed under the continuous supervision of competent personnel thoroughly experienced in the class of work specified.

Incompetent, careless or negligent employees or agents shall be forthwith discharged by the Contractor upon written request of the Engineer, and failure to comply with such request shall be sufficient grounds for termination of the contract.

The lack of proper supervision by the Contractor or by his supervisory personnel shall be just cause for termination of the contract, as set forth in Section 8.10.

8.12 OVERTIME WORK BY OWNER EMPLOYEES

Where the Contractor elects to work on a Saturday, Sunday, a holiday, or longer than an eight-hour work shift on a regular working day, as defined in the standard specifications, such work shall be considered as overtime work. On all such overtime work an inspector will be present, and a survey crew if required. The Contractor shall reimburse the Owner for the full amount of the straight time plus overtime costs for employees of the Owner required to work overtime hours.

Recognized holidays shall be as listed in paragraph 2 of Section 8.05.

The Contractor by these specifications does hereby authorize the Owner to deduct such costs from the amount due or to become due him.

Overtime due to special construction problems such as concrete finishing, asphalt rolling, making live sewer hookups, alleviating traffic problems, et cetera, will not be charged if the Engineer considers the overtime to be mutually justified.

Section 9—Measurement and Payment

9.01 MEASUREMENT

The determination of pay quantities of work performed under the contract will be made by the Engineer based upon the lines, grades, and cross section given, or measurements made by him or his assistants. All items will be computed in the units in the proposal.

9.02 SCOPE OF PAYMENT

The Contractor shall accept the compensation, as herein provided, in full payment for furnishing all materials, labor, tools and equipment necessary to the completed work and for performing all work contemplated and embraced under the contract; also for loss or damage arising from the nature of the work, or from the action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the work until the final acceptance by the Owner, and for all risks of every description connected with the prosecution of the work; also for all expenses incurred in consequence of the suspension or discontinuance of the work as herein specified; and for completing the work according to the plans and specifications.

Neither the payment of any estimate nor of any retained percentage shall relieve the Contractor of any obligation to make good any defective work or material. Payment will be made only for materials actually incorporated in the work. For payment of materials on site, see Section 9.05, Progress Payments.

The unit contract prices for the various bid items of the contract shall be full compensation for all labor, materials, supplies, equipment, tools and all things of whatsoever nature required for the complete incorporation of the item into the work the same as though the item were to read "In Place," unless the plans and special provisions shall provide otherwise.

9.03 PAYMENT FOR EXTRA WORK

Adjustments, if any, in the amounts to be paid the Contractor by reason of any change, addition, or deduction, shall be determined by one or more of the following methods:

(a) By an acceptable lump-sum proposal from the Contractor.

(b) By unit contract prices contained in the contract proposal, or by unit prices mutually agreed upon by the Contractor and the Owner.

(c) By force account.

It shall be the responsibility of the Contractor before proceeding with any change to satisfy himself that the change has been properly authorized in behalf of the Owner. No charge for extra work or any other change in the contract will be allowed unless the extra work or change has been authorized in writing by the Owner, and the compensation or method thereof is stated in such written authority.

9.04 FORCE ACCOUNT

Whenever in the opinion of the Owner the schedule of unit or itemized prices forming a part of the contract does not apply to items of extra work ordered in writing by the Engineer, such items of work shall be paid for at a price agreed upon in writing between the parties to the contract before such work is done, or on the basis of force account in the following manner:

1. Labor.

For all labor, including such foreman supervision, but excluding general superintendents as may be necessary upon any particular operation, the contractor shall be reimbursed for labor costs, overhead and profit as outlined hereinafter.

Payment made for labor shall be computed by the Engineer and shall be the sum of the following:

(a) Weighted Wage Rate: The agreed weighted wage rate for all labor used shall include and be restricted to the current prevailing basic wage plus fringe benefits made the obligation of the Contractor by regional labor agreement as shown in the contract "minimum wage rate schedule" and benefits paid on behalf of labor by the Contractor as follows:

(1) Federal Insurance Compensation Act (FICA)

(2) Federal Unemployment Tax Act (FUTA)

(3) State Unemployment Compensation Act (SUCA)

The above items shall be combined into a single wage rate for each classification of labor used which shall be designated as the "Weighted Wage Rate" for the identified class of labor.

(b) Travel Allowance and/or Subsistence: The Contractor shall be reimbursed the actual cost of travel and/or subsistence allowances paid to labor engaged upon the work when said allowances are required by regional labor agreement.

(c) Industrial Insurance and Medical Aid Premiums: The Contractor shall receive reimbursement for Marine Industrial Insurance, State of Washington Industrial Insurance and Medical Aid premiums which become an obligation of the Contractor and are chargeable to the force account work on the basis of time worked. The agreed rate(s) of compensation for the above premiums shall be a composite rate(s) based upon the full premium for Industrial Insurance and one-half the premium for Medical Aid which premiums are prescribed by the regulatory body for the Contractor(s) actually performing the force account work. This composite rate may be adjusted upon request to conform with adjustments prescribed by the regulatory body.

(d) Overhead and Profit: The Contractor shall be reimbursed an amount equal to twenty percent (20%) of the sum of the items hereinbefore listed under (a), (b) and (c) above as the cost of labor, which percentage payment shall constitute full compensation for overhead, profit and all other payments made to or on behalf of labor in addition to those items specifically set forth above.

2. Materials.

For all materials furnished by the Contractor for the work, payment shall be made for his actual invoice cost of such materials including actual freight and express charges and this state's Retail Sales and Compensating Taxes; and less all offered or available discounts and rebates, notwithstanding the fact that they may not have been taken by the Contractor. To the above cost shall be added a sum equal to fifteen percent (15%) for overhead and profit.

The Contractor shall furnish as support for all charges for materials valid copies of vendor's invoices including freight and express bills, except that such materials as may be furnished from Contractor's stocks for which an invoice is not available the Contractor shall furnish an affidavit certifying to his actual cost of such materials.

In the event the Contractor's cost of such materials furnished is in the opinion of the Engineer excessive, or if the Contractor does not furnish satisfactory evidence of his costs, the Owner reserves the right to establish the cost of all or part of such materials at the lowest current wholesale prices less all applicable discounts and exemptions at which said materials are available in the quantities required delivered to the location of the work.

The Owner reserves the right to furnish such materials as it deems advisable, and the Contractor shall have no claims for costs and profit on such materials.

3. Equipment

For any machine-power tools or equipment which the Engineer may deem necessary or desirable to use, the Contractor will be compensated in accordance with the current AGC-Dept. of Highways equipment rental agreement and the included "Maximum Hourly Rental Rates for Force Account Work" schedule for each and every hour that such tools or equipment are in use on such work. To the sum of the amount due the Contractor for rental of tools and equipment shall be added an amount equal to fifteen percent (15%) of that sum for overhead and profit.

The rates in effect at the time of the performance of the force account work, as set forth in the schedule of "Maximum Hourly Rental Rates for Force Account Work," are the maximum rates allowable for equipment of modern design and in good working condition and shall include and be full compensation for furnishing all fuel, oil, lubrication, repairs, maintenance, insurance and incidental expenses except labor for operation thereof. In the event equipment is required for which a rental rate is not included in the current schedule, an agreed rental rate shall be established for that equipment based upon the same elements of cost used in establishing the current schedule of rental rates. Such rates must be approved by the Engineer prior to use of the equipment on the force account work.

A current schedule of "Maximum Hourly Rental Rates for Force Account Work" will be maintained at each district office of the Department of Highways and at each of the offices of the Associated General Contractors of America, located at Seattle (Mountain Pacific), Spokane, Tacoma and Portland, where the schedule is available for inspection.

In event the necessary equipment is not already at the site of the project and it is not anticipated that it would be required for the performance of work under the terms of the contract other than force account, the Contractor will be paid an agreed amount for the necessary transportation of the equipment. To the agreed amount shall be added an amount equal to fifteen percent (15%) of that sum.

The compensation as herein provided shall be payment in full for all work done on a force account basis and shall cover all expenses of every nature, kind and description, including overhead expenses, payments required under the Social Security Act, State Unemployment Compensation Act, occupational tax and any other Federal or State revenue acts, together with all premiums on public liability and property damage insurance policies, use of small tools and equipment for which no rental is allowed, and profit.

No claim for such force account work shall be allowed except upon written order by the Engineer prior to the performance of such work. No work shall be construed as force account work which can be measured under the specifications and paid for at the unit prices named in the contract.

The amount and cost of any such force account work shall be computed by the Engineer and the amount certified to by him shall be final and conclusive and binding upon the Contractor. All claims for work done on such force account basis may be submitted for payment at any time subsequent to the performance of the work; however, all such claims must be cleared prior to final acceptance of work.

The Contractor's cost records pertaining to work paid for on a force account basis shall be open to inspection or audit by representatives of the Owner during the life of the contract and for a period of not less than 3 years after the date of acceptance thereof, and the Contractor shall retain such records, for that period. Where payment for materials or labor is based on the cost thereof to forces other than the Contractor, the Contractor expressly guarantees that the cost records of such other forces shall be open to inspection and audit by representatives of the Owner on the same terms and conditions as the cost records of the Contractor. If an audit is to be commenced more than 60 days after the acceptance date of the contract, the Contractor will be given a reasonable notice of the time when the audit is to begin.

9.05 PROGRESS PAYMENTS, FINAL PAYMENT, RETAINED PERCENTAGE

Payments will be made for work and labor performed and materials furnished under the contract according to the schedule of rates and prices and the specifications attached and made a part thereof. Partial payments under the contract will be made at the request of the Contractor once each month upon partial estimates by the Engineer, as hereinafter specified, provided they are in accordance with the provisions of RCW-60.28/010. There will be reserved and retained from monies earned by the Contractor, as determined by such monthly estimates, a sum equal to ten (10) percent of such estimates with the provision that if the Engineer finds that satisfactory progress is being made after fifty (50) percent of the original contract work has been completed, he may make any of the subsequent partial payments in full.

Cost of materials, properly stored, protected and insured at the site of the work will be paid on monthly estimates only when so provided for in the special provisions, and then only for the specific materials listed therein for partial payment. In preparing the monthly estimates, advancement will be made therein for ninety percent of the cost of such materials, as evidenced by invoices to the Contractor. Advancement will not be made for any item of material amounting to less than five hundred dollars ($500.00). All materials must conform to the requirements of the specifications; however, advancement for materials will not constitute acceptance, and any faulty material will be condemned although advancement may have been made for same in the estimates. Deductions at the same rates, and equal in amount to the advancements, will be made on the estimates as the material is used.

Quantities used for progress estimates shall be considered only as approximate and provisional, and shall be subject to recalculation, adjustment and correction by the Engineer in subsequent progress estimates and in final estimates. Inclusion of any quantities in progress estimates, or failure to disapprove the work at the time of progress estimate, shall not be construed as acceptance of the corresponding work or materials.

In the event that an unforeseen condition beyond the control of the Contractor will materially delay the final completion of a contract and if the retention of the monies reserved in accordance with the provisions of Chapter 236, Laws of 1955 will work undue hardship upon the Contractor, he may request payment of the retained percentage in accordance with the provisions of Chapter 91, Laws of 1957. If no claims have thus far been filed against the contract and if no taxes have been certified as due or about to become due by the State Tax Commission, the Owner, at its discretion, may pay the retained percentage or so much of it as appears to be proper, but no payment shall be made until the Contractor will have delivered to the Owner an acceptable bond in the full amount of the retained percentage thereupon released.

Payment of the retained percentage shall be withheld for a period of thirty (30) days following the final acceptance by the Owner, and shall be paid the Contractor at the expiration of said thirty (30) days in event no claims, as provided by law, have been filed against such funds; and provided further, that releases have been obtained from the State Department of Labor and Industries and also, except for contracts totaling less than $5,000.00, the Washington State Tax Commission, the State of Washington Employment Security Department, and all other departments and agencies having jurisdiction over the activities of the Contractor. In the event such claims are filed, the Contractor shall be paid such retained percentages less an amount sufficient to pay any such claims, together with a sum sufficient to pay the cost of such action, and to cover attorney fees as determined by the Owner.

9.06 ACCEPTANCE OF CONSTRUCTION

Acceptance of construction shall be defined as final approval of the project only in that it has been constructed, cleaned up, and completed in accordance with plans and specifications. See Section 8.06 for date of completion of the contract.

It is mutually agreed between the parties to the contract that a certificate of completion of the project, submitted by the Engineer or other officer of the Owner and approved by the governing body of the Owner, shall constitute final acceptance of the work and materials included in the contract on the date of such approval. It is provided further that such approval shall not constitute an acceptance of any unauthorized work, that no payment made under the contract except the final payment shall be evidence of the performance of the contract, either wholly or in part, and that no payment shall constitute an acceptance of unauthorized or defective work or improper material.

Projects will generally be accepted in respect to construction at such time as they are entirely completed; however, on projects consisting of several disconnected streets, sewer lines, or water lines, the Engineer may accept any of these separate sections if he so elects. On continuous street projects of less than twelve (12) city blocks, the Contractor shall be required to complete the entire project before acceptance. Street projects longer than twelve (12) blocks may be accepted in sections of six (6) blocks or more, as the Engineer may determine. Continuous sewer projects will not be accepted until completed in their entirety.

The acceptance of the contract work shall not prevent the Owner from making claim against the Contractor for any defective work if same is discovered within one (1) year from the date of acceptance. See Section 5.12.

Section 12—Clearing and Grubbing

12-1 CLEARING

12-1.01 DESCRIPTION

This item shall consist of clearing the areas shown on the plans or as described in the special provisions of all trees, brush, and other vegetation, down timber, rotten wood, rubbish, and other objectionable material. It shall include, but not limited to removing buildings, fences, lumber, trash piles and other obstructions interfering with the proposed work, and salvaging such of these materials as may be designated in the special provisions, burning or otherwise disposing of the debris as directed by the Engineer. All work under this item shall be done in accordance with these specifications and in conformity with the plans.

12-1.02 LIMITS OF CLEARING

-1.02A Sewers and Water Mains (Clearing and Grubbing)

The limits of clearing, as well as grubbing operations, on sewer and water main projects are dependent to a considerable degree upon the Contractor's operations and it shall be his responsibility to determine these limits providing he does not go beyond right-of-way or easement lines. The clearing and grubbing shall be to such width as will provide for the excavation of the trench, storage area alongside the trench for material excavated as trench excavation and backfill, an area for pipe and material storage, and for any haul roads which may be necessary. Clearing and grubbing of waste sites required for sewer and water main construction shall be considered as part of the project clearing. Clearing and grubbing on sewer and water main projects shall be measured and paid for at the unit contract price for "Clearing and Grubbing," per acre or per lump sum.

-1.02B Streets

In developed and semideveloped areas where driveable streets exist and where the project calls for grading and/or paving, the limits of clearing will include the area covered by the improvement under contract including all slope areas and the areas of approaches except private property where waste material is to be deposited; also slope areas, whether in excavation or embankment, extending beyond the street margins and staked accordingly by the Engineer.

-1.02C Landscaping Area

When an area is to be cleared prior to landscaping, the limits of the clearing will be outlined on the plans and will be staked by the Engineer.

12-1.03 CONSTRUCTION DETAILS

Within the limits described, all vegetable growth such as trees, shrubs, brush, logs, fences, upturned stumps and roots of down trees, and other similar items not specifically covered by unit prices shall be removed and disposed of. All trees shall be felled *within* the area to be cleared. Where the tree limb structure interferes with utility wires, or where the trees to be felled are in close proximity to utility wires, the tree shall be taken down in sections to eliminate the possibility of damage to the utility.

All buildings, fences, lumber piles, trash, and obstructions, except utility poles, within the area to be cleared shall be removed and disposed of by the Contractor. Any work pertaining to utility poles shall comply with Section 5.08.

All fences adjoining any excavation or embankment that may be damaged or buried shall be carefully removed and placed on the adjoining property.

No debris of any kind shall be deposited in any stream or body of water, or in any street or alley, or upon any private property except by written consent of the owner.

Trees, shrubbery, and flower beds designated by the Engineer shall be left in place and care shall be taken by the Contractor not to damage or injure such trees, shrubbery or flower beds by any of his operations.

Removal of ornamental or danger trees may or may not be a separate item of work on a project.

The refuse resulting from the clearing operation shall be hauled to a waste site secured by the Contractor and shall be disposed of in such a manner as to meet all requirements of State, county and municipal regulations regarding health, safety, and public welfare. When authorized by the proper fire authorities, the Contractor may dispose of such refuse by burning on the site of the project provided all requirements set forth by the authorities are met.

On easement through private property, such as is sometimes met in sewer construction, the Contractor shall not burn on the site unless specifically permitted in the special provisions, in which case he shall obtain permission as previously stated.

In all cases, the authority to burn shall not relieve the Contractor in any way from damages which may result from his operations. In no case shall any material be left on the project, shoved onto abutting private properties, or be buried in embankments or sewer trenches on the project.

Clearing operations shall be carried well in advance of the construction operations so as to permit a well planned schedule of work.

Where ornamental trees exist in planting areas and are not to be removed, it shall be the Contractor's responsibility to trim low limbs which will interfere with the normal operation of his equipment. The trimming shall be performed in a professional manner by competent personnel prior to his machine operations and in such a manner as the Engineer may direct.

The Contractor shall be responsible for all damages to existing improvements resulting from his operations.

12-1.04 MEASUREMENT

-1.04A Acreage Basis

When shown in the bid proposal, clearing will be paid on an acre basis, in which case clearing will be measured by the acre for the area cleared within the bounds staked by the Engineer, provided however, that the area within the existing street or highway where no clearing is required shall be excluded from the measurement.

In determining the pay area of clearing for intermittent or isolated areas in any fifty (50) foot station, the minimum area shall be fifty (50) feet by fifty (50) feet. If there is no clearing in a fifty (50) foot station, such area shall be excluded from the measurement.

-1.04B Lump Sum Basis

When shown in the bid proposal, clearing shall be upon a lump sum basis, in which case the lump sum shall include all clearing within limits outlined herein, or as otherwise defined in the plans or special provisions.

12-1.05 PAYMENT

When clearing is measured and paid for as a separate item it will be at one of the unit prices shown below:

"Clearing," per acre.

"Clearing," per lump sum.

The unit contract price for "Clearing," per acre, or "Clearing," per lump sum shall be full compensation for furnishing all labor, equipment and materials to complete the work as specified. See paragraph 2 of Section 12-3.03 when no pay item for "Clearing" is contained in the proposal.

12-2 GRUBBING

12-2.01 DESCRIPTION

This item shall consist of grubbing the areas outlined herein or as otherwise defined in the special provisions. The work shall include the removal of all stumps, roots, vegetable matter, and all structures in or upon the ground, the removal of which is not prescribed under the item of "Clearing," such as wood curb, planking, existing wooden culverts, wooden catch basins, drains, and stairways, et cetera.

12-2.02 LIMITS OF GRUBBING

-2.02A Sewers

Limits of grubbing for sewers shall be the same as the limits for clearing.

-2.02B Streets

Limits of grubbing for streets shall be the same as the limits for clearing.

12-2.03 PROTECTION OF EXISTING IMPROVEMENTS DURING GRUBBING OPERATIONS

Where it is necessary to remove stumps and where there are surface or subsurface improvements, the Contractor shall be responsible for determining which of the agencies, public or private, have underground or service utilities in the vicinity of the stump to be removed; and further, he shall notify each agency and request its assistance in locating its services. The Contractor will not be responsible for the cost of locating services.

Where sewer, water, electric, telephone, steam, gas and similar underground services into residences will be imperiled by stump removal, the utility agency affected will cut the service and replace same at no cost to the Contractor. Where telephone cable and/or ducts, water mains, gas mains, steam mains, and sewer trunks exist and are likely to be damaged, special care shall be taken, and roots of stump shall be cut off in such a manner that the existing utility installations will not be damaged in any way.

Regardless of the cooperation of affected agencies and utilities, the Contractor shall be responsible for any damage to services and utilities that are attributable to his operations, and he shall be responsible for the necessary repairs thereto as specified in Section 5.09.

Any damage resulting from the Contractor's operations to existing improvements within the area to be grubbed but which are not required to be removed by the grubbing shall be repaired by the Contractor at his expense. He will not be held responsible for damage to such improvements if the damage occurred previous to beginning of the contract.

If the Contractor removes stumps for private property owners along the project, he shall be responsible for all damage resulting therefrom.

12-2.04 CONSTRUCTION DETAILS

All stumps, roots, foundations and planking embedded in the ground within the limits described herein or otherwise described in the special provisions, shall be removed and disposed of. Piling and butts of utility poles shall be removed to a minimum depth of two (2) feet below subgrade or two (2) feet below original ground, whichever is lower. Disposal requirements for grubbing shall be the same as those described for clearing.

Removal of sod and lawns which are not to be replaced shall be considered as incidental to other work of the project and no payment will be made therefor. Grubbing shall otherwise meet requirements previously outlined under "Clearing."

12-2.05 MEASUREMENT

Measurement of grubbing shall be the same as described for clearing in Section 12-1.04.

12-2.06 PAYMENT

When grubbing is measured and paid for as a separate item, it will be at one of the unit prices shown below:

"Grubbing," per acre.

"Grubbing," per lump sum.

The unit contract price for "Grubbing," per acre, or for "Grubbing," per lump sum shall be full compensation for furnishing all labor, equipment and materials to complete the work as specified. See paragraph 2 of Section 12-3.03 when no pay item for "Grubbing" is contained in the proposal.

12-3 CLEARING AND GRUBBING

12-3.01 DESCRIPTION

This item shall consist of all clearing and grubbing hereinbefore described under the separate headings of "Clearing" and "Grubbing." It will include all areas for bridge sites, streets, highways, borrow pits, sewers, and related work whenever the special provisions and proposal provide for lump sum or per acre payment therefor.

12.-3.02 CONSTRUCTION DETAILS

The construction details outlined under the preceding specifications for "Clearing" and for "Grubbing" shall prevail in all respects.

12-3.03 MEASUREMENT AND PAYMENT

There will be no specific unit of measurement under the lump sum item of "Clearing and Grubbing," and all work hereinbefore specified under the headings of "Clearing" and "Grubbing" shall be paid for at the unit contract price for "Clearing and Grubbing," per lump sum or per acre, which shall be full compensation for all work required by the specifications.

If the proposal does not include a pay item of any kind pertaining to the work of clearing and grubbing, then the work specified therefor shall be considered as incidental to the construction of the project and all costs thereof incurred by the Contractor shall be included in other items of the construction.

12-4 ORNAMENTAL AND DANGER TREES

12-4.01 DESCRIPTION

Ornamental trees growing in areas that are to be graded or paved and which must be removed, shall be considered as part of the "Clearing and Grubbing." Trees other than those which have not been specifically shown on the construction plans or in the special provisions as part of the clearing and which are required to be removed, shall be considered as ornamental trees and their removal be paid for as such.

An ornamental tree is further defined as a woody perennial having a main stem (trunk) measuring 12 inches or more in circumference at a point 4 feet above average ground level. Where more than one stem exists, they shall be considered as individual trees as determined above. Trees of lesser dimensions, shrubs, and bushes which are not located in the areas to be cleared and grubbed but which are ordered to be removed, shall be paid for by force account.

It shall be the responsibility of the Contractor to preserve any tree for which the special provisions or plans so provide or for which the Engineer may direct the saving. If removal is required, the removal and disposition shall be by the same specifications as hereinbefore recited for clearing and grubbing, but the measurement and payment shall be upon the basis hereinafter defined.

In most cases, ornamental trees requiring removal will be shown on the plans. Failure to indicate them on the plans shall not, however, relieve the Contractor from responsibility of performing the work upon the unit price basis per each if there shall have been included in the proposal a range of circumferences pertaining to payment; otherwise he shall do the work upon a force account basis or upon a negotiated price basis.

The removal of all ornamental trees will be paid for in accordance with items set up in Section 12-4.03. All such trees shall be removed to a minimum of ten (10) inches below grade.

Danger trees are those trees which the Engineer determines shall be removed to eliminate danger. They shall be considered in the same category as for ornamental trees and measurement and payment will be made in the same manner by ranges of circumferences, force account, or negotiated price per each or otherwise as may be mutually agreed upon by the Engineer and the Contractor.

12-4.02 MEASUREMENT, ORNAMENTAL AND DANGER TREES

Measurement shall be by four (4) ranges of circumferences measured at four (4) feet above ground and classified as follows:

12 inches to 36 inches, CLASS I
36 inches to 72 inches, CLASS II
72 inches to 126 inches, CLASS III
126 inches and more, CLASS IV

12-4.03 PAYMENT

Payment will be made at the unit contract price per each of the following items:

1. "Remove Tree, Class I," per each.
2. "Remove Tree, Class II," per each.
3. "Remove Tree, Class III," per each.
4. "Remove Tree, Class IV," per each.

The unit contract price per each tree shall be full compensation for all labor, equipment, and materials required to perform the work in accordance with the specifications and directions of the Engineer.

Section 13—Street and Drainage Excavation

13-1 DESCRIPTION

This item shall consist of excavating and grading the roadway, side streets, alley and driveway approaches, sidewalk and planting areas, and alleys, and all work necessary for the completion of the cuts, embankments, slopes, roadway ditches, side street approaches, sidewalks and planting areas, alleys and subsidiary work, including disposal of all surplus material. All work shall be performed in accordance with the alignment, grades, and cross sections shown on the construction plans.

13-1.01 CLASSIFICATION

Roadway excavation, comprising all materials within the roadway, planting and sidewalk areas, but excluding trench excavation and borrow pits, will be classified under headings of "Unclassified Excavation," "Common Excavation," and "Solid Rock Excavation," in accordance with the specifications therefor.

"Unclassified Excavation" shall include all materials otherwise classified under the heads of "Solid Rock Excavation" and "Common Excavation" as hereinafter defined, and shall comprise all materials of whatsoever nature or character excavated within the previously defined areas without further classification. Materials from borrow pits shall be classified in the same manner as roadway excavation.

"Solid Rock Excavation" shall include all solid rock in ledges, bedded deposits and unstratified masses and conglomerate deposits so firmly cemented as to present all the characteristics of solid rock and which cannot be removed without drilling and blasting, and all boulders containing a volume of more than one-half cubic yard. All solid rock layers with an overburden of shattered rock or solid rock layers interspersed with strata of clay or similar material will be classified as "Solid Rock Excavation" for the total depth of excavation in which the solid rock strata constitutes not less than 85 percent of the total depth.

"Common Excavation" shall include all other material not classified as solid rock.

Drainage excavation shall include all excavation encountered in the construction of open ditches and channel changes, except ditches that are a part of the roadway section. Drainage excavation shall be of two classifications: "Ditch Excavation" and "Channel Excavation." Each of the two classifications may be classified into "Common," "Solid Rock," or "Unclassified," according to the materials encountered under the specifications for roadway excavation.

Ditch Excavation shall include all excavation encountered in the construction of open ditches as hereinafter described, and which have a bottom width of less than eight (8) feet.

Channel Excavation shall include all excavation encountered in the construction of open ditches as is hereinbefore described, and which have a bottom width of eight (8) feet or more.

13-2 PROTECTION OF EXISTING IMPROVEMENTS

13-2.01 SURFACE IMPROVEMENTS

The Contractor shall be responsible for the protection of existing surface improvements as described elsewhere in the various applicable sections of the specifications, and any damage resulting from his operations shall be his sole responsibility.

13-2.02 SUBSURFACE IMPROVEMENTS

-2.02A General

Utilities of record will be shown on the construction plans insofar as it is possible to do so. Failure of the Owner to show the existence of subsurface objects or installations on the plans shall not relieve the Contractor from his responsibility to make independent check on the ground, nor relieve him from all liability for damages resulting from his operations unless otherwise provided in the special provisions or by exceptions hereinafter mentioned.

It shall be the responsibility of the Contractor to give proper written notification to the agencies that have utilities in place and to cooperate with these agencies in the protection and relocation of the various underground installations. These agencies will give assistance in the location of the various utilities, but this shall not relieve the Contractor from responsibility for any damage incurred, except in case where the installations are not located as closely as is normally possible with electronic pipe locator. In such case the Contractor will not be liable if he has proceeded with due caution.

-2.02B Lighting Cables

Where lighting cables exist within the areas to be excavated and are not more than six (6) inches below the final grade of the excavation, the Contractor shall not be responsible for any damage done, provided he has given proper and timely notification, and has cooperated to keep damage to a minimum.

-2.02C Sewers and Appurtenances

Sewer manholes and catch basins shall be protected and particular care shall be taken to prevent gravel, earth, and other debris from getting into the sewer. The Contractor shall, at his own expense, clean out and flush debris from manholes, catch basins, main sewers, et cetera when that work is made necessary because of his excavations operations, and he shall leave all such free of debris at the conclusion of his contract.

Where house services are damaged through no fault of the Contractor, they shall be repaired and payment will be made therefor in accordance with the unit contract price, or by force account as the Engineer may determine.

-2.02D Water Mains and Appurtenances

The Contractor shall be responsible for any damage to water mains and water facilities caused by his operations, except that he will be relieved therefrom under the following conditions: (1) He has not excavated below or beyond the required excavation lines and, (2) he has given proper and timely notice of his work plans and, (3) he has used reasonable care and has cooperated in minimizing the damages, and (4) except as may be modified hereinafter.

Any damage to water gates, hydrants, valve chambers and other surface appurtenances which results from the Contractor's operation shall be his sole responsibility.

-2.02E Private Utilities

Utilities other than those owned and operated by Owner are in streets pursuant to franchises or to rights claimed under the laws of the U. S. A. or the State of Washington, and therefore, the respective utility agencies are responsible for all adjustments and relocations of their facilities. These agencies will locate their facilities for the Contractor and assist him in their protection. The Contractor shall co-ordinate his work with that of the affected agencies and shall protect them from damage. The Contractor shall be liable for all damages to private utilities resulting from his operations, and hold the Owner harmless.

13-3 CONSTRUCTION DETAILS

13-3.01 SIDE STREET, ALLEY AND DRIVEWAY APPROACHES

Approaches to the project shall be excavated to the limits indicated on the plans or to such limits as the Engineer may direct. This excavation shall be made in conjunction with the street excavation and in such a manner as to provide for easy and safe access for local and emergency traffic at all times.

13-3.02 EXCAVATION BELOW GRADE

Where the Engineer deems subgrade material to be unsatisfactory, excavation below grade will be required to such depths as he may direct. Excavation below grade shall be of the same classification as that above it provided it is removed in the same operation as the normal excavation. Where the Contractor has completed the roadway excavation and is required to move back to remove unsuitable material, or where the additional depth requires special equipment because of the presence of shallow utilities or other unforeseen conditions, the work shall be performed as directed and a payment for excavation below grade will be made on the basis of extra work as provided in Section 9.03.

If the excavation below grade is required because of negligence on part of the Contractor, the necessary excavation below grade and the backfilling required to restore the surface satisfactorily shall be at his expense.

13-3.03 PLANTING AND SIDEWALK AREAS

The class of excavation as specified shall include all excavation of planting and sidewalk areas and shall extend to the lateral and terminal limits shown on the construction plans. Planting areas shall be defined as those areas existing between the roadway surface and property line, exclusive of the areas occupied by other improvements such as sidewalks. On planting strips in developed areas, the excavations shall be made and be terminated to blend neatly with the existing contours. Where planting strips are low, they shall be filled with soil comparable to that which exists and conform to the plan grade.

13-3.04 PAVEMENT REMOVAL

Pavement removal shall be accomplished and compensation be made therefor in accordance with the requirements of Section 52. Where existing streets are to be excavated and are presently surfaced with asphalt concrete or bituminous mats on earth or granular base, these surfaces shall be considered as part of the excavation unless otherwise specified in the special provisions. Where existing street pavements extend beyond the back of the new curb line, the Contractor will also be required to remove the pavement as part of the excavation. It shall be the Contractor's responsibility to determine the thickness of such surfaces before submitting his proposal.

13-3.05 DISPOSAL OF EXCAVATED MATERIAL

Suitable excavated material shall be used for the making of all required project embankments. The more suitable portions of the excavated material shall be stored on or off the project, as the Contractor may elect, and used for backfilling of curbs and dressing up the planting areas, the cost of which shall be considered as incidental to the excavation. Excavated material in excess of that needed to complete all embankments and for backfilling curbs and dressing planting areas shall be wasted by an equitable distribution of the material to properties within the project limits, as directed by the Engineer. Any excess materials remaining shall be disposed of by the Contractor at his own expense.

The Contractor shall not waste any excavated material until he is certain there is sufficient material to complete all necessary project embankments and plantings. If an undue amount is wasted, the Contractor shall secure and furnish necessary borrow material at his own expense.

13-3.06 DITCHES

All ditches shall be constructed as shown on the plans and shall be so graded as to conform to the natural flow of the water to inlets, catch basins, culverts or channels. Ditches from cuts shall be located in such manner as to bypass any part of the adjacent fill so that no damage will be caused thereto by running water.

13-3.07 SELECTED MATERIAL

When called for on the plans or in the special provisions, or when ordered by the Engineer, suitable selected material encountered in excavating or widening the roadway prism or encountered in any other excavation within the street right of way, including the excavation of local borrow, shall be used for finishing the top portion of the subgrade or for structure backfill, or used as otherwise shown on the plans or in the special provisions, or as directed by the Engineer.

Unless otherwise specified in the special provisions, selected material shall be defined as material which is excavated from one or more of the above sources designated by the Engineer, and which is used for selective purposes by direction of the Engineer.

Selected material shall be placed on the roadbed in accordance with the requirements of Section 13-3.10E for constructing earth embankments, or Section 13-3.10F for embankments at trestles or bridge ends.

When the transporting of selected material directly from excavation to its final position on the roadway will be impracticable, the selected material shall be left in place until it can be placed in final position and no additional compensation will be made because of the delayed excavation. If, however, the conditions are such that the undisturbed selected material will hamper ordinary grading operations or cause unnecessary movements of equipment, the Engineer may allow the removal of sufficient selected material and the stockpiling thereof to enable practical hauling operations. If excavation and stockpiling of selected material is specified in the special provisions or is ordered by the Engineer, the excavation and stockpiling shall be at locations designated by the Engineer, and thereafter be removed from the stockpile and placed in final position upon the roadbed when directed by the Engineer.

Measurement and payment for selected material stockpiled as above provided shall apply in accordance with Sections 13-4 and 13-5 respectively, both for excavation and haul of the selected material from its natural position, and also from the stockpile. Measurement of the material taken from stockpile will be made of the neat line volume actually removed.

13-3.08 SLIDES

Side slopes in cuts and on embankments shall be constructed as staked or reestablished by the Engineer. In case a slope finished to the lines as staked or reestablished by the Engineer shall slide back of the established slope onto the roadway prism, or out of an embankment before final acceptance of the work, such slide material shall be removed by the Contractor from the roadway, or be replaced in the embankment by him, at the unit contract price for the class of excavation involved, and the slopes shall be refinished as directed by the Engineer. The resloping will be paid for upon a force account basis as defined in Section 9.04.

In event the slide material cannot be measured accurately, or if the slide material will require a different type of equipment than that available on the project, payment therefor may be made on a force account basis when so authorized by the Engineer.

Materials to replace embankment slides shall be obtained from sources designated by the Engineer. Slopes

undercut at the base or destroyed in any manner by act of the Contractor shall be resloped by him parallel to the damaged slope, or as reestablished by the Engineer, at his own cost.

13-3.09 OVERBREAK

In all materials encountered in the performance of the contract, overbreak is that portion of any such material which is excavated, displaced or loosened outside and beyond the slopes, lines, or grades as staked or reestablished, with the exception of such material which occurs as slides as described hereinbefore, regardless of whether any such overbreak is due to blasting, to the inherent character of any formation encountered, or to any other cause. All overbreak as so defined shall be removed by the Contractor at his own expense and shall be disposed of by the Contractor in the same manner as provided for the surplus under the heading of "Excavation," but at his own expense and without any allowance for haul.

Whenever it is agreed to in writing and in advance between the Contractor and the Engineer, overbreak may be used in forming any embankment as planned to replace borrow which otherwise would have to be provided for. In this event payment will be made for the volume of common borrow or solid rock borrow, as the case may be, which the overbreak replaces, at the respective contract prices per cubic yard for such borrow with the additional allowance for haul, if any, on such available borrow; provided however, that no allowance will be made for overbreak which is placed in the embankment as planned in lieu of available material coming from within the neat lines of the roadway prism.

13-3.10 EMBANKMENTS

-3.10A Foundation Treatment

The materials composing the embankments must be entirely imperishable and wherever the natural surface upon which the embankment is to be placed is of such nature as, in the judgment of the Engineer, will impair the stability or usefulness of the street, the natural surface shall be stablized or removed and disposed of as the Engineer may direct.

Where embankments are to be made on hillsides or where a new fill is to be applied upon an existing embankment, the slopes of the original ground or embankment (except rock embankments) shall be terraced or stepped by plowing deeply or by other approved means before filling is commenced.

If ordered by the Engineer, material at the point of transition from cut to fill or in areas upon which shallow embankments are to be placed shall be excavated to a minimum depth of two (2) feet below subgrade elevation for a lateral width three (3) feet greater than the traveled roadway and for such longitudinal distance as ordered by the Engineer. The excavated material shall be deposited in the lower portion of adjacent fills or wasted if directed by the Engineer. Payment for the excavated material shall be made at the unit contract price for the class of material involved, plus haul if included. No further compensation will be made.

If ordered by the Engineer, the earth remaining in the excavated area shall be loosened to a depth of eight (8) inches or such lesser depth as ordered by the Engineer, and then be compacted. Payment for compaction of the loosened material shall be made at the unit contract price per cubic yard for "Embankment Compaction".

Following preparation of the excavated area, the void shall be filled in layers with selected material from adjacent cuts and compacted as provided in the contract. Material used to backfill the excavated areas will be paid for at the unit contract price for the class of material involved. Such payment, plus payment for haul if provided for in the bid proposal, embankment compaction (of the method specified), and water shall be full compensation for all costs involved in excavating, loading, hauling and compacting the backfill materials.

-3.10A1 Unsuitable Foundation Excavation

When shown on the plans or when specified in the special provisions, unstable natural ground shall be excavated prior to the placement of embankment over the area. The unstable material may consist of peat, muck, swampy or unsuitable materials, including buried logs and stumps. The material shall be excavated by the Contractor as directed by the Engineer to give the constructed embankment full bearing on solid ground.

Materials excavated from the roadway or channel change prisms, the classification of which is covered by Section 13-1.01 will not be classified as unsuitable foundation excavation unless the removal must be accomplished by dragline operation or by special excavation methods requiring different equipment from that used for roadway excavation, in which case measurement and payment as "Unsuitable Foundation Excavation" on a per cubic yard basis will apply.

When no unit contract price is provided in the contract for "Unsuitable Foundation Excavation," such work as may be ordered by the Engineer shall be accomplished as extra work and payment will be made as provided in Section 9.03.

-3.10A2 Displacement of Unsuitable Foundation Materials

Where shown on the plans or where specified by the special provisions, the roadway embankments to be constructed across low, swampy ground shall be constructed on solid ground to the elevation as indicated by the roadway section on the plans. To obtain this result the overburden of peat, muck, swampy or other unsuitable material lying above the elevation of solid ground shall be displaced or removed by the Contractor, as directed by the Engineer, to give the constructed embankment full bearing on the solid ground, as shown by the plans.

The Contractor shall displace the overburden of unsuitable materials in constructing the embankment by such methods as the Engineer may approve. The overburden material outside of the new embankment slopes which is upheaved through displacement by the fill shall be leveled off as directed by the Engineer, and left in a neat condition.

All costs and expense involved in accomplishing displacement and/or removal of unstable materials encountered below the existing surface of the ground, and for leveling the upheaved material outside of the embankment slopes, will be paid for on a basis of extra work as defined in Section 9.03. All other costs in connection with the work shall be considered incidental to the construction of the embankment and shall be included in the unit contract prices for the various pay items of work involved.

-3.10A3 Backfilling

Where soft or unstable materials are removed the area shall be drained, if possible, in order that the backfill may be compacted. Where drainage is impossible, backfill to be placed in water shall be granular in character except when otherwise provided in the special provisions.

-3.10B Accelerated Subsidence by Vertical Sand Drains

Where shown on the plans or where specified by special provisions the overburden of soft or unstable material lying above the elevation of firm ground shall be stabilized by the construction of vertical sand drains and a sand drainage blanket.

-3.10B1 Vertical Sand Drains Including Backfill

Prior to constructing the vertical sand drains, a working platform consisting of roadway excavated material or common borrow shall be constructed to a depth of two (2) feet, or as shown on the plans or as ordered by the Engineer, and shall be placed over the entire area where sand drains are to be constructed, and be capable of supporting light construction equipment. This platform will provide access to the areas for the construction of sand drains.

If the equipment used cannot be supported on the working platform without displacement of the underlying soft soil, the equipment shall be supported on mats. The material may be placed in one lift, but in such a manner that will cause a minimum of displacement of the underlying soil.

Vertical holes eighteen (18) inches in diameter shall be constructed to the underlying firm strata, or to such a depth as the Engineer may direct, and the holes backfilled as hereinafter provided. The holes may be constructed by driving or jetting a casing down to the required depth, or by other approved methods.

The holes shall be vertical and shall be accurately spaced as indicated on the plans or as staked by the Engineer. Holes drilled out of place or that are damaged in excavating or backfilling shall be backfilled and abandoned, if so ordered by the Engineer, and no compensation will be allowed for excavating and backfilling holes that are abandoned.

If holes are excavated by jetting a casing to the desired depth, the jetting shall be continued for a sufficient length of time after the casing has reached final depth to remove all solid material within the casing.

After the hole has been backfilled, the casing shall be removed.

Each hole shall be inspected and approved by the Engineer before any filling material is placed therein.

Any method of construction that, in the opinion of the Engineer, is appreciably disturbing the adjacent ground, shall be discontinued.

Materials removed in excavating the holes shall be disposed of to and outside the limits of the working platform if they are suitable as a blanket adjacent thereto; otherwise the materials shall be disposed from the area by the Contractor.

Materials for use in backfilling sand drains shall consist of clean, coarse sand or fine gravel, shall be uniformly graded from coarse to fine, and shall be of such size that when tested on U. S. Standard sieves it will conform to the following:

Passing a ½ inch sieve	90% - 100%
Passing a ¼ inch sieve	65% - 100%
Passing a No. 10 sieve	40% - 100%
Passing a No. 50 sieve	3% - 30%
Passing a No. 100 sieve	0% - 4%
Passing a No. 200 sieve (wet sieving)	0% - 3%

It is the intent of these specifications that each hole be completely filled with backfill material. The Contractor shall use compressed air, or such other means as are necessary, to force the sand backfill from the casing in the event the sand does not fill the hole completely by gravity flow when the casing is removed.

-3.10B2 Sand Drainage Blanket

Before placing the sand drainage blanket the surface of the working platform shall be smoothed, and the surface of each drain shall be free of any clay or other material which may impede drainage.

The sand for the drainage blanket shall be spread uniformly over the area to a thickness of two feet above the working platform, or to such depth as directed by the Engineer.

Sand for the drainage blanket shall consist of granular material, free from wood, bark or other extraneous material and shall meet the following requirements for grading:

Passing 2½ inch square opening	90% - 100%
Passing ¼ inch square opening	30% - 100%

The portion passing ¼ inch shall meet the following requirements for grading:

Passing U.S. No. 10 sieve	50% - 100%
Passing U.S. No. 50 sieve	0% - 30%
Passing U.S. No. 100 sieve	0% - 7%
Passing U.S. No. 200 sieve (wet sieving)	0% - 3%

It shall be the responsibility of the Contractor to select or treat the material in such a manner as to meet fully the grading requirements as specified above.

-3.10C Embankment Construction

Embankment construction shall be divided into two classes, rock embankments and earth embankments. Rock embankments shall be all, or any part, of an embankment in which the material contains 10% or more by volume of gravel or stone four (4) inches or greater in diameter. Embankments of all other material shall be considered as earth embankments.

When embankments are constructed across wet or swampy ground which will not support the weight of heavy hauling and spreading equipment, the Contractor will be required to choose such methods of embankment construction and to use such hauling and spreading equipment as will least disturb the soft foundation. When soft foundations are encountered, the lower part of the fill may be constructed by dumping and spreading successive vehicle loads in a uniformly distributed layer of thickness not greater than that necessary to support the vehicle while placing subsequent layers, after which the remainder of the embankment shall be constructed in layers and compacted as specified.

It is not the policy of the Owner to allow an increase in the planned depth of embankment material over soft, wet, or swampy ground for the sole purpose of providing support for heavy hauling and spreading equipment, unless the Contractor proves to the satisfaction of the Engineer that the planned depth is inadequate to support lighter hauling vehicles. If it proves necessary for the Contractor to use smaller hauling vehicles or different methods of embankment construction than he had originally contemplated in order to comply with the foregoing, such shall not be the basis for a claim for extra compensation. The unit contract price for the various pay items involved shall be full compensation for all labor, materials and equipment necessary to perform the work as outlined herein.

At the time of compaction, the moisture content of that portion of the embankment material passing a one-fourth inch (¼") sieve shall be not more than three (3) percentage points above the optimum moisture content as determined in the "Compaction Control Test," specified in Section 13-3.10E5. Embankment material which contains less moisture than required for proper compaction with the compacting equipment being used shall be watered in the amount ordered by the Engineer.

Compaction of embankment material which contains excessive moisture shall not be started until the moisture content is reduced to the maximum amount specified heretofore. All costs and expenses involved in drying embankment materials shall be considered incidental to the various unit contract prices, unless a bid item or items for "Aeration Equipment" are included in the contract.

-3.10D Rock Embankment Construction

Rock embankments shall be constructed in layers not exceeding eighteen (18) inches in depth, except that when the average size of the fragments exceeds eighteen (18) inches, the layers may be as deep as required to allow their placement. Occasional fragments exceeding the average size shall be disposed of as directed by the Engineer instead of being incorporated in the embankment.

Each layer shall be compacted by routing the loaded and unloaded hauling equipment over the entire width of the roadway. In addition to compacting with hauling equipment, each layer shall be further compacted with at least one coverage of a 50-ton roller or four coverages of a 10-ton roller per six-inch depth of layer, or fraction thereof. The number of coverages for rollers weighing more than 10 tons and less than 50 tons shall be as directed by the Engineer. Rollers shall be so constructed that they will exert a reasonably uniform pressure over the area covered. Rolling may be omitted on any layer, or portion thereof when, in the opinion of the Engineer, it is not necessary.

The material shall be placed carefully so that the larger pieces of rock or boulders are well distributed. The intervening spaces and interstices shall be filled with the smaller stone and earth as may be available so as to form a dense, well compacted embankment. Each layer shall be compacted by routing the loaded transporting equipment over the entire width of the layer.

In making rock embankments, the Contractor will be required to bring the fills to within twelve (12) inches below grade, as designated by the Engineer, and to construct the remainder from fragmentary rock not to exceed six inches (6") in size from granular material to be obtained from the roadway excavations or from borrow pits as directed by the Engineer. The finer materials from rock excavations shall be saved as far as practica-

ble for use in topping out rock fills and backfilling over the subgrade excavation in rock cuts.

-3.10E Earth Embankment Construction

Earth embankments shall be constructed in compacted layers of uniform thickness by one of the three methods, A, B and C, described in subsequent subsections. Under all methods the layers shall be carried up full width from the bottom of the embankment to avoid widening the edges after the center has been brought to grade.

On tangents, the center of embankment layers shall be constructed higher than the sides. Side hill embankments shall be constructed with the intersection with the original ground as the high point of the layer and shall uniformly slope to the outer side with a slope not to exceed 1 foot in 20 feet.

-3.10E1 Compacting Earth Embankments

Earth embankment shall be compacted with modern, efficient, compacting units satisfactory to the Engineer. The compacting units may be of any type provided they are capable of compacting each lift of the material to the specified density. The use of hauling equipment to obtain partial compaction will be allowed but the Contractor will be required to compact the full width and depth of each layer of material to the required density. The right is reserved for the Engineer to order the use of any particular compacting unit discontinued if it is not capable of compacting the material to the required density in a reasonable time.

Embankments normally shall be constructed in successive horizontal layers not exceeding eight (8) inches in loose thickness when constructed by Method B or C as specified hereinafter. If approved by the Engineer, successive horizontal layers up to a maximum depth of eighteen (18) inches may be placed, provided the required density is obtained throughout the full width and depth of each layer. Unless otherwise stated in the special provisions, earth embankments shall be constructed by Method B.

-3.10E2 Method A

Under Method A, earth embankments shall be compacted in successive horizontal layers not exceeding two (2) feet in thickness. and each layer shall be compacted by routing the loaded haul equipment over the entire width of the layer. When permitted by the Engineer, side hill fills too narrow to accommodate the hauling equipment may be placed by end dumping until the embankment material can be spread to sufficient width to permit the use of the hauling equipment upon it. Thereafter, the remainder of the embankment shall be placed in layers and compacted as specified above. Suitable mechanical tampers shall be used to compact the layers adjacent to structures that are inaccessible to the loaded haul equipment.

-3.10E3 Method B

Under Method B, earth embankments shall be compacted in accordance with Section 13-3.10E1 and in addition thereto each layer in top two (2) feet shall be compacted to at least ninety-five (95) percent of the maximum density and each layer in the lower lifts to at least ninety (90) percent of the maximum density determined by the "Compaction Control Test" specified in Section 13-3.10E5.

At all locations that are inaccessible to a roller, the embankment shall be brought up in horizontal layers and compacted thoroughly with mechanical tampers. The horizontal layers shall not exceed eight (8) inches in loose thickness, except that the layers of the top two (2) feet shall not exceed four (4) inches in loose thickness.

-3.10E4 Method C

Under Method C, earth embankments shall be compacted in accordance with Section 13-3.10E1 and in addition thereto each layer shall be compacted to at least 95 percent of the maximum density as determined by the "Compaction Control Test" specified in Section 13-3.10E5. The moisture content of the earth at the time of compaction shall be uniform throughout the layer and shall be such that the specified density can be obtained, but in no case shall it vary more than three (3) percentage points above or below the optimum moisture content as determined in Section 13-3.10E5.

At all locations that are inaccessible to a roller the embankment shall be brought up in horizontal layers and compacted thoroughly with mechanical tampers. The horizontal layers shall not exceed eight (8) inches in loose thickness except that the layers of the top two (2) feet shall not exceed four (4) inches in loose thickness.

-3.10E5 Compaction Control Test

Optimum moisture content and maximum density for other than granular materials shall be determined in accordance with the Method of Test for Moisture-Density Relations of Soils, ASTM Designation D696, or in accordance with such other methods as may be outlined in the special provisions.

The maximum density for granular materials shall be determined in accordance with the Washington Method for compaction control test of granular materials developed by the Materials Laboratory of the Department of Highways, Olympia, Washington, or in accordance with such other methods as may be outlined in the special provisions. Instructions for using the Washington Method may be had without charge upon request to the Materials Laboratory, Department of Highways, Olympia, Washington, 98501.

-3.10F Embankments at Structures, Trestle and Bridge Ends

The work of filling around structures and the ends of trestles and bridges and the constructing of embankments shall be undertaken and completed as soon as possible after each structure is completed, or when ordered by the Engineer.

In filling around the structure, trestle and bridge ends, the Contractor shall bring the fill up equally on all sides of the bracing and the columns of the bridge to prevent distortion of the bents and columns. This method shall also be used in bringing up the fill on both sides of the bulkheads as shown in the sketch on the plans, or as directed by the Engineer. The embankments shall be constructed under the bridge to the height and dimensions as shown on the plans, or directed by the Engineer.

The embankment and backfill at both ends of all rigid frame concrete structures which do not have provisions for expansion shall be brought up and compacted simultaneously to prevent lateral displacement of the structure due to unbalanced earth loading.

All costs in connection with the above work shall be considered as incidental to the construction of the improvement and shall be included in the unit contract prices of the various pay items of work involved.

13–3.11 BORROW

Borrow shall consist of the excavation and disposal, as directed by the Engineer, of suitable and satisfactory material obtained from borrow pits designated and measured by the Engineer for the construction of embankments, subgrade, parking strips and sidewalk areas, or shoulders and other facilities. The widening of street cuts and ditches will be considered as street excavation and not as borrow.

Borrow materials shall be secured from pits on the right of way designated by the Engineer, or from such other pits as may be shown on the plans or designated in the special provisions. The Contractor may secure borrow from sources other than those designated in the contract, provided that the material is approved by the Engineer and that he secure the pit at his own expense. The haul on the borrow from sources furnished by the Contractor, if haul is a pay item, will be paid for according to the actual amount of haul from the sources from which the borrow is taken, provided, however, that no allowance will be made for haul from such sources in excess of the quantity computed from the sources specified in the contract. The borrow material secured by the Contractor shall be classified in accordance with the specifications for "Street and Drainage Excavation"; provided, however, that borrow will not be classified in a classification higher than that estimated for borrow from the site designated by the plans and specifications.

Borrow pits shall be so excavated that they will drain to the nearest natural outlet or to an outlet indicated on the plans or designated by the Engineer. Where directed by the Engineer, separated borrow pits shall be connected by ditches. Excavation for connecting ditches will be classified and paid for as ditch or channel excavation. Side slopes of borrow pits in all cases shall be dressed to such slope as the Engineer may direct. A berm of not less than six (6) feet in width shall be left between the outside slope of the borrow pit and the right of way line. The berm must consist of original unbroken ground.

13–3.12 STRIPPING QUARRIES AND PITS

Stripping of quarries and pits shall consist of the removal, after clearing and grubbing, of the surface material and overburden which is unsuitable for the kind of material to be borrowed or produced for use. The stripping shall be disposed of by the Contractor unless otherwise provided in the special provisions.

Whenever the Contractor elects to obtain material from a source other than that provided by the Owner, or whenever the Contractor is required by the special provisions to provide a source of material, the clearing, grubbing, and stripping therefrom shall be performed as directed by the Engineer and all costs incurred therefor shall be considered as incidental to the project and shall be included by the Contractor in his unit contract prices of borrow or processed materials to be removed.

13–3.13 COMPACTING CUT SECTIONS

When the density of the natural ground of a graded roadbed in a cut section, upon which a specified layer of surfacing or selected material is to be placed, is less than the requirements specified under Section 13–3.10 for the method of compaction used, the top two (2) feet of the graded roadbed shall be compacted in accordance with the requirements of Method B or Method C, whichever is specified. If ordered by the Engineer, the material shall be excavated to depth of sixteen (16) inches and stockpiled temporarily, and the underlying eight (8) inches be then loosened, watered if necessary, and compacted to the required density. The excavated material shall then be replaced in successive layers as required under Section 13–3.10E1, watered if necessary and compacted to the required density.

Where the subgrade material is excavated and temporarily stockpiled, measurement and payment will apply as specified in Section 13–3.07.

When compaction of cut sections is ordered by the Engineer, payment for compaction shall be on a cubic yard basis as outlined in Sections 13–4 and 13–5. The quantity to be paid for shall include a layer eight (8) inches in depth across the full width of the compacted area below the lowest depth excavated, but shall not exceed a total depth of twenty-four (24) inches.

13–3.14 AERATION EQUIPMENT

If test holes bored within the excavation or borrow areas show that substantial portions of either one contain moisture in excess of the optimum for proper compaction of embankments, the Owner will provide pay items for aeration equipment to reduce the moisture content of the embankment material prior to compaction. Aeration equipment may be used in the roadway excavation area, the borrow area, or on the embankments as the Engineer may direct.

Neither the exact extent of the excessively wet areas nor the climatic conditions that will prevail during construction can be determined accurately prior to construction. Consequently the Owner will assume no responsibility for the cost of aeration other than to pay the Contractor in accordance with the bid items of his proposal for furnishing and operating the equipment intended to accelerate evaporation of excess moisture.

The inclusion of bid items for aeration equipment shall not relieve the Contractor of the responsibility for employing such sound and workmanlike procedures in the prosecution of his work as are generally recognized to be effective in constructing embankments with wet materials. Open ditching to provide surface or subterranean drainage, or the placing of alternate layers of dry and wet material to reduce or control the moisture content of the composite layers, shall be considered as incidental to the excavation and all costs involved shall be included in the unit contract prices per cubic yard for "Common Excavation," per cubic yard for "Borrow (kind)," and per unit for "Haul" if "Haul" is included in the proposal.

The function of aeration equipment is to provide thin, loose layers of material from which moisture can evaporate. While certain aeration equipment has proved to be effective in reducing moisture content of embankment material, the Owner makes no claim as to the efficiency of any particular piece of equipment that may be provided as a pay item on any given project.

The Contractor shall furnish and operate such of the following equipment as may appear in the bid items, and as the Engineer shall deem best suited for the conditions encountered, and at such locations as he may direct:

Heavy duty power grader, with moldboard 12 feet long by 24 inches in height and ¾ inch thick, excepting however, that a 10 percent tolerance will be allowed for each dimension. Graders shall be equipped with V type scarifier having not less than nine (9) insert teeth.

Tamping roller with at least two (2) individually suspended drums with metal studs. The load on each tamper foot shall be not less than 135 pounds per square inch of area. The tamping roller shall be drawn by a suitable tractor. The tractor and tamping roller shall be considered a tamping roller unit.

Heavy duty rooter, and tractor capable of propelling the rooter while turning material eighteen (18) inches deep at a speed of not less than one and one-half (1½) miles per hour of material requiring aeration. The rooter and tractor shall be considered as an aerating unit.

Heavy duty gang plow having not less than five 16-inch bottoms, and tractor capable of propelling the gang plow while turning excavation material at least 9 inches deep at the rate of not less than 1½ miles per hour in fairly wet material.

Heavy duty tandem disk with 24-inch disks and cutting width of at least 7 feet, complete with tractor capable of propelling the assembly at not less than 2 miles per hour while turning fairly wet material to a depth of at least 6 inches.

Heavy duty, self-propelled rotary pulverizer employing a transverse shaft with paddles attached, capable of cutting and aerating wet material to a width of at least 6 feet and a depth of 6 inches while traveling not less than 1½ miles per hour.

The listing of the equipment described in this section, while considered most likely to be adaptable for the purposes described, will not preclude the use of other kinds or type of equipment upon a mutually agreed price between the Contractor and the Owner if, in the opinion of the Engineer, other equipment will be either as effective or more effective than that listed for bids.

The use of any of the above aerating equipment in tandem operation will not be permitted. The aerating equipment shall not be used for performing other work while used in aerating operations.

Measurement and payment for aeration equipment as above described shall be as outlined in sections 13–4 and 13–5. Payment for aerating will be made only when bid items for aeration equipment are included in the proposal unless, in the judgment of the Engineer, the provisions of Section 4.05 for changed conditions will apply.

13–3.15 SNOW REMOVAL

Whenever the surface of a cut or the site of an embankment is covered with snow sufficiently deep to impair the utility of the work, the snow must be removed and deposited beyond the slope stakes at the Contractor's own expense. Work of this nature shall be at least one hundred (100) feet in advance of the excavation and placing of the embankment.

13–4 MEASUREMENT

Excavation will be measured by the cubic yard in its original position by cross sectioning. Pay quantities will be computed to the neat lines of the cross sections as staked.

Borrow will be measured by the cubic yard in its original position in excavation and will be classified same as the classification for roadway and drainage excavation.

Stripping of quarries and pits will be measured by the cubic yard in its original position by cross sectioning.

Unsuitable foundation excavation will be measured by the cubic yard in its original position by cross sectioning.

Vertical sand drains will be measured by the vertical foot from the top of the working table to the bottom of the holes.

Sand borrow for drainage blanket will be measured by the cubic yard or by the ton, provided however, that moisture in excess of eight (8) percent will be deducted in ascertaining the pay quantities when measured by the ton.

Embankment compaction, except embankments constructed by Method A, will be measured by the cubic yard of compacted embankment material in place. Excavation material that is wasted, and excavation or borrow material placed under water by dredging operations, by end dumping, or by other methods in which the material is not compacted in layers in accordance with the provisions of sections 13–3.10D and 13–3.10E1, shall be excluded from measurement and payment for compaction. Pay quantities will be computed upon the compacted portion of the embankment to the neat lines of the staked cross sections, and no allowance will be made for subsidence or settlement.

Compacting cut sections as required in Section 13–3.13 will be measured by the cubic yard of compacted material in place.

Aerating equipment will be measured for each assembly of equipment, to the nearest one-half hour for the actual periods of operation in aerating material. No allowance will be made for time consumed in making repairs to the equipment, for moving equipment to or from areas on which aeration is required, or when the towing equipment is performing other work.

13–5 PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract:

1. "Unclassified Excavation," or "Unclassified Excavation Including Haul," per cubic yard.
2. "Common Excavation," or "Common Excavation Including Haul," per cubic yard.
3. "Solid Rock Excavation," or "Solid Rock Excavation Including Haul," per cubic yard.
4. "Unclassified Ditch Excavation," per cubic yard.
5. "Common Ditch Excavation," per cubic yard.
6. "Solid Rock Ditch Excavation," per cubic yard.
7. "Unclassified Channel Excavation," per cubic yard.
8. "Common Channel Excavation," per cubic yard.
9. "Solid Rock Channel Excavation," per cubic yard.
10. "Unclassified Borrow," per cubic yard.
11. "Common Borrow," per cubic yard.
12. "Solid Rock Borrow," per cubic yard.
13. "Unsuitable Foundation Excavation," per cubic yard.
14. "Stripping Quarries and Pits," per cubic yard.
15. "Vertical Sand Drains," per vertical foot.
16. "Sand Borrow for Drainage Blanket," per ton or per cubic yard.
17. "Water," per M gallons.
18. "Embankment Compaction," per cubic yard.

The unit contract prices per cubic yard for such types and classes of excavation and borrow listed above from items 1 to 14 inclusive, shall be full compensation for excavating, loading, placing or otherwise disposing of the material as shown on the plans, as specified herein, or as directed by the Engineer, and shall include the removal and disposal, the wasting or stockpiling of forest debris or any top soil, organic matter or other deleterious matter from the surface of a cut or fill, as may be specified or as may be directed by the Engineer.

As compensation for hauling excavated material, when so shown as an item in the proposal, the unit contract price per unit for "Haul" shall apply as provided in Section 14, except that when the pay item for excavation is shown as "Including Haul," the unit contract price per cubic yard for the item specified shall include all costs of hauling the material the full distance as required.

Except where otherwise provided, the work prescribed under the heading of "Embankment" will not be paid for directly as a pay item but shall be considered as incidental work pertaining to the placement of the several classes of excavation and borrow.

The unit contract price per vertical foot for "Vertical Sand Drains" shall be full compensation for furnishing all labor, tools, equipment and materials necessary or incidental to excavating the drain holes and for selecting, loading, hauling and placing the sand backfill material as specified above.

The unit contract price per ton for "Sand Borrow for Drainage Blanket" shall be full compensation for selecting and/or processing of the material, and for hauling and placing the material as a blanket over the sand drains.

Water will be paid for as provided in Section 16.

Payment for "Embankment Compaction" per cubic yard shall be made at the unit contract price for all compacted embankment material placed up to finish subgrade elevation, excepting that excavated material that is wasted and excavation or borrow material placed under water, or placed by dredging operations, or by end dumping or by any other method where compaction in uniform layers is not practicable, shall be excluded from the pay quantity, and excepting further that payment for "Embankment Compaction" will not be made for embankments constructed by Method A.

The unit contract price per cubic yard for "Embankment Compaction" shall be full compensation for all materials, labor, tools, equipment and incidentals required to complete the compaction of embankments in accordance with the specifications.

The quantities for embankment compaction represent the best judgement of the Owner as to the quantities that will be involved in compacting embankments and cut sections. The owner does not guarantee these estimated quantities, however, and the Engineer will be the sole judge as to the actual quantities required.

Unless the special provisions and proposal provide for different fixed rates per hour, the aeration equipment will be paid for at the fixed rates for those of the following items that are included in the bidding proposal:

"Heavy Duty Power Grader with Scarifier" at $15.00 per hour.

"Gang Plow and Tractor" at $15.00 per hour.

"Tandem Disc and Tractor" at $15.00 per hour.

"Heavy Duty Rooter" at $15.00 per hour.

"Heavy Duty Pulverizing Mixer" at $20.00 per hour.

The fixed rates listed herein shall be full compensation for furnishing and operating the assemblies and for all rentals, supplies and labor to perform the work specified.

Where solid rock is encountered on a project not bid as "unclassified excavation" and for which there is no pay item for solid rock excavation included in the proposal, then in that event the work and materials involved in the excavation of the solid rock shall be considered as extra work and be paid for in accordance with provisions in Section 9.03.

Compensation will be made for "Haul" in accordance with Section 14 at the unit price bid. If a bid item for "Haul" is not included in the project, the above fixed prices for excavation of solid rock materials shall include all haul.

Clearing and grubbing of borrow pits and channel excavation areas will be paid for as specified in Section 12. Clearing and grubbing of ditch excavation areas shall be considered as incidental to the construction, and the costs thereof shall be included in the pay item of ditch or channel excavation involved.

Section 14—Haul

14–1 DESCRIPTION

On much of the municipal work of excavation the method and details of haul and the payment therefor will be specified in the special provisions and the pay item, if any, will be shown in the proposal.

On projects involving large volumes of excavated materials requiring more or less balancing of quantities from cuts into fills, the plans may provide for measurement and payment of haul upon the "unit" basis. The specifications which follow are adaptable to such a method of measurement and payment for haul only when the unit contract price per "unit" for "Haul" is included in the proposal.

Under these specifications, the Contractor will not be allowed to waste and borrow in lieu of hauling the material as required. No allowance will be made for cross haul of material unless specifically ordered by the Engineer.

14–2 MEASUREMENT

14–2.01 HAUL QUANTITIES

Haul will be computed in "units" of 100 cubic yard stations for the transportation of excavated material. The quantity of cubic yard stations of haul is the product of the volume of the material measured in its original position in cubic yards by the distance transported, measured in stations of 100 feet. A cubic yard station of haul is, therefore, the equivalent of one cubic yard of material hauled one station. The measure of one "unit" of haul will represent 100 cubic yard stations.

The method of computing the haul shall be by the application of the mass diagram as shown on the Standard Mass Diagram, which is available for distribution upon request to the Director of Highways, Olympia, Washington.

Copies of the location mass diagram, when applicable for any particular project, will be made available to the Contractor upon request.

14–2.02 ROADWAY AND AUXILIARY LANES

Haul quantities will be computed on the basis of transporting the materials along the center line or base line of the highway or street without regard for any lateral distance from the outer limits of the right of way. Quantities thus computed will include the roadway prism or prisms, auxiliary lanes, borrow obtained by the widening of cuts, and waste deposited within the right of way and contiguous areas designated for wasting. Auxiliary lanes include frontage roads, speed change lanes, paralleling and loop ramps, cross roads and other lanes supplementary to through traffic movements.

On multi-lane streets where more than one center line or base line along the through traffic lanes is shown on the plans, the line on which haul is to be computed will be indicated on the plans or described in the special provisions.

In the event haul is to be computed on any base line other than as hereinbefore specified, the lines will be described in the special provisions.

14–2.03 BORROW OR WASTE

Haul on borrow or waste other than as included above will be computed in the following manner:

Quantities of excavation or embankment, as the case may be, will be computed normal to the long axis of the borrow pit or waste site. The distance of haul will be computed along the long axis, thence by the shortest and most practicable route to the street center line from the end of the axis nearest to the street center line, unless a haul route is designated on the plans or in the special provisions in which case the haul distance will be measured along the designated route. If the Contractor elects to use a route shorter than the computed or designated route, payment will be made on the basis of the length of route actually used.

The haul on borrow materials from sources furnished by the Contractor will be paid for according to the actual amount of haul from the sources from which the borrow is taken, provided, however, that no allowance will be made for haul from such sources in excess of the quantity computed from the sources specified in the contract.

14–3 PAYMENT

The contract price per unit of "Haul" shall be full compensation for all costs and expenses involved in the transportation of the materials.

Section 15—Subgrade

15–1 DESCRIPTION

The subgrade will be considered as those areas and surfaces of new or existing streets, alleys, driveways, sidewalks or other public places upon which additional materials are to be placed under contract, or which are to be constructed or prepared for the future placement thereupon of other materials in accordance with these specifications, the plans, the special provisions, and which will be staked for lines and grades by the Engineer.

No additional compensation will be made for any work required to accomplish the intent of this section except for payment at the unit contract prices for furnishing and compacting such additional material of the type ordered by the Engineer that may be necessary to bring the subgrade to the required line, grade and cross section.

All underground work contemplated in the area of the subgrade shall be completed and properly backfilled before subgrade work is started. This is intended to include work on the contract, work to be performed by the Owner, or by others.

These specifications are to be used in conjunction with requirements in those sections of the specifications having to do with specific types of base materials and pavements.

15–2 CONSTRUCTION DETAILS

15–2.01 SUBGRADE FOR BASE MATERIALS

In advance of setting line and grade stakes, the subgrade area shall be cleared of brush, weeds, vegetation, grass and debris, all of which shall be satisfactorily disposed of. All depressions or ruts which contain water shall be drained. The subgrade shall then be bladed and dragged to remove inequalities and secure a uniform surface.

After the foregoing requirements have been complied with, the proper alignment and grades will be given by the Engineer. Where normal crown sections are being constructed, stakes will be set at convenient offsets at intervals not to exceed fifty (50) feet and at closer intervals where necessary, such as at street and alley intersections. It shall be the responsibility of the Contractor to set centerline grades which may be needed except in cases where the street grades are warped or otherwise do not conform with the typical section, in which case the Engineer will set the stakes.

If ordered by the Engineer, an existing subgrade shall be compacted to 95% of maximum density measured in accordance with Section 13–3.10E5, or such other density as required by the Engineer, by use of such compaction epuipment as called for in the special provisions or as ordered by the Engineer. The compaction equipment shall comply with the requirements of Section 15–2.01A. Payment for compaction of subgrade shall be as outlined in sections 15-3 and 15-4.

All soft, spongy, or yielding spots which may be ordered removed by the Engineer, shall be entirely removed and the space refilled with suitable material and thoroughly compacted. Removal of such unsuitable material will be paid for on a Force Account basis as provided in Section 9.04 unless the unsuitable area was caused by negligence of the Contractor in his operations. In such case, the removal, replacement and compaction shall be done by the Contractor at his own expense.

The final finishing shall be to a height above the finished subgrade cross sections as may be determined, by trial and experience, to be proper to ensure thorough compaction to the grade as staked, by rolling.

When ordered by the Engineer, the Contractor shall sprinkle the subgrade with water in such quantities as directed, which will be paid for at the unit contract price for "Water".

Grade and line, throughout the stages of constructing the subgrade, shall be secured from the reference stakes. The subgrade shall be maintained in the finished condition until the first course of surfacing is placed upon it.

-2.01A Compacting Equipment

When called for on the plans or in the special provisions, or when ordered by the Engineer, the Contractor shall furnish any one or more of the following compacting equipment as may be specified or required:

Variable Load Compactor: A variable load compactor shall consist of four (4) pneumatic-tired wheels in a single axial line but supported on one or more axles, together with a box or body which will permit loading within specified amounts. Each tire shall be not less than sixteen (16) inches in width and shall support air pressure up to ninety (90) pounds per square inch. All tires shall be of equal size and diameter, with treads satisfactory to the Engineer, and the pressure in the several tires shall not vary from each other more than five (5) pounds per square inch.

The wheels shall be so mounted that they will not make locking contact at any time, and will permit free rocking and wheel oscillation so that equal bearing pressure will be applied to the ground at all times. The wheels shall be so mounted that the total weight of the vehicle and contents will be distributed equally to all wheels. The box or boxes shall be of sufficient capacity that a total maximum weight of not less than thirty-five (35) tons nor more than fifty (50) tons can be attained in the compactor.

The weight of the compactor shall be as approved by the Engineer to obtain maximum compaction. The compactor shall be drawn by a vehicle of sufficient horsepower to enable the unit to travel through a loose layer eighteen (18) inches thick at a speed of at least four (4) miles per hour. The towing vehicle and the roller meeting the above requirements shall be considered a variable load compactor unit.

Grid Roller: A grid roller shall consist of two or more cylindrical drums independently mounted on a common shaft in a rigid frame. Each drum shall have a minimum outside diameter of five feet (5') and a minimum width of two feet six inches (2'6"). The overall width of the roller exclusive of frame shall be not less than five feet six inches (5'6") of which not more than six inches (6") shall be used for center spacing between two roller drums. The face of the drums shall have the appearance of woven open-mesh made by interlacing bars of not less than one and one-fourth inch (1¼") nor more than one and three-fourths inch (1¾") diameter spaced on four and one-half inch (4½") to five and one-half inch (5½") centers. Net opening between the bars shall be not less than three inches (3") nor more than four inches (4").

The roller shall be so constructed that counterweights can be used to adjust the gross weight of the roller to not less than 30,000 pounds. The grid roller shall be drawn by a power unit capable of propelling the fully loaded roller through six (6) inches of loose embankment material at a speed of at least four (4) miles per hour.

The power unit used to draw the grid roller shall be used exclusively for that purpose at all times when material is being compacted. The power unit and the grid roller including counterweights, all meeting the above specifications, shall be considered a grid roller unit.

Pneumatic Tired Roller: The pneumatic tired roller shall have a minimum gross weight of 8 tons and a minimum width of 5 feet. Wobble wheel rollers will not be permitted. The tires shall be of equal size, diameter and ply rating with smooth treads. The inflation pressures of the several tires shall not vary more than 5 pounds per square inch from the designated pressure. Tires shall be so spaced that the entire gap between adjacent tires will be covered by the tire which follows, at all operating tire pressures.

The relationship between tire sizes, tire characteristics, ply rating, tire inflation pressures and operating weights per tire shall be such that the roller is capable of developing tire contact pressures on the roadway through the entire range of 40 and 80 pounds per square inch. The exact contact pressure to be used within that range shall be as directed by the Engineer.

Smooth-wheeled Power Roller: A smooth-wheeled power roller shall be a modern, self-propelled, three-wheeled roller weighing not less than ten (10) tons and providing a compression on the rear wheels of not less than 325 pounds per linear inch of tire width.

Vibratory Compactor: The vibratory compacting unit shall be a self-propelled multiple shoe vibratory such as the Jackson Multiple Vibratory Compactor, the Lima Roadpacker Model C, or equal. The unit shall have an adjustable compactor width from a minimum of eight (8) feet to a maximum of approximately thirteen (13) feet. Within range of width, the greatest number of compactor shoes commensurate with the width of the area being compacted shall be used as directed by the Engineer.

Tamping Roller: The tamping roller shall have at least two (2) individually suspended drums with metal studs. The load on each tamping foot shall be not less than 135 pounds per square inch of area. The tamping roller shall be drawn by a suitable tractor, and the tractor and tamping roller shall be considered as a tamping roller unit for measurement and payment.

Mechanical Tamper: A mechanical tamper shall be air or gasoline driven. The air-driven mechanical tamping unit shall consist of an air-driven tamper together with all necessary incidental equipment. The tamper shall be operated at an air pressure of not less than seventy-five (75) pounds per square inch. The tamping foot shall have an area of not less than nineteen (19) square inches nor more than twenty-nine (29) square inches. If approved by the Engineer, tampers conforming to the above and assembled in groups may be used, provided that the total tamping area of the assembly is not less than fifty-nine (59) nor more than eighty-five (85) square inches.

The gasoline-driven mechanical tamping unit shall be equipped with a tamping foot of not less than fifty-nine (59) nor more than eighty-five (85) square inches in area. The gasoline-driven tamper shall operate by alternately rising and falling approximately fifteen (15) inches and delivering a blow of not less than 250 foot-pounds with each fall.

A basic mechanical tamping unit shall have a tamping foot area of not less than nineteen (19) nor more than twenty-nine (29) square inches. An increase of fifty percent (50%) in the quantity of hours for "Mechanical Tamper" will be paid for units having a total tamping area between fifty-nine (59) and eighty-five (85) square inches during the time that such units are used for compaction.

15–2.02 SUBGRADE FOR CEMENT CONCRETE PAVEMENT

Profile grade is the point of gradient or vertical curve at the position indicated on the Roadway Section. Before any paving material is placed, the subgrade shall be brought to the proper line, grade, and cross section and shall be so maintained until the concrete is placed, except that extra depth of subgrade for increased thickness of the pavement, for pavement anchors, for pavement headers, and for increased thickness at the edges of the pavement may be removed just before the concrete is placed.

The subgrade shall be brought to a firm unyielding surface by rolling the entire area to a width of at least one (1) foot outside the edge of the pavement with a compacting unit meeting the requirements of Section 15-2.01A. All portions of the surface on the subgrade which are inaccessible to the compactor shall be thoroughly compacted with a mechanical tamper.

All soft, spongy or yielding spots and all vegetable or other objectionable matter shall be entirely removed and the space refilled with suitable material and thoroughly compacted. The removal of such unsuitable material will be paid for as extra work as provided in Section 9.03, unless the unsuitable area is caused by negligent operations of the Contractor. In such case, the removal, replacement and compaction shall be done by the Contractor at his own expense.

The full width of the roadway shall be kept well sprinkled with water before and during process of rolling the subgrade. The subgrade shall be rolled both before and after the forms are set.

When the pavement is to be constructed over an old roadbed composed of gravel and macadam, the old gravel or macadam shall be scarified and the material shall be uniformly spread and rolled until thoroughly compacted.

The subgrade shall be thoroughly saturated with water from twelve (12) to forty-eight (48) hours before the concrete is to be placed, and shall be thoroughly wet just before the concrete is placed. The work of saturating the subgrade shall be started and continued at the direction of the Engineer.

The elevation of the subgrade from one and one-half (1½) feet inside of the edge of the proposed pavement or form to one (1) foot outside of the edge of the pavement or form shall be brought to an elevation that is not more than one (1) inch above or below the elevation for the finished subgrade over this area before stakes will be set for the forms.

15–2.03 PROTECTION OF SUBGRADE

After preparing the subgrade as above specified, all unnecessary traffic shall be kept off. Should it be found necessary to haul the aggregate and cement over the prepared subgrade, the Contractor shall drag and roll the traveled way as frequently as may be necessary to remove ruts, cuts, and breaks in the surface. All cuts, ruts, and breaks in the surface of the subgrade that are not removed by the above operations shall be raked and hand tamped immediately preceding the placing of the concrete. All equipment used for transporting materials over the prepared subgrade shall be equipped with pneumatic tires.

Continued use of sections of prepared subgrade for hauling, so as to cut up or deform it from the true cross section, will not be permitted. The Contractor shall protect the prepared subgrade from both his own and public traffic.

If, in the opinion of the Engineer, it should be necessary, the Contractor will be required, at his own expense, to plank the subgrade before hauling materials or equipment over it.

15–3 MEASUREMENT

Compaction of subgrades, except as provided for under other sections of these specifications, will be measured to the nearest one-half (½) hour of actual time consumed in compacting for the various types of equipment used. No allowance will be made for time consumed in making repairs to the equipment, for moving equipment to or from areas on the work on which compaction is required, or when the towing equipment is performing other work.

15–4 PAYMENT

Payment will be made for such of the following bid items as are included in the bid proposal:

1. "Variable Load Compactor," per hour.
2. "Grid Roller," per hour.
3. "Pneumatic-tired Roller," per hour.
4. "Smooth-wheeled Power Roller," per hour.
5. "Vibratory Compactor," per hour.
6. "Tamping Roller," per hour.
7. "Mechanical Tamper," per hour.
8. "Water," per M gallons.

When any work described in this section is required but no item of payment is provided therefor in the proposal, the work required shall be considered as incidental to the construction and all costs thereof shall be included by the Contractor in other pay items of the contract.

All other costs for labor, materials, tools, and equipment required for, or incidental to the preparation, shaping, maintaining, and protection of the subgrade, except as outlined in Section 15-1, shall be included in the unit contract price in place for the particular class of surfacing or paving involved. No additional payment will be made for the preparation, shaping, and protection of the subgrade.

Water, when required and used to secure adequate compaction of the subgrade, shall be measured and paid for in accordance with the provisions of Section 16. Water used in sprinkling the subgrade for maintenance purposes shall not be a pay item, unless ordered by the Engineer.

The compacting equipment described in Section 15-2.01A will be considered pay items when used for compacting subgrades as specified in Section 15-2.01. Compaction required in Section 39-3.14 will not be a pay item. The accepted hourly quantities for compacting at the contract price per hour for "Variable Load Compactor," "Grid Roller," "Pneumatic-tired Roller," "Smooth-wheeled Power Roller," "Vibratory Compactor," "Tamping Roller," and "Mechanical Tamper" shall be full compensation for all materials, labor, equipment, tools and incidentals necessary to complete the compaction of subgrades in accordance with these specifications.

The proposal quantities for any type of compacting equipment represent the best judgment of the Owner as to the amount of rolling and compacting that will be necessary to secure compaction of subgrades in accordance with these specifications. The Owner does not, however, guarantee these quantities, and the Engineer will be the sole judge as to the type of compacting equipment to be used and the number of hours required.

Towing different types of rollers in tandem will not be allowed; however, additional towed rollers of the same type for tandem use with fully powered units may be used when authorized in writing by the Engineer. Additional rollers, when so used, will be paid for by an increase of fifty percent (50%) in the number of hours for the type of roller and for the time each additional roller is used for subgrade compaction.

Section 16—Water

16–1 DESCRIPTION

16–1.01 WATER FOR STREETS

Water for compacting embankment, constructing subgrade, placement of screened gravel and crushed surfacing, and for laying dust caused from grading operations or public travel, if ordered by the Engineer, shall be applied in the amounts and places designated by the Engineer and payment will be made therefore as described in Section 16-5. Water for sprinkling the subgrade between ribbons ahead of placing cement concrete pavement as required in sections 15 and 39 shall be considered as incidental to the construction of the pavement and the costs thereof shall be included by the Contractor in the unit contract price per square yard of "Cement Concrete Pavement", or other pay items of the contract.

16–1.02 WATER FOR TRENCHES

Where water settling is required for compaction of

trench backfill, the jetting method or the sluicing method shall be used. The method of water settling will be determined in the field to best suit the local site conditions.

16–2 SOURCE OF WATER AND GENERAL REQUIREMENTS

16–2.01 WATER SUPPLY

The Contractor shall make arrangements for and provide all necessary water at his own expense, unless otherwise provided in the special provisions.

If the Contractor purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment be made the utility on basis of the actual quantity of water metered.

16–2.02 REQUIREMENTS AND RESPONSIBILITY

The Contractor shall use only those hydrants designated by the agency in charge of water distribution and in strict accordance with its requirements for hydrant use.

The Contractor shall secure permission from and comply with all requirements of the water utility before obtaining water from the fire hydrants. The Engineer shall also be notified by the Contractor of such permission as soon as granted.

The Contractor shall use hydrant wrenches only to open hydrants. He shall also make certain that the hydrant valve is open "full", since "cracking" the valve causes damage to the valve. An approved auxiliary valve shall be provided on the outlet line for control purposes. Fire hydrant valves must be closed slowly to avoid a surge in the system which creates undue pressure on the water lines. The Contractor shall carefully note the importance of following these directions.

If one of the Contractor's employees shall knowingly or unknowingly use the wrong wrench on a hydrant and thereby damage the hydrant valve stem, the Contractor will be responsible. He shall immediately notify the water utility so that the damage can be repaired as quickly as possible.

Upon completing the use of the hydrants, the Contractor shall notify the water distribution agency, so that the hydrants may be then inspected for possible damage. Any damage resulting from the use of the hydrants by the Contractor will be repaired by the water agency and the cost thereof shall, if necessary, be withheld from the final payment to the Contractor.

The Contractor shall furnish all connectors, wrenches, valves, and small tools that may be necessary to meet the requirements of the water distribution agency pertaining to hydrant use.

Violation of these requirements will result in fines and will lay the Contractor liable for damage suits because of malfunctioning of damaged fire hydrants, in the event of fire.

16–3 CONSTRUCTION DETAILS

16–3.01 GENERAL

The Contractor shall furnish all hose and equipment necessary for sluicing or jetting. Minimum size of hose shall be such as will provide 35 pounds per square inch pressure at the discharge where jetting is being performed. The jet shall be a rigid iron pipe with a minimum diameter of one (1) inch, and of such length as may be directed by the Engineer.

Where hauled water is required, the tank truck and/or trailer shall meet all safety and licensing regulations and shall be provided with a pump of such size and capacity as to provide for a discharge equivalent to that required for hydrant settling water.

16–3.02 WATER FOR STREETS

Water upon streets shall be applied by sprinkling with tank trucks equipped with spray bars and suitable apparatus. When directed by the Engineer, sprinkling shall be done at night or in the early morning hours when evaporation loss is at a minimum.

16–3.03 WATER FOR SETTLING TRENCHES

–3.03A Jetting

Jets shall be inserted at not more than four (4) foot intervals as measured in any direction through the entire width of the top of trench backfill. Penetration shall be to the crown of the pipe, to native ground on side slopes, and to the preceding lift. The jetting operations shall be completed as closely as is practicable to the pipe laying and backfilling operation. In excessively deep trenches and where the Engineer may direct, the backfill shall be placed in two or more lifts and each be jetted separately.

Where the backfill has been placed and traffic has compacted the surface, the Contractor shall loosen and shape the surface with a motor patrol, as directed, before water settling is begun. Ponding will be required after the jetting only if and whenever the Engineer deems it to be necessary.

Hydrant settling water shall be utilized when hydrants or other sources of water exist within seven hundred (700) feet of the operations.

Hauled settling water shall be utilized when the water settling operation is more than seven hundred (700) feet from a hydrant.

–3.03B Sluicing

The rate and manner of placing the backfill material shall be such as to provide for the sluicing of the entire depth of backfill into its final position.

Payment for sluicing will be made in the same manner as for jetting.

16–4 MEASUREMENT

Water will be measured by unit of one thousand (M) gallons in tanks or tank trucks of known capacity, or by means of meters of a type approved by the Engineer, which shall be furnished and installed by the Contractor at his own expense.

16–5 PAYMENT

Payment will be made for such of the following bid items as are included in any particular contract:

"Water", per M gallons

"Hydrant Settling Water", per M gallons

"Hauled Settling Water", per M gallons

The unit contract price per one thousand (M) gallons of water shall be full compensation for furnishing all labor, materials, tools, equipment and doing all work incidental to furnishing, hauling and applying water as herein specified.

Section 17—Excavation for Structures

17–1 DESCRIPTION

The provisions of this section of the specifications concern the removal or excavation of all materials of whatsoever nature that is necessary for the construction of footings, bases or any other foundation work required to support pump stations, bridges, retaining walls, headwalls, water tanks, transmission towers, and similar structures, or for the placement of riprap and cribbing.

This section also contains the provisions which govern the construction and subsequent removal of all shoring, cribs, cofferdams or caissons; the pumping which may be necessary for the execution of the work, and the placement and compaction of all necessary backfill.

It is not intended that excavation for culverts, sewers and water mains and their appurtenances, manholes, inlets and catch basins, conduits and miscellaneous work

covered elsewhere in these specifications or in the special provisions shall be considered as structure excavation.

Attention is called to the fact that the provisions of these specifications dealing with a separate payment for shoring and cribs apply only where an item for "Shoring and Cribs or Extra Excavation" appears on the plans and proposal for a specific structure. Where no such item is shown, the cost of any shoring and cribs that may be required shall be included in the unit contract price bid for structure excavation.

17–1.01 CLASSIFICATION

Structure excavation will not be further classified into solid rock excavation or common excavation, nor into wet or dry excavation. Structure excavation shall include the necessary grubbing of structure sites which otherwise would not be grubbed, the excavation of any and all formations encountered inside the limits which define structure excavation, and the removal and disposal of all debris, including submerged or buried timber, and all pumping that may be necessary for draining and dewatering the excavation. It shall also include the furnishing of all equipment necessary for the performance of this work, the placement of all necessary backfill inside the limits which define structure excavation, as hereinafter specified, and the disposal of excavated material that is not required for backfill.

For those structures for which a bid item of shoring and cribs or extra excavation is shown on the plans, all work involved in the construction, placing and subsequent removal of shoring, cribs, cofferdams or caissons shall be classified and paid for as "Shoring and Cribs or Extra Excavation," lump sum. If excavation by means of an open pit is allowed and no shoring or cribs are required, the bid item for shoring and cribs will then cover the excavation of any and all material outside the limits which define structure excavations, including the removal and disposal of all debris or buried timber encountered outside such limits, the furnishing of all the equipment required, and the placement and compaction of all necessary backfill in the areas outside the limits that define structure excavation.

17–3 CONSTRUCTION DETAILS

17–3.01 PRESERVATION OF CHANNEL

When foundations or substructures are to be constructed in or adjacent to running streams, no excavation shall be done outside of cribs, cofferdams, caissons or sheet piling, nor shall the natural stream bed ajacent to the structure be disturbed without the written permission of the Engineer. If any open pit excavation or dredging is permitted at the site of the structure before the placement of cribs or cofferdams, the Contractor shall, after the foundations are in place, backfill such excavations to the original surface of the stream bed with material satisfactory to the Engineer. The backfilling material shall be of such quality and shall be placed in such a manner that it will offer the same resistance to scour as the material removed.

Materials deposited from foundation excavations within the stream area shall be removed and the stream bed freed from obstruction thereby. On navigable streams the Contractor shall at all times maintain the depth of water and horizontal clearances required for the passage of water traffic. He shall also furnish and maintain all necessary channel signals and lights during the construction period.

17–3.02 EXCAVATION IN OPEN PITS

When footings can be placed in the dry without the use of cofferdams and when cofferdams are not necessary for the preservation of conditions affecting the safety of the completed structure, the Engineer may permit the excavation of open pits without shoring, cofferdams or cribs. Such pits shall be constructed with side slopes sufficiently flat to prevent sliding or caving. The Contractor shall assume full responsibility for the prevention of slides adjacent to any such excavation, and in the event of any such slide the Contractor shall remove the additional material brought down by the slide at his own expense.

In case the material disturbed by a slide lies within an area upon which a portion of the structure is to be constructed, the Contractor shall excavate the disturbed material and backfill the excavated area to the original ground line with material satisfactory to the Engineer. This material shall be placed and compacted in the manner specified elsewhere herein. All costs in connection with excavating, backfilling, compacting and restoring such a slide area to its original position and condition shall be borne by the Contractor.

When water is encountered, ample provision shall be made for draining or pumping, and the excavation shall be accomplished by such means as will prevent stirring up or softening the bottom. Foundation material unduly disturbed or softened by the use of equipment in the bottom of the pit or by inadequate handling of water shall be removed by the Contractor at his own expense. Such material removed shall be replaced, at the Contractor's own expense, with material satisfactory to the Engineer. When the condition of the earth is such that the sides of the lower part of the excavation will stand vertically, back forms may be omitted with the approval of the Engineer, and the concrete for the footing may be deposited against the undisturbed earth. When back forms are omitted, the lower part of the excavation shall be made to the neat size of the footings, and if larger than neat dimensions, the cost of additional concrete shall be borne by the Contractor.

17–3.03 DEPTH OF FOOTINGS

Foundation for all structures shall be excavated to the depth and lines indicated on the plans or established by the Engineer. The Engineer may require the Contractor to excavate below the elevations shown on the plans, or may order him to stop above the elevations shown, depending upon where suitable foundation material is encountered.

17–3.04 PREPARATION FOR PLACING FOUNDATIONS

In solid rock or other hard material, the excavation shall be carried at least one foot into the rock or hard material to form a key for the concrete footing, or to such additional depth as shown on the plans. The bottom of the pit shall be cleaned of all loose material and cut to a firm surface, either level, stepped or serrated, as may be directed by the Engineer. The bottom of the foundation pit for an arch abutment shall be level or stepped as shown on the plans and the side of the pit back of the abutment shall be trimmed to true lines to permit placing of concrete against undisturbed material. When concrete is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of all loose or soft material shall be made just before the concrete is placed.

17–3.05 SHORING, CRIBS AND COFFERDAMS

Except as provided in Section 17-3.02, all excavations shall be shored, braced, or protected by cofferdams in accordance with approved methods. No excavation or dredging shall be done before shoring, crib or cofferdams are placed, except with the written permission of the Engineer. If permission is given, it shall not relieve the Contractor of his obligation to anchor or otherwise hold the crib or cofferdam in place and secure it against tipping or displacement. Cofferdams or cribs for foundation construction shall, in general, be carried well below the bottom of the footings and shall be well braced and as watertight as practicable. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction of the forms and the inspection of the concrete exteriors, and to permit pumping outside of the forms.

Where piles are required, the cofferdam shall be of sufficient size to permit the driving of the piles in the exact positions shown on the plans without interference from the wales or bracing. Cofferdams or cribs which are

tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance, and shall be constructed so as to protect green concrete against damage from sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in the cofferdams or crib in such a way as to extend into the substructure, without permission of the Engineer.

For substructure work, the Contractor shall submit four (4) sets of drawings showing his proposed method of cofferdam construction and other details left open to his choice or not fully shown on the Engineer's drawings. Such drawings shall be approved by the Engineer before construction is begun, but such approval shall not relieve the Contractor of responsibility for satisfactory results.

Upon completion of the work, all cofferdams and cribs shall be removed to the natural bed of the stream or channel, and on navigable streams they shall be removed to such elevations as required for depth of stream or channel to conform to the requirements of the regulations of the Corps of Engineers, U. S. Army. Removal shall be effected in such a manner as to not disturb or mar the finished concrete.

17–3.06 PUMPING

When conditions are encountered which, in the opinion of the Engineer, make it impracticable to dewater the foundation pit before placing concrete, he may require the construction of a concrete foundation seal of such dimensions as may be necessary. The water shall then be pumped out and the rest of the concrete placed in the dry. When weighted cribs are used and the weight is utilized to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal.

During the placing of a foundation seal, the elevation of the water inside the cofferdam shall be controlled with respect to the water elevation outside in order to prevent any flow through the seal in either direction. The cofferdam shall also be vented at the elevation of the water on which the designed thickness of the seal is based.

Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of any portion of the concrete materials being carried away. No pumping will be permitted during the placing of the concrete or for a period of 24 hours thereafter, unless it be done from a suitable sump separated from the concrete work by a water-tight wall.

Pumping to dewater a sealed cofferdam shall not commence until the seal concrete has set sufficiently to withstand the hydrostatic pressure. In general, no seal of the gravity type shall be dewatered until the concrete has set for at least three (3) days, and no seal containing piling shall be dewatered until the concrete has set for at least ten (10) days. These periods may be extended if, in the opinion of the Engineer, it is necessary for the safety of the structure.

17–3.07 INSPECTION

The Contractor shall notify the Engineer before starting any excavation. From time to time during the progress of excavation, the Engineer will examine the character of material taken out. He shall have authority to stop the excavation at any time to make bearing tests and the Contractor shall give any assistance the Engineer may need in making such tests.

Single bearing test periods shall not exceed 72 hours. Material and labor furnished by the Contractor for such tests will be paid for on a force account basis except that the Contractor shall maintain the ordinary working conditions at the bottom of the excavation during test periods, at his own expense. When any foundation excavation is completed, the Contractor shall notify the Engineer, and no concrete or other permanent structural material shall be placed therein until permission to proceed is given by the Engineer.

17–3.08 DISPOSAL OF EXCAVATED MATERIAL

The material obtained from structure excavation shall be used as the Engineer may require, either in construction embankments, or for backfilling over and around the structures after they are complete, or in case it is unsuitable or not required for either of these purposes it shall be disposed of as directed by the Engineer.

17–3.09 BACKFILLING

All material used for backfill shall be of a quality acceptable to the Engineer and shall be free from large or frozen lumps, wood, or other extraneous matter. The backfilling of openings made for structures shall be considered as a necessary part of the excavation, although the Engineer may require that the material for use in making a backfill be obtained from a source entirely apart from the structure, in which case compensation will be on a force account or agreed price basis unless otherwise specified. Except as may be otherwise specified hereinafter, spaces excavated and not occupied by abutments, piers or other permanent structures shall be backfilled up to the surface of the surrounding ground, with a sufficient allowance for settlement and, in general, the top surface of the backfill shall be neatly graded.

Backfill in existing street areas or in areas that must support roadway embankment or which is a part of any roadway embankment, including backfill behind abutments and wing walls of all bridge structures, shall be placed in horizontal layers not more than six (6) inches thick, and each layer shall be tamped and compacted to 95% of the maximum density as determined by the "Compaction Control Test" in Section 13-3.10E5.

The use of mechanical tampers may be required for compacting backfill for certain items as shown in the individual specifications for such items, and as may be required in the special provisions or on the plans where greater density than that specified above is to be obtained. Mechanical tampers, when required, will be paid for as a separate bid item. Mechanical tampers shall comply with the provisions of Section 15-2.01A.

Special precautions shall be taken to prevent any wedging action against abutments and wing walls. If the excavation has sloping sides, the slope shall be broken up by stepping or serrating to prevent wedge action before the backfill is placed. Fill placed around culverts, piers and other underground utilities shall be deposited on both sides to approximately the same elevation at the same time.

The Engineer may order the backfill around piers and in front of abutments and wings to be of stone or lean concrete if the excavation has been in hard material exposed to erosion. Backfill of this nature will be paid for by force account unless otherwise provided for in the proposal. If the material used in making the backfill is too dry to permit proper compaction, the Engineer may require the addition of sufficient water to allow satisfactory compaction. Compensation for the use of water for this purpose shall be included in the contract prices for "Structure Excavation," and for "Shoring and Cribs or Extra Excavation."

No backfill shall be placed against any concrete structure until the concrete has set at least twenty-one (21) days.

17–3.10 APPROACH EMBANKMENT

When the contract for any bridge structure involves the placement of approach embankments, these shall be constructed and paid for in accordance with the specifications governing this class of work.

17–4 MEASUREMENT

The materials excavated will be measured in their original position by volume in cubic yards. The quantity measured for payment will include only the material excavated from within the limits hereinafter defined, regardless of whether the excavation is made within a cofferdam enclosure or in an open pit. Any additional excavation outside of these limits shall be considered as having been made for the Contractor's benefit and all costs in connection with such excavation shall be at expense of the Contractor.

The horizontal limits for measuring the structure excavation for payment shall be for material removed up to but not beyond one foot outside the vertical planes of the footings, as shown on the plans.

The bottom limits for measuring the excavation for footings shall be the elevation of the bottom of the footing, as shown on the plans or as otherwise established by the Engineer. In pile foundations, the material resulting from the swell due to driving piles will not be included in the measured quantity.

The upper limit for measuring excavation shall be the top surface of the ground, or the bed of the stream as it exists at the time the excavation is started. When the contract designates the removal of certain materials in advance of excavation for structures and for which there is a designated pay item in the same contract, or in a separate contract, the upper limit shall be the completed subgrade of the designated grading section, as shown on the plans.

No measurement will be made of the materials involved in shoring, cribs, cofferdams and caissons.

The use of mechanical tampers will be measured only when compacting backfill within the limits which define structure excavation, and will be measured by the hour to the nearest one-half (½) hour of actual time consumed in compacting backfill. No allowance will be made for time consumed in making repairs to the equipment, or in moving the equipment to or from the work on which compaction is required.

17–5 PAYMENT

Excavation for structures will be paid for under such of the following bid items as are included and shown in any particular contract:

1. "Structure Excavation," per cubic yard.
2. "Shoring and Cribs or Extra Excavation," lump sum.
3. "Mechanical Tampers," per hour.

17–5.01 STRUCTURE EXCAVATION

Payment will be made at the unit contract price per cubic yard for "Structure Excavation" which price shall be full compensation for all necessary pumping, bailing, draining, the diversion of streams and all other work involved, including backfilling over and around structures to the original surface of the ground and disposing of all debris and surplus material, and for all necessary labor, materials, tools, and equipment. It shall also include the construction and subsequent removal of all cribs, cofferdams, caissons, and shoring, except where the construction of cribs, cofferdams, caissons and shoring is paid for under the bid item "Shoring and Cribs or Extra Excavation," per lump sum.

Payment for structure excavation carried below the elevations shown on the contract plans by order of the Engineer, will also be made at the unit contract price per cubic yard for structure excavations except as follows:

If there is no bid item of shoring and cribs for the structure and an increased depth greater than three (3) feet below the elevation shown on the contract plans is required, an allowance for extra cost may be made, based upon the actual cost to the Contractor of constructing, extending or reconstructing any shoring or cribbing that may be necessary to carry the excavation to the required depth below that shown on the plans. This extra cost to the Contractor will be paid for on the basis of "Force Account Work" as covered under Section 9.04.

No payment will be made for any material removed from below the elevations shown on the plans, or established by the Engineer, for the bottoms of the excavations. Any such material excavated below the established elevations shall be replaced by the Contractor at his own expense. Replacement shall be made with concrete or other material acceptable to the Engineer.

17–5.02 SHORING AND CRIBS

Payment for shoring and cribs will be made at the lump sum contract price, which shall be full compensation for the construction and subsequent removal of all shoring, cribs, cofferdams, and caissons, and for all necessary labor, materials, tools and equipment for performing such work.

No additional compensation over the contract price for shoring and cribs or extra excavation will be made for increased depth, to and including a depth of three (3) feet below the elevations shown on the contract plans; excepting, however, that if a depth greater than three (3) feet below the elevations shown is required, allowance for extra cost may be made, based upon the actual cost to the Contractor of constructing, extending or reconstructing any shoring or cribbing that may be necessary to carry the excavation to the required depth below that shown on the plans. This extra cost to the Contractor will be paid for on the basis of "Force Account Work" as covered in Section 9.04.

When the item "Shoring and Cribs or Extra Excavation," lump sum, is shown on the plans and proposal, and when with the written approval of the Engineer the actual installation of shoring, crib, cofferdam or caisson is not made, the Contractor will be paid in full for the bid item "Shoring and Cribs or Extra Excavation," lump sum, which price shall be full compensation for all excavation, backfill, backfill compaction, or other incidental work performed by him in lieu of constructing the shoring, crib, cofferdam or caisson.

17–5.03 MECHANICAL TAMPERS

Payment for mechanical tampers will be made at the unit contract price per hour for "Mechanical Tamper," which price shall be full compensation for all materials, labor, equipment, tools and incidentals required to compact backfill materials (within the limits which define structure excavation) to the density required by the Engineer. (See Section 15.)

Section 21—Weighing

21–1 DESCRIPTION

Scales for the weighing of crushed surfacing materials, mineral aggregates for bituminous construction, concrete aggregates, and other road materials which are to be obtained from bunkers, stockpiles and local deposits and which are required to be measured and paid for on a weight basis as specified in the standard specifications or in the special provisions, shall be furnished by and at the expense of the Contractor.

The Contractor shall be responsible for maintaining the scales in accurate condition at all times.

21–1.01 WEIGHING EQUIPMENT FOR AGGREGATES AND ROAD MATERIALS FROM BUNKERS

Aggregates and road materials proportioned or measured by the ton shall be weighed on beam or springless dial scales conforming to the following requirements:

1. At least that part of the total load weighed which is in fraction of one hundred pounds shall be indicated on a graduated dial.

2. The weighing equipment must be so arranged that the operator stands, when operating the bin gates, at such a position that he can conveniently shovel material from the weighing hopper. The weighing dial shall be in full view of the operator when he is in position to operate the gate which delivers material to the weighing hopper.

3. Clearances shall be provided between the scale parts and the hopper or bin structure to prevent displacement of the scale parts due to vibration or any other cause. There must be sufficient clearance between the top of the weighing hopper and any other part of the

bin structure so that the scale operator can conveniently shovel material from the weighing hopper.

4. In the case of weighing hoppers mounted on platform scales, the arrangement shall be such that the center of gravity of the total load on the scale is in the same vertical line as the center of the scale platform.

5. Scales shall be of a type well suited for supporting a weighing hopper under an overhead bin or structure and shall be of a simple rugged design with the minimum number of parts and adjustments for maintaining an accuracy within the limits hereinafter specified.

6. The use of springs to carry part or all of the load in the weighing mechanism will not be permitted.

Equipment for weighing shall be accurate within one-half percent through the range of use. Each scale installation shall be provided with at least eight standard fifty-pound weights for calibrating and testing weighing equipment.

All working parts of scales, particularly knife edges, shall be protected to prevent any material except wind borne material from falling upon or against them.

21–1.02 UNDERWEIGHTS

If an inspection of the scales discloses them to be underweighing, they shall be properly adjusted, and no additional payment will be allowed for tonnage previously weighed and recorded.

21-1.03 WEIGHING EQUIPMENT FOR AGGREGATES AND ROAD MATERIALS FROM LOCAL DEPOSITS AND STOCKPILES

When crushed surfacing and mineral aggregates are manufactured from local deposits or taken from stockpiles, or when other road materials are taken direct from local deposits, they shall be weighed, when so provided in the specifications, on platform scales of sufficient capacity to weigh the gross weight of the maximum loads hauled with type registering beams to record each weighing in duplicate, and to be furnished by and at the expense of the Contractor. If material is shipped by rail, the car weights will be accepted, provided however, that the actual weight of the material only will be paid for and not the minimum car weights used for assessing freight tariffs.

The Owner will furnish a man, at no cost to the Contractor, who will operate the scales while the loading and hauling of materials is in progress. This provision shall not relieve the Contractor from the responsibility of installing and maintaining the scales and equipment at his expense.

The Contractor shall provide for use of the scaleman a wind proof and weather-tight scale house of 6′ x 10′ minimum size, having a door for access and provisions for securely locking. It shall have suitable windows for light and ventilation, electric light, space heater, table and chair, all furnished by the Contractor. Sanitary facilities shall be nearby or furnished by the Contractor.

21–1.04 WEIGHING EQUIPMENT FOR BULK PORTLAND CEMENT

If portland cement is handled in bulk, it shall be weighed on scales meeting the requirements specified for the weighing of concrete aggregates. The scales used for weighing cement shall be separate from those used for weighing other material. The cutoff gate from the storage bin shall be of a design permitting positive shut off of the flow of cement. The weighing hopper shall be designed to assure complete discharge readily. Adequate provision shall be made to prevent loss of cement between the weighing hopper and the batch box.

21–2 PAYMENT

All costs in connection with the weighing of crushed stone surfacing, portland cement, aggregates, and road materials shall be included in the unit contract prices for the various pay items of the project.

Section 22—Production From Quarry and Pit Sites

22–1 DESCRIPTION

In many instances, with availability of commercial plants nearby, the awarding agencies do not always provide the Contractor with quarry and pit sites for production, but require him to provide such materials from sources of his selection that will meet the specifications herein. If the site is provided by the Owner, the plans and special provisions will so state and describe.

The requirements set forth in this section shall apply to the manufacturing and producing of crushed stone and screened materials of the kind, quality and grading specified for use in the construction of portland cement and asphalt concrete, cement treated base, asphalt treated base, crushed stone and screened gravel surfacing courses, ballast and bank run gravel, gravel backfill, riprap, and bituminous surface courses of all descriptions.

22–2 MATERIALS

The raw materials in the quarry or pit shall be of a quality such that, after being subjected to the manufacturing processes specified, the products will comply with the specifications for the particular class of material to be produced or manufactured.

22–3 CONSTRUCTION DETAILS

22–3.01 ACQUISITION OF SITES

Unless otherwise specified, the Owner will acquire and make available to the Contractor, without charge, the right to take stone from the quarries or pit sites specified in the special provisions and shown on the plans and to use such sites as may be required for his operations. The Owner will exercise its best judgment in the selection of quarry or pit sites; however, the failure of the quarry or pit to supply materials of uniform quality shall not constitute grounds for a claim against the Owner. The Contractor shall satisfy himself as to the grading and other characteristics of the raw material in the quarry or pit acquired by the Owner, and as to the nature and amount of work required to manufacture or produce materials that will meet all specified requirements.

The Contractor, if he so desires, may obtain the specified materials from other sources than those acquired by the Owner if they are approved by the Engineer, provided the material is of a quality equal to that in the source specified, in which event the Contractor, at his own expense, shall make all necessary arrangements for obtaining the materials and he shall satisfy himself as to the quantity of suitable material available.

If the Contractor elects to substitute a gravel deposit of an approved source for the manufacture of ballast, crushed surfacing or mineral aggregate in lieu of a ledge rock or talus source provided by the Owner in the contract plans, all pit-run material passing a one-half (½) inch square sieve, or larger if ordered by the Engineer, shall be removed prior to crushing so that the finished product will have approximately the same degree of fracture and stability as that which would have been obtained from the specified source.

Whenever the Contractor elects to obtain material from an approved source other than that provided him by the Owner, or whenever the Contractor is required by the special provisions to provide his own source of materials, the clearing, grubbing and stripping therefrom shall be performed as directed by the Engineer and all costs incurred therefor shall be considered as incidental to the project and shall be included by the Contractor in his unit contract prices of borrow or processed materials to be removed.

22–3.02 PREPARATION OF SITE

Before blasting or crushing operations are commenced, the portion of the quarry or pit site from which

the materials are to be taken shall be cleared, grubbed, and stripped free of vegetable growth, earth, sand, soft and unsound rock, and any material that will not make satisfactory surfacing. All combustible debris resulting from these operations shall be burned, and all other unsuitable materials and debris shall be removed and disposed of as directed by the Engineer. All overburden and unsuitable materials shall be conveyed to some point which will insure against the probability of any part of them becoming mixed with the stone which is to be crushed or produced. For the final stripping of a ledge quarry, the use of sluicing is recommended, and this method will be required unless the stone is satisfactorily cleaned by some other method.

The requirements for "Preparation of Site" as outlined above, insofar as they are applicable, shall obtain in the preparation of ledge rock, talus, gravel and sand, quarry or pit sites for all classes of materials which are required by the standard specifications to be produced in accordance with this Section 22. The quarry or pit site shall be cleared, grubbed and stripped free of all materials that will adversely affect the quality specified for the classes of products to be manufactured or produced.

22–3.03 PRODUCTION

In the event that the grading or quality of the raw material in sources used for the manufacture of products covered by this Section 22 is such that the fracture, grading, or quality of the product specified cannot be obtained by utilizing the natural material, fine portions of the raw material shall be rejected to the extent necessary to produce finished products meeting all requirements of these specifications. All oversize gravel occurring in gravel pits up to and including boulders of ten inches in the greatest dimension shall be utilized in the manufacture of crushed materials. Failure of the Owner to include a scalping requirement in the special provisions shall not relieve the Contractor of the responsibility for rejecting fine portions of the raw material if such becomes necessary to produce finished products meeting all requirements of the specifications.

When scalping over a screen of a specified size is required in the special provisions, the scalping screen shall be of such size and capacity that substantially all of the material smaller than the specified scalping screen size will be removed by the scalping operation.

Washing and reclaiming of the reject material and subsequent addition of this material to any finished products will not be allowed unless specifically authorized in writing by the Engineer.

If necessary to secure a product of the required quality, grading, and fracture, the materials shall be washed before and/or during crushing or screening. Washing will be required in the preparation of concrete aggregates. When specifically provided by the special provisions, the use of water will not be required in the production of mineral aggregates for the various types of bituminous surfaces. In such cases the mineral aggregate shall be cleaned by blowing with air until the resulting product meets the requirements for cleanliness and freedom from dust. If mineral aggregate is cleaned with air, it shall be produced only from such sources as will permit of ready removal of dust and coatings by this method.

When produced from a source provided by the Owner, all scalpings of material that is unsatisfactory under the specifications or special provisions shall be considered as reject material, subject to disposal as directed by the Engineer. Reject material shall be so placed that it will not foul the pit or quarry for any future operation.

Surplus screenings accumulated during the crushing and screening of specified roadway materials will be considered separate and distinct from reject material scalped ahead of the crushing operation. If the Contractor produces materials from a source provided by the Owner, the surplus screenings accumulated during the production of the specified materials shall be stockpiled at a location within the site provided and become the property of the Owner. The stockpiling shall be performed in an orderly and recoverable manner satisfactory to the Engineer. All costs incurred in producing, hauling and stockpiling the surplus screenings from a source provided by the Owner, except as provided for payment hereinafter, shall be considered as incidental to the production of the specified materials and shall be included by the Contractor in the pay items of the contract.

Surplus screenings accumulated during the manufacture of specified materials from a site provided by the Contractor shall become his own property, unless an item for surplus screenings has been included in the pay items of the contract.

If the special provisions and proposal include an item of surplus screenings, the Contractor will be paid therefor to the extent of the quantity set out in the proposal and no more, and the screenings shall be stockpiled either in a separate pile or with other surplus screenings as the Engineer may direct.

In the event the Contractor provides his own source for the production of the materials, surplus screenings, when included as a bid item, shall be furnished and stockpiled at the site specified, the same as provided above. It is not the intent to require the Contractor to produce "Surplus Screenings" in an amount greater than they will be accumulated during the normal production of other materials from the pit.

The stockpile sites for the surplus screenings shall be prepared and constructed by the Contractor as outlined in Section 23–3.01.

In event the Contractor shall elect to stockpile surfacing material or concrete aggregate from a source owned or controlled by the Owner ahead of its placement upon the roadway, he may do so if the stockpiling is within the area of the site provided by the Owner, and done in a manner approved by the Engineer. If he shall elect to stockpile such materials upon land leased by himself, he may do so upon approval of the Engineer and upon proof that the lease will extend for a period not less than one year beyond the completion date of his contract. All materials remaining after placing the amount required for the contract, whether upon the site provided or upon land leased by the Contractor, shall become the property of the Owner and all costs resulting from the production of such excess materials shall be considered as incidental to the production of the processed materials produced and placed on the roadway.

When more than one quarry or pit site is provided in the special provisions, the Contractor may obtain material from any one of the sources, and the Owner will specify the quantity of raw material which has been determined by tests to be available at each quarry or pit site. In the event that a Contractor sets up in a pit made available by the Owner and if the quantity from that site, when the pit is exhausted, is less than that stated by the Owner, then the provisions of Section 22-4 shall apply.

When the special provisions require material in a source provided by the Owner to be washed and/or scalped over a screen of a specified size, the scalping shall be performed after the pit or quarry-run material has passed through the primary crusher. If the native material in the sources proves to be of better quality than anticipated by the Owner, or if the Contractor provides a more efficient processing operation than was anticipated by the Owner, he will be allowed to change the size of the scalping screen or make such other changes in the operation as he may elect, provided that the finished product has value of sand equivalent equal to or better than those obtained on the same product produced in the specified manner; and provided further, that the finished product meets all other requirements of the specifications. The requirement for washing concrete aggregate will not be relaxed under any conditions.

For the allowable moisture content for payment in manufactured materials see Section 22-4.

22–3.04 FINAL CLEANUP

The quarry or pit site, upon completion of the Contractor's operations, shall be cleared of all rubbish, temporary structures and equipment, and shall be left in a

neat and presentable condition at the expense of the Contractor.

22–4 PAYMENT

All costs in connection with the production of the materials to meet the requirements specified shall be considered as incidental to the production of the required pay quantities of materials and shall be included in the unit contract prices for the pay items of materials involved. Clearing and grubbing will be measured and paid in accordance with the provisions of Section 12. Stripping will be measured and paid for in accordance with the provisions of Section 13. "Surplus Screenings" will be considered as a pay item only when it is included in the bid proposal of any particular contract.

For payment purposes, bank run gravel and crushed or screened materials, depending upon their grading, shall be limited to the following water contents:

% By Weight Passing ¼-inch Sieve	*Maximum Water Content % By Weight*
Less than 20%	4%
More than 20%	8%

The maximum allowable water content in the manufactured aggregates shall be as specified above, and the addition of water by the Contractor to the screened or crushed product for the purpose of increasing the water content to the allowable maximum will not be permitted. Water content in excess of permissible amount, as determined by the Engineer, will be deducted from the tonnage of material to be paid for.

If, in the opinion of the Engineer, there should be insufficient suitable material in any quarry or pit site made available by the Owner, the Owner will acquire at its own expense an additional source, in which event the Contractor will be required to move his crushing plant to the new quarry or pit. Under such conditions the following schedule of allowances, insofar as they may be applicable, shall govern the compensation to be made by reason of the move:

1. Crushing plants with two (2) crushing units $2,000.00
2. Crushing plants with three (3) crushing units 2,500.00
3. Crushing plants with four (4) or more crushing units 3,000.00
4. The clearing, grubbing and preparing of the new quarries or pit sites as specified under the heading "Preparation of Site" will be paid for in the manner provided in these specifications for "Clearing," "Grubbing," and "Excavation."

In the event there is no bid item applicable, the payment for the preparation of the new site shall be on a "Force Account" basis.

In the event the moving of the plant due to shortage of the supply of material necessitates a longer haul on materials than required from the original quarry, the Owner will reimburse the Contractor for the additional haul at the rate of $0.14 per ton-mile of haul. The unit ton-mile, shall be considered to be the equivalent of one ton of material hauled a distance of one mile. The haul distance will be measured in one-half (½) mile units, fractional half miles being allowed as full half miles. For material hauled within one-half (½) mile, the haul will be one-half (½) ton-mile of haul. For material hauled beyond the first one-half (½) mile and within the first mile, the haul will be one (1) ton-mile of haul, and so on. Payment for haul computed on this basis shall be made at the unit contract price per ton-mile of haul, which price shall be full compensation for hauling the materials one (1) mile or fraction thereof as stated above, to any distance that may be required.

The above allowances, insofar as they may be applicable, shall be full compensation for all claims of any kind or description by reason of the necessity of changing from one site to another due to shortage of the supply from sources made available by the Owner. No additional compensation or allowance whatsoever will be made by the Owner on account of such moves. In advance of moving any crushing plant as outlined above, the Contractor shall first secure from the Engineer an order in writing to do so. The order shall set forth in detail the allowance based upon the above schedule. Should the Contractor fail to secure such aforementioned order, it shall be considered sufficient proof that the move was immaterial insofar as to costs, and no allowance or compensation will be made by reason of such move.

Section 23—Crushed Surfacing, Ballasting, and Stockpiling

23–1 DESCRIPTION

Surfacing and ballasting, unless otherwise specified, shall consist of the construction of one or more courses of crushed stone upon an existing roadway surface, or upon a subgrade properly prepared under the provisions of these standard specifications.

Surfacing materials and ballast may also be specified to be stored in stockpiles for future use on anticipated future projects.

The aggregate shall be graded in such a manner that, with the incorporation of a minimum amount of "filler" or "keystone" material, it will compact into a dense and unyielding mass which will be true to the line, grade and cross section shown on the plans. The Contractor shall furnish all materials unless otherwise specified in the special provisions.

23–2 MATERIALS

23–2.01 CRUSHED SURFACING

Crushed surfacing shall be manufactured from ledge rock, talus or gravel in accordance with the provisions of Section 22. The materials shall be uniform in quality and substantially free from wood, roots, bark and other extraneous material, and shall meet the following test requirements:

Los Angeles Wear, 500 Rev. (ASTM Designation C 131) 35% maximum.

Crushing surfacing of the various classes shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into temporary stockpile.

	Base Course	*Top Course and Keystone*
% Passing 1¼" square sieve ..	100	
% Passing ⅝" square sieve ...	50 to 80	100
% Passing ¼" square sieve ...	30 to 50	50 to 65
% Passing U. S. No. 40 sieve ..	3 to 18	8 to 23
% Passing U. S. No. 200 sieve (wet sieving)	7.5 max.	10 max.
All percentages are by weight.		
Sand equivalent (Section 6) ...		40 min.

When separated on ¼-inch, ⅝-inch, 1-inch and 1¼-inch sieves, the crushed surfacing shall contain in each size, including material passing ¼-inch, not less than seventy-five (75) percent by weight of particles with at least one fractured face produced by mechanical crushing.

The portion of crushed surfacing retained on a ¼-inch square sieve shall not contain more than 0.15% wood waste. Wood waste shall be defined as all material which has a specific gravity less than 1.0 after drying to constant weight.

The portion of crushed surfacing passing a U. S. No. 10 sieve shall not have wood waste that will result in more than 250 parts per million of organic matter by colorimetric tests when tested in accordance with Section 37-2.02B1 except that the color shall be measured after the sample has been in the test solution for one hour.

23–2.02 BALLAST

Ballast shall consist of crushed, partially crushed or naturally occurring granular material from approved sources manufactured in accordance with the provisions of Section 22. In the manufacture of ballast all oversize material up to and including boulders of ten inches in the greatest dimension shall be utilized in the manufacture of the finished product.

The material from which ballast is to be manufactured shall meet the following test requirement:

Los Angeles Wear, 500 Rev. (ASTM Designation C 131) 40% maximum.

Ballast shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into temporary stockpile:

% Passing 2½" square sieve	100
% Passing 2" square sieve	65 to 100
% Passing 1" square sieve	50 to 80
% Passing ¼" square sieve	30 to 50
% Passing U. S. No. 40 sieve	16 max.
% Passing U. S. No. 200 sieve (wet sieving)	9 max.

All percentages by weight.

Dust ratio:

$$\frac{\%\ \text{Passing}\ \#200\ \text{(wet sieving)}}{\%\ \text{Passing}\ \#40} \quad \text{⅔ max.}$$

Sand equivalent (Section 6) .....35 min.

The portion of ballast retained on a ¼-inch square sieve shall not contain more than 0.2% wood waste. Wood waste shall be defined as all material which has a specific gravity less than 1.0 after drying to constant weight.

The portion of ballast passing a U.S. No. 10 sieve shall not have wood waste that will result in more than 250 parts per million of organic matter by colorimetric test when tested in accordance with Section 37-2.02B1 except that the color shall be measured after the sample has been in the test solution for one hour.

23–3 CONSTRUCTION DETAILS

23–3.01 STOCKPILING SURFACING MATERIAL

When specified, "Crushed Surfacing" and "Ballast" complying with these specifications, shall be placed in stockpiles at the points shown on the plans or as may be ordered by the Engineer. This work shall be designated and paid for as "Crushed Surfacing in Stockpile," per ton, and as "Ballast in Stockpile," per ton.

The stockpile sites shall be cleared of all vegetation, trees, brush, rocks or other debris, and a uniform ground surface made before the stockpile material is deposited upon the stockpile site.

Stockpiles shall be constructed on the previously prepared sites in accordance with the cross section stakes set by the Engineer, and when completed they shall be neat and regular in shape, occupying as small an area as is practicable, accessible for loading on a truck without obstructing the highway or street. Stockpiles shall be built up in layers not to exceed four (4) feet in thickness and the stockpile shall have a minimum height of eight (8) feet. The quantity of surfacing material to be piled at each site shall be the amount indicated on the plans or ordered by the Engineer.

Plank runways will be required for operating trucks on stockpiles when it is deemed necessary by the Engineer in order to avoid tracking dirt and other foreign matter on the crushed rock.

All costs in connection with the preparation of the stockpile sites and the construction of the stockpiles shall be included in the unit contract prices for the various types of material being stockpiled, except that "Clearing" and "Grubbing" of the site will be measured and paid for in accordance with Section 12 when such bid items are carried in and made a part of the particular project.

23–3.02 SUBGRADE

The subgrade shall be constructed in the manner specified under Section 15.

23–3.03 SHOULDERS

Shoulders shall be constructed in the manner shown on the cross section, made a part of the plans, and the material used shall conform to the same specifications and method for payment as like materials used and processed in the roadway itself.

23–3.04 DEPTH OF LAYERS

Crushed surfacing, base course and top course, shall be constructed in layers not to exceed four (4) inches in depth. The methods employed for each layer shall be the same as specified elsewhere for that particular course. Ballast shall be constructed in layers as described in Section 23-3.16A.

23–3.05 SPREADING MATERIALS

Spreading of the first course of surfacing shall begin at points nearest from the point of loading and each successive course shall begin at points farthest from the point of loading. Each course shall be constructed continuously from the beginning point of the course unless otherwise directed by the Engineer. If the Engineer shall deem it necessary for further stability or other reason, he may require a succeeding course to be placed over any section of a previously placed course before the final completion of that course.

Unless otherwise provided in the special provisions, the surfacing, keystone and ballast may be spread by any method that will result in an even distribution of the material upon the roadway without perceptible separation in gradation. The method of spreading and the field operation shall be satisfactory to the Engineer at all times.

Should there occur during any stage of the surfacing or stockpiling a separation of the coarser from the finer materials causing serious lack of uniformity in the grading, the Contractor shall immediately make changes in the method of handling such as will prevent separation amd meet approval of the Engineer.

Equipment such as scrapers and others essentially used for earth excavation will not be permitted.

23–3.06 ROLLING

Rolling shall be accomplished by means of such of the equipment described in Section 15-2.01A as may appear in the various bid items of the contract.

Each course of surfacing shall be rolled until the material does not creep under the roller before a succeeding course of surfacing material is applied. For each surfacing operation the Contractor shall provide sufficient rolling equipment to fully comply with these specifications.

All rolling shall commence at the outer edges of the surfacing and continue toward the center. Under no circumstances shall the center of the road be rolled first.

23–3.07 LOADING AGGREGATE FROM STOCKPILE

The use of dragline equipment to transport the aggregate from stockpiles to elevators or other loading devices will not be permitted.

23–3.08 HAULING

Hauling shall be distributed over the roadway in such a manner as to be most effective in the compacting of the surfacing. Hauling over any of the surfacing in process of construction will not be permitted when, in the opinion of the Engineer, the effect will be detrimental. The Contractor shall not haul loads in excess of the legal load or speed limit. All loads shall be of uniform capacity when it is practicable.

In hauling any material upon which the measure of quantity is to be determined by vehicle load, the loads shall be the water measure capacity of the body.

23–3.09 CORRECTION OF SURFACE DEFECTS

Should irregularities develop in any surface during or

after rolling, they shall be remedied by loosening the surface and correcting the defects, after which the entire area, including the surrounding surface, shall be re-rolled until thoroughly compacted. The finished surface shall be true to the proper grade and crown before proceeding with the surfacing.

23–3.10 FLOATING OR LOOSE STONE

Before placing the "Top Course" the preceding one shall be properly bound up and all floating or loose stone shall be removed from the surface.

23–3.11 HOURS OF WORK

Normally, the Contractor shall so arrange his surfacing operations that the work will be carried on during the hours of daylight. However, when necessary to complete the project within the time specified, work may be undertaken during the hours of darkness provided the Contractor furnishes and operates during such period, an adequate and effective artificial lighting apparatus to ensure that all work undertaken can be carried on satisfactorily in the manner contemplated by the specifications.

23–3.12 UNFAVORABLE WEATHER

When, in the opinion of the Engineer, the weather is such that satisfactory results cannot be secured, the Contractor shall suspend operations until the weather is favorable. No surfacing materials shall be placed in the snow or on a soft, muddy or frozen subgrade. The Owner shall not be liable for damages or claims of any kind or description by reason of suspending operations under directions of the Engineer.

23–3.13 PATROLLING

All surfacing in progress of construction shall be bladed and otherwise worked as may be necessary to maintain the proper grade and cross section at all times, and to keep the surface smooth and thoroughly compacted. The cost of any or all of the above work shall be included in the prices bid for the surfacing materials involved.

23–3.14 EQUIPMENT

The minimum amount of heavy equipment that will be considered necessary, in addition to crushing and hauling equipment, for the proper execution of these specifications shall be as follows:

1 Heavy duty self-propelled grader, of an approved type, equipped with scarifier, broom and not less than an 8-foot blade.

1 10-ton self-propelled three-wheel roller, or one (1) pneumatic-tired roller. Roller wheels may be weighted if necessary to secure specified weight per linear inch of tire width.

Other combinations and types of equipment may be substituted for the above if approved by the Engineer.

Additional equipment shall be supplied by the Contractor if required to properly care for the work. All equipment shall be kept in good repair at all times. The cost of furnishing and keeping all equipment in good repair shall be considered incidental to the performance of the contract and the cost shall be included in the unit contract prices for pay items of work involved.

Where the plans provide for the measurement and payment of surfacing material by the ton, the equipment for weighing the materials shall conform to the requirements of the specifications for "Weighing Equipment" in Section 21.

23–3.15 WATER

Where specified on the plans or ordered by the Engineer, the Contractor shall apply water to any course or courses in accordance with Section 16.

23–3.16 CONSTRUCTION OF COURSES

Whenever practicable any one course shall be completed in advance of laying the succeeding one. Any one course shall be completed as much in advance of the succeeding course as is practicable for good results and adequate inspection. The spread of any one course before another course is added shall be as much distance as is practicable under the circumstances, not less than one (1) block nor more than one-half (½) mile, and shall be subject to the direction of the Engineer.

Each layer shall be spread and compacted in accordance with sections 23-3.05 and 23-3.06. The completed layer shall have a smooth, tight and uniform surface reasonably true to the line, grade and cross section shown on the plans.

–3.16A Ballast

Ballast shall be spread upon the prepared subgrade by the methods specified in Section 23-3.05, and to the depth, width and cross section shown on the plans, or as directed by the Engineer. The maximum depth of any course shall not exceed six (6) inches.

The surface of the course shall be lightly bladed and then rolled until thoroughly compacted. When the aggregate does not compact readily, due to lack of fines or natural cementing properties, keystone and water shall be added in such amounts as the Engineer may direct, and in the manner specified below.

Top course surfacing material to be used as keystone shall be spread evenly on top of the ballast, using spreader boxes or chip spreaders. Thereafter the surface shall be rolled, wetted and, if necessary, broomed lightly until the keystone is worked into the interstices of the ballast stone without excessive displacement. The operations of adding keystone, rolling, wetting and brooming shall be continued until the course has become thoroughly keyed and compacted, and will not creep or move under the roller.

Ballast shall not be placed on the roadway in loads of widely varying gradations.

The surface of the stone at all times shall be kept to the true line, grade and cross section by blading or brooming.

–3.16B Base Course

Crushed surfacing for the base course shall be spread upon the roadway or upon the preceding course in layers not exceeding four (4) inches in thickness, to the amount and in accordance with the cross section shown on the plans. After each layer has been spread by the methods specified under Section 23-3.05, and has been lightly bladed, if necessary, the surface shall be rolled until the material is thoroughly compacted. The completed course shall have uniform distribution as to gradation.

When the depth of the base course is greater than four (4) inches, the next layer shall be constructed in the same manner as has been outlined above. The final result shall be an unyielding course, free from inequalities, with a smooth, tight, even surface, true to the grade, line and cross section shown on the plans.

–3.16C Top Course

Crushed surfacing for the top course shall be spread upon the roadway or upon the preceding course to the depth, grade and cross section shown on the plans, and by methods specified in Section 23-3.05. After spreading, the surface shall be lightly bladed and then rolled until the material is thoroughly compacted to line and grade shown on the plans, or as directed by the Engineer. Water shall be placed during the blading and rolling operations in the quantity directed by the Engineer.

The completed course shall have uniform distribution as to gradation, and all areas in which there is an excess of coarse or fine aggregate shall be removed and replaced with suitable material.

–3.16D Maintenance Rock

Maintenance rock, ½-inch minus, shall meet all requirements of Section 23-2.01 for crushed surfacing except that it shall meet the following specifications for grading:

% Passing ½" square sieve	100
% Passing ¼" square sieve	55 to 70
% Passing U. S. No. 40 sieve	10 to 30
% Passing U. S. No. 200 sieve (wet sieving)	10 max.

All percentages are by weight.

23–3.17 RESURFACING

The existing surface shall be scarified and then bladed until it has the uniform grade and cross section shown on the plans. In shaping the existing surfacing, all material that may have been displaced by traffic or otherwise shall be bladed into the newly formed surfacing section. The cost of scarifying and shaping existing surfacing shall be considered as incidental to the construction and shall be included in the unit contract price for "Crushed Surfacing."

Crushed surfacing as called for on the plans shall be uniformly spread upon the existing surfacing at such points as may be necessary to secure the required depth and to remove irregularities which could not be accomplished with the existing surfacing. Both old and new surfacing, in advance of incorporating "Filler," shall be bladed until the two have been thoroughly mixed. The cost of mixing old and new surfacing shall be included in the unit contract price bid for the new material. Should there not be sufficient "Filler" in the existing road, "Filler" of the kind and in such quantities as the Engineer may direct, shall be incorporated in the manner hereinbefore described. The surface shall then be rolled as described under the heading of "Base Course" in Section 23-3.16B.

In event no new surfacing material is required in advance of placing the "Top Course," the surface of the existing road which has been scarified and bladed shall be rolled in the same manner as though new surfacing material had been added. The cost of such rolling shall be included in the unit contract price for the succeeding course of surfacing material.

23–3.18 REMOVING AND REPLACING SURFACING MATERIAL

Whenever the special provisions require such work, the Contractor shall salvage as much as practicable of the existing surfacing and utilize it in the construction, as directed by the Engineer.

At such points as are indicated on the plans and at any other points where necessary, in order to secure satisfactory results, the existing surfacing shall be removed from the roadway and deposited in conveniently located piles. After the completion of the construction which necessitated such removal, the surfacing shall be uniformly spread upon the roadway and then shall be completed as provided for base course construction. Extreme care shall be taken to avoid an injurious amount of foreign material becoming mixed with the surfacing material. The moving of surfacing into piles and then back on the roadbed will be measured and paid for as provided in the special provisions of the project involved.

23–3.19 FINAL CLEANING UP

After the surfacing is completed and before final acceptance of the work, the entire roadway shall be neatly finished and trimmed to the lines, grades and cross section as shown on the plans.

After all required material has been removed from any stockpile site during contract operations and if there should be a surplus remaining in the stockpile, the Contractor shall clean up the stockpile site, leaving the surplus material in neat and compact piles. Care shall be taken to keep the aggregate free from dirt and foreign matter. All cost and expense in connection with this operation shall be included in the unit contract prices for the various pay items of work involved in the contract.

23–3.20 MAINTENANCE DURING SUSPENSION OF WORK PERIOD

The provisions of Section 8.04 shall apply to maintenance during suspension of work.

23–4 MEASUREMENT

Crushed surfacing materials will be measured by the ton in trucks at the point of loading, unless shown by the cubic yard in the proposal, in which case measurement will be made in trucks at the point of delivery in accordance with special provisions therefor. The provisions of Section 21 shall apply when measurement is by the ton.

Crushed surfacing materials for placement in stockpile will likewise be measured by the ton, unless the special provisions and proposal show measurement by the cubic yard, in which case the volume of pay material will be determined by cross sectioning the stockpile.

Top course surfacing material when used as keystone will be measured in the same manner as top course surfacing material, regardless of the classification of the course in which it is used.

Ballast consisting of crushed stone or naturally occurring granular material shall be measured in the same manner as crushed surfacing materials.

"Water" shall be measured as provided for in Section 16.

"Filler" will be measured in accordance with the provisions of Section 24.

Maintenance rock will be measured by the ton or by the cubic yard in trucks at the point of delivery.

Rolling equipment shall be measured as provided in Section 15.

23–5 PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract:

1. "Crushed Surfacing, Top Course (or Base Course)," per ton, or cubic yard.
2. "Crushed Surfacing, Top Course (or Base Course) in Stockpile," per ton, or cubic yard.
3. "Crushed Surfacing, Top Course (or Base Course) from Stockpile," per ton, or cubic yard.
4. "Ballast," per ton, or per cubic yard.
5. "Ballast in Stockpile," per ton, or per cubic yard.
6. "Ballast from Stockpile," per ton, or per cubic yard.
7. "Water," per M gallons.
8. "(Kind) Filler," per ton, or per cubic yard.
9. "Maintenance Rock (size) in Stockpile," per ton, or per cubic yard.
10. "Smooth-wheeled Power Roller," per hour.
11. "Pneumatic-tired Roller," per hour.

Crushed surfacing materials shall be paid for at the unit contract price per ton of 2,000 pounds, or per cubic yard when so shown in the proposal.

Top course surfacing material when used as keystone shall be paid for as top course surfacing material, regardless of the classification of the course in which it is used.

Ballast consisting of crushed or naturally occurring granular material shall be paid for in the same manner as crushed surfacing materials.

Removing and replacing surfacing material shall be paid for at the unit contract price per cubic yard, when shown in the proposal.

"Water" shall be paid for at the unit contract price per thousand (1,000) U. S. gallons at the point of delivery on the road.

"Filler" will be paid for in accordance with the provisions of Section 24.

The unit contract price per ton or per cubic yard for "Maintenance Rock ½" Minus in Stockpile," shall be full compensation for furnishing all labor, materials, tools and equipment required to manufacture the material in accordance with these specifications, and to haul and place it in stockpiles at designated sites.

All costs involved in preparing stockpile sites shall be included in the unit contract price for maintenance rock, excepting however, that clearing and grubbing of the designated sites will be measured and paid for in accord-

ance with Section 12 when such bid items are shown in the proposal of any particular project, and not otherwise.

All items of work and materials required by these specifications for which no payment is specified or provided, shall be considered incidental to and a part of the items for which payment is specified and the cost of such work and materials shall be included in the unit contract prices for the pay items shown on the plans.

The unit contract prices for the pay items enumerated shall be full compensation for furnishing all materials, labor, tools, and equipment necessary for the fulfillment of all the requirements of these specifications and those of any other pertinent specifications, in the execution of the work shown on the plans, or as ordered by the Engineer; also for all expense incurred in consequence of or discontinuance of the work covered by these specifications.

Section 24—Filler

24–1 DESCRIPTION

The term "Filler" as used in connection with the construction of gravel base, crushed stone surfacing courses and courses of naturally occurring granular material shall be classified into two classes, viz: (1) Crushed Stone Filler, and (2) Sand Filler. Where the term "Filler" is used in Section 23 of these specifications, it shall be construed to mean the class of filler specified in these specifications or the special provisions for the construction of various surfacing courses, or as called for on the plans.

Filler shall be obtained from approved sources. When sources of sand filler are designated in the special provisions, the Contractor may, after properly stripping the pit, place the naturally occurring material directly on the roadway without further treatment other than the removal of oversize particles. The Contractor shall, however, conduct his operations so as to avoid the inclusion of unsatisfactory material that may be present within the bounds of the pit site.

24–2 MATERIALS

The Owner will, when provided in the special provisions, acquire and make available to the Contractor without charge, the right to take "Filler" materials from the sources designated by the Engineer, and the right to use such sources as may be necessary for his operations.

Filler shall consist of naturally occurring sand or granular material manufactured from rock, gravel, or talus. Filler shall meet the requirements which follow for the two classes.

24–2.01 SAND FILLER

Sand filler shall consist of sand screened from natural deposits and shall be composed of naturally occurring grains, preferably angular.

Sand filler shall meet the following requirements for grading and quality:

Passing ⅜" square sieve	100%
Passing ¼" square sieve	90% to 100%
Passing U. S. No. 10 sieve	40% to 75%
Passing U. S. No. 40 sieve	15% to 40%
Passing U. S. No. 200 sieve (wet sieving)	0% to 15%
Sand Equivalent (see Section 6)	40 Minimum

All percentages are by weight.

24–2.02 CRUSHED FILLER

Crushed filler shall consist of the fine product resulting from crushing stone, and shall meet the following grading and quality requirements:

Passing ⅜" square sieve	100%
Passing ¼" square sieve	90% to 100%
Passing U. S. No. 10 sieve	40% to 75%
Passing U. S. No. 40 sieve	15% to 40%
Passing U. S. No. 200 sieve (wet sieving)	0% to 15%
Sand Equivalent (see Section 6)	40 Minimum

All percentages are by weight.

24–3 CONSTRUCTION DETAILS

Before commencing excavation in the filler pit, the Contractor shall remove all trees, brush, stumps, stripping and overburden as may be necessary to give access to the filler materials desired. The removal and disposal of overburden and debris shall be done in accordance with the instructions of the Engineer.

Stones, boulders, clods, and other unsuitable materials shall be left in the pit, and will not be included in the pay quantities.

Filler shall be spread uniformly on the road at the rate ordered. Unless this can be accomplished satisfactorily by other means, the Contractor shall use an approved adjustable mechanical spreader.

24–4 MEASUREMENT

Filler will be measured by weighing in trucks or by the cubic yard in trucks at the point of delivery. The proposal will indicate the measure of payment—by the ton, or by the cubic yard.

24–5 PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract.

1. "Sand Filler," per (ton, cubic yard).
2. "Crushed Filler," per (ton, cubic yard).
3. "Clearing and Grubbing," per acre, or lump sum.
4. "Stripping Quarries and Pits," per cubic yard.

Clearing and grubbing shall be measured and paid for in accordance with the provisions of Section 12. Stripping will be measured and paid for in accordance with the provisions of Section 13.

Payment for filler of the kind shown in the proposal shall be made at the unit contract price per ton or per cubic yard, whichever is designated in the proposal, for "(kind) Filler," which price shall be full compensation for furnishing all materials, labor, tools, and equipment, and for all other costs and expense necessary or incidental to excavating, loading, hauling the full distance and spreading on the roadbed as specified above, and for final cleaning up of the filler pit. No additional compensation will be made for haul.

Section 25—Screened Gravel Surfacing —One Course

25–1 DESCRIPTION

Screened gravel surfacing shall consist of screened gravel constructed on the properly prepared subgrade to the lines, grade and cross section shown on the plans or as directed by the Engineer. The screened gravel surfacing shall be so graded that it will readily compact into a dense unyielding mass.

25–2 MATERIALS

Screened gravel surfacing shall consist of crushed, partially crushed, or naturally occurring granular materials from approved sources, processed in accordance with the provisions of Section 22. It shall meet the following requirements for grading and quality when placed in hauling vehicles for delivery to the roadway, or during manufacture and placement into a temporary stockpile. The exact point of acceptance will be determined by the Engineer.

	CLASS A	*CLASS B*
% Passing 1-inch square opening	...	100
% Passing ¾-inch square opening	100	...
% Passing ¼-inch square opening	50 to 65	25 to 75
% Passing U. S. No. 200 sieve (wet sieving)	5 max.	10 max.

All percentages are by weight.

Dust Ratio:

$$\frac{\%\text{ Passing U. S. No. 200 sieve (wet sieving)}}{\%\text{ Passing U. S. No. 40 sieve}}$$

	⅔ max.	
Sand Equivalent (Section 6)	45 min.	40 min.

Screened gravel surfacing material retained on a ¼ inch square sieve shall not contain more than 0.15% by weight of wood waste. Wood waste is defined as all material which, after drying to constant weight, has a specific gravity of less than 1.0.

When tested for organic matter, that portion of screened gravel surfacing passing a U. S. No. 10 sieve shall not have wood waste that results in a darker color than that specified in Section 37–2.02B1, except that the color will be measured after the sample has been in the test solution for one hour.

25–3 CONSTRUCTION DETAILS

Immediately in advance of depositing the surfacing materials, the subgrade shall be prepared as specified in the specifications for subgrade for crushed surfacing in Section 23. Screened gravel surfacing shall be uniformly spread upon the prepared subgrade in amount, width and cross section shown on the plans or as directed by the Engineer, and shall then be bladed until the material shows a uniform grading.

If ordered by the Engineer, "filler" of the kind specified and conforming to the requirements of Section 24, shall be spread uniformly over the surfacing material in such quantities as the Engineer may direct. The filler shall then be mixed with the surfacing material by blading until a uniform product is obtained. The surfacing shall then be spread in such a manner that it will have a uniform depth, true to line and grade as staked by the Engineer. It shall then be rolled by either a smooth-wheeled power roller or by a pneumatic-tired roller.

The type of roller shall conform to the requirements set forth in Section 15-2.01A.

The type of roller to be used for any particular project shall be as set forth in the special provisions.

25–4 MEASUREMENT

Screened gravel surfacing will be measured by the ton at the point of loading if the quantity is enough to justify the use of scales, or it may be measured by the cubic yard in trucks at the point of delivery, in accordance with whichever unit of measure is shown on the plans and proposal.

25–5 PAYMENT

The unit contract price per ton or per cubic yard for "Screened Gravel Surfacing" shall be full compensation for all costs and expense necessary for preparing the subgrade, furnishing, screening, loading, hauling, spreading, blading and compacting of the surfacing material, and for incorporating filler and for all other costs and expense necessary or incidental to the completion of the work as specified above.

Filler will be measured and paid for as provided in Section 24.

Rolling equipment will be measured and paid for as provided in Section 15.

"Water" will be measured and paid for as provided in Section 16.

Section 26—Bank Run Gravel for Streets

26–1 DESCRIPTION

Where shown on the plans or where designated by the Engineer, embankments, shoulders and/or the top of embankments and the subgrade of cuts to a depth as shown on the plans or as designated by the Engineer, shall be composed of bank run gravel from approved sources prepared in accordance with Section 22. Bank run gravel is defined as naturally occurring material having characteristics such that when compacted in place on the roadway it will provide a course having greater supporting value than the subgrade on which it is placed.

26–2 MATERIAL

26–2.01 CLASSES AND GRADING OF BANK RUN GRAVEL

Bank run gravel shall be substantially free from wood, roots, bark or other extraneous material. It shall have such characteristics of particle size and shape that it will compact readily to a firm, stable course.

The maximum size of stone shall not exceed the depth of the course being applied less one (1) inch, except that in no case shall the maximum size exceed eight (8) inches.

Bank run gravel shall be termed Bank Run Gravel Class A, or Bank Run Gravel Class B. The following requirements shall govern for the separate classes:

	Bank Run Gravel Class A	*Bank Run Gravel Class B*
Passing ¼" sieve	25% min. 75% max.	25% min. 75% max.
Passing U. S. No. 200 sieve (wet sieving)	5% max.	10% max.
Dust Ratio: $\frac{\%\text{ Passing \#200 (wet sieving)}}{\%\text{ Passing \#40}}$	⅔ max.	⅔ max.
Sand Equivalent	50 min.	30 min.

26–2.02 BANK RUN GRAVEL FROM SPECIFIED SOURCES

When sources of bank run gravel are designated in the special provisions the Contractor may, after stripping a sufficient area to yield the required quantity as provided in Section 22, place the naturally occurring material directly on the roadbed without further treatment except removal of oversize stone. He shall, however, work the pit in such a way that individual loads do not vary greatly from the average grading available in the deposit, and he shall avoid or waste material that is designated by the Engineer as unsuitable for the specified class of bank run gravel. The Contractor shall make as many moves of loading equipment within the specified pit area as may be necessary to fulfill the above requirement.

26–2.03 BANK RUN GRAVEL FROM SOURCES PROVIDED BY THE CONTRACTOR

When bank run gravel is furnished from sources provided by the Contractor, the material shall be produced from approved sources in accordance with Section 22. The grading and quality shall be as specified in Section 26-2.01.

Bank run gravel for uses other than the support of portland cement concrete pavement shall meet the requirements of Section 26-2.01 and shall meet the following additional requirements thereto:

Stabilometer resistance value (Section 6)	68 minimum
Swell pressure (Section 6)	0.3 psi maximum

If bank run gravel from sources furnished by the Contractor has lower resistance value or higher swell pressure it may be used if approved by the Engineer, provided that the thickness of crushed surfacing is increased over that shown on the plans by such an amount

as the Engineer determines necessary to compensate for the lower values. The bank run gravel shall be decreased in thickness by an amount equal to the required increased thickness of crushed surfacing. The volume of crushed surfacing required to compensate for resistance value lower than, or swell pressure higher than that specified above, shall be measured for payment as "Bank Run Gravel, Class A or Class B" and not as crushed surfacing. All costs incurred therefor shall be included by the Contractor in his unit contract price for "Bank Run Gravel, Class A or Class B".

If, as an alternate to sources provided in the special provisions, the Contractor shall elect to furnish bank run gravel from another source in which the material has a lower resistance value or higher swell pressure than that in the designated source, the thickness of crushed surfacing and bank run gravel shall be adjusted to compensate the lower values as outlined in the preceding paragraph.

When the Contractor furnishes the source, he shall remove the materials in such manner that all parts of the pit will be drained to a natural drainage course at its normal water level.

26–3 CONSTRUCTION DETAILS

26–3.01 REMOVAL OF OVERBURDEN

Before any of the bank run gravel material is removed, the site shall be cleared and grubbed and all debris shall be disposed of by the Contractor. The entire area from which bank run gravel is to be taken shall be stripped of earth and other material unsuitable as bank run gravel. All overburden materials shall be conveyed by the Contractor at a location which will ensure against it becoming mixed with the selected material.

26–3.02 PREPARATION OF ROADBED

The surface of the roadbed upon which bank run gravel is to be placed shall be compacted as specified in Section 15-2.01, Subgrade for Base Materials. All loose stones shall be removed from the surface of the roadbed.

26–3.03 CONSTRUCTION OF COURSES

The bank run gravel material shall be uniformly spread upon the prepared subgrade to the depth, width and cross section shown on the plans.

The maximum depth of any course shall not exceed eight (8) inches unless otherwise specified in the special provisions.

Each course shall be bladed and rolled until it is thoroughly compacted and true to line, grade and cross section before the material for the succeeding course is spread. Rolling shall be done by means of the equipment described in Section 15-2.01A.

26–3.04 PIT OPERATIONS

Bank run gravel material shall be taken to the lines and grades staked by the Engineer from the portions of the pit which will furnish the most suitable material. Upon completion of the operation, the side slopes and floor of the pit shall be dressed to a uniform slope as directed by the Engineer. All debris and refuse shall be removed by the Contractor and the site left in a neat and presentable condition.

26–4 MEASUREMENT

Bank run gravel Class A or Class B will be measured by the ton in trucks at the point of loading if the quantity is enough to justify the use of scales, or by the cubic yard measured in trucks at the point of delivery, in accordance with whichever unit is shown on the plans and proposal.

The pay quantity for bank run gravel produced from a source provided by the Owner shall be the actual quantity delivered and used on the roadway except that water content in excess of eight (8) percent by weight, including water absorbed by the material, shall be deducted from the tonnage to be paid for if payment by the ton is specified. Crushed surfacing used for compensating lower resistance value or higher swell pressure than bank run gravel produced from a source provided by the Owner, shall be measured and paid for as "Bank Run Gravel, Class A or Class B".

If bank run gravel from a source provided by the Contractor has lower resistance value or higher swell pressure than that specified, the pay quantity of "Bank Run Gravel, Class A or Class B" shall be the quantity of bank run gravel actually delivered and used on the roadway, less water in excess of eight (8) percent by weight, plus the quantity of crushed surfacing, if any, used to compensate for lower resistance value or higher swell pressure, as described in Section 26-2.03. In no such case shall the crushed surfacing used to compensate for lower values than that specified, be included in any pay item for crushed surfacing.

The quantity for bank run gravel shall not include waste material or any material not suitable for the purpose intended.

26–5 PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract:

1. "Bank Run Gravel (Class A or Class B)," per ton, or cubic yard.
2. "Clearing" and "Grubbing," per acre (or lump sum).
3. "Stripping Quarries and Pits," per cubic yard.
4. "Water," per M gallons.
5. "Smooth-wheeled Power Roller," per hour.
6. "Pneumatic-tired Roller," per hour.
7. "Grid Roller," per hour.

The unit contract price per ton or per cubic yard for "Bank Run Gravel (Class A or Class B)," shall be full compensation for furnishing all material, labor, tools, equipment and all other costs and expense necessary or incidental to the preparation of the roadbed, excavating, loading, hauling the full distance, placing and blading the bank run gravel and for which no other specific bid item is provided.

Clearing and grubbing for borrow pits will be measured and paid for in accordance with the provisions of Section 12.

"Stripping Quarries and Pits," will be measured and paid for in accordance with the provisions of Section 13.

"Water" will be measured and paid for in accordance with the provisions of Section 16.

Rolling equipment will be measured and paid for in accordance with the provisions of Section 15.

Water and compaction of subgrade and gravel shall be considered as incidental to the construction whenever the items of water and compaction equipment are not included in the bid proposal and the special provisions so provide, and all costs incurred in complying with the specifications shall be included by the Contractor in his unit contract price per ton or per cubic yard for "Bank Run Gravel (Class A or Class B)."

Section 27—Asphalt Materials

27–1 DESCRIPTION

27–1.01 ASPHALT MATERIAL

Asphalt furnished under these specifications shall not have been distilled at a temperature high enough to injure by burning or to produce flecks of carbonaceous matter, and upon arrival at the work shall show no signs of separation into lighter and heavier components. Lots placed in storage for subsequent shipment shall be thoroughly mixed so there will be no appreciable difference in properties between individual shipments.

Asphalt of the grade specified shall fully comply with all of the requirements hereinafter set forth for each respective grade.

The particular grade or grades of asphalt to be used on any project will be those called for in the special provisions, on the plans, or in these specifications.

–1.01A Slow Curing Liquid Asphalt

		SC-70	SC-250	SC-800	SC-3000
Flash Point—Cleveland Open Cup	Min. °F.	150	175	200	225
Viscosity at 140° F., Kinematic, cs.		70–140	250–500	800–1600	3000–6000
Water Content	Max. %	0.5	0.5	0.5	0.5
Distillation:					
Total distillate at 680° F.	%	10–30	4–20	2–12	0–5
Kinematic Viscosity of Distillation Residue at 140° F.	Stokes	4–70	8–85	20–140	40–350
Float test on distillation residue at 122° F.	Seconds	20–100	25–110	50–140	75–200
Asphalt residue of 100 Penetration	Min. %	50	60	70	80
Ductility of Asphalt Residue at 77° F.	Min. Cm.	100	100	100	100
Solubility in Carbon Tetrachloride or Trichloroethylene	Min. %	99.5	99.5	99.5	99.5
Spot Test (Heptane-Xylene equivalent)	Max. %	35	35	35	35

–1.01B Medium Curing Liquid Asphalt

		MC-70	MC-250	MC-800	MC-3000
*Flash Point—Tag Open Cup	Min. °F.	100	150	150	150
Viscosity at 140° F., Kinematic, cs.		70–140	250–500	800–1600	3000–6000
Water Content	Max. %	0.2	0.2	0.2	0.2
Distillation, % by volume of total distillate to 680° F.:					
To 437° F.		0–20	0–10	.....	.....
To 500° F.		20–60	15–55	0–35	0–15
To 600° F.		65–90	60–87	45–80	15–75
Residue to 680° F.	Min. %	55	67	75	80
Properties of residue from distillation to 680° F.:					
Penetration at 77° F., 100 g., 5 sec.		120–250	120–250	120–250	120–250
†Ductility at 77° F., Cm., Minimum		100	100	100	100
Solubility in Carbon Tetrachloride or Trichloroethylene	Min. %	99.5	99.5	99.5	99.5
Spot Test (Heptane-Xylene equivalent)	Max. %	35	35	35	35

–1.01C Rapid Curing Liquid Asphalt

		RC-70	RC-250	RC-800	RC-3000
Flash Point—Tag Open Cup	Min. °F.	.....	80	80	80
Viscosity at 140° F., Kinematic, cs.		70–140	250–500	800–1600	3000–6000
Water Content	Max. %	0.2	0.2	0.2	0.2
Distillation, % by volume of total distillate to 680° F.:					
To 374° F. minimum		10	.....	.....	.....
To 437° F. minimum		50	35	15	.....
To 500° F. minimum		70	60	45	25
To 600° F. minimum		85	80	75	70
Residue to 680° F.	Min. %	55	65	75	80
Properties of residue from distillation to 680° F.:					
Penetration at 77° F., 100 g., 5 sec.		80–120	80–120	80–120	80–120
Ductility at 77° F., minimum Cm.		100	100	100	100
Solubility in Carbon Tetrachloride or Trichloroethylene	Min. %	99.5	99.5	99.5	99.5
Spot Test (Heptane-Xylene equivalent)	Max. %	35	35	35	35

*Flash point by Cleveland Open Cup may be used for products having a flash point greater than 175° F.

†If penetration of residue is more than 200 and its ductility at 77° F. is less than 100, the material will be acceptable if its ductility at 60° F. is not less than 100.

–1.01C1 Alternate Viscosity Requirements

At the option of the Owner, liquid asphalts may be tested for viscosity with the Saybolt Furol apparatus in lieu of the Zeitfuchs Cross-Arm Viscometer. If the Saybolt Furol apparatus is used, liquid asphalts shall meet the following requirements for viscosity:

GRADE LIQUID ASPHALT	Temperature	Saybolt Furol Viscosity in Seconds
SC, MC, or RC-70	122° F.	60 to 120
SC, MC, or RC-250	140° F.	125 to 250
SC, MC, or RC-800	140° F.	400 to 800
SC, MC, or RC-3000	180° F.	300 to 600

–1.01D Paving Asphalts

Paving asphalts shall be free from water and shall not foam when heated to 350° F. They shall conform to the requirements of the first table on page 44.

–1.01E Asphalt for Sub-Sealing and Crack Pouring

Asphalt for crack pouring and for sub-sealing under pavements shall be free from water and shall not foam when heated to 350° F. It shall conform to the following requirements:

Softening Point (Ring and Ball), °F.	160°–180°F.
Penetration of Original Sample:	
At 32° F., 200g., 60 sec.	15+
At 77° F., 100g., 5 sec.	25–40
At 115° F., 50g., 5 sec.	90—
Ductility at 77° F., cms.	3+
Flash Point (Cleveland Open Cup) °F.	425+
Solubility in Carbon Tetrachloride, %	99.0+
Loss on Heating, 325° F., 5 hrs., %	1.0—
Penetration After Loss on Heating, % of Original	70+

Specification		GRADE				
Penetration of Original Sample at 77° F., 100G., 5 Sec.		40–50	60–70	85–100	120–150	200–300
Flash Point, Pensky-Martens Closed. °F.	Min.	40–50	60–70	85–100	120–150	200–300
Penetration Ratio:						
Pen. 39.2° F., 200 G., 60 Sec. × 100		460	450	440	425	400
Pen. 77°F., 100 G., 5 Sec.						
Viscosity, Saybolt Furol, at 275° F.	Min.	25	25	25	25	25
Solubility in Carbon Tetrachloride, %		120–430	100–325	85–260	70–210	50–150
Spot test (Heptane-Xylene Equivalent), %	Min.	99.0	99.0	99.0	99.0	99.0
Thin Film Oven Test:*	Max.	35	35	35	35	35
Loss in Weight, %						
Penetration of Residue, 77° F., 100G., 5 Sec., % of Orig. Pen.	Max.	0.75	0.80	0.85	1.00	1.50
Ductility of Residue, 77° F., Cm.	Min.	52	50	47	44	40
	Min.	50	50	75	75	75

*The 75 minute exposure in the Rolling Thin Film Oven as currently described in the California Division of Highways Procedure No. Calif. 346 may be used as alternate to the 5-hour exposure at 325° F. in the Thin Film Oven. All requirements for loss in weight, penetration and ductility of residue after exposure remain unchanged.

–1.01E Asphalt for Sub-Sealing and Crack Pouring, *See Page 43.*

–1.01F Emulsified Asphalt

	RAPID SETTING		SLOW SETTING	
	RS-1	RS-2	SS-1	SS-1H
Viscosity, Saybolt Furol:				
at 77° F., Sec.	20–100	.....	20–100	20–100
at 122° F., Sec.	.....	75–400	.....	.....
Residue by distillation, %	57 Min.	62 Min.	57 Min.	57 Min.
Settlement, 5 days, %	3 Max.	3 Max.	3 Max.②	3 Max.②
Demulsibility:①				
35 ml. of 0.02 N. CaCl, %	60 Min.	50 Min.	.....	.....
Sieve test (Ret. on #20) %	0.10 Max.	0.10 Max.	0.10 Max.	0.10 Max.
Modified Miscibility with water	.....	.....	4.5 Max.	.....
Cement mixing test, %	.....	.....	2.0 Max.	2.0 Max.
Tests on Residue:				
Penetration at 77° F., 100g., 5 sec.	100–200	100–200	100–200	40–90
Solubility in CS_2, %	97.5 Min.	97.5 Min.	97.5 Min.	97.5 Min.
Ductility at 77° F., cm.	40 Min.	40 Min.	40 Min.	40 Min.

①The Demulsibility Test shall be made within 30 days from the date of shipment.
②If the sample of emulsified asphalt being tested fails to conform to the requirements for modified miscibility, the sample shall be tested for 5-day settlement and for miscibility. If the numerical difference between the average percentages of the asphalt residue in the 5-day settlement test is less than 3 and if the standard miscibility test shows no appreciable coagulation or visible separation in 2 hours, then the emulsified asphalt shall be considered as conforming to these specifications and shall be accepted.

–1.01G Test Methods

The properties enumerated above shall be determined in accordance with the following methods of test:

Test	*Designation*
1. Penetration	ASTM D-5
2. Penetration Ration	Section 6
3. Residue of Specified Penetration	ASTM D-243
4. Viscosity, Saybolt Furol	ASTM D-88
	E-102
5. Viscosity, Kinematic, Zietfuchs Cross Arm	ASTM D-445
6. Flash, Cleveland Open Cup	ASTM D-92
7. Flash, Tag Open Cup	ASTM D-1310
8. Flash, Pensky Martens Closed	ASTM D-93
9. Thin Film Oven Test	ASTM D-1754
10. Loss on Heating	ASTM D-6
11. Ductility	ASTM D-113
12. Bitumen Soluble in Carbon Disulphide	ASTM D-4
13. Proportion of Bitumen Soluble in Carbon Tetrachloride	ASTM D-165
14. Float Test	ASTM D-139
15. Water	ASTM D-95
16. Distillation	ASTM D-402
17. Spot Test	AASHO T-102
18. Softening Point	ASTM D-36
19. Emulsified Asphalt	ASTM D-244

–1.01H Change in Grades

At any time during the progress of the work, the Engineer may order the use of other grades of asphalt materials in substitution of the grades specified in the special provisions if, in his judgment, the results contemplated by the specifications will be better attained thereby.

If the market price of the grade substituted is higher than that of the grade specified, the difference will be added to the unit contract price for asphalt, or if lower, it will be deducted from the unit contract price. Furthermore in case any substitution so ordered makes it necessary to use a retort or superheater, where same is not required by the grade specified, the Contractor will be allowed $2.00 per ton (2,000 lbs.) in addition to the revised unit price for asphalt. No additional compensation will be made. If the contract is awarded for the use of asphalt that requires the use of a retort or superheater and substitution is made to a grade not requiring the use of such equipment, a deduction of two dollars ($2.00) per ton (2,000 lbs.) will be made from the revised unit price.

If the Engineer orders a change of paving asphalt, additional compensation, if any, will be limited to the actual additional cost of the asphalt based on invoices from the supplier. If the cost of the substituted paving asphalt is lower, the difference in its cost and that of the original material specified, based on invoices from the supplier, shall be deducted from monies due the Contractor.

–1.01I Notice of Shipment

The producer shall furnish a notice of shipment in triplicate at the time of shipment of each car load or other lot of asphalt cement. The original copy shall be mailed to the Engineer, the duplicate to the consignee and the triplicate with the shipment. The asphalt shall not be unloaded at the point of delivery until the Engineer has checked the notice of shipment. The notice shall contain the following information:

1. Name of shipper.
2. Date of shipment.
3. Car initial and number or suitable identification if shipped by other carrier.
4. Name of commodity.
5. Consignee and delivery point.
6. The contract number or Owner's purchase order number.
7. Point from which shipped.
8. Quantity contained. (When weighed on approved scales show gross, tare and net weights; otherwise show volume as loaded, temperature of loading, gallons at 60° F., and net tons.)
9. Certificate of grade. (Statement that material conforms to the specifications.)
10. Signature of shipper by authorized representative.

–1.01J Samples

The producer shall ship by prepaid express a sample of asphalt taken from each load or other lot that is shipped for use on work under the jurisdiction of the Owner. The sample shall consist of one quart, taken directly from the material after loading, properly labeled, which shall be forwarded promptly to the Engineer, or to a laboratory designated by him.

–1.01K Basis of Measurement

The quantity of asphalt to be paid for shall be the net amount determined by actual weight or by volume measurement. The method of measurement to be used in each instance shall be subject to determination by the Engineer. The apparatus used and the procedure employed in obtaining weight or volume measurements shall meet the approval of and shall be subject to inspection by the Engineer.

Deductions shall be made for any asphalt material included in the measurement that does not actually become incorporated in the work.

The unit of measurement for asphalt shall be a ton of two thousand (2,000) pounds. When measurement is made by volume, computations of weight shall be made in accordance with the following schedule:

Material	Gal. per ton at 60° F.	Material	Gals. per ton at 60° F.	Materials	Gals. per ton at 60° F.
SC-70	255	MC-70	255	RC-70	255
SC-250	247	MC-250	247	RC-250	247
SC-800	244	MC-800	244	RC-800	244
SC-3000	241	MC-3000	241	RC-3000	241

The volume of asphalt, with the exception of emulsified asphalt, shall be converted from any temperature to the volume at 60° F., in accordance with the standard ASTM -IP Petroleum Measurement Tables specified in ASTM Designation D 1250.

For the purposes of payment the unit of measurement of emulsified asphalt shall be a ton of two thousand (2,000) pounds. When measurement is made by volume, two hundred forty (240) U. S. gallons of emulsified asphalt at a temperature of sixty degrees (60°) F. shall be considered as equivalent to a ton of two thousand (2,000) pounds. The volume of emulsified asphalt at any temperature shall be converted to the volume at 60° F., using the coefficient of cubical expansion of 0.00025 per degree F.

–1.01L Temperature of Application

Asphalt materials shall be heated to the temperature directed by the Engineer, but within the limits, shown in the accompanying table, before they are applied to the roadway:

Material	App. Temp. Min. °F.	App. Temp. Max. °F.	Material	App. Temp. Min. °F.	App. Temp. Max. °F.	Material	App. Temp. Min. °F.	App. Temp. Max. °F.
SC-70	140	200	MC-70	140	190	RC-70	135	165
SC-250	180	270	MC-250	170	230	RC-250	155	205
SC-800	230	320	MC-800	185	245	RC-800	180	230
SC-3000	300	400	MC-3000	200	280	RC-3000	210	260

Emulsified Asphalt, RS-1 ..... Minimum 100° F. Maximum 130° F.
Emulsified Asphalt, RS-2 ..... Minimum 140° F. Maximum 170° F.
201-300 Penetration Paving Asphalt ..... Minimum 300° F. Maximum 400° F.
51-200 Penetration Paving Asphalt ..... Minimum 350° F. Maximum 400° F.
Asphalt for Subsealing and Crack Pouring ..... Minimum 350° F. Maximum 425° F.
Paving Asphalt for Use in Asphalt Plants ..... Minimum 250° F. Maximum 350° F.

The temperature of paving asphalts when loaded for transporting to destination shall not be greater than 400° F.

–1.01M Unauthorized Grades

The use of grades of asphalt other than those called for on the plans or in the special provisions, except as provided in Section 27-1.01H, will not be allowed. Any work which proves to be defective because of the use of unauthorized grades of asphalt shall be repaired or removed at the expense of the Contractor, if ordered by the Engineer.

–1.01N Anti-Stripping Additive

When called for on the plans or in the special provisions asphalt material shall be treated with an approved heat-stable anti-stripping additive before use:

Anti-stripping additive in the amount of 1% by weight of the asphalt, or less if ordered by the Engineer, shall be added to the asphalt at the point of shipment.

The anti-stripping additive shall be approved by the Engineer or laboratory prior to use.

Payment for the anti-stripping additive shall be incidental to the unit contract prices for the various items involved. No additional compensation shall be made.

Section 32—Bituminous Surface Treatment

32–1 DESCRIPTION

This specification shall apply to surfaces constructed by treating an existing crushed rock, screened gravel or bituminous roadway surface with asphalt and covering with mineral aggregate to obtain a surface thoroughly cemented to the roadway, having the contour and section shown on the plans and ensuring good riding and nonskid qualities.

32–2 MATERIALS

32–2.01 ASPHALT

The particular asphalt to be used on any project will be those which are called for in the proposal or shown on the plans. Asphalt of the grade or grades specified shall comply with all the requirements set forth in Section 27, Asphalt Materials.

32–2.02 MINERAL AGGREGATE

–2.02A General Requirements

Mineral aggregate to be used for bituminous surface treatment shall be of the type and size called for on the plans or in the proposal. Mineral aggregate may be obtained from Owner-owned stockpiles, produced from Owner-owned sources, or furnished by the Contractor, as may be called for on the plans or in the special provisions.

Any method of handling mineral aggregate which, in the opinion of the Engineer, causes segregation shall be corrected by the Contractor so that a uniform product will be incorporated in the work.

Mineral aggregate shall be manufactured in accordance with Section 22. It shall be manufactured from ledge rock, talus or gravel which meets the following test requirements:

Los Angeles wear, 500 Rev., ASTM Designation C 131 35% Max.

The finished product shall be clean, uniform in quality, and free from wood, bark, roots, and other deleterious materials.

Crushed screenings shall be substantially free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than fifty (50) percent of the surface area of any size between successive laboratory sieves.

The portion of mineral aggregate for bituminous surface treatment retained on a ¼-inch sieve shall not contain more than 0.1% wood waste by weight. Wood waste is defined as material with a specific gravity less than 1.0 after drying to constant weight.

The portion of mineral aggregate ofr bituminous surface treatment passing a U. S. No. 10 sieve shall not have wood waste that will result in more than 250 parts per million of organic matter by colorimetric tests when tested in accordance with Section 37-2.02B1, except that the color shall be measured after the sample has been in the test solution one hour.

–2.02B Test Requirements

Mineral aggregate for bituminous surface treatment shall conform to the requirements in the table below for grading and quality. The particular type or grading to be used shall be as shown on the plans. All percentages are by weight.

The requirements for grading shall apply at the time the aggregate is placed in the hauling vehicle for delivery to the project.

The crushed and screened cover stone and crushed screenings shall be damp when applied to the roadway. If the aggregates are dry and dusty in stockpile, the Contractor will be required to wet the stockpiles by spraying.

PASSING SIEVE	Crushed Cover Stone % Passing	Screened Cover Stone % Passing	CRUSHED SCREENINGS % Passing ⅜"–¼"	% Passing ½"–¼"	¼"–0
¾" Square	100	100	100	.....	.....
⅜" Square	95–100	95–100	95–100	100	.....
½" Square	.....	.....	.....	95–100	.....
⅜" Square	.....	.....	.....	.....	100
¼" Square	30–50	30–50	0–10	0–15	90–100
U. S. No. 10	.....	.....	0–3	0–3	30–60
U. S. No. 100	.....	.....	0–1	0–1	0–10
U. S. No. 200 (wet sieving)	0–7.5	0–2	.....	.....	.....
Fracture (each size, including material passing ¼"), minimum %	75	.....	75	75	75
Sand Equivalent (section 6) Min.	40	40	.....	.....	.....
Modified immersion compression test, section 6, minimum % retained strength	70	70	70	70	70

32–3 CONSTRUCTION DETAILS

32–3.01 PREPARATION OF UNTREATED ROADWAY

The existing roadway surface, including intersections and side street approaches, shall be shaped to a uniform grade and section shown on the plans or as directed by the Engineer, by using motor patrol graders equipped with scarifiers and weighing not less than ten (10) tons, by applying water in the amount directed by the Engineer with approved types of distributors, compacting the surface with pneumatic-tired and smooth-wheeled, three-wheel, or tandem rollers, one of which shall weigh not less than eight (8) tons. All equipment shall meet requirements outlined in Section 32-3.11.

The material on the existing street shall be loosened to a depth of approximately one (1) inch, scarifying if necessary. The material shall be drifted back and forth across the street, evenly distributed and compacted into an unyielding mass by blading, rolling, and watering. The grade shall be shaped so that all frame castings for manholes, monument boxes, gate valve boxes, catch basins, etc. within the roadway section to be treated, will extend one-half (½) inch to one (1) inch above the finished surface. Where existing oil mats are to be met, they shall be thoroughly swept and cleaned to provide proper connections, as the Engineer may direct.

Private driveways entering the street, if shown on the construction plans or indicated in the special provisions, shall be prepared in the same manner except that shaping shall be performed by hand methods to the extent that it is deemed necessary by the Engineer. The depth to which driveways shall be prepared from the street gutter line toward private property shall be as shown on the construction plans or as required in the special provisions.

Where intersections are so flat as to present potential drainage problems, and where street grades are one and one-half (1½) percent or less, the gutter grades will be staked by the Engineer, as required, at intersections, and at 50-foot intervals elsewhere. The roadway shall be graded and compacted to the exact grades as set by the Engineer. Where earth curbs are encountered, the curb shall be shaped in accordance with the section shown on the plans. Where concrete curbs or concrete curb and gutter are in place, grading shall be performed to meet the existing curbs and gutters. Any excess material encountered which cannot be incorporated into the roadway surface shall be removed and disposed of and will be paid for at the unit contract price per cubic yard for "Removal of Excess Surfacing Material."

Preleveling and patching shall be performed only when specified in the special provisions and in accordance with requirements specified therein.

32–3.02 FIRST APPLICATION OF ASPHALT

Before the first application of asphalt is applied, the entire roadway, all side street approaches at intersections, alley approaches, and driveways shall be stable and unyielding, be of medium damp condition, be free from irregularities and material segregation, and be true to line, grade, and cross section. All castings shall be covered with heavy building paper and weighted down with sand or crushed material.

Where concrete curb or curb and gutter exist, the distributor shall be equipped with a splash board of such design as to prevent spraying thereon.

Asphalt shall be applied at the rate of 0.25 to 0.45 gallon per square yard as directed by the Engineer, at temperatures set forth in Section 27-1.01L. The pattern of application of shots, and width and length of application of shots of asphalt material shall be such as to provide proper coverage of crushed material within times specified hereinafter, provide proper widths to such dimensions as to facilitate the most satisfactory coverage with crushed cover stone, lapping of subsequent adjacent applications, and in such a manner as the Engineer deems most satisfactory for the particular project. Asphalt shall be applied to spandrels of intersections and driveways immediately ahead of, or behind the adjacent longitudinal street application.

Where earth curbs exist, the application of asphalt shall extend four (4) inches beyond the gutter line. On projects that have concrete curb and gutter existing, the application shall lap onto the gutter section, but not to exceed two (2) inches. In the case of vertical concrete curb, the application shall be placed as closely as possible without excessive splash onto the curb.

Hand sprayers shall be used to apply asphalt around castings and wherever else cover is insufficient.

After applying the first shot of asphalt and at such time as the Engineer may direct, crushed cover stone shall be evenly applied to the roaday surface at a rate of twenty-five (25) to thirty-three (33) pounds per square yard. The quantity of cover stone to be applied shall be held to an absolute minimum, providing for just enough material so the asphalt will be uniformly covered and will not pick up under traffic. Where the Contractor places cover stone in excess of the amount directed by the Engineer, he shall remove the excess material before application of the second shot at his own expense. The cover stone shall be applied over the freshly spread asphalt by trailer-type or self-propelled spreader boxes of an approved design. The cover stone shall be applied so that trucks and spreader boxes will not travel on the fresh asphalt and it shall be spread in one operation for each application of asphalt. Spandrels of intersections, driveways, and bare spots shall be covered by hand spreading from trucks immediately back of the spreader box application. Cover stone shall be spread in such a manner as to provide a four (4) to eight (8) inch strip of asphalt exposed to provide a lap with the next application of asphalt cement. Successive spreads of asphalt will then be applied and covered as described above.

As soon as the crushed cover stone has been applied to the first half of the street, the cover stone shall be well rolled with pneumatic-tired roller. Places inaccessible to the pneumatic-tired roller, such as spandrels of intersections and private driveways, shall be rolled with a self-propelled smooth-wheel roller weighing not less than eight (8) tons.

Where excess rock has been applied, it shall either be removed as previously specified or be drifted uniformly over the adjacent roadway by using an approved motor patrol grader equipped with a wire broom mold board, subject to approval of the Engineer. This type of brooming shall be held to a minimum, and where necessary it shall be very carefully performed so as not to disturb the mat in any way. Thin or bare spots in the spread of cover stone shall be corrected by hand spreading or by use of a grader as described above.

Rolling and brooming shall continue until the roadway is evenly covered and the cover stone is well compacted and "set" into the asphalt. This operation will continue, as directed, until the asphalt has cured to the extent that it will not "pick up" under traffic. Primarily, all rolling will be performed with pneumatic rollers, except as otherwise described above, and the final rolling shall be performed with a self-propelled smooth-wheel roller weighing not less than eight (8) tons.

To avoid laps and joints at transverse junctions of separate applications of asphalt, the Contractor shall spread sufficient building paper over the treated surface to assure proper functioning of spray jets when untreated surface is reached.

During that period following the first application of the bituminous surface treatment and prior to the second, the Contractor shall perform brooming, spotting, and rolling as may be necessary to prevent "pick up" or other damage to the surface.

32–3.03 SECOND APPLICATION OF ASPHALT

The final application shall not be applied sooner than five (5) days from the date of completion of the first application of bituminous surface treatment, and the time may be extended for a period in excess of five (5) days if so directed by the Engineer. The roadway surface, including intersections and side street approaches, shall be prepared by use of an approved type of motor patrol grader, equipped with a wire broom mold board. All loose material shall be distributed over the entire roadway so as to provide a uniform thickness of material consisting primarily of coarse material not in excess of one rock thickness. Rotary brooms will not be permitted unless specifically called for in the special provisions. Castings and curbs shall again be protected as described in Section 32-3.02.

As directed by the Engineer, asphalt shall be applied at the rate of 0.2 to 0.35 gallon per square yard and crushed cover stone at the rate of 25 to 33 pounds per square yard. The manner of applying both materials, and the procedure of rolling and brooming shall be the same as for the first application described in Section 32-3.02.

32–3.04 ADDITIONAL ASPHALT AND MINERAL AGGREGATE

If the application of asphalt or cover stone, or both, shall indicate the quantities placed on any particular portions of roadway to be too little or too much for the required results, the Engineer may direct the Contractor to make an additional application of one or both materials in accordance with these specifications, or his directions. Additional asphalt or mineral aggregate thus used will be paid for at the unit contract price for each of the materials used, and no further compensation will be allowed.

32–3.05 PATCHING

Omissions by the distributor or damage to the treated surface of any coat shall be immediately covered by hand patching with asphalt in adequate quantities. Holes which develop in the surface shall be patched. All costs incurred in coating omissions and patching shall be included by the Contractor in his unit contract prices for the materials used and no additional compensation will be made for such work.

32–3.06 CORRECTION OF DEFECTS

Defects such as raveling, low centers, lack of uniformity, or other imperfections caused by faulty workmanship shall be corrected as directed by the Engineer, and new work shall not be opened to traffic until such defects have been remedied.

All improper workmanship and defective materials resulting from overheating, improper handling or application shall be removed from the roadway by the Contractor and be replaced with approved materials and workmanship at his own expense.

32–3.07 PROTECTION OF STRUCTURES

All curbs, curb and gutters, castings, guard rails, road signs, and other facilities shall be protected from splashing of the asphalt. All costs incurred by the Contractor in necessary protective measures shall be included by the Contractor in his unit contract prices for various pay items of the contract.

32–3.08 UNFAVORABLE WEATHER

Asphalt may be applied to damp but not wet material. Subject to the determination of the Engineer, asphalt shall not be applied during rainfall or any imminent storms that might damage the construction. The Engineer shall determine whether the surface and materials are dry enough to proceed with construction.

In general, it is the policy of the Owner to prohibit the application of any asphalt when the ground temperature is lower than fifty degrees (50°) F. The Engineer may require the Contractor to delay the application of asphalt until the atmospheric and roadway conditions are satisfactory. No asphalt shall be placed which cannot be covered before darkness.

32–3.09 MAINTENANCE

Unless otherwise provided in the special provisions, the Contractor shall, at his own expense, maintain the completed roadway for a period of five (5) days after the completion of all work on any one continuous section, adding screenings when surplus asphalt cement appears on the surface due to action of traffic or climatic conditions.

In the event of the Contractor's failure or neglect to faithfully perform this maintenance, resulting in injury to the surface, the Contractor shall make the necessary repairs at his own expense, to the satisfaction of the Engineer.

32–3.10 PROGRESS OF WORK

The Contractor shall so organize his work that the entire operation will progress in an orderly and expeditious manner, satisfactory to the Engineer.

32–3.11 ORGANIZATION AND EQUIPMENT

Personnel: The Contractor shall have on hand sufficient personnel and required equipment before commencing any stage of construction. Each stage of the construction shall be supervised by competent personnel, thoroughly experienced in the particular type of work. All operators of graders, distributors and trucks shall be experienced in the equipment they operate. Anyone of the Contractor personnel found to be incompetent in execution of his work by the Engineer, shall be replaced by the Contractor upon request of the Engineer.

Equipment: The equipment listed below will be the minimum required for this type of construction, and additional units must be secured if, in the opinion of the Engineer, it becomes necessary to fulfill the conditions of these specifications, or to complete the improvement within the time specified.

1 Asphalt cement heater capable of heating the asphalt cement to the required temperature.

1 Asphalt distributor of at least 1,000 gallon capacity which will distribute the asphalt cement uniformly at the required rate of application. It shall be insulated and equipped with an adequate heating device. It shall be equipped with a ten-foot (10') spray bar with extensions, pressure pump and gauge, volume gauge so located as to be observed easily by the inspector from the ground, a tachometer to control accurately the speed and spread of asphalt cement, and two thermometers, one to be installed permanently in the tank to indicate temperatures of the cement at all times. The power for operating the pressure pump shall be supplied by an independent power unit which will develop a minimum of twenty-five (25) pounds per square inch pressure at the spray bars.

Necessary asphalt patching equipment.

2 Asphalt thermometers.

Necessary insulated transfer supply tanks with a minimum capacity of 1,000 gallons.

Motor patrol graders as required, each equipped with 10-foot blades and wire broom moldboards, weighing not less than ten (10) tons for use on bituminous surface treatment.

1 Spreader box which may be self-propelled or be attached to the rear of the hauling truck. The spreader box must be supported on at least four (4) pneumatic-tired wheels, and equipped with a satisfactory device for metering and distributing the aggregate evenly over the roadway surface.

1 Multiple wheel pneumatic-tired 2-axle roller, having a width of not less than five (5) feet and not more than seven and five-tenths (7.5) feet, equipped with pneumatic tires of equal size and diameter with smooth or "Highway" treads, satisfactory to Engineer. The tires on the front and rear axles shall be staggered and the angle between the center line of the wheel and tire assembly and the center line of the axle shall be ninety (90) degrees throughout the complete revolution of the wheel on the axle. The air pressure in the several tires shall not vary from each other more than five (5) pounds per square inch.

The gross weight of each roller shall be not less than eight (8) tons nor more than eleven (11) tons. The weight of the rollers shall be as ordered by the Engineer within the above limits, to obtain maximum compaction. The rollers shall be towed by a rubber tired tractor or light truck. The above described roller may be towed or self-propelled if it meets all other requirements of these specifications.

1 Smooth wheeled power roller weighing not less than eight (8) tons.

1 Two-axle power patching roller.

Trucks of uniform capacity equipped with power hoists.

1 Loading device of adequate capacity to load trucks with mineral aggregate.

Hand push brooms.

1 Water tank truck of 1,000-gallon minimum capacity with 10-foot spray bar or splash plates.

All of the mobile equipment listed above except smooth-wheeled power rollers shall be equipped with pneumatic tires. All equipment shall be maintained in good working order to ensure the progress and quality of work.

The right is reserved for the Engineer to disapprove any equipment that in his opinion will not or does not accomplish the work satisfactorily.

32–3.12 TRAFFIC AND DETOURS

Unless otherwise provided in the special provisions, the Contractor shall plan his operations on the basis that the project will be closed to all traffic during working hours except emergency vehicles such as fire and police departments and ambulance service. The project shall be opened to local traffic after working hours. The project will be opened to all traffic during the time between the first and second applications of light bituminous surface treatment and immediately after completing the last application.

Unless otherwise stated in the special provisions, the Contractor shall furnish and place all necessary detour signs. These shall be placed as directed each day at commencement of work and be removed at completion of the work each day. "Slow" signs and other necessary signs shall be furnished and placed on the project as directed. The cost of this work shall be considered as incidental to the construction and shall be included by the Contractor in the unit pay items of the contract. Further requirements shall be as outlined elsewhere in these general specifications, or in the special provisions.

32–3.13 FINISHING AND CLEANUP

Finishing and cleanup shall be performed as specified in sections 4.08 and 57.

32–4 MEASUREMENT AND PAYMENT

Payment will be made for such of the following bid items as appear on the contract bid proposal and in accordance with requirements described hereinafter:

1. "Preparation of Untreated Roadway," per square yard.
2. "Asphalt (grade)," per ton.
3. "Crushed Stone Surfacing Top Course," per cubic yard, or per ton.
4. "Crushed Cover Stone," per cubic yard, or per ton.
5. "Water," per M gallons.
6. "Removal of Excess Surfacing Material," per cubic yard.
7. "Finishing and Cleanup," per lump sum, or per station (100').

32–4.01 PREPARATION OF UNTREATED ROADWAY

Preparation of untreated roadway shall be a pay item on the bid proposal in all cases where bituminous surface treatment is a part of the contract.

The unit contract price per square yard for "Preparation of Untreated Roadway" shall be full compensation for all labor, equipment, and material necessary to perform the required blading, scarifying, processing, leveling, rolling, and all other work incidental to fulfilling the requirements of the specifications not otherwise covered by other pay items.

32–4.02 ASPHALT

The unit contract price per ton for "Asphalt (particular type required)" shall be full compensation for furnishing, heating, hauling, and spreading. The quantity of asphalt shall be upon measurement described in Section 27-1.01K.

32–4.03 CRUSHED STONE SURFACING AND CRUSHED COVER STONE

The measurement of aggregates to be furnished by the Contractor shall be by the cubic yard based on net volume at point of delivery, or by the ton in truck, whichever is shown on the bid proposal.

The unit contract price for these items shall be full compensation for furnishing the material, hauling, and placing in accordance with the specifications.

32–4.04 WATER

Water shall be paid for in accordance with the unit contract price per M gallons for "Water," which shall be full compensation for hauling, placing, and also the furnishing of water unless the special provisions provide otherwise.

32–4.05 REMOVAL OF EXCESS SURFACING MATERIAL

Where excess material is encountered on the roadway at any stage of the work and where, in the opinion of the Engineer it must be removed, it shall be paid for at the unit contract price per cubic yard for "Removal of Excess Surfacing Material," as measured in trucks at point of loading. Where excess material has been placed through carelessness or poor workmanship of the Contractor, no payment will be made for such removal.

32–4.06 FINISHING AND CLEANUP

Whenever any contract has for its major purpose the construction of bituminous surface treatment, the payment for cleanup as described in the specifications shall be by a lump sum or per station (100') in accordance with the bid item for "Finishing and Cleanup," provided, however, that if the proposal does not contain a bid item for "Finishing and Cleanup," then in that event all cleanup work specified in the contract shall be considered as incidental to the construction and all costs thereof shall be included by the Contractor in his various unit contract prices of other items.

Whenever the light bituminous surface treatment is only a minor part of a contract which includes other types of work, the cleanup required for the light bituminous surface treatment part of the contract shall be considered as incidental to the general cleanup of the entire project and the cost thereof to meet the requirements of the specifications shall be included in the various unit contract prices of other items by the Contractor.

32–4.07 INCIDENTAL WORK

Any incidental work required to complete the bituminous surface treatment as specified herein, but which is not specifically mentioned in the foregoing specifications, shall be performed by the Contractor and shall be considered as incidental to the construction, and all costs therefor shall be included in the unit contract prices of the bid items.

Section 33—Bituminous Plant Mix Pavement (Vacated)

Section 33, Bituminous Plant Mix Pavement, which was included in the 1963 APWA edition of municipal specifications, has been vacated in this 1969 APWA edition. The materials and construction procedures are now included as Class F asphalt concrete in Section 34, Asphalt Concrete Pavement.

Section 34—Asphalt Concrete Pavement

34–1 DESCRIPTION

These specifications shall apply to pavements including bases, leveling courses and wearing surfaces consisting of one or more courses of asphalt concrete. The number of courses in the cross section of the pavement shall be as shown on the plans. With the exception of Class D, all mixtures are designed as dense graded asphalt concrete.

Asphalt concrete shall be composed of asphalt and mineral aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed in the proportions hereinafter specified to provide a homogeneous and workable mixture.

The various mineral materials may be furnished in whole or partial amounts by the Owner for the manufacture of asphalt concrete, when the special provisions so provide; otherwise the Contractor shall furnish them. In the event any of these mineral materials are not provided by the Owner, it shall be understood that the Contractor will furnish mineral materials in the amounts required for the designated mix without compensation other than as covered by the bid items in the contract. Mineral materials shall include coarse and fine mineral aggregates, mineral filler and blending sand.

Asphalt concrete surfaces shall be so constructed that the finished pavement will conform to the cross section, line and grade shown on the plans and will also have acceptable riding surface and non-skid qualities.

34–2 MATERIALS

34–2.01 ASPHALT

The particular asphalt to be used on any project shall be that called for in the special provisions, on the plans, or in the standard specifications. Asphalt of the grade or grades specified shall comply with all the requirements of Section 27, Asphalt Materials.

34–2.02 MINERAL AGGREGATE

–2.02A General Requirements

The material from which mineral aggregate for asphalt concrete is manufactured shall meet the following test requirements:

Los Angeles Wear (ASTM Designation C 131) 500 Rev. 30% Max.

Mineral aggregate for asphalt concrete shall be manufactured from ledge rock, talus, or gravel in accordance with the provisions of Section 22. It shall be uniform in quality, substantially free from wood, roots, bark, or other extraneous materials, and free from adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be considered as coating unless it exists on more than fifty (50) percent of the surface area of any size between consecutive laboratory sieves.

Mineral aggregate removed from deposits contaminated with various types of wood waste shall be washed, processed, selected or otherwise treated to remove as much of the wood waste as possible from the finished product. The Engineer may require the material to be washed if, in his judgment, an undue amount of wood contamination will otherwise be present in the finished product.

Mineral aggregate retained on a ¼-inch square sieve

will be considered free from wood waste if the oven-dried aggregate does not contain more than 0.1% by weight of material with a specific gravity less than 1.0.

That portion of the mineral aggregate passing the U.S. No. 10 sieve, when tested for organic matter, shall not have wood waste that results in a darker color than that specified in Section 37-2.02B1 except that the color shall be measured after the sample has been in the test solution for one hour.

–2.02B Test Requirements

Mineral aggregate for asphalt concrete shall meet the following test requirements:

CLASS OF ASPHALT CONCRETE	B	G	D	E	F
% Fracture, size above U.S. No. 10..	75	75	75	50	50
% Minimum sand equivalent.....	45	45	45	45	35

The properties of the mineral aggregate for asphalt concrete shall be such that when it is combined within the limits set forth under Section 34-2.03 and mixed in the laboratory with the designated grade of asphalt, the mixtures can be produced with the minimum value shown below.

CLASS OF ASPHALT CONCRETE	B	G	D	E	F
Minimum Stabilometer	30	30	..	25	25
Minimum Cohesiometer	100	100	..	100	50
% Air voids.....	3–5	3–5	..	3–5	3–5
Modified Immersion, Compression, retained strength % min.....	70	70	70	70	70

Stockpiling

Preparation of stockpile site, the stockpiling of mineral aggregates and the removal of the materials from stockpiles shall conform to the requirements of the specifications for stockpiling surfacing materials in Section 23-3.01. The method of producing and stockpiling mineral aggregates selected by the Contractor shall be approved by the Engineer. Approval will be contingent upon proof submitted by the Contractor that a completed mix can be produced satisfactorily.

In taking mineral aggregates from stockpiles, the Contractor shall use only the amount of material required by these specifications and shall load it in a manner to avoid separation of sizes or the admixture of any dirt or foreign material. The Contractor shall clean up the remainder of the stockpile and leave it in a uniform and compact pile with a minimum waste.

–2.02C Grading of Mineral Aggregates

Mineral aggregate for classes B, E and F asphalt concrete shall be produced or furnished in the following sizes as they apply to the class of asphalt concrete to be produced: 1¼" to ¼", ⅝" to ¼", and ¼" to 0. Each size shall be stockpiled separately regardless of whether it is being produced for future work on other contracts or for immediate use, with the exception that, if the Contractor proportions the asphalt concrete in a batch type plant with approved automatic controls or with a continuous mix plant, he may then use one or more stockpiles provided that the stockpiled aggregate with blending sand, if necessary, shall meet the grading requirements determined by the Engineer to be within the specifications for the class of asphalt concrete to be produced. Mineral aggregate for classes G and D shall be produced or furnished in one size designation, as specified hereinafter.

The gradation of all stockpiles shall be such that when recombined with an approved blending sand—if that becomes necessary—an aggregate is produced which will result in a completed mix in compliance with all requirements.

When the grading is determined before the aggregate is introduced into the pug mill, the amount of material passing the U.S. No. 200 sieve shall be determined by "wet sieving".

Stockpiling for Future Use

The various sizes of mineral aggregate to be stockpiled for future use on other contracts shall be graded as follows:

COARSE AGGREGATE

CLASS OF ASPHALT CONCRETE	B	E	F
% Passing Sieve.....	⅝" to ¼"	1¼" to ¼"	⅝" to ¼"
1¼"	.....	100	.....
1"	.....	85–100	.....
¾"	.....	.....	.....
⅝"	100	45–70	100
½"	75–100	.....	40–100
¼"	0–15	0–15	0–30

All percentages by weight.

FINE AGGREGATE

CLASS OF ASHALT CONCRETE	B	G	D	E	F
Size Designation					
% Passing Sieve	¼" to 0	⅜" to 0	⅜" to 0	¼" to 0	¼" to 0
½"	100	100	100	100	100
⅜"	.....	.....	90–100	.....	.....
¼"	75–100	62–82	54–72	75–100	70–100
U.S. No. 10..	50–75	32–48	12–28	50–75	45–80
U.S. No. 40..	.....	.....	0–10	.....	.....
U.S. No. 200.	3–12	3–7	0–3	3–12	3–12

All percentages by weight.

The total aggregate shall consist of the following approximate ratios of coarse and fine aggregates for each of the various classes of asphalt concrete:

CLASS OF ASHALT CONCRETE	B	G	D	E	F
% Coarse aggregate	35	....	....	50	35
% Fine aggregate	65	100	100	50	65

All percentages by weight.

Stockpiles for Immediate Use

If the materials are stockpiled by the Contractor for use in the immediate work, samples of the material being produced, and of the available blending sand, shall be submitted to the Engineer as soon as crushing starts in order to determine whether the material produced, when combined with the blending sand, will meet the grading and fracture requirements for the completed mix.

The sizes of coarse aggregate for classes B and E shall meet the following requirements for grading:

COARSE AGGREGATE

CLASS OF ASPHALT CONCRETE	B	E
Size Designation	⅝" to ¼"	1¼" to ¼"
% Passing 1¼" sieve.....	.....	100
% Passing 1" sieve.....	.....	85–100
% Passing ⅝" sieve.....	100	45–70
% Passing ½" sieve.....	75–100	.....
% Passing ¼" sieve.....	0–25	0–25

All percentages by weight.

If a suitable source of blending sand is available and has been approved by the Engineer or laboratory as a source of supplemental fines, the fine aggregate may be graded as follows:

FINE AGGREGATE

CLASS OF ASPHALT CONCRETE	B	G	D	E
Size Designation	¼" to 0	¼" to 0	⅜" to 0	¼" to 0
% Passing ½" sieve...	100	100	100	100
% Passing ¼" sieve...	70–100	62–82	50–72	70–100
% Passing No. 10 sieve	35–75	32–48	10–28	35–75
% Passing No. 200 sieve	2–12	3–7	0–3	2–12

All percentages by weight.

In those classes of asphalt concrete where separation into two sizes is required, the Contractor shall so control the separation and stockpiling of coarse and fine mineral aggregate that the quantity of material passing the ¼-inch sieve in the coarse aggregate shall not vary more than 10% throughout the entire stockpile.

The material in each separate stockpile, including mineral aggregate ¼"-0 (but not including blending sand), shall meet the test requirements in Section 34-2.02B.

The stockpiled materials shall meet the grading requirements for stockpiles for immediate use and in addition thereto, the grading of the stockpiled materials shall be such that when they are recombined in appropriate ratios, together with blending sand if necessary, the completed mixture will meet all pertinent requirements of Section 34-2.03. It shall be the responsibility of the Contractor to furnish such blending sand as may be required to bring the completed mix within the above prescribed gradation limits.

Mineral aggregate for asphalt concrete Class F need not be separated into two sizes provided that the stockpiled aggregate, when supplemented by an approved blending sand if required, will produce a completed mixture complying with all pertinent requirements of Section 34-2.03. If blending sand is required to bring the completed mix within the prescribed gradation limits, it shall be the responsibility of the Contractor to furnish it in the quantity required. If blending sand is required for the production of asphalt concrete Class F, it shall be fed onto the cold stone belt or elevator by a separate mechanical feeder.

–2.02D Mineral Filler

Mineral filler shall be portland cement or commercially ground stone dust, and shall be approved by the Engineer. It shall be free of lumps and extraneous material and shall meet the following requirements:

Passing U. S. No. 10 sieve.....	100%
Passing U. S. No. 200 sieve, not less than.....	75%
Particles smaller than .025 mm., not less than..	50%
Particles smaller than .005 mm., not more than	35%
Plasticity index, ASTM Designation D 424, not more than	2
Specific gravity, not less than.....	2.50

The determination of percentage of particles smaller than .025 mm. and .005 mm. shall be by means of the hydrometer method, ASTM Designation D 422.

–2.02E Blending Sand

In the production of mineral aggregates for asphalt concrete there is often a deficiency of material passing the U. S. No. 40 sieve. When this occurs, blending sand in an amount specified by the Engineer may be used to make up the deficiency, *Provided however,* that the aggregate in the final mix meets pertinent fracture requirements.

Blending sand shall be clean, hard and sound material, either naturally occurring sand or crushed fines which will readily accept asphalt coating. The exact grading requirements shall be such that, when it is mixed with the mineral aggregate, the combined product shall meet the requirements of Section 34-2.03 for the class of material involved. When used, blending sand shall be added to the aggregate by means of a fully controlled adjustable feeder which can be synchronized with the aggregate feeder(s).

Blending sand must be tested by the Engineer (laboratory) before it will be approved for use, and must have a minimum Sand Equivalent Value of 30.

If the project includes a bid item for blending sand and the Contractor shall elect to provide mineral aggregates from sources other than provided by the Owner, he will be compensated for the actual quantity of blending sand used, but not to exceed the quantity set forth in the contract.

34–2.03 PROPORTIONS OF MATERIALS

The materials of which asphalt concrete is composed shall be of such sizes and grading that, when proportioned and mixed together, they will produce a uniformly graded mixture which will conform to the requirements given in the table which follows.

The percentages of aggregate include mineral filler, when used, and refer to the complete dry mix. The percentages of asphalt refer to the complete asphalt concrete mixture. All percentages are by weight.

GRADING AND ASPHALT REQUIREMENTS

Percentages by Weight Passing Sieves					
ASPHALT CONCRETE CLASS	B	G	D	E	F
Pavement Type	ACP	ACP	ACP	ACB	ACP
Normal Use	Wearing	Pre/ leveling Wearing	Open Seal Wearing	Base/ leveling	Pre/ leveling Wearing
Nominal Compacted Depth Limits for Each Course	0.10–.25'	.04'–0.10'	.04'–.08'	.15'–.45'	0.10'–.25'

COMPOSITION AND GRADING OF ASPHALT MIXTURES

Sieve Size	% by Weight Passing Square Opening Sieves				
1¼"	.....	.....	.....	100	.....
1"	.....	.....	.....	90–100	.....
¾"	.....	.....	.....	.....	100
⅝"	100	.....	.....	67–86	.....
½"	90–100	100	100	60–80	80–100
⅜"	75–90	97–100	90–100	.....	.....
¼"	55–75	62–82	54–72	40–62	45–75
US # 10	32–48	32–48	12–28	25–40	30–50
US # 40	11–24	11–24	0–10	10–23	.....
US # 80	6–15	6–15	.....	8–14	.....
US #200	2–7	2–7	0–3	2–9	2–8
% Mineral Filler.....	0–2	0–2	.....	.....	.....
Asphalt % of Total Mixture	4–7.5	4–7.5	4–6	3.5–7	4–7

The percentage of aggregate include mineral filler, when used, and refer to complete dry mix. Percentages of asphalt refer to the complete asphalt concrete mixture. All percentages are by weight.

–2.03A Mix Design

The actual proportions of the several constituents to be used in the production of the asphalt mixture shall be determined by the Engineer within the foregoing table limits, so as to provide a pavement having air voids, stabilometer, cohesiometer values and surface texture satisfactory to the Engineer. The fixed proportions shall be changed only by order of the Engineer.

–2.03B Aggregates in Mixture

Aggregate gradings within the ranges in the table shall be such that there will be a minimum of 3% of the total aggregate retained between any successive pair of sieves finer than the U. S. #10 for classes B and G, and 2% for Class E.

For asphalt concrete Class B and Class F the Engineer may at his discretion approve an aggregate grading with up to 9.5% maximum passing the U. S. #200 sieve, but with the further provisions that the gradation of the materials retained on all sieves larger than U. S. #200 are within the above prescribed ranges.

The gradings shall be of such uniformity that the fractions of aggregate passing the ¼" and #10 sieves during the run of any day will conform to the following limitations:

Maximum variation in percentage of material passing ¼" sieve	10
Maximum variation in percentage of material passing U.S. No. 10 sieve	8

–2.03C Asphalt in Mixture

The grade of paving asphalt shall be 85-100 penetration unless otherwise required in the special provisions, or ordered by the Engineer.

When mineral aggregates or a source for the production of mineral aggregates is provided by the Owner, the approximate percentage of asphalt required in the mixture for the particular class of pavement will be set forth in the special provisions under the heading "Asphalt Concrete Pavement Asphalt Content". The percentage set under this heading shall be considered as informational and tentative only and the actual quantity of asphalt used shall be such a percentage as will meet the requirements for the mixture as set forth in these specifications.

No additional compensation will be allowed in event the percentage of asphalt required in the mixture is greater than that indicated under the special provisions heading of "Asphalt Concrete Pavement Asphalt Content".

If the total amount of asphalt used on the entire project, exclusive of waste, is greater than the amount computed from the maximum percentage in the foregoing table, the Owner will reimburse the Contractor for the cost of the extra asphalt, based on invoices by the supplier.

34–3 CONSTRUCTION DETAILS

34–3.01 PREPARATION OF ROADWAY

–3.01A Preparation of Asphalt, Concrete or Brick Surfaces

Before construction of an asphalt concrete pavement on an existing surface, all fatty asphalt patches, grease drippings, and other objectionable matter shall be entirely removed from the existing pavement. All excess asphalt joint filler shall be completely removed and all premolded joint filler shall be removed to at least one-half inch (½") below the surface of the existing pavement. All types of existing pavement or bituminous surfaces shall be thoroughly cleaned by sweeping to remove dust and other foreign matter.

A tack coat of asphalt applied at the rate of .02 to .05 gallon per square yard of retained asphalt shall be applied uniformly to all surfaces on which any course of asphalt concrete is to be placed, unless its omission is specifically directed by the Resident Engineer in charge of construction.

The tack coat shall be a heated cutback asphalt, or emulsified asphalt, mixing grade, as directed by the Engineer. The emulsified asphalt may be mixed with water at the rate of 1 to 2 parts water to 1 part of emulsified asphalt, as directed by the Engineer. Asphalt used for tack coat shall conform with the requirements of Section 27.

When asphalt concrete pavement is to be constructed over an existing paved or oiled surface, in addition to the preparation as outlined hereinbefore, all holes and small depressions shall be filled with an appropriate class of asphalt concrete mix by hand shoveling. The surface of the patched area shall be leveled and compacted thoroughly, as directed by the Engineer.

–3.01B Preparation of Untreated Roadway

The existing roadway shall be prepared and the roadway primed as provided under "Bituminous Surface Treatment Class A" in Section 32, except that only one application of asphalt and one application of cover stone will be required. All other provisions of Section 32 pertaining to bituminous surface treatment Class A shall apply, except as hereinafter modified.

The prime coat shall be applied over the full length of the project, and asphalt concrete pavement shall not be placed until the prime coat has cured for the full 5 days, as specified, unless otherwise directed by the Engineer.

Should any holes, breaks, or irregularities develop in the roadway surface after the prime coat has been applied, they shall be patched with asphalt concrete, as described in Section 34-3.01A immediately in advance of placing the asphalt concrete. The Contractor shall maintain the completed prime coat by blading or brooming with motor patrol graders, as directed by the Engineer, until the asphalt concrete is placed.

After the maintenance, patching or repair work has been completed and immediately prior to placing the asphalt concrete pavement, the surface of the prime coat shall be swept clean of all dirt, dust, or other foreign matter.

When the prime coat application is not specified in the special provisions or shown on the plans, the Contractor shall prepare the untreated roadway as described above and shall omit the prime coat treatment. The asphalt concrete pavement shall be constructed on the prepared subgrade.

–3.01C Removing Existing Pavement

Where shown on the plans or where designated by the Engineer, the existing pavement of the type shown on the plans shall be broken up, loaded, hauled, and disposed of in accordance with requirements outlined in Section 52, "Removal of Existing Street Improvements."

34–3.02 CONNECTIONS WITH EXISTING FACILITIES

Where the bituminous pavement is to be connected with an existing roadway surface, bridge, railway crossing or other facility, the Contractor will be required, under direction of the Engineer, to modify the existing roadway profile in such a manner as to produce a smooth riding connection to the existing facility.

Where it is necessary to remove existing asphalt surfaces or oil mat surfaces to provide proper meet lines and riding surfaces, the Contractor shall burn or chip the existing surface so that there will be sufficient depth to provide a minimum of one (1) inch of asphalt concrete, and the waste material shall be disposed of to the satisfaction of the Engineer. Prior to placing the asphalt concrete, these areas shall be tacked in accordance with requirements previously described in Section 34-3.01A. Meet lines shall be straight and the edges be vertical. The edges of meet line cuts shall be painted with diluted cutback asphalt or SS-1 emulsion prior to placing asphalt concrete. After placing the asphalt concrete, the meet line shall be sealed by painting with a cutback asphalt or SS-1 emulsion and immediately covered with clean dry sand. Chipping or burning will be paid for at the unit contract price per square yard for "Chipping Existing Asphalt Surface."

Where it is required to remove sections of existing pavements such as portland cement concrete, cobblestone, brick and other rigid type, the removal shall be performed and paid for as described in Section 52, "Removal of Existing Street Improvements."

34–3.03 PREPARATION AND HEATING AGGREGATES

For control of the cold aggregates before they are fed onto the cold stone belt or elevator, each size designation or grading separation of the cold aggregates, as well as blending sand, shall be fed onto the cold stone belt or elevator by separate mechanical feeders of the plate, vibratory, or continuous belt types. A mechanical feeder may have one or more vertical divider plates for feeding two (2) or more size designations through a single feeder if the feeder is equipped with individual gates that can be operated separately for each aggregate size. The feeder for blending sand, when required, shall require particular attention, to ensure a consistent, uniform flow in the amount ordered by the Engineer.

Partition walls or other means shall be provided for keeping the various grades of cold aggregate from becoming mixed in the stockpile.

The aggregates, exclusive of mineral filler, shall be heated to a temperature directed by the Engineer, but within the limits of the following table, and immediately thereafter separated into 3 sizes or grades for classes A, B and E, and 2 sizes or grades for classes C, D and F asphalt concrete.

Grade of Asphalt to Be Used	*Pugmill Mixing Temperature of aggregates*	
PAVING ASPHALTS	*Min. °F.*	*Max. °F.*
40- 50 Penetration	300	375
60- 70 Penetration	275	350
85-100 Penetration	275	350
120-150 Penetration	225	275
200-300 Penetration	225	300
EMULSIFIED ASPHALTS		
SS-1	50	130
SS-1h	50	130
SM-K	60	140
*SS-K	50	130
SS-Kh	50	130
LIQUID ASPHALTS		
**SC, MC, 70 Viscosity	90	135
**SC, MC, 250 Viscosity	135	175
**SC, MC, 800 Viscosity ...	165	210
**SC, MC, 3000 Viscosity	200	240

*Intended for damp, cold aggregate. Heating required only to reduce moisture content and for screening.

**Rapid cure liquid asphalts are not shown because of volatility of cutback and hazard involved in use.

At least one of the above sizes or grades for each class of asphalt concrete shall be aggregate containing material passing the U. S. No. 10 sieve. The other separation of the aggregate shall be between such limits as may be necessary to produce the mixture specified under the direction of the Engineer.

The screening mechanism of the plant shall be of the vibratory or shaker type. The screens and storage bins shall be protected from the weather by adequate enclosures and shall be of sufficient capacity to furnish the necessary amounts of all aggregates when operating at the maximum rated capacity of the plant with no undue waiting for material. Each screen shall be of adequate size so that the aggregates of each bin will be separated within the limit set forth in the specifications.

The heating and drying of the aggregate shall be done in a suitably designed rotary drier. The drier shall be capable of preparing aggregates to specification requirements at a rate equal to the maximum rated capacity of the plant.

The plant shall be equipped with an adequate exhaust system including an exhaust fan and dust collector. The exhaust system shall be so constructed as to furnish adequate draft through the drier and screen and bin enclosures to eliminate leakage of dust and smoke. The dust collector shall be capable of collecting fine material passing through the exhaust system and shall be equipped with facilities for wasting and/or returning to the plant the material collected.

When the asphalt plant is erected at a site for the primary purpose of producing mixtures for a specific project, dust and smoke from the asphalt plant shall be eliminated to the extent that they will cause no inconvenience to property owners in the area or damage to their property. The Contractor will be required to install a satisfactory precipitation device or use such other methods as may be necessary to control the dust and smoke to the satisfaction of the Engineer.

On projects involving production of asphalt concrete, the asphalt plant shall have a minimum capacity rating by the manufacturer as shown in the following table.

For projects involving 3,000 tons or more:
Batch type plants—2,000 lbs. per bath.
Continuous mix type plants—90 tons per hour.

For projects involving less than 3,000 tons:
Batch type plants—1,000 lbs. per batch.
Continuous mix type plants—45 tons per hour.

The plant shall be equipped with an approved dial scale mercury actuated thermometer, an electric pyrometer or other approved thermometric instrument so placed at the discharge chute of the drier as to register the temperature of the heated aggregates automatically. This device shall be in full view of the drum fireman or the head feeder.

The right is reserved for the Engineer to pass upon the efficiency of the above instruments, and for better regulation of temperature of the aggregates he may direct the replacement of the instrument by some approved temperature recording apparatus and may further require daily charts of the regulator to be filed with the Engineer.

Each size or grade of the heated aggregate shall be deposited in a separate bin. Each bin shall be provided with an overflow pipe of sufficient net opening so placed as to prevent the overflow from one bin into another.

Should the material in any one bin contain ten (10) percent or more of material which is undersize or oversize, the bin shall be drawn and the material rescreened.

Segregation of fine aggregate passing the U. S. No. 10 sieve shall be prevented by collecting and conveying it to the center of the bin. The bin for this material shall be equipped with two aprons fastened to opposite sides of the bin, at the upper edges. The aprons shall be at right angles to the center line of the screen and shall slope downward toward the center line of the bin at an angle of approximately forty-five degrees (45°). An opening on the center line of the bin of from four (4) to six (6) inches shall be left between the lower edges of the aprons.

34–3.04 HEATING ASPHALT

The asphalt shall be heated in insulated tanks so designed that the heating will be uniform throughout the entire mass and be positively controlled at all times. The asphalt circulating system shall be of adequate size to give proper and continuous circulation of asphalt throughout the operating periods. An armored thermometer reading from 200° F. to 400° F. shall be fixed in the asphalt line at a suitable location near the weigh bucket discharge valve.

The asphalt shall be heated to between 250 and 350 degrees Fahrenheit, the temperature within this range to be determined by the Engineer. The asphalt storage tanks and delivery lines shall be equipped so that the temperature of the asphalt shall not vary more than 25 degrees Fahrenheit plus or minus from the temperature ordered by the Engineer.

The discharge end of the asphalt circulation system shall be maintained below the surface of the asphalt in the storage tank to prevent discharging hot asphalt into open air.

Asphalt storage tanks shall be calibrated accurately to 100 gallon intervals and maintained to this accuracy. The Contractor shall provide a calibrated measuring rod and access for measuring the volume of the asphalt in the storage tank at any time.

34–3.05 PROPORTIONING

The aggregate shall be proportioned in a weigh box mounted on approved multiple beam or springless dial charging scales, the different sizes of aggregate being weighed into the weigh box one at a time in the proportions directed by the Engineer.

If no provision is made to weigh the mineral filler in the weigh box with the other aggregates, the proportions of mineral filler and/or collector dust shall be determined on a weight basis and shall be measured separately from the other aggregates. After the exact proportions of mineral filler and collector dust have been determined for one batch, the material or materials may be added to the mixer by volume measurement. After measuring, it may be added to the aggregates either in the weigh box or in the mixer. If added in the mixer, it shall be added at the center of the mixer at the time mixing is started.

The Engineer may order the mineral filler to be added to the aggregates in the weigh box if there is any indication of improper or incomplete mixing of the filler when added directly to the mixer.

The asphalt shall be weighed on separate dial or beam scales limited in capacity to two times the weight of asphalt required for one mixer batch. The graduations on the scales shall be not more than one (1) pound. If a beam scale is used it shall be equipped with a "Tell Tale" dial with graduations of not more than one (1) pound.

The asphalt may also be proportioned by a device which sprays the asphalt into the mixer through six or more nozzles, and which weighs or proportions the material for each batch by a positive rotating meter which is calibrated in pounds. The metering device shall have an established background of service and shall be approved by the Engineer.

The number of pounds of each size or grade of aggregates, pounds of mineral filler, and pounds of asphalt to be used in each mixer batch shall be as the Engineer directs. The quantities directed by the Engineer shall be such, however, that the proportions of the different materials will be within the limits hereinbefore specified.

The scales used for weighing aggregate, filler, and asphalt shall conform to the requirements of Section 21, Weighing Equipment. The use of springs to carry part or all of the load in the weighing mechanism for the measuring of aggregate, filler and asphalt will not be permitted. The main weigh box shall be equipped with a discharge gate so arranged that, as the aggregates are discharged into the mixer, the different sizes of aggregates will be blended together uniformly.

Volumetric proportioning may be used instead of weight proportioning as described above.

The use of continuous mix plants will be allowed subject to the following requirements: The device for proportioning volumetrically the mineral aggregate shall be equipped with accurately controlled and calibrated gates or other satisfactory devices for each bin of the various sizes of aggregates and be so designed that the flow of aggregate from each bin can be accurately determined and controlled. Means shall be provided so that by actuation of a single lever the flow of aggregate from each feeder may be diverted simultaneously into separate compartments or containers placed beneath the feeder in order that each size of aggregate can be sampled at intervals determined by the Engineer. The Contractor shall furnish suitable containers of a minimum 200 lb. capacity and shall also furnish a platform scale of a minimum 300 lb. capacity. The drive shaft of the aggregate feeder shall be equipped with a revolution counter reading to 1/100th of a revolution and of sufficient capacity to register the total number of revolutions in a day's run.

A positive signal system shall be provided to indicate the level of aggregates in each bin, and a device shall be provided to close down the plant automatically at any time that the level of material in any one bin falls to the strikeoff capacity of the feed gate.

The volumetric proportioning device for the asphalt shall be a positive displacement type of pump and a satisfactory spray nozzle arrangement at the mixer. Means shall be provided to maintain pressures constant on each side of the pump. Means shall be provided for diverting the flow of asphalt from the pump into a suitable container of a minimum 100 lb. capacity in order that the accuracy of the asphalt delivery from the pump may be checked at intervals to be determined by the Engineer.

The driven speed of the pump shall be synchronized with the driven speed of the aggregate feeders by positive interlocking mechanical means and the driven speed of the asphalt pump shall be adjustable to control accurately the quantity of the asphalt delivered to the mixer as ordered by the Engineer.

–3.05A Automatic Controls—Batch Type Plants

When required by the Special Provisions and when asphalt concrete Class A and asphalt concrete Class B are mixed in a batch type mixer, the following provisions shall apply. Automatic control of batch mixing operations may be used even though not required by the Special Provisions providing the requirements of this subsection are complied with.

It is the intention of these provisions that the proportioning and timing devices shall be automatic to the extent that the only manual operation required for the proportioning and mixing of materials for one batch shall be a single operation of a switch or starter.

The mixing plant shall be equipped with automatic weight proportioning devices to monitor and control the weights of the several components of mineral aggregates and of the asphalt plus timing lock devices to monitor and control the position of the aggregate weigh hopper dump gate, the asphalt bucket discharge valve and the mixer discharge gate.

The means of withdrawal from the aggregate bins and the discharge of the weigh hopper shall be so interlocked that the weigh hopper cannot discharge until the required quantity of aggregate from each bin has been deposited therein. The weigh hopper may be of the single compartment individual weight control type or of the divided compartment, preset volume type. When the single compartment weight control type is used the automatic scale weight system shall discharge and weigh material from one bin at a time and provision shall be made to allow the order of discharge to be changed at the Engineer's discretion. When the preset volume weigh hopper is used the automatic control system shall check the total weight of each aggregate batch and provision shall be made to allow the Engineer to check easily and quickly the individual aggregate weights at any time.

The timing lock devices shall be actuated by the opening of the aggregate weigh hopper dump gate. They shall lock the asphalt bucket discharge valve until preset dry mixing time is expired and shall lock the mixer discharge gate throughout the preset dry and wet mixing periods. The dry mixing period is the interval of time between the opening of the aggregate weigh hopper dump gate and the opening of the asphalt bucket discharge valve. The wet mixing period is the interval of time between the opening of the asphalt bucket discharge valve and the opening of the mixer discharge gate. The control of the timing shall be flexible and capable of being set at intervals of not more than 5 seconds throughout cycles up to 60 seconds. The minimum dry mixing period shall be 5 seconds and the minimum wet mixing period shall be 25 seconds. The Engineer shall have the right to increase either or both the dry and wet mixing period up to a total mixing cycle of 60 seconds, as necessary to produce a homogeneous mixture of unvarying appearance.

The dials of the timing locks and automatic weighing controls shall be so arranged that the time interval and weight proportion controls may be set and locked by the Engineer.

If at any time a breakdown of the automatic proportioning and timing controls should occur, the Contractor may continue operation of the plant using manually operated controls for a maximum period of 3 working days, to allow time for repair of the automatic control system.

34–3.06 MIXING

The mixing of the asphalt concrete shall be done in a mixer of the pugmill type. The mixer shall be in first-class condition, and the number, type, arrangement and speed of rotation of the paddles shall be such as will quickly produce thoroughly and uniformly mixed asphalt concrete.

The properly proportioned hot aggregate and mineral filler shall be placed in the mixer first. The hot asphalt shall then be added and the mixing commenced. The mixing period, after the hot aggregate is placed in the mixer, shall be at least thirty (30) seconds and as much longer as may be necessary to produce a homogeneous mixture of unvarying appearance.

For batch type mixers the quantity of aggregate in each batch shall not exceed the manufacturer's rated capacity of the mixer. Each batch type mixer shall be equipped with a device for counting automatically the number of mix batches discharged during the day's operation.

For continuous mix plants the rate of feed of aggregates to the mixer shall not exceed the manufacturer's rated capacity of the mixer. Each continuous type mixer shall be equipped with a discharge hopper having a minimum capacity of 1,000 lbs. of mixture. The hopper shall be equipped with dump gates which will permit rapid and complete discharge of the mixture without segregation. If the mixture shows segregation during discharge from the pugmill into the hopper or into the truck, the mixing operation shall be discontinued and the Contractor shall make whatever change is necessary to prevent segregation.

Upon each mixer shall be affixed a manufacturer's name plate upon which shall be stamped the manufacturer's rated capacity of the mixer.

34–3.07 HAULING

The asphalt concrete mixture shall leave the mixing plant at a temperature between 260° F. and 350° F., and when deposited on the road it shall have a temperature not less than 250° F. The exact temperature range within the above limits shall be as directed by the Engineer.

When the asphalt concrete mixture has been mixed as specified, it shall be transported in suitable dump trucks of sufficient size and design to easily accommodate the load. When required by the Engineer, each load shall be covered with a suitable tarpaulin while in transit to prevent unnecessary loss of heat. The sides and bottoms of the trucks shall be lubricated with a mixture of water and light oil or diesel oil before receiving a load of mixture. Excess water and oil shall not be left in the bottom of the trucks.

Hauling trucks which contact the paving machine during the dumping or spreading process at any point other than the pushing rollers on the paving machine will not be allowed.

The speed and weight of hauling trucks shall be regulated so that, in the opinion of the Engineer, no damage will occur to any portion of the work under way. Any damage to the prime coat or the bituminous mat caused by Contractor equipment shall be repaired by the Contractor at his own expense.

34–3.08 SPREADING AND FINISHING

Unless otherwise provided in the special provisions, each course of the pavement shall be spread with a mechanical, self-propelled spreading and finishing machine equipped with a hopper or mixture compartment to receive the mixture from the hauling trucks, and a screed or cutoff device that oscillates in a horizontal motion or vibrates vertically when striking off the course or lift under construction.

The spreading machine shall be of a type and design approved by the Engineer. It shall have a runner length or wheel base of at least six feet (6'). It shall be operated in such a manner as to distribute the mixture to proper cross section, width, and thickness without segregation of aggregates. The spreading machine shall leave the mixture uniformly dense throughout, smooth, and free from inequalities and irregularities.

Any failure of the machine to produce a smooth and uniform spread of the mixture shall be corrected immediately to the satisfaction of the Engineer.

Small segregated or nonuniform surface areas which occur shall be immediately corrected by hand methods whereby the finer portions of the mix are raked into the segregated areas and the larger particles raked off and wasted.

The spreading machine shall be capable of placing a uniform layer of asphalt mix to the depth shown on the plans or ordered by the Engineer. The forward motion of the spreading machine shall be regulated, as directed by the Engineer, so that no irregularities in the pavement surface are caused by excessive forward speed of the machine. The forward speed shall be adjusted to that speed which obtains the best results for the particular spreading machine being used. The rate of placement of the mixture shall be uniform, and shall be coordinated with the rate of production from the mixing plant, without excessively intermittent operation of the spreading machine.

Areas which are inaccessible to the spreading machine may be paved by other methods, as directed by the Engineer. When ordered by the Engineer, motor patrol graders or approved types of truck-attached spreaders shall be used to pave inaccessible or irregularly shaped areas. Hand raking shall be kept to a minimum.

Workmen shall not be allowed to walk or stand on the finished mixture before it has been rolled. Provisions must be made for breaking up any partially compressed masses of mixture after they are discharged from the truck.

34–3.09 COMPACTING

The Contractor will be required to place two (2) smooth-wheeled power rollers and one (1) self-propelled pneumatic-tired roller on each project to roll and compact the pavement mixture. The smooth-wheeled rollers shall weigh not less than eight (8) tons, exclusive of water ballast in the wheel drums, and may be either of the three-wheeled or tandem type, excepting that at least one (1) smooth-wheeled roller of the tandem type shall be placed on each project. The compression wheels on all three-wheeled rollers shall each be not less than twenty (20) inches wide, and all rollers shall be so constructed that they will be capable of rolling a true plane.

Self-propelled pneumatic tired rollers shall have a minimum gross weight of 8 tons and a minimum width of 5 feet. Wobble-wheel rollers will not be permitted. The tires shall be of equal size diameter and ply rating with smooth compactor treads. The inflation pressures of the several tires shall not vary more than 5 pounds per square inch from the designated pressure. The tires shall be so spaced that the entire gap between adjacent tires will be covered by the following tire at all operating tire pressures.

The relationship between tire sizes, tire characteristics, ply rating, tire inflation pressures and operating weights per tire shall be such that the roller is capable of developing tire contact pressures on the pavement through the entire range of 40 and 80 pounds per square inch. The exact contact pressure to be used within that range shall be as ordered by the Engineer.

Additional rollers shall be furnished and operated by the Contractor if, in the opinion of the Engineer, they are necessary to compact the pavement mixture satisfactorily. When asphalt concrete pavement Class D is being constructed, the use of pneumatic-tired rollers will not be permitted. The Contractor will be required to furnish 3 or more smooth-wheeled rollers, one of which shall be a tandem roller of not less than 8 tons weight exclusive of water ballast in the wheel drums. Other rollers shall weigh in excess of 3 tons not including ballasting.

All rollers shall be in good condition, and the reversing mechanism so maintained that the roller is capable of changing directions smoothly. The roller shall be kept in continuous motion while on the hot mat in such a manner that all parts of the pavement receive equal compression. Rollers shall be operated by competent and experienced personnel.

All rolling shall proceed as directed by the Engineer, but in general shall be longitudinal, starting near the edge of the pavement and proceeding toward the center of the roadway, overlapping on successive trips by not less than one-half (½) and not more than three-fourths (¾) the width of the rear wheel of the three-wheeled roller. Alternate trips of the roller shall be of slightly different lengths. Rolling shall continue, as directed by the Engineer, until all roller marks are eliminated. The initial rolling shall take place as closely behind the laying machine as the temperature and condition of the mat will allow.

The motion of the roller shall be slow enough at all times to avoid displacement of the hot mixture. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected immediately by the use of rakes and fresh mixture when required. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excess water will not be permitted.

Immediately after spreading, each course of the pavement mixture shall be compacted by rolling. The initial, or "breakdown" rolling shall be accomplished with either type of smooth-wheeled roller. The pneumatic-tired roller shall be used to knead and compact the pavement mixture following the initial rolling and preceding the final rolling. Care shall be exercised in the use of the pneumatic-tired roller to ensure that the pavement mixture is sufficiently cooled to avoid "picking up" of the mixture on the tires of the roller, and also to ensure that the pneumatic-tired rolling is completed before the mixture becomes too cool to allow satisfactory finish rolling. Final, or finish rolling, shall be done with a tandem-type, smooth-wheeled roller.

The surface of the mixture after compaction shall be smooth and true to established section and grade. Any mixture which shows an excess or deficiency of asphalt, or uneven distribution of asphalt due to insufficient mixing, or which becomes loose, broken, raveled, mixed with dirt, or is in any way defective, shall be removed and replaced with fresh hot mixture at the Contractor's expense, and be immediately compacted to conform with the surrounding area. Areas of one square foot or more showing an excess or deficiency of asphalt shall be removed and replaced.

Areas inaccessible to the roller shall be compacted by tamping with mechanical or hand tampers.

34–3.10 PRELEVELING FOR ASPHALT CONCRETE

Preleveling of uneven or broken surfaces over which asphalt concrete is to be placed may be required by the Engineer, and if required may be accomplished by the use of an asphalt concrete (of class included in the project) placed with a motor patrol grader, a paving

machine, by hand raking, or by a combination of these methods as directed by the Engineer.

After placement, the asphalt concrete used for preleveling shall be compacted thoroughly with pneumatic-tired rollers.

The unit contract price per ton for "Asphalt Concrete Pavement, Class ....." shall be full compensation for all costs and expense involved in furnishing all labor, material, tools and equipment necessary in preleveling the surface as herein specified.

34–3.11 CONSTRUCTION OF COURSES

The asphalt concrete pavement shall be constructed in one or more courses as shown on the plans or required in the special provisions.

Where more than one course is specified, the first course shall include widening of the existing pavement (if specified) and leveling up of all irregularities in the surface of the existing pavement or foundation as described in Section 34-3.10. The leveling shall be to such elevation that when a uniform wearing surface is placed the finished pavement will conform to the grade and cross section shown on the plans.

Longitudinal joints in the leveling and wearing courses shall be offset a minimum of two (2) inches, so that one joint will not be directly over the other. In construction of two-lane pavement, the longitudinal joints shall be offset in such a manner that the longitudinal joint in the wearing course will coincide with the centerline of the pavement.

As specified on the plans or in the special provisions, various classes of asphait concrete shall be used to construct base, leveling and wearing courses. Unless otherwise directed by the Engineer, or specified on the plans or in the special provisions, the nominal compacted depth of any course shall not exceed the following depths:

Asphalt Concrete Class E	0.35 foot.
Asphalt Concrete Classes B and F	0.25 foot.
Asphalt Concrete Class G	0.10 foot.
Asphalt Concrete Class D	0.08 foot.

Where the compacted depth of any course, as shown on the plans, exceeds the depth specified above for the particular class of mixture, the course shall be constructed in two or more layers.

34–3.12 JOINTS

The placing of the top or wearing course shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued for such length of time as to permit the mixture to become chilled.

When the work is resumed, the previously compacted mixture shall be cut back to produce a slightly beveled edge for the full thickness of the course. The material which is cut away shall be wasted and new mix shall be laid against the fresh cut. Rollers or tamping irons shall be used to seal the joint.

34–3.13 SURFACE SMOOTHNESS

The completed surface of the top or wearing course shall be of uniform texture, smooth, uniform as to crown and grade, and free from defects of all kinds. The completed surface shall not vary more than ⅛ inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the center line. The transverse slope of the completed surface shall vary not more than ¼ inch in 10 feet from the rate of transverse slope shown on the plans.

When deviations in excess of the above tolerances are found, the pavement surface shall be corrected by the addition of asphalt concrete mixture of an appropriate class to low places or the removal of material from high places by methods satisfactory to the Engineer or by removal and replacement of the wearing course of asphalt concrete. Correction of defects shall be carried out until there are no deviations anywhere greater than the allowable tolerances.

All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above shall be removed and replaced to the satisfaction of the Engineer.

However, if deviations are found which exceed the allowable tolerances but are not in excess of 2 times the dimensions specified above as allowable tolerances and in the opinion of the Engineer, correction by means of any of the methods specified above will not produce satisfactory results as to smoothness and serviceability, the Engineer may at his discretion accept the completed pavement and shall deduct from monies due the Contractor on the final estimate the sum of $100.00 for each and every section of single traffic lane 100 feet in length in which any deviations as described above are found. Under the circumstances described above the decision whether to accept the completed pavement or to require corrections as described above shall be vested entirely in the Engineer.

All costs involved in making the corrections of defects described above shall be borne by the Contractor and no compensation will be made for this work.

34–3.14 HEATER-PLANING BITUMINOUS PAVEMENT

–3.14A General

Where shown on the plans or where directed by the Engineer, the existing bituminous pavement shall be planed in accordance with the following specifications:

This item shall consist of planing or shaving the surface irregularities from the existing bituminous pavement to produce a smooth surface by means of equipment hereinafter specified. The finished surface shall be free from gouges, grooves, ridges and other imperfections of workmanship.

The temperature at which the work is performed, the nature and condition of the equipment, and the manner of performing the work shall be such that the pavement is not torn, broken, burned or otherwise injured by the planing operations.

All cuttings or other debris resulting from the heater-planing operations shall be disposed of by the Contractor to the satisfaction of the Engineer. Unless otherwise provided, the Contractor shall provide his own waste site for the disposition of these materials.

–3.14B Equipment

The planing shall be performed with a pavement planing machine of a type that has operated successfully on work comparable with that to be done under the contract.

The machine shall have a furnace for heating the pavement, the heat developer to be controlled from the operator's station; and a blade for cutting the high spots from the pavement, the blade to be controlled from the operator's station so that the proper depth of cut may be maintained at all times. The position of the blade shall be such that the cuttings will be delivered in a single windrow. The planing operation shall be performed continuously by the forward motion of the machine. The width of heating and cutting shall be not less than four (4) feet and the effective wheel base of the machine not less than eighteen (18) feet.

34–3.15 MISCELLANEOUS DETAILS OF CONSTRUCTION

Unless otherwise directed by the Engineer, the construction of each course of asphalt concrete pavement shall commence at the point farthest away from the mixing plant and progress toward the plant so that no hauling will be done over freshly placed pavement.

Construction of one course or lift upon another shall not proceed until the underlying course has completely cooled and set.

Asphalt concrete mixture shall not be deposited on the road if the rolling cannot be completed before dark. The placing of asphalt concrete mixture at night will not be permitted.

Where the asphalt concrete is to be placed against a concrete or stone curb or gutter, or against a cold pavement joint or any metal surface, a thin paint coat of cutback asphalt shall be applied in advance of the placing. The application shall be thin and uniform, care being exercised to avoid accumulation of asphalt in depressions.

No traffic other than that necessary for construction purposes shall be allowed on any course of the pavement until the course has completely cooled and set.

34–3.16 SAMPLES

When called upon to do so, the Contractor shall, without charge, provide the Engineer with test samples of asphalt concrete cut from the completed pavement or the individual courses thereof. He shall also provide the Engineer with test samples of the uncompressed asphalt concrete mixtures, and all materials incorporated in the work.

34–3.17 SHOULDERS

Shoulders, if required, shall be constructed to the lines, grades, and cross sections shown on the plans and in accordance with the specifications for materials and construction.

34–3.18 VACANT

34–3.19 UNFAVORABLE WEATHER

Asphalt for "Prime Coat" shall not be applied when the ground temperature is lower than fifty (50) degrees F., without written permission of the Engineer.

Asphalt concrete shall not be placed when the atmospheric temperature is lower than 40° Fahrenheit nor during heavy rainfall nor when the surface upon which it is to be placed is frozen. It is further provided that asphalt concrete shall not be placed during the following periods of any year at the location shown except upon written order of the District Engineer:

West of the summit of the Cascade Range, December 1 to March 1.

East of the summit of the Cascade Range, November 1 to April 1.

34–3.20 TRAFFIC AND DETOURS

Unless otherwise provided in the special provisions, the Contractor shall plan his operations on the basis that traffic will be carried through the work continuously, or on detours if they are specifically mentioned and described in the special provisions. The Contractor will not be responsible for the maintenance of the designated detours unless otherwise specified in the special provisions, but all costs incurred by him due to continuous passage of traffic through the work, except as provided in special provisions, shall be considered as incidental to the construction and shall be included in the pay items of the contract.

34–3.21 ORGANIZATION AND EQUIPMENT

Each stage of the work shall be under competent supervision as outlined in Section 8.11. The plant foreman and street foreman shall be thoroughly experienced in the class of work they supervise.

34–5 MEASUREMENT AND PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract.

1. "Preparation of Untreated Roadway," per mile, or square yard.
2. "Asphalt (grade specified) Prime Coat," per ton.
3. "Prime Coat Aggregate," per cubic yard.
4. "Asphalt for Tack Coat," per ton.
5. "Asphalt Concrete Pavement (Class ———)," per ton.
6. "Mineral Aggregate (size) in Stockpile," per ton.
7. "Blending Sand," per cubic yard.
8. "Mineral Filler," per ton.
9. "Water," per M gallon.
10. "Removing (type) Pavement," per square yard.
11. "Heater-Planing Bituminous Pavement," per hour.

34–5.01 PREPARATION OF UNTREATED ROADWAY

The unit contract price per mile or per square yard for "Preparation of Untreated Roadway" shall be full compensation for all labor, tools, and equipment required to do the work described under Section 34-3.01B with the exception, however, that all costs involved in labor, materials, and equipment for patching the roadway prior to placement of asphalt concrete shall be included in the unit contract price per ton for "Asphalt Concrete Pavement" of the class used for patching.

Fractions of miles will be paid for to the nearest one-hundredth (0.01) mile.

34–5.02 ASPHALT—PRIME COAT

The unit contract price per ton for "Asphalt Prime Coat" of the grade specified shall be full compensation for furnishing and applying the asphalt, including heating, hauling, and applying to the roadway, and other incidental work as hereinbefore described in Section 34-3.01B.

The quantity of asphalt will be determined as described in Section 27-1.01K.

34–5.03 PRIME COAT AGGREGATE

The unit contract price per cubic yard for "Prime Coat Aggregate" shall be full compensation for furnishing, loading and hauling aggregate to the place of deposit and spreading the mineral aggregate in the quantities required by the Engineer.

Prime coat aggregate, unless otherwise specified in the special provisions, shall conform to the requirements of Section 23-2.01 for Crushed Surface Top Course, of Section 32-2.02 for Crushed Cover Stone, or of Section 34-2.02C for Class F Mineral Aggregate ¼"-0".

The quantity of prime coat aggregate to be paid for shall be the quantity actually furnished, loaded, hauled, and used in construction of the prime coat.

Measurement will be made by the cubic yard at the point of delivery on the road. The volume shall be the "strike off" capacity of the truck bodies.

34–5.04 ASPHALT FOR TACK COAT

The unit contract price per ton for "Asphalt for Tack Coat" shall be full compensation for all costs of material, labor, tools, and equipment necessary for the application of the tack coat as specified. Water added to emulsion will not be paid for as emulsified asphalt. The pay quantity shall be the amount of undiluted emulsion used as tack coat.

34–5.05 ASPHALT CONCRETE PAVEMENT

The unit contract price per ton for "Asphalt Concrete Pavement" of the class specified, shall be full compensation for the furnishing of all labor, equipment, materials, and supplies required in the construction of each class of asphalt concrete pavement complete in place, including the preparation of any existing portland cement concrete, brick or bituminous surface, or pavement base, and all other work incidental to fulfilling the requirements described in Section 34-3 and not set forth as bid items of any particular project.

In the event the Contractor is required to furnish the mineral aggregates, all costs of furnishing, hauling and processing mineral aggregates, blending sand, and mineral filler into the complete mix shall be included in the unit contract price per ton for "Asphalt Concrete Pavement" of the class specified, except that mineral filler and blending sand when set up as bid items will be paid for in the manner hereinafter described.

If any of the mineral aggregates are furnished in stockpile by the State, the cost of hauling and incorporating those mineral aggregates in the mix, and all costs of furnishing, hauling, and incorporating the necessary blending sand mineral filler, and any additional mineral aggregate shall be included in the unit contract price per ton for "Asphalt Concrete Pavement," of the class specified, excepting however, that mineral filler and blending sand, when set up as bid items, will be paid for in the manner hereinafter described.

34–5.06 MINERAL AGGREGATES IN STOCKPILE

The unit contract price per ton for "Mineral Aggregate (size) in Stockpile" of the various size designations shall be full compensation for all costs in connection with the preparation of the stockpile sites, the quarrying, crushing, screening, washing, cleaning, loading, hauling,

and placing of the mineral aggregate in stockpiles at sites designated in the plans or special provisions, and for all other expenses incidental thereto, excepting however, that clearing, grubbing, and stripping of quarries or pits made available to the Contractor by the State for the manufacture of mineral aggregate will be paid for under the provisions of Sections 12 and 13.

34–5.07 BLENDING SAND

The unit contract price per cubic yard for "Blending Sand" shall be full compensation for all costs in connection with the furnishing, hauling, and incorporating blending sand in the mixed aggregates, as required by the Engineer. Unless otherwise specified, measurement will be made by the cubic yard in trucks at the plant.

If there is a bid item for blending sand and the Contractor elects to provide mineral aggregates from a source other than that provided by the State, and if it becomes necessary, in the opinion of the Engineer, to use blending sand for proper grading of the aggregates, then in that event the Contractor shall furnish and incorporate sufficient quantities of blending sand to meet the requirements as determined by the Engineer. The pay quantity will be the amount actually used up to, but not exceeding, the quantity set up in the contract. If there is no bid item for blending sand, whatever amount of blending sand as may be needed to meet the requirements as determined by the Engineer, shall be furnished by the Contractor at his own expense.

34–5.08 FURNISHING MINERAL FILLER

Mineral filler, if used, will be paid for at the fixed rate of $25.00 per ton, which shall be full compensation for all costs in connection with furnishing, hauling and incorporating mineral filler in the quantities ordered by the Engineer.

34–5.09 WATER

Water will be measured by the M gallons and paid for as provided in Section 16.

34–5.10 REMOVING EXISTING PAVEMENT

The unit contract price per square yard for "Removing (type) Pavement" of the type shown on the plans and specified in the proposal, shall be full compensation for removing the pavement and disposing of it as hereinbefore specified, and for all other expense necessary to complete the work as specified.

34–5.11 HEATER-PLANING BITUMINOUS PAVEMENT

The unit contract price per hour for "Heater-Planing Bituminous Pavement," for the actual time consumed in heater-planing shall be full compensation for furnishing all tools, equipment, labor, materials, supplies, and incidentals necessary to accomplish the work in accordance with the specifications, including the removal and disposal of all cuttings and debris, and for all other costs required to accomplish the work. No allowance will be made for time consumed in making repairs to the equipment or for moving the equipment to or from the work on which heater-planing is ordered.

34–5.12 INCIDENTAL WORK

Any incidental work required to complete the asphalt concrete pavement specified herein, but which is not specifically mentioned in the foregoing specifications of Section 34, shall be performed by the Contractor and shall be considered as incidental to the construction, and all costs therefor shall be included by the Contractor in his unit contract prices of the bid items.

Section 35—Extruded Asphalt Concrete Curb

35–1 DESCRIPTION

Extruded asphalt curb shall be constructed at such locations as shown on the plans and to the cross section shown on the standard drawing.

35–2 MATERIALS

The extruded asphalt concrete curb shall consist of a hot-mix asphalt concrete Class B mix conforming to the provisions of Section 34-2.03. The grade of paving asphalt shall be penetration 85-100 unless otherwise specified in the special provisions or by the Engineer.

35–3 CONSTRUCTION DETAILS

The asphalt pavement shall be dry and cleansed of loose or deleterious material. Immediately after cleaning the pavement surface, a tack coat of cut-back or emulsified asphalt shall be applied to the asphalt curb area of the pavement at the rate of .08 to 0.20 gallons per fifteen linear feet of curb area, depending on the width of curb and age of pavement. Care shall be taken to prevent applying too wide or too heavy a tack coat.

35–3.01 EQUIPMENT FOR LAYING CURB

The machine for laying the curb shall be of the self-propelled type equipped with a material hopper, distributing screw, and adjustable curb forming devices capable of laying and compacting the hot-mix asphalt concrete to the lines, grades and cross section as shown on the plans, and in an even homogeneous manner free of honeycombs.

35–3.02 MIXING AND PLACING

The asphalt concrete mixture shall be homogeneously mixed to conform with Section 34-3.06 and shall be delivered to the hopper of the laying machine at a temperature of not less than 200 F. nor more than 300 F. Each hopper load of the asphalt concrete mix shall be run through the curb laying machine, properly adjusted to form and properly compact the asphalt concrete curb.

35–3.03 JOINTS

Unless conditions warrant, asphalt concrete curb construction at the specified temperature shall be a continuous operation in one direction so as to eliminate curb joints. However, where conditions are such that this is not possible, the joints between successive days work shall be carefully made in such a manner as to ensure a continuous bond between the old and new sections of the curb. All contact surface of the previously constructed curb shall be painted with a thin, uniform coat of hot bituminous material immediately prior to placing the fresh asphalt concrete curb material against the old joint.

35–3.04 CURING

The newly laid curb shall be protected from traffic by barricade or other suitable means until the heat of the asphalt concrete mixture has been dissipated and the mixture has attained its proper degree of hardness.

35–3.05 FURTHER PROVISIONS

Section 34 of the specifications shall apply where specific details are required and where such provisions have not been included in this section of the specifications.

35–4 MEASUREMENT AND PAYMENT

The extruded asphalt concrete curb will be measured by the linear foot along the front face of the curb and returns.

Payment will be made for the following bid item when included and shown in any particular contract:

1. "Extruded Asphalt Concrete Curb," per linear foot.

The unit contract price for the above item shall be full compensation for all costs of labor, tools, equipment and materials and for complete installation in accordance with the plans and specifications.

Section 37—Portland Cement Concrete—Materials

NOTE: The 1963 APWA edition of specifications included portland cement concrete pavement and concrete materials within a single section entitled "Section 39, Cement Concrete Pavement." This 1969 edition separates the subject matter into two separate sections, this one "Section 37, Portland Cement Concrete—Materials" containing materials specifications, and another section entitled "Section 39, Cement Concrete Pavement," covering construction specifications. The numbering and titles of subsections correspond closely with those of Section 39 in the 1963 edition. Where "Vacated" is shown for any subsection in this Section 37, the subject matter in the title has been included in Section 39, Cement Concrete Pavement.

37–1 DESCRIPTION

This section contains the materials requirements for portland cement concrete to be used in pavements, curbs, sidewalks, driveways and miscellaneous items in streets and public rights of way.

37–2 MATERIALS

The materials for portland cement concrete and related items shall conform to the following requirements:

37–2.01 CEMENT

–2.01A General Requirements

Cement shall be classified as (a) portland cement, (b) air-entraining portland cement and (c) high-early-strength cement.

–2.01B Storage on the Work (Vacated)

–2.01C Sampling and Acceptance (Vacated)

–2.01D Portland Cement

Portland cement shall conform to the requirements for Type II cement of the Standard Specifications for Portland Cement, AASHO Designation M85; except that a maximum of fifty-five (55) percent of tricalcium silicate (3 CaO SiO_2) will be permitted; also that the content of alkalies shall not exceed seventy-five hundredths (0.75) percent by weight calculated as Na_2O, plus $0.658K_2O$. Alkalies shall be determined in accordance with ASTM Designation C 114. It shall meet the requirements of the above specifications both for tensile strength and compressive strength and for time of setting by both the Gillmore and Vicat methods.

–2.01E Air-Entraining Portland Cement

Air-entrained portland cement shall meet the requirements for Type IIA cement of the specifications for air-entrained portland cement of AASHO Designation M134, except that a maximum of fifty-five (55) percent of tricalcium silicate (3 CaO SiO_2) will be permitted, and also that the content of alkalies shall not exceed seventy-five hundredths (0.75) percent by weight, calculated as Na_2O plus $0.658K_2O$. Alkalies shall be determined in accordance with ASTM Designation C 114. It shall meet the requirements of the above specifications for time of setting by both the Gillmore and Vicat methods.

–2.01F High-early-strength Cement

High-early-strength cement shall conform to the requirements for Type III cement of the standard specifications for portland cement AASHO Designation M85, except that the content of alkalies shall not exceed seventy-five hundredths (0.75) percent by weight calculated as Na_2O, plus $0.658K_2O$. Alkalies shall be determined in accordance with ASTM Designation C 114. It shall meet the requirements of the above specifications both for tensile strength and compressive strength and for time of setting by both the Gillmore and the Vicat methods.

–2.01G Low-Alkali Cement

When the special provisions state that low-alkali cement shall be used, the percentage of alkalies in the cement shall not exceed six-tenths (0.60) percent by weight calculated as Na_2O, plus $0.658K_2O$. This limitation shall apply to portland cement, air-entraining portland cement and high-early-strength cement. Alkalies shall be determined in accordance with ASTM Designation C 114.

37–2.02 CONCRETE AGGREGATES

Concrete aggregates shall be manufactured from ledge rock, talus or sand and gravel in accordance with the provisions of Section 22, Production from Quarry and Pit Sites.

–2.02A General Requirements

Aggregates shall possess such characteristics of shape and size that concrete, prepared from a mixture of fine and coarse material in the proportions specified, will be of satisfactory workability in the opinion of the Engineer. Regardless of compliance with all other provisions of these specifications, if the concrete is not of a workable character, or when finished does not exhibit a proper surface, either the fine or the coarse aggregate or both shall be rejected or altered as required by the Engineer.

If, in the judgment of the Engineer based on previous experience or on laboratory tests, concrete aggregates from a given source are detrimentally reactive with alkalies in portland cement, they shall be used in concrete in combination with low-alkali cement only.

–2.02B Fine Aggregate

Fine aggregate shall consist of sand or other inert materials, or combinations thereof approved by the Engineer, having hard, strong, durable particles, free from adherent coating. Fine aggregate shall be thoroughly washed to remove clay, loam, alkali, organic matter or other deleterious matter.

–2.02B1 Deleterious Substances. The amount of deleterious substances in the washed aggregate shall not exceed the following values:

(1) Amount finer than No. 200 sieve (wet sieving) 2% by weight
(2) Particles of specific gravity less than 1.95 1% by weight
(3) Organic matter, by colorimetric test, shall not be darker than 250 parts per million unless other tests prove a darker color to be harmless.

–2.02B2 Grading. Fine aggregate shall be regularly graded from coarse to fine in two (2) sizes and when tested by means of the U.S. Standard sieves shall conform to the following requirements expressed as percentages by weight:

	Grading No. 1		*Grading No. 2*	
	Max.	*Min.*	*Max.*	*Min.*
Passing No. 4	100	95	...	100
Passing No. 6	98	82	100	93
Passing No. 8	86	68	95	85
Passing No. 16	65	47	80	63
Passing No. 30	42	27	60	40
Passing No. 50	20	12	30	15
Passing No. 100	7	2	8	2
Passing No. 200 (wet sieving)	2	0	2	0

In individual tests, variations under the minimum or over the maximum will be permitted as follows provided the average of three consecutive tests is within the above limits:

Sieve Number	*Permissible % of Variation in Individual Tests*
No. 30 and coarser	2
No. 50 and finer	0.5

–2.02B3 Use of Substandard Gradings. Fine aggregate with more than the maximum percentage passing any sieve may be accepted provided the mix proportions are adjusted to produce concrete having the same net water-cement ratio, slump and workability. Any resulting increase in the cement content shall be at the ex-

pense of the Contractor. Under no circumstances shall fine aggregate, which has a grading finer than Grading No. 2, be used in paving concrete.

–2.02B4 Mortar Strength. Fine aggregate shall develop in the mortar strength test at an age of 14 days a compressive strength of not less than ninety-five (95) percent Ottawa sand, as determined by ASTM Designation C 109.

–2.02C Coarse Aggregate

Coarse aggregate shall consist of gravel, crushed stone, or other inert material or combinations thereof approved by the Engineer, having hard, strong, durable pieces free from adherent coatings. Coarse aggregate shall be thoroughly washed to remove clay, loam, bark, sticks, alkali, organic matter, or other deleterious material.

–2.02C1 Deleterious Substances. The amount of deleterious substances shall not exceed the following values:

Amount finer than No. 200 sieve (wet sieving)	0.5% by weight
Pieces of specific gravity less than 1.95	2.0% by weight
Clay lumps	0.5% by weight
Shale	2.0% by weight
Wood waste	0.05% by weight

Wood waste is defined as all material which, after drying to constant weight, has a specific gravity less than 1.0.

–2.02C2 Wear in Los Angeles Machine. Coarse aggregate shall not have a percentage of wear in the Los Angeles machine in excess of thirty-five (35) after 500 revolutions.

–2.02C3 Grading. Coarse aggregate when tested by means of laboratory screens shall conform to one or more of the following gradings as called for elsewhere in the specifications, special provisions, or on the plans.

	Grading No. 1		Grading No. 2		Grading No. 3		Grading No. 4		Grading No. 5	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Passing 2½" sq. opening	98	100	.....	.....	95	100	.....	.....	.....	.....
Passing 2" sq. opening	92	100	.....	.....	75	100	.....	.....	.....	.....
Passing 1½" sq. opening	72	87	100	100	30	60	100	.....	.....	.....
Passing 1¼" sq. opening	58	75	95	100	0	15	95	100	.....	.....
Passing 1" sq. opening	.....	.....	.....	.....	.....	.....	.....	.....	100	.....
Passing ¾" sq. opening	27	47	40	70	0	1	0	20	95	100
Passing ⅜" sq. opening	3	14	5	20	.....	.....	0	2	10	40
Passing U. S. No. 4 sieve	0	1	0	2	.....	.....	.....	.....	0	4

The above values are in percentages by weight.

In individual tests a variation of four (4) under the minimum percentages or over the maximum percentages will be allowed. The average of three (3) successive tests shall be within the percentages stated above. Coarse aggregate shall contain no piece of greater size than five (5) inches measured along the line of greater dimension.

–2.02C4 Use of Substandard Gradings. Coarse aggregate containing more than the maximum percentage passing any screen may be accepted provided the mix proportions are adjusted to produce concrete having the same net water-cement ratio, slump and workability. Any resulting increase in the cement content shall be at the expense of the Contractor.

Coarse aggregate shall not be used under any circumstances in paving concrete when the amount by weight passing the screens exceeds the following:

¾" square opening	70%
⅜" square opening	30%

–2.02C5 Concrete Strength. Concrete made from the coarse aggregate, graded to comply with the requirements of these specifications, combined with the specified proportions of cement and the fine aggregate proposed for use with the coarse aggregate, or the washed sand from Steilacoom, Washington, shall develop compressive and flexural strengths at age of 14 days of not less than ninety (90) percent of that developed by concrete made from the same cement and washed sand and gravel from Steilacoom of the same grading, and mixed in the same proportions and to the same consistency.

–2.02D Test Methods for Concrete Aggregates

The properties enumerated in these specifications shall be determined in accordance with the following methods of test:

–2.02D1 Sampling: ASTM Designation D 75.

–2.02D2 Amount of Material Finer than No. 200 Sieve in Aggregates: ASTM Designation C 117.

–2.02D3 Organic Impurities: ASTM Designation C 40.

–2.02D4 Compressive Strength of Concrete: ASTM Designation C 39.

–2.02D5 Flexural Strength of Concrete: ASTM Designation C 78.

–2.02D6 Percentage of Particles of Less than 1.95 Specific Gravity: AASHO T 150.

–2.02D7 Clay Lumps in Aggregates: ASTM Designation C 142.

–2.02D8 Abrasion of Coarse Aggregate by Use of the Los Angeles Machine: ASTM Designation C 131.

–2.02D9 Mortar Strength: Compressive Strength of Concrete Mortars, ASTM Designation C 109.

37–2.03 MIXING WATER

–2.03A Requirements

Water for use with cement in mortar or concrete shall be reasonably clear and free from oil. It shall not contain chlorides calculated as sodium chloride in excess of 2,500 parts per million, nor sulphates calculated as sodium sulphate in excess of 1,000 parts per million. It shall not contain any impurities in amount sufficient to cause unsoundness or marked change in time of setting in the cement with which it is mixed nor a reduction in mortar strength of more than five (5) percent compared to the results obtained with distilled water.

–2.03B Test Methods

The properties enumerated above shall be determined in accordance with AASHO Method of Test No. T 26.

37–2.04 REINFORCING STEEL

All reinforcing steel and wire mesh shall meet the requirements in sections 111-2.01 and 111-2.02, respectively.

37–2.05 TIE BARS

Tie bars shall be deformed steel bars meeting the requirements in Section 111-2.01. The bars shall be free from rust, loose mill scale, dirt, grease or other defects affecting the strength or bond with the concrete.

37–2.06 PREMOLDED JOINT FILLER

–2.06A Contraction and Longitudinal Joints

Premolded joint filler for use in contraction and longitudinal joints shall be not less than one eighth (⅛) inch in thickness and shall consist of a suitable asphalt

mastic encased in asphalt-saturated paper or asphalt-saturated felt. It shall be sufficiently rigid for easy installation in summer months and not too brittle for handling in cool weather. Premolded joint filler shall be kept on a flat surface in storage before insertion in the concrete, and no warped or damaged material shall be used. Warped or damaged material shall be removed from the project.

–2.06B Expansion (Through) Joints

Premolded joint filler for use in expansion (through) joints shall conform to the standard specifications for Preformed Expansion Joint Fillers for Concrete, AASHO Designation M 213.

37–2.07 COTTON MATS

Cotton mats shall conform to the standard specifications for AASHO Designation M73, Cotton Mats for Curing Concrete.

37–2.08 WHITE PIGMENTED CURING COMPOUNDS

White pigmented curing compounds shall consist of finely ground white pigment and vehicle, ready-mixed for immediate use without alteration other than stirring. It shall adhere firmly to concrete either partially set or hardened. It shall meet the requirements that follow.

The compound shall provide a uniformly white appearance and shall effectively obscure the original color of concrete when applied at the rate of 200 square feet per gallon. When tested with the Pfund Cryptometer, Model E, Black Plate, Wedge Constant 0.007 inch and viewed in light of approximately 50-foot candles intensity the scale reading shall not exceed 40.

The compound shall dry to touch in not more than 8 hours when applied to a glass plate at a film thickness of 0.006 inch and exposed at an atmospheric temperature of 70°.

The viscosity of the compound at a temperature of 77° F. shall not exceed 60 Krebs units when tested by means of the Krebs-Stormer viscosimeter, ASTM Designation D 562.

The compounds shall be of such composition that the coating formed by its application on concrete surfaces will provide an effective seal for at least 10 days. There shall be no evidence that new concrete surfaces are softened by reaction with the compound.

When tested for moisture retaining effectiveness, as described in Section 6.03 of these specifications, the loss of moisture shall not exceed two (2) grams per specimen.

37–2.09 TRANSPARENT CURING COMPOUNDS

Transparent curing compounds shall meet the following requirements:

The compound shall be a liquid that, at the time of application, is free from suspended matter. It shall be sufficiently low in viscosity to result in an even, uniform coating when applied by spraying.

The compound shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from that of the natural concrete at the conclusion of the curing period. The compound shall, however, contain a dye of color strength sufficient to render the film distinctly visible on the concrete for a period of at least four (4) hours after application.

When tested for moisture retaining effectiveness as described in Section 6.03, the loss of moisture shall not exceed two (2) grams per specimen.

37–2.10 WATERPROOF PAPER

Waterproof paper shall meet the requirements of AASHO Designation M139.

37–2.11 WHITE POLYETHYLENE SHEETING

White polyethylene sheeting shall meet the requirements of AASHO Designation M171.

37–2.12 FORMS

Covered in Section 39-3.13.

37–2.13 JOINT-SEALANTS

Joint sealants used in sealing pavement joints shall meet the requirements of one of the following: (1) AASHO Designation M 173, Concrete Joint Sealer, Hot Poured Elastic Type, (2) ASTM Designation D 1850, Concrete Joint Sealer, Cold Application Type, excepting however, that the tests for evaluation of bond requirements in the above mentioned specifications shall be in accordance with the method used by and available from the Materials Laboratory, Department of Highways, Olympia, Washington, 98501.

Unless otherwise stated in the special provisions, the Contractor will have the option of using either of the two types above noted.

Upon request by the Engineer, joint sealing materials shall be tested by an independent laboratory. In such case, a certificate shall be furnished by the laboratory stating that the materials have been tested and that they fully conform to the requirements of this section of the specifications.

37–3 CONSTRUCTION—CONCRETE MIXES

37–3.01 CLASSIFICATION AND USE

The class of concrete refers to the nominal number of sacks of cement per cubic yard, although this designation does not constitute a guarantee of yield. The figure in parenthesis indicates maximum aggregate size. Example: 5.5 (1½) is a 5.5 sack mix with 1½ inch maximum size coarse aggregate.

H.E.S. indicates high-early-strength cement and may be required at the option of the Engineer for any of the classes of mix. Whenever it is called for, it will be measured and payment will be made as provided.

The Contractor may, with approval of the Engineer, elect to use high-early-strength cement in any of the mixes, but no extra compensation will be made him for the high-early-strength cement.

–3.01A Cement Content for Designed Age Requirements (Vacated)

37–3.02 AIR-ENTRAINED CONCRETE

Air-entrained concrete shall be used, unless otherwise provided for in the special provisions.

Either air-entrained portland cement or an air-entraining admixture shall be added at the mixer. Both the air-entrained cement and the air-entrained admixture shall conform to requirements of Section 37-2.01E.

The volume of air in freshly mixed concrete shall conform to that specified in the table which follows:

AIR CONTENT OF FRESHLY MIXED CONCRETE

Maximum Size of Coarse Aggregate (Inches)	Air Content Precent by Volume
1½, 2, and 3	5 ± 1
¾ and 1	6 ± 1
⅜ and ½	7½ ± 1

If the measured air content is found above or below the values contained in the table, the Contractor shall immediately make changes in mixing or materials as will be necessary to comply with the requirements for air content.

If an air-entraining agent is used, it shall be introduced at the nominal rate of one fluid ounce per sack of cement, but the rate shall be varied, if necessary, to comply with the requirements for air content.

An automatic dispenser, accurate to 10%, which will introduce into the mixing water the specified amount of air-entraining agent for each cycle of mixing, shall be connected to the mixer.

Aggregates shall be adjusted to compensate for increased yield resulting from air-entrainment so that the specified amount of cement is contained in each cubic yard of concrete. Adjustment shall be made by decreasing the weight of fine aggregates only, unless otherwise directed by the Engineer.

Other admixtures: Calcium chloride or any other admixture for any purpose other than air-entrainment may be added only upon the approval of the Engineer and under his supervision.

37–3.03 MEASURING OF MATERIALS

–3.03A Aggregates

The fine aggregate and each size of coarse aggregate shall be measured by weighing. Corrections shall be made for variations in weight of material due to moisture content and specific gravity. The quantities of aggregates used in each batch shall be such that the cement can be measured in full sacks unless it is weighed in bulk.

The equipment for weighing aggregates shall conform to requirements set forth in Section 21, Weighing Equipment.

–3.03B Cement

Cement handled in bulk shall be weighed on scales meeting requirements specified in Section 21. Adequate precaution shall be taken to prevent loss of cement between the batch box and the mixer.

–3.03C Water

–3.03C1 Water Cement Ratio. In adjusting concrete mixes, the following water-cement ratios shall not be exceeded:

Cement Sacks per Cu. Yd.	Max. Water Gals. per 94 Lb. Sack
3	11.0
4	8.2
5	6.5
5.5	6.0
6	5.5
6.5	5.1

The slump of the mixes shall be as specified in the appropriate section, or as provided in the special provisions. If, however, it is necessary for purpose of placing, additional water may be used provided that additional cement is also added to maintain the water-cement ratio as shown above.

–3.03C2 Water Measuring Equipment. Water measuring equipment shall consist of a supply tank and a measuring tank. The supply tank shall be open to the air and shall receive water from the supply main. The water used for mixing concrete shall not be used to cool the mixer motor. The measuring tank shall receive water by gravity from the supply tank only. It shall be equipped with a riser pipe extending to the top of the supply tank, or shall have other adequate means of permitting free flow of air above water.

The valves on the supply and discharge lines to and from the measuring tank shall be so arranged that it will be impossible for both to be open at the same time or for the water to pass directly from the supply line to the mixer. The measuring tank shall be provided with an easily read device, at all times exposed to view, that will accurately indicate within one (1) quart the volume of water delivered to the mixer.

37–3.04 PROPORTIONING MATERIALS

Fine and coarse aggregates shall be proportioned by weight except that if the project is small, volumetric proportioning may be used with permission of the Engineer. In proportioning, the unit of measure for cement will be by the sack—ninety four (94) pounds.

Weights of fine and coarse aggregate are based on a bulk specific gravity, saturated surface dry, of 2.67. When volume measurements are used, one cubic foot of sand shall be taken as equivalent to 100 pounds of sand, and one cubic foot of gravel shall be taken as equivalent to 105 pounds of gravel. Corrections must be made for contained moisture in the aggregate and variation in specific gravity.

Concrete mixes shall be proportioned as specified in the table which follows. The weight of each size of aggregate is the estimated quantity to be used with one sack of cement weighing 94 pounds. With approval of the Engineer, the proportion of aggregate may be altered to give better workability.

Class of Concrete	3(1½)	4(1½)	5(¾)	5(1½)	5(3)	5.5(1½)	6(1½)	6.5(1½)
Sacks per cu. yd.	3	4	5	5	5	5.5	6	6.5
Lbs. dry fine Aggregate No. 1	473	346	.....	275	275	248	220	210
Lbs. dry fine Aggregate No. 2	710	.....	291	.....	.....	.....	.....	.....
Lbs. No. 2 coarse aggregate	.....	521	.....	.....	248	.....	.....	280
Lbs. No. 3 coarse aggregate	.....	.....	.....	.....	166	.....	.....	.....
Lbs. No. 4 coarse aggregate	.....	.....	.....	166	.....	150	132	.....
Lbs. No. 5 coarse aggregate	.....	.....	387	248	.....	223	201	.....

37–3.05 TRANSPORTING MATERIALS

Materials shall be transported from the batch plant to the mixer in suitable batch trucks of approved design. The trucks shall meet all legal load restrictions when hauling on a public highway or street. Trucks shall be of sufficient size to prevent spillage from the trucks or from one compartment to another at any time during loading, hauling or dumping operations, and they shall be capable of dumping the entire batch into the mixer skip without spillage of cement or aggregates on the subgrade.

Transportation of cement in the same compartment with the aggregates will be permitted if the aggregates are fed simultaneously with the cement into the truck compartment to avoid loss of the dry cement while en route to the job site. Batches of concrete materials containing dry cement shall be used the same day they are made up. No dry batches left in trucks overnight shall be used for concrete. The Engineer may order suitable tarpaulins or other protective covers to be placed over the loaded batch beds of trucks if he deems it necessary to prevent loss of cement or aggregates.

37–3.06 CONSISTENCY OF CONCRETE

The concrete materials shall be mixed with the required amount of water to give a stiff, workable mix. The consistency shall be such that the concrete will not crumble and handling will not cause the mortar to separate from the aggregates. Additional water to improve workability or prevent the formation of honeycomb or rock pockets may be added only if approved by the Engineer.

The consistency of the concrete will be evaluated by either of two test methods: Method of Test for Slump of Portland Cement Concrete, ASTM Designation C 143, and the Method of Test for Ball Penetration in Portland Cement Concrete, ASTM Designation C 360.

37–3.07 CONCRETE MIXED AT ROAD SITE

The materials shall be mixed in a batch mixer in first-class condition having a rating not less than 27–E + 10% and of the boom and bucket type, approved by the Engineer. Mixing shall continue after all materials are in the drum for at least fifty (50) seconds before any part of the batch is discharged from the drum.

The drum shall be completely emptied before receiving materials for the next batch. The drum shall revolve at the rate of speed specified for the particular mixer used but it shall make not less than fourteen (14) nor more than twenty (20) revolutions per minute.

Every concrete mixing machine shall be equipped with a suitable timing device. The mechanism of such timing device shall be so constructed as to automatically be put into operation as soon as all materials are in the drum and to lock the mixer so as to prevent discharge until the specified mixing time has elapsed. This timing device shall be tested each day before beginning work and shall be regulated only in the presence of the Engineer or his representative.

The interior of the drum of the mixer shall be kept free of incrustations of concrete. The pick-up and throw-over or mixing blades in the drum shall be replaced when they show a wear of more than three-fourths (¾) of an inch. The wear of blades shall not exceed the tolerance recommended by the manufacturer.

The boom bucket shall have discharge doors at right angles to the boom and be kept in good order so that mortar will not leak out when the doors are closed.

Concrete mixers shall not be operated with a batch in excess of the rated capacity of the mixer. The mixture shall be homogeneous and a mixer that discharges concrete with separation of gravel from mortar shall not be used.

37–3.08 READY MIXED CONCRETE

Ready mixed concrete may be used if the concrete delivered to the job site will meet the requirements of these specifications and the special provisions.

Ready mixed concrete may be produced by either a stationary mixer or a truck mixer. After the mixing, the concrete may be agitated by agitator truck or mixer truck. Agitators and mixers shall be identified as to uses, capacity in volume of concrete, and speed of rotation of mixing drums or blades. Stationary mixers shall be equipped with timing devices which will prevent the premature discharge of the concrete batch, and truck mixers shall have counters which will record the revolutions of the drum or blades.

Mixers and agitators must be capable of producing concrete, when delivered to the job site, that is thoroughly mixed with a satisfactory degree of uniformity and with the specified slump. Slump tests made at the one-quarter or three-quarter points of the load, if differing by more than two (2) inches, shall be cause to discontinue use of the equipment until the condition is corrected.

Ready mixed concrete shall be mixed and delivered by one of the following operations:

1. *Central-mixed Concrete:* Concrete mixed at central location and transported to job site in agitator truck or truck mixer operated at the agitator speed specified by the equipment manufacturer. Mixing time shall be sixty (60) seconds.

2. *Shrink-mixed Concrete:* Concrete is partially mixed by stationary mixer and mixing is completed by truck mixer. Stationary mixing time shall be thirty (30) seconds and truck mixer shall make not less than fifty (50) nor more than 100 revolutions of the drum or blades at the equipment manufacturer's designated speed; further mixing at agitator speed.

3. *Transit-mixed Concrete:* Concrete is completely mixed by truck mixer, with mixing as specified above for truck mixer under "Shrink-mixed Concrete." Truck mixers shall be equipped with accurate revolution counters.

Concrete transported by agitator or truck mixer shall be completely discharged at the job site within ninety (90) minutes after water is added to the cement and aggregates, or after the addition of cement to the aggregates, or when the concrete has been subjected to a maximum of 250 revolutions of the drum or blades, whichever comes first. A lesser time will be required whenever the weather accelerates the stiffening of the concrete. When a truck mixer is used to mix the concrete, the mixing shall begin within thirty minutes after the cement is intermixed with the aggregates.

Ready-mixed concrete may also be transported to the job site in nonagitated conveyances provided that the concrete is delivered and discharged complete within 30 minutes after the introduction of mixing water to cement and aggregate.

All equipment used in producing ready-mixed concrete shall be maintained in first class condition. Equipment, deemed by the Engineer to be inadequate to produce the quality of concrete required under these specifications, shall be removed from service until restored to proper operation conditions or be replaced by acceptable equipment.

Mixing and transporting equipment shall be adequate in quantity to deliver the required amount of concrete to the job site. The rate of delivery shall be such that the concrete can be properly handled, placed and finished. The interval between batches shall not be more than thirty (30) minutes. Delivery shall be made in a manner that will minimize rehandling and prevent damage to concrete previously placed.

37–3.09 BATCH METERS (Vacated)

37–3.10 RETEMPERING

Concrete shall be mixed only in such quantities as are required for immediate use and shall be used while fresh before initial set has taken place. Any concrete having initial set before placing and finishing shall be wasted and not used for the work. No retempering of concrete (remixing with water or other materials) will be allowed.

Section 38—Cement Concrete Stairways, Landings and Steps (New Section)

38–1 DESCRIPTION

Cement concrete stairways, landings and steps, unless otherwise shown on the project plans, shall be constructed in accordance with standard plan and these specifications.

38–2 MATERIALS

Portland cement concrete, reinforcing steel, forms and curing materials shall conform to the requirements therefor in Section 37.

The concrete mix shall be Class 6(¾), unless otherwise specified in the special provision or directed by the Engineer.

Galvanized iron pipe railing shall be fabricated from standard weight galvanized steel pipe conforming to ASTM Designation A 120.

38–3 CONSTRUCTION DETAILS

38–3.01 SITE PREPARATION AND GRADING

The staked area where cement concrete stairways and landings are to be constructed shall be cleared, grubbed and graded in accordance with the applicable requirements therefor in Sections 12 and 13. Excavation for cement concrete stairways and landings shall be considered as "Common Excavation," described in Section 13-1.01 unless otherwise provided in the special provisions. Any required compaction of excavation will be paid for as provided hereinafter for the type of equipment employed.

38–3.02 SUBGRADE PREPARATION AND FORMS

Subgrade preparation and compaction required in preparing a proper subgrade for cement concrete stairways and landings shall conform to the applicable requirements for subgrade for pavement as specified in Section 15, and shall be acceptable to the Engineer.

Forms may be of any suitable material provided the material used will form a finished cement concrete stairway or stairway landing of dense concrete conforming to the alignment, grade, and cross section dimensions required by the construction plans.

38–3.03 REINFORCING STEEL

Reinforcing steel for cement concrete stairways shall be placed as shown on the standard plan. The steel shall be assembled and securely tied with annealed wire of not less than No. 16 gauge at each bar lap or crossing and be rigidly supported in the plan location during the concrete placement.

38–3.04 RAILINGS

Hand railings for cement concrete stairways shall be of welded galvanized steel pipe construction, as shown on the plans. Welds shall be made by experienced welders and each weld shall be ground and buffed to a smooth surface and then hot dipped. Field welds shall be galvanized with "Galvalloy," or approved equal. Painting of

welds will not be permitted. After installation is completed, the railing shall be painted with one (1) coat of metal primer and one (1) coat of aluminum paint as specified in Section 116-2.02T.

The railing may be placed either completely assembled at the time when stairway concrete is placed, or recesses may be provided in the concrete for grouting in the railing posts after the concrete has been placed, finished and cured. The installed railing shall be in true alignment, on proper grade, and all posts plumb.

38–3.05 PLACING CONCRETE, FINISHING AND CURING

Concrete for stairways and landings shall be Class 6 (¾) unless otherwise provided in the special provisions or ordered by the Engineer. Placing, finishing and curing shall conform to the applicable requirements in Section 39-3, as they would apply to cement concrete stairway construction.

Front and side edging of stair treads shall be to a radius of one-half (½) inch.

Landings for stairways shall be marked as specified for concrete sidewalks in Section 42 except that transverse and longitudinal markings shall be modified as necessary to result in uniform size of squares in each landing. Where gutters are along the side of the stairways, the gutter portion of stairway landing shall be smooth finished without markings to conform with the stairway gutter.

38–4 MEASUREMENT

Measurement of "Unclassified Excavation," when required, will be made on the basis of volume, as specified in Section 13-4.

Measurement of cement concrete stairways or cement concrete steps shall be by the linear foot for the horizontal distance from face of lower riser to face of upper riser, plus one (1) foot.

Measurement of railing shall be on the slope for the length of the top rail.

Measurement of concrete landings shall be by the square yard measured from the bottom of the riser at one end to the top of the riser at the other end, less one (1) foot.

Measurement for compaction equipment to compact embankment or subgrades for cement concrete stairways and landings will be made to the nearest one-half (½) hour of actual time consumed for the particular type of equipment used in compacting, as directed. No allowances will be made for time consumed in making repairs to equipment, for moving equipment from one area to another, or for time the towing equipment is performing other work.

38–5 PAYMENT

Payment will be made for such of the following bid items as are included in any particular contract:

(1) "Common Excavation," per cubic yard.
(2) "Cement Concrete Stairway," per linear foot.
(3) "Cement Concrete Stairway Landing," per square yard.
(4) "Stairway Steel Pipe Railing," per linear foot.
(5) "Mechanical Tamper," per hour.
(6) "Cement Concrete Steps," per linear foot.

38–5.01 EXCAVATION FOR GRADING

The unit contract price per cubic yard for "Common Excavation," shall be full compensation for excavating, loading, placing or disposing of the material as may be required, including also the removal and disposal of debris from clearing and grubbing operations including top soil, organic matter and other deleterious matter from surface of a cut or fill, as may be necessary.

38–5.02 CEMENT CONCRETE STAIRWAY OR STEPS

The unit contract price per linear foot for "Cement Concrete Stairway," or "Cement Concrete Steps," shall be full compensation for all clearing and grubbing, subgrade preparation, constructing forms, furnishing and placing reinforcing steel, furnishing, placing and consolidating concrete Class 6(¾), finishing and curing in accordance with the plan and specifications.

38–5.03 CEMENT CONCRETE STAIRWAY LANDINGS

The unit contract price per square yard for "Cement Concrete Stairway Landing," shall be full compensation for all clearing and grubbing, subgrade preparation, forms, reinforcing steel, furnishing, placing and consolidating concrete, finishing, marking and curing in accordance with the plan and specifications.

38–5.04 STAIRWAY STEEL PIPE RAILING

The unit contract price per linear foot for "Stairway Steel Pipe Railing," shall be full compensation for all costs of all materials, labor and equipment to construct and complete the railing in accordance with the plan and specifications.

38–5.05 COMPACTION EQUIPMENT

The unit contract price per hour for "Compaction Equipment (type specified)," shall be full compensation for the time the equipment is used in compacting embankments or subgrades for cement concrete stairways and landings to the density required by the Engineer.

Section 39—Cement Concrete Pavement

39–1 DESCRIPTION

The work covered in this section of specifications pertains to the construction of portland cement concrete pavements in streets, alleys and public rights of way.

39–2 MATERIALS

Cement and other concrete materials, joint filler, curing materials and reinforcing steel, required by the plans and specifications, shall conform to the requirements of Section 37. The class of concrete mix shall be that shown in the proposal. Ordinarily, the slump of the concrete when placed by machine methods shall not exceed two (2) inches. When hand methods are used, the slump shall not exceed three and one-half (3½) inches.

39–3 CONSTRUCTION

NOTE: Section 39, Cement Concrete Pavement of the 1963 APWA edition, embraced specifications for both materials and construction. This new edition has recast specifications for materials into Section 37 and includes the construction specifications in this revised Section 39. In the breakdown of Section 39 (1963 edition), its sections 39-3.01 through 39-3.11 have become sections 37-3.01 through 37-3.11 because they pertain to materials. To accommodate numerous references in other sections of this new edition which were formulated before the split of Section 39 into Sections 37 and 39, the same numbering sequence is being continued, where applicable, in this revised Section 39. Consequently, disregard the apparent gap of sections 39-3.01 thru 39-3.11 because, as materials, they are included as 37-3.01 thru 37-3.10.

39–3.12 SUBGRADE

The preliminary subgrade before the setting of forms shall be graded and compacted as required under Section 15.

After the forms have been securely set to grade and alignment, the subgrade between the forms shall be brought to true cross section by dragging a subgrade template as many times as may be necessary to secure a true subgrade. The finished subgrade shall be brought to an unyielding surface by rolling with compacting units meeting the requirements in Section 15.

Where thickened edges for pavements are required, such as shown on the standard plans, the subgrade shall be excavated and shaped to provide for the section shown.

Wherever possible, vehicles shall be kept off the finished subgrade. If vehicles must travel on the subgrade ahead of the paving, a power drag shall be carried immediately ahead of placing concrete. Irregularities in the subgrade caused by trucks during the placement of concrete shall be smoothed out and compacted immediately ahead of placing the concrete.

No concrete shall be placed until the subgrade is approved by the Engineer. The subgrade as finally completed and approved shall be maintained by the Contractor at an optimum moisture content by wetting with water until the concrete is actually placed.

39–3.13 FORMS

Forms may be of wood or metal or any other material at the option of the Contractor, provided the forms as constructed result in a pavement of specified thickness, cross section, grade and alignment as shown on the plans.

Forms shall be adequately supported to prevent deflection or movement and which will result in concrete pavement conforming with the plans and specifications. The top of the forms shall not deviate more than one eighth (⅛) inch in 10 feet and the alignment of forms shall be within one fourth (¼) inch in 10 feet. The forms may be removed the day after pouring if the concrete is sufficiently set to withstand removal without danger of chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth or sprayed with curing compound. All forms shall be cleaned, oiled, and examined for defects before they are used again.

39–3.14 COMPACTION AND COMPACTING EQUIPMENT

Covered in Section 15-2.

39–3.15 PLACING CONCRETE

The concrete shall be placed upon the prepared subgrade between the forms to the required depth and cross section in a continuous operation between construction or expansion joints.

The concrete shall be thoroughly consolidated against and along all forms or adjoining pavements by such means as will prevent gravel pockets along the edges of the finished pavement. Any gravel pockets found after removing the forms shall be repaired.

When integral curb is being constructed with the pavement, fresh concrete for the integral curb shall be placed at such time as will enable the top section of the curb to be consolidated, finished, and bonded to the pavement slab while the concrete is plastic.

Where curb is not being placed integral with the pavement slab, reinforcing steel dowels shall be placed in the base section for the curb in the manner described in Section 40-3.01C.

Prior to placing concrete around manholes, catch basins, gate chambers, etc., a temporary cover fitting below the rim of the ring casting shall be provided to prevent the concrete from flowing into them.

–3.15A Placing Concrete at Expansion Joints

Concrete placement around expansion joints shall be such that the expansion joint assembly will not be disturbed and that it will remain in a straight line perpendicular to the subgrade, as shown on the standard plan. The concrete shall then be spaded thoroughly or vibrated along the entire length of the joint to consolidate the concrete and leave no rock pockets anywhere at the joint. If any rock pockets are exposed, they shall be repaired.

–3.15B Placing Concrete With Reinforcing Steel Bars or Wire Mesh

Concrete may be placed in two courses. The first course shall be struck off at elevation established for reinforcing steel bar or wire mesh, or as designated on the plans. Immediately prior to placing the reinforcement, the concrete shall be brought to a fairly even surface by means of a template conforming to the depth of the reinforcement.

Reinforcing steel bars or wire mesh shall be placed on the bottom course before the concrete attains initial set. No more than 45 minutes shall elapse between mixing of the first course and placement of the second course.

Reinforcement shall be free of dirt, mill scale, oil, grease or other foreign material that may impair bond. Steel, coated with rust, may be used if the oxidations are not deep or loose coated.

Successive mats of steel or wire mesh shall be securely lapped together and tied so that longitudinal bars will lap 40 diameters and wire mesh will lap 6 to 12 inches.

Reinforcing steel or wire mesh shall be laid as a continuous mat. Continuity shall be maintained between expansion joints. Steel shall terminate within four inches of the joint.

Concrete may be placed in one lift, provided a method is used to position and secure the reinforcing bars or wire mesh at the designated locations in the slab.

If the concrete is placed in two courses where reinforcement is used, all dirt, sand or dust which collects on the base course shall be removed before the top course is placed.

–3.15C Slip Form Construction

At the option of the contractor and with the approval of the Engineer, concrete pavement may be constructed by the use of slip-form paving equipment.

Slip-form paving equipment shall be provided with traveling side forms of sufficient dimensions, shape, and strength to support the concrete laterally for a sufficient period of time during placement to produce pavement of the required cross section; and the equipment shall spread, consolidate, screed, and float-finish the freshly placed concrete in such a manner as to provide a dense and homogenous pavement.

The concrete shall be distributed uniformly into final position by the slip-form paver and the horizontal deviation in alignment of the edges shall not exceed one-half (½) inch from the alignment established by the Engineer.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels, offset to run a sufficient distance from the edge of the pavement to avoid breaking or cracking the pavement edge.

After the concrete has been given a preliminary finish by the finishing devices in the slip-form paving equipment, the surface of the fresh concrete shall be checked with a straight edge to comply with the tolerances and finish specified in Section 39-3.19E.

Final finishing of slip-form pavement shall be as specified in Section 39-3.19D.

39–3.16 COMPACTING CONCRETE

Concrete may be compacted by (1) hand methods, (2) machine methods and (3) combined machine and vibrators method at the option of the Contractor. The hand method will be limited to irregular areas, irregular sections, alleys and pavements placed in confined work areas.

–3.16A Hand Compacting

Concrete shall be spread evenly with shovels and spaded along the forms with a perforated spade after which it shall be struck off with a metal shod tamping rod. The rod shall be cut to exact crown of the roadway and be fitted with handles at each end and of such depth or trussed to be rigid. The strike-off rod shall be operated with a combined tamping, crosswise and sawing action to produce a smooth surface free from depressions or inequalities. A small amount of mortar must be kept ahead of and extending substantially along the entire length of the rod. Excessive swinging of the rod will not be permitted.

The concrete shall be struck off again with a "second strike rod" operated in the same manner as the first rod and following not closer than twenty (20) feet behind the first. The second strike rod may be eliminated on alley pavements having the "V" section of the center. The second rod may also be eliminated on small pours

of pavement of substandard width, unless use of the rod is required by the Engineer.

–3.16B Machine Compacting

The machine used for compacting shall be self-propelled and designed to run on the side forms. Movable parts shall be capable of adjustment and they shall be adjusted so as to produce accurately the roadway sections shown on the plans. The machine shall be equipped with two reciprocating screeds. The tops of the forms shall be kept clean with a suitable device attached to the machine.

The travel of the machine on the forms shall be maintained true without lift, wobble or other variations which might prevent a precise strike off.

The machine shall be put in forward motion as soon as concrete is deposited on the subgrade. On the first pass, a roll of concrete shall be carried ahead of the screed. Screeds and tampers shall be operated so as not to disturb expansion joints and caps.

Machines shall be operated prior to placing longitudinal and transverse dummy joints.

Machines shall be operated at least twice and as many more times as may be necessary to compact concrete free from rock pockets, and to a section that can be finished properly.

Care must be exercised not to overwork the concrete and bring an excess of mortar to the surface.

–3.16C Combined Vibration and Machine Compacting

The combined vibration and compaction equipment shall be demonstrated to the satisfaction of the Engineer as being capable of consolidating the concrete across the full width of the pavement into a homogeneous mass, free of rock pockets, and without separation of mortar and aggregates.

The equipment shall consist of the machine described in Section 39-3.16B, Machine Compacting, or an approved spreading machine to which is attached a vibrating unit composed of individual internal vibrators spaced not more than 29 inches apart. The vibrators shall be spaced equidistantly, and the distance from the side forms to the nearest vibrator shall not exceed 14 inches. The vibrators shall be carried behind and independent of the strike-off screed of the spreading machine, or ahead of and independent of the strike-off screed of the first compacting machine.

The vibrating unit shall not rest upon the side forms nor impart vibration to the strike-off screeds. The individual vibrators shall be attached to a frame in a manner which will permit adjustment of both the depth of penetration into the concrete and the angle of the vibrator with the horizontal.

The entire vibrating unit shall allow raising the vibrator tips completely clear of the concrete surface.

The vibrators shall be capable of vibrating at rates between 4,800 and 8,000 impulses per minute when inserted in the concrete. All vibrators shall be synchronized to vibrate at a frequency specified by the Engineer, within the limits established.

On the first trip over the freshly placed concrete the vibration equipment shall be submerged in the concrete to ensure adequate consolidation. Unless otherwise directed by the Engineer, the vibration equipment shall be operated on the first pass only. The vibration equipment shall not be operated when the machine is not in motion except when vibrating near an expansion joint.

After the first pass with vibration, one or more trips without vibration shall be made as described in Section 39-3.16B, Machine Compacting.

Two hardwood strips faced with metal shall be provided as described in Section 39-3.16B.

When combined vibration and machine compacting is used, the cement content of the specified concrete mix may be reduced by ten one-hundredths (0.10) barrel per cubic yard, except that no reduction will be permitted for mixes calling for 1.25 barrels per yard or less, provided it can be demonstrated to the satisfaction of the Engineer that:

(1) The equipment can compact and strike off concrete containing the full amount of cement specified in Section 37-3, Concrete Mixes, or the special provisions and with the water content reduced by 7%

(2) With the cement content reduced, the water requirements must not exceed that for a mix with the full cement content and compacted without vibration.

(3) The workability of concrete with a reduced cement content will allow finishing of the surface free of depressions or inequalities of any kind.

As often as the Engineer may require, the Contractor shall make trial runs with concrete containing the full amount of cement as specified in Section 37-3, Concrete Mixes, or as specified in the special provisions, compacting with and without vibration to determine the relative water contents required.

–3.16D Vibrating Screed Concrete Pavement Construction

The type of vibrating screed which the contractor proposes to use, whether roller or beam, shall be subject to approval by the Engineer. Upon request by the Engineer a test section of pavement shall be placed for the purpose of demonstrating the capabilities of the screed to satisfactorily compact and strike off the concrete to the established grade and section.

Concrete shall be uniformly distributed between the forms and it shall then be compacted and screeded to the level of the top of the forms by means of the vibrating screed. Supplemental compaction by hand spading or mechanical vibration of the concrete adjacent to the forms will be required if the concrete cannot otherwise be adequately compacted.

The vibrating screed shall be operated over the freshly placed concrete in successive passes only a sufficient number of times to obtain maximum compaction. Over-vibration of the concrete, resulting in an excess of mortar at the surface of the pavement, will not be permitted.

After the final passage of the vibrating screed, the surface of the concrete shall be at the established pavement grade and cross section and shall be sufficiently smooth as to require only a very moderate amount of hand finishing for smoothness to meet approval of the Engineer.

39–3.17 WATER

Water for all construction needs shall be furnished by the Contractor unless otherwise provided in the special provisions. Water quality shall conform to requirements of Section 37-2.03.

39–3.18 JOINTS

Transverse and longitudinal joints for street pavement may be contraction joints, construction or expansion joints as shown on the standard plan. When the pavement abuts an existing pavement, the locations of the joints in the new pavement shall coincide with the joints in the existing pavement unless otherwise shown on the plans or specified in the special provisions.

–3.18A Formed Transverse Contraction Joints

Standard spacing of transversely formed contraction joints along straight sections of streets between through expansion joints or between intersections or other irregular areas, shall be at intervals of fifteen (15) feet across the full width of the pavement and at right angles to the center line of roadway. Where the spacing between through expansion joints are not in even multiples of 15 feet for transverse joints, the last several spaces approaching the expansion joint or header shall be varied by shortening the spaces, as directed by the Engineer. On horizontal curves the spacing of fifteen (15) feet shall be along the outer edge of the pavement.

For intersections and other irregular areas, the arrangement of contraction joints shall be placed in accordance with standard intersection patterns, or as directed by the Engineer. The area of any one irregular pattern formed by contraction joints in intersections shall not exceed two hundred twenty-five (225) square feet and the greatest dimension thereof shall not exceed sixteen and one-half (16½) feet.

When paving a second lane adjacent to the previously paved lane, the contraction joints shall be matched with the former.

Where uncontrolled cracks are existing in the first lane, they shall be matched as nearly as possible in the second lane. Should the uncontrolled cracks in the existing paved lane be too frequent or in random locations and impossible to match with a uniform spacing in the second lane, then in that event the two lanes shall be completely separated by ⅜-inch joint material extending from the surface to one (1) inch below the bottom of the concrete being placed.

Where full joint material is required to separate two paving lanes, its location shall be noted on the plans or in the special provisions and the cost thereof will be paid for at the unit bid price per linear foot.

Where integral curb or doweled curb is placed along with the concrete pavement, premolded joint filler material shall be placed in the full section of the curb in true alignment with the pavement joint and in perpendicular position.

–3.18B Construction of Formed Contraction Joints

Formed contraction joints shall be constructed by imbedding a preformed joint material. The filler shall be cut to the exact sections of the joint. The length of the premolded joint filler shall extend to within one-fourth (¼) inch of both edges of any panel.

Transverse contraction joints (dummy joints) shall be placed after compaction and finishing of concrete have been completed and before initial set. A groove shall be cut into the surface at the location of joint, using a tool provided with stops (tee iron) to prevent cutting the groove deeper than the planned depth of the joint filler. The joint filler shall then be forced into the groove until the top is flush with the pavement surface, with a deviation of not more than one-eighth (⅛) inch below the surface. The joint filler shall be at right angles to the surface and always in a straight line.

After the joint filler has been imbedded in the concrete, the surface of the pavement shall be finished against the filler strip with hand floats to restore the surface finish. While performing this operation, the filler strip must be maintained in a vertical or normal position, true to alignment. After finishing, the entire area of the joint shall be true to grade and smoothness without any irregularities.

No payment will be made for contraction joint material or its placement, and all costs thereof shall be included in the unit contract price per square yard for "Cement Concrete Pavement (class, inches)."

–3.18C Sawed Contraction Joints

Sawed contraction joints shall be constructed by sawing a vertical groove in the hardened concrete on an approved schedule after placing and before development of random cracks in the concrete slab. Transverse contraction joints shall be sawed before the longitudinal joints are sawed.

Sawed longitudinal joints in general are not critical as to a specific time schedule after hardening of the concrete and may be delayed under favorable conditions before an incidence of longitudinal random cracking begins. The Engineer shall direct the time schedule for sawing contraction joints.

Any scheduling for the sawing of joints that results in premature or uncontrolled cracking shall be revised immediately, under direction of the Engineer, by adjusting the time interval between placing of concrete and the sawing of joints. After the schedule has been approved, the sawing shall proceed as a continuous operation day and night until all joints have been completed.

Two or more sawing units may be required to accomplish the sawing in order to minimize random cracking. Standby equipment shall be on the job to ensure continuous sawing as specified regardless of any breakdown of equipment.

Where curing membrane is used, the area disturbed by sawing of joints shall be resprayed immediately upon completion of the sawing operation and care shall be exercised to prevent the curing compound from getting into the groove. Joint sealing compound will not adhere to concrete if curing compound is present.

The depth of sawed transverse contraction joints shall be a minimum of one and one-half (1½) inches. Longitudinal joints shall be sawed to a depth of not less than one-fourth (¼) the depth of the slab.

After the curing period the joints shall be cleaned and sealed with joint sealants meeting requirements in Section 37-2.13. Excess sealing material shall be cleaned off the surface of the pavement before opening to traffic.

–3.18D Transverse Construction Joints

Transverse construction joints shall be made at the end of each day's paving, or when placing of concrete is discontinued for more than 60 minutes, by placing a header board transversely across the subgrade. The header board shall be located to conform to the spacing for the transverse contraction joints (or an expansion joint) and shall be left in place until the paving is resumed. If the location of the header board is to be a contraction joint, then the header shall have fastened to the concrete side a wedge-shaped strip of wood to form a key in the concrete. Thickened edge must be constructed at the construction joint header to provide ample depth of concrete above and below the keyway. Where preformed contraction joints are used, the joint made by the construction joint header shall have a two-inch strip of joint material imbedded against the hardened concrete when paving is resumed.

Where sawed contraction joints are specified, the construction joint made by the header may be sealed or may have a two-inch strip inserted as specified herein.

No separate payment shall be made for construction joints or for the premolded joint material, extra concrete, or sealing compounds required for the construction joints. All costs therefor shall be included in the unit contract price per square yard for "Cement Concrete Pavement."

–3.18E Transverse Expansion Joints

Transverse expansion joints are placed only where shown on the plans or where directed by the Engineer.

Transverse expansion joints shall be constructed with premolded material, three-fourths inch (¾") in thickness and conforming to Section 37-2.06B. They shall extend the full width of the pavement and from one inch (1") below the subgrade to one inch (1") below the top of the pavement. The joint alignment must be at right angles to the pavement center line unless otherwise specified.

The filler material shall be held accurately in place during the placing and finishing of the concrete by a bulkhead, a holder, a metal cap or any other approved method. The joint must be at right angles to the paved surface and the holder must be in place long enough to prevent sagging of the material, especially on streets having steep grades.

In multiple lane construction, the joints shall be matched so as to form a continuous alignment over all lanes.

Expansion joints shall extend continuously through all curbs, special care being exercised to preserve alignment perpendicular to the pavement in the curb section.

A wood filler strip or metal cap shall be placed on the top of the premolded joint filler to form the groove one inch (1") deep, and it shall remain in place until after the finishing and the concrete is sufficiently set to resist sloughing into the groove. The joint filler must be stapled together at the ends to preserve continuity. Immediately after removal of side forms, the edges of the pavement shall be carefully inspected and wherever the joint filler is not fully exposed, the concrete shall be chipped down until the edge of the filler is fully exposed for the entire depth.

No additional payment will be made for expansion joint material or its placement. All cost therefor shall be included in the unit contract price per square yard for "Cement Concrete Pavement" of the required class and thickness.

–3.18F Sealing Expansion Joints

After the pavement is cured and before any traffic, the space above the top of expansion joint filler strip shall be thoroughly cleaned of all loose material. The groove three-fourths inch (¾") wide shall be completely free of any projecting concrete from the sides and the groove shall be continuous across the slab to each edge. It shall then be filled level with the pavement surface with joint sealant meeting the requirements of Section 37-2.13.

The joint sealant material shall be heated and placed

in complete accord with the manufacturer's instructions. Burned material will be rejected. The expansion joint groove shall be dry at the time of pouring the sealing compound. No additional payment will be made for the sealing filler or its application and the cost thereof shall be included in the unit contract price per square yard for "Cement Concrete Pavement" of the required class and thickness.

–3.18G Longitudinal Contraction Joints

The joints shall be constructed in true alignment with respect to their proper location on center line or parallel thereto as is shown in a succeeding subsection. No payment will be made for contraction joint material and its placement except in case of alternate bids as described in Section 39-3.18B.

–3.18H Standard Location for Longitudinal Joints

Standard location for longitudinal joints, whether contraction or construction, shall be as shown below unless otherwise specified in the plans and special provisions:

Width Curb to Curb	*Joint Locations*
25 Feet	Center line
32 Feet	Center line
36 Feet	Center line and 10 feet each side of center
40 Feet	Center line and 12 feet each side of center
44 Feet	Center line and 12 feet each side of center

In the event the roadway is divided into two lanes, the construction joints shall be located on the center line of the roadway unless otherwise approved by the Engineer. In separate lane construction, a joint filler ⅜ inch by 2 inches shall be placed between the two lanes when the second lane is constructed.

–3.18I Longitudinal Expansion Joints

Longitudinal expansion joints shall be placed where shown on the plans or where required for concrete pavement between or along retaining walls, curbs or other structures. Unless otherwise shown on the plans, longitudinal expansion joints shall be three-eighths inch (⅜") thick and of a width equal to the full depth of the pavement.

The furnishing and placing of longitudinal expansion joints, using premolded joint filler material, shall be considered as incidental to the construction of the pavement and the cost thereof shall be included in other bid items of the work unless otherwise covered in the special provisions and proposal.

39–3.19 FINISHING CONCRETE

Hand finishing or machine finishing of the entire pavement surface will be permitted unless otherwise provided in the special provisions.

On all vertical curves and at irregular intersections, modified tools shall be provided as necessary to secure a smooth, uniform contour and surface.

All tools shall be kept in first-class working order and shall be inspected daily. Worn or defective tools will not be permitted. A sufficient number of tools shall be provided for the work to proceed efficiently.

–3.19A Hand Finish

After the concrete has been struck off and consolidated, it shall be smoothed by longitudinal floating. Movement ahead shall be in successive advances of not more than one-half the length of the float. Floating shall continue until all irregularities are removed. Longitudinal floating shall follow the compaction of the concrete by not less than 30 feet. Free water on the pavement shall be removed with the float or other suitable tool.

After the final passage of the longitudinal float, transverse floating shall be continued with long handled floats operated from outside the pavement slab.

After floating, the surface shall be scraped with a grout rod at least ten (10) feet in length with a long handle for operating at the edge of the pavement. The grout rod shall be operated to correct irregularities in the pavement surface and remove water and laitance. Contraction joints shall be placed after all floating has been completed in accordance with provisions of Section 39-3.18A, Formed Transverse Contraction Joints.

–3.19B Machine Finishing

The finishing machine shall be of a type approved by the Engineer. The machine shall be adjustable to both crown and plane of the finished pavement surface. The screed shall oscillate longitudinally during its travel transversely across the pavement. It shall be operated in the forward direction so that the screed will pass over the same section of pavement at least two times during its transverse travel.

The finishing machine shall be moved over the pavement as many times as is necessary to give the pavement a smooth even texture surface, conforming to the exact crown and cross section specified on the plans.

The floating shall not be considered complete until all free water is removed from the surface.

The finishing operations shall be performed at a time and over such lengths of the pavement surface as existing conditions necessitate. All finishing operations are subject to strict control by the Engineer, and shall be performed to his satisfaction.

The surface smoothness of the completed pavement shall be tested with a ten-foot straightedge and shall meet the surface smoothness requirements specified in Section 39-3.19E.

–3.19C Edging

Before the final finishing is completed and before the concrete has taken the final set, the pavement shall be edged as indicated below.

LOCATION	RADIUS
Edge of pavement	One-half (½) inch
Formed longitudinal contraction joints	One-fourth (¼) inch
Longitudinal construction joints	One-fourth (¼) inch
Transverse construction joints	One-fourth (¼) inch
Formed transverse contraction joints	One-fourth (¼) inch
Through joints	One-half (½) inch
Curbs—back edge	One-half (½) inch
Curbs—front edge	One (1) inch

Particular attention shall be given to edge at the appropriate time. The concrete shall have attained a partial set and all free water shall have disappeared so that the edged joints will be clearly defined, with no tearing or slump of the edges.

–3.19D Final Finish

The pavement surface, after edging, shall be given a uniform, gritty texture true to grade and cross section. The final finish shall be accomplished by one of the methods described hereinafter, or as otherwise directed by the Engineer to achieve the specified surface texture.

Burlap Finish: A burlap drag at least three (3) feet wide and the length of the pavement section shall be dragged forward over the pavement surface. The burlap drag shall be wet and clean when in use. The burlap shall not be left on the pavement surface between dragging operations.

Brush Finish: After edging, the pavement shall be brushed transversely with a fiber or wire brush of a type approved by the Engineer.

Before using either the drag or the brush, the concrete shall have set sufficiently that the surface is not grooved or gouged in the finishing operation.

–3.19E Surface Smoothness

After all finishing is complete, the surface smoothness shall be checked with a straightedge ten (10) feet long, mounted to a long handle to permit operation from outside the pavement. The straightedge shall be placed on the surface of the pavement parallel to the center line and at intervals of no more than five (5) feet across the full width of the pavement. At conclusion of the finishing operation the surface of the pavement shall not vary from a true surface, when tested with a 10 foot testing straightedge, more than one-eighth (⅛) inch in 10 feet on arterials, one-fourth (¼) inch in 10 feet on residential streets, three-eighth (⅜) inch in 10 feet in alleys, and one-half (½) inch in 10 feet in concrete bases.

In no case shall the grade in the gutter be such that it will allow ponding of water. If the surface smoothness of the pavement after curing is found to exceed the tolerance permitted, the high spots shall be ground until

they meet the tolerance. If the surface tolerance cannot be met satisfactorily by grinding, then in that event the pavement shall be removed and be replaced in conformity with the specifications at the expense of the Contractor.

39–3.20 CURING AND PROTECTION

The concrete pavement shall be protected against excess loss of moisture, rapid temperature change, rain, water and mechanical injury during and immediately following the placing and finishing operations.

The concrete pavement shall be cured for the minimum number of days listed below, exclusive of the day the concrete is placed.

Portland cement	5 days
High-early-strength cement	3 days

Moist curing by sprinkling or by saturated mats, waterproof paper, white polyethylene sheeting, liquid membrane or a combination of these may be used for curing medium and shall be applied in a manner and in quantity appropriate to the particular conditions as approved by the Engineer. Pavement edges which are exposed by the removal of the forms shall be protected by the immediate application of a curing medium or moist earth.

All curing materials shall be free of all substances which are considered to be harmful to portland cement. The curing medium shall be capable of preventing checking, cracking and dry spots regardless of conditions existing at the time of placement. Concrete placement will not be permitted unless curing materials are on the job site and ready for immediate application. Failure to comply with all provisions of the curing procedures hereinafter specified will be sufficient reason to suspend all concrete operations.

–3.20A Sprinkling System

The sprinkling system shall keep the entire surface of the concrete pavement continuously wet, twenty-four (24) hours a day. Care shall be taken to avoid damage to the surface of the pavement during placement of the equipment. The water flowing off the pavement shall be wasted in a manner satisfactory to the Engineer.

–3.20B Saturated Mats

Cotton mats shall be placed over the entire area of the concrete pavement and kept saturated during the full curing period. The mats shall be lapped at all joints, and they shall be securely held in place to prevent displacement. The material which composes the mats shall conform to the requirements of Section 37-2.07.

–3.20C Waterproof Paper

The wet concrete shall first be wetted with a fine spray of water and then completely covered with a waterproof paper, lapping all joints at least twelve (12) inches. The paper shall be weighted sufficiently to prevent displacement. All tears and holes shall be repaired promptly. The waterproof paper shall conform to the requirements contained in Section 37-2.10.

–3.20D White Polyethylene Sheeting

White polyethylene sheeting shall conform to requirements contained in Section 37-2.11. The installation and maintenance of the sheeting shall be as specified for "Waterproof Paper."

–3.20E White Liquid Membrane Curing Compound

White pigmented curing compound shall conform to the requirements in Section 37-2.08. The entire surface of the pavement shall be sprayed uniformly with sufficient compound to obscure the natural color of the concrete, but not less than one gallon for each 200 square feet of area. The curing compound shall be applied immediately after the finishing is completed and all free surface water has disappeared, or after initial curing when other methods are used in combination with the liquid curing compound.

If hair checking occurs before the finishing operations are completed, the Engineer may require a fog spray as defined in Section 39-3.20H. Any mortar scraped from the pavement surface shall be wasted. When it becomes necessary to fill depressions in the pavement surface, concrete shall be brought from the mixer. Whenever the pavement surface has been disturbed after the initial application of the curing membrane, it shall be restored by respraying.

The curing compound shall be applied with pressure spraying equipment having a feed tank equipped with a mechanically driven agitator and operated with sufficient air to properly atomize the compound.

If forms are removed from the pavement prior to the end of the curing period, curing compound shall be applied to the exposed surfaces within a period of one hour.

Curing compound shall not be applied either immediately before or after a rainfall. If the curing membrane is damaged by rain, it shall be restored to the original condition by respraying.

Provision shall be made for the Engineer to ascertain the rate at which the curing compound is being applied to the pavement. The compound shall be drawn directly from manufacturer's containers bearing the manufacturer's name, brand and lot number. Before placing the compound in the spray tank, it shall be agitated thoroughly to disperse the pigment. The compound shall not be diluted with solvent or altered in any way from its original condition. If the compound has become chilled, it shall be heated but not above 100 degrees Fahrenheit.

After the compound has been applied, the curing membrane shall be protected against damage from any source, including traffic by foot or other. If any traffic is permitted, a protective cover approved by the Engineer shall be placed over the pavement not less than 24 hours after application of the compound.

The Contractor shall have readily available protective covering such as waterproof paper or plastic membrane sufficient to cover concrete pavement that can be placed in one full day.

The Contractor shall assume all liabilities for and protect the Owner from any damages or claims arising from use of materials or processes described herein.

–3.20F Transparent Liquid Curing Compound

The use of transparent liquid curing compounds shall be restricted to areas not exceeding 1,000 square yards. The compound shall meet requirements contained in Section 37-2.09. Sufficient pigment shall be present so that the sprayed compound is easily discernible. The application and the curing shall be the same as for "White Liquid Membrane Curing Compound" in Section 39-3.20E.

–3.20G Emulsified Asphalt

Concrete pavement when laid as a base for an asphalt wearing course shall be cured by spraying with an asphalt emulsion type SS-1 cut back with one or two parts of water for one part of asphalt emulsion. The amount of asphalt emulsion to be applied shall be as directed by the Engineer but not to exceed 0.10 gallon of retained asphalt per square yard.

–3.20H Curing in Hot Weather

In periods of low humidity, drying winds, or high temperatures, a fog spray shall be applied to concrete as soon after placement as conditions warrant in order to prevent the formation of shrinkage cracks. The spray shall be continued until conditions permit the application of a liquid curing membrane or other curing media. The Engineer shall make the decision when the use of a fog spray is necessary.

39–3.21 COLD WEATHER WORK

Concrete shall not be placed when the temperature is below forty (40)degrees Fahrenheit, nor shall concrete be placed on a frozen subgrade.

If, during a period of concrete placement and curing, the temperature is expected to drop to thirty (30) degrees Fahrenheit within twenty-four (24) hours in the opinion of the Engineer, all concrete not already cured for at least six (6) days shall be covered with an insulating material in a manner and to a depth which will prevent freezing of the concrete. The insulating material shall be such that it will not stain or injure the concrete. The curing period shall be extended as much time as the Engineer may determine the conditions justify.

Concrete damaged by frost action shall be replaced at the Contractor's expense.

39–3.22 CONCRETE PAVEMENT CONSTRUCTION IN SINGLE LANE

Unless otherwise shown on the plans or in special provisions, the pavement shall be constructed in single lanes. Concrete shall not be placed in a succeeding lane sooner than 48 hours after finishing of the first lane. Whenever possible, the mixer shall be operated on the subgrade or on the shoulder adjacent to the lane being paved.

If the Engineer shall deem conditions to be such as to justify the operation of a mixer and trucks upon newly paved concrete because of lack of space elsewhere, he may give permission to do so, but only under the following restrictions:

1. The concrete in the new lane shall have attained a compressive strength of twenty five hundred (2500) pounds per square inch as determined by the Engineer.
2. The surface of the new pavement shall be protected from scarring and abrasion by operating the mixer on mats, skids or other protective devices satisfactory to the Engineer. Any accumulation of concrete, sand, and gravel, or other debris deposited on the new pavement shall be completely removed as directed by the Engineer.
3. Suitable cushioning material shall be placed on the bottom of the mixer skip so that the pavement is protected against severe local shocks when the skip is lowered to the pavement to receive a new charge of materials. Lowering the skip in a careless manner will not be permitted.
4. The Contractor shall replace at his own expense any panels on the new pavement that are cracked or broken as a result of operating the mixer thereon.

A protective ramp shall be constructed at the pavement edge where vehicles may be driven on and off the pavement. The forms shall be left on the outside edge of the first lane at all turnouts until the pavement is opened to traffic.

When tie bars are specified, they shall be placed before the concrete is struck off during the last pass with the strike-off screed whether hand or machine operated. The tie bars shall be protected from traffic by bending down and back against the side form. Prior to placing the adjacent lane, the tie bars shall be straightened.

A metal strip three (3) inches wide by one-eighth (⅛) inch thick and at least five (5) feet in length shall be placed on the complete pavement lane near to the common joint with the adjacent lane to be paved, and the concrete placed in the adjacent lane shall be struck off from the plate, whether by machine or hand placement.

All roadways, shoulders, and subgrade in use by the Contractor shall be kept adequately dampened to prevent dust upon the freshly placed concrete.

39–3.23 CONCRETE BASE PAVEMENT

Cement concrete pavement, which is intended as a base for an asphalt wearing course, shall be constructed in accordance with the appropriate sections of these specifications for finished concrete pavement with the following exceptions:

(1) The surface tolerance shall be three-eighths (⅜) inch to ten (10) feet.
(2) The surface of the concrete base, if hand compacted, may be struck off with only one strike-off rod. Brushing of the surface of concrete base will not be required.
(3) The curing compound shall be an asphalt emulsion.
(4) Dummy or through joints shall not be constructed unless required in the special provisions.

39–3.24 VIBRATING SCREED CONCRETE PAVEMENT CONSTRUCTION

Refer to Section 39-3.16D.

39–3.25 TEMPORARY TRAFFIC CROSSINGS AT NEW PAVINGS (Special Provisions)

39–3.26 BARRICADES AND SAFEGUARDS

See Section 7.14.

39–3.27 OPENING PAVEMENTS TO TRAFFIC

The Contractor shall not open newly constructed cement concrete pavement to traffic until the concrete has attained a compressive strength of twenty five hundred (2500) pounds per square inch, as determined by the Engineer.

Streets with curbs shall not be opened until the curb has cured for at least 72 hours. If the curb has not attained the above-mentioned 2500 pound strength for the pavement, the Contractor shall place form lumber on the pavement two feet away from the curb, or place standard barricades and maintain them to the satisfaction of the Engineer. Such curb protection remain in place as long as may be necessary for protection of the curb.

39–3.28 CLEANUP

In addition to the cleanup specified in Section 4.08 and Section 57, the Contractor shall, before final acceptance of the work, flush the pavement clean and remove the debris. He shall also clean out all open culverts and drains, inlets, catch basins, manholes and water main valve chambers, within the limits of the project, of dirt and debris of any kind which is the result of the Contractor's operations. The cleaning and disposal of such waste material shall be considered as incidental to the construction and all costs thereof shall be included in the unit contract prices of various items of the work, unless there is included in the proposal an item for "Finishing and Cleanup," per lump sum, or per station (100').

39–3.29 EXTRA CONCRETE FOR ALLEY APPROACH RAMP

When constructing and finishing cement concrete alley pavement, the Engineer may in some cases require the Contractor to place additional concrete over the surface of the alley pavement to serve as an integral ramp or vehicular access to abutting private property. Such extra concrete shall be placed and finished to the additional thickness directed by the Engineer. Additional thickness for such ramps shall not exceed six (6) inches above the original planned concrete surface at any point.

Payment for placing and finishing such ramps will be made at the unit contract price per square yard for cement concrete pavement by increasing the area of alley pavement by the amount of area occupied by such ramp or ramps. Measurement shall be to the meet line area of each ramp placed.

39–4 MEASUREMENT AND PAYMENT

Payment will be made for such of the following bid items as are included in any particular contract:

(1) "Cement Concrete Pavement (class, thickness)," per square yard.
(2) "Cement Concrete Base Pavement (class, thickness)," per square yard.
(3) "Extra Concrete for Thickened Edge (inches × inches)," per linear foot.
(4) "Steel Reinforcing Bars," per pound.
(5) "Sawing Contraction Control Joints (depth)," per linear foot.
(6) "Extra for Furnishing High-early-strength Cement," per barrel.

39–4.01 CEMENT CONCRETE PAVEMENT

Payment for "Cement Concrete Pavement" and "Cement Concrete Base Pavement" shall be at the unit contract price for the specified class and thickness, complete in place.

Measurement for payment shall be by the square yard of concrete in place, including the area underneath curbs. No deduction will be made for castings in pavement.

The unit contract price shall be full compensation for subgrade preparation, furnishing of all labor, tools, equipment, materials excepting reinforcing steel, and for constructing, curing and protecting the cement concrete pavement.

All work, material and equipment not included in a separate unit contract price item shall be considered as incidental to the construction of the pavement and the costs thereof shall be included in the unit contract price per square yard of the cement concrete pavement.

39–4.02 EXTRA CONCRETE FOR THICKENED EDGE

Measurement and payment of "Extra Concrete for Thickened Edge (inch × inch)," shall be by the unit contract price per linear foot as measured along the face of the thickened edge.

The unit contract price per linear foot shall be full compensation for excavation and all costs of labor, tools, equipment and materials required in shaping the subgrade to the required section, and for constructing the thickened edge of the same mix and consistency as the pavement with which it will become an integral part.

39–4.03 STEEL REINFORCING BARS

Steel required for pavement reinforcement will be paid for at the unit contract price for "Steel Reinforcing Bars" which shall be full compensation for furnishing and placing steel reinforcement as detailed on the construction plans. Measurement for payment will be by the pound of steel reinforcement in place.

Reinforcing steel shown on the standard drawings and required for ties of the pavement to driveway, curb, and curb and gutter will not be paid for under the item of "Steel Reinforcing Bars," per pound. Such steel shall be considered as incidental to the construction of the pavement and all costs thereof shall be included in the unit contract price per square yard of "Cement Concrete Pavement."

39–4.04 SAWING CONTRACTION CONTROL JOINTS

Measurement for payment will be by the linear foot of contraction joint sawed, cleaned and sealed in accordance with the plans and specifications.

The unit contract price per linear foot for sawing joints shall be full compensation for all labor, equipment and materials required to saw joints to the depth specified, and the unit contract price shall include all costs of labor and material for the sealing of the sawed joint as specified.

39–4.05 EXTRA FOR FURNISHING HIGH-EARLY-STRENGTH CEMENT

If the Engineer shall direct that high-early-strength cement be used on any part of the work in lieu of standard portland cement, extra compensation will be made the Contractor in an amount per barrel equal to the difference between the price paid by him for standard portland cement and the price paid by him for high-early-strength cement.

39–4.06 COMPACTION OF SUBGRADE, EQUIPMENT

Compaction of subgrade and other parts of the contract will be considered as incidental to the construction and the expense therefor shall be included by the Contractor in other items of work unless the special provisions specify payment for compaction and the proposal includes items of compaction equipment.

Measurement and payment for such of the equipment as may be shown in the proposal will be by the hour for the following items as described in Section 15-2.01A:

1. "Variable Load Compactor," per hour.
2. "Grid Roller," per hour.
3. "Pneumatic-tired Roller," per hour.
4. "Smooth-wheeled Power Roller," per hour.
5. "Mechanical Tamper," per hour.
6. "Vibratory Compactor," per hour.

Section 40—Cement Concrete Curb, Curb and Gutter

40–1 DESCRIPTION

The construction of cement concrete curb, and curb and gutter shall be in conformance with these specifications and with the standard drawings. The particular type of curb used shall be that specified in the plans and proposal.

40–2 MATERIALS AND FORMS

40–2.01 CONCRETE

The portland cement concrete, joint filler, reinforcing steel and curing materials shall conform to specifications in Section 37, Portland Cement Concrete—Materials. Concrete mix for curbs shall conform to the requirements for Class 5(1½), but when doweled curb is constructed, Class 5 (¾) mix may be used. Slump of the concrete mix shall not exceed three and one-half (3½) inches.

40–2.02 REINFORCING STEEL AND STEEL DOWELS

See Section 111-2.01.

40–2.03 PREFORMED EXPANSION AND DUMMY JOINT FILLER

See Section 37-2.06.

40–2.04 CURING COMPOUNDS

See sections 37-2.08 and 37-2.09.

40–2.05 FORMS

Forms may be of wood or metal or any other material at the option of the Contractor, provided that the forms as set will result in a curb, or curb and gutter of the specified thickness, cross section, grade and alignment shown on the plans.

Forms shall be adequately supported to prevent deflection or any movement so that the finished construction will conform in all ways with the plans and specifications. The top of the forms shall not deviate more than one-eighth (⅛) inch in ten (10) feet, and the alignment of forms shall be within one-fourth (¼) inch in 10 feet.

Forms may be removed on the day following pour if the concrete is sufficiently set that removal will be without danger of chipping or spalling. When forms are removed before the expiration of the curing period, the edges of the concrete shall be protected with moist earth, or sprayed with curing compound. All forms shall be cleaned, oiled and be examined for defects before they are used again.

40–3 CONSTRUCTION DETAILS

40–3.01 CURBS

–3.01A Erecting Forms

Forms, wood or steel, shall be staked securely in place, true to line and grade.

Sufficient support shall be given to the form to prevent movement in any direction, resulting from the weight of the concrete or the concrete placement. Forms shall not be set until the subgrade has been compacted within one inch of the established grade. Forms shall be clean and well oiled prior to setting in place. When set, the top of the form shall not depart from grade more than one-eighth (⅛) inch when checked with a ten-foot straightedge. The alignment shall not vary more than one-fourth (¼) inch in ten (10) feet. Immediately prior to placing the concrete, forms shall be carefully inspected for proper grading, alignment and rigid construction. Adjustments and repairs as needed shall be completed before placing concrete.

–3.01B Placing Concrete

The subgrade shall be properly compacted and brought to specified grade before placing concrete. The subgrade shall be thoroughly dampened immediately prior to the placement of the concrete. Concrete shall be

spaded and tamped thoroughly into the forms to provide a dense, compacted concrete free of rock pockets. The exposed surfaces shall be floated, finished and brushed longitudinally with a fiber hair brush approved by the Engineer.

The rate of concrete placement shall not exceed the rate at which the various placing and finishing operations can be performed in accordance with these specifications.

If concrete is to be placed by the extruded method, the Contractor shall demonstrate to the satisfaction of the Engineer that the machine is capable of placing a dense, uniformly compacted concrete to exact section, line and grade.

The concrete shall meet the strength requirements as set forth in Section 37-2.02C5.

–3.01C Dowels and Keyways

Dowels and keyways shall be placed in the pavement slab as detailed on standard drawings.

Keyways shall be formed by forcing a pointed stick, two inches square, into the plastic concrete midway between each set of dowels. The dowel bars shall be set while the concrete is still plastic enough to not require hammering them into place.

In lieu of the straight dowel bar, three-eighths (⅜) inch dowel bar bent into the shape of a "U" may be used. Dimensions of this alternate dowel are shown on standard drawings. When this type of dowel is used, the keyway may be omitted.

–3.01D Stripping Forms and Finishing

The face form of the curb shall be stripped at such time in the early curing as will enable inspection and correction of all irregularities that appear thereon.

Forms shall not be removed until the concrete has set sufficiently to retain its true shape. For Type A curb, the face of the curb shall be troweled with a tool cut to the exact section of the curb and at the same time maintain the shape, grade and alignment of the curb. The exposed surface of the curb shall be brushed with a fiber hair brush.

–3.01E Curing

White pigmented or transparent curing compounds shall be applied to all exposed surfaces immediately after finishing. Transparent curing compounds shall contain a color dye of sufficient strength to render the film distinctly visible on the concrete for a minimum period of four (4) hours after application.

When the curb section is to be placed separately, the surface of the gutter directly underneath the curb section shall be covered with a protective cover to protect that area from the curing agent when the gutter is sprayed. This cover must remain in place until the curb is placed. Care shall be taken in the placing of this cover to prevent the steel dowels from puncturing the cover.

If, at any time during the curing period any of the forms are removed, a coat of curing compound shall be applied immediately to the exposed surface. The curing compound shall be applied in sufficient quantity to obscure the natural color of the concrete. Additional coats shall be applied if the Engineer determines that the coverage is not adequate. The concrete shall be cured for the minimum period of time set forth in Section 39-3.20.

–3.01F Expansion and Dummy Joints

Joints shall be constructed in the manner and at the locations shown on standard drawings. They shall be cleaned and edged as shown on the drawings and as further specified in Section 39. All expansion and contraction joints shall extend entirely through the curb section above the pavement surface. Joint filler in the curb shall be normal to the pavement and in full butt contact with pavement joint filler.

–3.01G Curb Drains

Curb drains shall be placed to vent all existing drains. Additional curb drains shall be placed as directed by the Engineer.

Curb drains shall be three (3) inches in diameter and shall be formed with metal, plastic or other suitable tubular material approved by the Engineer. Curb drains that are required shall be considered as incidental to the construction and all costs thereof shall be included by the Contractor in his unit contract price for the curb.

–3.01H Finished Work

The work shall be performed in a manner which results in a curb or curb and gutter constructed to specified line and grade, uniform in appearance and structurally sound. Curbs found with unsightly bulges, ridges, low spots in the gutter or other defects shall be removed and replaced at the Contractor's expense if the Engineer considers them to be irreparable. When checked with a ten (10) foot straightedge, grade shall not deviate more than one-eighth (⅛) inch, and alignment shall not vary more than one-fourth (¼) inch.

40–3.02 TYPE A AND TYPE B CURB

Types A and B curb may be constructed concurrently with the concrete pavement, or construction may be delayed until after the pavement slab has been placed and cured, unless otherwise noted in the special provisions. Dowels shall be placed as shown on standard drawing.

Types A or B curb, when placed separately, may be constructed with conventional forms as described herein, or by the extruded method if so provided for in the special provisions. If constructed by the extruded method, the curb shall conform in all respects to the requirements of Section 40-3.01H.

In transporting concrete over the new pavement slab to construct Type A or Type B curb, if ready-mix concrete trucks are used, the concrete shall have attained a compressive strength of 2,500 lbs. or a flexural strength of 500 psi using test specimens cured under the same conditions as the concrete pavement.

If concrete buggies are used, at least 48 hours shall have elapsed between the placing of the new pavement slab and the start of curb construction. Damage to the liquid curing membrane on the pavement surface resulting from the curb construction shall be repaired by spraying the damaged area with curing compound.

40–3.03 TYPE C AND TYPE D LOW CURB

Type C low curb shall be constructed at the time the concrete pavement is placed.

Where Type D low curb is used as a driveway crossing, and if the curb is to be constructed separately, then the concrete pavement or concrete gutter section shall be blocked out to provide for later installation of the curb. For details of construction see standard drawings.

40–3.04 TYPE E SEPARATE CURB

Type E curb may have the batter on the front or on the back side, whichever the Engineer may direct. See standard drawing for construction details. Excavation required shall be considered as incidental to the cost of the curb and no payment will be made therefore.

40–3.05 TRANSITIONAL CURB

Transitional curb shall be constructed monolithically with the pavement slab on which it is located. The curb shall be carefully shaped to blend in with existing or new construction. Dowels and keyways are not required.

40–3.06 CURB AND GUTTER

Curb and gutter shall be constructed on a compacted subgrade prepared in accordance with applicable subgrade specifications for cement concrete pavement in Section 39. The placing, consolidating, jointing, finishing and curing of the concrete shall comply with the requirements for concrete curb as specified in Section 40-3.01, except that the top of the gutter shall be steel troweled and fiber brushed parallel to the curb.

Curb and gutter may be constructed by the extruded method only if such construction is called for in the special provisions. The curb and gutter may be extruded as a unit, or the curb may be extruded upon the gutter section in which case steel dowels and keyways shall be provided as specified in Section 40-3.01C.

40–4 MEASUREMENT AND PAYMENT

Measurement and payment will be made for such of the following bid items as may appear in the proposal:

1. "Cement Concrete Curb, Type ....," per linear foot.
2. "Cement Concrete Curb and Gutter, Type ....," per linear foot.
3. "Cement Concrete Transitional Curb," per linear foot.
4. "Extra for Furnishing High-early-strength Cement," per barrel.

Concrete curb and curb and gutter will be measured by the linear foot along the face of curb for the actual length constructed.

Curbs types A, B, C, D and the transitional curb do not include the pavement slab upon which they are placed. That portion of the pavement slab underneath the curb will be paid for as concrete pavement.

The unit contract prices for the above items shall be full compensation for furnishing all labor, materials, equipment, work, and incidentals necessary to construct the various types of curb, and curb and gutter in accordance with the requirements of the specifications. Excavation, select materials, and other work items will be paid for by applicable bid items in the proposal.

Section 41—Cement Concrete Driveway and Alley Return

41–1 DESCRIPTION

Cement concrete driveway and alley returns shall be constructed at the locations shown on the construction plans and where directed by the Engineer, and shall be in accordance with these specifications and standard drawings.

The number of private driveways may be increased over that shown on the construction plans, if required by the Engineer. Sufficient notice of the additional installations shall be given by the Engineer to enable the Contractor to schedule the private driveways along with other construction in the same general area without moving equipment back for the purpose.

The particular type of driveway or alley return to be used shall be that which is specified in the plans and included in the proposal.

41–2 MATERIALS

The portland cement concrete, joint filler, reinforcing steel and curing materials shall conform to requirements outlined in Section 37, Portland Cement Concrete—Materials. The concrete mix shall be as specified for Class 5 (1½), and the slump of the concrete shall not exceed three and one-half (3½) inches.

41–3 CONSTRUCTION DETAILS

41–3.01 EXCAVATION AND SUBGRADE

Excavation for driveways and alley returns shall be considered incidental to the construction of the driveway, and no payment will be made the Contractor therefor.

Where directed by the Engineer, unsuitable material in the subgrade shall be removed to a specific depth and backfilled with select materials which shall be compacted by Method B, as specified in Section 13-3.10E3. Payment for excavation below grade and additional selected materials will be paid for under the unit contract prices for "common excavation" and "ballast," respectively.

Payment will not be allowed for excavation below grade nor for the additional backfill materials required to compensate for excavation below the required depth resulting from negligence of the Contractor.

Subgrade preparation for driveways and the required compaction shall conform to the applicable requirements in Section 15-2.02 to provide a firm, unyielding subgrade, acceptable to the Engineer.

41–3.02 FORMS AND FINE GRADING

Forms for the straight sections of the driveway or alley return shall have a minimum thickness of two (2) inches and be equal to the nominal depth of the concrete. Plywood or one (1) inch lumber may be used on radii. All forms shall be securely staked and blocked to true line and grade.

A template shall be set upon the forms and the subgrade shall be fine graded to conform to the required section. The subgrade shall then be compacted to the approval of the Engineer. Prior to placement of the concrete, the subgrade shall be thoroughly dampened.

41–3.03 PLACING AND FINISHING CEMENT CONCRETE PAVEMENT

The concrete shall be spread uniformly between the forms and thoroughly compacted with an approved type of strikeboard. Through joints and dummy joints shall be located and constructed in accordance with applicable standard drawings. In the construction of through joints, the premolded joint filler shall be adequately supported until the concrete is placed on both sides of the joint.

Dummy joints shall be formed with a tee bar by first cutting a groove in the concrete to a depth equal to, but not greater than the joint filler material and then working the premolded joint filler into the groove. Premolded joint filler for both through and dummy joints shall be positioned in true alignment and at right angles to the center line of the driveway or alley return.

After the concrete has been thoroughly compacted and leveled, it shall be floated with wood floats and finished at the proper time with a steel float. Joints shall be edged with one-fourth (¼) inch radius edger and the driveway or alley return edges shall be tooled with one-half (½) inch radius edger.

The surface shall be brushed in a transverse direction in relation to the center line of the driveway or alley return with a fiber hair brush of approved type.

Driveways and alley returns shall not be constructed at the same time the pavement is placed unless authorized by the Engineer.

41–3.04 CURING AND PROTECTION

The curing materials and procedures defined in sections 37 and 39 shall be used. The driveway and the alley return shall be protected against damage or defacement of any kind until acceptance by the Owner. Any driveway or alley return not acceptable, in the opinion of the Engineer because of damage or defacement, shall be removed and be replaced by the Contractor at his expense.

Before placing any concrete, the Contractor shall have on the job site enough protective paper to cover the pour of an entire day, in event of rain or other unsuitable weather conditions.

41–4 MEASUREMENT

Measurement for cement concrete driveway and for alley return will be made by the square yard for the class and thickness of concrete placed, and will be measured as shown on the standard plans.

Measurement for cement concrete transitional curb will be by the linear foot for curb constructed.

Measurement for cement concrete curb Type D will be by the linear foot, radius point to radius point through the driveway for curb constructed.

41–5 PAYMENT

Payment will be made for such of the following bid items as are included in the contract:

1. "Cement Concrete Driveway (thickness, class)," per square yard.
2. "Cement Concrete Transitional Curb," per linear foot.
3. "Cement Concrete Curb Type D," per linear foot.

The unit contract prices shall be full compensation for all labor, tools, equipment and materials required to perform the work as specified. Any work which is essential to the construction but for which no bid item is included in the proposal shall be considered as incidental and the costs thereof shall be included in the pay items of the proposal.

Section 42—Cement Concrete Sidewalks

42–1 DESCRIPTION

Cement concrete sidewalks shall be constructed in compliance with these specifications and the standard drawings. The particular type of sidewalk to be used will be that specified in the plan and proposal.

42–2 MATERIALS

The portland cement concrete, joint filler, reinforcing steel and curing materials shall conform to the requirements specified in Section 37, Portland Cement Concrete—Materials. The concrete mix for sidewalk shall conform to the requirements for Class 5 (1½). Slump of the concrete mix shall not exceed three and one-half (3½) inches.

42–3 CONSTRUCTION DETAILS

42–3.01 EXCAVATION AND SUBGRADE

Excavation for sidewalks shall be considered as "Unclassified Excavation," as described in Section 13-1.01, unless otherwise provided for in the special provisions. Where directed by the Engineer, unsuitable material in the subgrade shall be removed to a specific depth and then backfilled with selected materials. Payment will not be allowed for excavation below grade and for backfill materials required when such excavation is caused by negligence of the Contractor.

Embankments shall be compacted by Method B as specified in Section 13-3.10E3. Equipment used for the compaction of this embankment shall meet requirements described in Section 15-2.01A. In areas that are inaccessible to normal compaction equipment, approved tampers shall be used.

Before the forms are set, the subgrade shall be graded to within one (1) inch of established grade and the area between the sidewalk and the adjacent private property line shall be shaped to line, grade, and section shown on the construction plans.

42–3.02 FORMS AND FINE GRADING

Forms shall conform to requirements outlined in Section 39. Wood forms shall be two (2) inches by four (4) inches and in lengths of not less than ten (10) feet. Steel forms may be used upon approval of the Engineer. Forms shall be staked to a true line and grade. A subgrade template shall then be set upon the forms and the fine grading completed so that the subgrade will be a minimum of three and five-eighths (3⅜) inches below the top of the forms.

Low areas in the subgrade shall be backfilled with select materials or with suitable native material as directed by the Engineer. The backfill shall then be compacted to the satisfaction of the Engineer and any high areas in the subgrade shall be cut down to meet the subgrade requirements specified above. The subgrade shall be thoroughly dampened prior to the time the concrete is placed. No payment will be made for water and the work of placing and cost thereof shall be considered as incidental to the construction of the concrete sidewalk.

42–3.03 PLACING AND FINISHING CEMENT CONCRETE SIDEWALK

The concrete shall be spread uniformly between the forms and thoroughly compacted with a steel shod strikeboard. Through joints and dummy joints shall be located and constructed in accordance with standard drawing. In construction of through joints, the premolded joint filler shall be adequately supported until the concrete is placed on both sides of the joint.

Dummy joints shall be formed by first cutting a groove in the concrete with a tee bar of a depth equal to, but not greater than the joint filler material, and then working the premolded joint filler into the groove. Premolded joint filler for both through and dummy joints shall be positioned in true alignment at right angles to the line of the sidewalk and be normal to and flush with the surface. Where the sidewalk will be contiguous with the curb, it shall be constructed with a thickened edge as shown on standard drawing.

After the concrete has been thoroughly compacted and leveled, it shall be floated with wood floats and finished at the proper time with a steel float. Joints shall be edged with a ¼-inch radius edger and the sidewalk edges shall be tooled with a ½-inch radius edger.

Depending on the type, the sidewalk shall be divided into panels by scoring one-fourth (¼) inch deep in the manner shown on the standard drawing.

The surface shall be brushed with a fiber hair brush of an approved type in a transverse direction except that at driveway and alley crossings it shall be brushed longitudinally. The placing and finishing of all sidewalk shall be performed under the control of the Engineer, and the tools used shall meet with his approval.

Additional requirements for placing and finishing concrete in cold weather shall be as outlined in Section 39-3.21.

42–3.04 CURING AND PROTECTION

The curing materials and procedures outlined in Section 39-3.20 shall prevail, except that white pigmented curing compound shall not be used on sidewalks. The curing agent shall be applied immediately after brushing and be maintained for a period of five (5) days.

The Contractor shall have readily available sufficient protective covering, such as waterproof paper or plastic membrane, to cover the pour of an entire day in event of rain or other unsuitable weather.

The sidewalk shall be protected against damage or defacement of any kind until it has been accepted by the Owner. Sidewalk which is not acceptable to the Engineer because of damage or defacement, shall be removed and replaced at the expense of the Contractor.

Additional requirements for curing in hot weather shall be as outlined in Section 39-3.20H. Additional requirements for curing in cold weather shall be as outlined in Section 39-3.21.

42–4 MEASUREMENT

Measurement for cement concrete sidewalk will be by the square yard for all surface of concrete walk placed. Measurement for thickened edge of sidewalk will be by the linear foot for the distance thickened.

42–5 PAYMENT

Payment will be made for such of the following bid items as are included in the contract:

1. "Cement Concrete Sidewalk Type A," per square yard.
2. "Cement Concrete Sidewalk Type B," per square yard.
3. "Type A Thickened Edge for Sidewalk," per linear foot.
4. "Extra for Furnishing High-early-strength Cement," per barrel.

The unit contract prices shall be full compensation for all labor, tools, equipment and materials required to perform the work as specified. Any work which is essential to the construction but for which no bid item is included in the proposal shall be considered as incidental and the costs thereof shall be included in the pay items of the proposal.

Excavation, selected materials, water and compaction will be measured and paid for in accordance with applicable sections of the specifications only if they are set up among the items in the proposal; otherwise, the work and materials involved shall be considered as incidental to the sidewalk construction and the costs thereof shall be included in the bid items of the proposal.

Section 43—Cement Concrete Combined Sidewalk Curb and Gutter

43–1 DESCRIPTION

Cement concrete combined sidewalk, curb and gutter, and combined cement concrete curb and sidewalk shall be constructed in accordance with these specifications and the standard drawing. The type of construction to be used and the location will be as shown on the construction plans, or as directed by the Engineer, and shall be in accordance with the provisions of this section.

43–2 MATERIALS

Portland cement concrete, joint filler, reinforcing steel and curing materials shall conform to the requirements in Section 37, Portland Cement Concrete—Materials. The concrete mix shall conform to the requirements for Class 5 (1½). Slump of the concrete mix shall not exceed three and one-half (3½)inches.

43–3 CONSTRUCTION DETAILS

43–3.01 GENERAL

The curb and gutter section shall be placed prior to the placement of the sidewalk section unless otherwise directed by the Engineer. Basic construction shall conform to Section 42, "Cement Concrete Sidewalk," and Section 40, "Cement Concrete Curbs, Curb and Gutter."

43–3.02 EXCAVATION AND SUBGRADE

Excavation and subgrade shall be as defined in Section 42-3.01.

43–3.03 FORMS AND FINE GRADING

Forms and fine grading shall be as defined in sections 42-3.02 and 40-3.01A.

43–3.04 PLACING AND FINISHING CONCRETE

Placing and finishing concrete shall be as defined in sections 42-3.03 and 40-3.01B.

43–3.05 DOWELS AND KEYWAYS

Dowels and keyways, where called for in the special provisions or directed by the Engineer, shall be as defined in Section 40-3.01C and as shown on the standard drawing.

43–3.06 STRIPPING FORMS AND FINISHING

Stripping forms and finishing shall be as defined in Section 40-3.01D.

43–3.07 CURING AND PROTECTION

Curing shall be as defined in sections 42-3.04 and 40-3.01E.

43–4 MEASUREMENT

For purposes of measurement and payment, the "Cement Concrete Combined Sidewalk, Curb and Gutter" shall be considered as three component sections.

The first component, "cement concrete sidewalk," shall comprise that portion of the combined section beginning six (6) inches behind face of curb and shall be the actual square yards of sidewalk constructed.

The second component, "curb and gutter," shall comprise that portion of the combined section beginning at back of curb and through the gutter section, and shall be the actual linear feet of curb and gutter constructed.

The third component, "thickened edge," shall comprise the triangular portion of the combined section below the bottom of sidewalk and butting the back of the curb and gutter section. The thickened edge shall be actual length in linear feet of thickened edge constructed.

Measurement for combined cement concrete curb and sidewalk shall be made as shown on the standard drawing.

43–5 PAYMENT

Payment will be made for such of the following bid items as are included in any particular contract:

1. "Cement Concrete Sidewalk Type A," per square yard.
2. "Cement Concrete Sidewalk Type B," per square yard.
3. "Cement Concrete Curb and Gutter Type A," per linear foot.
4. "Cement Concrete Curb and Gutter Type B," per linear foot.
5. "Type A Thickened Edge for Sidewalk," per linear foot.
6. "Extra for Furnishing High-early-strength Cement," per barrel.

The unit contract prices for the above items shall be full compensation for all labor, materials and equipment and incidentals in the construction of them in accordance with specifications and standard drawing.

Excavation, selected materials, water and compaction will be measured and paid for in accordance with specifications in applicable sections only when they are included in the bid proposal; otherwise, the work and materials involved shall be considered as incidental to the construction and all costs thereof shall be included in bid items of the proposal.

Section 44—Precast Concrete Traffic Curb Class I, Traffic Buttons, and Extruded Traffic Curb

44–1 DESCRIPTION

Precast concrete traffic curb Class I, precast traffic buttons, and extruded traffic curb shall be constructed in accordance with the design standards, or as shown on the plans and shall be placed in locations shown on the plans, or as directed by the Engineer.

44–2 MATERIALS

44–2.01 PRECAST CONCRETE TRAFFIC CURB CLASS I, AND TRAFFIC BUTTONS

The cement, fine and coarse aggregates, and reinforcing steel shall conform to the following requirements:

The cement shall conform to the requirements for either Type I or Type III of the standard specifications for Portland Cement, AASHO Designation M 85.

The aggregate shall be a granular material uniformly graded up to a maximum size of ⅜ inch and shall contain sufficient fine fractions to permit securing the type of surface finish specified herein. The aggregate shall be approved by a materials laboratory or by the Engineer before it is used.

Reinforcing steel shall conform to the requirements of Section 37-2.04.

44–2.02 ALUMINUM COVERED TRAFFIC BUTTONS

Aluminum covered traffic buttons shall conform to the details shown on the standard drawing and to the following additional material requirements:

The cement shall conform to the requirements for either Type I or Type III of the standard specifications for Portland Cement, AASHO Designation M 85.

The aggregate shall be a granular material uniformly graded up to a maximum size of three-eighths (⅜) inch.

The cement concrete mix shall be composed of not less than one (1) part portland cement to approximately two (2) parts of sand and three and one-fourth (3¼) parts of coarse aggregate adjusted to secure proper workability. The contractor will be allowed to use a different concrete mix if approved by the Engineer, provided that it develops not less than 4,000 pounds per square inch compressive strength when tested at the age of 28 days.

44–2.03 EXTRUDED TRAFFIC CURB

Extruded traffic curb shall be constructed with a cement concrete mix that will have a dense, uniform

texture which will not sag or displace behind the machine.

The concrete mix shall be proportioned as follows:

Sacks of cement per cubic yard	6.5
Pounds of dry fine aggregate per sack of cement	245
Pounds of dry ¾" maximum coarse aggregate per sack of cement	238
Slump (ASTM Designation C 143)	Not over one inch

The ¾" maximum coarse aggregate shall meet all requirements of Section 39 except that it shall meet the following requirements for grading:

Passing 1" square screen	100%
Passing ¾" square screen	95-100%
Passing ⅜" square screen	20- 40%
Passing U. S. No. 4 sieve	0- 3%

The Contractor will be allowed to use a different concrete mix if approved by the Engineer, provided that it develops not less than 4,000 pounds per square inch compressive strength at 28 days. It is the intent of these specifications to provide a concrete mix having such characteristics of mobility and workability that it can be extruded without slumping, deforming or displacing. The finished curb shall have a dense, smooth and uniform surface texture and shall develop a minimum of shrinkage cracks upon curing.

44–3 CONSTRUCTION DETAILS

44–3.01 PRECAST CONCRETE TRAFFIC CURB AND TRAFFIC BUTTONS

–3.01A Manufacture

–3.01A1 Proportioning

The cement concrete mix shall be composed of not less than one (1) part portland cement to approximately two (2) parts of sand and three and one-fourth (3¼) parts of coarse aggregate (1:2:3¼). The ratio of fine and coarse aggregates may be adjusted to secure proper workability.

The Contractor may use a different concrete mix if approved by the Engineer, provided it develops not less than 4000 pounds per square inch compressive strength when tested at the age of 28 days.

–3.01A2 Mixing

The mixers shall be kept in good repair and be equipped with an automatic timing device and a positive device for regulating the quantity of water added to each batch. Such device must be approved by the Engineer before use.

After all materials, including water, have been placed in the mixer, the materials shall be mixed for a period of not less than 1¾ minutes, or as much longer as may be necessary to produce a thorough and uniform mixture of the concrete. No water shall be added to any batch after the completion of the initial mixing period. Each batch of concrete shall be completely emptied from the mixer before placing more materials in it. A batch which has not been placed within 30 minutes from the time water was first added, shall not be used.

The amount of water in the concrete shall be kept at a minimum consistent with the manufacture of dense curb, free from air bubbles and surface defects in excess of the tolerance limits herein specified.

–3.01A3 Forms

Forms shall be of concrete or steel. The use of forms or molds made of plaster of paris, wood, or other absorptive material will not be permitted.

Bulkheads shall be tight fitting so that there is no leakage of mortar between the bulkhead and form.

The materials and methods used for lubricating the forms shall be such as will not result in discoloration of the curb at any time. A minimum quantity of lubricant shall be used and all excess shall be removed.

–3.01A4 Placing Concrete

The concrete shall be consolidated by external vibration, or by other means if approved by the Engineer, so as to produce a dense concrete throughout having a minimum of air bubbles and honey-combing.

Reinforcing steel shall be placed and maintained in its proper position as shown in the standard drawing.

Curb or buttons shall not be manufactured in an atmospheric temperature of less than 50° Fahr.

–3.01A5 Removal of Forms

The curb shall be removed from the molds or forms in accordance with the instructions pertaining thereto, or by some other method acceptable to the Engineer. Failure to remove the curb from the molds in accordance with the instructions issued by the Engineer, or removal by any method which, in the opinion of the Engineer, is detrimental to the curb will be cause for rejection of the curb.

The loosening of the curb or buttons from the molds shall be carefully performed to avoid excessive shock and straining of the curb and buttons. When, in the opinion of the Engineer, undue shock is required to remove the curb from the molds, the stripping operation shall be deferred until such time as the curb may be removed without breakage.

–3.01A6 Curing Concrete

Immediately after the concrete has been placed and consolidated in the mold each unit shall be placed in a curing room fitted with water sprays and maintained at a relative humidity of not less than 90% and a temperature of not less than 60 degrees Fahr., nor more than 100 degrees Fahr. Each unit shall remain in the curing room for a period of not less than ten (10) days except that if high-early-strength cement is used the period in the curing room may be reduced to five (5) days.

–3.01A7 Finish

The buttons shall be white. Both curb and buttons shall have a smooth, glassy finish on all exposed surfaces.

Excess honey-combing in the back of the curb may be cause for rejection of the curb. Honey-combing areas in the back of the curb which, in the opinion of the Engineer, are not detrimental to the curb need not be patched. The workmanship of the bottom finish shall be such that no mechanical interlocking of the mortar bed and the curb bottom or anchor groove will occur.

–3.01A8 Surface Treatment

As soon as the units have been taken out of the curing room the curb shall be placed in a drying room and thoroughly surface dried to a depth of at least one-fourth (¼) inch, and then one coat of an approved water-repellent compound shall be flowed on with a brush.

When the first coat has dried, a second coat of water-repellent compound shall be applied. The water-repellent compound shall be approved by a materials laboratory, or by the Engineer before it is used.

The water-repellent compound shall be a clear, penetrating type silicone resin base compound containing no filler or other material which will leave a film on the surface of the masonry after it is applied. It shall be of such consistency that it can be readily applied by brush or spray to the masonry at atmospheric temperature down to -20° Fahr.

The average absorption of three test specimens treated with the water-repellent compound, when tested in accordance with the methods used in the materials laboratory, shall not exceed two percent (2%) after being partially immersed in water for 72 hours immediately after curing.

The average moisture vapor transpiration (breathing) of three test specimens, when tested in accordance with the methods used in the materials laboratory, shall not be less than 50% at seven days.

–3.01A9 Dimensions and Shape

The curb shall be manufactured according to the dimension and shape shown on the standard drawing within a tolerance of ¼" in length and ⅛" in alignment.

–3.01A10 Curb Lengths

The curb shall be made and laid in pieces not less than five (5) feet nor greater than nine (9) feet in length, except in special instances where shorter lengths

are required. However, no curb piece less than four (4) feet in length shall be laid without the approval of the Engineer. Circular curbing shall be made only for such radii as called for on detail plans. For radii from 100 feet to 600 feet the curb shall be in straight pieces with beveled ends as shown on plans, the length of which shall vary between four and eight feet, as required. For any radius greater than 600 feet the curb pieces shall be straight and the ends shall be square.

–3.01A11 Defective Curb

Not more than two (2) percent of the top area in any one piece of curb shall be defective and not more than five (5) percent of the total length of the top corners of reflecting faces in any one piece of curb shall be broken or rounded. There shall be not more than 30 air holes in any linear foot of curb nor more than 50 in any three (3) linear feet of curb. All curb having defects in excess of any of the above will be rejected immediately upon inspection after removal from the forms. However, failure to reject the curb at that time will not assure its final acceptance. Ninety (90) percent of the curb laid shall have not more than ten (10) percent of the maximum allowable number of defects specified above.

An air hole shall be defined as any hole ½ inch or larger in diameter or depth.

All defects within the limits herein permitted, apparent upon removal of forms, shall be repaired immediately thereafter.

The sum of the lengths of the lines of discoloration caused by a cracked mold in any one piece of curb shall not exceed fifty (50) percent of the length of the curb, and the maximum length of any single line of discoloration shall not exceed eighteen (18) inches. Seventy-five (75) percent of the curb laid shall be entirely free from lines of discoloration. The employment of means involving the use of heat to obliterate lines of discoloration will not be permitted. Any means utilized to obliterate lines of discoloration shall be subject to the approval of the Engineer.

The repairing of molds which are chipped or broken shall be done in such a manner that the broken or chipped areas will not be apparent on the curb made in these molds.

All curb in which surface checking develops during the first five (5) days after manufacture will be rejected.

Hidden air holes at or immediately below the exposed surface of the curb, in excess of the limits specified herein, which are disclosed by testing the surface by means of a rubber hammer will be cause for rejection of the curb.

All curb in which cracking is in evidence immediately after removal from the molds will be rejected. A crack is defined as any separation of the concrete of a continuous length greater than three (3) inches.

All curb which varies in dimensions, alignment, or surface contour in excess of the tolerance specified herein will be rejected.

Not more than one (1) square inch of gray concrete shall be apparent in any one location in the exposed surface of the curb and the total area of the gray concrete showing through shall not exceed four (4) square inches for any piece of curb. Not more than 16 square inches of the exposed surface of any piece of curb shall be discolored by reason of the gray concrete mixing with the white concrete. At least 75 percent of the curb pieces laid shall be entirely free from discoloration.

Failure to comply with the plans, specifications or instructions of the authorized representative of the Owner in the manufacture and laying of any curb will be cause for rejection of such curb.

–3.01A12 Repairing Curb

Curb having defects which are not sufficient cause for its rejection shall be neatly repaired immediately after removal from the molds, in a manner subject to the approval of the Engineer. However, no patching or other repairs shall be made without the permission of the inspector. Patches shall be undercut if, in the opinion of the inspector, this operation is necessary to cause the patch to remain.

All holes larger than one-sixteenth (1/16) inch diameter in the exposed surface of acceptable curb or buttons shall be filled with cement mortar.

–3.01A13 Identification Marking

The date of manufacture, the length and the identification number corresponding to the detail layout shall be stenciled in black paint on the back or end of each piece of curb.

Rejected curb or buttons shall be marked on the back or end surfaces in a practicable and semi-permanent manner to identify each cause of rejection.

–3.01A14 Shipping

No unit of curb or buttons shall be shipped from the manufacturing plant prior to 21 days after manufacture, excepting however, that if Type III cement has been used the units may be shipped 14 days after manufacture.

–3.01A15 Samples

The Contractor shall submit, for the approval of the Engineer, an advance sample of curb or button which shall be at least equivalent in color, surface texture, and bottom finish to the standard as set forth in these specifications. No repairing of any kind shall be done to the advance sample. Upon approval, the advance sample shall be stored at the plant or site of manufacture in a location readily accessible to the inspector where there is adequate daylight for examination. The advance sample shall be protected from damage and discoloration, and shall be used as a standard of comparison for color, surface texture, and bottom finish for all curb manufactured. All curb and buttons furnished for this contract shall be at least equivalent thereto in the foregoing respects.

–3.01A16 Inspection at Plant

The inspection at the plant will be made just prior to shipment, at which time examination will be made of the alignment, contour, color, cracks, surface damage or discoloration, broken corners or edges, and any other defects which may have developed, and to check with the laboratory test reports for strength. Intermediate inspections, however, may be made to determine surface checking and hidden air holes if it is impractical to examine for these defects at the final inspection.

–3.01B Installation of Curbs

–3.01B1 Nosings

Where curb nosings are to be placed on asphalt pavement the Contractor will be required to construct a recess two (2) inches deep and six (6) inches in width, continuous under each nose piece only. No recess will be required except under nose pieces.

–3.01B2 Joints

Except where expansion joints are to be placed as designated by the Engineer, all joints between adjacent pieces of curb shall be filled with mortar composed of one part portland cement and two parts sand.

The joints between adjacent units of block traffic curb will not require mortaring.

–3.01B3 Bedding

The curb shall be firmly bedded for its entire length and breadth on a mortar bed composed of one (1) part portland cement and two (2) parts of concrete sand. The anchor grooves in the bottom of the curb shall be entirely filled with the mortar.

–3.01B4 Alignment

The alignment and the top surface of adjoining sections of curb shall be true and even within a maximum tolerance of one-sixteenth (1/16) inch.

–3.01B5 Cleaning Pavement

Before the cement mortar bed is laid, all dirt shall be cleaned from the pavement surface by washing.

All old pavements and any portion of new pavements constructed under this contract, which are covered with oil or grease within the curb limits, shall be further cleaned as follows:

1. The concrete shall be flushed with water.
2. While the concrete is still wet, sodium metasilicate, complying with the requirements as specified else-

where herein shall be evenly distributed over the pavement surface at a rate of 1 to 2 pounds per 100 square feet of pavement surface.

3. The sodium metasilicate shall remain on the pavement for at least 15 minutes. Where patches of oil, tar or grease occur these areas shall be scrubbed with a brush or broom.
4. The pavement surface shall be thoroughly rinsed.

–3.01B6 Sodium Metasilicate

Sodium metasilicate shall comply with ASTM Designation D 537.

–3.01B7 Layout Design

Before starting manufacture of curb for any project, the manufacturer shall make a complete detailed layout of each island and submit the same in duplicate to the Engineer for his approval. The Engineer will mark necessary corrections on the drawings and return one to the manufacturer. The manufacturer shall then make corrected layout drawings and furnish one copy to the Engineer and two copies to the Contractor.

–3.01C INSTALLATION OF BUTTONS

Precast concrete traffic buttons shall be attached to the pavement by placing a tack coat of hot asphaltic cement on the pavement and firmly pressing the traffic buttons onto it.

44–3.02 EXTRUDED TRAFFIC CURB

Where the extruded curb is to be constructed, the existing pavement shall be swept clean of all drippings from cars, grease, dirt and any other matter found objectionable by the Engineer.

The curb shall be placed, shaped and compacted true to line and grade with an approved machine capable of shaping and thoroughly compacting the material to the required cross section as shown on the plans. Where the length of curb is more than 200 feet, drainage openings two (2) feet in width shall be provided at 200-foot intervals along the curb.

The extruded traffic curb shall be protected from traffic for a period of 48 hours by the use of sufficient portable barricades, and by lighted bombs or flashing light of a type approved by the Engineer, during the hours of darkness.

All additional costs required to hand form the curb at the terminals shall be included in the unit contract price per linear foot.

–3.02A Joints in Extruded Curb

Through joints shall be made at all points of tangents to returns, and not to exceed 15-foot intervals elsewhere. The through joints shall be made by hand sawing through the entire curb section so it will be clearly opened throughout while the concrete is yet in plastic state. The cut shall be neatly dressed. No filler will be required. The work of sawing and dressing joints shall be considered as incidental to the construction of the extruded traffic curb and all costs incurred shall be included in the unit contract price per linear foot of "Extruded Traffic Curb."

44–4 MEASUREMENT

Type A traffic curb will be measured along the front face of the curb and returns. Type C traffic curb will be measured along the axis of the curb. Nosing pieces and dividers will be measured as Type A and Type C, respectively. The unit of measurement for curbs shall be the "linear foot."

Precast traffic buttons will be measured by "each."

Aluminum-covered traffic buttons will be measured by "each."

Extruded traffic curb will be measured by the "linear foot," along the axis of the curb.

44–5 PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract:

1. "Type A Precast Traffic Curb Class I," per linear foot.
2. "Type C Precast Traffic Curb Class I," per linear foot.
3. "Precast Concrete Traffic Button," per each.
4. "Aluminum-covered Traffic Button," per each.
5. "Extruded Traffic Curb," per linear foot.

The unit contract price for each of the above bid items shall be full compensation for all costs of labor, tools and materials and for complete installation in accordance with the standard drawings and specifications.

Section 45—Block Precast Traffic Curb Class II

45–1 DESCRIPTION

Block precast traffic curb shall be constructed at the location shown on the plans and in accordance with the details as shown on the standard drawing. In construction of the block precast traffic curb, the Contractor shall have the option of using either length of block shown in the standard drawing, provided the same length of block is used throughout the entire project.

45–2 MATERIALS

The curb units shall be made from portland cement and high quality sand and gravel, the proportions of which will be left to the discretion of the producer as long as the unit develops a minimum compressive strength of 4,000 psi at 28 days when tested for end loading.

45–3 CONSTRUCTION DETAILS

The proportions of sand, gravel and cement, the type of forms used, and the method of compacting the concrete in the forms shall all be such that a dense, smooth and uniform a surface as is practicable for a concrete masonry unit will be obtained on the finished curb units. The faces that are to be exposed shall be free from chips, cracks, air holes, honeycomb or other imperfections except that if there be no more than five (5) percent of the curb units having slight cracks, small chips not larger than ½ inch, or air holes not more than ½ inch in diameter or depth, the imperfections will not be deemed grounds for rejection.

Special reflector blocks shall be installed at spacings noted in the block precast traffic curb detail shown in the standard drawing.

45–3.01 INSTALLATION

The curb shall be installed in accordance with Section 44-3.01B except that the joints between the adjacent units will not be filled with mortar.

After the curb is installed, it shall be covered with one full brush coat of water-repellent compound, meeting the requirements of Section 44-3.01A8. The surface of the curb shall be dry when the water-repellant compound is applied.

45–4 MEASUREMENT

Block precast traffic curb will be measured by the linear foot along the front face of the curb and returns. Type C traffic curb will be measured by the linear foot along the axis of the curb. Nosing pieces and dividers will be measured as Type A and Type C, respectively.

45–5 PAYMENT

Payment will be made for such of the following bid items as are shown in any particular contract:

1. "Block Precast Traffic Curb, Class II, Type A," per linear foot.
2. "Block Precast Traffic Curb, Class II, Type C," per linear foot.

The unit contract price for each of the above items shall be full compensation for all costs of labor, tools and materials and for complete installation in accordance with the standard drawings and specifications.

Section 46—Illuminated Terminal Nosing

46–1 DESCRIPTION

The work to be performed consists of furnishing and installing all necessary materials to complete in place the illuminated terminal nosing Type 1 or Type 2 as shown on the plans and as specified in the standard drawings and specifications.

Included in the work is the furnishing and placing of the terminal nose castings, lamp box, conduit, pull boxes or junction boxes, as specified herein, in the special provisions, or as shown on the plans.

Unless otherwise noted, the location of the illuminated terminal nosings, pull boxes or junction boxes and conduit shown on the plans are approximate and the exact location will be established by the Engineer in the field.

46–1.01 REGULATIONS AND CODE

All electrical equipment shall conform to the standards of the National Electrical Manufacturers Association (NEMA) or the Radio Manufacturers Association, whichever is applicable. In addition to the requirements of these specifications, the plans and the special provisions, all material and work shall conform to the requirements of the National Electrical Code, hereinafter referred to as the Code; the Rules for Electrical Construction and Installing Electric Wires and Equipment, of the Department of Labor and Industries, State of Washington; the American Society for Testing Materials (ASTM); the United States of America Standards Institute (USASI), and any local ordinance which may apply.

Wherever reference is made in these specifications or in the special provisions to the Code, the rules or the standards mentioned above, the reference shall be construed to mean the code, rule or standard that is in effect at the date of advertising of these specifications.

Attention is directed to the provisions of Section 7.10, Permits and Licenses, of these specifications.

–1.02 INDUSTRY CODES AND STANDARDS

The following electrical industry codes and standard procedures are listed for reference purposes:

National Electrical Manufacturers' Association (NEAMA), 155 East 44th Street, New York 17, New York.

National Board of Fire Underwriters—National Electrical Code (NEC), 85 John Street, New York 7, New York.

Underwriters' Laboratories (UL), 207 East Ohio Street, Chicago 11, Illinois.

Institute of Traffic Engineers (ITE), 2029 K Street, Washington 6, D. C.

Edison Electric Institute (EEI), 420 Lexington Avenue, New York 17, New York.

Insulated Power Cable Engineers' Association (IPCEA) 283 Valley Road, Montclair, New Jersey.

American Society for Testing Materials (ASTM), 1916 Race Street, Philadelphia, 3, Pennsylvania.

United States of America Standards Institute (USASI), 70 East 45th Street, New York 17, New York.

American Wood Preservers' Association (AWPA), 839 Seventeenth Street, Washington 6, D. C.

46–2 MATERIALS

46–2.01 GENERAL

Unless otherwise indicated on the plans or specified in the special provisions, all materials shall be new.

Where existing systems are to be modified, the existing material shall be incorporated in the revised system, salvaged, or abandoned as specified in the special provisions, or as ordered by the Engineer.

46–2.02 INSPECTION

All material shall be subject to inspection after delivery to the site and during installation in the work. Failure of the Engineer to note faulty material during construction shall not relieve the Contractor of the responsibility for removing or replacing any such material at his own expense.

Inspection or sampling of certain materials may be made at the factory or warehouse prior to delivery to the site, when required by the Engineer.

Material which has been rejected previous to delivery shall not be delivered to the work, and all material which has been rejected at the work shall be immediately removed from the site.

46–2.03 TERMINAL NOSE CASTING

The casting shall be malleable iron casting, ASTM Designation A 47 or steel casting, ASTM Designation A 27, Grade 60-30.

The lamp box and cover shall be No. 16 gage galvanized sheet metal, or aluminum sheeting of equivalent thickness.

The terminal nose casting together with the lamp box and fittings shall be made in accordance with the detail plans or standard drawings.

46–2.04 CONDUIT

Conduit to be installed underground, on the surface of poles, or in structures shall be rigid metal type, conforming to Article 346 of the Code.

Exterior and interior surfaces of all steel conduit shall be uniformly and adequately zinc-coated by a hot-dip galvanizing process. The average weight of zinc coating shall be not less than 1.00 ounce per square foot of single surface area, as determined by tests on 12-inch samples taken from each end of a standard length of conduit. The weight of zinc coating on any individual test specimen shall not be less than 0.90 ounce per square foot of single surface area. The weight of zinc coating will be determined in accordance with AASHO Designation T 65. In addition, the exterior as well as the interior of the sample shall withstand 4 dips in the Preece Test in accordance with AASHO Designation T 66.

Aluminum conduit will be acceptable when used with an approved insulated coupling if connected to galvanized steel conduit. Such insulated couplings shall be provided with a tinned bonding wire to provide ground continuity between the dissimilar metal conduits.

All aluminum surfaces in contact with steel or concrete shall be given one coat of zinc chromate primer, conforming to U. S. Federal Specifications, TTP 645.

Aluminum conduit shall be fabricated from 6063 T 42 alloy. Fittings and other metals in contact with aluminum conduit shall be of a compatible material. Ground clamps shall be of tinned copper with copper ground wire. A 12-inch length of each size conduit cut from the end of a standard length of conduit shall be submitted to the Materials Laboratory for test prior to use.

Every length of rigid metal conduit shall bear the label of Underwriters Laboratories, Inc. Installation shall conform to appropriate articles of the Code. Unless otherwise stated in the special provisions, the Contractor shall have the option of furnishing rigid metal conduit fabricated from either galvanized steel or aluminum.

46–2.05 PULL BOXES, JUNCTION BOXES

Metallic pull boxes may be cast iron or welded 3/16 inch thick or cast aluminum of the sizes noted on the plans. Boxes used shall not be of dissimilar metal to the conduit used in any given electrical system. Boxes shall be watertight with lids securely gasketed to exclude water. Boxes installed underground shall have screened drains installed as detailed on the plans. Cast iron or steel boxes shall be hot-dipped galvanized conforming to the applicable portions of ASTM Designation A 153.

Where indicated on the plans, concrete pull boxes shall be used and shall be constructed as detailed on the standard drawings. Where concrete pull boxes or junction boxes are to be placed in areas subject to traffic load, a steel or cast iron cover of approved design to withstand such loads shall be used. Such pull boxes or junction boxes shall be installed on a suitable concrete footing to withstand traffic loads. Covers shall be inscribed as specified on the plans.

46–3 CONSTRUCTION DETAILS

46–3.01 GENERAL

All electrical construction shall be carried out by competent crews under the direction of able foremen of

the Contractor, or by the manufacturer's representatives where so required in the special provisions. All workmanship shall be complete and in accordance with the latest accepted standards of the industry, as determined by the Engineer, and the special provisions.

Failure of the Engineer to note faulty workmanship during construction shall not relieve the Contractor of the responsibility for correcting the faults at his own expense.

46–3.02 EXCAVATING AND BACKFILLING

The excavations required for the installation of conduit, foundations, poles and other appliances shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks, and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavating shall not be performed until immediately before installation of conduit and other appliances. The material from the excavation shall be placed in a position where the least damage and obstruction to vehicular and pedestrian traffic, and the least interference with the surface drainage will occur.

All surplus excavated material shall be removed and disposed of by the Contractor in accordance with Section 13, or as directed by the Engineer.

The excavations shall be backfilled in conformance with applicable requirements of Section 17.

Excavations after backfilling shall be kept well filled and maintained in a smooth and well drained condition until permanent repairs are made.

At the end of each day's work and at all other times when construction operations are suspended, all equipment and other obstructions shall be removed from that portion of the roadway open for use by public traffic.

Excavations in the street or highway shall be performed in such a manner that not more than one traffic lane is restricted in either direction at any time.

46–3.03 REMOVING AND REPLACING IMPROVEMENTS

Improvements such as sidewalks, curbs, gutters, portland cement concrete and asphalt concrete pavement, bituminous surfacing, base material, and any other improvements removed, broken or damaged by the Contractor, shall be replaced or reconstructed with the same kind of materials as found on the work, or with materials of equal quality. The new work shall be left in a serviceable condition satisfactory to the Engineer.

Whenever a part of a square or slab of existing concrete sidewalk or driveway is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed as above specified.

The outline of all areas to be removed in portland cement concrete sidewalks and pavements shall be cut to a minimum depth of 1½ inches with a saw, prior to removing the sidewalk and pavement material. Cut for remainder of the required depth may be made by a method satisfactory to the Engineer. Cuts shall be neat and true with no shatter outside the removal area.

46–3.04 CONDUIT

Installation of conduit shall conform to appropriate articles of the Code, and these specifications.

The size of conduit used shall be as shown on the plans. Conduits smaller than one-inch electrical trade size shall not be used, unless otherwise specified, except that grounding conductors at service points may be enclosed in ½-inch diameter conduit.

Conduit installed under the travelled way, including auxiliary lanes, shall be a minimum of one and one-fourth (1¼) inch diameter. No smaller size diameter shall be used except by written permission of the Engineer.

It shall be the option of the Contractor, at his own expense, to use larger size conduit if desired, and where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

The ends of all conduits shall be well reamed to remove burrs and rough edges. Field cuts shall be made square and true so that the ends will butt or come together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used.

The threads on all conduit shall be well painted with a good quality of lead or rust preventative paint before couplings are made up. All couplings shall be screwed up until the end of the conduits are brought together, so that a good electrical connection will be made throughout the entire length of the conduit run. Where coating on conduit has been injured in handling or installing, such injured places shall be thoroughly painted with rust preventative paint.

All conduit ends shall be threaded and capped with standard pipe caps until wiring is started. When caps are removed, the threaded ends shall be provided with approved conduit bushings. The use of any plugs, even though temporary, in lieu of the aforementioned pipe caps is expressly prohibited.

Conduit stubs from bases shall extend at least six inches from face of foundation and at least 18 inches below top of foundation.

Conduit stubs, caps, and exposed threads shall be painted with rust preventative paint.

Conduit bends, except factory bends, shall have a radius of not less than six times the inside diameter of the conduit. Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable.

Conduit shall be laid to a depth of not less than 18 inches below the curb grade in the sidewalk areas and to a depth of not less than 18 inches below the finished grade in all other areas, except that conduit may be laid on top of and secured to the existing pavement in curbed dividing strips. Conduit under railroad tracks shall be not less than 24 inches below bottom of tie.

Conduit shall be placed under existing pavement by approved jacking or drilling methods. Pavement shall not be disturbed without the approval of the Engineer and then only in the event obstructions are encountered. Upon approval of the Engineer, small test holes may be cut in the pavement to locate obstructions. Jacking or drilling pits shall be kept two feet clear of the edge of any type of pavement wherever possible. Excessive use of water such that pavement might be undermined, or subgrade softened, will not be permitted.

Where conduit is required to be installed across the surface of a pavement which is to be resurfaced, there shall be a minimum cover of one inch over the pipe or its fittings. In case the resurfacing material is not of sufficient depth to allow for the minimum coverage, the Contractor shall chip out the existing pavement to such depth as required to obtain the desired covering. Before constructing the resurface to finished grade, the Contractor shall bed the conduit in such a manner that there will be no lateral or longitudinal movement of it during the construction of the wearing course of the new pavement. This may require chipping out in the course below the wearing course in order to obtain proper embedment.

On new construction, conduit shall be placed prior to placement of base course and pavement.

Conduit terminating in standards or pedestals shall extend approximately two inches above the foundation vertically and shall be sloped towards handhole opening.

Conduit entering through the bottom of a pull box shall be located near the end walls to leave the major portion of the box clear. At all outlets, conduit shall enter from the direction of the run.

Suitable marker stakes shall be set at the ends of conduits which may be buried so that they may be easily located.

Condulets and other fittings shall be installed at locations as designated by the Engineer so as to provide a conduit channel that will permit freedom for installing the electrical control wires. When condulets are called for on the plans, or where their installation is required by the Engineer, the Contractor shall also furnish all necessary condulet covers and gaskets.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

A No. 12 AWG galvanized pull wire shall be installed in all conduits which are to receive future conductors. At least two (2) feet of pull wire shall be doubled back into the conduit at each termination.

Conduit runs shown on the plans are for bidding purposes only and may be changed, with approval of the Engineer, to avoid underground obstructions.

46–3.05 PULL BOXES, JUNCTION BOXES

Pull boxes or junction boxes shall conform to standard drawings and shall be installed at the locations shown on the plans and at such additional points as ordered by the Engineer, when conduit runs are more than 200 feet. The Contractor may install, at his own expense, such additional boxes as may be desired to facilitate the work.

Location of underground pull boxes shall be marked by the installation of a standard guide post installed on the shoulder adjacent to the pull box, or in the island near the pull box, with the top six inches painted red.

46–4 MEASUREMENT AND PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract:

1. "Illuminated Terminal Nosing (Type No. ....)," per each.
2. "Galvanized Conduit Pipe (Diameter)," per linear foot.

The unit contract price per each for "Illuminated Terminal Nosing (Type —)," shall be full compensation for furnishing all labor, material including lamp box and flasher, tools and equipment necessary to install each unit in accordance with the plans and specifications.

The unit contract price per linear foot, measured by the actual length of completed pipe in place for "Galvanized Conduit Pipe (diameter)," shall be full compensation for furnishing all pipe, pipe connections, elbows, bend caps, reducers, condulets, unions, pull boxes and junction boxes for placing the pipe in accordance with the above provisions, including all excavation or jacking required, backfilling of the trenches, chipping of pavement and bedding of the pipe and all other work incidental to the construction of the conduit.

Section 50—Monuments

50–1 DESCRIPTION

This work consists of the resetting of survey monuments, cast iron frames and covers which during construction will be covered over, damaged or otherwise rendered useless. The work may consist of constructing monuments, adjusting monuments to proper grade, and the furnishing and placing of materials and other related work in accordance with the standard drawings.

50–2 MATERIALS

Monument cast iron frames and covers, bronze marker plugs, precast concrete monuments, poured monuments, or other types of monuments shall be of the quality, material, and the dimensions shown on the standard drawings, the plans and the special provisions.

Frame and cover castings shall conform to the requirements of ASTM A 48 Class 25 and shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. Repair of defects by welding, or by the use of "smooth-on" or similar material will not be permitted. The manufacturer shall provide test bars as per ASTM A 48 for all orders of 200 or more units when called for in the special provisions, and upon request of the Owner the manufacturer shall certify that the product conforms to the requirements of these specifications.

When painting is called for in the special provisions, a bituminous coating equivalent to Preservative Paint Co. No. 25-22 Black Dip Paint shall be applied to all faces. The Owner shall have the right to require inspection and approval of all castings prior to painting.

Monument cast iron frames and covers shall be machine finished or ground on seating surfaces so as to assure non-rocking fit in any position, and interchangeability. At the request of the Owner, there shall be made available at the foundry standard frames and standard covers for use by inspectors in testing fit and seating.

50–3 CONSTRUCTION DETAILS

50–3.01 REFERENCE POINTS

The Engineer will reference all monuments in advance of construction and will reset the points and grades at the proper time.

It shall be the responsibility of the Contractor to furnish materials and install required monuments and castings in accordance with the plans as and where directed by the Engineer. The Contractor shall carefully protect all reference points to the monuments and he shall give the Engineer reasonable notice of the schedule for monument work in order to avoid destruction of the points.

50–3.02 PRECAST CONCRETE MONUMENTS

Where called for on the plans or where directed by the Engineer, the Contractor shall furnish and install precast monuments. These monuments shall be set to proper line and grade upon a sound, well compacted base, and shall be backfilled and thoroughly tamped to the satisfaction of the Engineer.

50–3.03 POURED MONUMENT

Where called for on the plans, or where directed by the Engineer, the Contractor shall construct the monument by placing it in concrete mix and inserting a bronze marker plug to the required line and grade.

The Owner will furnish the bronze marker plug without charge.

Poured monuments shall be either Type A or Type B, as required in the special provisions and by the standard drawings.

50–3.04 MONUMENTS ON CEMENT CONCRETE PAVING PROJECTS

Unless otherwise provided, bronze marker plugs will be furnished by the Owner and will be placed by its own forces in the pavement surface at the time of pour. The Contractor will be required, however, to block out forms where necessary to provide for placement of monument in the subsequent adjacent pour and this work shall be considered as incidental and the costs thereof shall be included in various pay items of the work. Where conditions require other types of monuments, the Contractor shall construct them in accordance with the plans and for such payment as may be shown in the proposal or otherwise provided.

50–3.05 FURNISHING AND PLACING MONUMENT CASTINGS

Where called for on the plans or where directed by the Engineer, the Contractor shall furnish and install castings to the line and grade established by the Engineer.

50–3.06 ADJUSTMENT OF EXISTING MONUMENT CASTINGS TO GRADE

Where shown on the plans or where encountered on the project the existing monument castings shall be adjusted to the grade furnished by the Engineer. Procedure for these adjustments is described in Section 53 entitled, "Adjustment of New and Existing Utility Structures to Finish Grade."

50–4 MEASUREMENT AND PAYMENT

Payment will be made at the unit contract price for such of the following bid items as are included in any particular contract:

1. "Precast Monument," per each.
2. "Poured Monument (Type ....)," per each.
3. "Furnish and Place Monument Frame and Cover," each.
4. "Adjust Monument Frame and Cover," per each.

The unit contract prices for the items enumerated above shall be full compensation for all labor, tools and materials and for all incidental work required in setting the monuments and castings in accordance with the plans, drawings and specifications to the satisfaction of the Engineer.

Section 51—Sidewalk Drain for Building Downspout

51–1 DESCRIPTION

Where shown on the plans or designated by the Engineer, the Contractor shall construct sidewalk drains of the required type which are designed to carry storm water from the building downspouts under the sidewalk surface to the street gutter.

With some modification, the drains may be installed to serve paved areas requiring surface drainage. If modification becomes necessary to meet a particular need and has not been described on the plans or special provisions, the modification shall be made by the Contractor under directions by the Engineer.

51–2 MATERIALS

The dimensions and quality of materials for the sidewalk drains shall be as indicated on the standard drawings for the type of drain indicated, unless otherwise modified on the plans or special provisions.

51–3 CONSTRUCTION DETAILS

51–3.01 GENERAL

The two types of sidewalk drains for building downspout are Type I and Type II, as shown on standard drawings.

Sidewalk drains may be constructed simultaneous with new sidewalk construction or may be constructed where a sidewalk already exists.

51–4 MEASUREMENT AND PAYMENT

51–4.01 MEASUREMENT

Measurement for sidewalk drain for building downspout will be per linear foot for the length of drain constructed.

51–5 PAYMENT

Payment will be made for such of the following bid items as are included in any particular contract:

1. "Sidewalk Drain for Building Downspout, Type I," per linear foot.
2. "Sidewalk Drain for Building Downspout, Type II," per linear foot.

The unit contract price per linear foot for sidewalk drain of the type specified shall be full compensation for all labor, materials and tools required for the construction of the sidewalk drain, including the removal of existing sidewalk area and any necessary replacement items. Any additional work involved by reason of a modification to meet a particular need shall be considered as incidental to the construction and all costs thereof shall be included in the pay item or items of the work.

Section 52—Removal of Existing Street Improvements

52–1 DESCRIPTION

The work shall consist of the removal and disposal of various existing improvements, such as pavements, structures, pipe, curb, curb and gutter, gutter, and other items necessary for the accomplishment of the improvement. Some of the items may be included in the bid proposal or covered elsewhere in the specification or special provisions.

Removal of items or things not contained in this section or in other sections of these standard specifications shall be considered as incidental to the construction and the costs thereof shall be included in other items of the contract by the Contractor, unless the special provisions and proposal specifically provide payment therefor.

52–2 CONSTRUCTION DETAILS

52–2.01 GENERAL

The removal of street improvements shall be conducted in such a manner as not to injure utilities and any portion of the improvement that is to remain in place. Any deviation in this matter will obligate the Contractor at his own expense, to repair, replace or otherwise make proper restoration to the satisfaction of the Engineer.

When sawing of concrete or combinations of rigid materials is called for in the plans or in the special provisions, the Contractor will be paid therefor at the unit contract price for the quantity involved. The depth of cut shall be such as will accomplish the intended purpose and will be determined in the field to the satisfaction of the Engineer.

Whenever the sawing will be performed by forces of the Owner, it will be so noted in the special provisions; otherwise, the Contractor shall perform the sawing.

52–2.02 REMOVAL OF PAVEMENT

Removal of existing pavement, i.e., bituminous mixes as surfacing upon earth or granular subgrades averaging four (4) inches and less in thickness, when required, shall be removed and be paid for as unclassified excavation, unless otherwise provided in the special provisions.

The Contractor shall remove existing permanent type pavement and driveway pavement shown on the plans or as directed by the Engineer. Permanent type pavements will be classified according to their composition and thickness as defined below, unless the special provisions and proposal provides otherwise.

In the event a pavement, classified as described below, shall average more than the maximum thickness specified for its class, an additional payment will be made to cover the extra thickness removed by a proportional conversion into additional square yards as extra work under Section 9.03.

–2.02A Pavement Removal, Class A

Class A pavement removal shall apply to all nonreinforced cement concrete pavement having average thickness between four (4) inches and ten (10) inches.

–2.02B Pavement Removal, Class AA

Class AA pavement removal shall apply to the removal of all cement concrete pavement which is reinforced with uniformly spaced longitudinal and transverse steel bars, or steel wire mesh, and which has pavement thickness that averages between four (4) inches and ten (10) inches.

–2.02C Pavement Removal, Class B

Class B pavement removal shall apply to all pavements which have a wearing surface of asphalt concrete upon a cement concrete pavement or cement concrete base, and for which the total combined thickness of the pavement will average between seven (7) inches and twelve (12) inches.

–2.02D Pavement Removal, Class C

Class C pavement removal shall apply to early type pavement of a cement concrete base upon which is a brick or cobblestone wearing surface (or perhaps an additional layer of asphalt concrete upon that), and for which the total combined thickness of pavement will average between ten (10) inches and sixteen (16) inches.

52–2.03 REMOVAL OF ASPHALT CONCRETE PAVEMENT

Asphalt concrete pavement upon an earth or granular base shall be considered as part of the roadway excavation, except as otherwise described hereinafter or otherwise provided in the special provisions.

Where asphalt concrete pavement exists in planting strips and is to be removed, it will be paid for as "Remove Existing Asphalt Concrete Pavement," per square yard.

Side street approaches to the project and street approaches at each end of the project paved with asphalt concrete on an earth or granular base and which are to be removed, will be paid for as "Remove Existing Asphalt Concrete Pavement," per square yard beyond the radius point of returns to the limits of construction, as directed by the Engineer.

Immediately prior to the placing of asphalt concrete against the meet line, the existing edge shall be removed by cutting the existing pavement vertically a sufficient distance from the line of excavation to avoid damaged areas (not to exceed three feet). Unless such work is made a bid item in the contract proposal and special provisions, it shall be considered as incidental to the construction and no payment will be allowed. When made an item for payment, such pavement trimming shall be paid for at the unit contract price per linear foot for "Chipping Existing Asphalt Surface." Removal of asphalt concrete pavement will be paid for when the removal is for the purpose of making underground installations, and only when provided for in the proposal and special provisions.

52–2.04 REMOVAL OF CURBS

Existing curbs shall be removed where shown on the plans or where encountered in the work and designated by the Engineer. There are several types of this work. When the integral curb is to be removed by cutting the base horizontally and thus preserve the slab or base below the curb, the removal shall be considered as Class A. When the integral curb is to be removed together with the base material by cutting vertically, it shall be considered as Class B. When pavement is being removed, the curb shall be considered as pavement removal and the measurement for payment thereof will be made to the back of the curb. Precast curbs and curbs of other materials which are to be removed will be further identified on the plans and in the proposal if payment is contemplated; otherwise, the second paragraph of Section 52-1 will apply.

52–2.05 REMOVAL OF CURB AND GUTTER

Curb and gutter to be removed may be of cement concrete, or may be a cement concrete curb with a brick gutter on a cement concrete base, or may be other combinations of rigid materials. In any event it is intended that the full section shall be removed.

Where cement concrete pavement is being removed, curb and gutter removal shall be considered as pavement removal and the measurement for payment thereof will be to the back of the curb.

52–2.06 REMOVAL OF CEMENT CONCRETE SIDEWALKS

All concrete slabs that average four (4) inches or less in thickness and which are to be removed, shall be considered as sidewalk removal. Pavement breakers used for this purpose shall meet the requirements previously outlined for pavement removal. Where concrete sawing is required, the provisions previously described shall obtain. Sidewalk aprons and private walks on street grading and paving projects shall be removed to the extent necessary to provide for construction of pavements and curbs. After the curbs and pavement have been constructed, the Contractor will be required to remove any additional sidewalk required to provide proper connections and grades, as determined by the Engineer.

52–2.07 REMOVAL OF CATCH BASINS, MANHOLES, CURB INLETS, SUMPS, ETC.

Where structures or installation of concrete, brick, blocks, etc. interefere with the construction, they shall be removed and all pipe openings shall be properly plugged watertight with Class 5 (¾) concrete, or with mortar and masonry, blocks or brick. Payment therefor will be made in accordance with bid items in the proposal. If however, there is no bid item to cover any one or more of such removals, then in that event the removal shall be considered as incidental to the construction and costs thereof shall be included in other items of the work.

Where the structures are removed, the voids shall be backfilled with suitable job excavated material and compacted as the Engineer may direct, and such compaction work shall be considered as incidental to the removal work whenever the compaction is by water-settling. If the Engineer directs compaction by mechanical tampers, payment will be made at the unit contract price in the proposal.

If the Engineer determines the job-excavated material to be unsuitable for backfill and he, therefore, specifies or directs a backfill from another source shall be used, the payment therefor will be made at the unit contract price if same is carried in the proposal, or as extra work under Section 9.03 if not included as an item in the proposal.

The removal and disposal of wooden structures shall be considered as incidental to the work, unless payment is otherwise provided in the special provisions and proposal.

52–2.08 SALVAGE

Unless otherwise indicated in the construction plans or in the special provisions, all castings, pipe and other material of recoverable value taken from the discarded facilities shall be carefully salvaged and delivered to the Owner in good condition and in such order of salvage as the Engineer may direct. Materials and things deemed of no value by the Engineer shall be salvaged by the Contractor and become his property to be disposed of as he wishes.

52–2.09 WASTE DISPOSAL

Unless otherwise provided in the plans, the Contractor shall provide the waste site for disposal of materials not required for the construction, as defined in Section 4.06.

52–3 MEASUREMENT AND PAYMENT

Measurement and payment will be made for such of the following items as may be included in the proposal of any particular contract:

1. "Remove Existing Pavement, Class A," per square yard.
2. "Remove Existing Pavement, Class AA," per square yard.
3. "Remove Existing Pavement, Class B," per square yard.
4. "Remove Existing Pavement, Class C," per square yard.
5. "Remove Existing Asphalt Concrete Pavement," per square yard.
6. "Remove Existing Curb Type ....," per linear foot.
7. "Remove Existing Curb and Gutter," per linear foot.
8. "Remove Cement Concrete Sidewalk," per square yard.
9. "Remove Catch Basin," per each.
10. "Remove Manhole," per each.
11. "Remove Inlet," per each.
12. "Remove Curb Inlets," per each.
13. "Remove Sumps," per each.
14. "Sawing Pavement (*depth inches*)," per linear foot.
15. "Chipping Existing Asphalt Surface," per linear foot.

The unit contract prices for such of the items as are included in the proposal shall be full compensation for all labor, tools and incidentals required to perform the work as specified.

Payment for selected materials, if required, will be made in accordance with applicable bid items, but the compaction of the materials shall be considered as incidental to the construction and the costs thereof shall be included in bid items of the proposal.

Section 53—Adjustment of New and Existing Utility Structures To Finish Grade

53–1 DESCRIPTION

This work consists of constructing and/or adjusting all new and existing utility structures encountered on the project to finished grade.

53–2 DIVISION OF RESPONSIBILITY

53–2.01 PRIVATELY OWNED UTILITY STRUCTURES

Privately owned utilities are generally in streets and road rights of way pursuant to franchises or to rights claimed under the laws of the United States of America, or the State of Washington and, therefore, these utility agencies will be responsible for all adjustments and relocations of their facilities. These agencies will locate and make all adjustments to their respective structures at no charge to the Contractor.

53–2.02 PUBLICLY OWNED UTILITY STRUCTURES

Publicly owned structures that are to be adjusted to finished grade by the Contractor will be listed in the bid proposal. Where these are not shown in the proposal, the public utility will make necessary adjustments at no cost to the Contractor.

53–2.03 CONTRACTOR TO SCHEDULE WORK

The Contractor shall schedule his work and cooperate to the fullest extent so that structure adjustments by others can be satisfactorily accomplished. The Contractor shall do all pavement patching which may be necessary after adjustment of structures, and the cost thereof shall be considered as incidental to the adjustment of the various structures, except as modified hereinafter, and except that private utilities shall reimburse the Contractor for such patching.

53–3 CONSTRUCTION DETAILS

53–3.01 ADJUSTING OF MANHOLES, CATCH BASINS AND SIMILAR STRUCTURES

–3.01A General

Manholes shall be brought to proper finished grade by utilizing the same methods of construction as required for manhole construction in Section 63.

–3.01B Unpaved Street Grading Projects

New manholes, catch basins and similar structures constructed in conjunction with street grading projects which are to be surfaced with gravel or crushed stone shall be constructed to a point approximately eight (8) inches below the subgrade and covered with a temporary wood cover as shown on the standard drawing. Existing manholes encountered shall be cut off and covered in similar manner. The Contractor shall carefully reference each manhole so that they may be easily found upon completion of the street work.

After placing the gravel or crushed stone surfacing, the manholes and manhole castings shall be constructed to the finished grade of the roadway surface. Excavation necessary for bringing manholes to grade shall center about the manhole and be held to the minimum area necessary. At the completion of the manhole adjustment, the void around the manhole shall be backfilled with materials which will result in the section required on the typical roadway section, and be thoroughly compacted.

Where bituminous surface treatment is to be placed, the manhole castings shall be installed from one-half (½) inch to one (1) inch higher than the roadway surface, as the Engineer may direct.

–3.01C Cement Concrete Paving Projects

Manholes, catch basins and similar structures shall be constructed or adjusted in the same manner as outlined in Section 53–3.01B except that the final adjustment shall be made and cast iron frame be set after forms have been placed and checked. In placing the concrete pavement, extreme care shall be taken not to alter the position of the casting in any way.

–3.01D Asphalt Concrete Paving Projects

On asphalt concrete paving projects, the manholes shall not be adjusted until the pavement is completed, at which time the center of each manhole shall be carefully relocated from references previously established by the Contractor. The pavement shall be cut in a restricted area and base material be removed to permit removal of the cover. The manhole shall then be brought to proper grade utilizing the same methods of construction as for the manhole itself.

The cast iron frame shall be placed on the concrete blocks and wedged up to the desired grade. The asphalt concrete pavement shall be cut and removed to a neat circle, the diameter of which shall be equal to outside diameter of the cast iron frame plus two (2) feet. The ballast and crushed stone shall be removed and Class 5(1½) concrete placed so that it extends below the frame for a minimum of six (6) inches for the entire area of the excavation and up to within but not to exceed one and one-half (1½) inches of the finished pavement surface.

On the following day the concrete, the edges of the asphalt concrete pavement, and the outer edge of the casting shall be painted with hot asphalt cement. Asphalt concrete shall then be placed and compacted with hand tampers and a patching roller. Asphalt concrete will be paid for as "Asphalt Concrete Pavement, Class B," per ton.

The completed patch shall match the existing paved surface for texture, density, and uniformity of grade. The joint between the patch and the existing pavement shall then be carefully painted with hot asphalt cement or asphalt emulsion and shall be immediately covered with dry paving sand before the asphalt cement solidifies.

The inside throat of the manhole shall be thoroughly mortared and plastered.

–3.01E Asphalt Resurfacing Projects

Adjustment of manholes on asphalt resurfacing projects shall meet the requirement of Section 53–3.01D. Unless adjustment rings for castings are provided for in the special provisions and bid proposal, existing pavements shall be removed to the extent necessary to remove the manhole casting. The cost of removing the pavement, either asphalt concrete or cement concrete base, shall be considered as incidental to the work of adjusting the manhole.

–3.01F Storm and Sanitary Sewer or Water Projects

Manholes, catch basins, gate valve structures and other similar type structures being constructed in conjunction with sewer or water projects on graded or paved streets shall be brought to final grade as outlined previously in these specifications.

–3.01G Establishment of Grade for Top of Manhole

The Owner will establish approximate grade for top of manholes, catch basins and similar structures for the various stages of construction; however, these grades will be approximate only. The Owner assumes no responsibility in this regard, except when the final grade is set.

53–3.02 ADJUSTMENT OF INLETS

The final alignment and grade of cast iron frames for new and old inlets to be adjusted to grade will be established from the forms or adjacent pavement surfaces. The final adjustment of the top of the inlet will be performed in similar manner to that described for manholes. On asphalt concrete paving projects using curb and gutters, that portion of the cast iron frame not embedded in the gutter section shall be solidly embedded in concrete also. The concrete shall extend a minimum of six (6) inches beyond the edge of the casting and shall be left one and one-half (1½) inches below the top of the frame so that the wearing course of asphalt concrete pavement will butt the cast iron frame. The existing concrete pavement and edge of the casting shall be painted with hot asphalt cement.

Adjustments in the inlet structure shall be constructed in the same manner and of the same material as that required for new inlets. The inside of the inlets shall be plastered.

53–3.03 ADJUSTMENT OF MONUMENTS AND CAST IRON FRAME AND COVER

Monuments and monument castings shall be adjusted to grade in the same manner as for manholes.

53–3.04 ADJUSTMENT OF VALVE BOX CASTINGS

Adjustment of valve box castings shall be made in the same manner as for manholes.

53–3.05 FURNISHING CASTINGS

Where adjustment of existing manholes, catch basins, inlets, valve boxes, etc. are required and the existing castings are discarded or ordered to be salvaged by the Engineer, the Contractor shall furnish new castings of the type specified, and payment therefor will be made as specified in the proposal and will be in addition to payment for making the adjustment.

53–4 MEASUREMENT AND PAYMENT

Payment will be made for such of the following applicable bid items as are included and shown in any particular contract, consistent with measurement and payment requirements contained in the specifications for each particular item.

1. "Adjust Existing Manhole or Catch Basin to Grade," per each.
2. "Adjust Existing Inlet to Grade," per each.
3. "Adjust Existing Monument Frame and Cover to Grade," per each.
4. "Adjust Existing Valve Box to Grade," per each.
5. "Type.....(or size) Manhole, Extra Depth," per vertical foot.
6. "Additional Depth Shaft for Existing Manhole," per vertical foot.
7. "Type.....Inlet," per each.
8. "Furnish Locking Manhole Frame and Cover (heavy, light)," per each.
9. "Furnish Manhole Frame (heavy, light) and Cover," per each.
10. "Furnish Metal Frame and Grate for Catch Basin, Inlet, Valve Chamber," per each.
11. "Asphalt Concrete Pavement, Class B," per ton.
12. "Asphalt Concrete," per ton.

53–4.01 ADJUST EXISTING MANHOLE OR CATCH BASIN TO GRADE

The unit contract price for "Adjust Existing Manhole or Catch Basin to Grade," shall be full compensation for removing the cast iron frame and cover, removing necessary pavement, cutting the existing structure down where necessary, furnishing and placing temporary wood cover, rebuilding the structure, resetting the existing cast iron frame and cover to proper grade, backfilling the void around the structure, and plastering the structure throat and extension. Where manholes are to be adjusted downward and it is necessary to remove the entire cone section, the entire adjustment will be paid for on basis of extra work as provided in Section 9.03. Where an existing manhole is to be raised from its present grade in excess of two and one-half (2½) feet, the shaft portion above the two and one-half (2½) foot adjustment will be paid for as "Additional Depth Shaft for Existing Manhole," per vertical foot.

53–4.02 ADJUST EXISTING INLET TO GRADE

The unit contract price for "Adjust Existing Inlet to Grade," shall be full compensation for removing pavements, casting, upper portion of inlet, whether it is cast iron, concrete or blocks, reconstructing the inlet to the new and proper grade, backfilling the void around the structure, and utilizing the existing cast iron frame and cover.

53–4.03 ADJUST EXISTING MONUMENT FRAME AND COVER TO GRADE

The unit contract price for "Adjust Monument Frame and Cover to Grade," shall be full compensation for removing necessary pavement, for removing and resetting the existing cast iron frame and cover to proper grade, and for backfilling the void around the structure. Where existing castings are not to be used, new ones shall be installed and will be paid for in accordance with Section 53–4.08.

53–4.04 ADJUST EXISTING VALVE BOX TO GRADE

The unit contract price for "Adjust Existing Valve Box to Grade," shall be full compensation for removing necessary pavement and for resetting the casting to proper grade, including backfilling the void around the structure, and all other work incidental thereto.

53–4.05 TYPE, OR SIZE, MANHOLE EXTRA DEPTH

The unit contract price per vertical foot for "Type.....(or size) Manhole, Extra Depth" shall be full compensation for all costs incurred in completing the construction of the new manhole in accordance with the specifications of Section 63, with measurement and payment as described in sections 63-4 and 63-5.

53–4.06 ADDITIONAL DEPTH SHAFTING FOR EXISTING MANHOLE

The unit contract price per vertical foot for "Additional Depth Shafting for Existing Manhole" shall be full compensation for all costs incurred in completing the upward adjustment of the manhole frame and grate to proper grade. Construction of the additional shafting shall comply with Section 63.

53–4.07 TYPE.....INLET IN PLACE

The unit contract price per each for "Type ..... Inlet," shall be full compensation for furnishing all labor, equipment and material necessary to construct inlets as shown on the standard drawing and in accordance with Section 64, including the adjustment to finished grade.

53–4.08 FURNISHING CASTINGS

Where adjustment of existing manholes, catch basins, inlets, valve boxes, etc. are required, and where the existing castings are discarded or ordered to be salvaged by the Engineer, the Contractor shall furnish new castings of the type specified. In such case, the Contractor will be paid the unit contract price for each adjustment item and also the unit contract price for each type of casting involved.

53–4.09 ASPHALT CONCRETE

Asphalt concrete or bituminous plant mix used in patching around various types of structures or casting adjustments will be paid for in accordance with the unit contract price per ton for "Asphalt Concrete, Class B" or per ton for "Class F Asphalt Concrete," whichever is used.

53–4.10 INCIDENTAL WORK

Any work required to make adjustments to manholes, catch basins, inlets, sumps, valve boxes, monuments, etc., which is not specifically mentioned in the foregoing specifications, shall be considered as incidental to the construction, and all costs thereof shall be included by the Contractor in his unit contract prices.

Section 54—Pavement Patching

54–1 DESCRIPTION

This work shall consist of the patching of various types of pavement cuts, the performance of which shall be in accordance with the requirements outlined hereinafter and as shown on standard drawing.

54–2 MATERIALS

All materials shall conform to the requirements specified for material in other sections of these standard specifications, such as for instance, sections 27 and 37.

54–3 CONSTRUCTION DETAILS

54–3.01 GENERAL

Pavement patching shall be scheduled to accommodate the demands of traffic and shall be performed as rapidly as possible to provide maximum safety and convenience to public travel.

The placing and compaction of the trench backfill, and the preparation and compaction of the subgrade shall be in accordance with the requirements of the various applicable sections of these specifications.

Before the patch is constructed all pavement cuts shall be trued so that the marginal lines of the patch will form a rectangle with straight edges and vertical faces. The use of a concrete saw will not be required unless provided for in the special provisions.

The class of concrete used in patches will depend upon the urgency of opening the street to traffic. The

class of concrete shall be as specified in the special provisions and proposal. Curing compound as specified in Section 37-2.09 shall be placed on the concrete immediately after finishing.

Proper signs, barricades, lights and other warning devices, as may be approved by the Engineer, shall be maintained all 24 hours of the day until the patch is completed and ready for traffic.

54-3.02 CEMENT CONCRETE PAVEMENTS

After the subgrade for the pavement has been compacted and constructed to line and grade, the cement concrete pavement patch shall be placed, compacted and struck off to the grade of the adjacent pavement in accordance with the pertinent provisions of Section 39. Through and dummy joints shall be placed and edged where directed. The surface shall be finished and brushed with a fiber brush. Approved curing compound shall be placed on the finished concrete immediately after finishing.

54-3.03 RIGID TYPE PAVEMENTS RESURFACED WITH ASPHALT CONCRETE

Streets which have rigid type pavements resurfaced with asphalt concrete shall be patched as shown on the standard drawing, or as otherwise specified. The surface of the cement concrete portion of the patch shall be left low enough to accommodate the asphalt portion of the patch. Brush finishing will not be required. Joints shall be placed if directed by the Engineer. Curing shall be accomplished with an SS-1 emulsion cut back with water as directed by the Engineer.

Asphalt concrete or bituminous plant mix shall not be placed until the day after the cement concrete has been placed unless otherwise permitted by the Engineer. The edges of the existing asphalt pavements and castings shall be painted with hot asphalt cement or asphalt emulsion immediately before placing the asphalt patching material. The asphalt concrete pavement shall then be placed, leveled, and compacted to conform to the adjacent paved surface. Immediately thereafter, all joints between the new and original asphalt pavement shall be painted with hot asphalt or asphalt emulsion and be covered with dry paving sand before the asphalt solidifies.

54-3.04 ASPHALT CONCRETE STREETS ON GRANULAR BASE

After the subgrade has been prepared as shown on the standard drawing, or as directed by the Engineer, asphalt concrete pavement Class B or Class F shall be placed to a thickness of the existing asphalt pavement depth, or to a minimum of two (2) inches, whichever depth is the greater, and compacted in the manner specified in Section 54-3.03.

54-3.05 OIL MAT STREETS

The existing oil mat shall be uniformly trimmed to a straight line. After the subgrade has been prepared as shown on the standard drawing, or as directed by the Engineer, a minimum of two (2) inches of asphalt concrete pavement Class B shall be placed and completed in the same manner as specified in Section 54-3.03.

54-3.06 INCIDENTAL WORK

All incidental work required to complete the patching of street surfaces as specified, including joints where required, shall be considered as incidental to the patching and the costs thereof shall be included in the items for which payment is provided.

54-4 MEASUREMENT AND PAYMENT

Payment for pavement patching above subgrade will be made in the following items:

1. "Cement Concrete Class 6.5(1½) H.E.S. for Pavement Patch," per cubic yard.
2. "Asphalt Concrete Class B for Pavement Patch," per ton.
3. "Asphalt Concrete Class F for Pavement Patch," per ton.

Measurement for payment of cement concrete used in patching will be based upon computation of the neat lines of the section shown on standard drawing, and not by batch volume.

The unit contract price per cubic yard for cement concrete and per ton of asphalt concrete or bituminous plant mix as shown in the proposal shall be full compensation for all labor, tools and materials and for all incidental work required to complete the patching in accordance with the specifications and standard drawing, excepting however, that payment for selected materials will be made in accordance with applicable bid items but compaction of the materials shall be considered as incidental to the construction and no payment will be made therefor.

Section 55—Top Soil

55-1 DESCRIPTION

These specifications shall apply where the plans or special provisions require the procurement of top soil by the Contractor for the surface finishing of an area, or where the removal and replacement of existing top soil is required for the finishing of a specific construction area, generally in lawns or planting strips.

55-2 MATERIALS

55-2.01 TOP SOIL, PROCURED

Top Soil that is required to be furnished by the Contractor from a source other than the area upon which it will be placed shall consist of fertile, friable soil, preferably of a loamy character, typical of the top soil common to the locality, and it shall contain a normal amount of organic matter. It shall be obtained from arable land and shall be free from subsoil, refuse and other deleterious substances. It shall be reasonably free from brush, roots, heavy clay, sticks and other litter, and shall contain no stones or gravel larger than one-half (½) inch in diameter. It shall be free of toxic amounts of either acid or alkaline elements and be capable of sustaining healthy plant life. It shall be approved by the Engineer before placement.

55-3 CONSTRUCTION DETAILS

55-3.01 PLACEMENT OF TOP SOIL

Immediately prior to placing top soil, the surface area upon which it is to be placed shall be cleaned of objectionable matter and the area be smoothed and compacted.

Top soil shall be placed where shown on the construction plans and to depths provided for in the special provisions, or direction of the Engineer. It shall be leveled, raked, and compacted so as to provide a well-shaped and uniform appearance.

55-3.02 REMOVAL AND REPLACEMENT OF TOP SOIL

Whenever it is necessary to remove top soil with the purpose of later replacing it in the same area, the Engineer will direct the limits of the area and the depth of top soil to be removed. The top soil shall be removed in a uniform depth and be stored in such manner that it will not become mixed with unsatisfactory soils. After the trench has been backfilled, the stored top soil shall be replaced at a uniform depth in its original area. The top soil shall then be shaped, leveled, and compacted to blend with the contour of adjacent ground.

In the event that additional top soil is required and is procured from a source other than the construction area, the Contractor shall furnish and place it in compliance with Section 55-3.01 and the intent of this subsection.

55-4 MEASUREMENT

55-4.01 TOP SOIL, PROCURED

Measurement of procured top soil will be made by the cubic yard in net volume of truck loads at point of delivery.

55-4.02 REMOVAL AND REPLACEMENT OF TOP SOIL

Top soil removed and later replaced in original area will be measured by the cubic yard calculated upon the square footage of the area by the depth of soil removed.

55-5 PAYMENT

Payment will be made for such of the following items as are included in the proposal of any particular contract:

1. "Top Soil," per cubic yard.
2. "Remove and Replace Top Soil," per cubic yard.

The unit contract price per cubic yard for "Top Soil" shall be full compensation for the furnishing, hauling and placing of the soil in accordance with the specifications, whether it be for the full depth upon any area or an additional quantity required where removal and replacement of top soil resulted in a deficiency.

The unit contract price per cubic pard for "Remove and Replace Top Soil" shall be full compensation for all work and costs of scalping the original soil from an area, transporting it to storage, and then replacing it in the area in accordance with the specifications.

Section 56—Lawn Removal and Replacement

56-1 DESCRIPTION

The work shall consist of the removal and replacement of existing lawn turf by cutting the sod to be removed into convenient sized squares or strips, cutting to uniform thickness, piling and storing, and finally replacing the sod in its original position. This work will be performed only where the special provisions provide for such work.

56-2 CONSTRUCTION DETAILS

The area of sod to be removed shall be laid out in squares or strips of such size as to provide easy handling and matching. The sod shall then be carefully cut along these lines to a depth of four (4) inches, taking care to keep all cuts straight and strips of the same width. After the sod has been cut vertically, it shall be removed to a uniform depth of approximately three (3) inches with an approved type of sod cutter. This operation shall be performed in such manner as to insure uniform thickness of sod throughout the operation.

As the sod scalping proceeds, the sod strips shall be placed in neat piles at convenient locations and from then on they shall be maintained in a damp condition continuously until the sod strips are replaced on the lawn. In no case shall the sod remain in piles longer than ten (10) days before replacement on the lawn.

Prior to replacing the strips of sod, the scalped area shall be carefully shaped to proper grade and be thoroughly compacted. Wherever the construction operations have resulted in the placement of unsuitable or poorer soils in the area to be resodded, the surface shall be left low and covered with top soil meeting all requirements of Section 55.

The finished grade, after shaping and compacting the top soil, shall be thoroughly dampened prior to and immediately before replacing the sod. The sod shall be replaced to the required grade, taking care to butt each piece tightly against the adjacent one. Upon completion, the sod shall be dampened and rolled with a lawn roller.

All tools used shall be of the type specially designed for the work and be satisfactory to the Engineer. In no case shall sod be removed by the use of a mattock or other tool which will not meet requirements specified herein.

56-3 MEASUREMENT

Measurement for cutting, removing, storing, and replacing sod will be made by the square yard on the plane of surface scalped and resodded.

Measurement for top soil required within the scalped area will be by the cubic yard measured in trucks at point of delivery.

56-4 PAYMENT

Payment will be made for such of the following items as are included in the proposal of any particular contract:

1. "Remove and Replace Lawn," per square yard.
2. "Top Soil," per cubic yard.

The unit contract price per square yard for "Remove and Replace Lawn" shall be full compensation for the complete operation of cutting, removing, dampening, storing, and replacing the sod as specified. The unit contract price per cubic yard for "Top Soil" shall be full compensation for the furnishing, hauling, leveling and placing of the top soil as required.

Section 57—Finishing and Cleanup

57-1 DESCRIPTION

After all other work embraced in the contract is completed and before final acceptance of the contract, the entire roadway including the roadbed, planting, sidewalk areas, shoulders, driveways, alley and side street approaches, slopes, ditches, utility trenches, and construction areas shall be neatly finished to the lines, grades, and cross sections shown on the plans and as hereinafter specified.

57-2 CONSTRUCTION DETAILS

Slopes, sidewalk areas, planting areas, and roadway shall be smoothed and finished to the required cross section and grade by means of a grading machine insofar as it is possible to do so without damaging existing improvements, trees, and shrubs. Machine dressing shall be supplemented by hand work to meet requirements outlined herein, to the satisfaction of the Engineer.

Upon completion of the cleaning and dressing the project shall appear uniform in all respects. All graded areas shall be true to line and grade as shown on the typical sections and as required by the Engineer. Where the existing planting is below sidewalk and curb, the area shall be filled and dressed out to the walk regardless of limits shown on the plans. Wherever fill material is required in the planting area it shall be left enough higher to allow for final settlement but, nevertheless, the raised surface shall present a uniform appearance.

All rocks in excess of one (1) inch diameter shall be removed from the entire construction area and shall be disposed of the same as required for other waste material. In no instance shall the rock be thrown onto private property. Overhang on slopes shall be removed and slopes dressed neatly so as to present a uniform well sloped surface.

All windrows of earth at the outer lateral limits of the project shall be removed entirely. Trash of all kinds resulting from clearing and grubbing or grading operations shall be removed and not placed in areas adjacent to the project. Where machine operations have broken down brush and trees beyond the lateral limits of the project, the Contractor shall remove and dispose of same at his own expense.

Drainage facilities such as inlets, catch basins, culverts, and open ditches shall be cleaned of all debris which is the result of the Contractor's operations, unless the specifications of any particular section or the special provisions provide otherwise.

Where, by permission, spoil is dumped on private property, the Contractor will not be required to perform any work beyond that described in the special provisions.

The Contractor shall remove and dispose of all construction stakes.

All pavements and oil mat surfaces, whether new or old, shall be thoroughly cleaned. Existing improvements such as portland cement concrete curbs, curb and gutters, walls, sidewalks, and other facilities which have been sprayed by the asphalt cement shall be cleaned to the satisfaction of the Engineer. Castings for manholes, monuments, water gates, lamp poles, vaults, and other similar installations which have been sprayed with the asphalt material shall be cleaned to the satisfaction of the Engineer.

The Contractor shall flush the street at the conclusion of the work unless otherwise provided in the special provisions. Flusher shall be of a pressure type and approved by the Engineer. The Contractor shall furnish the water required and will be paid therefor at the unit contract price per M gallons for "Water." Sidewalks shall be hand broomed.

On sewer and water distribution projects where all or portions of the construction is in undeveloped areas, the entire area which has been disturbed by the construction shall be shaped so that upon completion the area will present a uniform appearance, blending into the contour of the adjacent properties. All other requirements outlined previously shall be met, except that it will not be necessary to pick up rocks unless so provided in the special provisions.

57-3 MEASUREMENT AND PAYMENT

Measurement for finishing and cleanup will be based upon a lump sum contract price, or upon a per station (100-foot) unit contract price, whichever is shown in the proposal.

Payment will be made for such of the following bid items as are included in any particular contract:

1. "Finishing and Cleanup," per lump sum.
2. "Finishing and Cleanup," per station (100-foot).
3. "Water," per M gallons.

Regardless of whether payment is made by lump sum or upon measurement by stations, it shall include the finishing and cleaning of all side street approaches. Where payment is based upon the station unit, measurement will be along the center line of the project and the finishing and cleaning of side street approaches will not be included in the station quantities. Finishing and cleaning of side street approaches shall be considered as incidental to the construction and all costs thereof shall be included in the lump sum, or in the unit contract price per station as measured along center line of the project.

Water used for flushing will be measured and paid for by the unit of one thousand (M) gallons in accordance with provisions of Section 16.

In event the proposal does not include a bid item for "Finishing and Cleanup," the work thereof, including water for flushing, shall be considered as incidental to the construction of the project and all costs thereof shall be included by the Contractor in other items of work.

Section 60—Pipe Materials and Testing for Sewers, Drains and Culverts

60-1 DESCRIPTION

Pipe used in sanitary sewer construction, unless otherwise specified, shall be of cement concrete, vitrified clay, or asbestos cement. Storm drains and culvert pipe, unless otherwise specified, shall be concrete, asbestos-cement, vitrified clay, or corrugated galvanized metal. All sanitary sewer pipe shall have flexible gasketed joints unless otherwise specified. Storm drain and culvert pipe shall be jointed as specified.

60-2 GENERAL

Where reference is made to an ASTM or AASHO designation, it shall be the latest revision at time of call for bids, except as noted on the plans or in the special provisions.

Pipe eight (8) inches in diameter and larger shall be furnished in units of not less than three (3) feet, except as noted in Section 60-3.01B.

60-3 MATERIALS AND TESTING

60-3.01 PIPE MATERIALS

-3.01A Concrete Pipe, Nonreinforced

Nonreinforced concrete pipe shall conform to ASTM Designation C14, Table II (extra strength), except as otherwise provided and except that the permeability test shall be conducted as follows:

The pipe selected for test shall be placed either end down on a soft rubber pad, at the option of the Engineer, and filled with water. The pipe shall be kept full of water for a period of two minutes. At the end of that period the outer surface of the pipe shall be examined for leaks. A leak is defined as a moist spot from which water may be wiped with the hand; when wiped dry with a cloth, moisture will reappear at the surface of the leak. The Engineer may select a maximum of two percent (2%) but in no case shall less than five (5) pipes of each size be tested.

-3.01B Concrete Pipe, Reinforced

Reinforced concrete pipe shall conform to ASTM Designation C76, except as otherwise provided, and shall be of the class noted on the plans or in the special provisions.

Pipe ends of reinforced concrete pipe may be bell and spigot, modified bell and spigot, or tongue and groove unless otherwise specified in the special provisions.

Acceptance shall be based on load bearing tests, material tests and inspection of the product at all stages of construction. Acceptance by cylinders instead of load bearing tests is permissible when agreed upon by the manufacturer and the Engineer prior to manufacture.

Both bells and spigots shall be reinforced in pipe thirty (30) inches or more in diameter.

-3.01C Vitrified Clay Pipe

Vitrified clay pipe shall conform to ASTM Designation C278, unless otherwise provided.

-3.01D Asbestos-Cement Pipe

Asbestos-cement pipe shall conform to ASTM Designation C428, unless otherwise provided, and shall be of the class noted on the plans or in the special provisions.

-3.01E Galvanized Corrugated Steel Pipe

Galvanized corrugated steel pipe as specified in the plans or special provisions shall conform to the material, fabrication and inspection requirements of AASHO Designation M 36, except that gauges and types shall be as noted on the plans.

When specified, all circular pipes 48 inches or more in diameter shall be fabricated five percent (5%) out of round to form an elliptical section. The vertical longer axis of the elliptical section shall be clearly marked before shipping.

-3.01E1 Bituminous Coated Paved Invert Metal Pipe. Bituminous coated paved invert galvanized corrugated metal pipe shall conform both as to base metal analysis and fabrication to the standard specifications of AASHO M 36, and in addition shall be coated inside and out with a bituminous coating which shall meet the following requirements:

A. *Coating.* The bituminous coating shall be 99.5% soluble in Carbon Disulfide.

B. *Thickness of Coating.* The pipe shall be uniformly coated inside and out to a minimum thickness of .05 inch, measured on the crests of the corrugations. Additional bituminous material shall be added to the bottom quarter of the circumference, or as otherwise specified, to form a smooth pavement with a minimum thickness of ⅛ inch above the crests of the corrugations.

C. *Performance Requirements.* The asphalt cement shall adhere to the metal tenaciously, shall not chip off in handling, and shall protect the pipe from deterioration as evidenced by samples prepared from the coating material meeting the following tests:

1. *Shock Test.* Four specimens in the form of disks, each ⅜ inch thick and 1¾ inches in diameter, shall be cooled in a brine solution at a temperature of 30° F. for a period of at least one hour. The samples shall then be removed from the solution one at a time and quickly centered under the plunger of the impact test apparatus and the hammer dropped from a height of 5⅛ inches. Not more than one of the specimens shall show a crack.

2. *Flow Test.* Two specimens in the form of cylinders, each ⅜ inch in diameter and ¾ inch long shall be placed on a corrugated brass slide which is supported on a 45° slope. The apparatus shall then be placed in a constant temperature oven and left at 150° F. for a period of four (4) hours. The flow of lower edge of either specimen must not exceed ¼ inch.

-3.01E2 Asbestos Impregnated Galvanized Corrugated Metal Pipe. Asbestos impregnated galvanized corrugated metal sewer pipe shall be fabricated from asbestos bonded corrugated sheets. Both sides of the metal sheets shall be coated with a layer of asbestos fibers applied in a sheet form by pressing into a molten metallic bonding medium. Immediately after the metallic bond has solidified, the asbestos fibers shall be thoroughly saturated with a bituminous saturant. The finished sheets shall be of first-class commercial quality, free from blisters or unsaturated spots and with the fibers adhering tightly to the metal. In addition, the pipe shall be coated inside and out with a bituminous coating which will meet the requirements as described in Section 60-3.01E1.

-3.01E3 Smooth Lined Corrugated Metal Pipe. As noted on the plans, the pipe shall be fabricated from either corrugated galvanized sheets as specified in Section 60-3.01E or from corrugated asbestos impregnated galvanized sheets as specified in Section 60-3.01E2.

The outside of the pipe shall be coated uniformly with bituminous material to a minimum thickness of .05 inch measured on the crests. The inside of the pipe shall be coated with bituminous material so that a smooth surface will be formed, completely filling the corrugations and having a minimum thickness of ⅛ inch above the crests of the corrugations. Straight pipe shall have the interior coating applied by a centrifugal method. The interior coating shall be free from sags and runs.

The thickness of the interior lining shall be maintained to the ends of the pipe. The ends of the pipe shall be so trimmed and finished that a minimum gap results when straight pipe sections are properly joined. The bituminous material shall meet the solubility, shock and flow requirements of Section 60-3.01E1.

-3.01E4 End Sections

Galvanized steel end sections shall be flared, beveled shop-assembled units to serve as structural, hydraulic and esthetic end treatment to corrugated steel culverts. They may be attached to corrugated steel culverts by threaded rods, by riveting or bolting per manufacturer's standard procedure. End sections shall have a turned-down lip or toe plate at the wide end to act as a cut-off, and toe plate extensions shall be available at extra cost.

The material for the end section shall be galvanized steel meeting the requirements of AASHO M 36. The gage shall be as follows:

16 gage through 24" round or 29" x 18" Pipe-arch
14 gage for
30" round and 36" x 22" Pipe-arch
36" round and 43" x 27" Pipe-arch
12 gage over 36" round and 43" x 27" Pipe-arch (except that the center panels of 60" round and larger, and 72" x 44" Pipe-arch and larger, shall be 10 gage.)

Galvanized stiffener angles shall supplement the usual reinforced side edges for 60" round and larger, and 79" x 49" Pipe-arch and larger.

If the end section is shop attached to a stub of pipe (manufacturer's standard Type No. 3 connection), the pipe stub shall not be lighter in gage than the end section.

The end section will be paid for separately from the pipe, the pipe being measured to its ends before attaching the end section by manufacturer's standard Types 1 or 2 connection. In the case of the Type 3 manufacturer's standard connection, the pipe stub attached to the end section will be paid for as pipe.

–3.01F Cast Iron Pipe

Cast Iron Pipe shall conform to AWWA C106 or C108, or USASI Specification A21.6, with Type II Push-on Joint or Type III Mechanical Joints, manufactured in accordance with Federal Specification WW-P-421B.

The cast iron pipe shall be lined with 3/32-inch thin cement and seal coated in accordance with USASI Standard A21.4 and AWWA C104 except thickness of lining and except as otherwise specified in WW-P-421B. The Contractor shall provide all foundry records of pipe as described in Section 6-6 of USASI-A21.6, when requested by the Engineer.

–3.01G Corrugated Aluminum Alloy Culvert Pipe.

Corrugated aluminum alloy culvert pipe and coupling bands, as specified in the plans or special provisions, shall conform to the material, fabrication and inspection requirements of AASHO Designations M196, M197, M211 and M219, except that gauges and types shall be as noted on the plans.

When specified, all circular pipes 48 inches or more in diameter shall be fabricated 5% out of round to form an elliptical section. The vertical longer axis of the elliptical section shall be clearly marked before shipping.

–3.01G1 Bituminous Coated Corrugated Aluminum Alloy Culvert Pipe.

Protective treatment shall comply with applicable provisions of Section 60-3.01E1.

–3.01G2 Bituminous Coated Paved Invert Corrugated Aluminum Alloy Culvert Pipe.

Protective treatment shall be in accordance with Section 60-3.01E1.

–3.01G3 Smooth Lined Corrugated Aluminum Alloy Culvert Pipe.

Protective treatment shall comply with applicable provisions of Section 60-3.01E3.

–3.01G4 Aluminum Alloy End Sections.

Material shall comply with the provisions of AASHO Designation M196 and fabrication shall comply with the requirements of Section 60-3.01E4.

60–3.02 JOINTING MATERIALS

–3.02A Flexible Gasketed Joints

Flexible joints shall be rubber gasketed when used with concrete, asbestos-cement, corrugated galvanized steel, or corrugated aluminum pipe; or shall be factory manufactured joints in accordance with ASTM Designation C425 when used with vitrified clay pipe.

Rubber gaskets for asbestos-cement sewer pipe shall conform to the requirements of ASTM Designation D 1869, Rubber Rings for Asbestos-Cement Pipe.

Rubber gaskets for concrete sewer pipe shall meet the physical requirements of ASTM C443, plus such other specifications as may be claimed for the particular brand of gasket furnished.

Gaskets used with corrugated metal pipe shall be made of three-eighths (⅜) inch thick by six (6) inch minimum width closed cell synthetic sponge rubber, per ASTM Designation D1056-59T, grade SCE-43, fabricated in the form of a cylinder with a diameter of approximately ten (10) percent less than the nominal pipe size. The gasket shall be centered under the band and lapped an equal distance on the ends of the adjoining pipe sections.

Where gaskets are specified, the exterior rivet heads for the last twelve (12) inches of longitudinal seam at both ends of each pipe section shall be kept from projecting past the outside of the pipe. This may be accomplished by the use of countersunk rivets or by welding the last twelve (12) inches of seam. Gaskets are necessarily used with the "U-Bolt" bands, and may be specified with the "Angle-Lug" or "Rod and Lug" bands.

Flexible gasketed joints shall be subject to the following yard tests:

A. *With Pipe in Proper Alignment.* Not less than three nor more than five pipes selected from stock by the Engineer shall be assembled according to installation instructions issued by the manufacturer, and with ends bulkheaded and restrained against internal pressure shall be subjected to ten (10) psi hydrostatic pressure with no resultant leakage at the joints. When approved by the Engineer, internal hydrostatic pressure may be applied by a suitable joint tester.

B. *With Pipe in Maximum Deflected Position.* Upon completion of the test for pipe in proper alignment, the test section shall be deflected to create a position one-half (½) inch wider than the fully compressed position on one side of the outside perimeter. When thus deflected, there shall be no leakage at the joints from an applied internal hydrostatic pressure of ten (10) psi. When approved by the Engineer, internal hydrostatic pressure may be applied by a suitable joint tester.

C. *With Joints Under Differential Load (15" diameter rigid pipe and larger).* The test section shall be supported on blocks, or otherwise, so that one of the pipes is suspended freely between adjacent pipes, bearing only on the joints. The suspended pipe shall then be loaded, in addition to the weight of the pipe, an amount as given in the following table:

DIAMETER	LOAD
15 inches	7,400 lbs.
18 inches	8,800 lbs.
21 inches	10,000 lbs.
24 inches and over	11,000 lbs.

While under this load, the stressed joints shall show no leakage when subject to five (5) lbs. hydrostatic pressure. As an acceptable alternate, one-half of the load may be applied on the bell of the suspended pipe.

Pipe of less than fifteen (15) inch diameter shall be tested with joints under differential load according to the procedures contained in ASTM Designation C425.

–3.02B Coupling Bands for Corrugated Metal Pipe

–3.02B1 Coupling Bands for Corrugated Galvanized Steel Pipe

As noted on the plans, coupling bands for corrugated galvanized steel pipe shall be one of the following types:

1. The type of band described as "Angle-Lug" band shall not be less than 7 inches wide for diameters of 8 inches to 30 inches, inclusive; not less than 12 inches wide for pipe with diameters 36 inches to 54 inches, inclusive, and not less than 24 inches wide for pipe with diameters 60 inches and over. Such bands shall be so constructed as to lap on an equal portion of each of the pipe sections to be connected. The ends of the band segments shall be connected by galvanized angles having minimum dimensions of 2 inches x 2 inches x 3/16 inch.

The 7-inch band shall have at least two galvanized bolts not less than ½-inch diameter, the 12-inch band shall have three ½-inch bolts, and the 24-inch band shall have five ½-inch bolts. The band may be furnished in two halves with one half shop riveted to the end of one pipe section. The band shall be made from the same type of corrugated sheets as the pipe except that coupling band sheet may be 2 gauge numbers lighter than the pipe corrugated sheets.

2. The type of band described as "Rod and Lug" band shall be made from the same type of corrugated sheets as the pipe except that the coupling band sheets may be 2 gauge numbers lighter than the pipe corrugated sheets. The bands may be made in two halves, and one half may be shop riveted to one end of one pipe section. Instead of "Angle-Lugs", the bands shall be tightened by means of threaded galvanized rods and galvanized cast lugs. For pipe 21-inch diameter and smaller, four ⅜-inch diameter rods are to be used with bands not less than 12 inches wide. For pipe 24-inch through 54-inch, four ½-inch diameter rods are to be used with bands not less than 12 inches wide. For pipe 60-inch and larger, four ⅝-inch diameter rods are to be used with bands not less than 24 inches wide.

3. The type of bands described as "U-bolt" bands shall be fabricated 16-gauge galvanized metal bands, complete with gaskets which mesh into one corrugation on the end of each pipe section. The bands and the gaskets shall be at least 6 inches wide. The gaskets shall be as described in Section 60-3.02A. The metal bands shall lap at least two inches at the joints and shall be tightened by ½-inch diameter galvanized U-bolts with malleable iron band bars. The bolt assembly shall be anchored to the band by galvanized straps fastened by three ⅜-inch diameter rivets or bolts through each strap. Two-piece bands shall be used on pipe 42 inches and larger in diameter.

–3.02B2 Coupling Bands for Corrugated Aluminum Alloy Pipe

Coupling bands for aluminum alloy pipe shall be in accordance with AASHO Designation M196 or M197.

–3.02C Mortar Joints

Pipe ends designed for rigid mortar joints shall conform to ASTM Designations C13, C14, or C76 as may be applicable. Mortar shall be cement mortar mixed in the proportion of one part portland cement to one and one-half (1½) parts plaster sand, mixed with the least amount of clean water necessary to provide a workable mortar.

60–3.03 FITTINGS

Unless otherwise specified, tee fittings shall be provided in the sewer main for side sewer, catch basin or inlet connections. Tees shall be six (6) inches inside diameter, unless otherwise specified or noted. All fittings shall be of sufficient strength to withstand all handling and load stresses normally encountered. All fittings shall be of the same material as the pipe. Material joining the fitting to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

60–3.04 CAP FOR FITTINGS

All fittings shall be capped with a plug of an approved material and gasketed with the same gasket material as the pipe joint, or be integrally cast. The plug shall be able to withstand all test pressures involved without leakage.

60–4 MEASUREMENT AND PAYMENT

Measurement and payment for pipe and incidental accessories, and for the testing as has been specified herein, will be included in such other of the sewer and culvert sections as their use is related to. Accessories and testing shall be considered as incidental to the materials affected and the costs thereof shall be included in the unit contract prices of applicable bid items in the proposals.

Section 61—Trench Excav., Backfill, Foundation and Bedding for Sewers, Drains and Culverts

61–1 DESCRIPTION

Trench excavation and backfill shall include all excavation, backfilling, disposal of surplus material, and all other work incidental to the construction of trenches, including any additional excavation which may be required for manholes or other structures forming a part of the pipe line and not otherwise classified as "Structure Excavation".

61–2 CLASSIFICATION

Trench excavation and backfill shall be classified as Class A or Class B for earth excavation, Class C for rock excavation, and Class D for excavation in unsuitable earth below grade. The approximate limits and quantities for Classes A, B, and C will be shown on the construction plans except for those projects where it is contemplated that all trench excavation and backfill will be Class A in which case no classification will appear on the construction plan.

Classes A, B, and C excavation and backfill, where ordered by the Engineer, shall extend to a depth not more than one foot below the invert elevation. Beyond this depth, Class D excavation will be paid for.

The Engineer shall have the authority to change classifications and the limits thereof as he may deem necessary, consistent with requirements outlined under definitions of the classifications.

61–2.01 TRENCH EXCAVATION AND BACKFILL, CLASS A

Class A shall be trench excavation where the excavated material is piled beside the trench as it is removed and backfilled from this position, or wasted immediately adjacent to the excavation. The disposal of excess material resulting from pipe volume shall be considered as incidental to Class A, unless otherwise provided for in the special provisions.

61–2.02 TRENCH EXCAVATION AND BACKFILL, CLASS B

Class B shall cover all cases of trench excavation where the excavated material, instead of being piled beside the trench, is transported to another site for wasting, or is transported to another point on the trench for backfill, or to another site for storage, as a result of confined operational conditions where no space is available for storage beside the trench.

Where the excavated material is transported to another site for storage all the cost including that of returning the material to the trench site for backfill shall be considered as incidental to this item and no additional payment will be made therefor.

The Contractor shall secure and maintain all necessary waste and storage sites unless otherwise designated on the plans or in the special provisions.

Where the Engineer directs that a blanket of select material be placed over the upper portions of the trench, the excavated material which is displaced by the select material shall be disposed of elsewhere, and shall be considered as Class B.

61–2.03 TRENCH EXCAVATION AND BACKFILL, CLASS C

Class C shall cover the removal and disposal of solid rock, i. e. ledge rock that requires systematic drilling and blasting for its removal, and also boulders exceeding one-half cubic yard in volume. All ledge rock, boulders, or stones shall be removed to provide a minimum clearance of six inches under the pipe.

Hard clay or hardpan will not be classified as solid rock excavation.

All materials removed shall be replaced with satisfactory waste materials from adjacent trenches or from imported bedding or backfill, as determined by the Engineer. All costs for backfilling not requiring haul shall be considered as incidental to this item. Payment for imported materials, where required, shall be in accordance with applicable bid items in the proposal.

61–2.04 TRENCH EXCAVATION AND BACKFILL, CLASS D

Class D shall apply to the excavation of unsuitable material which lies in excess of one foot below the invert elevation, the removal of which may be ordered by the Engineer. Excavated materials shall be disposed of at an approved waste site and all costs involved in the excavating and wasting of this material shall be considered as incidental to this item. The imported material for foundations required for backfill will be paid for in accordance with the applicable bid items in the proposal.

61–3 CONSTRUCTION DETAILS

61–3.01 EXCAVATION

The length of trench excavated in advance of the pipe laying shall be kept to a minimum, and in no case shall it exceed three hundred (300) feet unless otherwise specifically authorized by the Engineer.

The maximum permissible trench width from the bottom of the trench to the crown of the pipe shall be as follows:

15-inch diameter and smaller ... 40 inches
18-inch diameter and larger ... 1½ x inside diameter + 18 inches

In all cases, trenches must be of sufficient width to permit proper jointing of the pipe and backfilling of material along the sides of the pipe. Trench width at the surface of the ground shall be kept to the minimum amount necessary to install the pipe in a safe manner. If the maximum trench width is exceeded by the Contractor without the written authorization of the Engineer, the Contractor will be required at his own expense to provide pipe of higher strength classification, or to provide a higher class of bedding, as may be deemed necessary by the Engineer.

Excavation for manholes and other structures shall be sufficient to provide a minimum of twelve (12) inches between their surfaces and the sides of the excavation.

All material excavated from trenches and piled adjacent to the trench or in a roadway or public thoroughfare shall be piled and maintained so that the toe of the slope of the material is at least two (2) feet from the edge of the trench. It shall be piled in such manner as will cause a minimum of inconvenience to public travel, and provision shall be made for merging traffic where such is necessary. Free access shall be provided to all fire hydrants, water valves and meters, and clearance shall be left to enable free flow of storm water in all gutters, other conduits, and natural watercourses.

61–3.02 DEWATERING

Pipe trenches shall be kept free from water during pipe laying and jointing by such method as the Contractor may elect, provided the method is acceptable to the Engineer. The Contractor shall be responsible for damages of any nature resulting from the dewatering operations, notwithstanding tacit approval of the method by the Engineer.

Dewatering of the trench shall be considered as incidental to the construction and all costs thereof shall be included in various unit contract prices in the proposal, unless otherwise provided in the special provisions.

61–3.03 FOUNDATIONS AND BEDDING

–3.03A Foundation Preparation

Proper preparation of foundation, placement of foundation material where required, and placement of bedding material shall precede the installation of all sewer and culvert pipe. This shall include necessary leveling of the native trench bottom or the top of the foundation material as well as placement and compaction of required bedding material to a uniform grade so that the entire length of pipe will rest firmly on a well compacted material, so the backfill material around the pipe will be placed in a manner to meet requirements specified hereinafter.

–3.03B Classification of Bedding

Bedding procedures shall be classified as Class A, Class B, Class C, and Class D. The approximate limits for the various classes of bedding will be indicated on the construction plans where it is feasible to do so.

Where no special reference is made to the classification of bedding on the plans or in the specifications, it shall be construed that all bedding procedures shall be as described for Class D.

The Engineer shall have the authority to change bedding classifications and the limits thereof as he may deem necessary during the progress of the construction, consistent with the requirements outlined under the definitions and requirements of the various classifications contained herein. Classification of bedding will not constitute a pay item in itself, with the exception of Class A bedding, but the materials used will be paid for in accordance with applicable bid items in the proposal.

Where unauthorized excavation has been made below the established grade, the Contractor shall provide, place and compact suitable bedding material to the proper grade elevation at his own expense.

–3.03B1 Class A Bedding. Class A bedding shall consist of a pipe cradle constructed of Class 4(1½) portland cement concrete as specified in Section 37-3.04. The bottom of the trench shall be fully compacted before placement of pipe or cradle. Cradle construction shall conform to the details on standard drawing.

The unit contract price per linear foot for Class A bedding shall be full compensation for furnishing all labor, equipment, and materials necessary to construct the concrete cradle. Any trench excavation, furnishing and placing of select bedding material and compaction of same will be paid for in accordance with applicable bid items in the proposal.

–3.03B2 Class B Bedding. Class B bedding shall consist of the leveling of the bottom of the trench or the top of the foundation material at such elevations as the Engineer may direct, and the furnishing and placing of bedding materials under the pipe and long the sides to the springline of the pipe. Minimum thickness of the layer of bedding material required under any portion of the pipe shall be four inches for all pipe sizes of 27 inches diameter and smaller, and six inches for all pipe sizes of 30 inches diameter and larger.

Bedding material used in classes B and C bedding shall consist of clean, granular, unfractured pea gravel of which 100 percent will pass the U. S. Standard ¾-inch opening; not more than 3 percent will pass the U. S. No. 200 (wet sieve); 0-8 percent will pass the U. S. No. 8 sieve and 95-100 percent will pass the U. S. Standard ⅜-inch opening. The material shall have a minimum sand equivalent of 50.

Where bedding material of classes B or C is required, all costs for its procurement, hauling and placement shall be included in the unit contract price for "Bedding Material", per linear foot for each size of pipe.

Compaction shall be as directed by the Engineer and payment will be made in accordance with applicable bid items in the contract.

–3.03B3 Class C Bedding. Class C bedding shall meet the requirements outlined for Class B bedding except that bedding material need be placed only to approximately the lower quadrant of the pipe.

Material for Class C bedding shall conform to the specification for Class B bedding, and payment will be made at the unit contract price per linear foot per pipe size for "Bedding Material."

Compaction shall be as directed by the Engineer and payment will be made in accordance with applicable bid items in the contract.

–3.03B4 Class D Bedding. Class D bedding shall consist of carefully excavating the trench to proper grade and placing select native material around the pipe and backfilling in accordance with Section 61-3.05. Class D bedding, as described, shall be considered as incidental to the construction and all costs thereof shall be included in other unit contract items of the proposal.

–3.03C Pipe Bedding in Solid Rock Excavation

In solid rock excavation, all ledge rock, boulders, or stones shall be removed to provide a minimum clearance of six (6) inches under the pipe. All materials thus removed shall be replaced with the classification of bedding noted on the plans, or directed by the Engineer.

–3.03D Foundation Material and Placement

Prior to instaliation of bedding and pipe, the trench bottom shall be brought to grade as indicated for the type of bedding specified, and stabilized if necessary, by one of the following methods to provide a foundation capable of supporting the pipe in its proper position. The trench bottom will be considered to meet this requirement, with or without stabilization, when it has strength sufficient to support a length of the pipe to be used without noticeable deflection when an additional weight equal to the weight of one length of pipe is placed on it.

Method 1. **Subsoil Modification.** Crushed rock, gravel, sand, or other durable inert material, 100% passing a 3" screen, shall be worked into the subsoil to the extent necessary to accomplish the required stabilization. Tight sheeting may be driven below the grade of the trench bottom in order to limit the quantity of subsoil to be stabilized, and if called for will be a pay item. Such sheeting shall be left in place below the elevation of the top of the bedding material. Unless the aggregate is well graded from coarse to fine as specified under method 2, the completed trench bottom shall not contain a top layer more than 2" thick containing aggregate unmixed with native material.

Method 2. **Ballasting.** A ballast layer of crushed rock, gravel, sand or other durable inert material, well graded from coarse to fine is required. The maximum size of ballast shall not exceed one inch per each foot of pipe diameter up to a maximum of three inch. The material shall be placed to a minimum depth of four inches or as may be necessary to provide the required stabilization. Note that bedding material described in 61-3.03B2 may be used as ballast, and that ballast material as herein described may be used as bedding, up to the bottom of the pipe. Tight sheeting may be driven below the grade of the trench bottom in order to increase the effectiveness of the ballasting, and if called for will be a pay item. Such sheeting shall be left in place below the top of the bedding material.

Where it is determined by the Engineer that the native material is of such character that it is not likely to be transported by moving ground water, the requirements for gradation to assure minimum void space will not apply.

Where foundation material is required, all costs for its procurement and placement shall be included in the unit contract price per cubic yard for "Foundation Material".

61–3.04 CRIBBING AND SHEETING

Unless otherwise provided in the special provisions, the Contractor shall provide all cribbing and sheeting needed to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench. Such cribbing and sheeting shall be according to the Contractor's design which shall comply with applicable local and state safety codes.

Removal of any cribbing and sheeting from the trench shall be accomplished in such a manner as to fulfill the above requirements.

Damages resulting from improper cribbing or from failure to crib shall be the sole responsibility of the Contractor. Cribbing will not be a pay item and the cost thereof shall be included in the unit contract price for "Trench Excavation" of the particular class of trench excavation required, unless otherwise provided in the special provisions.

61–3.05 BACKFILLING

As the pipe is installed, it shall be backfilled by hand with selected native material up to an elevation six (6) inches above crown, taking care that the backfill is in contact with the entire periphery of the pipe. The backfill shall be so carefully placed that subsequent backfilling operations will not disturb the pipe in any way. If the Engineer deems it necessary to compact the hand placed backfill, it will be paid for in accordance with the applicable unit contract price. If there is no such bid item, the compaction will be paid for under a mutually agreed price.

Temporary cribbing, sheeting, or other timbering shall be removed unless specific permission is given by the Engineer to leave it in place.

In backfilling the trench, the Contractor shall take all necessary precautions to protect the pipe from any damage or shifting of the pipe. In general, backfilling shall be performed by pushing the material from the end of the trench into, along and directly over the pipe so that the material will be applied in the form of a rolling slope rather than by side filling which will damage the pipe. Backfilling from the sides of the trench will be permitted after sufficient material has first been carefully placed over the pipe to such a depth as the Engineer may approve.

Pipe placed below the water table shall be kept from floating by placing backfill material upon it, or by maintaining the water level at the bottom of the trench.

During all phases of the backfilling operations and testing as outlined herein, the Contractor shall protect the sewer installation, provide for the maintenance of traffic as may be necessary, and provide for the safety of property and persons.

Where it is required that a blanket of select material or bank run gravel be placed on top of the native backfill, the backfill shall be placed to such elevation as shown on the plans, or as the Engineer may direct, and shall be leveled to provide for a uniform thickness of the borrow material. Where compaction is required, it shall be performed prior to placing the borrow material.

The cost of backfilling shall be included in the unit contract price per linear foot for the particular class of trench excavation and backfill, and in addition thereto, payment will be made for tamping, water settling, and furnishing and placing of bank run gravel when any of these are included in the plans and proposal, or ordered by the Engineer.

61–3.06 COMPACTION OF TRENCH BACKFILL

Where compaction of trench backfill material is required, one of the following methods or combination thereof as set forth in the special provisions shall be used and payment will be made in accordance therewith. The Engineer shall have the right to change methods and limits to better accommodate field conditions. The density of backfilled material shall meet requirements outlined in the special provisions.

–3.06A Water Setting

Water settling shall be performed and payment will be made therefor as specified in Section 16, entitled "Water."

–3.06A1 Water for Uses Other Than Trench Backfill

Water required for dust control and uses other than described in this section shall be used and paid for in accordance with the requirements of Section 16, "Water."

–3.06B Mechanical Tamper

The mechanical tamper shall meet the specifications described for it in Section 15-2.01A.

–3.06C Vibratory Compactor

The vibratory compactor shall be a single hand operated unit, a group hand operated unit, or a vibratory roller. Where vibratory units will be required on the job, it will be so specified in the special provisions, and the method of payment therefor will be included in the proposal.

If vibratory compactors are required on a project for which the plans and proposal make no provisions for the use and payment therefor, the Contractor shall furnish and operate such compactors as the Engineer may require for proper compaction. In the absence of any unit contract prices for the equipment, the Contractor shall be paid therefor upon an hourly basis for each compactor or combination thereof in accordance with the latest semi-annual issue of "Rental Rates for Equipment Used on Force Account," by the Department of Highways, Olympia, Washington.

61–3.07 BANK RUN GRAVEL FOR TRENCH BACKFILL

Wherever a trench is excavated in paved roadway, sidewalk or other area where minor settlement would be detrimental and where the native excavated material is not suitable for compaction as backfill, the trench shall be backfilled to such depth as the Engineer may direct with Bank Run Gravel, Class A or Class B as specified in Section 26-2, excepting that 100 percent of the material shall pass the 2½ inch square opening.

61–3.08 TOP SOIL REMOVAL AND REPLACEMENT

Removal of top soil and replacement of it shall be performed in accordance with the provisions of Section 55 and payment will be made at the unit contract price per cubic yard as specified therein.

61–3.09 LAWN REMOVAL AND REPLACEMENT

Removal of lawn and the replacement of it shall be performed in accordance with the provisions of Section 56 and payment will be made at the unit contract price per square yard as specified therein.

61–4 MEASUREMENT AND PAYMENT

61–4.01 TRENCH EXCAVATION AND BACKFILL

When the proposal contains a bid item of "Sewer Trench Excavation and Backfill," the measurement for payment therefor will be made on the basis of one or both of the units described in sections 61-4.01A and 61-4.01B, as they apply to the proposal and special provisions.

When no bid item for "Sewer Trench Excavation and Backfill" is included in the proposal, all work and costs for excavating trenches to the grades shown on the proposal plans and for backfilling with excavated materials shall be considered as incidental to the construction, and shall be included in other items of the contract.

–4.01A Measurement by the Linear Foot

When measurement and payment is called for by a unit contract price per linear foot, the trench shall be measured continuously along center line from the beginning point to the terminus and including the distances through structures, excepting however, that if excavation for structures is a bid item in connection with the structures the allowable distance along center line through the structure excavation shall be deducted from the total length of trench.

The unit contract price per linear foot for "Trench Excavation and Backfill, Class .....," shall be full compensation for all labor, materials, tools and equipment required to excavate and backfill the trench in accordance with the plans and specifications. The unit contract price does not, however, include the work and expense of bank run gravel, foundation material, bedding material, water settling and compaction equipment such as tampers which, if required, will become separate bid items in the proposal.

–4.01B Measurement by the Cubic Yard

When measurement and payment is called for by a unit contract price per cubic yard, the volume shall be computed upon the following basis for length, width and depth of trench:

Length. The entire horizontal distance in feet along the center line of the trench, including measurement through manhole or structure locations, excepting however, that the measurement through such structures will be deducted if the proposal carries a separate item of structure excavation that is applicable to the structures.

Width. For 24-inch pipe and smaller, the width upon which excavation will be calculated will be the inside diameter of the pipe plus 24 inches. For pipes with inside diameter greater than 24 inches, the calculated width will be the inside diameter plus 36 inches.

Depth. The vertical measurement shall be whichever is the lesser dimension arrived at from the following possible cases: (a) the vertical measurement from invert of pipe to original ground or paved surface, (b) the vertical measurement from invert of pipe to the scalped surface after removal of top soil or lawn, and (c) the measurement from invert of pipe to roadway excavation subgrade in cases where it is intended that sewer and street construction are to be performed in conjunction with each other. In cases where a blanket of bank run gravel is placed upon a lower layer of compacted native backfill, the vertical measurement of the "Bank Run Gravel, Class B" will be from the top of the compacted native backfill to the completed surface of the bank run gravel.

Measurement will be made at intervals of not more than 50 feet along the center line of the trench, and closer if the terrain justifies.

The unit contract price per cubic yard for "Trench Excavation and Backfill, Class .....," shall be full compensation for all labor, material, tools and equipment required to excavate and backfill the trench in accordance with the plans and specifications: The unit contract price does not, however, include the work and expense of bank run gravel, foundation material, bedding material, water settling and compaction equipment such as tampers which, if required, will be separate bid items for payment.

61–4.02 BANK RUN GRAVEL FOR TRENCH BACKFILL

Bank run gravel of class specified will be measured by the cubic yard in the trucks at the point of delivery.

61–4.03 PIPE BEDDING CLASS A

Measurement will be for the actual number of linear feet of concrete cradle constructed for each pipe size.

61–4.04 FOUNDATION MATERIAL

Foundation material will be measured by the cubic yard in trucks at the point of delivery.

61–4.05 PIPE BEDDING MATERIAL CLASS B AND CLASS C

Measurement will be for the actual linear feet of bedding placed for each size of pipe.

61–4.06 MECHANICAL TAMPERS AND VIBRATORY COMPACTORS

Measurement will be to the nearest one-half (½) hour of actual time consumed in compacting for each of the types of equipment used. No allowance will be made for time consumed in making repairs to the equipment, nor for moving equipment to or from areas on the work for which compaction is required.

61-5 PAYMENT

Payment will be made for such of the following bid items as are included and shown on any particular contract:

1. "Trench Excavation and Backfill Class A", per linear foot.
2. "Trench Excavation and Backfill Class B", per linear foot.
3. "Trench Excavation and Backfill Class C", per linear foot.
4. "Trench Excavation and Backfill Class D", per linear foot.
5. "Trench Excavation and Backfill Class A", per cubic yard.
6. "Trench Excavation and Backfill Class B", per cubic yard.
7. "Trench Excavation and Backfill Class C", per cubic yard.
8. "Trench Excavation and Backfill Class D", per cubic yard.
9. "Bank Run Gravel Class A", per cubic yard.
10. "Bank Run Gravel Class B", per cubic yard.
11. "Pipe Bedding Class A for (size) Pipe", per linear foot.
12. "Pipe Bedding Class B for (size) Pipe", per linear foot.
13. "Pipe Bedding Class C for (size) Pipe", per linear foot.
14. "Foundation Material", per cubic yard.
15. "Mechanical Tamper", per hour.
16. "Vibratory Compactor", per hour.
17. "Hydrant Settling Water", per M gallons.
18. "Haul Settling Water", per M gallons.
19. "Water", per M gallons.
20. "Top Soil Removal and Replacement", per cubic yard.
21. "Lawn Removal and Replacement", per square yard.

Section 62—Pipe Laying, Jointing and Testing

62–1 DESCRIPTION

This section covers the pipe laying, jointing and testing of sanitary sewers, storm drains and culverts. The construction of these lines shall meet the requirements herein and as shown on the plans, special provisions and standard drawings.

Any pipe or appurtenance which inadvertently or otherwise has been laid or jointed in non-accordance with the specifications and special provisions shall, upon direction of the Engineer at any time before final acceptance of the contract or before expiration of the guaranty period, be repaired or be removed and replaced at the expense of the Contractor, and to the satisfaction of the Engineer.

62–2 MATERIALS

The materials shall conform to requirements outlined in the various applicable sections of the specifications.

62–3 CONSTRUCTION DETAILS

62–3.01 SURVEY LINE AND GRADE

Survey line and grade control hubs will be provided by the Engineer in a manner consistent with accepted practices.

The Contractor shall constantly check line and grade and in the event they do not meet specified limits described hereinafter, the work shall be immediately stopped, the Engineer notified, and the cause remedied before proceeding with the work.

62–3.02 SEWER PIPE LAYING

Laying of sewer pipe shall be accomplished to line and grade in the trench only after it has been dewatered and the foundation and/or bedding has been prepared in accordance with Section 61. Mud, silt, gravel and other foreign material shall be kept out of the pipe and off the jointing surfaces.

All pipe laid shall be retained in position by mechanical means or otherwise, as approved by the Engineer, so as to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. All pipe shall be laid to conform to the prescribed line and grade shown on the plans, within the limits that follow.

Variance from established line and grade shall not be greater than one thirty-second (1/32) of an inch per inch of pipe diameter and not to exceed one-half (½) inch, provided that such variation does not result in a level or reverse sloping invert; provided also, that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one sixty-fourth (1/64) per inch of pipe diameter, or one-half (½) inch maximum.

The sewer pipe, unless otherwise approved by the Engineer, shall be laid up grade from point of connection on the existing sewer or from a designated starting point. The sewer pipe shall be installed with the bell end forward or upgrade, unless approved otherwise. When pipe laying is not in progress the forward end of the pipe shall be kept tightly closed with an approved temporary plug.

Where pipe lines are to be laid on specified curves of sufficiently short radius to deflect the pipe joints in an amount greater than recommended by the manufacturer, the pipe ends shall be canted at the factory in an amount necessary to meet the manufacturer's recommendations. The pipe lines laid on curved alignment will be measured for payment along the center line of the pipe, and no additional compensation will be allowed for canting.

62–3.03 CULVERT PIPE

Laying of culvert pipe shall conform to the requirements of Section 62-3.02 except that variation from established line and grade, measured at each joint, shall not exceed one thirty-second (1/32) inch per inch of pipe diameter, and provided that resulting level or backsloping length of pipe does not occur.

62–3.04 DEWATERING

Dewatering, sufficient to maintain the ground water level at or below the surface of trench bottom or base of the bedding course, shall be accomplished prior to pipe laying and jointing, if not prior to excavation and placing of the bedding as called for in other sections of the specifications or special provisions. The dewatering operation, however accomplished, shall be carried out so that it does not destroy or weaken the strength of the soil under or alongside the trench. The normal water table shall be restored to its natural level in such a manner as to not disturb the pipe and its foundation.

62–3.05 BEDDING

The pipe bedding shall be placed so that the entire length of the pipe will have full bearing. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete. Bell holes shall be dug as required to assure uniform support along the pipe barrel.

62–3.06 PLUGS AND CONNECTIONS

Plugs for pipe branches, stubs or other open ends which are not to be immediately connected shall be made of an approved material and shall be secured in place with a joint comparable to the main line joint, or stoppers may be of an integrally cast breakout design.

62–3.07 PIPE MARKINGS

Elliptically reinforced concrete pipe shall be placed so that the top and bottom markings, indicating the minor axis of the reinforcement, are positioned within five (5) degrees of a vertical plane through the center of the pipe.

62–3.08 PIPE JOINTING

All sanitary sewer pipe shall have flexible gasketed joints unless otherwise specified.

All sanitary sewer pipe, storm drains and side sewers shall be subject to tests described in Section 62-3.10.

–3.08A Hand Mortared Joints

When hand mortared joints are specified they shall be made with cement mortar mixed in the proportions of one (1) part cement to one and one-half (1½) parts commercial plaster sand, mixed with the least amount of clean water necessary to provide a workable mix. Before jointing, the interior of the bell shall be wiped clean, dampened, and the lower one-third shall be well covered with cement mortar before the insertion of the spigot end of the adjoining pipe. Special care shall be taken to avoid shoving mortar ahead of the spigot end of the pipe when inserting it into the bell.

The spigot end shall be firmly seated against the shoulder of the bell. After the two adjoining pipe sections have been centered and the inverts aligned, the annular space shall be partially filled with mortar to hold the two pipe sections in place. Then, beginning at the bottom, the mortar shall be thoroughly pressed into the annular space and a neat forty-five (45) degree fillet built up on the outside.

Pipe twenty-four (24) inches and over in diameter, and all pipe laid on curves shall have the joints pointed on the inside. In all cases, after jointing is completed the inside of the pipe shall be wiped clean and shall have a smooth surface free from protrusions of any kind. All joints shall be protected from water and the drying effects of wind and sun. Wet burlap sacks or other approved means of protection shall be provided if required by the Engineer.

The work of jointing shall follow at such a distance behind pipe laying as may be necessary to insure that joints once mortared will not be disturbed by pipe laying operations. There shall be no walking or backfilling upon the pipe until the joints have set hard.

–3.08B Gasket Type Joints

Flexible gasketed joints shall be made in strict accordance with the instructions furnished by the pipe manufacturer, and shall be in accordance with other provisions described below except in any case where they may be inconsistent with the manufacturer's instructions.

Pipe handling after the gasket has been affixed shall be carefully controlled to avoid disturbing the gasket and knocking it out of position, or loading it with dirt or other foreign material. Any gaskets so disturbed shall be removed and replaced, cleaned and relubricated if required, before the jointing is attempted.

Care shall be taken to properly align the pipe before joints are entirely forced home. During insertion of the tongue or spigot, the pipe shall be partially supported by hand, sling or crane to minimize unequal lateral pressure on the gasket and to maintain concentricity until the gasket is properly positioned. Since most flexible gasketed joints tend to creep apart when the end pipe is

deflected and straightened, such movement shall be held to a minimum once the joint is home.

Sufficient pressure shall be applied in making the joint to assure that it is home, as described in the installation instructions provided by the pipe manufacturer. Sufficient restraint as specified in Section 62-3.02 shall be applied to the line to assure that joints once home are held so, until fill material under and alongside the pipe has been sufficiently compacted. At the end of the work day, the last pipe laid shall be blocked in an effective way to prevent creep during "down time."

Pipe required to be laid on curved alignment shall be joined in straight alignment and then be deflected, joint by joint. Special care shall be taken in blocking the pipe just previously laid, by tamped fill or otherwise to resist the misaligning forces generated during compression of the joints being made.

–3.08C Jointing of Dissimilar Pipes

For dissimilar pipes where suitable adaptor couplings are not available, the jointing shall be accomplished with a special fabricated coupling or concrete encasement expansion block, as approved by the Engineer.

–3.09 SEWER LINE CONNECTIONS

Sewer line connections to trunks, mains, laterals or side sewers shall be left uncovered until after an acceptance inspection has been made. After approval of the connection, the trench shall be backfilled as specified in Section 61-3.05, after first covering the bare pipe with select material compacted to a depth of six (6) inches above crown of pipe.

–3.09A Side Sewer Connections

Where a side sewer is larger than the trunk, main, or lateral to which it is to be connected, the connection shall be made only at a standard manhole unless otherwise provided in the plans or special provisions, or unless otherwise authorized by the Engineer.

–3.09B Manhole Connections

Connection to a manhole shall be made in accordance with the provisions of Section 63-3.12.

62–3.10 TESTING FOR ACCEPTANCE

All sanitary sewers, storm drains and side sewers shall be cleaned and tested after backfill by the exfiltration method, or by the low pressure air method, unless otherwise provided in the special provisions; it is excepted, however, that where the ground water table is such as to preclude a proper exfiltration test, the Engineer may require infiltration tests.

All work involved in cleaning and testing sewer lines between manholes and/or rodding inlets as required herein shall be completed within 15 working days after backfilling of sewer lines and structures. Any further delay will require the written consent of the Engineer. The Contractor shall furnish all labor, materials, tools and equipment necessary to make the test, clean the lines and to perform all work incidental thereto. Precautions shall be taken to prevent joints from drawing during tests, and any damage resulting from tests shall be repaired by the Contractor at his own expense. The manner and time of testing shall be subject to approval of the Engineer, provided that the Engineer may limit pipe footage to be laid without testing.

All wyes, tees and stubs shall be plugged with flexible jointed caps, or acceptable alternate, securely fastened to withstand the internal test pressure. Such plugs or caps shall be readily removable, and for their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

In the event that the Contractor elects to test large diameter pipe one joint at a time, leakage allowances shall be converted from GPM per 100 feet to GPM per joint by dividing by the number of joints occurring in 100 feet. If leakage exceeds the allowable amount, corrective measures shall be taken and the line be then retested to the satisfaction of the Engineer.

–3.10A Exfiltration Test

Prior to making exfiltration leakage tests, the Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls; provided, however, that after so filling the pipe he shall complete the leakage test within twenty-four (24) hours after filling. When under test, the leakage allowable shall comply with the provisions that follow.

Leakage shall be no more than five-tenths (0.5) gallon per hour per inch of diameter per one hundred (100) feet of sewer pipe, with a minimum test pressure of six (6) feet of water column above the crown at the upper end of the pipe or above the active ground water table, whichever is higher as determined by the Engineer. The length of pipe tested shall be limited so that the pressure on the invert of the lower end of the section tested shall not exceed sixteen (16) feet of water column, and in no case shall be greater than 700 feet or the distance between manholes when greater than 700 feet. For each increase in pressure of two (2) feet above a basic six (6) feet measured above the crown at the lower end of the test station, the allowable leakage shall be increased by 10 percent, tabulated in the table which follows.

ALLOWABLE LEAKAGE IN GALS. / 100 LINEAR FEET / HR.

Head Above Crown on Lower End of Test Section

Pipe Size (Inches)	6 Ft.	8 Ft.	10 Ft.	12 Ft.	14 Ft.	16 Ft.
4	2.0	2.2	2.4	2.6	2.8	3.0
6	3.0	3.3	3.6	3.9	4.2	4.5
8	4.0	4.4	4.8	5.2	5.6	6.0
10	5.0	5.5	6.0	6.5	7.0	7.5
12	6.0	6.6	7.2	7.8	8.4	9.0
15	7.5	8.2	9.0	9.8	10.5	11.2
18	9.0	9.9	10.8	11.7	12.6	13.5
21	10.5	11.6	12.6	13.6	14.7	15.8
24	12.0	13.2	14.4	15.6	16.8	18.0
27	13.5	14.9	16.2	17.6	18.9	20.2
30	15.0	16.5	18.0	19.5	21.0	22.5
36	18.0	19.8	21.6	23.4	25.2	27.0
42	21.0	23.1	25.2	27.3	29.4	31.5
48	24.0	26.4	28.8	31.2	33.6	36.0
54	27.0	29.7	32.4	35.1	37.8	40.5
60	30.0	33.0	36.0	39.0	42.0	45.0
72	36.0	39.6	43.2	46.8	50.4	54.0

In any case where the measured leakage is exceeded but is not more than one hundred and forty percent (140%) of the allowable leakage, the Contractor will be permitted, at his option and at his own expense, to repair the defective section without removing and relaying the pipe. Such repairs shall satisfactorily comply with requirements of the leakage test.

In event the measured leakage should be more than one hundred forty percent (140%) of the allowable, the Contractor, at his own expense, shall remove and discard all defective pipe and relay new pipe to conform with the requirements of the leakage test.

Testing of storm drains shall be the same as for sanitary sewers, except that the calculated leakage allowable for acceptance shall be two (2) times that of a sanitary sewer.

The Contractor shall furnish all equipment, materials and labor necessary for making the leakage tests. Any arrangement of test equipment which will provide accurate means of measurement will be approved by the Engineer. The leakage test shall be made by the Contractor in the presence of the Engineer.

–3.10B Infiltration Test

When the natural ground water table is above the crown of the higher end of the test section, the maximum allowable limit for infiltration shall be four tenths (0.4) gallon per hour per inch of internal diameter per 100 feet of length, with no allowance for external hydrostatic head.

–3.10C Other Test Allowances

All lateral or side sewer branches included in the test section shall be taken into account in computing allowable leakage. An allowance of two tenths (0.2) GPH per foot of head above invert shall be made for each manhole included in a test section.

–3.10D Air Pressure for Sewers and Storm Drains

1. Air pressure testing may be used for pipe 30" I.D. and smaller in lieu of the water exfiltration test by either of two methods: (A) the Rotometer or constant pressure, or (B) timed pressure drop method:

(A) Rotometer or Constant Pressure

The line shall be tested at 3.0 psig and the volume of air leaked at this pressure shall be read by the use of a Rotometer placed in the system.

The maximum rate of air loss for an acceptable sewer line shall not exceed 0.003 C.F.M. per square foot of interior pipe surface, or 2.0 C.F.M. minimum when subjected to a constant pressure of 3.0 psig. The rate of loss to be determined when the system reaches an equilibrium state. For each foot of water table elevation above the invert of the pipe under test, the allowable loss shall be reduced six (6) percent.

(B) Time Pressure Drop Method

This method shall be conducted according to the procedure described below.

Sample Calculations for Time Pressure Drop Method

Example 1 (Refer to NOMOGRAPH on Page 98)

Given: 300 feet of 8-inch Pipe. Set straight edge on 8-inch in "d" column and 300 feet in "L" column. Read 0.92 on C scale and 215 on K scale. Reading on C scale is less than one so the K reading of 215 seconds would be the minimum time allowable (in seconds) for this run of nine.

Example 2

Given: 500 feet of 10-inch Pipe. Set straight edge on 10-inch in right hand column and 500 feet in "L" column. Read C of 1.95 and K of 550. C is greater than one so divided C into K $\frac{550}{1.95} = 282$ seconds for this run of pipe. This result may also be read on the Nomograph in column t_q.

2. The test equipment used with either method of air pressure testing shall be certified as satisfactory by the Engineer at the beginning of a job. The inspector may at any time require a calibration check of the instrumentation used, i.e., rotometers, bourdon gages, pressure reducing valves, etc.

AIR TESTING BY TIME PRESSURE DROP METHOD

Recommended Procedure For Conducting Acceptance Test

1. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
2. All gauge pressures in the test should be increased by the amount of ground water pressure at the crown of the pipe.
3. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
4. After an internal pressure of 4.0 psig is obtained allow at least two minutes for air temperatare to stablize, adding only the amount of air required to maintain pressure.
5. After the two minute period, disconnect air supply.
6. When pressure decreases to 3.5 psig, start stop watch. Determine the time in seconds that is required for the internal air pressure to reach 2.5 psig. This time interval should then be compared with the time required by specification as computed below.
7. List size and length of all portions of pipe under test in table similar to the one that follows. The maximum reach to be tested in one operation shall be the reach between two consecutive manholes.
8. By use of Nomograph, compute K and C. Use scales d and L, read K and C, and enter these values in the table above.
9. Add all values of K and all values of C for pipe under test.
10. If the total of all C values is less than one, enter the total of all K values into the space for "Time Required by Specification."
11. If the total of all C values is greater than one, divide the total of all K values by the total of all C values to get t_q. To make this division with the Nomograph, use scales C and K, and read t_q.

Diameter Inches	Length Feet	K = .011 d²L	C = .0003882 dL

Total K——— Total C———

Time required by specification———

3. SAFETY PROVISIONS. Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug which can become a high velocity projectile. Gages, air piping manifolds and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. Four pounds (gage) air pressure develops a force against the plug in a 12-inch diameter pipe of approximately 450 lbs. Pipes larger than 30-inch diameter shall not be air tested because of the difficulty of adequately blocking the plugs. Air testing apparatus shall be equipped with a pressure release device such as a rupture disk or a pressure relief valve designed to relieve pressure in the pipe under test at 6 p.s.i.

–3.10E Payment for Tests

The work of cleaning and testing and the furnishing of caps and plugs for the tests shall be considered as incidental to the construction and all costs incurred therefor shall be included in the unit contract price of pay items in the proposal.

The Contractor shall arrange for and provide all necessary water at his own expense, unless otherwise provided in the special provisions.

If the Contractor shall purchase water from a water utility at a fire hydrant on or near the project, he shall make all arrangements at his own expense and shall pay the utility on basis of actual quantity of water metered.

62–4 MEASUREMENT

Measurement for payment shall be by the linear foot of pipe laid and tested and shall be along the pipe through the tees and fittings. Measurements shall be from center to center of standard types of manholes or to inside face of structures, and shall be taken to the nearest one tenth (0.1) foot.

Measurement for tees and fittings shall be per each for each size as constructed.

62–5 PAYMENT

Payment for all pipe shall be the unit contract price "per linear foot" for each class, size and type of pipe laid and satisfactorily tested in accordance with the specifications. No additional compensation will be allowed for testing.

Payment for tees and fittings shall be the unit contract price "per each" for each size, including caps or plugs laid and tested. No additional compensation will be allowed for testing or providing the cap or plug.

Payment will be made for such of the following bid items as are included and shown on any particular contract:

1. "(size) (class) Pipe in Place," per linear foot.
2. "Tees or Wyes (size)," per each.

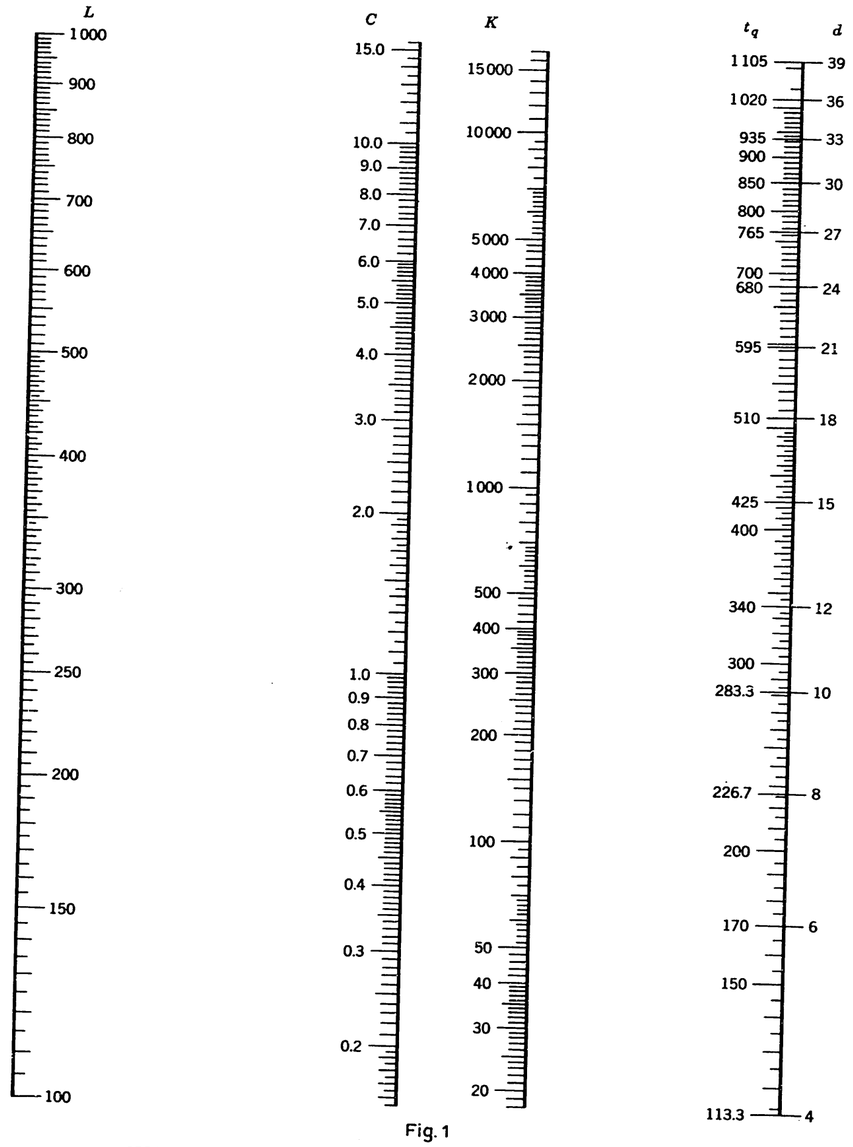


Fig. 1

NOMOGRAPH FOR THE SOLUTION OF $K = .011d^2L$, $C = .0003882dL$, $t_q = K \div C$

Section 63—Manholes for Storm and Sanitary Sewers

63–1 DESCRIPTION

Standard manholes may be constructed of precast units, concrete masonry units or concrete or clay brick, cast-in-place concrete, or shop-fabricated corrugated metal when used with corrugated metal pipe, all in accordance with the standard plans and these specifications; excepting, however, that the contractor's choice of alternates may be limited in the special provisions.

63–2 MATERIALS

63–2.01 REINFORCED CONCRETE

Reinforced concrete shall consist of portland cement, mineral aggregates and water, in which steel has been embedded in such manner that the steel and concrete act together.

–2.01A Cement

Portland cement shall conform to the requirements of the Specifications for Portland Cement ASTM C 150, any type, unless otherwise limited in the special provisions; or it may be air-entraining portland cement conforming to ASTM C 175.

–2.01B Wire Fabric Reinforcement

Reinforcement shall consist of wire conforming to ASTM A 185.

–2.01C Bar Reinforcement

Bar reinforcement shall conform to ASTM A 15, intermediate grade.

–2.01D Aggregates

Aggregates shall conform to ASTM C 33, except that the requirement for gradation shall not apply to precast items.

–2.01E Mixture

The aggregates shall be so sized and graded, and proportioned and thoroughly mixed in proportions of cement and water as will produce a homogeneous concrete mixture of such quality that the manhole components will conform to the strength and watertightness requirements of these specifications. Admixtures or blends may be used with the written permission of the Engineer.

–2.01F Curing

Upon completion of casting, the precast manhole components shall be placed in a location free from outside drafts, covered and cured in a moist atmosphere maintained by an injection of steam for such time and under such temperature as may be needed to enable the manhole components to meet the strength requirements. Or, precast components may be water-cured by covering the manhole components with a water saturated material, or by a system of perforated pipes, mechanical sprinklers, porous hose, or by any other approved method that will keep the manhole components continuously moist during the curing period. Cast-in-place manhole components shall be moist-cured for a period not less than seven days, except that when high-early-strength cement is used the curing shall be not less than three days. Pigmented membrane curing compound or other approved method may be applied in lieu of moist curing.

–2.01G Strength

All concrete placed under these specifications shall have a minimum compressive strength of 3000 psi at 28 days. Strength determination shall be in accordance with ASTM C 39, unless otherwise approved by the Engineer. Precast components shall not be moved from the manufacturer's yard until a compressive strength of at least 1500 psi has been reached.

63–2.02 STEPS

Manhole steps may be either of the following, at option of the contractor or option of the manufacturer of the manhole:

–2.02A Aluminum Steps

Aluminum steps shall be forged of 6061-T6 alloy having a minimum tensile strength of 38,000 psi. The cross section shall be not less than ¾″ wide by ⅞″ deep with two non-skid grooves not to exceed ⅛″ deep and ⅛″ wide. Pattern and dimensions shall conform to the standard drawings.

–2.02B Galvanized Deformed Bar Steps

Galvanized deformed bar steps shall be 1″ diameter deformed bar conforming to ASTM A 15, intermediate or standard grade, hot bent and galvanized after bending. For bending, the temperature shall be at least 1600° F. Galvanizing shall conform to ASTM A 123. Step dimensions and pattern shall conform to the standard drawings.

63–2.03 LADDERS

Except as otherwise provided in the special provisions, base sections of precast manholes more than three feet in height shall be provided with a ladder as detailed on the standard plans, made of aluminum or steel galvanized after fabrication, conforming to the requirements for steps given in sections 63–2.02A and 63–2.02B. Base sections three feet or less in height require no steps or ladder.

63–2.04 MORTAR

–2.04A Mortar for Jointing

Mortar for jointing precast manhole sections or masonry manhole units shall be one part portland cement to not less than one part nor more than two parts plaster sand, mixed with the least amount of clean water necessary to provide a workable mortar.

–2.04B Mortar for Plaster-coating

Mortar for plaster-coating masonry unit manholes shall be proportioned according to either of the two alternates tabulated below:

	Parts by volume portland cement	Parts by volume masonry cement	Parts by volume hydrated lime or lime putty	Plaster sand measured in damp loose condition
Alt. 1	1	1 (Type II)	0	Not less than 2¼ and not more than 3 times the sum of volumes of cement and lime.
Alt. 2	1	0	¼	

63–2.05 CONCRETE MASONRY UNITS

Concrete manhole block shall conform to the Specifications for Concrete Masonry Units for Construction of Catch Basins and Manholes ASTM Designation C 139, except that nominal horizontal thickness shall be 6″ measured radially, and blocks shall have semicircular mortar grooves approximately 1″ radius at the ends.

63–2.06 CONCRETE BRICK

Concrete brick shall conform to the Specifications for Concrete Building Brick ASTM C 55 Grade A.

63–2.07 CLAY BRICK

Clay brick shall conform to ASTM C 32, Grade NA unless otherwise provided in the special provisions.

63–2.08 CAST IRON FRAMES AND COVERS

Cast iron frames and covers shall conform to the standard drawings.

Castings shall conform to the requirements of ASTM A 48 Class 25 and shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. Repair of defects by welding, or by the use of "smooth-on" or similar material will not be permitted. The manufacturer shall provide test bars as per ASTM A 48 for all orders of 200 or more units when called for in the special provisions and, upon request of the Owner, shall certify that the product conforms to the requirements of these specifications.

Manhole rings and covers shall be machine finished or ground on seating surfaces so as to assure non-rocking fit in any position, and interchangeability. At the request of the Owner, there shall be made available at the foundry

standard rings and standard covers for use by inspectors in testing fit and seating.

Where lock-type castings are called for, the locking device shall be such that the cover may be readily released from the ring, and all movable parts shall be made of non-corrosive metals and otherwise arranged to avoid possible binding. At the request of the Owner there shall be made available at the foundry a testing device suitable for proving the capacity of the assembly to resist an uplift pressure on the lid equal to 20-ft. head.

Nodular iron covers, when specified, shall conform to ASTM Designation A-339, Grade 60-45-10.

63–2.09 PRECAST MANHOLE COMPONENTS

–2.09A Base Sections

Base sections for Type I construction shall conform to the requirements for precast manhole sections in Section 63–2.09B herein, except that the reinforced base slab shall be made an integral part of the unit, and openings for pipe shall be provided to meet job requirements as indicated on the plans. The base slab shall be not less than 6″ in thickness and shall be cast monolithically with the wall section, or otherwise constructed in such manner as to achieve a completely watertight structure.

Reinforcement of the base slab shall consist of No. 4(½″) steel bars on eight-inch centers, both directions (90°). The steel shall be placed not less than 2″ nor more than 4″ from the top, and shall extend into the wall of the manhole section and be tied to the longitudinal steel.

Openings to receive pipe shall be circular, tapered in toward the inside of the section, and shall be held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joint. Openings for pipe up to 21″ diameter may be provided in 48″ base sections. Openings for pipe up to 42″ diameter may be provided in 72″ base sections. Where pipe of larger diameters are to be accommodated, a monolithic base structure as described in Section 63-3.04 shall be provided.

–2.09B Precast Manhole Sections

Standard precast sections shall consist of circular sections, in standard nominal inside diameters, 36″, 48″, and 72″. Heights of sections shall be multiples of 12″ at option of the manufacturer, excepting however, that each manufacturer shall produce at least three standard heights in each standard diameter. The nominal thickness of the 36″ and 48″ sections shall be 4″, and the nominal thickness of the 72″ sections shall be 6″.

Reinforcement for standard sections shall consist of a single cage of steel, placed at the approximate center of the wall of the section. The 36″ and 48″ standard sections shall have not less than 0.12 square inches, and the 72″ standard sections not less than 0.17 square inches of circumferential steel per linear foot. The cage shall be welded at every circumferential wire, or lapped 40 diameters and tied. The welded splice shall develop a tensile strength of 50,000 psi of wire diameter.

Joints between sections shall be tongue and groove, and shall provide ½″ nominal annular space and a minimum of 1¼″ lap.

No more than two lift holes shall be cast into each section. Holes shall be so located as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

Unless otherwise provided in the special provisions, steps shall be installed in each section so that sections placed together in any combination will provide a continuous vertical ladder with rungs equally spaced at 12″. Steps shall project uniformly from the inside wall of the manhole as per the standard drawings, and shall be cast or firmly grouted in place so as to ensure complete watertightness. Where it is intended that manholes be installed without fixed steps, the special provisions shall so specify.

–2.09C Precast Cones

Standard precast cones shall provide concentric reduction from 48″ to 36″, from 48″ to 24″; and from 36″ to 24″, inside diameters. Cones 48″ to 36″ shall be not less than 24″ in height; others not less than 17″ in height. Tongue and groove jointing shall be provided for fitting to adjoining sections, excepting, however, that the top surface of cones 48″ to 24″ and 36″ to 24″ shall be flat and at least 6″ wide, radially, to receive adjustment block or brick.

Wall thickness shall be 4″ nominal, and reinforcing shall conform to the requirements specified for standard sections of the larger diameter. Steps shall be provided as specified for standard precast sections, and an additional step shall be provided in the 48″ to 24″ and the 36″ to 24″ cones opposite the ladder steps and about midway in elevation, as shown on the standard drawings. No more than two lift holes shall be cast into each cone, and they shall be located so they will not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling, in lieu of lift holes.

–2.09D Flat Slab Covers

Standard flat slab covers shall be a minimum of 8″ thick and shall conform to the outer dimension of the 72″ or 48″ standard sections upon which they are to be placed. The 24″ diameter opening shall be eccentrically located as shown on the standard plans so as to provide at least 6″ minimum radial distance from edge of the 24″ opening to outer edge of slab, but not more than 2½″ offset distance from edge of the 24″ opening to the inside face of the standard section below. Reinforcing shall be as shown on the standard plans.

–2.09E Flat Slab Reducing Sections

Reduction from 72″ standard section to 48″ or 36″ shall be made by means of a flat slab reducing section as shown on the standard plans. The section shall be a minimum of 8″ thick and shall conform to the outer dimension of the 72″ section upon which it is to be placed. The 48″ or 36″ opening shall be located as shown on the plans or noted in the special provisions. Reinforcing shall be as shown on the standard plans.

–2.09F Permissible Variation in Precast Section Dimensions

(1) Variations in the inside diameters of standard sections, or in the diameters of openings in cones and slabs, shall not exceed 1½% of the nominal dimensions. Wall thicknesses of sections and cones shall be not less than 94% of the nominal dimensions specified in sections 63-2.09B and 63-2.09C. Outside dimensions of flat slab covers and reducing sections shall not be less than the nominal outside diameters of the standard sections to which they are to be joined. Thickness of precast slabs shall be not less than the nominal dimensions called for. Thickness variation in any slab shall be no more than ½″. Permissible eccentricity of standard sections and cones shall be such that when sections are placed together with steps in alignment, the maximum offset between sections will not exceed ¾″. The planes of the ends of cones and sections shall be perpendicular to their longitudinal axis within ¾″ measured across any diameter. Variation in the step spacing shall not exceed 1½″.

(2) Reinforcement in standard sections and cones shall be placed within 1″ of the center of the walls. Bar reinforcement in slabs shall conform to the standard drawings and shall not vary more than the dimensional tolerances shown on the drawings.

–2.09G Workmanship and Finish of Precast Sections

Cones and sections shall be substantially free from fractures, large or deep cracks and surface roughness. Slabs shall be sound and free from gravel pockets. All manhole elements shall be capable of producing a watertight structure when properly assembled and jointed.

63–2.10 SHOP FABRICATED CORRUGATED METAL MANHOLES

Where corrugated metal manholes, Type V, are used with corrugated pipe, detailed plans shall be submitted by the manufacturer to the Engineer for approval prior to shipment.

63–2.11 MONOLITHIC CONCRETE MANHOLES

Monolithic concrete manholes, Type III, shall conform to detailed plans submitted to the Engineer for approval prior to beginning work and shall conform to the dimensional requirements specified in Section 63-3.05. Walls and base shall be 6″ minimum thickness, and spacing of steps shall be 12″.

63–3 CONSTRUCTION DETAILS

63–3.01 FOUNDATION PREPARATION

–3.01A Dewatering

Dewatering of the site shall conform to the requirements for sewer trench dewatering in Section 62-3.04.

–3.01B Sub-base Preparation

Adequate foundation for all manhole structures shall be obtained by removal and replacement of unsuitable material with well graded granular material; or by tightening with coarse ballast rock, or by such other means as provided for foundation preparation of the connected sewers, or as required in the special provisions. Where water is encountered at the site, all cast-in-place bases or monolithic structures shall be placed on a one-piece waterproof membrane, so placed as to prevent any movement of water into the fresh concrete.

63–3.02 BEDDING

Precast base sections shall be placed on a well graded granular bedding course conforming to the requirements for sewer bedding in Section 61-3.03, but not less than 4″ in thickness and extending either to the limits of the excavation or to a minimum of 12″ outside the outside limits of the base section. In the latter case, the balance of the excavated area shall be filled with select material well tamped to the level of the top of the bedding to positively prevent any lateral movement of the bedding when the weight of the manhole is placed upon it. The bedding course shall be firmly tamped and made smooth and level to assure uniform contact and support of the precast elements.

63–3.03 CAST-IN-PLACE BASE

Cast-in-place concrete base and vertical base wall section for supporting manhole structures shall be constructed in accordance with the standard plans.

63–3.04 MONOLITHIC BASE STRUCTURE

Monolithic concrete base manholes shall be constructed as shown on the standard plans. The manhole base sections shall be formed and cast in place around the existing large diameter pipe.

63–3.05 MANHOLE DIMENSIONS

Manhole dimensions for the numbered types of manhole specified on the contract plans shall conform in all respects to the applicable requirements therefor on the corresponding standard plan for each type.

63–3.06 BLOCK OR BRICK MANHOLES

Masonry units or brick shall be laid up in full unfurrowed mortar joints to provide complete filling of all horizontal and vertical joints. The inside of the manhole shall be made to conform to the shape and dimensions shown on the standard plans with reasonably even surfaces and with joints scraped or wiped flush. Ladder rungs shall be as specified for precast manholes except that uniform spacing shall not exceed 16″.

The inside of all masonry manholes shall be plaster coated with mortar not less than ½″ thick for the purpose of waterproofing, unless otherwise provided in the special provisions.

63–3.07 PRECAST MANHOLES

–3.07A Type I-A

The base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment, and making sure that all entering pipes can be inserted on proper grade.

All lift holes and all joints between precast elements shall be thoroughly wetted and then be completely filled with mortar, smoothed and pointed both inside and out, to ensure watertightness.

Precast sections shall be placed and aligned to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimensions, and be watertight.

In precast manhole sections where steel loops have been provided in lieu of lift holes, the loops shall be removed flush with the inside wall surface after the manhole has been completed. No sharp cutoff protusions will be permitted. If concrete spalling occurs as a result of the loop removal, the spalled area shall be restored in a workmanlike manner to a uniform smooth surface with mortar.

–3.07B Type I-B and Types IV-A-1 and IV-B-1

The first precast section shall be placed on the monolithic base structure before the base has taken initial set, and shall be carefully adjusted to true grade and alignment with all inlet pipes properly installed so as to form an integral, watertight unit; or the section shall be mortared into a suitable groove provided in the top of the monolithic base. The first section shall be uniformly supported by the base concrete, and shall not bear directly on any of the pipes.

All lift holes and all joints between precast elements, and all connections between precast elements and cast-in-place bases or structures shall be thoroughly wetted and completely filled with mortar, smoothed and pointed both inside and out to ensure watertightness.

Precast sections shall be placed and aligned so as to provide vertical sides and vertical alignment of the ladder rungs. The completed manhole shall be rigid, true to dimension, and be watertight.

63–3.08 MONOLITHIC CONCRETE MANHOLES

Monolithic concrete manholes, Type III, shall be constructed in accordance with the provisions of this Section 63, and applicable provisions of Sections 37 and 39 where not in conflict.

63–3.09 SHOP FABRICATED CORRUGATED METAL MANHOLES

Shop fabricated corrugated metal manholes, Type V, shall be constructed in strict accordance with the detailed plans approved by the Engineer, and shall conform to all applicable provisions of these specifications.

63–3.10 GRADE ADJUSTMENT

The Contractor shall initially construct manholes of the type specified on the project plans so as to provide adjustment space for setting cover fastenings to a finished grade, as hereinafter specified. The manhole grade sheet furnished by the Engineer for manhole construction shows the approximate top grade for the manhole plus or minus two-tenths (0.2) foot, and the final grade will be set by the Engineer after backfilling has been completed to the grade established by the Engineer. No separate payment for final adjustment of the cover castings for new construction will be made and all costs thereof shall be considered as incidental and be included in the unit contract price for the manhole, except as provided in Section 63-5.

–3.10A Streets at Grade

Where work is in paved streets or areas which have been brought to grade, not less than 8″ or more than 20″ shall be provided between the top of the cone or slab and the underside of the manhole casting ring for adjustment of the casting ring to street grade.

–3.10B Streets with no Established Grade

Where work is in streets or other areas which have not been brought to grade, the top of cone or slab shall be constructed so as to provide clearance not less than 24″ or more than 36″ below the surface to be restored, unless otherwise directed by the Engineer.

63–3.11 CHANNELS

Channels shall be made to conform accurately to the sewer grade and shall be brought together smoothly with well rounded junctions, satisfactory to the Engineer. Channel sides shall be carried up vertically to the crown elevation of the various pipes, and the concrete shelf between channels shall be smoothly finished and warped evenly with slopes to drain.

63–3.12 PIPE CONNECTIONS

All unreinforced pipes entering or leaving the manhole shall be provided with flexible joints within 12" of the manhole structure and shall be placed on firmly compacted bedding, particularly within the area of the manhole excavation which normally is deeper than that of the hole excavation which normally is deeper than that of the sewer trench. Special care shall be taken to see that the openings through which pipes enter the structure are completely and firmly rammed full of mortar to ensure watertightness.

63–3.13 BACKFILL

Backfill around the manhole and extending at least one pipe length into each trench shall be hand placed and tamped with selected native material up to an elevation of six (6) inches above the crown of all entering pipes. Work shall conform to the applicable provisions of sections 61-3.05, 61-3.06 and 61-3.07, as required by the Engineer.

63–3.14 DROP MANHOLES

Drop manholes, wherever shown on the plans, shall conform in all respects to the requirements for standard manholes of the type or types used on the project except for the additional drop detail as shown on the standard drawing.

63–4 MEASUREMENT

Each manhole will be measured to the nearest one-tenth (0.10) of a foot, from invert of the outlet pipe vertically to the top of the casting. Drop connections will be measured vertically from invert to invert.

63–5 PAYMENT

Payment for each manhole shall consist of a basic price for each, plus a unit price per foot for all depth in excess of five (5) feet, plus a unit price per linear foot for drop connections where they occur.

Where more than one type or size designation is shown on the drawings or called for in the special provisions, each shall be covered by a separate bid item of the following form:

1. "Manhole Type (No.....), Basic Price," per each.
2. "Extra Depth Manhole Type (No.....)," per vertical foot.
3. "Drop Connection, (size)," per vertical foot.

Where an existing manhole is encountered in the work and it is required that it must be adjusted to new grade, the work and payment therefore shall be as extra work provided in Section 53-4.01, Adjust Existing Manhole or Catch Basin to Grade.

Where a new constructed manhole cover casting has been completed to the finished grade set by the Engineer, and is later required to be adjusted up or down to a revised grade by the Engineer, the adjustment shall be paid for as provided in Section 9.03, Extra Work.

4. "Adjust Existing Manhole or Catch Basin to Grade," per each.

The unit contract prices shall be full compensation for furnishing and constructing manholes complete and connected to the sewers, excepting however, that excavation, backfill, gravel bedding or foundation material, or additional connections not shown on the plans will be paid for in accordance with the applicable bid items of other sections.

Section 64—Catch Basins and Inlets

64–1 DESCRIPTION

Standard catch basins and inlets may be constructed of precast units, concrete masonry units, or of concrete or clay brick, or cast-in-place concrete, all in accordance with the standard drawings and specifications; excepting however, that the Contractor's choice of alternates may be limited in the special provisions.

64-2 MATERIALS

Materials for catch basins and inlets shall conform to the applicable provisions of Section 63-2 except as specified in subsections that follow.

64-2.01 FRAME AND GRATE

The frame and grate shall conform to the standard drawings.

The frame may be made of cast iron, ASTM A-48 Class 25, cast steel, STM A-27, Grade 70-36, or nodular cast iron, ASTM A-339, Grade 60-45-10, at the manufacturer's option. The grate may be cast steel or nodular cast iron only, at the manufacturer's option. Other applicable provisions of Section 63-2.08 shall apply.

64–2.02 TRAPS

Where traps are required, they shall be either of sheet metal or of cast iron as specified and detailed for Type A and Type B on the standard drawing.

64–2.03 MORTAR

Mortar for jointing catch basins and inlets shall be one part portland cement and not less than one part nor more than two parts plaster sand, mixed with the least amount of water necessary to provide a workable mortar. Mortar for plaster coating shall conform to Section 63-2.04B.

64–3 CONSTRUCTION DETAILS

Construction details for catch basins and inlets shall follow all applicable provisions of Section 63-3, Construction Details for Manholes. Sections 63-3.10, Grade Adjustment, and 63-3.12, Pipe Connections, will not be applicable, but shall be replaced by the subsections which follow.

Backfill around catch basins shall be adequate as a foundation to support shallow outlet connection pipe from settlement after backfilling has been completed. To prevent settlement and shearing damage to pipe connecting to the catch basin, the backfill material placed around the catch basins shall be compacted into place with mechanical tampers in succesive layers six (6) inches in thickness up to the crown of the highest pipe connected to the catch basin, unless otherwise provided in the special provisions or authorized by the Engineer.

The density to which each layer shall be compacted shall be as directed by the Engineer. Payment for mechanical tamping to the extent directed by the Engineer will be made as specified in Section 15.

64–3.01 GRADE ADJUSTMENT

The inlet frame may be either cast into a concrete collar or set flange down on concrete adjustment blocks and mortared, as directed by the Engineer. It shall not, in any case, be grouted to final grade until the final elevation of the pavement, gutter, ditch or sidewalk in which it is to be placed has been established and permission has been given by the Engineer to grout the casting in place. Location of catch basins will be staked by the Engineer.

64–3.02 PIPE CONNECTIONS

All openings in the walls of catch basins constructed with precast sections for the insertion of pipe connections and outlet trap castings shall, after pipe or castings have been placed to their final position, be grouted tight in place in a workmanlike manner to present an inside and outside surface conforming to the standard plans. Pipe placed through walls to which connections will be made shall be so placed that the socket end of the pipe is backed against the outside surface of the catch basin as closely as practicable for the angle of entrance. The spigot end of the pipe shall be cut square with the last point of contact with the inside wall surface.

64–3.03 SUBGRADE DRAINAGE OPENINGS

Bankrun gravel or crushed rock shall be packed around the openings in the catch basin inlets to provide uninterrupted drainage from the adjacent roadway subgrade into the catch basin. Where directed by the Engineer, subgrade drainage openings may be omitted or, if existing in precast elements may be grouted full in lieu of placing filter material.

64–3.04 SEEPAGE STRUCTURE

Catch basin inlets may be specified with perforated side walls, as detailed in the special provisions or supplementary drawings, in lieu of outlet pipes. Where called for, the excavation shall be carefully made so that clean filter material, as described in the special provisions, can be packed around the structure to a thickness of not less than 12 inches at any point and more if specified, and extending up from the base of the structure to not less than 6 inches above the highest perforation. Plugged outlet pipes may be stubbed out for future connection to sewers, where specified.

64–3.05 TRAPS

Traps shall be installed where shown on the construction plans. Traps shall meet the requirements outlined in Section 64-2.02 and be in accordance with the standard drawing.

64–4 MEASUREMENT

64–4.01 CATCH BASIN AND INLET

Measurement for payment of all catch basins or inlets of 5-foot depth or less shall be per each. Measurement for payment of all catch basins or inlets more than five feet deep shall be taken to the nearest one-tenth (0.10) foot, from top of grating to inside bottom of catch basin.

64–5 PAYMENT

Payment will be made for such of the following bid items as are included in the proposal:

1. "Type I, 5-foot Catch Basin Inlet," per each.
2. "Type II, 5-foot Catch Basin Standard Inlet," per each.
3. "Type II, 5-foot Catch Basin Large Inlet," per each.
4. "Type III 5-foot Combination Curb and Curb and Gutter Catch Basin Inlet," per each.
5. "Type IV Curb Inlet," per each.
6. "Additional Depth to 5-foot Type ..... Catch Basin Inlet," per vertical foot.
7. "Additional Depth to 5-foot Type ..... Combination Curb and Curb and Gutter Catch Basin Inlet," per vertical foot.
8. "Catch Basin Trap (type, size)," per each.
9. "Furnish Metal Frame and Grate for Catch Basin or Inlet, Type ....," per each.

64–5.01 CATCH BASIN AND INLET

Catch basins and inlets of each type required will be paid for at the unit contract price bid per each in place, plus the unit contract price per vertical foot for all depth in excess of five feet as defined in Section 64-4.01.

64–5.02 TRAP

Traps, where required, will be paid for at the unit contract price bid per each in place, for each size required.

64–5.03 CATCH BASIN INLET FRAME AND GRATE

Catch basin frame and grate casting shall be considered as incidental to the unit contract price for the particular type of catch basin inlet designated in the proposal. Where existing catch basin inlets are encountered and where new castings are to be placed thereon, the cost of furnishing and placing new castings will be paid for at the unit contract price per each for "Furnish Metal Frame and Grate for Catch Basin or Inlet."

The unit contract price per each shall include the furnishing of the frame and grate on the job site, and shall be full compensation for materials and all costs incurred in placing the casting.

64–5.04 ADJUSTMENT OF EXISTING CATCH BASIN AND INLET

Payment for adjustment of existing catch basin and inlet will be made in accordance with Section 53-4.02 when and if the proposal carries an item of "Adjust Existing Catch Basin (or Inlet) to Grade," per each.

Section 65—Subsurface Drains

65–1 DESCRIPTION

This section is intended to cover only the collection and control of subsurface water and does not apply beyond the point at which the water is discharged into the storm sewer or other outlet.

65–2 MATERIALS AND TESTING

65–2.01 CORRUGATED METAL PIPE

Corrugated metal pipe for underdrains shall meet the requirements of AASHO M 136 as hereinafter supplemented.

–2.01A Bituminous Coated Corrugated Metal Pipe

When so specified, corrugated metal pipe shall be bituminous coated. The bituminous material used for coating shall meet the requirements of AASHO M 190.

65–2.02 CLAY PIPE

Clay pipe shall meet the requirements of ASTM Designation C278 for extra strength pipe and shall be perforated in accordance with ASTM Designation C211.

65–2.03 PERFORMATED CONCRETE PIPE

Perforated concrete pipe and fittings shall meet the requirements of ASTM Designation C444.

The class of pipe furnished shall be as specified or as shown on the plans.

Perforated concrete pipe may be either bell and spigot or tongue and groove pattern unless otherwise specified.

65–2.04 PERFORATED ASBESTOS-CEMENT PIPE

Perforated asbestos-cement pipe and fittings shall meet the requirements of AASHO M 189.

65–2.05 INSPECTION

–2.05A Inspection at Factory

If requested in writing by the Engineer, all pipe shall be inspected by the Engineer or his representative at the manufacturer's plant before shipment.

–2.05B Disposition of Defective Material

All material found to be defective at time of delivery or at any time during the progress of the work will be rejected by the Engineer. Rejected material shall be promptly removed from the site of the work by the Contractor.

–2.05C Material Furnished by Contractor

The Contractor shall be responsible for all material furnished by him and shall replace at his own expense any pipe or other material which is found defective.

–2.05D Material Furnished by Owner

The Contractor shall inspect all pipe or other materials furnished by the Owner at time of delivery to him, and shall at that time reject any material found defective. Once accepted by the Contractor, any damaged or otherwise defective material found prior to final acceptance of the work shall be replaced at the expense of the Contractor and the cost of all labor, equipment and incidental expense necessary for its replacement and incorporation in the work to the satisfaction of the Engineer shall be borne by the Contractor.

65–3 CONSTRUCTION DETAILS

65–3.01 EXCAVATION

–3.01A General

The trench shall be dug to the required alignment and grade only so far in advance of pipe laying as the Engineer will approve. The clear width of unsheeted or sheeted trench measured at the horizontal diameter of the pipe in place shall be 18 inches or one (1) foot greater than the outside diameter of the pipe, whichever is the greater. Any part of the trench excavated below grade or to a greater width than specified shall be

backfilled at the expense of the Contractor with filter material hereinafter described.

Extreme care shall be exercised by the Contractor at all times during the performance of the work to maintain the trench and excavated material in such condition that there will be no mixing of excavated material with the filter material to be used for backfilling. All excess excavated material not required for construction shall be disposed of by the Contractor, unless otherwise provided in the special provisions.

–3.01B Protection of Existing Utilities (Vacated)

Covered in Section 5.09.

–3.01C Braced and Sheeted Trench

Wherever necessary, sheeting, bracing, or cribbing shall be provided in accordance with the provisions of Section 61-3.04.

65–3.02 PIPE LAYING

–3.02A General

Pipe laying shall conform to the requirements of Section 62, "Pipe Laying, Jointing and Testing", except as hereinafter supplemented.

–3.02B Bedding

Prior to laying any pipe, a 6-inch layer of filter material, as hereinafter described, shall be placed uniformly in the bottom of the trench. This material shall be placed immediately prior to laying the pipe and shall be uniformly spread to true grade and be properly compacted. Should any of this filter material become contaminated by slough of the trench, by storm water or from other cause, it shall be immediately removed and be replaced with acceptable filter material at the expense of the Contractor.

–3.02C Inspection

All pipe shall be inspected prior to lowering into the trench and, if necessary, cleaned of any material tending to plug the perforations of the pipe.

–3.02D Lowering Pipe and Fittings into Trench

The Contractor shall have available the proper tools, men and equipment for efficient execution of the work. All pipe and fittings shall be carefully lowered into the trench to avoid any contamination of the filter bedding material. Pipe or fittings shall not be dumped into the trench. Pipe shall be laid with perforations down, unless otherwise specified or directed by the Engineer.

65–3.03 PIPE JOINTING

–3.03A Corrugated Pipe

Corrugated metal pipe and fittings, if so specified, shall be connected with an approved galvanized band or plastic band provided by the manufacturer.

–3.03B Asbestos-Cement Pipe

Asbestos-cement pipe shall be supplied with plain ends or with ends machined for tapered couplings. Couplings furnished shall be of asbestos cement or polyethylene plastic and shall be compatible with the end machining of the pipe furnished. Couplings shall also comply with the requirements of AASHO M 189 Section 5.

–3.03C Clay Pipe

Clay pipe shall be butted up tight and centered so as to provide a continuous and uniform line of pipe with a smooth and regular interior surface. Pipe shall be paid without joint closure unless otherwise provided in the special provisions. Clay pipe joints, if specified, may be cement mortar, hot-pour compounds, or bituminous or coal tar base as approved by the Clay Pipe Institute, or factory applied resilient joints per ASTM Designation C425, depending on the service intended.

–3.03D Concrete Pipe

Concrete pipe shall be butted up tight and centered so as to provide a continuous and uniform line of pipe with a smooth and regular interior surface. Pipe shall be laid without joint closure unless otherwise provided in the special provisions. Where joint closure is specified, jointing shall conform to the requirements of Section 62-3.08A or Section 62-3.08B except that the dimensional requirements for rubber gaskets and annular spaces will not apply.

65–3.04 BACKFILLING WITH FILTER MATERIAL

–3.04A Filter Material

Filter material used as backfill shall comply with the following requirements:

GRADING (% by weight)

% Passing ¾" square sieve	100
% Passing ¼" square sieve	30–60
% Passing No. 8 sieve	20–50
% Passing No. 30 sieve	8–30
% Passing No. 50 sieve	3–12
% Passing No. 200 sieve (wet sieve)	0–1

Filter materials shall be crushed or natural granular material and shall contain not more than 1% by weight of clay lumps.

–3.04B Placing Filter Material

The filter material shall be damp when placed in the trench and shall be deposited uniformly on both sides of the pipe for the full width of the trench and to the horizontal diameter of the full length of the pipe. The material shall be tamped in 4-inch layers to provide thorough compaction under and on each side of the pipe. Succeeding layers of filter material shall be deposited in 8-inch layers and be thoroughly compacted to the depth shown on the plans, or as specified.

65–3.05 RESTORATION, FINISHING AND CLEANUP

The Contractor shall restore and/or replace all paved surfaces, curbing, sidewalks, or other disturbed surfaces to their original condition in such manner as to meet the requirements of applicable sections. All surplus material and temporary structures, as well as all excess excavation, shall be removed and the entire site of Contractor operations shall be left in a neat and clean condition, as specified in Section 57.

65–4 MEASUREMENT AND PAYMENT

65–4.01 GENERAL

Except as otherwise specified herein, no direct payment will be made for the various miscellaneous and incidental items of work to be performed, nor for accessories to be furnished and installed. All costs in connection therewith shall be considered as incidental to the construction and shall be included in the unit contract prices of items in the proposal affected thereby.

65–4.02 PIPE

Pipe of each kind and size shall be measured by the linear foot for the pipe in place and accepted. The unit contract price per linear foot shall be full compensation for the kind and size specified in place, including connecting accessories, all fittings such as elbows, tees, wyes, etc., and the price shall be full compensation for the furnishing of all material, labor and equipment necessary to complete the pipe laying and jointing as specified, and to the satisfaction of the Engineer.

65–4.03 EXCAVATION AND BACKFILL

Excavation and backfill shall be measured and compensation be made as provided in Section 61.

65–4.04 FILTER MATERIAL

Filter material in place will be paid for at the unit contract price per cubic yard (compacted) as measured within the limits described in Section 61-4.01B for length and width, and with measurement for depth to be from a point six (6) inches below the bottom of the pipe barrel up to the completed surface of the filter material. The unit contract price per cubic yard shall be full compensation for furnishing and placing the material in accordance with the specifications, excepting however, that the unit contract price will not include mechanical tamping.

65–4.05 MECHANICAL TAMPER

The mechanical tamper shall meet the specifications described for it in Section 15-2.01A. Measurement and payment will be to the nearest one-half (½) hour of actual time consumed in compacting. No allowance will be made for time making repairs to the equipment, nor for moving to or from areas on the work for which compaction is required.

Section 66—Side Sewers

66–1 DESCRIPTION

A side sewer is considered to be that portion of a sewer line that will be constructed between a main sewer line and a property line or easement limit.

The general requirements for construction of sewers in other sections of these specifications shall apply for side sewers unless they be inconsistent with any of the provisions of this particular section.

66–2 MATERIALS

66–2.01 PIPE

Approved pipe materials shall be cast iron, concrete, vitrified clay, or asbestos-cement. Pipe materials other than these shall not be used, unless otherwise specified in the special provisions or unless authorized by the Engineer.

Clay, concrete and asbestos-cement pipe shall conform to the requirement of ASTM designations C278, C14 (extra strength), and C428, respectively. Cast iron pipe shall conform to Federal Specifications WW-P-421A. Class of asbestos-cement pipe shall be as shown on the drawings or designated in the special provisions.

66–2.02 JOINTS

Approved jointing materials shall be flexible gasketing or lead.

Flexible gasketing shall be construed to include rubber, synthetic rubberlike and plastic materials specially manufactured for the joint, pipe size, and use intended and shall be furnished by the manufacturer of the pipe to be used. Physical properties of the flexible gasketing shall conform to that defined in Section 60-3.02A.

66–2.03 FITTINGS

Tees, wyes, bends, couplers, adapters, hubs and transition sections shall conform to the requirements of sections 66-2.01 and 66-2.02.

66–3 CONSTRUCTION DETAILS

66–3.01 GENERAL

Side sewer construction shall conform to all applicable ordinances or regulations with respect to equipment, methods to be used, protective measures, size of pipe, depth of cover, number of users per pipe, permissible connections, inspection, and testing.

Permits, if necessary, shall be obtained by the Contractor before work of constructing side sewers is started.

Side sewer locations shown on the plans shall be subject to relocation in the field after construction starts. Regardless of the plan location, the Contractor shall place the tee and wye branch in the main sewer line at any other location designated by the Engineer.

The Engineer will stake and indicate the depth for the invert elevation of end pipe at the street margin or property line.

–3.01A Side Sewers Not Shown on the Plans

In cases where side sewers are not shown on the plans an abutting property owner may, upon approval of the Engineer, make application for side sewer, provided however, that he does so while construction is still under way and provided further that substantially all the necessary equipment for excavating, backfilling and compacting has not been removed from the block by the Contractor. In such cases the Contractor shall complete the side sewer construction at his unit contract prices.

The Contractor will not be required to construct side sewers for which applications are received after completion of construction and removal of equipment from the block containing the applicant's property. Under such a condition, the Contractor may construct the side sewer by negotiating the conditions and price with the applicant and look to him for payment.

If the Contractor shall elect to construct a side sewer after completion of work in the block and after removal of his equipment therefrom, and do so at his bid price, payment will be made by the Owner in the normal manner under the contract.

66–3.02 EXCAVATION AND BACKFILL

Excavation and backfilling for side sewers shall conform to the requirements of Section 61.

66–3.03 PIPE LAYING AND JOINTING

Pipe laying and jointing, except as hereinafter provided, shall conform to the requirements of Section 62.

–3.03A Line and Grade

Side sewers shall be laid to a line and grade between the main sewer tee branch or wye branch and the right of way margin, so as to best serve the property relative to the following conditions, as may be directed by the Engineer:

1. Where a vacant property is level with or lower than the street grade, the invert elevation of the side sewer end pipe at the right-of-way margin shall be one (1) foot higher than the elevation of the crown of the main sewer at the location of its tee or wye branch.
2. Where an occupied property is higher than the street grade and where the slope will be greater than called for in (1) above, the maximum grade of the side sewer at the right of way margin will be established by the Engineer so as to place the side sewer pipe at an elevation that will be below the invert of any proposed storm drain pipe, unless other conditions prevent. Where a storm drain pipe exists, the clearance between the crown of one and the bottom of the other shall be not less than six (6) inches. In either of the above described conditions, the end pipe of the side sewer, when placed at the right of way margin, shall be such as to enable a backfill cover over the crown of the pipe of not less than two and one-half (2½) feet below the established street grade.
3. Where an occupied property is level with or lower than the street grade, side sewer pipe shall be laid on a grade not less than one-fourth (¼) inch per linear foot wherever possible. If this is not feasible, the Engineer may authorize the laying of pipe on a grade as little as one-eighth (⅛) inch per linear foot, but then only if extreme care is used in the selection and placement of bedding, and the jointing of the pipe sections and fittings.

–3.03B Pipe Laying

Belled pipe shall be laid with the bell end up grade and, in general, all pipe laying shall start and proceed up grade from the point of connection at the public sewer or other starting point.

Pipe shall be laid in a straight line at a uniform grade between fittings, or on a uniform horizontal or vertical curvature achieved by deflecting pipe joints within the limits recommended by the manufacturer of the pipe used.

–3.03C Jointing

Jointing for cast iron side sewers shall be by means of approved flexible gaskets or caulked lead. For other kinds of pipe the jointing, including jointing for adapters, shall be by means of approved flexible gaskets.

66–3.04 FITTINGS

All fittings shall be factory-produced and shall be designed for installation on the pipe to be used. Fittings shall be of the same quality and material as the pipe used except that tees, wyes, and bends for use with asbestos-cement pipe may be cast iron.

The maximum deflection permissible at any one fitting shall not exceed 45 degrees (45°) (one-eighth (⅛) bend). The maximum deflection of any combination of two adjacent fittings shall not exceed 45 degrees (45°) (one-eighth (⅛) bend) unless straight pipe of not less than two and one-half (2½) feet in length be installed between such adjacent fittings, or unless one of such fittings be a wye branch with a cleanout provided on the straight leg.

Side sewers shall be connected to the tee, wye, or riser provided in the public sewer where such is available, utilizing approved fittings or adapters. Where no tee, wye, or riser is provided or available, connection

shall be made by machine-made tap and suitable saddle, or otherwise as approved by the Engineer.

66–3.05 CLEANOUTS

Not less than one cleanout shall be provided for each side sewer and/or each total change of 90 degrees (90°) of grade or alignment, except that no cleanout will be required at the connection of the side sewer to a riser on the public sewer. A suitably located cleanout in the house piping or plumbing may be considered as a cleanout for the side sewer.

Cleanouts shall be placed at intervals of not more than 100 feet in straight runs. Cleanouts in the line shall utilize a wye branch at the side sewer.

The extension of house sewer cleanouts to grade will be optional with the home owner. When installed to grade, cleanouts shall be full side sewer diameter and shall be extended to a point not less than six (6) inches nor more than twelve (12) inches below the finished ground surface and shall be plugged with a removable stopper which will prevent passage of dirt or water. When specified, the Contractor shall install an approved casting to provide ready access to the cleanout stopper. A one-eighth (⅛) bend shall be used to deflect the side sewer upward as a cleanout where the terminal end of the side sewer lies upstream from the last point of connection.

66–3.06 INSPECTION AND TESTING

–3.06A Inspection

Side sewers shall comply with the inspection and leakage requirements specified in Section 62, excepting however, that when side sewers are tested separately the backfilling may be delayed until after testing.

–3.06B Testing

All side sewers constructed in conjunction with the main sewer shall, for purpose of testing as specified in Section 62-3.10, have a six (6) inch tee fitting pipe placed at the point where the side sewer crosses the street or other public right of way margin. The tee opening shall be positioned perpendicular to the side sewer slope, unless otherwise directed by the Engineer.

When side sewers are not tested simultaneously with the test of the main sewer, the Contractor at his own cost shall furnish and place an additional tee in the first pipe out of the main sewer tee or wye branch, so that an inflatable rubber ball can be inserted for sealing off the side sewer and thus permit separate tests.

The ends of side sewers or test tee openings, as required, shall be plugged watertight with materials and by method acceptable to the Engineer.

Payment for one test tee in each side sewer will be made the Contractor on a per each basis, same being additional to the payment for side sewer pipe.

66–3.07 MISCELLANEOUS REQUIREMENTS

–3.07A Requirements

1. *Pipe and Connections.* Side sewer shall be not less than six (6) inches in diameter unless otherwise specified.

2. *Proximity to Water Supply Lines.* Any side sewer which at any point will lie within ten (10) feet of a water supply line shall be constructed so that it will be at least six (6) inches in elevation below the water supply line. If this requirement will prohibit a connection of the side sewer, the Contractor shall proceed under such method and with such materials as may be detailed on the plans, or as directed by the Engineer.

3. *Plugs.* Any unused openings to the side sewer shall be closed with a watertight stopper fastened in place.

4. *Septic Tanks and Cesspools.* No side sewer shall be constructed through or adjacent to an existing cesspool or septic tank. If the conditions prohibit any other location, the Contractor shall abate the cesspool or septic tank by such means as the Engineer may direct, and by such payment as may be specified or agreed upon.

66–3.08 RESTORATION, FINISHING AND CLEANUP

The Contractor shall restore and/or place all paved surfaces, curbing, sidewalks, or other disturbed surfaces to their original condition in such manner as to meet the requirements of applicable sections. All surplus material and temporary structures, as well as all excess excavation shall be removed and the entire site of contractor operations shall be left in a neat and clean condition, as specified in Section 57.

66–3.09 EXTENDING SIDE SEWERS INTO PRIVATE PROPERTY

Property owners will be permitted to extend side sewers onto their property and connect fixtures thereto, as soon as the main sewer construction has progressed past the point of side sewer construction and leakage tests have been satisfactorily completed, provided the use of the connections will not interfere with the completion of the other parts of the contract work and provided the extension is approved by the Engineer. Such side sewer connections, when authorized by the Engineer, shall not relieve the Contractor of his responsibility to maintain the main sewer until final acceptance of the contract work.

66–3.10 END PIPE MARKER

Where a side sewer ends at the street margin or other right of way margin, the end pipe shall be referenced by fastening around it a No. 12 galvanized wire, or acceptable substitute, which shall be extended vertically to the surface during backfilling and then be attached to a well bedded stake.

66–4 MEASUREMENT

Measurement will be along the pipe from the tee or wye of the main sewer through tees, wyes and other fittings to the street margin or right of way margin. Measurement will be to the nearest one-tenth (0.10) foot.

66–5 PAYMENT

Payment for side sewers will be made for such of the following bid items as are included in any particular contract:

1. "(size) (class) Side Sewer Pipe in Place," per linear foot.
2. "Tee or Wye, (size)," per each.
3. "Mechanical Tamper," per hour.
4. "Foundation Material, Type .....," per cubic yard.
5. "Pipe Bedding (class) (size) Pipe," per linear foot.

The unit contract prices shall be payment in full for all labor, materials, tools and other necessary things as may be required to complete the items of work in accordance with the plans and the specifications.

Section 67—Pipe Covering and Embankment for Sewer Construction

67–1 DESCRIPTION

This section of the specification applies to the construction of pipe covering and embankment. Pipe covering shall be constructed where the invert of the pipe is so shallow that placing of earth over the pipe becomes necessary to provide a minimum depth of cover. Pipe cover and embankment shall be constructed where the invert of the pipe is above existing ground and it becomes necessary to construct an embankment upon which the pipe and pipe covering is to be placed. The embankment and cover shall be constructed to lines shown on the standard drawing.

67–2 CONSTRUCTION DETAILS

67–2.01 PIPE BED

The area upon which the embankment for the pipe bed is to be placed shall be stripped to the extent the Engineer directs, and the cost thereof will be paid for by force account as defined in Section 9.04.

The embankment upon which the pipe is to be installed shall be constructed in accordance with requirements outlined in Section 13-3.10E3 Method B, up to a point equal to the spring line of the pipe. The material used in constructing the embankment shall be such that it will readily compact to required density. The Contractor may use any type of compacting equipment he wishes provided the required end result is obtained, and provided no damage occurs to surface or subsurface improvements.

67–2.02 PIPE COVER

The pipe cover material above the compacted embankment shall be placed without compaction, and shall be shaped to the required section.

67–2.03 SOURCE OF MATERIAL

The source of material shall be that which is specified in the special provisions.

67–3 MEASUREMENT

Measurement will be by the cubic yard as calculated from cross sections based on elevations of the ground surface and the neat lines of the section conforming to the standard drawing, from which will be deducted the volume in cubic yards displaced by pipe larger than twenty-four (24) inches I.D.

67–4 PAYMENT

Payment will be made at the unit contract price per cubic yard for "Pipe Covering and Embankment," which price shall be full compensation for furnishing all labor, equipment, and materials necessary to construct and compact the embankment and cover.

Section 68—Finishing and Cleanup for Underground Conduits

68–1 CLEANUP

Before acceptance of sewer line construction, all pipes, manholes, catch basins, and other appurtenances shall be cleaned of all debris and foreign material.

After all backfill has been completed, the ground surface shall be shaped to conform to the contour of adjacent surfaces. General cleanup of the entire construction area shall otherwise conform to applicable requirements specified in Section 57.

Section 69—Miscellaneous Pipe Connections

69–1 DESCRIPTION

This section covers miscellaneous sewer and storm drain connections other than those described in sections 62 and 66, for the purpose of connecting various sewer appurtenances.

69–2 MATERIALS

Pipe, for connections as herein described shall conform to the applicable requirements in Section 60.

69–3 CONSTRUCTION DETAILS

69–3.01 EXCAVATION AND BACKFILL

All costs for trench excavation, backfill, and disposal of surplus excavation shall be considered as incidental to the construction of the pipe connections, unless the proposal contains a unit contract price for "Sewer Excavation and Backfill". When the proposal contains such a bid unit, payment therefor will be made on the basis shown in the proposal and will be additional to the unit contract price for pipe connections.

69–3.02 PIPE LAYING, JOINTING AND TESTING

Pipe laying, jointing and testing for pipe connections shall conform to the applicable requirements of Section 62, excepting however, that testing for acceptance as provided in Section 62-3.10 will not be required when such pipe connections are not connected directly to a main sanitary sewer or storm drain pipe for testing simultaneously with the main pipe test.

69–3.03 CATCH BASIN CONNECTIONS

Catch basin connections are pipe lines connecting outlets of catch basins to a receiving sewer, storm drain, or other approved outlet. Both the alignment and the slope shall be on straight line, unless otherwise approved by the Engineer.

No connection shall be made to the catch basin spigot pipe of casting until after backfill for the catch basin excavation has been compacted in place to the elevation specified in Section 64-3.

69–3.04 INLET CONNECTIONS

Inlet connections are pipe connections from standard types of drainage inlets to catch basins, storm sewers or other approved outlets. Inlet connections shall be laid upgrade from catch basins openings, storm drain tees or wyes or other originations in straight alignment and be on a uniform slope. Where a straight alignment, or a uniform slope is not feasible and curves or bends are necessary, the Engineer will approve the altered alignment and slope.

Pipe connections shall not be made to a catch basin until the compaction requirements of Section 64-3 have been completed and approved by the Engineer.

69–3.05 VERTICAL CONNECTIONS

Vertical pipe connections are concrete encased pipe connections as shown on the standard plan.

The concrete block foundation for supporting vertical connections in a sewer trench shall bear upon firm native ground to avoid any concentrated load on the main sewer pipe.

All applicable construction details pertaining to the laying and jointing of pipe in Section 62 shall apply to the placement of the vertical pipe for encasement in concrete above the foundation, including the sealing of unused tee or wye branches at the top of the connection.

Backfilling around vertical pipe connections, unless otherwise provided in the special provisions or authorized by the Engineer, shall be made by compacting suitable excavated materials in eight (8) inch layers with mechanical tampers. The density shall be as directed by the Engineer. Backfilling shall start from a wide base foundation and slope up evenly to the top of the vertical connection, thus to provide a compacted subgrade for the connecting pipe that will be supported thereon.

69–4 MEASUREMENT

Measurement for catch basin pipe connections shall be the actual length of pipe installed between the tee opening or wye branch in the receiving main pipe, or other approved terminal at which the connection is discharged, and the spigot end of a catch basin outlet pipe.

Measurement for inlet pipe connections will be made upon basis of linear feet of pipe laid.

Measurement for vertical pipe connections shall be by the linear foot for the overall length of vertical connection in place, measured from the bottom of the concrete block foundation to the top of the highest pipe of the vertical connection which is encased or partially encased in concrete. Payment for tee or wye branch pipe used in constructing vertical connections will be made on a per each basis, which will be additional to the measurement for vertical connection.

Measurement for use of the mechanical tamper will be made upon basis of per hour for a tamper meeting the specifications for it in Section 15-2.01A.

69–5 PAYMENT

Payment for pipe connections of the kind specified shall be made by such of the following bid items included in any particular contract:

1. "(Size) Catch Basin Connection," per linear foot, or "(Size) Inlet Connection," per linear foot.
2. "(Size) Vertical Connection," per linear foot.
3. "Tee or Wye, (size)," per each.
4. "Mechanical Tamper," per hour.

The above unit contract prices shall be payment in full for all labor, materials, tools and any other work that may be required to complete the work items as described, in accordance with the standard specifications.

Section 70—Sewer Lamphole

70–1 DESCRIPTION

This section of these specifications shall apply to the construction of sewer lampholes as shown on the standard plan.

70–2 MATERIALS

All materials incorporated into the total lamphole structure shall meet the requirements of the various applicable sections of these specifications.

70–3 CONSTRUCTION DETAILS

Pipe joints shall be of the type specified in Section 60-3.02.

The trench excavation shall be made in such a manner as to provide an undisturbed base upon which the pipe shall be placed. Bedding around the wye and under the pipe connecting to the wye shall be thoroughly tamped as directed. Construction shall otherwise conform to requirements shown on the standard plan.

The unit contract price per each for "Sewer Lamphole, in place," shall be full compensation for furnishing and placing the wye, sewer pipe, pipe bends, pipe plug, casting, and concrete collar as indicated on the standard plan.

70–4 MEASUREMENT

Measurement for lamphole section shall begin at the wye branch and extend to the lamphole casting, as shown on the standard plan.

70–5 PAYMENT

Payment will be made in accordance with the following bid item:

1. "Sewer Lamphole, in place," per each.

Section 72—Pipe for Water Mains

72–1 GENERAL

These specifications cover the pipe and fittings normally used for water distribution systems. Special considerations will be covered in the plans and special provisions.

Specification references made herein for manufactured materials such as pipe, hydrants, valves and fittings refer to designations for American Water Works Association (AWWA), or to United States of America Standards Institute (USASI), as they are effective on the date of call for bids.

72–2 PIPE

72–2.01 CAST IRON PIPE

Cast iron pipe shall conform to the latest AWWA Standard C106 or C108. Cement lining shall be in accordance with AWWA C104, with the exception of thickness. The interior coating thickness shall be as follows: 4" to 12" pipe, 1/16 inch; 14" to 24" pipe, 3/32 inch. Type of joint, class, thickness designation, castings, lining, marking, testing, etc., shall be as specified in the special provisions in accordance with applicable USASI or AWWA designations.

72–2.02 ASBESTOS-CEMENT PIPE

Asbestos-cement pipe shall conform to the latest AWWA Standard C400. Class, marking, testing, etc., shall be as specified in the special provisions.

72–2.03 CONCRETE CYLINDER PIPE

Reinforced concrete water pipe. steel cylinder type prestressed, shall conform to the latest AWWA Standard C301. Size, class, marking, specials, lengths, etc., shall be as specified in the special provisions.

72–2.04 STEEL PIPE

Steel pipe up to 3½" in diameter shall conform to ASTM Designation A120 and shall (including fittings) be hot dip galvanized inside and out. The pipe shall be coupled by using malleable iron screw coupling in accordance with USASI Specification B16.3.

Steel pipe 4" to 30" in diameter shall conform to the latest issue of AWWA Standard C202. Special provisions shall include outside diameter, wall thickness, class and details lengths, tests (including hydrostatic), protective treatment, etc.

–2.04A Coatings for Steel Pipe

Types of protective treatment shall be as follows:

1. Coal tar coating per AWWA Standard C204.
2. Other special coatings as may be described in special provisions.

–2.04B Couplings for Steel Pipe

All steel pipe 4" and larger shall be coupled by the following:

1. Dresser coupling style 38, or equal.
2. Bell and spigot with O-ring rubber gasket which provides unrestricted flow in either direction.
3. Flanges shall conform to AWWA Standard C207.
4. Other types as specified in special provisions. Couplings shall be coated same as the pipe.

72–2.05 GALVANIZED STEEL PIPE

Galvanized steel pipe shall conform to latest revision of ASTM Designation A 120.

72–2.06 GALVANIZED WROUGHT IRON PIPE

Galvanized wrought iron pipe shall conform to latest revision of ASTM Designation A 72 for wrought iron pipe. Specify standard in special provisions.

72–2.07 PIPE FITTINGS

–2.07A Cast Iron

All cast iron fittings shall conform to the latest USASI Specifications A21.10 for short body, cast iron fittings 12" and less, and AWWA C100 for fittings 14" and larger. Lining, type of joints or other special items shall be specified in special provisions.

–2.07B Steel

Steel fittings for pipe 4" and larger shall conform to AWWA C208 - class to be at least the same as pipe. Fittings shall be coated the same as pipe.

For pipe 3½" and smaller, malleable iron screwed fittings in accordance with USASI Specification B16.3. They shall be galvanized unless black is specified.

72–2.08 SPECIAL FITTINGS

Special fittings shall be in accordance with special plans and provisions.

72–3 MEASUREMENT AND PAYMENT

Payment for pipe, valves and fittings is described in Section 74-3.

Section 73—Trench Excavation and Backfill for Water Mains

73–1 GENERAL

The specifications in this section, and those of sections 72 through 78, shall apply to the construction of water distribution mains and appurtenances in sizes up to and including twenty-four inches (24") in diameter for both temporary and permanent installation under ordinary conditions.

Specification references for manufactured materials such as pipe, hydrants, valves and fittings will refer to the designations for American Water Works Association (AWWA), or to United States of America Standards Institute (USASI), as effective on the date of call for bids. Copies of these publications may be obtained at nominal cost from the American Water Works Association, 2 Park Avenue, New York 16, New York, and from the United States of America Standards Institute, 10 East 40th Street, New York, New York.

Water mains will be constructed on locations as shown on the plans.

Where grading is required, such grading as excavation and embankment shall conform to the requirements of Section 13, and rough grading shall be completed before excavation of the water main trench.

Guaranty: Unless otherwise provided by the special provisions, the unit contract prices shall include a guaranty by the Contractor that the design, materials, workmanship and performance of the pipe, valves, hydrants, valve chambers, boxes, fittings and accessories furnished by him will be as specified, and that they and the installation of them will be satisfactory to the Owner for the purpose intended for a period of one year after final acceptance of the contract.

73–1.01 UNGRADED STREETS

On ungraded streets, when grading is not provided in the contract schedule, the depth of trench excavation shall be as shown on the plan and profile and as staked by the Engineer.

Where the plans show the pipe is to be laid above the existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the plans and the water main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Method B of Section 13-3.10E3.

Where no bid items are provided in the contract schedule for earthwork, filling, or embankment fill, such work shall be considered as incidental to the construction and all costs thereof shall be included in the unit contract price per linear foot for "Trench Excavation and Backfill."

Where, in the opinion of the Engineer, the extent of the work of earthwork, filling, or embankment fill justifies bid items, such items and payment will be as provided in Section 13, under the specifications of which the work shall be done, unless otherwise provided in the special provisions.

Section 70—Sewer Lamphole

70–1 DESCRIPTION

This section of these specifications shall apply to the construction of sewer lampholes as shown on the standard plan.

70–2 MATERIALS

All materials incorporated into the total lamphole structure shall meet the requirements of the various applicable sections of these specifications.

70–3 CONSTRUCTION DETAILS

Pipe joints shall be of the type specified in Section 60-3.02.

The trench excavation shall be made in such a manner as to provide an undisturbed base upon which the pipe shall be placed. Bedding around the wye and under the pipe connecting to the wye shall be thoroughly tamped as directed. Construction shall otherwise conform to requirements shown on the standard plan.

The unit contract price per each for "Sewer Lamphole, in place," shall be full compensation for furnishing and placing the wye, sewer pipe, pipe bends, pipe plug, casting, and concrete collar as indicated on the standard plan.

70–4 MEASUREMENT

Measurement for lamphole section shall begin at the wye branch and extend to the lamphole casting, as shown on the standard plan.

70–5 PAYMENT

Payment will be made in accordance with the following bid item:

1. "Sewer Lamphole, in place," per each.

Section 72—Pipe for Water Mains

72–1 GENERAL

These specifications cover the pipe and fittings normally used for water distribution systems. Special considerations will be covered in the plans and special provisions.

Specification references made herein for manufactured materials such as pipe, hydrants, valves and fittings refer to designations for American Water Works Association (AWWA), or to United States of America Standards Institute (USASI), as they are effective on the date of call for bids.

72–2 PIPE

72–2.01 CAST IRON PIPE

Cast iron pipe shall conform to the latest AWWA Standard C106 or C108. Cement lining shall be in accordance with AWWA C104, with the exception of thickness. The interior coating thickness shall be as follows: 4" to 12" pipe, 1/16 inch; 14" to 24" pipe, 3/32 inch. Type of joint, class, thickness designation, castings, lining, marking, testing, etc., shall be as specified in the special provisions in accordance with applicable USASI or AWWA designations.

72–2.02 ASBESTOS-CEMENT PIPE

Asbestos-cement pipe shall conform to the latest AWWA Standard C400. Class, marking, testing, etc., shall be as specified in the special provisions.

72–2.03 CONCRETE CYLINDER PIPE

Reinforced concrete water pipe, steel cylinder type prestressed, shall conform to the latest AWWA Standard C301. Size, class, marking, specials, lengths, etc., shall be as specified in the special provisions.

72–2.04 STEEL PIPE

Steel pipe up to 3½" in diameter shall conform to ASTM Designation A120 and shall (including fittings) be hot dip galvanized inside and out. The pipe shall be coupled by using malleable iron screw coupling in accordance with USASI Specification B16.3.

Steel pipe 4" to 30" in diameter shall conform to the latest issue of AWWA Standard C202. Special provisions shall include outside diameter, wall thickness, class and details lengths, tests (including hydrostatic), protective treatment, etc.

–2.04A Coatings for Steel Pipe

Types of protective treatment shall be as follows:

1. Coal tar coating per AWWA Standard C204.
2. Other special coatings as may be described in special provisions.

–2.04B Couplings for Steel Pipe

All steel pipe 4" and larger shall be coupled by the following:

1. Dresser coupling style 38, or equal.
2. Bell and spigot with O-ring rubber gasket which provides unrestricted flow in either direction.
3. Flanges shall conform to AWWA Standard C207.
4. Other types as specified in special provisions. Couplings shall be coated same as the pipe.

72–2.05 GALVANIZED STEEL PIPE

Galvanized steel pipe shall conform to latest revision of ASTM Designation A 120.

72–2.06 GALVANIZED WROUGHT IRON PIPE

Galvanized wrought iron pipe shall conform to latest revision of ASTM Designation A 72 for wrought iron pipe. Specify standard in special provisions.

72–2.07 PIPE FITTINGS

–2.07A Cast Iron

All cast iron fittings shall conform to the latest USASI Specifications A21.10 for short body, cast iron fittings 12" and less, and AWWA C100 for fittings 14" and larger. Lining, type of joints or other special items shall be specified in special provisions.

–2.07B Steel

Steel fittings for pipe 4" and larger shall conform to AWWA C208 - class to be at least the same as pipe. Fittings shall be coated the same as pipe.

For pipe 3½" and smaller, malleable iron screwed fittings in accordance with USASI Specification B16.3. They shall be galvanized unless black is specified.

72–2.08 SPECIAL FITTINGS

Special fittings shall be in accordance with special plans and provisions.

72–3 MEASUREMENT AND PAYMENT

Payment for pipe, valves and fittings is described in Section 74-3.

Section 73—Trench Excavation and Backfill for Water Mains

73–1 GENERAL

The specifications in this section, and those of sections 72 through 78, shall apply to the construction of water distribution mains and appurtenances in sizes up to and including twenty-four inches (24") in diameter for both temporary and permanent installation under ordinary conditions.

Specification references for manufactured materials such as pipe, hydrants, valves and fittings will refer to the designations for American Water Works Association (AWWA), or to United States of America Standards Institute (USASI), as effective on the date of call for bids. Copies of these publications may be obtained at nominal cost from the American Water Works Association, 2 Park Avenue, New York 16, New York, and from the United States of America Standards Institute, 10 East 40th Street, New York, New York.

Water mains will be constructed on locations as shown on the plans.

Where grading is required, such grading as excavation and embankment shall conform to the requirements of Section 13, and rough grading shall be completed before excavation of the water main trench.

Guaranty: Unless otherwise provided by the special provisions, the unit contract prices shall include a guaranty by the Contractor that the design, materials, workmanship and performance of the pipe, valves, hydrants, valve chambers, boxes, fittings and accessories furnished by him will be as specified, and that they and the installation of them will be satisfactory to the Owner for the purpose intended for a period of one year after final acceptance of the contract.

73–1.01 UNGRADED STREETS

On ungraded streets, when grading is not provided in the contract schedule, the depth of trench excavation shall be as shown on the plan and profile and as staked by the Engineer.

Where the plans show the pipe is to be laid above the existing ground surface, an embankment fill shall be made and compacted to conform with the section shown on the plans and the water main trench shall be excavated therein. That portion of the embankment below the bottom of the pipe shall be compacted with rollers or mechanical compactors under controlled moisture conditions as required under Method B of Section 13-3.10E3.

Where no bid items are provided in the contract schedule for earthwork, filling, or embankment fill, such work shall be considered as incidental to the construction and all costs thereof shall be included in the unit contract price per linear foot for "Trench Excavation and Backfill."

Where, in the opinion of the Engineer, the extent of the work of earthwork, filling, or embankment fill justifies bid items, such items and payment will be as provided in Section 13, under the specifications of which the work shall be done, unless otherwise provided in the special provisions.

73–1.02 CLEARING AND GRUBBING IN UNGRADED STREETS

Where not provided under schedules for "Grading" the area to be excavated or filled shall be cleared and grubbed by the Contractor. This work shall consist of the removal and disposal of all logs, stumps, roots, brush and other refuse. All such material shall be burned, or removed and disposed of as directed by the Engineer. Burning shall be done in a manner that will avoid all hazards such as damage to existing structures, construction in progress, or to trees and vegetation. All burning operations shall be in accordance with federal, state and local regulations, and shall be conducted in such a manner as not to create undue or unnessary nuisance.

Payment for clearing and grubbing will be made in accordance with provisions in Section 12.

73–1.03 REMOVAL OF PAVEMENT FROM DRIVEWAYS AND SIDEWALKS

Removal of existing street improvements shall be performed as specified in Section 52 except that payment therefor shall be considered as incidental to the construction and the costs thereof shall be included by the Contractor in the unit contract price per linear foot for "Trench Excavation and Backfill."

The removal of material from pavement, driveway and sidewalk and the disposal thereof shall be considered as incidental to the construction, and the costs thereof shall be included by the Contractor in the unit contract price per linear foot for "Trench Excavation and Backfill."

73–1.04 GRADE AND ALIGNMENT

Grade and alignment on ungraded streets will be given from hubs set parallel to the line of the pipe, and on graded streets the grade and alignment shall be taken from established points on the existing curbs or sidewalks, when directed by the Engineer. Trenches for the pipe shall be opened in accordance with the lines and grades given or to the standard depth of cover provided in the special provisions. The Contractor shall transfer lines and grades to the pipe from hubs set by the Engineer or from existing concrete curbs or sidewalks as an incidental part of his work.

Sequence of operations, traffic requirements, or restrictions on the amount of open trench, if any, will be provided in the special provisions.

73–1.05 LOCATING AND MARKING UNDERGROUND UTILITIES

See sections 5.09 and 5.10.

73–2 TRENCH EXCAVATION

The Contractor shall perform all excavation of every description and of whatsoever substances encountered to the depth indicated on the drawings or specified herein. All excavations shall be made by open cut unless otherwise provided in the special provisions. The banks of the trenches shall be kept as nearly vertical as soil conditions will permit, and where required to control trench width or to protect adjacent structures the trench shall be properly sheeted and braced.

The maximum trench excavation width for pipes four (4) inches to twelve (12) inches shall not exceed thirty (30) inches, and for larger sizes of pipe the trench bottom width shall not exceed that specified in Section 61-3.01 for sewers, unless authorized by the Engineer.

Work shall comply with the Washington State Safety Code for construction work as required by the State Safety Inspector. Where, in the opinion of the Engineer, damage is liable to result from withdrawing sheeting, the Engineer may require the sheeting to be left in place and payment therefor will be made in accordance with Section 73-3.07.

All grading and other excavations nearby shall be controlled to prevent surface water from flowing into the excavations. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance away from the edges of trenches to avoid overloading and to prevent slides or cave-ins. Unsuitable material, or that in excess to the needs for embankments or backfill, shall be wasted and disposed of by the Contractor.

The Contractor shall exercise sound engineering and and construction practices in excavating the trench and maintaining it so that no damage will occur to any foundation, structure, pole line, pipe line, or other facility because of slough of slopes, or from any other cause. If, as a result of the excavation, there is disturbance of the ground such as to endanger other property, the Contractor shall immediately take remedial action at his own expense. No act, representation or instruction of the Engineer or his representatives shall in any way relieve the Contractor from liability for damages or costs that result from trench excavation.

Care shall be taken not to excavate below the depth indicated, and excavation below that depth shall be backfilled with selected backfill material and compacted to the satisfaction of the Engineer at the Contractor's expense.

The bottom of trenches shall be accurately graded to provide uniform bearing and support for each length of pipe on undisturbed or compacted soil at every point along its entire length, except at the joints. Bell holes shall be excavated to an extent sufficient to permit accurate work in making and inspecting the joints.

–2.01 CUTTING EXISTING SERVICES

When utility services occupy the same space as the new water main, the Owner will cut the utility services ahead of the excavating machine and reconnect them after the machine passes.

The Contractor shall carefully do all necessary excavation to fully expose such services. If the Contractor elects to excavate the trench without first exposing the services, he shall be responsible for any and all damages incurred to the services by reason of his operations and shall immediately arrange for replacement of all damaged services. All additional costs incident to such work under either method by the Contractor shall be considered as incidental to the construction and shall be included in the unit contract price per linear foot for "Trench Excavation."

73–2.02 SOLID ROCK EXCAVATION

Solid rock shall include solid rock formations requiring systematic drilling and blasting with explosives and any boulders or broken rock larger than one-half cubic yard in volume. Hardpan or cemented gravel, even though it may be advantageous to use explosives in its removal, shall not be classified as solid rock excavation. Solid rock shall be excavated to a width equal to the outside barrel diameter of the pipe plus 24 inches, and to a grade line not less than six inches below bottom of pipe. Bottom of the trench shall be brought up to grade by backfilling with selected backfill material and be compacted to the satisfaction of the Engineer.

The Contractor shall notify the Engineer at least 24 hours prior to any blasting. All blasting shall be done in accordance with local, county and state regulations governing this class of work. Any damage to persons or property resulting from blasting operations shall be the sole responsibility of the Contractor and his surety.

Payment for solid rock will be made in accordance with Section 73-3.03.

73–2.03 EXTRA EXCAVATION

Changes in grades of the water main from those shown on the plans, or as provided in the special provisions, may be necessary because of unplotted utilities, or for other reasons. If, in the opinion of the Engineer, it is necessary to adjust, correct, relocate or in any way change the line and grade, such changes shall be made by the Contractor under the terms of these specifications.

When a change in horizontal alignment is ordered by the Engineer, payment will be made for any trench which has been excavated upon the original location at the unit contract price per linear foot for "Trench Excavation and Backfill."

Changes in grade which will involve additional depth of trench by not more than four feet will be paid for at the unit contract price per cubic yard for "Extra Excavation," computed on the basis of the specified minimum trench width and additional depth.

Additional depth of trench involving more than four feet will be paid for either on a negotiated price basis or as force account work, as the Engineer may determine.

In cases where sheeting becomes necessary on account of the additional depth, payment therefor will be made the Contractor on a negotiated price basis or as force account work, as the Engineer may determine.

73–2.04 UNFORESEEN BURIED OBJECTS ENCOUNTERED IN TRENCH EXCAVATION ON GRADED STREETS

Where streets have been graded, it is presumed that stumps, railroad ties, buried pavements, etc., will have been removed in the original grading work. Where such unexpected objects are encountered in trench excavation for water mains, they shall be removed and disposed of by the Contractor. In cases where they can be removed by the same equipment or method at hand for excavating, and where it is unnecessary to employ special equipment, install shoring or bracing, or to increase the trench width or depth more than two feet for any one object, then in that event the removal of such obstructions shall be considered as an incidental part of the Contractor's work and no additional payment will be made therefor.

Where objects, railroad ties, buried pavements, etc. are continuous and require extra work beyond the scope of the work outlined above, or extra equipment for their removal, additional payment will be made upon a negotiated price basis, or as force account work as the Engineer may determine.

73–2.05 REMOVAL OF UNSUITABLE MATERIALS

Wherever in excavating the trench for water mains the bottom of the trench exposes peat, soft clay, quicksand or other material which is unsuitable in the opinion of the Engineer, such material shall be removed and disposed of by the Contractor. The material thus removed shall be replaced by suitable surplus material obtained from trench excavation within the limits of the project which shall be deposited and compacted in eight-inch layers by mechanical compaction. If surplus material is not available within the limits of the project, the Contractor shall furnish suitable material, as provided in Section 73-2.08, Bank Run Gravel for Trench Backfill.

Measurement and payment for removal and replacement of unsuitable material will be made in accordance with Section 73-3.04.

73–2.06 BACKFILLING TRENCHES

Backfilling of trenches shall be made with the same materials excavated from the trenches unless these materials are found to be unsuitable by the Engineer.

Prior to backfilling, all form lumber and debris shall be removed from the trench. Sheeting used by the Contractor shall be removed just ahead of the backfilling unless it is ordered by the Engineer to be left in place.

Bedding for water mains will not ordinarily be required. When required, it shall consist of clean granular sand and gravel of which 100% will pass the U. S. standard ¾-inch opening and not more than 3% will pass the U. S. No. 200 (wet sieve), with a minimum sand equivalent of 50. Payment for furnishing and placing bedding material will be made upon measurement in trucks at point of delivery at the unit contract price per cubic yard for "Bedding Material."

Backfill up to six inches over the top and both sides of the pipe shall be evenly and carefully placed, but not until all large rocks capable of damaging the pipe or its coating have been removed from the backfill material. The balance of the material may be placed by dumping into the trench by any method at the option of the Contractor and shall be compacted as specified hereinafter.

73–2.07 COMPACTION OF BACKFILL

On graded streets without pavement or on roadway shoulders and unimproved areas, compaction of backfill shall be by water settling or wheel rolling.

–2.07A Water Settling of Trenches

Where water settling of trenches is required, the jetting method shall be used. Jets shall be inserted at not more than four-foot intervals throughout the length of the backfilled area and shall be slowly forced down to the bottom of the trench and held until the trench backfill is completely saturated with water. The jetting operations shall be completed as close behind the pipe laying and backfilling as practicable.

After the water-settled trench has set for several days, any depression in the trench shall be filled and mounded up over the trench, and then further compacted by the use of heavy rubber-wheeled equipment.

–2.07B Equipment for Water Settling Trenches

The Contractor shall furnish all hose and equipment necessary for jetting operations. The minimum size of hose and equipment shall be such as to provide not less than thirty-five (35) pounds per square inch pressure at the discharge. The jet shall be a rigid iron pipe with a minimum diameter of one (1) inch.

–2.07C Source of Water for Water Settling

Source of water will depend upon local conditions and shall be as provided in the special provisions. Where no provision for water is made in the special provisions, the Contractor shall make his own arrangements for it.

–2.07D Compaction of Backfill under Special Conditions

At locations where paved streets, driveways or sidewalks will be constructed or reconstructed over the trench, or where provided for in the special provisions or directed by the Engineer, the backfill shall be spread in layers and be compacted by mechanical tampers. In such cases the backfill material shall be placed in successive layers, not exceeding eight (8) inches in thickness and each layer shall be compacted with mechanical tampers to the density directed by the Engineer. Mechanical tampers shall be of the impact type as specified in Section 15-2.01A.

73–2.08 BANK RUN GRAVEL FOR TRENCH BACKFILL

Selected backfill material shall consist of bank run gravel Class A or Class B, as specified in Section 26 excepting, however, that 100% of the material shall pass the 2½-inch square opening.

Payment for bank run gravel Class A or Class B will be made in accordance with Section 73-3.06.

73–2.09 SHEETING LEFT IN PLACE

When, in the opinion of the Engineer, the withdrawal of sheeting from the trench will result in damage to adjacent utilities or other property, the Engineer may order all or a portion of the sheeting to be left in place, in which case it shall be cut off 24 inches below grade. Payment will be made in accordance with Section 73-3.07.

73–2.10 TEMPORARY PEDESTRIAN CROSSINGS

The Contractor shall provide all necessary temporary pedestrian crossings for the proper handling of pedestrian traffic over the trench and shall provide access to private property where required by the Engineer. Temporary pedestrian crossings shall have the minimum requirements shown on standard plan.

73–3 MEASUREMENT AND PAYMENT

73–3.01 CLEARING AND GRUBBING

When an item for "Clearing and Grubbing" is provided in the bid proposal, payment will be made on basis of a "Lump Sum" contract price which shall be in full for the removal and disposal of all material as specified, or in accordance with provisions of Section 12.

When no item is provided in the bid proposal, all clearing and grubbing shall be considered as incidental to the work of constructing the water main and all costs thereof shall be included in the unit contract price per linear foot for "Trench Excavation and Backfill."

73–3.02 TRENCH EXCAVATION AND BACKFILL

Measurement for "Trench Excavation and Backfill" shall be by the linear foot measured along the center line of the pipe from end to end, including also fittings, valves, etc. When two trenches intersect, the measurement of each shall be to the intersection of the center lines of the cross or tee.

Payment for "Trench Excavation and Backfill" will be made at the unit contract price per linear foot of

trench, which price shall be full compensation for all costs of materials, labor and equipment required to excavate the trench to the depth and in the manner required by the plans and specifications including: (a) excavation for bell holes, valves, fittings, and other appurtenances except chambers, (b) the removal and disposal of pavements, sidewalks and driveways, (c) the furnishing, placing and removal of sheeting, (d) the clearing and grubbing if there be no separate item for such in the proposal, and (e) the backfilling of the trench and compaction of backfill in accordance with the specifications. Exception is made, however, that excavation of solid rock and of unforeseen buried objects will be paid for additionally in the manner hereinbefore described.

73–3.03 SOLID ROCK EXCAVATION

Payment for "Solid Rock Excavation" will be made at the unit contract price per cubic yard, which price shall be in addition to the price per linear foot for "Trench Excavation and Backfill." The volume of solid rock excavation will be based upon a trench width equal to the outside barrel of the pipe plus 24 inches, and to a grade six inches below the bottom of the pipe and the profile of the top of the rock as established by field measurements.

Selected backfill used in adjusting the bottom of the trench to grade will be measured and paid for as described in Section 73–2.06.

73–3.04 REMOVAL AND REPLACEMENT OF UNSUITABLE MATERIAL

Payment will be made at the unit contract price per cubic yard for "Removal and Replacement of Unsuitable Material," which price shall be full compensation for excavating and disposing of the unsuitable material as defined in Section 73–2.05 herein, and the loading, hauling and placing of suitable excess material in the trench as specified.

If suitable excess material is not available, the Contractor will be paid for furnishing suitable material from other approved source as provided in Section 73–2.08, "Bank Run Gravel for Trench Backfill."

Compaction of suitable replacement material shall be by mechanical tampers as specified in Section 73–2.07D, as directed by the Engineer, and will be paid for at the unit contract price per hour for "Mechanical Tamping."

73–3.05 MECHANICAL TAMPING

Where mechanical tamping is required, payment will be made at the unit contract price per hour for "Mechanical Tamping," which price shall be full compensation for any additional costs of spreading backfill in layers and for all materials, labor, equipment, tools and incidentals required to complete the mechanical tamping in accordance with the specifications. Payment will be made for the actual time that mechanical tamping is performed, and as and when required by the Engineer.

Mechnical tamping is work not required within the payment scope of "Trench Excavation and Backfill."

73–3.06 BANK RUN GRAVEL FOR TRENCH BACKFILL

Measurement of "Bank Run Gravel for Trench Backfill," will be by the cubic yard measured in trucks at point of delivery.

Payment for "Bank Run Gravel" will be made at the unit contract price per cubic yard, which price shall be full compensation for the furnishing and hauling of the material to the trench. Handling of the material at the trench shall be included in the unit contract price per cubic yard for "Trench Excavation and Backfill."

73–3.07 SHEETING LEFT IN PLACE

Sheeting left in place at the discretion of the Engineer will be paid for at the unit contract price per thousand feet board measure (MBM) for the actual amount of lumber left in the trench. Such payment shall be full compensation for the material, and for the labor and equipment required to cut off that portion of the sheeting not intended to be left in place and to make satisfactory disposal of it.

73–3.08 TEMPORARY PEDESTRIAN CROSSINGS

Payment for temporary pedestrian crossings will be made at the unit contract price per each for "Temporary Pedestrian Crossing," which price shall be full compensation for furnishing, placing and removal of the crossing. Each crossing will be paid for as a separate unit whether it is new construction or has been moved from a prior location.

Section 74—Pipe Installation for Water Mains

74–1 GENERAL

Pipe shall be installed in accordance with the manufacturer's specifications and instructions for installing the type of pipe used unless modified or changed in the special provisions. The Contractor shall provide all tools and equipment including any special tools designed for installing each particular type of pipe used.

74–2 CONSTRUCTION

74–2.01 DEWATERING OF TRENCH

Where water is encountered in the trench, it shall be removed during pipe-laying operations and the trench so maintained until the ends of the pipe are sealed and provisions are made to prevent floating of the pipe. Trench water shall not be allowed to enter the pipe at any time.

74–2.02 HANDLING OF PIPE

All types of pipe shall be handled in such manner as will prevent damage to the pipe, pipe lining or coating. Damage to pipe, pipe lining or coating shall be repaired to the satisfaction of the Engineer or be removed from the job and methods of handling shall be corrected to prevent further damage.

Threaded pipe ends shall be protected by couplings or other means until laid.

The pipe and fittings shall be inspected for defects and cast iron pipe, while suspended above grade, shall be rung with a light hammer to detect cracks.

Dirt or other foreign material shall be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it shall be removed, cleaned and relaid. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or by other means approved by the Engineer to ensure absolute cleanliness inside the pipe.

74–2.03 LAYING OF PIPE ON CURVES

Long radius curves, either horizontal or vertical, may be laid with standard pipe by deflections at the joints. If the pipe is shown curved on the plans and no special fittings are shown, the Contractor can assume that the curves can be made by deflection of the joints with standard lengths of pipe. If shorter lengths are required, the plan will indicate maximum lengths that can be used.

Where field conditions require deflection or curves not anticipated by the plans, the Engineer will determine the methods to be used. No additional payment will be made for laying pipe on curves as shown on the plans, nor for field changes involving standard lengths of pipe deflected at the joints. When special fittings not shown on the plans are required to meet field conditions, additional payment will be made for special fittings as provided in Section 74–3.02.

Maximum deflections at pipe joints and laying radius for various pipe lengths are as found in the following standards:

Cast Iron Pipe Bell and Spigot Lead Joints	AWWA C 600-64 Sec. 7.8
Cast Iron Pipe Mechanical Joints	AWWA C 600-64 Sec. 9b.5
Cast Iron Pipe Push-on Joints	AWWA C 600-64 Sec. 9c.4
Asbestos-cement Pipe	AWWA C 400 53T
Concrete Cylinder Pipe	AWWA C301-64 Sec. 4.4
Steel Pipe O-Ring Joints	See manufacturer's recommendations
Steel Pipe Welded Joints	See latest AWWA Spec.

When rubber gasketed pipe is laid on a curve, the pipe shall be jointed in a straight alignment and then deflected to the curved alignment. Trenches shall be made wider on curves for this purpose.

74–2.04 LAYING CAST IRON PIPE

–2.04A Joints for Cast Iron Pipe

Joints for cast iron pipe shall consist of one of the three following types unless otherwise provided in the special provisions:

1. Bell and spigot pipe with lead joints.
2. Mechanical joints.
3. Rubber gasket joints (Push-on).

–2.04B Bell and Spigot Pipe with Lead Joints

This type joint shall be made by use of a packing material followed by melted lead calked in place.

–2.04C Packing Material

Packing material shall be molded rubber rings. Dry braided sterile packing of a type approved by the Engineer and State Department of Health may be used only when the space between the bell and the spigot will not permit use of a rubber ring. When removed from the container, special care shall be used to prevent contamination to the rings or the braided packing.

–2.04D Preparation of Joint

The bell and spigot ends of the pipe shall be thoroughly brushed and cleaned of all oil, grit, tar and other foreign matter. The molded rubber packing ring shall be placed on the spigot end and the pipe entered to the full depth of the socket. The rubber ring shall be driven home and the joint filled with molten lead.

When yarning material is used, it shall be placed around the spigot of the pipe and shall be of proper dimensions to center the spigot in the bell. When the spigot is shoved home, the yarning material shall be driven tightly against the inside base or hub of the bell with suitable yarning tools.

When a single strand of yarning material is used, it shall have an overlap at the top of not more than two inches. When more than a single strand is required for a joint, each strand shall be cut to sufficient length so that the ends will meet without causing overlap. Ends of successive yarning rings shall be staggered and shall be driven home separately.

–2.04E Depth of Jointing Material

The depth of the lead joints shall be not less than 2¼" for pipe having a nominal diameter of 20" or less, and 2½" in 24-inch pipe.

–2.04F Lead

Lead for calking purposes shall contain not less than 99.73 percent pure lead. Impurities shall not exceed the following limits:

	PERCENT
Arsenic, antimony and tin together	0.015
Copper	0.08
Zinc	0.002
Iron	0.002
Bismuth	0.25
Silver	0.02

The producer's name or the mark of Lead Industries shall be clearly cast or stamped upon each piece of lead.

–2.04G Heating and Pouring of Lead

Lead shall be heated in a melting pot, kept in easy reach of the joint to be poured so that the molten metal will not be chilled in being carried from the melting pot to the joint, and shall be brought to a proper temperature so that when stirred it will show a rapid change of color. Before pouring, all scum shall be removed. Each joint shall be made with one continuous pour filling the entire joint space with solid lead. Spongy or imperfectly filled joints shall be burned out and be repoured.

–2.04H Position of Joint Runner

The joint runner shall fit snugly against the face of the bell and the outside of the pipe and shall be dammed with clay to form a pouring lip to provide for filling the joint flush with the face and to the top of the bell.

–2.04I Calking Lead Joints

After the lead has cooled to the temperature of the pipe, lead joints shall be calked with pneumatic or hand tools operated by competent workmen until such joints are thoroughly compacted and watertight, without overstraining the bell of the pipe. The finished joint shall show a hard and even hammered surface overall.

74–2.05 JOINTING MECHANICAL JOINT PIPE

The outside diameter of the spigot end of bell-and-spigot pipe varies with the type, size and class of pipe. There is only one joint size for each diameter of mechanical joint pipe. Thus, difficulty may be met when attempts are made to connect existing bell-and-spigot pipe to mechanical joint pipe. When such a connection must be made, an adapter having a fitting bell and a mechanical joint socket is manufactured and shall be used.

–2.05A Cleaning and Assembling Joint

The last 8 inches outside of the spigot and inside of the bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter from the joint, and then painted with a soap solution made by dissolving one-half cup of granulated soap in one gallon of water. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with the thick edge toward the gland.

–2.05B Bolting of Joint

The entire section of the pipe shall be pushed forward to seat the spigot end of the bell. The gasket shall then be pressed into place within the bell, being careful to have the gasket evenly located around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting, all of the nuts inserted, and the nuts screwed up tightly with the fingers. All nuts shall be tightened with a torque wrench. The torque for various sizes of bolts shall be as follows:

Size Inch	*Range of Torque Ft. - Lbs.*
⅝	40 - 60
¾	60 - 90
1	70 - 100
1¼	90 - 120

Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

74–2.06 JOINTING RUBBER GASKET JOINT PIPE

–2.06A Cleaning and Assembling Joint

The inside of the bell shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other foreign matter from the joint. The circular rubber gasket shall be flexed inward and inserted in the gasket seat provided in the socket and released with the gasket fitting over the bead in the gasket seat.

A thin film of gasket lubricant shall be applied to the inside surface of the gasket. Gasket lubricant shall be a solution of vegetable soap or other solution supplied by the pipe manufacturer and approved by the Engineer.

The spigot end of the pipe shall be cleaned and entered into the rubber gasket in the socket, using care to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket, using a forked tool or jack-type tool or other device approved by the Engineer. Pipe which is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.

Field-cut pipe lengths shall be filed or ground to resemble the spigot end of manufactured pipe.

74–2.07 LAYING ASBESTOS-CEMENT PIPE

–2.07A Couplings for Asbestos-cement pipe

Asbestos-cement pipe shall be furnished with one of the following types of couplings: Super Simplex Automatic, Fluid-tite and Ring-tite. Each coupling shall be grooved to fit the type of rubber ring used. Rings shall

be molded rubber, of manufacturer's design and as furnished by manufacturer to fit the type of pipe and coupling used.

–2.07B Cleaning and Assembling Joint

All parts of the pipe ends and couplings shall be thoroughly cleaned to remove oil, grit or other foreign matter from the joint.

Insert the two molded rubber joint rings in the grooves provided in the coupling.

Lubricate the outside surface of the pipe ends back to the stop shoulder with a solution of vegetable soap and water or other prepared solution supplied by the manufacturer and approved by the Engineer.

Align the pipe and coupling and jack the pipe home until rings are properly seated with recommended tolerance between pipe lengths.

–2.07C Short Lengths and Field Cut Joints

Short lengths of pipe supplied by the manufacturer shall be used whenever possible to provide the proper spacing of valves, tees or special fittings.

Whenever it becomes necessary to cut a length of pipe, the cut shall be made by abrasive saw or by a special pipe cutter, using a cutting blade rotated around the pipe at right angles to the axis of pipe.

Cut ends shall be machined with special machining equipment to the exact dimensions of the pipe supplied by the manufacturer.

74–2.08 LAYING STEEL PIPE

–2.08A Threaded Steel Pipe in Sizes up to and Including 3½ Inch

All steel pipe in sizes up to and including 3½ inch shall be connected with malleable iron screwed couplings in accordance with USASI Specification B16.3. Couplings shall be galvanized. Unions or flanges shall be used at all equipment and valves.

Exposed threads, after jointing, shall be brush-coated with an asphalt coating approved by the Engineer.

–2.08B Coupled Pipe 4-inch and Larger

All steel pipe 4-inch and larger for use in underground services shall be coupled by either one of the following methods:

Dresser Couplings, Style 38 or approved equal.

O-Ring rubber gasket joint of a design approved by the Engineer and having the following basic design:

One end expanded to form a bell.

The other, or spigot end, shall have a rolled groove to accommodate a round rubber gasket of proper diameter and cross section.

All parts shall be thoroughly cleaned before assembly and a vegetable soap solution shall be brushed on the inside of the bell just prior to assembly.

All component parts of couplings, rings, bells, etc., shall receive a protective coating in the same manner as specified for steel pipe. Bolts and nuts, exposed edges, flanges, etc. shall, after installation, be covered with a heavy hot pour of asphalt if asphalt coated pipe is used, or with coal tar enamel if coal tar coated pipe is used.

All steel pipe 4-inch and larger for above ground service shall be coupled with flanges, dresser type or victaulic type couplings. All flanges for steel pipe shall conform to AWWA Standard C-207, Class B for working pressures up to 86 psi, Class D for working pressures up to 150 psi, and Class E for working pressures up to 275 psi.

Pipe for outdoor service above ground shall be protected with one coat primer and one coat bitumastic paint approved by the Engineer.

Pipe for indoor service shall be protected with one coat of red lead and two coats of approved enamel paint of a color specified or selected by the Engineer.

74–2.09 LAYING CONCRETE PIPE

Concrete cylinder pipe with steel joint rings, or concrete non-cylinder pipe when called for on the plans or special provisions, shall be laid to conform with requirements that follow.

–2.09A Cleaning and Assembling Joint

All parts of the joint, both bell and spigot ends, shall be thoroughly brushed and cleaned to remove oil, grit and other foreign matter. The circular rubber gasket provided with the pipe shall be stretched and snapped into the groove provided on the spigot end. It shall be lifted and released at several points on the circumference to equalize tension and remove twist in the gasket.

The bell end of the pipe shall be lubricated with a solution of vegetable soap and water or other prepared solution supplied by the pipe manufacturer and approved by the Engineer. The pipe shall then be jacked home until it stops.

The outside annular space at the joint shall be filled with cement mortar.

The grouting of the outside joints shall be made by wrapping the joint with two bands of strong waterproof sisalkraft paper. The bands of paper shall then be tightly strapped to the pipe with ⅜-inch box strapping, using tools recommended by the manufacturer of the strapping. Hand-tamped backfill shall be built up around the band to the horizontal diameter of the pipe. The joint shall then be filled with mortar from one side only until the mortar appears on the other side of the pipe. Mortar shall be mixed with the least amount of water that will permit placing by the method described. Flexible wires shall be worked around the joint to assist grouting and ensure proper filling of the joint. The top of the pipe shall then be grouted and the paper band laid over the entire joint to protect it while curing.

The inside annular space shall also be filled with cement mortar and troweled hush. Mortar shall consist of one part portland cement and two parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for "dry packing."

No grouting of joints will be allowed within three joints of laying operations. A representative of the Engineer shall be present when outside joints are being poured.

74–2.10 CONNECTIONS TO EXISTING MAINS

All connections to water mains in use shall be made by the utility unless otherwise provided in the special provisions. All crosses or other specials required to be inserted in any main already in use shall be furnished by the Contractor and be set by the utility. The Contractor shall furnish the special, as shown on the plans, and all other material required. He shall make all necessary excavations to assure gradual transition between the new and existing water main, and he shall perform all necessary backfilling.

Where the connection of new work to old requires interruption of service and notification of customers affected, the superintendent of the utility, the Engineer and the Contractor shall mutually agree upon a date for connections which will allow ample time to assemble labor and materials, and to notify all customers affected.

74–2.11 WATER SERVICE CONNECTIONS

The utility will, at no cost to the Contractor, make all taps for service connections and install the service pipe, unless otherwise provided on the plans or in the special provisions.

The Contractor shall leave the main trench open at all points where service connections are to be made until such services are installed and tested to the curb cock.

When requested by the Engineer, the Contractor shall open side trenches to such depths as may be necessary to carry services from the main to the curb. Excavation and backfill of side trenches for water service connections shall be as specified for water main trenches in Section 73. Unless otherwise provided, payment for side trenches will be made at the unit contract price per linear foot for "Trench Excavation and Backfill for Water Service Connections."

Where existing services are to be transferred from old to new mains, the Contractor shall plan and coordinate his work with that of the utility so that service will be resumed with the least possible inconvenience to consumers.

Whenever the Contractor is required by the plans and special provisions to remove an existing water main, the special provisions will state whether or not the salvage of pipe, valves, hydrants and fittings will be required, and the method of payment therefor.

The Contractor shall not in any case remove old pipe until all service connections have been transferred to the new main. Adequate provisions shall be made by the Contractor during construction for the care and protection of mains or services in use.

Where salvage of pipe, valves, hydrants and fittings is required under the contract, salvage methods shall be used which will save all materials intact and undamaged. Salvaged material shall be stored at the trench side for removal by the utility, unless otherwise provided.

If salvage is not specified, the materials therefrom shall become the property of the Contractor and shall be promptly removed from the site for disposal as he sees fit.

To supply customers with water during the construction of a water main project where any section of the pipe has passed a satisfactory hydrostatic and bacteriological test, the Utility reserves the right to tap corporation cocks into the section of a new main and install service connections at such locations as the Utility may elect, at no expense to the Contractor. The attaching of any such service connections by the Utility shall not be construed by the Contractor as an acceptance by the Owner of any part of the work required under the contract.

74–2.12 FIELD TESTS

All pipe and appurtenances shall be subjected to a hydrostatic test after they are laid. Each section of pipe between gate valves shall be tested as soon as possible after laying, or when directed by the Engineer.

At points where pressure reaction and movement may occur, such as at bends, tees and plugs the pipe shall be properly blocked or braced. Where permanent blocking is not required, the Contractor shall furnish and install temporary blocking and remove it after testing. All costs to the Contractor for installing temporary blocking shall be included in the unit bid prices for the water mains.

The Contractor shall furnish all labor and equipment necessary to make the tests except for pressure gauges which will be furnished by the Utility.

Where the Utility has water available for testing, it will be furnished without charge. All costs of tapping and piping shall be borne by the Contractor unless otherwise specified in the special provisions. Where water is not available from the Utility, the Contractor shall provide water from an approved source for testing and the cost thereof shall be included in other unit contract prices of the work.

Hydrostatic tests shall be performed on every complete section of water main between two gate valves, and each gate shall withstand the same test pressure as the pipe, with no pressure active in the section of pipe beyond the closed gate valves.

The test pressures to which cast iron pipe water mains and appurtenances shall be tested hydrostatically are as follows:

Diameter Pipe-inches	4	6	8	10	12	16	Over 16
Test Pressure lbs. per square inch	300	300	300	275	250	225	200

The test pressure shall be applied at the low end of the section of water main being tested. Air in the pipe shall be vented at all high points.

The hydrostatic test pressure shall be maintained until the Engineer has determined that the section of pipe, gate valves, and fittings are watertight. If there are no visible leaks and the test pressure is maintained without pumping for fifteen (15) minutes and the pressure drop is less than fifteen (15) pounds the main will be accepted as a watertight installation. When testing short lengths of main pipe, or hydrants, maintaining the test pressure without pumping for five (5) minutes with less than five (5) pounds drop in pressure will be evidence of a satisfactory test.

Defective materials or workmanship, discovered as a result of hydrostatic field test, shall be replaced by the Contractor at his expense. Whenever it is necessary to replace defective material or correct the workmanship the hydrostatic test shall be re-run at the Contractor's expense until a satisfactory test is obtained.

–2.12A Testing Sections with Hydrants Installed

When hydrants are included with the section of main pipe to be tested, the testing shall be conducted in three separate tests as follows:

Test No. 1—Water main gate valves and all hydrant auxiliary gate valves closed, with the hydrant operating stem valves and hose ports wide open.

Test No. 2—Water main gate valves and the hydrant operating stem valves tightly closed but the hydrant auxiliary gate valves and hose ports shall be wide open. (150 psi)

Test No. 3—Each hydrant shall be tested to a pressure of three hundred (300) pounds per square inch with the hydrant auxiliary gate valve and hose ports closed, but the hydrant operating stem valve shall be wide open. No pressure above twenty-five (25) pounds per square inch shall be in the supply main beyond the hydrant auxiliary gate valve when testing a hydrant singly.

–2.12B Testing Extensions from Existing Mains

When an existing water main is extended with new pipe to a new gate valve and the distance from the existing pipe to the new gate valve is eighteen (18) feet or less, the section of new pipe installed between the new gate valve and the end of the existing main shall be made by the Utility with pretested, prechlorinated pipe, and no hydrostatic test will be required. When the required hydrostatic tests are conducted in the new main section beyond the installed new gate valve in the closed position, the normal pressure of the existing main may be present against the other side of the new gate valve.

Where the distance between the end of an existing water main pipe extension to the gate valve is more than eighteen (18) feet, the connection of the new pipe to existing pipe shall not be made until after hydrostatic tests have been made to the required pressure in both directions against the new gate valve. This shall be accomplished by a temporary cap or plug installed on the end of the new pipe, beyond the new gate, as close as possible to the existing pipe for testing purposes.

The short length of pipe between the temporary cap or plug end with the new gate valve in the closed position, with no hydrostatic pressure active on the opposite side of the gate valve, shall be subjected to the required test pressure. The same test shall be made against the other side of new gate when that section of pipe is tested with no hydrostatic pressure active in the short section of pipe toward the existing main pipe. The final connection to the existing main shall be made by the Utility with pretested prechlorinated pipe.

–2.12C Testing Hydrants Installed on Existing Mains

Hydrants shall be installed and connected to an existing main, in accordance with the standard plans. The hydrant connection, including hydrant tee, connection pipe and six (6) inch auxiliary gate valves, will be installed by the Utility with pretested materials.

After the hydrant connection has been made to the existing main, the hydrant installation shall be subjected to the hydrostatic test No. 3 of Section 74–2.12A.

74–2.13 DISINFECTION OF WATER MAINS

Before being placed in service, all new water mains and repaired portions of, or extensions to existing mains shall be chlorinated and a satisfactory bacteriological report obtained. The Owner will pass on the results of the bacteriological test. No separate payment will be made for chlorinating water mains.

–2.13A Flushing

Sections of pipe to be disinfected shall first be flushed to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, then a tap shall be provided large enough to develop a velocity of at least 2.5 fps. in the main. One 2½ inch hydrant opening will, under normal pressure, provide this velocity in pipe sizes up to and including 12-inch.

Taps required by the Contractor for chlorination or flushing purposes shall be provided by him as a part of the construction of water mains, unless otherwise provided in the special provisions. Service taps or taps that are necessary for temporary or permanent release of air

will generally be provided by the Utility; if not performed by the Utility, the Engineer may direct the Contractor to make the taps for which work he will receive extra compensation.

Where dry calcium hypochlorite is used for disinfection of the pipe, flushing shall be done after disinfection.

The Contractor shall be responsible for disposal of treated water flushed from mains and shall neutralize the waste water for protection of aquatic life in the receiving water before disposal into any natural drainage channel. However, disposal may be made to any available sanitary sewer provided the rate of disposal will not overload the sewer.

–2.13B Requirement of Chlorine

Before being placed into service, all new mains and repaired portions of, or extensions to existing mains shall be chlorinated so that a chlorine residual of not less than 10 ppm remains in the water after standing 24 hours in the pipe. The initial chlorine content of the water shall be not less than fifty (50) parts per million.

–2.13C Form of Applied Chlorine

Chlorine shall be applied by one of the methods which follow, to give a dosage of not less than 50 ppm of available chlorine.

–2.13D Dry Calcium Hypochlorite

As each length of pipe is laid, sufficient high test calcium hypochlorite (65–70% chlorine) shall be placed in the pipe to yield a dosage of not less than 50 ppm available chlorine, calculated on the volume of the water which the pipe and appurtenances will contain.

The number of ounces of 65% test calcium hypochlorite required for a 20-foot length of pipe equals $.008431d^2$, in which "d" is the diameter in inches.

–2.13E Liquid Chlorine

A chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device, or the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the pipe being treated. Chlorinating devices for feeding solutions of the chlorine gas, or the gas itself, must provide means for preventing the backflow of water into the chlorine.

–2.13F Chlorine-bearing Compounds in Water

A mixture of water and high-test calcium hypochlorite (65–70% Cl) may be substituted for the chlorine gas-water mixture. The dry powder shall first be mixed as a paste and then thinned to a 1 percent chlorine solution by adding water to give a total quantity of 7.5 gallons of water per pound of dry powder. This solution shall be injected in one end of the section of main to be disinfected while filling the main with water in the amounts as shown in the table which follows.

Chlorine Requirements for 100-Ft. Lengths of Various Sizes of Pipe

Pipe Size Inches	Volume of 100-ft. Length Gals.	Amount Required to Give 50 ppm Cl. 100% Chlorine Lb.	1% Chlorine-Water Solution in Gals.
4	65.3	0.027	½
6	146.5	0.061	¾
8	261.0	0.108	1¼
10	408.0	0.170	2
12	588.7	0.240	3

–2.13F1 Sodium Hypo-chlorite

Sodium Hypochlorite, commercial grade (15% Cl) or in the form of liquid household bleach (5% Cl) may be substituted for the chlorine gas-water mixture. This liquid chlorine compound may be used full strength or diluted with water and injected into the main in correct proportion to the fill water so that the dosage applied to the water will be at least 50 ppm.

–2.13G Point of Application

The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it, and through a corporation stop inserted by the utility in the horizontal axis of the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap made by the utility on the pressure side of the gate valve controlling the flow into the pipe line extension. Alternate points of application may be used when approved or directed by the Engineer.

–2.13H Rate of Application

Water from the existing distribution system, or other source of supply, shall be controlled to flow very slowly into the newly laid pipe line during application of the chlorine. The rate of chlorine gas-water mixture or dry gas feed shall be in such proportion to the rate of water entering the newly laid pipe that the dosage applied to the water will be at least 50 parts per million.

–2.13I Preventing Reverse Flow

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water. Check valves may be used if desired.

–2.13J Retention Period

Treated water shall be retained in the pipe at least twenty-four (24) hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least ten (10) parts per million.

–2.13K Chlorinating Valves and Hydrants

In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent and under normal operating pressure.

–2.13L Final Flushing and Testing

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe until the replacement water throughout its length shows, upon test, the absence of chlorine. In the event chlorine is normally used in the source of supply, then the tests shall show a residual not in excess of that carried in the system.

After flushing, the Engineer will arrange for taking samples by the Utility or by health authorities.

–2.13M Repetition of Flushing and Testing

Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained. Failure to get a satisfactory test shall be considered as failure of the Contractor to keep the pipe clean during construction, or to properly chlorinate the main, and no additional payment will be made for reflushing and rechlorinating until a satisfactory test is made.

74–2.14 CONCRETE BLOCKING

Concrete thrust blocking, as detailed on the plans or on the standard drawings, shall be placed at bends, tees, and crosses as directed by the Engineer. Blocking shall be Class 5(1½) concrete mix poured in place, unless precast blocks are authorized by the Engineer.

Concrete blocking, when placed as indicated on the standard drawing, shall be bearing against solid undisturbed earth at the sides and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints of the pipe or fittings.

74–2.15 1½ INCH BLOWOFFS

Water main blowoff assemblies shall be constructed as shown on the standard plan.

Drilling and tapping of the Mueller pipe thread into the water main will be performed by the Utility.

Seamless copper tubing for blowoffs shall conform to the requirements for Seamless Copper Water Tube, ASTM Designation B 88, Type K. Galvanized steel pipe, fittings and gate valves shall conform to the requirements in Section 72.

The unit contract price for the blowoff assembly shall include all materials called for on the standard plan, with the exception of copper pipe and concrete blocking.

Payment will be made for such of the following bid items as are included and shown on any particular contract:

1. "1½-inch Blowoff Assembly," per each.
2. "1½-inch Copper Pipe," per linear foot.
3. "Concrete Blocking," per cubic yard.

The unit contract price for the above items shall be full compensation for all labor, tools and equipment necessary for complete installation in accordance with the plans and specifications.

74–3 MEASUREMENT AND PAYMENT

74–3.01 MEASUREMENT OF WATER MAINS

Measurement shall be based on the slope distance from point to point. The point of beginning or ending of measurement in any particular run of pipe shall be the vertical intersection of the center line of the pipe measured with the center line of the intersecting pipe, or with the beginning or ending of any new pipe laid. No deductions will be made for the linear length of fittings, valves, couplings, etc. contained within the measured length. At changes in pipe size connected by a reducer, the point of measurement shall be taken as the midpoint of the reducer.

74–3.02 PAYMENT FOR WATER MAINS AND WATER SERVICE CONNECTIONS

The unit contract price per linear foot for each size and kind of pipe shall be full compensation for furnishing the pipe and all fittings required for complete installation along the run of each pipe size and kind. The unit contract price per linear foot shall also include all costs of every nature for the laying and jointing of the pipe and fittings along each run, and also all costs for the testing, flushing and disinfecting of the pipe line.

In case any fittings are omitted in the construction by direction of the Engineer, or if any additional ones not shown on the plans are required, then in that event an adjustment, down or up, will be made the Contractor upon basis of the unit contract price per pound for "Extra Fittings." If there is no such item in the proposal the adjustment will be made upon a negotiated basis.

Excavation and backfilling of trenches, pipe line accessories such as hydrants, hydrant connections, gate valves, etc., will be paid for separately as provided in sections 73, 77 and 75, respectively.

74–3.03 PARTIAL PAYMENT FOR MATERIALS DELIVERED

Pipe and fittings delivered to the trench side but not installed will be included in the estimate of monthly payments to the Conractor, as provided in Section 9.05.

74–3.04 CONCRETE BLOCKING

The unit contract price per cubic yard for "Concrete Blocking in Place" shall be full compensation for all labor, material, equipment and tools necessary to place concrete blocking of the proportions required. It shall include also, all excavation, concrete form work, finishing, removal and disposal of excavation not required for backfill, and any other work that may be necessary for constructing the blocking in place as specified.

–3.05 TRENCH EXCAVATION AND BACKFILL FOR WATER SERVICE CONNECTIONS

Trench excavation and backfill for water service connections shall be measured and paid for in accordance with Section 73–3.02.

74–4 UNIT PRICE METHOD OF PAYMENT FOR WATER DISTRIBUTION MAIN CONSTRUCTION (An alternate method)

74–4.01 MEASUREMENT OF WATER MAINS FOR UNIT PRICE PAYMENT

Measurement for all piping shall be based upon the center line slope distance (laying length) of the pipe installed in any particular run, excluding the lengths so determined for all valves, fittings and specials. This method of measurement shall apply also to pipe installed for "Hydrant Connections."

74–4.02 PAYMENT FOR WATER MAIN CONSTRUCTION UNDER UNIT PRICE METHOD

Payment will be made for various kinds and sizes of pipe, fittings and specials at the unit contract price per linear foot, in place. Such payment shall be compensation in full for all labor, equipment, tools and materials required to lay, joint, disinfect and test the pipe line.

The unit contract price shall be used for price adjustment for either an increase or a decrease in quantities from that shown on the plans or listed in the proposal.

Excavation and backfilling of trenches including water settlement, pipe line accessories such as hydrants, gate valves, bank-run sand and gravel, disposal of spoil, concrete thrust anchors, etc., will be paid for separately at unit contract prices upon items and units contained in the proposal.

Section 75—Gate Valves for Water Mains

75–1 DESCRIPTION

The valves shall be suitable for a ordinary waterworks service, intended to be installed in a normal position on buried pipe lines for water distribution systems.

The minimum requirements for all gate valves shall, in design, material and workmanship, conform to the standards of the AWWA C500-61. All materials used in the manufacture of waterworks gate valves shall conform to the AWWA Standards designed for each material listed. All gate valve operating stems shall be equipped with a two (2) inch operating nut. All gate valves shall open either counterclockwise or clockwise at the discretion of the Owner.

75–2 MATERIALS

75–2.01 MANUFACTURE AND MARKING

The gate valves shall be standard pattern of a manufacturer whose products are approved by the Owner and shall have the name or mark of the manufacturer, year valve casting was made, size and working pressure plainly cast in raised letters on the valve body.

75–2.02 TYPE AND MOUNTING

The valve bodies shall be cast iron, mounted with approved noncorrosive metals. All wearing surfaces shall be bronze or other approved noncorrosive material and there shall be no moving bearing or contact surfaces of iron in contact with iron. Contact surfaces shall be machined and finished in the best workmanlike manner, and all wearing surfaces shall be easily renewable.

All gate valves shall be two-faced, double disc, with parallel seats and bronze or other approved wedging devices placed between them. The stem shall be of high tensile strength bronze or other approved noncorrosive metal. All nonferrous bushings shall be of substantial thickness, tightly fitted and pressed into machined seats.

75–2.03 END CONNECTIONS

The dimensions of hub or bell end connections shall conform to the dimensions of the AWWA Standard No. C100-55. The dimensions for the mechanical joint connections shall conform to the USASI Specifications No. A21.11.

The end flanges of flanged gate valves shall conform in dimensions and drilling to the standard USASI B16.1 for cast iron flanges and flanged fittings, Class 125, unless specifically provided otherwise. The bolt holes shall straddle the vertical center line.

75–2.04 GATE VALVES 16-INCH AND LARGER

Gate valves 16-inch and larger shall be double square bottom arranged for operation in the horizontal position and shall be equipped with bronze tracks fastened into a groove or slot within the valve body casting, together with bronze rollers, shafts, bushings and scrapers. They shall be nonrising stem type and shall be equipped with approved barrel type rugged gate position indicators. The valves shall be provided with handwheels or operating nuts as designated in the proposal. Where handwheels are called for, a design of ample proportion is required. Where operating nuts are called for, a standard 2" operating nut shall be furnished.

All gears on gate valves shall be cut tooth steel gears, housed in heavy cast iron extended type grease cases of approved design. When by-pass and gate valves are called for, the valves shall be equipped with by-passes and gate valves of the sizes adopted as standard in the specifications of AWWA. All by-pass gate valves shall be

equipped with standard 2″ operating nuts, except as otherwise specified.

All gate valves 16-inch and larger shall be enclosed in a masonry chamber and shall be geared with gearing designed for handwheel operating in a horizontal plane, or for an operating nut mounted on a vertical pinion shaft, as shown on the standard drawings.

75–2.05 GATE VALVE STEM SEALS

Unless otherwise designated in the proposal, all gate valves up to and including 12-inch in size shall be furnished with O-Ring Stem Seals. Number, size and design shall conform to the AWWA Standards for gate valve O-Ring Stem Seals. For all valves over 12″, the stem seals shall be conventional type stuffing-box with graphited packing per AWWA Standard No. C600-18.1.

75–2.06 TAPPING VALVES

Tapping valves shall be furnished with flanged inlet end connections having a machined projection on the flanges to mate with a machined recess on the outlet flanges of the tapping sleeves and crosses. The outlet ends shall conform in dimensions to the AWWA Standards for hub or mechanical joint connections, except that the outside of the hub shall have a large flange for attaching a drilling machine. The seat opening of the valves shall be larger than normal size to permit full diameter cuts.

75–2.07 HYDROSTATIC TEST PRESSURE AT FACTORY FOR CLASS 150 VALVES

Each gate valve shall be tested at the factory for performance and operation prior to painting and shall be subjected to the following hydrostatic pressure tests: each 3-inch to 12-inch valve, inclusive, shall be subjected to hydrostatic test under pressures of both 300 psi and 175 psi, and each 16-inch to 48-inch valve, inclusive, shall be subjected to test pressures of 300 psi and 150 psi. These tests shall be conducted in accordance with provisions of AWWA C500-61 Sec. 29, or latest revision thereof. Tests for special valves shall be made as provided in the special provisions.

75–2.08 PAINTING AT FACTORY

After the factory test and inspection, all ferrous parts of the valves except finished or bearing surfaces shall be painted inside and out with two coats of asphalt varnish, Federal Specifications TT-V-51A or approved equal.

75–3 INSTALLATION OF GATE VALVES

All gate valves shall be inspected upon delivery in the field to insure proper working order before installation. They shall be set and jointed to the pipe in the manner as set forth in the AWWA Standards for the type of connection ends furnished. The valves shall also be carefully inspected for injury to the outer protective coatings. At all places where the coating has been ruptured or scraped off, the damaged area shall be thoroughly cleaned to expose the iron base installation, and the cleaned area shall then be recoated with two or more field coats of Quigley Triple A-10 or Triple A-20, or equal.

Valves 12-inch and under shall be installed in a vertical position and be provided with a standard valve chamber or cast iron gate box so arranged that no shock will be transmitted to the valve. The box shall be centered over the operating nut, and the cast iron box cover shall be set flush with the roadbed or finished paved surface.

After installation, all valves shall be subjected to the field test for piping as outlined in Section 74-2.12 of these specifications. Should any defects in design, materials or workmanship appear during these tests, the Contractor shall correct such defects with the least possible delay and to the satisfaction of the Engineer. Should the Contractor fail to do this within a reasonable period of time in the judgment of the Engineer, he may cause such defects to be corrected and deduct the cost thereof from any moneys or payments due or to become due the Contractor.

75–4 MEASUREMENT AND PAYMENT

75–4.01 PAYMENT FOR GATE VALVES

Payment for "Gate Valve (size)" will be made at the unit contract price per each, which price shall be full compensation for all labor, material, equipment and tools necessary to furnish and install the valve complete in place in the water main, including trenching, jointing, painting, disinfecting and hydrostatic testing.

Section 76—Valve Chambers and Boxes for Water Mains

76–1 DESCRIPTION

This section shall apply to the construction of standard valve chambers, special valve chambers and cast iron valve boxes, all in accordance with the standard drawings.

Where shown on the plans or where directed by the Engineer, gate valves shall be enclosed in valve chambers, or shall be provided with cast iron valve boxes set over the operating stem.

76–2 MATERIALS

76–2.01 RING AND COVER AND VALVE BOX CASTINGS

Castings for cast iron ring and cover and for cast iron parts of valve boxes shall conform to the requirements of Standard Specifications for Gray Iron Castings, ASTM Designation A-48-56.

76–2.02 PORTLAND CEMENT CONCRETE BLOCKS

Portland cement concrete blocks shall be solid and conform to the requirements of ASTM Designation C 139-39. Over-all thickness of block shall be six (6) inches with optional lengths and widths. Curved manhole blocks shall be used for round valve chambers.

76–2.03 PORTLAND CEMENT CONCRETE

Concrete for cast in place valve boxes shall be Class 5(1½) mix.

76–2.04 MORTAR

Portland cement mortar shall be one (1) part portland cement to not less than one and one-half (1½) parts nor more than three (3) parts of plaster sand, mixed with the least amount of water necessary to provide a workable mix. Dehydrated lime in an amount not exceeding 50 percent of the portland cement, by weight, may be added to the mix at the option of the Contractor.

76–2.05 BRICK

–2.05A Concrete Brick

Concrete brick when used, shall conform to the Specification for Concrete Building Brick ASTM C 55, Grade A.

–2.05B Clay Brick

Clay brick, when used, shall conform to the ASTM Specification C 62, Grade SW.

76–3 CONSTRUCTION DETAILS

Valve chambers may be either precast, cast in place, or be made of solid concrete blocks according to the details shown on the standard drawings.

76–3.01 PRECAST VALVE CHAMBERS

Precast valve chambers for nominal depth of cover from 2′-6″ to 3′-6″ are cast in one piece with slotted holes for placing over the main.

Precast valve chambers for nominal depth of cover from 4′-6″ to 6′-6″ are made in two sections.

The concrete base shall be poured in place or precast. Poured-in-place base shall be allowed to attain sufficient strength to support the chamber (usually 2 or 3 days), as directed by the Engineer. Precast chambers shall be set on the base in cement mortar with the slotted holes straddling the water main.

The water main shall first be wrapped with two (2) inch thick styrafoam material under the chamber walls and after setting the chamber the remaining space shall be filled with cement mortar or mortared bricks. In no case shall the chamber walls rest on the pipe.

76–3.02 CAST-IN-PLACE CHAMBERS

Cast-in-place chambers may be constructed by using forms and poured concrete. Finishing of walls is not required other than the patching of porous spots (rock pockets) and bolt holes. Forms shall be removed for inspection of concrete.

76–3.03 CHAMBERS MADE WITH PRECAST CONCRETE BLOCKS

Circular or rectangular chambers may be made with solid precast concrete blocks. The base shall first be poured in place and after reaching sufficient strength (usually 2 or 3 days), the walls may be constructed of concrete blocks with water-tight cement mortar joints.

Circular chambers shall be constructed with curved manhole blocks. The chamber top shall be tapered in to the dimensions shown on the standard drawings.

Rectangular chambers shall have a cast-in-place or precast concrete cover.

76–3.04 SETTING CAST IRON FRAME AND COVER

The cast iron frame and cover shall be set to grades furnished by the Engineer. Provisions for future adjustment of frame to changes in grade shall be made by constructing two courses of brick with mortar joints between the top of the chamber and the bottom of the casting. Brick for this purpose shall be standard clay or cement-lime brick 2¼ inches thick.

76–3.05 VALVE CHAMBER DRAIN

Unless otherwise specified, each rectangular valve chamber shall be provided with a drain consisting of a short length of four-inch (4″) sewer pipe leading to a gravel drain.

The gravel drain shall consist of one-half (½) cubic yard of clean paving gravel (3″ to ⅜″) placed outside of and below the bottom of the chamber. In naturally porous soils the gravel may be omitted at the direction of the Engineer.

76–3.06 CAST IRON VALVE BOXES

Cast iron valve boxes, as shown on the standard drawing, are placed for enclosing gate valves of small size in lieu of gate valve chambers.

Cast iron valve boxes in general are set to position during backfilling operations so they will be in a vertical alignment to the gate valve operating stem. The lower casting of the unit is installed first in such a manner as to be supported by a minimum backfill or by a styrafoam collar not less than two (2) inches in thickness. The casting shall not rest directly upon the body of the gate valve or upon the water main. The upper casting of the unit is then placed in proper alignment and to such an elevation that its top will be at final grade. Backfilling around both units shall be placed and compacted to the satisfaction of the Engineer.

76–4 MEASUREMENT AND PAYMENT

76–4.01 PAYMENT FOR VALVE CHAMBERS

For purposes of payment, valve chambers will have three classifications as follows: "Valve Chambers, Standard" for valve chambers for valves up to and including 12-inch set vertically; "Valve Chambers, Large" for rectangular valve chambers for valves 16-inch to 30-inch, inclusive, laid horizontally, and "Valve Chambers, Special" with inside dimensions given to nearest foot according to detail plans (i. e. "Valve Chamber Special 5′ 8″).

In each case payment will be made at the unit contract price per each, which price shall be in full for all materials, labor and equipment, including cast iron ring and cover, cast iron valve box, concrete, bricks, grout, expansion material (for large or special), one length of sewer pipe drain, gravel pocket, excavation and backfilling, and disposal of surplus excavation not needed for backfilling.

76–4.02 PAYMENT FOR CAST IRON VALVE BOXES

The unit contract price per each for "Cast Iron Valve Box," shall be full compensation for all labor, material, equipment and tools necessary to furnish and install a cast iron valve box in proper position during the backfilling operations, as specified.

Section 77—Fire Hydrants

77–1 DESCRIPTION

These specifications are to be used in conjunction with the AWWA Standard C502-54 approved as Standard May 27, 1954, or the latest revision thereof for fire hydrants for ordinary water works service.

77–2 MATERIALS

77–2.01 MATERIAL FOR HYDRANTS AND APPURTENANCES

All materials used in the production of fire hydrants for ordinary service shall conform to the specifications designated for each material listed in AWWA Standard C502-54.

77–2.02 MANUFACTURER AND MARKING

The hydrant shall be of standard manufacture and of a pattern approved by the Owner-municipality. The name or mark of the manufacturer, size of the valve opening and year made shall be plainly cast in raised letters and so placed on the hydrant barrel as to be visible after the hydrant has been installed.

77–2.03 TYPE AND MOUNTING

As a minimum requirement, all hydrants shall be designed for a working pressure of 150 lbs. per square inch and in workmanship, design and material, shall conform to the AWWA Standard C502-54, or latest revision thereof. The hydrant bodies shall be cast iron, fully mounted with approved noncorrodible metals. All wearing surfaces shall be either bronze or some other approved noncorrodible material, and there shall be no moving bearing or contact surfaces of iron in contact with iron or steel. All contact surfaces shall be finished or machined in the best workmanlike manner and all wearing surfaces shall be easily renewable.

The design of the hydrant shall be such that all working parts may be removed through the top of the hydrant and shall have the required AWWA specified number of turns of the stem to open the gate an area equal to the area of the valve opening. Any change in area of the water passage through the valve must have an easy curve, and all outlets must have round corners of good radius.

77–2.04 END CONNECTIONS

The dimensions of hub or bell end connections shall conform to the dimensions of the AWWA Standard No. 100-55. The dimensions for the mechanical joint connections shall conform to the USASI Specification No. A21.11.

The flanged lateral connection shall be faced and drilled to conform to the American Standard for 125-lb. W. P. flanged fittings. Flanges shall be machine finished to a true surface. Bolt holes shall straddle the vertical center line.

77–2.05 HYDRANT DIMENSIONS

The dimensions and details of hydrant and nozzles, unless otherwise noted, shall be as follows:

	Hydrant 4-inch Connection	*Hydrant 6-inch Connection*
Hydrant connection pipe size inside dia.	4 inches	6 inches
Standpipe, minimum inside dia.	6 inches	7 inches
Length of hyd. from bottom of hyd. conn. to sidewalk ring	As required by Owner	
Valve opening, minimum dia.	4 inches	5 inches
Size of auxiliary gate valve	4 inches	6 inches
Hose nozzles, number and size	2—2½ inches	2—2½ inches
Thread (Nat. Board of Fire Underwriters)	7½ per inch	7½ per inch
Outside dia. finished	3-1/16 ins.	3-1/16 ins.
Dia. at root of thread	2.8715 inches	2.8715 inches
Pattern of thread	60° V-thread	60° V-thread
Total length of threaded male nipple	1 inch	1 inch
Streamer nozzles, number and size	to match Owner's existing pattern	
Thread, outside dia. finished		
Dia. at root of thread		
Spreads		
Pattern of thread		
Total length of threaded male nipple		

All nozzles shall be fitted with cast iron threaded caps with operating nut of the same design and proportions as the hydrant stem nut. Caps shall be threaded to fit the corresponding nozzles and shall be fitted with suitable gaskets for positive water tightness under test pressures.

77–2.06 OPERATING NUTS

The operating nuts on hydrant stem and nozzle caps shall be the same for both sizes of hydrants. Dimensions shall be as follows:

Pattern of Nut.....Tapered Pentagonal
Height .....1-1/16 inch
Size of Pentagon.....1.35-inch at bottom of nut
1.23-inch at top of nut
(measured from point to flat)

The hydrant valve shall open by turning to the left (counterclockwise).

77–2.07 SHACKLING LUGS

Lugs, if required for harnessing the hydrant to the connecting pipe from the main in the street, shall be provided on the bell of the elbow or on the hydrant bottom casting. A drawing of the lug construction shall be submitted for approval, on request of the Engineer.

77–2.08 SIDEWALK FLANGE CONSTRUCTION

Hydrants shall be provided with a sidewalk flange. Breaking devices, if required, shall be at the sidewalk flange which will allow the hydrant barrel to separate at this point with a minimum breakage of hydrant parts in case of damage. There shall also be provided at this point a safety stem coupling on the operating stem that will shear at the time of impact. Unless otherwise specified, all hydrants shall be equipped with O-Ring stem seals.

77–2.09 FACTORY HYDROSTATIC TEST

Before the hydrant is painted at the factory, it shall be subjected to an internal hydrostatic test of 300 pounds per square inch with the hydrant valve in a closed position and again with the hydrant valve in an open position.

77–2.10 PAINTING

All iron parts of the hydrant both inside and outside shall be thoroughly cleaned and painted. All inside surfaces and the outside surfaces below the ground line shall be coated with asphalt varnish, Federal Specification TT-V-51a or J. A. N. P-450, unless otherwise specified. They shall be covered with two coats, the first having dried thoroughly before the second is applied.

The outside of the hydrant above the finished ground line shall be thoroughly cleaned and thereafter painted with one coat of paint of a durable composition conforming to Federal Specification TT-P-86a, Type IV, and one additional coat of a color specified by the Owner.

77–3 CONSTRUCTION DETAILS

–3.01 SETTING HYDRANTS

Where shown on the plans or where designated by the Engineer, hydrants shall be installed in accordance with the detail shown on the standard drawings.

All hydrants shall be inspected in the field upon arrival to ensure proper working order. After installation, they shall be subjected to a hydrostatic test not to exceed the factory test pressure.

77–3.02 HYDRANT CONNECTIONS

Hydrant laterals shall consist of a section of 4-inch or 6-inch pipe from the main to the hydrant and shall include an auxiliary gate valve set vertically and placed in the line as indicated in the standard drawing for hydrant settings.

–3.02A Shackle Rods

Hydrants shall be harnessed to the auxiliary gate valve and the valve to the tee at the main with steel rods of size, shape and arrangements, as indicated in the detail drawing for hydrant settings.

All hydrant shackle rods, after installation, shall be thoroughly cleaned and painted with two (2) coats of asphalt varnish, as specified in Section 77-2.10, or with such other bituminous paint as may be authorized by the Engineer.

–3.02B Auxiliary Gate Valve

All auxiliary gate valves shall conform to Section 75 in all respects, except that the end connections shall be provided with lugs for rodding or the bells shall have sufficient clearance between the body of the valve and the hub to permit the installation of shackles.

–3.02C Cast Iron Valve Boxes

See Section 76-3.06.

77–3.03 RESETTING EXISTING HYDRANTS

Where existing hydrants are shown on the plans for adjustments to conform to new street alignment and/or grade, the hydrant shall be relocated without disturbing the location of the hydrant lateral tee at the main.

The method of harnessing the hydrant shall be determined by the conditions found in the field and shall be reshackled or reblocked as directed by the Engineer.

This work shall conform in all respects to the specifications for setting hydrants mentioned elsewhere in these specifications.

77–3.04 MOVING EXISTING HYDRANTS

When shown on the plans or when directed by the Engineer, existing hydrants shall be moved. When the existing tee is moved to a new hydrant location, a new tee shall be inserted and the open part of the abandoned tee shall be securely sealed and shackled. When the existing hydrants are blocked to the main line, the same method shall be used to anchor the hydrants at their new locations unless, in the judgment of the Engineer, it is found necessary to shackle them in which case the harnessing of the hydrants shall be as indicated in the standard detailed drawings for Hydrant Setting Type A and Type B. The work shall conform in all respects to hydrant settings as described elsewhere in these specifications.

77–3.05 RECONNECTING EXISTING HYDRANTS

When reconnecting existing hydrants is specified, the hydrants remain unchanged in their original position, but the existing hydrant connection is changed to connect with a new hydrant tee provided in a new main.

Hydrant reconnections shall meet all the requirements for new work.

Where existing hydrants were not shackled to the old main, the new connection shall be shackled with steel rods as shown on the standard drawings, or by such other shackling method as may be directed by the Engineer.

All hydrants shall be set on concrete pier blocks as shown on the standard drawing.

The hydrant drain shall waste into a pit of crushed stone or gravel situated at the base of the hydrant as shown on the standard drawing.

77–3.06 HYDRANT EXTENSIONS

The minimum requirements for all flanged hydrant barrel extensions, operating stems and flanged adaptors for hydrant lateral connections shall, in design, material and workmanship conform to the AWWA Standards for such castings. The drilling of the flanges on the extensions shall match the drilling of the flanges on the hydrant. The drilling of the adaptor flanges shall match those of the hydrant foot flange and the auxiliary gate valve flange.

77–4 MEASUREMENT AND PAYMENT

77–4.01 FIRE HYDRANTS

Payment will be made at the unit contract price per each for "Hydrant, 4-inch Connection" and "Hydrant, 6-inch Connection" which shall be full compensation for the hydrant in place. As incidental thereto, the Contractor shall include in his unit contract prices of the hydrants all costs of every kind for shackles, tie rods, pier blocks, coarse gravel, painting, and other things that will be required for the complete installation of the hydrant as specified, excepting however, that the 4-inch and 6-inch cast iron pipe connecting the hydrant to the main will be paid for at the unit contract price per linear foot for "Water Mains." Auxiliary gate valves will be paid for at the unit contract price per each for "Gate Valves."

77–4.02 RESETTING EXISTING HYDRANTS

Payment for "Resetting Existing Hydrants" will be made at the unit contract price per each and shall include the costs for shackling, painting and all other labor, material and equipment necessary to place and connect the hydrant in its new location, but the unit contract price shall not include payment for new pipe used for hydrant connections. New pipe will be paid for at the unit contract price per linear foot for "Water Mains" of the size used.

77–4.03 MOVING EXISTING HYDRANTS

Payment will be made for "Moving Existing Hydrants" at the unit contract price per each and shall include all costs for shackling, painting and all other labor, material and equipment necessary to move and reconnect the hydrant in its new position, excepting however, that the new pipe and fittings for hydrant connections will be paid for at the unit contract price per linear foot for "Water Mains."

77–4.04 RECONNECTING EXISTING HYDRANTS

Payment for "Reconnecting Existing Hydrants" will be made at the unit price per each, and it shall be full compensation for adjustment of hydrant connections, shackling, painting and all other labor, material and equipment necessary to connect the hydrant to the new main, excepting however, that any new pipe used for the connection will be paid for at the unit contract price per linear foot for "Water Mains."

77–4.05 HYDRANT EXTENSIONS

Payment for vertical and horizontal hydrant extensions will be made at the unit contract price bid for "Hydrant Extension Vertical," per pound in place, and "Hydrant Extension Horizontal," per pound in place. The weight paid for shall include the weight of castings and the weight of additional length of hydrant rods, bolts, nuts, washers and gaskets.

The price paid per pound shall cover the cost of all machine work and all labor required to lengthen the rods and there will not be any additional compensation either per pound additional or otherwise for such work. Lengthening of hydrants to specified length with vertical hydrant extensions will not be allowed except by permission of the Engineer, and in such cases no extra payment will be allowed for vertical extensions, and such costs shall be included in the unit price bid for "Hydrants."

Section 78—Restoration and Cleanup of Water Main Construction

78–1 GENERAL

Surface improvements such as pavement, curb, curb and gutter and other like surface facilities that have been removed or damaged during the construction of water mains, shall be restored by the Contractor if there is one or more bid items in the proposal to cover the work.

If there is no bid item in the proposal for restoration, it will be assumed that the Owner will do the work with its own forces. The Contractor shall, however, backfill the trench to the surface and perform such work as may be required under the specifications and special provisions.

78–2 CONSTRUCTION DETAILS

78–2.01 REMOVAL OF EXISTING STREET IMPROVEMENTS

Removal and disposal of existing street improvements shall be done in accordance with applicable sections of the specifications, and Section 73-1.03 which provides that removal and disposal shall be considered as incidental to the construction and the costs thereof shall be included in the unit contract price per linear foot for "Trench Excavation and Backfill."

78–2.02 RESTORATION OF EXISTING STREET IMPROVEMENTS

Restoring of existing street improvements shall be as specified in the applicable sections of these specifications pertaining to their construction and the measurement and payment will be as described in Sections 78-3.01 and 78-3.02.

At all pavement openings where backfill is to be compacted with mechanical tampers in accordance with Section 73-2.07D and where the pavement is not restored immediately, the Contractor shall place and maintain at his own expense an asphalt concrete surfacing to the elevation of the existing pavement until final restoration is made.

In the event backfill is placed at the direction of the Engineer without proper compaction to accommodate a critical traffic condition and the final settlement and compaction is made by traffic or otherwise, the cost of placing and maintaining the temporary asphalt concrete surfacing until final restoration is made will be paid for as extra work in accordance with Section 9.03.

78–2.03 MAINTAINING POSTAL SERVICE

Maintenance of postal service including removal and replacement of mail boxes, and new supports for boxes whenever such is necessary for proper replacement, shall be in accordance with Section 7.19.

78–2.04 FINISHING AND CLEANUP

Finishing and cleanup shall be as specified in Section 57.

78–3 MEASUREMENT AND PAYMENT

78–3.01 EXISTING STREET IMPROVEMENTS

Cement concrete pavement, driveway, sidewalk, asphalt concrete pavement, or bituminous plant mix pavement will be measured and payment made therefor at the unit contract prices specified in the applicable sections pertaining to their construction, excepting however, that measurement and payment will be limited to a trench width equal to the outside diameter of the barrel of the pipe plus forty-eight (48) inches. Any surfaces requiring restoration outside of this limit which is removed or damaged by the Contractor, shall be restored by him at his own expense. Payment will be made, however, for any additional area of cement concrete pavement necessitated by expansion joints or cracks that occur within three (3) feet of the recovery width above described.

78–3.02 CEMENT CONCRETE CURB, CURB AND GUTTER

Payment for cement concrete curb and curb and gutter will be made at the unit contract prices set up for same in applicable sections pertaining to their construction. Measurement for payment will be restricted as follows:

1. Where the water main crosses the curb or curb and gutter at right angles, measurement for payment will be the length of the curb removed but not more than the outside diameter of the pipe plus forty-eight (48) inches.
2. Where the water main crosses the curb or curb and gutter in a diagonal course, the measurement will be no more than the diagonal distance along the face of the curb between two lines, each projected parallel to the outside of the barrel of the pipe and each twenty-four (24) inches distant therefrom.
3. Where it is necessary to remove curb or curb and gutter within the pay width of trench excavation (outside pipe diameter plus 24 inches each side), and where the curb or curb and gutter parallels the center line of the water main, or approximately so, measurement and payment will be at the unit contract price per linear foot for the actual length of curb, or curb and gutter, that is required to be constructed.

78–3.03 FINISHING AND CLEANUP

Whenever the proposal includes an item per lump sum or per station for "Finishing and Cleanup," the measurement and payment will be made in accordance with Section 57, Finishing and Cleanup.

If the proposal does not include an item for "Finishing and Cleanup," the work required shall be performed as specified in Section 57, but shall be considered as incidental to the construction and the costs thereof shall be included by the Contractor in other bid items of the contract.

Section 100—Structures—General

100–1 DESCRIPTION

The provisions of this section of the specifications relate to certain structural features and incidental items which are either common to all types of sturctures or which may apply to any one of them.

The provisions herein are supplemental to detailed specifications for definite types of structures, and shall apply whenever they are relevant to any structure and if they are not in conflict with the special provisions or plans for the construction of the structure.

100–2 MATERIALS

The materials furnished and used shall comply with the provisions of the specification pertaining to the various materials and contract items which enter into and form a part of the completed structure.

100–3 CONSTRUCTION DETAILS

All construction details shall be in accordance with the detailed requirements described in this section and with the specifications for the various contract items involved.

100–3.01 NAME PLATES

When specified, the Contractor shall furnish and install name plates of such form, dimension, material and design as may be shown on the plans. Unless otherwise provided, the unit contract prices for the structures shall include the cost of the name plates.

No permanent plates or markers other than those shown on the plans or approved by the Engineer will be permitted on any structure.

100–3.02 BRIDGE DRAINS

The Contractor shall furnish and install drains in the roadway slab, of the type specified on the plans and in the locations shown thereon.

Bridge drains shall be made of cast steel conforming to the requirements outlined in Section 113-2.01.

Grating covers shall be fitted to the individual drain castings with which they are to be used and shall be ground to rest evenly and without rocking. Each grating cover shall be fastened to the drain casting with a one-quarter (¼) inch galvanized iron chain of length sufficient to allow the cover to be lifted from the casting and rotated to a vertical position. One end of the chain shall be welded to the end of the casting and the other end shall be welded to the inside face of the end grating web as shown on the plans.

To each drain casting there shall be a piece shop welded or threaded, either of standard galvanized steel or galvanized wrought iron pipe of the size, length and type as shown on the plans.

The length of steel pipe shall be galvanized in accordance with the provisions of ASTM Designation A 120, Black and Hot Dipped Zinc-coated Welded and Seamless Steel Pipe for Ordinary Uses, and the wrought iron pipe in accordance with the provisions of ASTM Designation A 72, Welded Wrought Iron Pipe. Galvanizing shall be done after cutting to length, grooving, threading or other fabrication.

After welding, the drain castings and grating covers shall be coated inside and outside with an asphaltum base black dipping paint, approved by the Engineer. This coating shall extend over that portion of the galvanized steel pipe adjacent to the casting far enough to cover the welds.

Payment will be made at the unit contract price per each for "Bridge Drains," which price shall be full compensation for furnishing, coating and installing the complete drain with grating cover, chain, and galvanized steel or galvanized wrought iron pipe outlet.

100–3.03 DOWNSPOUTS

The Contractor shall furnish and install 4-inch and/or 6-inch standard weight steel pipe downspouts at the locations shown and as detailed on the plans.

The downspouts shall be full length pipe sections in all straight runs. If the Contractor elects, he may use other types of couplings and fittings in lieu of the grooved couplings and fittings shown on the plans, provided they are equal and are approved by the Engineer.

All downspouts shall be hot-dipped galvanized in accordance with ASTM Designation A 120 after cutting to length, grooving, threading, bending or any other fabrication.

All fastenings of the downspouts to the structure, couplings, and pipe supports shall be galvanized in accordance with ASTM Designation A 153.

The portion of downspouts and/or drain pipe constructed within concrete shall be fully encased in a sponge rubber compound ½ inch thick and meeting the requirements of ASTM Designation D 1752-66, Type No. 1, except that the color requirement is waived. All costs in connection with furnishing and installing the sponge rubber compound will be considered as incidental to the construction and shall be included in the unit contract price per linear foot for "Downspouts."

Payment for downspouts will be made at the unit contract price per linear foot for "Downspouts," which price shall be full compensation for all costs in connection with furnishing and installing the downspouts, including galvanizing and all fastenings, couplings and other items as outlined herein.

100–3.04 METAL RAILING

Care shall be taken in handling metal railing so that no damage of any kind will occur to the rail members. If, in the opinion of the Engineer, any of the rail members become damaged by improper handling it shall be remedied to the satisfaction of the Engineer, or be replaced with new material by the Contractor.

100–3.05 CLEARING THE SITE

The Contractor shall clear all of the site of the proposed structure to the full width of the right of way of all trees, brush, stumps and debris, in the manner outlined in Section 12, Clearing and Grubbing. When no payment is specifically provided, the cost of such clearing shall be included in the unit contract prices for the various items of the structure.

Special clearing of the site such as removal of existing bridges, buildings, concrete pavements, etc., will generally be paid for at prices bid for these items, but where no such items are provided in the proposal, all cost in connection therewith shall be included in the unit contract prices for other items in the structure.

–3.05A Clearing Utilities From Site of Construction

As described in Section 5.08, the removal, relocation or reconstruction of utilities such as telephone and electric power lines, sewer and water lines, railway tracks and appurtenances that will interfere with the actual construction will generally be performed by the Utility concerned with its own forces and upon agreement or arrangement previously completed by the Owner (city). In some cases, however, the specifications or directions of the Engineer may require that the alterations be performed by the Contractor.

The area required for clearance of utility installations from within the practicable bounds of the completed structure or item of work will be noted on the plans or will be described in the special provisions. When the practicable bounds of the completed structure or item of work is not noted on the plans or described in the special provisions, the utilities to be cleared will be only those necessary to provide room or clearance for the completed structure or item of work.

Where the Contractor is required to perform certain of the utility alterations within the practicable bounds of the completed structure or item of work, and the payment therefor is not otherwise provided in the plans or proposal, then such work shall be performed as directed by the Engineer in compliance with sections 5.09 and 5.10, and payment will be made therefor upon basis of extra work in accordance with one of the three methods stated in Section 9.03.

Unless the special provisions provide otherwise, the Owner will not make any payment to the Contractor for the removal or alteration of any utility feature that would interfere with his equipment or construction operations outside and beyond the practicable bounds of the completed structure or item of component construction;

and, if payment therefor is not provided in the plans and special provisions, the Contractor shall make arrangements with the Utility for clearance of whatever additional area is needed by him to accommodate his equipment and operations, and bear all costs of such alterations. If the Contractor performs the alterations outside the practicable bounds of the completed structure or item of work for the purpose aforesaid, he shall comply with the protective provisions of sections 5.09 and 5.10 and to the satisfaction of the Utility concerned.

If the Owner elects to bear the costs of clearing utility installations from an enlarged area contiguous to or beyond the construction area because of special equipment or operations required to accomplish the specified type of construction, or for any other reason, the plans and special provisions will so state and the Contractor will be paid for any work required by him in the same manner as described herein for work performed by him within the practicable bounds of the completed structure or item of work hereinbefore described.

The Contractor shall, regardless of who—the Utility or Contractor—performs the utility alterations, give due notice to the Utility and to the Engineer at least fifteen (15) calendar days in advance of any work that will interfere with the utility facilities.

The Contractor shall make no claim against the Owner because of any delay by the Utility in clearing the specified areas to accommodate the construction schedule, regardless of any reasons whatsoever for the delay.

In order to effectuate the provisions of this subsection and be compatible with Section 5.08 insofar as construction of structures only is concerned, the second and concluding paragraph thereof shall be made to read:

> "It is provided that no utility, private or public, shall be moved to accommodate the Contractor's equipment or his method of operation when such utility does not interfere with the improvement under construction, unless the costs of such removal shall be at the expense of the Contractor. *It is further provided, however, that the costs of utility alterations to accommodate equipment and operations outside the practicable bounds of the completed structure or item of work will be borne by the Owner (city) whenever the plans and specifications specifically so state, and not otherwise.*"

100–3.06 FOUNDATION DATA

Foundation data, when shown on the plans, have been obtained from test borings, test pits or other sources and represent the best information in the possession of the engineering department as to the character of the underlying material at the locations actually tested.

100–3.07 ALIGNMENT AND GRADE

Structures on vertical curves, structures which have superelevated roadways because of horizontal curves and those spans on which a definite finished camber is necessary in order to form a uniform grade line, all require special care and attention in regard to the elevation and alignment of their railings and curbs.

Bridge railings, including curbs, wheel guards, and collision rails, shall be so constructed that the finished vertical alignment or grade will be of pleasing appearance. Pronounced sags or humps in the grade line will not be permitted.

Rails and curbs on the curbed portion of a structure shall be constructed, insofar as possible, after the completion of the entire roadway and sidewalk slabs. In such cases, the heights of rails and curbs may be varied with respect to the grade line of the slabs in order to produce the desired appearance.

All costs in connection with the adjustments abovementioned shall be included in the unit contract prices for the various contract items involved, except as described in the last paragraph of Section 117-3.01B.

100–3.08 APPROACHES TO MOVABLE SPANS

The roadway and sidewalk slabs of approach spans adjacent to each end of movable spans shall not be constructed until the moveable span is completely erected, adjusted and placed in a closed position.

100–3.09 ERECTION METHODS

When requested by the Engineer, the Contractor shall submit for approval an outline of the method he proposes to follow in the erection of the structure, and submit four (4) copies of erection plans designed by and bearing the seal of a licensed professional engineer. This requirement shall apply particularly to steel spans of cantilever, suspension or movable type. The method of erection finally decided upon and approved shall be adhered to in its essential details, but approval by the Engineer shall not relieve the Contractor from his responsibility for the sufficiency of the method used.

100–3.10 SAFETY NETS AND STAGING

Where workmen on bridge work are employed 25 feet or more above the ground, water or other level of construction and it is impracticable to provide temporary decking, personal safety life nets shall be provided for the protection of the employees engaged in such work.

Where temporary decking is used in bridge construction work, it shall be placed directly under and as near as possible to where the work takes place, but not to exceed ten (10) feet. The openings between the planks or decking shall not exceed nine (9) inches. Decking shall be securely fastened to prevent displacement and shall extend at least six (6) feet beyond each side of the structure. A standard hand rail, such as defined in "Safety Standards for Construction Work" by the Division of Safety of the Department of Labor and Industries, shall be placed on the outer edges. Decking shall otherwise conform to the requirements of the Department of Labor and Industries for heavy duty scaffolds as specified in "Safety Standards for Construction Work."

When safety nets are used they shall be constructed of at least ⅜ inch diameter No. 1 soft lay manila mesh ropes with ¾ inch diameter border ropes. The mesh ropes shall be arranged at 6-inch centers positively attached to avoid wear at each point of crossing and at points of contact with the ¾ inch diameter border rope, or wire mesh of equivalent strength or better, not to exceed 2 inch diameter mesh. Nets shall be placed directly under and as near as possible to where the work is being done. They shall extend at least 6 feet beyond each side of the structure.

If the nets are expected to provide protection for workmen at heights greater than ten (10) feet above the nets, the nets should be extended proportionately beyond the six feet from the sides of the structure.

It shall be the option of the Contractor to place the net under the entire structure or it may be formed in sections and placed under the areas only where work progresses and men are exposed to falling.

Where the nature of the project or portions thereof make the use of nets or decking impractical, the use of same may be waived by the Supervisor of Safety of the Department of Labor and Industries upon application by the Contractor.

All costs in connection with furnishing, installing, maintaining, and removing safety nets or staging shall be considered as incidental to the construction and shall be included in the various pay items or work involved in the project.

100–3.11 NAVIGABLE STREAMS

The channels of navigable streams shall be kept clear for the safe passage of water traffic. The Contractor shall provide and maintain all necessary lights and signals in accordance with the requirements of the Corps of Engineers, U. S. Army. All material deposited in the channel shall be removed to the required depth and clearance lines.

100–3.12 ARCHITECTURAL FEATURES

Architectural treatment of the various parts of concrete structures requires that the concrete be of uniform texture and color. For this reason the Contractor shall secure all cement for the structure from the same manufacturing plant unless otherwise authorized in writing by the Engineer.

100–3.13 APPROVAL OF MATERIALS

The sources of all materials entering into the completed structure shall be approved by the Engineer.

Promptly after the approval of the contract, the Contractor shall submit to the Engineer a list or lists showing the names of the firms or manufacturers from whom he proposes to secure the various materials. This requirement shall apply particularly to fabricated structural steel and machinery where prompt information regarding the fabricator is essential in order that mill and shop inspection may be arranged.

The quality of all materials shall be subject to the approval of the Engineer and to the provisions of Section 6, as they may apply.

100–3.14 FINAL CLEANING UP

Upon completion of the structure, the Contractor shall clean up the site, remove all temporary buildings, falsework, piling, lumber, equipment and debris. He shall level off and dispose of all excess excavated material not used for backfill, and fine grade the surface of all backfilled, sloped and other areas disturbed by the construction. The decks of the structure shall be swept and washed clean. The entire site and structure shall be left in a clean and workmanlike condition.

100–3.15 NORMAL TEMPERATURE

Dimensions on plans are for a normal temperature of 64° F.

100–3.16 PREMOLDED JOINT FILLER

The material detailed and noted on the plans as premolded joint filler and/or asphalt filler shall conform to the specifications for "Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction," ASTM Designation D-1751.

The premolded joint filler shall be fastened to one side of the joint with galvanized wire nails at a maximum of 6 inch centers over entire joint area with 1½ inches edge distance. The nails shall be a minimum of 1½ inches longer than the thickness of the filler.

100–4 MEASUREMENT

Measurement of the items included in the completed structure will be made in accordance with the specifications for the various items.

100–5 PAYMENT

Payment will be made at the unit contract prices for the various items entering into the completed structure in accordance with the specifications for the various items.

Section 101—Concrete Structures

101–1 DESCRIPTION

This section of the specifications shall apply to all concrete structures including concrete substructures, composite structures of concrete and steel, or concrete and timber, and all structures in which concrete is used. Such structures shall be built as indicated on the plans and in conformity with the lines, grades, dimensions and details there shown. They shall also be in accordance with the provisions of the specifications pertaining to the various materials and contract items which enter into and form a part of the complete structure.

Concrete manholes, catch basins, pipe, valve chambers and inlets constructed for sewers, storm drains and water distribution as described elsewhere in these standard specifications shall not be classified as concrete structures.

101–2 MATERIALS

101–2.01 CONCRETE

The materials for making concrete shall be as defined in Section 107, Portland Cement Concrete for Structures.

101–2.02 REINFORCING STEEL

Reinforcing steel used in constructing concrete structures shall conform to the specifications in Section 111-2, Reinforcing Steel.

101–2.03 STRUCTURAL STEEL

Structural steel for composite structures of concrete and steel shall be as defined in Section 112-2, Structural Steel.

101–2.04 TIMBER

Timber and lumber when required for a composite structure of concrete and timber shall meet the requirements therefor specified in Section 114, Timber and Lumber.

101–2.05 PILING

Piling when required for concrete structures shall be as defined in Section 106, Piling.

101–2.06 MISCELLANEOUS METALS

Castings, copper, bronze and other metals for use in concrete structures shall meet the requirements specified in Section 113 for the kind of metal item involved.

101–3 CONSTRUCTION DETAILS

All construction details shall be in accordance with the requirements of this Section 101 and also in compliance with Section 107 for portland cement concrete, Section 111 for reinforcing steel, Section 106 for piling and other sections of these standard specifications for other component things as they may apply unless otherwise provided in the special provisions or as otherwise authorized by the Engineer.

101–3.01 DATE PANELS

Standard date panels shall be placed where shown on the plans. The date shall be for the year in which the structure is completed. All costs for making and placing date panels shall be included in the unit contract prices for concrete of the various classes.

101–3.02 FALSEWORK

The Contractor shall submit to the Engineer for approval, detailed plans for falsework or centering, in accordance with the requirements of Section 101-3.04. For calculating the strength of falsework or centering, a weight of one hundred sixty (160) pounds per cubic foot shall be assumed for fresh concrete.

In general, falsework shall be supported on piling. Mudsills for footings in lieu of piling will not be allowed except by approval of the Engineer. Falsework piling shall be spaced and driven in accordance with the approved falsework plans.

Falsework shall be set to give the structural camber indicated on the plans or as directed by the Engineer, plus an allowance for shrinkage or settlement. Compensation for falsework and falsework piling shall be considered as incidental to the construction and the cost thereof shall be included in the unit contract prices for the several bid items in the proposal.

–3.02A Restricted Overhead Clearance Sign

Whenever the overhead clearance over railroad tracks, traveled streets or other critical traffic rights of way will be restricted by erection of construction falsework, the Contractor shall place restricted overhead clearance signs as detailed on Standard Plan No. G-10, Washington Department of Highways to serve as a warning of the restricted overhead clearance. All costs therefor shall be considered as incidental to the construction of the structure and shall be included in the unit contract prices of bid items in the proposal.

101–3.03 FORMS

For the purpose of form design, concrete shall be assumed to exert on vertical surfaces the pressures per square foot as shown in the following table:

RATE OF POURING FEET PER HOUR	PRESSURES, POUNDS PER SQUARE FOOT, FOR TEMPERATURE OF CONCRETE AS SHOWN				
	40°	50°	55°	60°	70° and Above
2	725	600	560	470	375
3	900	760	690	640	565
4	1,075	875	800	725	625
5	1,250	1,000	900	815	690
6	1,425	1,125	1,000	900	750
7	1,600	1,250	1,110	990	815
8	1,775	1,375	1,215	1,075	875

The pressures in the above table have been increased to provide an allowance for vibration and impact.

Horizontal surfaces shall be designed to withstand a pressure of one hundred sixty (160) pounds per square foot for each foot of height of concrete supported.

–3.03A Requirements

All forms shall be set true to the lines designated, and the interior shape and dimensions shall be such that the finished concrete will conform exactly with the plans of the structure within the limits specified in Section 107-3.16. Before proceeding with the form work for any structure the Contractor shall submit detailed plans of the forms he proposes to use to the Engineer for approval. The plans shall be in accordance with the requirements of Section 101-3.04. In no case shall any concrete be poured in any form until the form has been checked by the Engineer.

–3.03B Form Footings and Posts

All form footings must be properly designed to carry the maximum load that can come upon them. They shall be as nearly unyielding as possible under full load. In cases of footings on rock or coarse sand and gravel, grouting may be required to ensure uniform bearing.

All systems of supports shall be provided with wedges or other devices which will permit the uniform release and take-up of forms.

–3.03C Stringers and Beams

All stringers and beams used to support form work shall be particularly rigid; their design shall be determined on the basis of deflection, which shall not exceed 1/500 of the span under full load unless otherwise designated by the Engineer.

–3.03D Bracing

All bracing shall be as rigid as possible and where there is any likelihood of movement, braces shall be provided with wedges to take up such displacements.

–3.03E Lagging VACATED

–3.03F Form Ties

All ties used for securing forms shall be so arranged as to allow the removal of all metal to a depth of not less than one-half (½) inch below the surface. Threaded rods are preferred but standard manufactured form ties may be used when specifically approved by the Engineer. Examination of test data or actual tests of specimens may be required by the Engineer as a condition for approval.

Wire form ties will not be allowed.

–3.03G Face Lumber

Lumber used for facing of forms shall be plywood or matched tongue and groove lumber of good quality, not less than three-fourths (¾) inch in thickness, except that plywood one-fourth (¼) inch in thickness may be used when backed with three-fourths (¾) inch lumber.

When sheathing less than two (2) inches thick is used, the spacing of studs shall be not more than sixteen (16) inches center to center, except that the studs for framing the exposed surfaces of abutments and wing walls shall not be spaced at more than twelve (12) inches center to center. When the intrados of arches and arch rings are formed with tongue and groove lumber, it shall be two (2) inches thick, surfaced on both sides, free from knots, and be placed transversely to the center line of the roadway being supported by the arch. After the lumber is in place and nailed, all uneven joints or projecting edges shall be adzed or planed off.

The facing lumber, either plywood or matched tongue and groove, shall be free from surface defects of any kind to ensure a smooth dense concrete surface that will require a minimum of surface treatment to remove form markings as specified in Section 107-3.14.

Forms for constructing round columns shall be a self-supporting metal shell form or a form tube which will give a smooth, even surface without markings on the concrete column after form is removed. Wood forms shall not be used for constructing round columns.

All exposed corners, except on railings, shall be chamfered three-fourths (¾) inch. Railings shall not be chamfered except where called for on the plans. The corners around the window or rail openings and vertical corners on end posts shall be square.

–3.03H Oiling

Surfaces of wood forms against which concrete will be placed shall be coated with non-staining mineral oil approved by the Engineer prior to constructing the forms in place. The oil shall be applied a sufficient time prior to use so that it will be fully absorbed by the wood.

–3.03I Temporary Holes in Forms

Retaining wall forms, or other forms for structures that are over twelve (12) feet in height shall be provided with temporary construction openings eighteen (18) inch minimum size in the forms to provide access for vibrating concrete and visual inspection when concrete is being placed in accordance with the provisions of Section 107. The maximum spacing of such temporary construction opening shall be twelve (12) feet horizontally and eight (8) feet vertically. The surfaces of plugs for closing off temporary construction openings, when placed, shall meet the requirements of Section 101-3.03G.

All forms for columns, walls, beams, slabs, etc., as may be necessary, shall have large cleanout openings at their lowest points, and shall not be closed until just before placing concrete. All forms shall be thoroughly cleaned out and soaked with water before filling.

–3.03J Steel Forms

The specifications of Section 101-3.03G, as they apply to the end result, shall be applicable to the use of metal forms. The thickness of metal forms and their design shall be such as to construct the concrete to the exact dimensions required. When steel forms are used, special care shall be exercised to prevent denting, bulging or harmful rusting of the surfaces against which concrete will be placed.

–3.03K Concrete Slab Forms on Steel Spans

Forms for roadway and sidewalk slabs on steel truss or girder spans shall be constructed to provide openings, where necessary, for truss or girder members.

The openings shall be made of such size that when the forms are removed there will be a clear space between the steel member and the concrete slab of at least one and one-half (1½) inches on all sides of the steel member. All costs in connection with forming openings for steel members shall be included in the unit contract price for concrete in place.

The supports for formwork for roadway slabs which bear on plate girder flanges shall be constructed so that the load is applied within six (6) inches of the center line of girder webs.

101–3.04 PLANS FOR FALSEWORK AND FORMS

The Contractor shall submit to the Engineer, for approval, four (4) copies of plans showing details of the falsework and forms intended to be used.

The plans shall show the construction of the proposed form work in sufficient detail so that all elements of construction and materials for proper evaluation of safety and adequacy of the form work can be ascertained. In addition, the plans shall specify the maximum allowable rate of pour and the manufacturer's recommended safe working capacity of all patented form ties and column clamps.

Falsework and forms shall not be constructed until the falsework plans have been approved by the Engineer, but approval by the Engineer shall not relieve the Contractor of responsibility for the sufficiency of the falsework and forms. The Contractor's plans shall be designed by and bear the seal of a licensed professional engineer.

All plans shall be drawn on sheets each measuring twenty-two (22) inches wide by thirty-six (36) inches long in overall dimensions, or on smaller sheets that are multiples of eight and one-half (8½) inches by eleven (11) inches.

101–3.05 REMOVAL OF FALSEWORK AND FORMS

Forms for various parts of the structure shall not be removed before the number of days specified in the table below shall have elapsed after placing of the concrete,

unless otherwise authorized by the Engineer as meeting strength requirements. The exact number of days shall be determined by the Engineer and will depend upon curing conditions subsequent to placement of concrete.

	Portland Cement	*High Early Strength Cement*
(a) Columns and wall faces (not yet supporting loads)	3 days	3 days
(b) Mass piers and abutments (not yet supporting loads) except pier caps and copings	3 days	3 days
(c) Sidewalk on bridges—Sidewalk forms shall, in all cases, be released before the main girder and slab forms are released	10 days	4 days
(d) T-beam, girder, box girder and slab, crossbeams, caps, struts, and top slabs on concrete box culverts	14 days	5 days
(e) Trestle slabs when supported on wood stringers	10 days	4 days
(f) Slabs, when supported on steel stringers or prestressed concrete girders	10 days	4 days
(g) Pier caps and copings	7 days	3 days
(h) Arches	21 days	.....
(i) Railings	3 days	3 days

Items c, d, e, f, g and h apply to falsework and forms supporting the full load of the concrete. Side forms and forms not supporting loads shall not be removed before 3 days have elapsed after the placing of the concrete, except that side forms of footings may be removed at the end of 24 hours after the placing of concrete if a curing compound is applied immediately. Curing compound shall not be applied to the area of the construction joint between the footing and column, or footing and wall.

Falsework under all spans shall be completely released before forms are constructed and concrete is placed in railings or rail bases.

In order to determine the condition of column concrete, forms shall always be removed from columns before releasing supports from beneath beams and girders.

Forms shall not be released from under concrete which was placed at a temperature under fifty (50) degrees Fahrenheit without first determining if the concrete has attained adequate strength irrespective of the time element.

The forms for footings constructed within cofferdams or cribs may be left in place when authorized by the Engineer, provided that the forms so left intact will not be exposed to view when the structure is completed. The forms supporting the roadway slab of box girder type structures shall be supported on wales or similar supports fastened, as nearly as possible, to the top of the web walls, and may be left in place.

The forms supporting the roadway slab shall not be shored to or supported on the bottom slab. All other forms shall be removed whether above or below the ground line or water level. Inside forms of hollow piers, girders, abutments, etc., shall be removed through openings provided for that purpose. The removal of forms for concrete exposed to sea water or to alkaline water or soil shall be in accordance with the provisions of sections 107-3.09 and 107-3.10.

In no case shall forms, centers of falsework be removed at any time without the approval of the Engineer.

101-3.06 PLACING ANCHOR BOLTS

All necessary anchor bolts in piers, abutments, or pedestals shall be accurately set, either in the original masonry, or in holes drilled after the masonry has set. If drilled, the holes shall be at least one (1) inch larger in diameter than the bolt to afford ample room for "grouting in." If set in the original masonry, the bolts shall be placed as shown on the plans. If setting in pipe is specified, the pipe must in all cases be filled with grout as outlined for grouting shoes in Section 102-3.09.

Anchor bolt sleeves, into which the anchor bolts cannot be grouted until after freezing weather, shall be protected against damage from expanded ice by filling the sleeves with an approved non-evaporating antifreeze solution.

101-3.07 EXPANSION SHOES AND PLATES—ELASTOMERIC BEARING PADS

Main expansion shoes and plates under girders or slabs may be either sliding or rolling, as shown on the plans. All sliding expansion plates shall be of bronze and of the grade specified in Section 113-2.05. Sliding surfaces shall be planed true and smooth and then polished. All surfaces shall be planed in a direction paralleling the movement of the joint. Expansion plates shall be well anchored and set true to line and grade as shown on the plans. All sliding surfaces of expansion plates shall be thoroughly coated with graphite and oil just before being placed in position, and special care shall be exercised to avoid placing concrete in such a manner as to interfere with their free action.

When grout is to be placed under steel shoes, the placement of the grout and the necessary steel shims shall be in accordance with Section 102-3.09.

The elastomeric bearing pads shown and noted on the plans shall conform to the physical property requirements of the current AASHO Standard Specifications for Highway Bridges, articles 1.7.51 and amendments.

All bearing pads shall be individually cast with fully molded edges. Corners and edges of molded pads may be rounded at the option of the Contractor. Radius at corners shall not exceed ⅜ inch, and radius of edges shall not exceed ⅛ inch.

Shims contained in laminated bearing pads shall be mill rolled steel sheets not less than 20 gage in thickness with a minimum cover of 1/16 inch of elastomer on all edges and shall be spaced to divide the pad thickness into equal laminations. The bond between the elastomer and metal shims shall be such that, when a sample is tested for separation, failure shall occur within the elastomer and not between the elastomer and the metal shim.

The grade or durometer hardness of the bearing pads shall be noted as on the plans.

The lower contact surface of the bearing pads shall be bonded to the structure with an approved rubber cement, except where the plans call for additional surfaces of the pads to be bonded.

101-3.08 DRAINAGE OF BOX GIRDER CELLS

To provide drainage for box girder cells, the Contractor shall furnish and install short lengths of three (3) inch asbestos-cement pipe, or equal, in the bottom slab at the low point of each cell. The pipe shall extend one-fourth (¼) inch below the bottom of the slab and shall not protrude above the top surface of the slab.

101-3.09 OPENING TO TRAFFIC

Concrete structures which will support heavy vehicular traffic loads, constructed with portland cement concrete, shall remain closed to all traffic for at least twenty-one (21) days after placing of final concrete to complete such structures. This minimum requirement may be reduced by the Engineer if, in his opinion, the concrete tests justify reduction. If high-early-strength concrete is specified, the opening time to traffic will depend on tests made by the Engineer, but in no case shall the time of opening be less than seven (7) days after final concrete for the structure is placed.

The above times of opening to traffic is applicable when temperatures are above fifty (50) degrees F. When temperatures are below fifty (50) degrees F., the time of opening to traffic will be increased at the discretion of the Engineer.

Bridges with concrete decks shall not be opened to traffic without the approval of the Engineer.

101-3.10 PRESTRESSED CONCRETE GIRDERS

General

This item shall consist of the furnishing and placing complete precast prestressed reinforced concrete girders constructed in accordance with the details shown on the plans and described herein. The precast girder shall be cast to the dimension shown on the plans.

The Contractor, only with the approval of and under the observation of the Engineer, will be allowed to repair rock pockets and other minor deficiencies of a non-structural character in a girder. Any girder which is repaired without approval and actual observation of the repair by the Engineer will be rejected, regardless of the extent of the repair work.

The top of the precast girder shall be kept wet continuously until the side forms are removed. Subject to the provision that he shall be fully responsible for any damage incurred therefrom, the Contractor will be permitted to remove the side forms any time after the concrete has attained a compressive strength of 3,000 psi as indicated by test cylinders cast and cured under the same conditions as the stripped girder. If a girder is stripped at this earlier period, it shall be covered immediately with a wet curing pad and the entire surface of the girder shall be kept wet continuously until the concrete has attained a strength of 5,000 psi.

When approved by the Engineer, precast prestressed concrete girders may be cured with saturated steam or by hot air. If steam or hot air is used for curing, the temperature of the enclosure shall not be raised above 100° F. for a minimum period of two hours after it has been placed. After the minimum two-hour period, the temperature of the enclosure may be raised to a maximum of 150° F. in increments of not more than 25° F. per hour.

If steam is used for curing, the unit must be so arranged on the casting bed that the entire surface of each unit is enveloped in saturated steam. If hot air is used, heat shall be admitted at the end of the girder and the entire surface of each unit must be enveloped in saturated atmosphere. Curing with hot air will not be permitted until after the Engineer has approved the methods proposed for maintaining the saturated atmosphere.

In no case shall dry heat strike the girder surface at any point. If steam or hot air curing is used, the Contractor must provide a recording thermometer so arranged and calibrated that a continuous record of the temperature of the enclosure is maintained.

The thermometer shall be placed in the vicinity where the heat first reaches the girder. At all times that steam or hot air curing is being used, a printed record of the hourly temperature readings, properly dated and identified, shall be available for inspection by the Engineer. The temperature and recording device shall be accurate within plus or minus 5° F.

The concrete for the prestressed girders shall have a minimum ultimate compressive strength of not less than 6,000 pounds per square inch at the age of 28 days.

The table below shows a concrete mix which will achieve the desired compressive strength; the Contractor, however, may deviate from this mix if he so elects, upon approval of the Engineer. The use of calcium chloride as an admixture to the concrete will not be allowed.

	Aggregate developing not less than 95% of strength of Steilacoom Aggregate	*Aggregate developing between 90.0% & 94.9% of strength of Steilacoom Aggregate*
Maximum total mixing water in gallons per 94 pound sack of cement	4.5	4.5
Sacks of cement per cubic yard	8.0	8.5
*Pounds of dry fine aggregate per 94 pound sack of cement	180	137
Pounds of dry coarse aggregate per 94 pound sack of cement	205	208

GRADING FOR COARSE AGGREGATE

Passing 1" Square Opening	100%
Passing ¾" Square Opening	95-100%
Passing ⅜" Square Opening	20- 40%
Passing No. 4 Sieve	0- 3%

*Based on aggregate with a bulk specific gravity of 2.67.

Fine aggregate shall conform to the requirements of the standard specifications for paving sand in Section 37-2.02.

The conditions of design for the prestressing of the girders are shown on the plans. The Contractor shall employ methods and related equipment in the prestressing operations which will be in conformance with the details shown on the plans, except that approved variations of such methods and equipment will be permitted if, in the opinion of the Engineer, equal results can be obtained.

Before casting the girders the Contractor shall submit to the Engineer for his approval, complete details of the method, materials and equipment the Contractor proposes to use in the prestressing operations. The Contractor shall also furnish shop plans of the girders outlining the method and sequence of stressing, details of the prestressing tendons and steel reinforcement, anchoring devices proposed for use, anchoring stresses, type of enclosures for the post-tensioning cables, and all other data pertaining to the prestressing operations.

The approval of shop plans shall be understood to be only an acceptance of the character and sufficiency of the details, and not a check of the dimensions. The arrangement of the prestressing units in the girders shall be such that the center of gravity of the prestressing steel will follow the locations shown. Steel forms shall be used for casting the prestressed girders.

Deviations from prestressing details approved by the Engineer will not be permitted unless details of such deviations are submitted well in advance of use for the engineering approval. The approval by the Engineer of any proposed method, materials or equipment shall not be construed as in any way relieving the Contractor of full responsibility for successfully completing the prestressing operations in accordance with the plans and requirements defined herein.

Before completion of the project the Contractor shall furnish the original tracings of the shop detail drawings, or acceptable reproductions showing all approved deviations of detail for the prestressed girders.

–3.10A Post-Tensioning

Each prestressing cable or bar shall be encased in a flexible metal conduit of the diameter required, or be formed within the girders by means of cores or ducts composed of rubber or other suitable material which can be removed prior to installing the post-tensioning reinforcement. The metal conduit shall be stiff enough to maintain the desired profile between points of supports and shall be completely sealed against leakage of mortar into the conduit. The ends of the conduit shall be made so as to provide free movement of end anchorage devices. Couplings or splices in the prestressing steel will not be permitted. Where cables or bars are to be curved, the metal conduit shall be set low enough to offset the tendency of the prestressing steel to straighten out when stressed. Unless otherwise specified, the locations of the cables with respect to the concrete beam (as shown on the plans) shall be construed to be the final locations after stressing.

Immediately after completion of the concrete pour, the metal conduit shall be blown out with compressed air to the extent necessary to break up and remove any mortar in the conduit before it hardens. The metal conduits shall be flushed out with water and then blown out with compressed air within 24 hours after the concrete pour.

After cables or bars have been stressed to the required tension, each conduit encasing the prestressing steel shall be blown out with compressed air. The conduit shall then be completely filled from one end with grout under pressure and a minimum of one-half (½) gallon of grout shall be pumped through the outlet to ensure the removal of air bubbles.

The grout mixture shall be as follows with the exact proportions adjusted to make a grout having the proper consistency:

1 Sack Type II portland cement
4¾ Gallons of water
1 Teaspoon unpolished aluminum powder
2 Ounces sika-plastiment

The grout shall be fluid but proportioned so that free water will not separate from the mix. Mixing, preferably in a propeller type mixer, shall be performed for several minutes until the grout is of uniform consistency, and the aluminum powder shall then be added and mixing continued until the powder is thoroughly incorporated. Commercial plastercizers used in accordance with the manufacturer's recommendation may be used provided they do not contain ingredients that are corrosive to steel.

Sufficient pressure shall be used in grouting to force the grout completely through the duct, care being taken not to rupture the duct.

–3.10B Prestressing Reinforcement

Prestressing reinforcement shall be high tensile bars or high tensile wire strands and shall be mill bright, or with light surface rust.

The requirements for breaking strength, yield strength and elongation of wire strand for longitudinal

post-tensioning and pre-tensioning shall conform to ASTM Designation A 416-59T.

The Contractor may, if he elects, furnish the new 270,000-pound per square inch prestressing strand in ½ inch or 7/16 inch diameter strand in lieu of the strand designated on the plans and as outlined hereinbefore, provided that the new strand is fabricated and tested in accordance with the requirements of ASTM Designation A 416-59T with the following exceptions:

1. **½ Inch Strand**
   a. Minimum ultimate strength equals 41,300 pounds per strand.
   b. Nominal steel area equals 0.153 square inch per strand.
2. **7/16 Inch Strand**
   a. Minimum ultimate strength equals 31,000 pounds per strand.
   b. Nominal steel area equals 0.115 square inch per strand.

All wires shall be stress-relieved as a unit after the wires have been formed into a strand.

All prestressing reinforcement shall be free of dirt, rust, grease or other deleterious substance.

All prestressing reinforcement furnished for a given girder shall have a maximum elongation differential of 3 percent. All prestressing reinforcement shall be stress-relieved and all reels of strand shall be accompanied with an inspection certificate furnished by the supplier indicating the number of reels represented by the certificate and shipped for this project.

For each certificate furnished, a sample as described hereinafter shall be sent to the Engineer, or to the laboratory he may designate for testing.

–3.10C Anchorages

All post-tensioning reinforcement shall be secured at the ends of the girders and diaphragms by means of approved anchoring devices which shall be of such nature that they will not kink, neck down or otherwise damage the post-tensioning reinforcement.

Anchoring devices and couplings other than those previously approved shall be submitted to the Engineer and approved by him prior to construction.

Distribution and anchoring assemblies designed by the Contractor shall meet with the following requirements:

1. When external bearing plates are used, the maximum concentrated bearing stress in the concrete directly underneath the bearing plate shall not exceed 3,000 pounds per square inch.
2. Bending stresses in the bearing plates induced by the pull of the prestressing reinforcement shall not exceed 16,000 pounds per square inch.
3. Materials and workmanship shall conform to the applicable requirements of Section 112, Structural Steel.

If the bearing area of the anchorage device is sufficiently large so that a local concentrated bearing compressive stress of not more than 3,000 pounds per square inch is obtained in the concrete, steel bearing assemblies as above specified may be omitted.

Anchorage devices proposed for use shall be submitted for testing as provided elsewhere in this section.

After the post-tensioning cables have been anchored they shall be cut flush with the face of the anchoring device and the entire assembly shall be satisfactorily grouted in.

–3.10D Prestressing

The releasing of the pre-tensioning reinforcement or the tensioning of the post-tensioning reinforcement shall not be commenced until tests on concrete cylinders, manufactured of the same concrete and cured under the same conditions as the girders, indicate that the concrete of the particular girder to be prestressed has attained a compressive strength of 5,000 pounds per square inch when 7/16" or ½" strands are used, and 4,800 pounds per square inch when ⅜" strands are used.

All prestressing reinforcement shall be tensioned to the jacking load shown on the plans.

At such time as the jacks are to be removed from either the pre-tensioning or post-tensioning reinforcement the stress at the jack shall be relieved by gradual release before cutting of the reinforcement. Exposed pre-tension steel shall be burned off flush with the concrete surface and the exposed ends shall be protected with an approved epoxy coating.

Jacks shall be equipped with accurate reading calibrated hydraulic pressure gages to permit the stress in the prestressing reinforcement to be computed at any time. A certified calibration curve shall accompany each jack.

After anchoring the post-tensioning reinforcement, an approved non-shrinking cement grout shall be forced under pressure into the enclosures around the reinforcement until the entire enclosure is filled.

–3.10E Testing

The vendor shall furnish to the Engineer for testing the following samples selected at random from the lot or reels covered by each certificate:

For bars: Not less than five (5) feet of each diameter, furnished with threaded ends and nuts.

For strands: Not less than five (5) feet of each diameter, measured between near ends of fitting, furnished with or without fittings attached.

In addition to the above and for the post-tensioning reinforcement, the vendor shall furnish two anchorage assemblies of each size or type to be furnished, if anchorage assemblies are not attached to reinforcement samples.

All samples submitted shall be accompanied by a certification from the vendor certifying that the samples were taken from and are representative of the lot or reel to be furnished.

All of the above materials specified for testing shall be furnished without cost to the Owner and well in advance of anticipated time for use. The Contractor will not be entitled to any additional compensation if his work is delayed awaiting approval of the materials required for testing.

101–4 MEASUREMENT

Measurement of the various items entering into the construction of concrete structures will be made in accordance with the specifications for the several items involved.

Measurement of prestressed concrete girders will be by the linear foot measured along the bottom center line of the completed girder.

101–5 PAYMENT

Payment for the various items entering into the construction of concrete structures will be made in accordance with the specifications at the unit contract prices for the several items involved in the proposal. Payment shall include the furnishing of all materials, labor, equipment and all items of cost required to complete the work.

Payment for prestressed concrete girders will be made at the unit contract price per linear foot for "Prestressed Concrete Girders," which price shall be full compensation for all costs in connection with furnishing all labor, tools, equipment, materials, and forms necessary to construct the prestressed girders, in accordance with the details shown on the plans and specifications, all transportation costs, and complete erection at the locations shown. The unit contract price for the prestressed girders shall also include all costs in connection with furnishing and placing the high tensile steel, reinforcing steel included with the prestressed girders, anchorage assemblies, pipe sleeves, grouting in the post-tensioning strands, painting girder ends with epoxy resins, bearing pads, concrete and all other parts incidental to final acceptance of the prestressed girders.

All costs in connection with furnishing and installing cell drain pipes for box girder structures and for furnishing and placing grout and shims under steel shoes shall be considered as incidental to the construction and no payment will be made therefor.

Section 102—Steel Structures

102–1 DESCRIPTION

This section of the specifications shall apply to all steel structures, including composite structures of steel and other materials, and to all structures in which fabricated metal, except steel reinforcing bars, is used.

102–2 MATERIALS

The materials furnished and used shall be those described in Section 112, Structural Steel, and other sections for the other items involved.

102–3 CONSTRUCTION DETAILS

All construction details shall be in accordance with the requirements specified in this section, in Section 112, Structural Steel, and in other sections for the various items involved.

102–3.01 STORAGE IN FIELD

All materials shall be stored in such manner as to prevent deterioration by rust or loss of minor parts. No material shall be piled to rest upon the ground or in water, but must be placed on suitable skids or platforms.

102–3.02 FALSEWORK

All falsework shall conform to the specifications for falsework as specified under Section 101–3.02.

102–3.03 HANDLING STEEL MEMBERS

The field assembling of the component parts of a structure shall involve the use of methods and appliances not likely to produce injury by twisting, bending or otherwise deforming the metal. No member slightly bent or twisted shall be put in place until its defects are corrected, but members seriously damaged in handling will be rejected.

102–3.04 ALIGNMENT AND CAMBER

Before beginning the field connections, the structure shall be adjusted to correct grade and alignment and the elevations of panel points (ends of floor beams) properly regulated. For truss spans a slight excess camber will be permitted while the bottom chords are being connected, but the correct camber and relative elevations of panel points shall be secured before connecting the top chord joints, top lateral system, and sway bracing.

No connecting shall be done at compression joints until the blocking has been adjusted so that there will be full and even bearing over the entire joint.

102–3.05 STRAIGHTENING BENT MATERIALS

The straightening of bent edges of plates, angles and other shapes shall be done by methods not likely to produce fracture or other injury. The metal shall not be heated unless permitted by the Engineer, in which case the heating shall not be to a higher temperature than that producing a dark cherry red color. The metal shall be cooled as slowly as possible after heating.

After completing the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of incipient fractures or other damage.

102–3.06 ASSEMBLING AND RIVETING

All field connections and splices shall be securely drift pinned and bolted as erection proceeds. With the exception of bracing, the pinning and bolting specified herein shall be accomplished for each member as it is erected before additional weight is imposed.

Important connections in trusses, girders, floor system, etc., shall have at least 50 percent of the holes filled. An ample number of drift pins shall be used to prevent slipping at joints and splices. Structures erected by the cantilever method shall be field bolted and pinned to 75 percent full strength unless otherwise permitted by the Engineer.

The results obtained in the field assembling and riveting of the members of a structure shall conform to the requirements for shop assembling and riveting. Field driven rivets shall be inspected and accepted before being painted.

Field riveting shall be done before the falsework is removed unless special permission otherwise is given by the Engineer.

Rallings may be erected but shall not be adjusted until after the falsework has been released and the deck placed.

102–3.07 ADJUSTING PIN NUTS

All nuts on pins shall be thoroughly tightened and the pins shall be so located in the holes that the members will take full and even bearing upon them. All pins shall have sufficient threading to allow "burring" after the nuts are tightened.

102–3.08 SETTING ANCHOR BOLTS

Anchor bolts shall be set in the masonry in accordance with requirements specified under Section 101–3.06, Placing Anchor Bolts. Anchor bolts shall be grouted in after the shoes have been set and the span is completely erected to line and camber.

102–3.09 SETTING AND GROUTING SHOES

Shoes shall be set on the anchor bolts provided in the masonry and shimmed up with steel shims until the pin centers are in the proper position as to line and grade and with respect to each other. The bases of the shoes shall be level. The anchor bolt nuts shall then be drawn down tight and a recheck of the pin centers shall be made. Steel shims shall be not more than two and one-half (2½) inches square and shall be placed under the webs of shoes. Not less than three-fourths (¾) of an inch of space shall be provided under shoes for grout.

After the shoes have been set and the span completely erected, the space between the top of the masonry and the bottom of the shoes shall be filled with cement mortar or grout. Grout shall be composed of one (1) part of high-early-strength cement to one (1) part of clean, fine grained sand, well mixed with sufficient water to produce a mix that will flow. Unpolished aluminum powder shall be added in the proportion of one (1) teaspoonful per sack of cement. Great care shall be used to work the grout under all parts of the shoes.

A form shall be constructed around the base of the shoes four (4) inches outside of the base and approximately four (4) inches high. The form shall be filled to the top with grout. After the grout has set sufficiently hard, the form shall be removed and the grout outside of the shoe shall be removed to the base of the shoe and beveled off neatly to the top of the masonry.

No additional load shall be placed on the shoe until the grout has set seventy-two (72) hours.

The above procedure for setting shoes applies to shoes for all steel spans, including shoes and turning racks on movable bridges, excepting however, that main shoes for cantilever spans shall be set and grouted in before any steel work is erected.

102–3.10 PLACING SUPERSTRUCTURE

No superstructure load shall be placed upon finished piers or abutments until the Engineer gives his approval. In general, a minimum time of twenty-one (21) days shall be allowed for ample curing of concrete before the superstructure load is placed thereon.

102–3.11 SETTING EXPANSION BEARING BED PLATES

Expansion bearing bed plates shall be set to the proper position for a normal temperature of 64° F. Adjustment shall be made for any inaccuracy in the fabricated length so that the expansion shoe will be centered at normal temperature after the dead load camber is out.

102–3.12 AIR FOR RIVETING

Air compressors and air storage tanks shall be provided, capable of delivering not less than one hundred (100) pounds per square inch of air pressure to each operating riveting hammer.

102–3.13 CONCRETE FLOORS ON STEEL SPANS

Before concrete floors are placed on steel spans, the centering under the bridge shall be released and the span be supported free on its supports.

102–3.14 FILLING AND DRAINING POCKETS

All pockets in shoes, in which water or debris can be deposited, shall be painted with one coat of paving asphalt of 61-70 penetration applied hot, and the pockets shall then be filled with asphalt concrete of approved proportions and materials. Where drain holes have been provided, they shall be plugged before the asphalt concrete is placed. The top of the concrete shall be well rounded so water will drain clear of the shoes.

Pockets in truss, girder and other members shall be provided with sufficient drain holes to drain all water from the pockets.

All costs incurred in filling pockets and providing drain holes shall be included in the unit contract prices for structural steel or cast steel.

102–3.15 PAINTING

All structural steel and all other metal parts except steel surfaces embedded in concrete, unless otherwise provided, shall be painted three (3) coats of paint conforming to the requirements outlined in Section 116, Paints and Painting. Metal surfaces embedded in concrete shall be painted one (1) shop coat of paint as specified in Section 112-3.15. The first coat of paint shall be applied immediately after the steel has been cleaned by sand blasting.

The two field coats for roadway expansion dams shall be applied sufficient time in advance of opening to traffic to allow the paint to become thoroughly dry.

All metal surfaces which will be inaccessible for painting after erection, except those embedded in concrete, shall be painted with all three (3) coats of paint prior to erection.

The tops of all floor beams over which a slab joint occurs shall be coated on the tops and edges of the flange with a heavy mop coat of paving asphalt of 61-70 penetration applied hot, and a protective covering of 3-ply asphalt saturated roofing felt. This coating shall be applied over the shop paint and will take the place of two field coats of paint specified for other parts of the structural steel.

102–4 MEASUREMENT

Measurement of the various items entering into the construction of steel structures shall be made in accordance with the specifications for the several items involved.

102–5 PAYMENT

Payment for the various items entering into the construction of steel structures will be made in accordance with the specifications, at the unit contract price for the several bid items in the proposal.

All costs in connection with furnishing and placing grout and shims under steel shoes shall be considered as incidental to the construction and no separate payment will be made therefor. Payment shall include the furnishing of all materials, labor, equipment and all items required to complete the work.

Section 103—Timber Structures

103–1 DESCRIPTION

The provisions of this section of the specifications are intended to apply to bridges constructed primarily of timber and lumber but which are in reality composite structures in which other materials are employed to a greater or less extent. Timber bridges as thus defined shall be built as indicated on the plans and in accordance with the provisions of the specifications pertaining to the various materials and contract items which enter into and form a part of the complete composite structure.

The provisions and details of construction herein outlined shall apply, insofar as they are pertinent, to timber structures other than bridges except as such structures may be specifically mentioned elsewhere.

103–2 MATERIALS

103–2.01 TIMBER AND LUMBER

Timber and lumber shall conform to the requirements of Section 114, Timber and Lumber. If preservative treatment is required, it shall conform also to the requirements of Section 115, Preservative Treatment for Timber, Lumber and Piles.

103–2.02 CASTINGS

Castings used on timber bridges shall conform to the requirements of Section 113, Castings, Steel Forgings, and Miscellaneous Metals.

103–2.03 BOLTS, WASHERS AND OTHER HARDWARE

Ordinary machine bolts and flat head bolts shall be made from commercial bolt stock meeting the specifications of ASTM Designation A 307, Steel Machine Bolts and Nuts and Tap Bolts, and shall be grade A. Drift bolts and dowels may be either wrought iron or medium steel. Washers may be cast iron ogee or malleable iron, or may be cut from medium steel or wrought iron plate, as specified.

103–2.04 STRUCTURAL METAL

Rods, special bolts, plates, shapes and eye bars used on timber bridges and classed as structural metal shall be of structural carbon steel, conforming to the requirements of Section 112, Structural Steel.

103–2.05 OTHER MATERIALS

Materials furnished and used in the construction of timber bridges and not specifically mentioned above, shall be those prescribed for the several specifications and contract items which are required for the completed structure.

103–3 CONSTRUCTION DETAILS

103–3.01 STORAGE OF MATERIAL

Timber and lumber on the site of the work shall be stored in piles. Untreated material shall be open stacked at least twelve (12) inches above the ground surface, and piled to shed water and prevent warping. Creosoted timber and piling shall be close stacked, piled to prevent warping and when required by the Engineer shall be protected from the weather by suitable covering.

The ground underneath and in the vicinity of all such piles of material shall be cleared of weeds and rubbish.

103–3.02 WORKMANSHIP

Workmanship shall be first class throughout. None but competent bridge carpenters shall be employed and all framing shall be true and exact. Nails and spikes shall be driven with just sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces shall be considered evidence of poor workmanship and sufficient cause for the removal of the workman causing them. The workmanship on all metal parts shall conform to the requirements specified for steel structures.

103–3.03 SHOP DETAILS

The Contractor shall submit to the Engineer for approval two sets of shop detail plans of all treated timber, showing thereon the dimensions of all timbers which are cut, framed or bored. The Engineer will retain one set of the shop detailed plans and return the other approved, or with the corrections marked thereon. No material shall be framed or bored until the shop plans have been approved.

All plans shall be drawn on sheets each twenty-two (22) inches wide by thirty-six (36) inches long in overall dimensions, or on smaller sheets that are multiples of eight and one-half (8½) inches by eleven (11) inches.

103–3.04 HANDLING TREATED TIMBER

Treated timber shall be carefully handled without sudden dropping, breaking of the outer fibers, bruising or penetrating the surface with tools. It shall be handled with rope or chain slings and no cant dogs, peavies, hooks or pike poles shall be used.

All cutting, framing and boring of treated timbers shall be done before treatment, insofar as it is practicable.

103–3.05 FIELD TREATMENT OF CUT SURFACES, BOLT HOLES AND CONTACT SURFACES

All cuts in treated piles or timbers and all abrasions, after having been trimmed carefully, shall be coated with two coats of hot creosote and covered with hot roofing pitch.

All bolt holes drilled in the field shall be treated with hot creosote oil, using a pressure bolt-hole treater except that, if painting is required, the bolt holes shall be pressure treated with the same preservatives as used for the timber. Any unfilled holes, after treatment with the appropriate preservative, shall be filled with plugs treated with the same preservative as applied to the holes.

For structures of untreated timber, the heads of all piles, the ends, tops and all contact surfaces of sills, caps, floor beams, stringers, wheel guards, all end joints and contact surfaces of bracing and truss members, back faces of bulkheads, and all other timber in contact with earth—all these shall be thoroughly coated with two (2) coats of hot creosote oil. Particular attention is called to the necessary avoidance of stains from creosoting on surfaces that are to be painted.

In addition to the above treatment, all depressions or openings around bolt holes, joints or caps which may retain moisture and cause decay, shall be carefully sealed by means of a hot waterproofing pitch conforming to coal tar pitch AASHO Designation M 118. Waterproofing pitch, Type B shall be furnished unless otherwise specified. Primer for use with coal tar pitch in dampproofing and waterproofing shall conform to AASHO Designation M 117 (ASTM D 173). Special field treatment for the heads of treated piles shall be as described in Section 106-3.02G.

103–3.06 PAINTING

Unless otherwise specified, rails and rail posts shall be given two (2) coats of paint of the quality specified in Section 116-3.03 and it shall be applied as described therein. The color of the paint shall be as shown on the plans, specified in the special provisions, or as designated by the Engineer. Metal parts other than the parts classified as hardware shall be painted with one coat of shop paint, and after erection be given two coats of field paint, all as specified in Section 116, Paints and Painting.

103–3.07 HOLES FOR RODS, BOLTS AND BOAT SPIKES

Holes for drift bolts and boat spikes shall be bored with a bit one-sixteenth (1/16) inch less in diameter than the bolt or spike to be used.

Holes for machine bolts, flat head bolts and dowels shall be bored with a bit of the same diameter as the bolt or dowel, and holes for truss rods shall be bored with a bit of a diameter one-sixteenth (1/16) inch larger than that of the rod.

103–3.08 BOLTS, WASHERS AND OTHER HARDWARE

All bolts and other hardware, which are to be galvanized and which require bending or shaping shall be hot forged to the required shape before galvanizing. Cold bending of such material will not be permitted because of the tendency toward embrittlement during the galvanizing process.

Washers of the size and type specified shall be used under all bolt heads and nuts which would otherwise come in contact with wood, except that washers are not required under the heads of standard flat head bolts.

All bolts shall be effectively checked by burring the threads after the nuts have been finally tightened. Vertical bolts shall have the nuts on the lower end.

In all cases where bolts are used to fasten timber to timber, timber to concrete or timber to steel, the members shall be bolted tightly together when they are installed and shall be retightened immediately prior to final acceptance of the contract. All bolts shall have sufficient additional threading to provide at least three-eighths (⅜) inch per foot thickness of timber for future re-tightening.

Standard flat head bolts shall be used in timber bridge construction unless otherwise specified.

Nails shall be round wire of standard form. Spikes shall be wire spikes or boat spikes, as specified on the plans. Bolts, dowels, washers and other hardware, including nails, shall be black or galvanized as specified on the plans, but if not so specified, all such hardware shall be galvanized if to be used in treated timber structures.

103–3.09 COUNTERSINKING

Countersinking shall be done wherever smooth faces are required. Recesses formed for countersinking shall be painted with hot creosote oil and, after the bolt or screw is in place, shall be filled with hot pitch conforming to the requirements of Section 103-3.05.

103–3.10 FRAMING

All lumber and timber shall be accurately cut and framed so the joints will have a close fit over the entire contact surfaces. Mortises shall be true to size for their full depth, and tenons shall make a snug fit therein. No shimming will be permitted in making joints, nor will open joints be accepted.

103–3.11 FRAMED BENTS

Untreated timber for mudsills shall preferably be of cedar. Mudsills shall be firmly and evenly bedded to solid bearing and tamped in place.

Concrete pedestals for the support of framed bents shall be carefully finished so that the sills will take even bearing on them. Dowels of not less than three-fourths (¾) inch diameter and projecting at least six (6) inches above the tons of the pedestals shall be set in them when they are cast, for anchoring the sills. The concrete shall be of the class indicated on the plans and shall conform to the requirements of Section 107, Portland Cement Concrete for Structures.

Sills shall have true and even bearing on mudsills, piles or pedestals. They shall be drift bolted to mudsills or piles with bolts not less than three-fourths (¾) inch diameter and extending into the mudsills or piles at least six (6) inches. When possible, all earth shall be removed from contact with the sills so there will be free circulation of air around them.

Posts shall be fastened to sills with dowels of not less than three-fourths (¾) inch diameter extending at least six (6) inches into the posts.

103–3.12 CAPS

Timber caps shall be placed to secure an even and uniform bearing over the tops of the supporting posts or piles and to secure an even alignment of their ends. All caps shall be secured by drift bolts not less than three-fourths (¾) inch in diameter extending at least nine (9) inches into the posts or piles. The drift bolt shall be approximately in the center of the pile or post.

When the roadway grade exceeds two percent, caps shall be bevel sawed to fit the grade.

103–3.13 BRACING

All pile bents over ten (10) feet high shall be braced transversely at each bent and longitudinally in alternate pairs of bents. Single story bracing shall not exceed twenty (20) feet. The ends of bracing shall be bolted through the pile, post or cap with a bolt not less than three-fourths (¾) inch in diameter. Intermediate intersections shall be bolted or boat spiked, as indicated on the plans. Sway bracing shall extend far enough to lap both upper or lower caps or sills and shall be bolted to the caps or sills at each end.

103–3.14 STRINGERS

All stringers carrying laminated decking and any stringer varying in depth by more than one-eighth (⅛) inch shall be sized to an even depth at bearing points.

Outside stringers shall be butt jointed and spliced, but interior stringers shall be lapped to take bearing over the full width of the cap or floor beam at each end. Joints shall be broken if stringers cover two spans and stringers shall be either toenailed or drift bolted, as specified on the plans. Stringers may be of sufficient length to cover two spans, except on sharp horizontal and vertical curves. The ends of lapped stringers on untreated timber structures shall be separated for the

circulation of air by a 1" x 3" strip of wood 2" shorter than the depth of stringer and securely fastened across the face of one of the stringers between the lap.

Between stringers, cross bridging or solid bridging, as shown on the plans, shall be neatly and accurately framed and securely toenailed at each end with at least two (2) nails for cross bridging and four (4) nails for solid bridging. The size and spacing of bridging shall be as shown on the plans.

103–3.15 WHEEL GUARD AND RAILING

Wheel guards and railings shall be accurately framed and bolted in accordance with the plans and be erected true to line and grade. Wheel guards shall be laid in sections not less than twelve (12) feet long, bolted through the floor plank and through the outside stringer or nailing piece with three-fourths (¾) inch bolts spaced not over four (4) feet apart. Wheel guards shall be beveled on the roadway side as shown on the plans. Wheel guard material shall be surfaced on the top edge and roadway side or may be surfaced four (4) sides (S4S). All material for railings shall be surfaced four (4) sides (S4S).

103–3.16 TRUSSES

Trusses, when completed, shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection, and in vertical projection shall show a smooth curve through panel points conforming to the correct camber. All bearing surfaces shall fit accurately. Uneven or rough cuts at the points of bearing shall be cause for rejection of the pieces containing the defects. Unless otherwise directed by the Engineer, all trusses shall be completed, swung free of their falsework and adjusted for line and camber before the hand railing is placed.

103–3.17 SINGLE PLANK FLOORS

Single plank floors shall consist of a single thickness of plank supported by stringers or joists. Unless otherwise directed by the Engineer, the plank shall be laid with the heart side down, and with tight joints. Each plank shall be spiked to each joist or nailing strip with not less than two spikes, the length of which shall be at least four (4) inches greater than the thickness of the plank. The spikes shall be placed not less than two and one-half (2½) inches from the edges of the plank. The ends of the plank shall be cut off on a straight line parallel to the center line of the roadway. The planks shall be carefully graded as to thickness and laid so adjacent planks will not vary more than one-sixteenth (1/16) inch. Roadway and sidewalk plank shall be surfaced one side and one edge (SISIE), unless otherwise specified.

103–3.18 LAMINATED FLOORS

The strips shall be placed on edge and shall be drawn down tightly against the stringer or nailing strip and the adjacent strip, and shall be spiked while held in place. Each strip shall extend the full width of the deck unless some other arrangement is shown on the plans or authorized by the Engineer.

Each strip shall be spiked to the adjacent strip at intervals of not more than two (2) feet, the spikes being staggered eight (8) inches in adjacent strips. The spikes shall be of sufficient length to pass through two strips and at least half way through the third. In addition, unless bolting is specified on the plans, each strip shall be toenailed to alternate stringers with forty penny (40d) common nails and adjacent strips shall be nailed to every alternate stringer. Ends of all pieces shall be toenailed to the outside stringer. The ends of the strips shall be cut off on a true line parallel to the center line of the roadway. When bolts are used to fasten laminated floors to stringers, the bolts shall be placed at the spacing shown on the plans and the pieces shall be drawn down tightly to the bolting strips. The bolt heads shall be driven flush with the surface of the deck. Double nuts or single nuts and lock nuts shall be used on all bolts. The strips shall be spiked together in the same manner as specified above.

103–3.19 PLANK SUB-FLOORS FOR CONCRETE DECKS

The plank sub-floor shall be laid surfaced side down with close joints at right angles to the center line of the roadway. The sub-floor shall be spiked in place in the same manner as specified for single plank floors in Section 103-3.17.

Floor plank shall be pressure treated with creosote as described in Section 115, Preservative Treatment for Timber, Lumber and Piles. The amount of creosote oil to be used shall be as indicated on the plans, or as specified in the special provisions.

103–4 MEASUREMENT

The quantities of timber, lumber and various other items which constitute a complete and accepted structure will be measured for payment in units as described in the specifications and proposal for each individual item.

The weight of structural metal, other than hardware, will be determined in the manner specified for structural steel in Section 112.

103–5 PAYMENT

The quantities measured as above mentioned, will be paid for at the unit contract prices for the several items which, except as otherwise provided, shall be full compensation for all labor, material, tools and equipment and for all incidental work necessary to complete the structure ready for use.

The lump sum contract price for "Structural Metal" shall include full compensation for furnishing all materials, labor, tools and equipment and all incidental work necessary to install structural metal as shown on the plans. If no item for structural metal is included in the proposal, the materials and work involved shall be considered as incidental to the construction and all costs therefor shall be included by the Contractor in the bid items of timber or lumber, or other bid items of the proposal.

Section 104—Concrete Culverts and Retaining Walls

104–1 DESCRIPTION

All drainage structures constructed of concrete that have span lengths less than twenty (20) feet, but not including concrete pipe drains, shall be considered as concrete culverts. Concrete culverts may be arched, circular, single box, double box or simple span culverts as shown on the plans.

All concrete walls, including gravity, cantilever, counterforted, buttressed and tied walls, shall be considered as concrete retaining walls.

104–2 MATERIALS

All reinforcing steel and materials for concrete shall conform to the requirements outlined in Section 111 for reinforcing steel, and in Section 107 for portland cement concrete. The classes of concrete shall be as shown on the plans.

104–3 CONSTRUCTION DETAILS

104–3.01 GENERAL

Concrete culverts and retaining walls shall be constructed in accordance with the requirements specified in Section 101 for concrete structures, Section 107 for portland cement concrete for structures, and Section 111 for reinforcing steel.

The Contractor may employ the use of precasting techniques in the construction of reinforced concrete retaining walls, provided the methods for precasting, handling, installing the precast units and the method of providing watertight joints are submitted to and approved by the Engineer.

104–3.02 EXCAVATION AND BACKFILL

Excavation and backfill shall be in accordance with the specifications for excavation and backfill as described in Section 17.

104–3.03 DRAINAGE—BACKFILL AND SUBSTRUCTURE

Backfill material placed back of retaining walls, abutments and wing walls shall be a gravel material that will drain readily. In general, when original excavation is not suitable for backfilling and unless otherwise shown on the plans or provided in the special provisions, the backfill material shall be a bank run material conforming to the requirements for Bank Run Gravel, Class A, in Section 26. Such backfill shall be placed in layers and compacted as described in Section 17-3.09.

Drainage through backfill behind walls shall be intercepted and removed by the means shown on the plans; through weep holes, tile drains, french or rock drains, or a combination of such means. If a specific method of drainage collection is not shown on the plans, the Contractor shall install such drains as may be directed by the Engineer to adequately pick up and dispose of the drainage.

Gravel backfill for drains shall conform to the requirements for filter material as described in Section 65-3.04, unless otherwise provided for in the special provisions.

104–5 MEASUREMENT AND PAYMENT

Measurement and payment for the various items involved will be made in accordance with the provisions of the specifications and the plans for those items, excepting, that all costs in the connection with the construction of weep holes and the gravel backfill for drains surrounding the weep holes shall be included by the Contractor in the unit contract price per cubic yard for concrete in place.

Payment for gravel backfill for walls shall be made at the unit contract price per ton or per cubic yard in place for "Gravel Backfill for Walls" which price shall be full compensation for all other costs and expenses necessary or incidental to furnishing, loading, hauling the full distance, and placing of the gravel backfill as specified hereinbefore.

Section 105—Metal Retaining Walls

105–1 DESCRIPTION

Metal retaining walls shall be constructed in accordance with these specifications and in conformity with the type, lines, grades and dimensions shown on the plans or as directed by the Engineer.

Metal retaining walls are classified into 5 types, according to bin widths as follows:

Type	*Base Width in Feet*
1	5.5
1	7.7
3	9.9
4	12.1
5	14.3

105–2 MATERIALS

105-2.01 METAL RETAINING WALLS

Metal retaining walls shall be galvanized metal members and fittings consisting of columns, stringers, spacers, column caps, column splice plates, connecting channels, base plats, stringer stiffeners, bolts, nuts, washers and other fittings which are designed, formed and patterned to be field-assembled into a continuous closed faced wall of connected bins. The designs, shapes and patterns of the various members and their assembly shall be in accordance with the details shown on the plan.

–2.01A Base Metal and Spelter Coating

The galvanized sheets used in fabricating the several members shall conform to the requirements of the current specifications for Corrugated Metal Culvert Pipe, AASHO Designation M 36. Bolts, nuts and miscellaneous hardware shall be galvanized in accordance with the requirements of ASTM Designation A 153, Zinc Coating on Hardware, Iron and Steel.

–2.01B Gage

The various members of the wall shall be of the gage designated on the plan for the type of metal retaining wall to be constructed.

–2.01C Fabrication

All members shall be so fabricated that members of the same nominal size and gage shall be fully interchangeable.

No drilling, punching or drifting to correct defects in manufacture shall be permitted. Any members having holes improperly punched shall be replaced by the manufacturer free of charge.

105–2.02 FIBER-BONDED METAL RETAINING WALL

When specified on the plans, Fiber-Bonded Metal Retaining Walls shall be constructed meeting the above specifications except that members shall be fabricated using fiber bonded sheets, the base metal of which shall be made by the open hearth process.

The base metal of the sheets shall contain a total of not more than 0.70% of carbon, manganese, phosphorous, sulphur, and silicon in the aggregate, with a maximum sulphur content of 0.05%. In the check analysis of the finished sheet, the following tolerances are permitted: sulphur, .01%; total of five elements, .04%

The metal sheets used to form the members of the bin-wall (except the base plates and the connecting channels) shall be coated on both sides with a layer of asbestos fibers, applied in a sheet form by pressing it into a molten metallic bonding medium. Immediately after the metallic bond has solidified, the asbestos fibers shall be thoroughly saturated with a bituminous saturant. The finished sheets shall be of first-class commercial quality free from blisters and unsaturated spots.

105–3 CONSTRUCTION DETAILS

–3.01A Structure

Bearings for the base of the bins shall be firm and shall be approved by the Engineer.

–3.01B Erection of Bin-Wall

The units shall be erected as shown on the plans. Members shall be handled carefully and any which are damaged shall be removed and replaced with new members at the Contractor's expense.

Each shipment of materials furnished under this specification shall be accompanied by the fabricator's or manufacturer's instructions and recommendations for the field assembly of the materials.

If requested by the Engineer, a qualified representative of the supplier on the materials shall visit the site of the field assembly to assist and advise field forces in the proper manner of assembly of the materials.

–3.01C Backfilling

Backfilling shall be in accordance with the provisions of Section 17-3.09.

Backfill in the interior of the bins and behind the wall shall be placed in horizontal layers not more than six (6) inches thick and each layer shall be tamped and compacted to 95% of the maximum density as determined by the "Compaction Control Test" in Section 13-3.10E5.

Backfilling behind the wall shall progress with the filling of the bins and shall not be carried ahead of binfill.

105–4 MEASUREMENT

Metal retaining wall shall be measured on the square foot basis by adding the facial areas of the bins of the various types of metal retaining walls.

For the purpose of determining facial areas, each bin will be considered as having ten (10) feet of length even though short stringers may be used on the face of the wall. The height of each bin will be the product obtained by multiplying the number of stringers in the face of the bin by 1.33 feet. The facial area of each bill will be computed as follows: Facial Area = (No. of stringers in face) X 1.33 X 10.

Excavation will be measured in cubic yards as provided in Section 17.

The use of a mechanical tamper will be measured in hours as provided in Section 17-5.03.

105–5 PAYMENT

Payment will be made for such of the following bid items as are included in any particular contract:

1. "Metal Retaining Wall Type .....," per square foot.
2. "Fiber Bonded Metal Retaining Wall Type .....," per square foot.
3. "Structure Excavation," per cubic yard.
4. "Mechanical Tamper," per hour.

Payment will be made at the contract price per square foot for "Metal Retaining Wall Type ....." and for "Fiber Bonded Metal Retaining Wall Type .....," which price shall be full compensation for furnishing all labor, materials, tools and equipment necessary or incidental to the construction of the metal retaining wall complete in place.

All costs involved in the use of special corners shall be included by the Contractor in the unit contract price per square foot for the adjacent bins measured as specified in Section 105-4. No further compensation will be made.

Section 106—Piling

106–1 DESCRIPTION

These specifications cover only such piling as is shown upon the plans, or ordered in writing by the Engineer. Piling under these specifications may be of any of the several types and kinds described herein.

106–1.01 TIMBER PILING

Timber piling shall be untreated, or treated with the preservatives specified in the plans and completely described in Section 115, Preservative Treatment for Timber, Lumber and Piles.

106–1.02 COMPOSITE PILING

Composite piling as contemplated under these specifications shall consist of a pile made up of two (2) timber sections, or of a reinforced concrete pile and a timber pile section.

For the composite piling made up of two (2) timber sections, the lower section shall be untreated and the upper section shall be creosote treated. For the composite piling made up of reinforced concrete and timber, the lower section shall be untreated timber and the upper section shall be either precast or cast-in-place reinforced concrete.

106–1.03 PRECAST CONCRETE PILING

Precast concrete piles shall consist of concrete sections properly reinforced to withstand handling and driving stresses and shall conform to the dimensions and details shown on the plans.

If a square section is specified, the corners shall be chamfered one inch. Precast concrete piles may be either precast concrete piles with deformed steel reinforcing bars or precast-prestressed concrete piles with prestressed steel strands.

106–1.04 CAST-IN-PLACE CONCRETE PILING

Cast-in-place concrete piles shall consist of steel casings or shells driven in the ground and filled with concrete.

106–1.05 STEEL PILING

Steel piling shall consist of rolled steel H pile sections or other structural steel members of the size and weight shown on the plans.

106–2 MATERIALS

106–2.01 TIMBER PILING

Timber piles shall have the following limiting diameters in inches:

LENGTH	BUTT		TIP
	Minimum 3 Ft. Above Butt	Maximum 3 Ft. Above Butt	Minimum
Feet	Inches	Inches	Inches
Under 40	12	20	8
40 to 50 Inclusive	12	20	7
51 to 70 Inclusive	13	20	7
71 to 90 Inclusive	13	20	6
Over 90	13	20	5

–2.01A Untreated Piling

Except where specifically provided otherwise, untreated timber piling shall be Douglas fir, Western red cedar or larch. Piling shall be cut from sound, live trees and shall contain no unsound knots. Sound knots will be permitted, provided the diameter of the knot does not exceed four (4) inches or one-third (⅓) of the small diameter of the stick at the point where they occur, whichever is smaller. Any defect or combination of defects which will impair the strength of the pile more than the maximum allowable knot will not be permitted.

Piling shall be cut above the ground swell and shall have a uniform taper from butt to tip. A line drawn from the center of the tip to the center of the butt shall not fall outside the center of the pile at any point more than one percent (1%) of the length of the pile. A spiral grain or twist in excess of one-fourth (¼) turn in ten (10) feet of length will be cause for rejection.

Untreated timber trestle piling shall have an average of at least five (5) annual rings per inch measured radially over a distance of three (3) inches at the butt, beginning at a point three and one-half (3½) inches from the heart. At least nine (9) inches of heartwood shall show at the butt.

Ring count requirements for untreated timber foundation piling and detour trestle piling will be waived.

–2.01B Creosote Treated

For creosote treated piling, Douglas fir timber shall be the same as for untreated piling except that the ring count requirement will be waived.

–2.01C Composite Piles

The treated and untreated sections of composite pile shall meet the respective requirements specified above for full length treated and untreated timber piling.

106–2.02 PRECAST CONCRETE PILING

–2.02A Concrete

Portland cement or high-early-strength cement shall be used in all precast concrete piles.

The concrete for precast-prestressed piles shall have a minimum compressive strength of 6,000 pounds per square inch at the age of 28 days. The minimum compressive strength of concrete at the transfer of prestress shall be 4,800 pounds per square inch.

The concrete for other precast piles shall be Class AX.

Mixing, transporting, placing and curing concrete shall be in accordance with the provisions of Section 107, Portland Cement Concrete for Structures.

–2.02B Reinforcing Steel

For precast-prestressed piles, each prestressing strand shall consist of bright stress-relieved wires. Each strand shall have a nominal diameter of seven-sixteenths (7/16) inch and shall conform to the requirements of ASTM Designation A 416-57T.

For other precast piles the reinforcing steel shall be deformed bars conforming to the requirements of Section 111, Reinforcing Steel, and to the requirements of ASTM Designation A 15, intermediate grade.

106–2.03 CAST-IN-PLACE CONCRETE PILING

–2.03A Steel Shells or Casings:—

–2.03A1 Self-Supporting Driven Shells

The steel shells or casings shall conform to the requirements of the specifications for Steel for Bridges, ASTM Designation A 7 or ASTM Designation A 252, Grade 2, Welded and Seamless Steel Pipe Piles.

The pipe shells shall have sufficient thickness of shell to permit driving without damage to the shell and the Contractor shall make his own determination of the shell thickness required.

Casings may be used meeting the 50,000 psi yield strength requirement as determined by mill tests, or physical tests on material as fabricated in the casings.

–2.03A2 Mandrel Driven Steel Shells

Mandrel driven steel shells shall have sufficient thickness of shell to permit driving without any damage to the shell and the Contractor shall make his own determination of the shell thickness required.

–2.03B Concrete

Class AX concrete shall be used in all cast-in-place reinforced concrete piles. Mixing, transporting, placing and curing shall be in accordance with the specifications in Section 107, Portland Cement Concrete for Structures.

–2.03C Reinforcing Steel

Reinforcing steel for cast-in-place concrete piling shall be deformed steel bars conforming to the requirements of Section 111, Reinforcing Steel.

106–2.04 STEEL PILING

The material for steel piling shall conform to the requirements of the specifications for Steel for Bridges, ASTM Designation A 7. This materials specification shall apply to the pile caps and splice plates as well as the pile section itself.

106–2.05 PRESTRESSED HOLLOW CONCRETE PILING (New Section)

Materials

Cement:

Portland cement shall be used and shall conform to the standard specifications for Portland Cement, ASTM Designation C-150, Type II, or Type III.

Concrete Mix:

The concrete for the prestressed piles shall have a minimum ultimate compressive strength of not less than 6,000 pounds per square inch at the age of 28 days.

The following is a concrete mix which will achieve the desired compressive strength, however, the Contractor may deviate from this mix and gradings of aggregate if he so elects, subject to the approval of the Engineer. The approved gradings shall be subject to the penalties outlined in the 1st sentence of sections 37-2.02B3 and 37-2.02C4 of the standard specifications. The use of calcium chloride as an admixture to the concrete will not be allowed.

	Aggregates developing not less than 95% of strength of Steilacoom aggregate	*Aggregates developing between 90.0% and 94.9% of strength of Steilacoom aggregate*
Maximum total mixing water in gallons per 94 pound sack of cement	4.5	4.5
Sacks of cement per cubic yard	8.0	8.5
*Pounds of dry fine aggregate per 94 pound sack of cement	180	137
*Pounds of dry coarse aggregate per 94 pound sack of cement	205	208

*Based on aggregate with a bulk specific gravity of 2.67.

Fine aggregate shall conform to the requirements of the standard specifications for paving sand.

Coarse aggregates shall meet the requirements of Section 37 of the standard specifications, except that grading requirements shall be as follows:

Passing 1" Square Opening	100%
Passing ¾" Square Opening	95–100%
Passing ⅜" Square Opening	20– 40%
Passing No. 4 Sieve	0– 3%

Water:

The water used in mixing the concrete shall be clear and free from injurious amounts of oil, acid, alkali, organic material or other deleterious material.

Prestressing Reinforcement

Prestressing reinforcement shall be high tensile wire strands and shall be mill bright.

The requirements for breaking strength, yield strength and elongation of wire strand for longitudinal pretensioning shall conform to ASTM Designation A416-59T.

The Contractor shall furnish ½ inch diameter, 7 wire prestressing strands which have a minimum ultimate strength of 270,000 pounds per square inch as designated on the attached plans. The strands shall be fabricated and tested in accordance with the requirements of ASTM Designation A 416-59T with the following exceptions:

1. ½ Inch Strand
   a. Minimum ultimate strength equals 41,300 pounds per strand.
   b. Nominal steel area equals 0.153 square inches per strand.

All wires shall be stress-relieved as a unit after the wires have been formed into a strand.

All prestressing reinforcement shall be free of dirt, rust, grease or other deleterious substance.

All prestressing reinforcement furnished for a given pile shall have a maximum elongation differential of 3 percent. All prestressing reinforcement shall be stress relieved and all reels of strand shall be accompanied by an inspection certificate furnished by the supplier indicating the number of reels represented by the certificate and shipped for the project.

For each certificate furnished, a sample (as described herein) shall be furnished to the Engineer for testing.

Pile Manufacture:

All piles shall be full length, except where piles are spliced as approved by the Engineer.

Metal forms shall be used, and they must be braced and stiffened against deformations under pressure of the wet concrete. They shall have smooth joints and inside surfaces accessible for cleaning after each use. The portions of the forms which form the end surfaces of the pile shall be a true plane and be perpendicular to the axis of the pile. The concrete mixture shall be such that it will give the most uniform distribution of the aggregates. The fine and coarse aggregates shall have as near the same specific gravity as possible.

The piles shall have a cage of non-prestressed reinforcing steel, arranged and dimensioned as shown on the plans and securely held in position during the casting of the concrete. The spiral steel reinforcing shall have a minimum concrete cover of 1½ inches to the outside surface of the piles.

The exposed surfaces of the precast piles shall be kept continuously wet until the side forms are removed. The Contractor will be permitted to remove the side forms any time after the concrete has attained a compressive strength of 3,000 psi as indicated by test cylinders cast and cured under the same conditions as the piles with the understanding that he shall be fully responsible for any damage to the piles due to early stripping; and provided further that following stripping the pile shall be immediately covered with a wet curing pad and the entire surface of the pile shall be kept continuously wet until the concrete has attained a strength of 5,000 psi. When steam or hot air curing is used, the test cylinders shall be placed in the lower heat zone during the curing period.

If the Contractor elects, precast prestressed concrete piles may be cured with saturated steam or by hot air. If steam or hot air curing is used, the temperature of the concrete shall not be raised above 100° F. for a minimum of 2 hours after it has been placed. After the 2 hour period, the temperature of the concrete may be raised to a maximum of 150° F. in increments not to exceed 25° F. per hour.

If steam curing is used, the unit must be so arranged on the casting bed that the entire surface of each unit is enveloped in saturated steam. If hot air curing is used, heat shall be admitted at each end of the pile and the entire surface of each unit must be enveloped in a saturated atmosphere.

Curing with hot air will not be permitted until the Engineer has approved the methods proposed for maintaining said saturated atmosphere.

In no case shall dry heat impinge on the pile surface at any point. If steam or hot air curing is used, the Contractor must provide a recording thermometer so arranged and calibrated that a continuous record of the temperature of the enclosure is maintained.

The thermometer shall be placed in the vicinity where the heat first reaches the pile. At all times that steam or hot air curing is being used, a printed record of the hourly temperature readings properly dated and identified shall be available for inspection by the Engineer.

The temperature and recording device shall be accurate within plus or minus 5° F.

The cables or wires shall be tensioned to a stress as noted on the plans. This tension shall be measured either by the elongation of the wire or by the jack pressure. The tension in the cables shall be maintained temporarily by mechanical locks or anchors.

Jacks shall be equipped with accurate reading calibrated hydraulic pressure gauges to permit the stress in the prestressing reinforcement to be computed at any time. A certified calibration curve shall accompany each jack.

All piles shall be pretensioned. Post tensioning will not be allowed.

Before the start of the manufacture of any piles, the Contractor shall submit for approval of the Engineer complete plans showing the details for the manufacture of the piles.

Testing

The vendor shall furnish to the Owner for testing the following samples selected at random from the lot or reels covered by each certificate:

For strands—Not less than 5 feet, measured between near ends of fitting, to be furnished with fittings attached.

All samples submitted shall be accompanied by a certification from the vendor certifying that the samples were taken from and are representative of the lot or reel to be furnished.

All of the above materials specified to be furnished for testing shall be furnished free of cost and shall be furnished well in advance of anticipated time of use. The Contractor shall have no claim for additional compensation, if his work is delayed awaiting approval of the materials furnished for testing.

Handling and Installing

Concrete Strength:

The piles shall not be placed until the concrete has cured for at least 10 days and has attained a minimum compressive strength of 6,000 psi.

Pile Lengths:

The Contractor shall furnish pile lengths as required by the tip elevations shown on the layout sheet of the plans. If these pile lengths are short for any given location, the required pile lengths shall be secured by a solid build-up of the pile with concrete class AX, as detailed on the plans.

Forms for the extension of the concrete piles shall be metal shells, approved by the Engineer.

106–3 CONSTRUCTION DETAILS

106–3.01 GENERAL PROVISIONS

–3.01A Ordering Piling

All piling, with the exception of cast-in-place concrete piling and steel piling, shall be ordered by the Contractor in accordance with an itemized list which will be furnished by the Engineer. This list will show the number and length of piles required and will be based on information secured from the driving of test piles or other data available to the Owner. The lengths shown on this list shall be the lengths required below cutoff and the Contractor shall, at his own expense, increase the lengths the necessary amount to provide for fresh heading and to reach from the cutoff elevation up to the position of his driving equipment.

In the case of cast-in-place concrete piling and steel piling, no order list will be furnished by the Engineer and the Contractor shall determine the length required from the results obtained by the driving of the test piles called for on the plans and subsurface exploration data.

–3.01B Piling Ordered But Not Driven

Piling purchased in accordance with the Engineer's itemized list, but not incorporated in the finished structure, shall be immediately delivered to and become the property of the Owner (city). The purchase of additional piles or piles of greater length than those shown on the Engineer's list shall be at the Contractor's risk.

–3.01C Piles Destroyed in Handling or Driving

Any pile which is damaged or destroyed before or at the time it is being driven shall be replaced by the Contractor at his own expense.

–3.01D Preparation for Driving

Foundation pits, including construction of cofferdams or cribs where required, shall be completely excavated before the driving of foundation piles is begun. Allowance for upheaval of the pit bottom, due to driving the piles, shall be made, the amount of allowance depending upon the character of the material through which the piles are to be driven. Any material forced up between the piles to above the elevation shown for the bottom of the foundation pit shall be removed to the correct elevation before the foundation masonry is placed. In the event that too great an allowance is made for upheaval due to driving of piles, backfilling with gravel will, in general, be permitted to raise the pit bottom to the correct elevation.

–3.01E Penetration

In general, the penetration for any pile shall be not less than ten (10) feet in hard material and not less than twenty (20) feet in soft material. For foundation work, piles shall not be used to penetrate a very soft upper stratum overlying a hard stratum unless the piles penetrate the hard material a sufficient distance to rigidly fix the bottom of the pile.

Unless otherwise specified, all piling driven into previously placed embankment material shall be driven to penetrate through the embankment material with full bearing secured in the underlying foundation material.

To secure the minimum general depths of 10 feet and 20 feet respectively, in hard and soft materials, to penetrate hard material underlying a soft upper stratum and to penetrate through a previously placed embankment, the Contractor shall employ whatever means as are necessary to secure the required penetration without injury to the pile. The Contractor shall provide a suitable means or device to indicate the penetration of the pile. Whatever means as is employed shall be visible from the ground at any reasonable and safe distance from the pile driving.

In addition to the minimum load bearing capacity and/or penetration as specified, the Contractor shall, if directed by the Engineer, overdrive each pile to such additional penetration as requested; provided, however, that jetting or other unusual means will not be required to secure the additional penetration. If the Engineer specifically directs the Contractor to drive piles over the minimum bearing capacity specified and/or beyond the minimum penetration specified, the Contractor will not be required to remove or replace the pile at his own expense because of damage resulting from such overdriving.

–3.01F Elevation of Cutoff

The tops of all piles shall be sawed or cut to a true plane as shown on the plans, and at the elevation fixed by the Engineer. Piles which support timber caps or grillages shall be sawed to the exact plane of the superimposed structure and shall exactly fit it. Broken, split or misplaced piles shall be withdrawn and be properly replaced.

–3.01G Piles Driven Below Cutoff

Piles driven below the cutoff elevation without authority of the Engineer shall be withdrawn and replaced by new and, if necessary, longer piles at the expense of

the Contractor. All piles raised during the process of driving adjacent piles shall be driven down again, if required by the Engineer.

–3.01H Equipment for Driving

–3.01H1 Hammers

Timber piles shall be driven either with drop hammers, steam or air driven hammers, or with a combination of water jets and hammers. Underwater hammers may be used, subject to approval of the Engineer. Drop hammers shall weigh not less than 3,000 pounds for piles less than fifty (50) feet long and not less than 4,000 pounds for piles over fifty (50) feet long. If a drop hammer is used for driving timber piles, it is preferable to use a heavy hammer and operate with a short drop. The maximum height of drop shall be ten (10) feet.

Steam or air driven hammers for driving timber piles shall develop not less than 13,000 foot-pounds of energy per blow.

Steel shells for cast-in-place concrete piles and steel piles, shall be driven with steam or air hammers developing not less than 13,000 foot-pounds of energy per blow.

Precast concrete piles shall be driven with a single acting steam or air hammer developing not less than 13,000 foot-pounds of energy per blow.

Diesel pile hammers will be approved for driving timber piles, steel piles and steel shells for cast-in-place concrete piles provided the ram weighs not less than 3,600 pounds and the energy developed exceeds 13,000 foot-pounds of energy per blow. Diesel pile hammers will not be approved for driving precast concrete piles.

The Contractor shall furnish the Engineer with the manufacturer's specifications and catalog for all steam, diesel or air hammers used, showing all the data necessary for computing the bearing value of piles driven. Gravity or drop hammers shall be weighed in the presence of the Engineer, or a certificate of weight may be furnished the Engineer. Hammers so weighed shall have the exact weight stamped on them.

–3.01H2 Leads

Fixed lead pile drivers shall be used in driving all piles. The use of hanging or swinging leads will not be allowed unless they are so constructed that they can be held in a fixed position during the driving operations. Leads shall be of sufficient length so that the use of a follower will not be necessary, except as hereinafter provided for timber piles. When driving treated timber piles the use of spuds and chocks in the leads shall be kept at a minimum in order that the protective treatment will not become bruised or broken. Leads adapted to the driving of batter piles shall be employed for trestle construction or for foundation work involving inclined piles.

–3.01H3 Water Jets

Water jets shall not be used unless, in the opinion of the Engineer, such use is necessary or desirable. When water jets are used the number of jets and the volume and pressure of the water at the jet nozzles shall be sufficient to freely erode the material adjacent to the pile. The plant shall have sufficient capacity to deliver at all times at least one hundred (100) pounds per square inch pressure at two (2) three-fourths (¾) inch jet nozzles. Before the desired penetration is reached the jets shall be withdrawn and the piles shall be driven with the hammer to secure the final penetration and bearing value. Piles previously driven that become loosened due to the use of the water jets shall be redriven in place or pulled and a new pile driven. A careful check shall be made during driving of piles to determine if the piles are becoming loosened by attempting to redrive at least one pile in every five piles. No allowance will be made for cost to the Contractor for redriving of loosened piles due to the use of water jets.

All costs resulting from the use of water jets shall be included in the unit contract price for driving piles and no additional compensation will be allowed.

–3.01I Test Piles

When specified on the plans or ordered by the Engineer, the Contractor shall drive test piles to determine the lengths of piling required to obtain the necessary load carrying capacity or penetration. These piles shall be driven at the locations designated by the Engineer and shall be of sufficient length to provide for any variation in soil conditions. Test piles shall be of the same material as the permanent piles which are to be driven. Test piles for treated timber piles may be either treated or untreated timber piles conforming to the requirements of these specifications. Steel shells or casings used as test piles for cast-in-place concrete piles and precast concrete and steel test piles shall have the same cross section and other characteristics as the permanent piles.

Driving equipment used to drive test piles shall be the same as that to be used for driving the permanent piles.

–3.01J Loading Tests

When specified or required by the Engineer, the size and number of piles shall be determined by actual loading tests. In general, these tests shall consist of the application of test loads placed upon a suitable platform supported by the pile, together with suitable apparatus for accurately determining the superimposed weight and the settlement of the pile under each increment of load. The safe allowable load shall be considered as fifty (50) percent of that load which, after forty-eight (48) hours application, causes a permanent settlement of not more than one-fourth (¼) inch measured at the top of the pile. At least one pile for each group of one hundred (100) piles shall be thusly tested.

–3.01K Alignment of Piles

Piles shall be driven as accurately as possible in true line and position. All piles shall be vertical unless otherwise specified or shown on the plans.

106–3.02 TIMBER PILES

–3.02A Peeling

–3.02A1 Untreated and Creosote Treated Piles

Untreated and creosote treated piles shall be peeled by removing all of the rough bark and at least 80% of the inner bark. No strip of inner bark remaining on the stick shall be over three-fourths (¾) inch wide or over eight (8) inches long, and there shall be at least one (1) inch of clean wood surface between any two such strips. Not less than 80% of the surface on any circumference shall be clean wood. All knots shall be trimmed close to the body of the pile.

–3.02A2 Composite Piles

Composite piles shall be peeled in the same manner as untreated and creosote treated piles.

–3.02B Storage and Handling

The method of storing and handling shall be such as to avoid injury to the piles. Special care shall be exercised to avoid breaking the surface of treated piling, and cant hooks or pike poles shall not be used. Cuts or breaks in the surface of treated piling shall be given three (3) brush coats of hot creosote oil of approved quality. Cuts or breaks may also be cause for rejection of piling for use in the structure.

Treated piling shall be close stacked and piled so as to prevent warping.

The ground underneath and in the vicinity of the piles shall be cleared of weeds, brush and rubbish.

–3.02C Preparation for Driving

–3.02C1 Fresh Cut Heads

Timber piles, treated and untreated, shall be fresh cut on the butt end just before placing in the leads for driving. Caps, collars or bands shall be placed on the butt end of the pile when the pile is being driven in hard material to avoid crushing or brooming the head of the pile. When the area of the head of any timber pile is greater than that of the face of the hammer, the pile shall be snipped or chamfered to at least the depth of the sap to avoid splitting of the sap from the body of the pile during driving.

–3.02C2 Followers

Followers, made of steel with driving head and cap

made to fit snugly over the head of the pile, may be used when driving timber piles. The use of wood followers will not be permitted.

All timber piles shall preferably be driven by striking directly on the head of the pile without the use of cushions, blocks or followers. When followers are used, one pile from every group of ten (10) shall be a long pile driven without a follower as a test pile to determine the bearing power of the group.

–3.02C3 Pointing and Placing Metal Shoes

Timber piles preferably shall be driven with squared ends; however, when conditions require they may be pointed or shod with metal shoes of a design satisfactory and subject to the approval of the Engineer.

–3.02C4 Splicing

Full length piles shall always be used where practicable, but if splices cannot be avoided the method of splicing shall be subject to the approval of the Engineer.

–3.02D Pile Bents

The location of all piles shall be "spotted" by pegs set to true line and position. For pile bents, the piles shall be reasonably uniform in size to avoid undue bending or distortion of sway bracing. Piles shall be driven with a variation of the portion above ground of not more than one-fourth (¼) inch per foot from the vertical or batter indicated. Excessive pulling or stressing of piles in a bent to bring them into suitable line and position for cutoff and capping will not be permitted. The Contractor will be required to remove and redrive piles that do not meet the above tolerance without undue stressing.

Cutoff of piles for a pile bent shall be accurately made to ensure perfect bearing between cap and piles. No shimming on top of any piles will be permitted.

The piles of any one bent shall be carefully selected as to size to avoid undue bending or distortion of the sway braces.

–3.02E Splicing Composite Piles

Composite untreated timber and treated timber piles, where shown on the plans, shall be driven the same as other timber piles, except that the lower or untreated pile shall first be driven to approximately the ground or water line before splicing the two sticks together. Splices shall usually consist of lengths of steel pipe securely fastened to both the untreated and the treated piles with spikes or bolts. The untreated piles shall have the butt end rounded to form a tight driving fit into the pipe splice. The treated piles shall have the tip end rounded, prior to treatment, to form a tight driving fit into the pipe splice. The composite pile shall then be driven to the required penetration or bearing value. Composite piles shall be driven in such a manner that the position of the splice will be well into the ground to provide lateral support for the pile, and also below the level of permanent ground water.

Before ordering lengths of piles for timber composite piles, the relative positions of the ground line and the permanent water table shall be carefully determined and the piles ordered accordingly.

–3.02F Penetration

The minimum penetration shall be approximately ten (10) feet and the Contractor shall employ whatever means as may be necessary to secure this penetration without injury to the pile.

–3.02G Treatment of Pile Heads

The heads of all untreated piles, except those encased with concrete, shall be thoroughly coated with two coats of hot creosote oil.

The heads of all treated piles, except piles covered with concrete footings or concrete caps, after being cut to correct elevation, shall be given three (3) brush coats of hot creosote oil. They shall then be capped with a covering built up of alternate layers of hot pitch or approved roofing asphalt, and waterproofing fabric conforming to the requirements of Section 118-2.02 using four (4) layers of pitch and three (3) layers of fabric. The cover shall measure at least six (6) inches more in each dimension than the diameter of the pile top. The cover shall be bent down over the pile and the edges fastened with large headed galvanized nails or secured by binding with three (3) turns of galvanized wire. The edges of the fabric shall be trimmed around the pile to give a neat appearance.

–3.02H Elevation of Pile Tops

Where untreated timber piles are used for foundations, the tops of the piles shall be kept well below the plane of permanent ground water or low water level.

–3.02I Determination of Bearing Values

In the absence of loading tests, the safe bearing values for timber piles shall be determined by the following formulas:

$$P = \frac{2WH}{S + 1.0}$$ for gravity hammers

$$P = \frac{2WH}{S + 0.1}$$ for single-acting steam or air hammers

$$P = \frac{2H\,(W + Ap)}{S + 0.1}$$ for double-acting steam or air hammers

Where P = safe bearing power in pounds
W = Weight in pounds, or striking parts of hammer
H = drop of hammer or stroke of ram, in feet
A = area of piston in square inches
P = steam pressure in pounds per square inch at the hammer
S = the average penetration in inches per blow for the last five (5) to ten (10) blows for gravity hammers and the last ten (10) to twenty (20) blows for steam or air hammers.

The above formulas are applicable only when:

(a) The hammer has a free fall.
(b) The head of the pile is free from broomed or crushed wood fiber.
(c) The penetration is at a reasonably quick and uniform rate.
(d) There is no sensible bounce after the blow. Twice the height of the bounce shall be deducted from "H" to determine its true value in the formula.

The Engineer may require the installation of an adequate pressure gauge at the inboard end of the hose for the purpose of checking the pressure at the hammer.

The bearing power of timber piles, as determined by the foregoing formulas, shall be considered effective only when they are less than the crushing strength of the piles. Unless otherwise specified on the plans, timber piling driven under these specifications shall have the following minimum bearing values as determined by actual test loads or by the foregoing formulas:

(a) Timber piles in foundations, 20 tons.
(b) Timber piles for trestle bents, 15 tons.

In case water jets are used in connection with driving, the bearing power shall be determined by the above formulas from the results of driving after the jets have been withdrawn, or a test load applied.

106–3.03 PRECAST CONCRETE PILING

–3.03A Forms

Forms for precast concrete piles shall conform to the general requirements for concrete form work, as provided herein under Section 101. Forms shall be accessible for tamping and consolidation of the concrete.

–3.03B Reinforcement

Reinforcing bars, hoops, shoes, etc., shall be placed as shown on the plans. All parts shall be well wired and tied together and placed to the spacings shown. All reinforcements shall be in place in the forms before any concrete is placed.

–3.03C Casting

Piling may be cast either in a vertical or horizontal position. Care shall be exercised to vibrate and tamp the concrete around the reinforcement to avoid the formation of stone pockets. The use of internal vibrating tampers will be required when placing concrete in forms. Concrete shall be placed continuously in each pile, special care being taken to avoid horizontal or diagonal cleavage planes, and to see that the reinforcement is properly embedded in the concrete.

–3.03D Finishing

As soon as the forms are removed, concrete piles shall be carefully pointed with a 1:2 mortar, filling all cavities

or irregularities. Trestle piling exposed to view shall be finished above the ground line in accordance with the provisions governing the finishing of concrete columns. Foundation piling, that portion of trestle piling which will be below the ground or low water surface, and piles for use in salt water or alkali soils shall not be finished except by pointing as above specified.

–3.03E Curing

Precast concrete piling shall be cured with water, unless curing with saturated steam or other method is authorized by the Engineer. When cured with water, the piles after casting shall be kept wet continuously for ten (10) days if portland cement is used, and three (3) days if high-early-strength cement is used. Side forms of piles cast horizontally may be removed any time twenty-four (24) hours after the concrete is placed, provided the air temperature surrounding the piles is maintained at or above fifty (50) degrees F. for the remaining required curing time for prestressed concrete piles.

Piling, during the curing period, shall not be subjected to any handling stresses until the concrete has attained a minimum compressive strength of forty-eight hundred (4800) pounds per square inch, or the Class AX (Sec. 107-3.02A) concrete for other precast piles has attained a strength of thirty-three hundred (3300) pounds per square inch, as determined by test cylinders cured with the piling. Test cylinders shall be cast with each set of piles as they are poured.

For steam curing of piles when authorized, the Contractor shall provide a suitable steam curing means equipped with a recording thermometer so arranged and calibrated that a continuous twenty-four (24) hour record of the temperature of the enclosure is recorded and available for inspection by the Engineer at all times that steam curing is in progress. The temperature recording device shall be accurate to within plus or minus five (5) degrees F.

Steam curing shall start as soon as practicable after casting of piles, and for the first two (2) hours the temperature of the concrete shall not be raised above one hundred (100) degrees F. After this initial two-hour starting period, temperature of the concrete may be raised to a maximum of one hundred fifty (150) degrees F. in increments not to exceed twenty-five (25) degrees F. per hour. Thereafter, this maximum temperature in the concrete shall be maintained continously until the concrete has attained a minimum compressive strength of thirty-six hundred (3600) pounds per square inch as determined from test cylinders cured with the piling.

After the concrete has attained the required strength, it shall be cooled to air temperature by reducing the heat in increments of not more than twenty (20) degrees F. per hour by reducing the amount of heat applied. After the units have been removed from the casting bed, they shall be protected, as necessary, to avoid cooling at a rate greater than 20 degrees F. per hour.

–3.03F Storage and Handling

The method of storing and handling shall be such as to eliminate the danger of fracture by impact or undue bending stresses in curing or transporting the piles from the forms and into the leads. In general, concrete piles shall be lifted by means of a suitable bridle or sling attached to the pile at points not over twenty (20) feet apart and not more than ten (10) feet from the ends of the pile. In no case shall the method of handling be such as to induce stresses in the reinforcement in excess of twelve thousand (12,000) pounds per square inch, allowing one hundred (100) percent of the calculated load for impact and shock effects. In handling piles for use in sea water or alkali soils, special care shall be exercised to avoid injury to the surface of the pile.

Piles shall not be subjected to any handling stress until a test cylinder, made from the concrete pour for the piles involved and cured with the piles, shows a strength of at least 4,800 pounds per square inch for precast-prestressed piles or 3,300 pounds per square inch for other precast piles.

–3.03G Age Before Driving

Precast concrete piles shall not be driven until a test cylinder, made from the concrete pour for the piles involved and cured with the piles, shows a strength of at least 6,000 pounds per square inch for precast-prestressed piles or 4,000 pounds per square inch for other precast piles.

–3.03H Protection of Head

The heads of all precast concrete piles shall be protected during driving by caps of approved design, with a suitable cushion next to the pile head and fitting into a casting which in turn supports a shock block. The diameter of the inside of the cap shall be determined before the pile is cast and the head of the pile shall be formed to make a loose fit inside the cap.

–3.03I Extensions or Build-ups

Extensions, splices or "build-ups" on precast concrete piles, when necessary, shall be made as follows after the driving is completed:

For precast-prestressed piles, any spilled concrete shall be removed and the pile shall be fresh-headed to provide a top surface that is perpendicular to the axis of the pile. Ten (10) holes, 1¼ inches in diameter shall be drilled 26 inches deep in space between prestressing strands. Deformed bars No. 6 (¾-inch in diameter) shall be grouted in the drilled holes, and the necessary formwork shall be placed to form a build-up similar in cross section to the pile, care being exercised to prevent leakage along the pile. The concrete in the build-up shall be Class AX, Section 107-3.02A.

For other precast piles the concrete at the head of the pile shall be cut away a depth of forty (40) diameters of the bar size of the vertical reinforcing steel. The final cut of the concrete shall be perpendicular to the axis of the pile. Reinforcement similar to that used in the pile shall be firmly fastened to the projecting steel and the necessary formwork shall be placed, care being exercised to prevent leakage along the pile. The concrete in the build-up shall be of the same quality as that used originally in the pile.

Just prior to placing concrete, the top of the pile shall be thoroughly moistened. The forms shall remain in place at least three (3) days. Spliced piles shall not be driven.

–3.03J Determination of Bearing Values

In the absence of loading tests the bearing values of precast piles shall be determined by the formulas under Section 106-3.02I.

Unless otherwise specified on the plans, precast concrete piles shall be driven to develop a bearing value of not less than thirty (30) tons for thirteen inch (31") diameter or thirty-five (35) tons for sixteen inch (16") diameter piles.

106–3.04 CAST-IN-PLACE CONCRETE PILES

–3.04A Steel Shells or Casings:

–3.04A1 Self-supporting Driven Shells

The steel casings for cast-in-place piles shall be of adequate strength and rigidity to permit driving and prevent distortion due to soil pressure or driving of adjacent piles. The casings shall be sufficiently watertight to exclude water before and during placing of the concrete.

The casings may be straight, tapered, or a combination of straight and tapered.

Constant diameter pile casings shall have a minimum outside diameter of twelve (12) inches.

Tapered casings shall have a minimum outside butt diameter of 12 inches and a minimum outside tip diameter of 8 inches. Tapered casings manufactured of steel, having a yield strength of less than 50,000 psi, shall have a minimum diameter of 10 inches at fifteen (15) feet below cutoff or original ground line, whichever is lower.

The diameter of fluted pile sections shall be measured from crest to crest of flutes.

Unless otherwise approved by the Engineer, the joints in the casings shall be electrically welded. A driving point having a wall thickness of not less than ¾ inch shall be welded to the lower end of each casing.

–3.04A2 Mandrel Driven Steel Shells

Mandrel driven steel shells for cast-in-place piles shall be of sufficient strength and rigidity to permit of their

driving and to prevent distortion caused by soil pressure or the driving of adjacent piles. The minimum outside diameter for constant diameter shells shall be 12 inches. The shells shall be sufficiently watertight to exclude water before and during the placing of the concrete.

The shells may be tapered, step-tapered or a combination of either with cylindrical sections.

Stepped or tapered shells shall have a minimum outside butt diameter of twelve (12) inches for a minimum distance of 15 feet below cutoff elevation or original ground line, whichever is the lower elevation, and a minimum outside tip diameter of eight (8) inches. The average outside diameter of the pile shall not be less than ten (10) inches.

The lower end of each shell shall be provided with a steel driving point having a wall thickness of sufficient strength to prevent driving without distortion and remain watertight.

–3.04B Driving Steel Shells

The top of the steel shell shall be protected with a combination driving head and pilot of proper size for the hammer to ensure a properly distributed blow and to prevent damage to the shell during driving. Both the hammer and the pile shall be supported in rigid leads.

Pile shells shall be driven in true alignment at the locations shown on the plans and shall be plumb or battered as indicated thereon. All pile shells in each footing shall be driven and left empty until inspected and approved by the Engineer, and no shell shall be driven within fifteen (15) feet of a pile in which the concrete has set less than seven (7) days if reinforced with bars and 48 hours if the concrete does not enclose reinforcing steel bars.

–3.04C Cutting Off Steel Shells

The pile shells after being driven, inspected and approved shall be cut off on a horizontal plane at the required elevation.

–3.04D Inspection

After being driven and prior to placing concrete and reinforcing steel therein, the steel shells shall be examined for collapse or reduced diameter at any point. Any shell which is improperly driven or broken or shows partial collapse to such an extent as to materially decrease its bearing value will not be accepted and shall be replaced by the Contractor at his own expense. Driven shells shall be clean and free of water before concrete and reinforcing steel are placed. The Contractor shall have available at all times a suitable light for inspection of the shells throughout the entire length before the shells are filled with concrete and reinforcing steel.

–3.04E Determination of Bearing Values

In the absence of loading tests the bearing values of cast-in-place concrete piles shall be determined by the formulas under Section 106-3.02I. Unless otherwise specified on the plans, steel shells shall be driven to develop a bearing value of at least thirty (30) tons.

–3.04F Reinforcement

Reinforcement for cast-in-place piles shall be sufficient to provide not less than six (6) three-fourths (¾) inch round bars conforming to the requirements of ASTM Designation A 15, intermediate grade, or four (4) No. 5 high strength steel bars conforming to the requirements of ASTM Designation A 431, shall extend a minimum of fifteen (15) feet below the ground line, or longer where called for on the plans; it is excepted, however, that where self-supported steel casings are used which provide more than one-eighth (⅛) inch shell thickness no reinforcement will be required.

All bars shall be rigidly fastened together in a single unit which shall be lowered into the shell before the concrete is placed. No loose bars will be permitted. The reinforcements shall be carefully positioned and securely fastened in such a manner as to ensure proper clearance between the reinforcing bars and the pile shell. The spiral reinforcement shall be No. 2 gauge spiral hooping at 6" centers unless otherwise noted on the plans and in the special provisions.

–3.04G Placing Concrete

Concrete shall be placed continuously in each pile and be vibrated with mechanical vibrating tools, proper care being exercised to fill every part of the shell and to work the concrete around the reinforcement without displacing it. All debris and water shall be removed from the shell before concrete is placed. Placing of concrete in shells containing water will not be permitted. In case the water cannot be removed the shell shall be pulled or filled with sand and a new shell shall be driven.

–3.04H Trestle Piles

Where cast-in-place concrete piles are used for trestle bents, the metal shells or casings shall not extend above the finished ground line. The piles above the finished ground shall conform to the details shown on the construction plans therefor. The reinforcing steel for the section of pile above the ground line shall extend a minimum of four (4) feet into the lower section to tie the two sections together.

All costs for splicing and building up the pile shall be included by the Contractor in his unit contract price per linear foot for "Furnishing Concrete Piling" and no other compensation will be allowed.

106–3.05 STEEL PILES

–3.05A Storage and Handling

The method of storing and handling steel piles shall be such as to avoid injury to the piles. Bent or kinked piles which, in the opinion of the Engineer, cannot be straightened without injury to the metal will be rejected.

–3.05B Driving

Piles shall have square-cut ends and the heads shall be protected during driving by a metal cap made to fit the head of the pile.

Piles shall be driven in true alignment at the locations shown on the plans and shall be plumb or battered as indicated thereon.

–3.05C Splicing

Splicing of steel piles will, in general, be permitted subject to the approval of the Engineer as to the necessity for splicing and the manner in which the splice is to be made.

–3.05D Capping

When specified on the plans, steel piles after being cut off at the required elevation shall be capped with a steel plate. In such cases the pile top shall be cut square and as smooth as practicable. The pile cap shall consist of a steel plate of the size and shape shown on the plans. The method of attachment of the pile cap shall be by electric welding in the amount and in the manner shown on the plans.

–3.05E Determination of Bearing Values

In the absence of loading tests the bearing values of steel piles shall be determined by the formulas under Section 106-3.02I. Unless otherwise specified on the plans, steel piles shall be driven to develop the following bearing values:

8" H-pile section	24 tons
10" H-pile section	32 tons
12" H-pile section	40 tons
14" H-pile section	48 tons

106–5 MEASUREMENT AND PAYMENT

1. "Driving Timber Piles (untreated or name treatment)," per each.
2. "Driving Timber Composite Piles," per each.
3. "Driving Concrete Piles," per each.
4. "Driving Steel Piles," per each.
5. "Furnishing and Driving (as specified) Test Piles," per each.
6. "Furnishing Timber Piling (untreated or name treatment)," per linear foot.
7. "Furnishing Concrete Piling," per linear foot.
8. "Furnishing Prestressed Hollow Concrete Piling (size)," per linear foot.
9. "Furnishing Steel Piling," per linear foot.
10. "Pile Splices (timber)," per each.
11. "Pile Splices (steel)," per each.
12. "Pile Loading Test," lump sum.

Payment for the furnishing and driving of piles of the various types in place other than test piles, shall be included in the following bid items, except as may be modified in Sections 106-5.01 to 106-5.05, inclusive, for each particular kind of piling.

a. "Driving (kind) Piles," per each.
b. "Furnishing (kind) Piling," per linear foot.

No additional compensation over the contract price for "Driving (kind) Piles" will be made for driving piles to the additional penetration as directed by the Engineer as provided in Section 106-3.01E excepting that if driving to an additional penetration of more than three (3) feet is required, the cost to the Contractor of driving more than three (3) feet additional penetration will be paid for on the basis of "Force Account Work" as covered in Section 9.04.

Measurement for "Driving (kind) Piles" shall be the number of piles driven in place.

Measurement for "Furnishing (kind) Piling," shall be made in accordance with sections 106-5.01 to 106-5.04, inclusive, for each particular kind of piling.

Irrespective of the provisions in Section 4.03, no compensation or unit price adjustment additional to the unit contract prices will be allowed for any increase or decrease in the quantities as shown in the proposal for furnishing and driving piling as a result of information gained from the driving of test piles.

106–5.01 TIMBER PILING

Payment for "Furnishing Timber Piling (untreated or name treatment)," shall be made at the unit contract price per linear foot for the number of linear feet actually driven below cutoff or as shown on the Engineer's order list.

The unit contract prices per each for "Driving Timber Piles (untreated or name treatment)," and per linear foot for "Furnishing Timber Piling (untreated or name treatment)," shall be full compensation for piling in place. The unit contract price for "Furnishing Timber Piling (untreated or name treatment)," shall be full compensation for piling ordered but not driven. The prices shall include the furnishing of all materials, tools, equipment, labor, and all expenses incidental thereto. The cost of all materials, labor, tools and equipment necessary for treatment of the pile head, as specified in Section 106-3.02G, shall be included in the unit contract price per each for "Driving Timber Piles (untreated or name treatment)."

106–5.02 COMPOSITE PILING

–5.02A Treated Timber and Untreated Timber

A composite pile made with two (2) or more sticks spliced together will be considered as one (1) pile.

Payment for "Furnishing Timber Piling (name treatment)," and for "Furnishing Timber Piling (untreated)," will be made at the unit contract prices per linear foot for the number of linear feet actually driven below cutoff or as shown on the Engineer's order list for each type of pile used.

Payment of pile splices will be made at the unit contract price per each for "Pile Splices (timber)" for the number of splices made in accordance with the plans or as ordered by the Engineer.

The unit contract price per each for "Driving Timber Composite Piles," per linear foot for "Furnishing Timber Piling (untreated or name treatment)" and per each for "Pile Splices (timber)" shall be full compensation for the piling in place. The prices shall include the furnishing of all materials, tools, equipment, labor and all expenses incidental thereto. The unit contract price per each for "Driving Timber Composite Piles" shall also include the cost incidental to treatment of pile heads as specified in Section 106-3.02G.

The unit contract price for "Furnishing Timber Piling (untreated or name treatment)" shall be full compensation for piles ordered but not driven.

–5.02B Reinforced Concrete and Untreated Timber

A composite pile made with an untreated timber lower section and a reinforced concrete upper section spliced together will be considered as one (1) pile. The reinforced concrete upper portion may be either precast concrete conforming to Section 106-3.03 or cast-in-place concrete conforming to Section 106-3.04 except as provided in Section 106-3.04H.

Payment for "Furnishing Timber Piling (untreated)" and for "Furnishing Concrete Piling" will be made at the unit contract price per linear foot for the number of linear feet actually driven below cutoff, or as shown on the Engineer's order list for each type of pile used.

Payment for pile splices will be made at the unit contract prices per each for "Pile Splices" for the number of splices made in accordance with the plans, or as ordered by the Engineer.

The unit contract prices per each for "Driving Composite Piles," per linear foot for "Furnishing Timber Piling (untreated)," per linear foot for "Furnishing Concrete Piling," and per each for "Pile Splices" shall be full compensation for the piling in place. The prices shall include the furnishing of all materials, tools, equipment, labor and all expenses incidental thereto.

The unit contract prices for "Furnishing Timber Piling (untreated)" and for "Furnishing Concrete Piling" shall be full compensation for piles ordered but not driven.

106–5.03 CONCRETE PILING

Payment for "Furnishing Concrete Piling" will be made on the following basis:

–5.03A Precast Concrete Piling: Payment will be made at the unit contract price per linear foot for "Furnishing Concrete Piling" for the number of linear feet actually driven below cutoff or shown on the Engineer's order list.

In case build-ups or splices are necessary on precast concrete piles, the built-up length will be paid for at three (3) times the unit contract price per linear foot for "Furnishing Concrete Piling." The length of build-up will include the length cut off of the pile first driven for making the splice. For precast prestressed concrete piles the built-up length will include the length in which holes are drilled and reinforcing bars are grouted. No allowance will be made for build-ups which are made necessary by damage to the pile during driving. The entire spliced pile shall be considered as one (1) pile.

–5.03B Prestressed Hollow Concrete Piling: Payment will be made at the unit contract price per linear foot for "Furnishing Prestressed Hollow Concrete Piling (size)", which price shall be full compensation for the piling at the site of the project. This price shall include the furnishing of all metal reinforcement, tools, equipment, labor, prestressing cable and all other items and costs necessary for casting the piles as shown and noted on the plans and in the specifications, and for delivery at the site.

Payment for build-up or splices of prestressed hollow piling will be made at the unit contract price per cubic yard for "Concrete Class AX," and per pound for "Steel Reinforcing Bars," which prices shall be full compensation for the cast-in-place section of the pile.

–5.03C Cast-in-Place Concrete Piling: Payment will be made at the unit contract price per linear foot for "Furnishing Concrete Piling" for the number of linear feet actually driven below cutoff and no Engineer's order list will be furnished.

–5.03D Piling in Place: The unit contract prices per each for "Driving Concrete Piles" and per linear foot for "Furnishing Concrete Piling" shall be full compensation for the piling in place. The prices shall include the furnishing of all materials, steel shells, reinforcement, tools, equipment, labor and other expenses or items necessary for casting, curing, driving and cutting off the piles.

106–5.04 STEEL PILING

Payment will be made at the unit contract price per linear foot for "Furnishing Steel Piling" for the number of linear feet actually driven below cutoff and no Engineer's order list will be furnished.

The unit contract prices per each for "Driving Steel Piles" and per linear foot for "Furnishing Steel Piling" shall be full compensation for piling in place. The prices

shall include the furnishing of all materials, tools, equipment, labor and expenses incidental thereto.

No payment will be made for splices.

106–5.05 TEST PILES

When test piles are driven to determine the lengths of piles required, they will be paid for at the contract price for "Furnishing and Driving Test Piles," which price shall be full compensation for furnishing and driving the test piles to the bearing capacity or penetration required by the Engineer and for pulling the piles or cutting them off, as required, and for removing them from the site or for delivery to the Owner (city) for salvage when so ordered by the Engineer. This price shall also include all costs in connection with moving all pile driving equipment or other necessary equipment to the site of the work and for removing all such equipment from the site after the piles have been driven. If, after the test piles have been driven, it is found necessary to eliminate the piling from all or any part of the structure, no additional compensation will be allowed for moving the pile driving equipment to and from the site of the work.

When steel piles are used for test piles, they shall be driven in place of permanent piles and the number of piles called for on the plans shall be reduced by the number of test piles thus driven in place of permanent piles. They shall be driven to a minimum load bearing capacity of fifteen (15) tons more than the minimum load bearing capacity specified for the permanent piles.

If, in the opinion of the Engineer, any test pile is damaged by handling or driving to such extent that it is unfit for use as a permanent pile, the damaged pile shall be removed and replaced at the Contractor's expense. If the Engineer specifically directs the Contractor to drive the test pile to more than 15 tons over the minimum bearing capacity specified for permanent piling, the Contractor shall overdrive the test pile as directed but will not be required to remove and replace the test pile at his own expense because of damage resulting from such overdriving.

Timber piles, precast concrete piles, or cast-in-place pile shells when used as test piles shall not be used in place of permanent piles and shall be driven outside of the footing. Test piles shall be cut off one foot below the finished ground line. Cast-in-place concrete pile shells driven outside of the footing shall be filled with sand.

106–5.06 LOADING TESTS

When loading tests are required, payment will be made on the basis of the unit contract price for "Pile Loading Tests" or, in the absence of such a price, will be paid for upon force account basis.

The unit contract price shall include the cost of all materials, equipment, labor and expenses incidental to constructing the loading platform, procuring and placing the loading materials, and the removal and disposal of the platform and material to the satisfaction of the Engineer.

When payment for loading tests is made on a force account basis, deduction will be made for such costs of material, tools and equipment as would have been incurred in any event if loading tests had not been required.

Section 107—Portland Cement Concrete For Structures

107–1 DESCRIPTION

Portland cement concrete shall consist of a mixture of portland cement, fine aggregate, coarse aggregate and water in the approximate proportions specified for the several classes of concrete hereinafter designated. It shall be designed to produce at least the minimum allowable compressive strength required for the various classes of concrete.

107–2 MATERIALS

The materials used for making concrete for structures, except for proportioning of the mixes and their classification as hereinafter specified, shall conform in all respects to the requirements for cement, aggregates and water as specified in sections 37-2.01 through 37-2.13.

For the purpose of making portland cement concrete for structures, sections 37-2.01 through 37-2.13 shall be considered as sections 107-2.01 through 107-2.13, respectively, and thus make it unnecessary to reprint and include the identical texts herein. Consequently, the next subsection will become 107-2.14.

107–2.14 PLASTIC WATERSTOP

Plastic waterstop shall be furnished to the cross section detailed on the plans, unless otherwise provided in the special provisions. It shall be fabricated from a plastic compound, the basic resin of which shall be polyvinyl chloride having such additional resins, platiscizers, inhibitors and other material incorporated therewith that will result in a compound that can be moulded or extruded to the required cross section as a dense, homogeneous strip free of porosity or other imperfections.

Plastic waterstop shall meet all physical and other test requirements as defined in the proceedings of the Journal of American Concrete Institute, Volume 30, June, 1959, except that the minimum tear resistance shall be one hundred sixty (160) pounds per square inch using a Die "C" test specimen.

If not otherwise shown on the plans or in the special provisions, the waterstops shall be similar to Type B, symmetrical in shape, 3¾ inches in width by 3/16 inch thick, with ⅜ inch bulb thickness and a minimum of 4 ribs on each side of the bulb. The bulb diameter shall be as noted on the plans.

In the production of plastic waterstop, single-pass reworked material of the same composition generated from the fabricator's operations may be used. No reclaimed polyvinyl chloride shall be used, however.

The Contractor shall furnish the Engineer with a 6-foot length for testing at least thirty (30) days before installing waterstop material.

Unless otherwise provided in the proposal, all costs for furnishing and installing plastic waterstop as required on the plans shall be considered as incidental to the construction and be included in the unit contract price for concrete.

107–2.15 EXPANSION JOINT FILLER AND SEALER

Expansion joints to be sealed watertight by poured rubber sealing compound are made by placing a suitable premoulded rubber strip material or a plastic sheeting lengthwise in the joint, at the required depth, and then pouring the joint full of rubber sealing compound. Cross section details of expansion joints, location therein of the premoulded rubber strip material or plastic sheeting and depth of poured rubber seal shall be as indicated on the plans.

Premoulded rubber joint material, as shown on the plans or required by the special provisions, shall be made from rubber stock composed of a high grade tread compound made exclusively from new plantation rubber, reinforcing carbon black, zinc oxide, accelerators, antidioxidants and softeners.

Plastic sheeting (PVC) shall be an approved strip of two-inch width, 60 mils in thickness. The plastic sheeting shall be installed in the expansion joint by applying an approved anchor adhesive along the edges of the sheeting and the bottom of the concrete joint one-half inch wide. The adhesive shall be allowed to become tack free, and the concrete surface shall be thoroughly cleaned and be free of standing water before installing the plastic sheeting.

The poured rubber sealer shall conform to the current specifications for Concrete Joint Sealer by the Materials Laboratory, Washington Department of Highways. Copies of the specifications, including methods of testing, may be obtained upon request to the Materials Engineer, Materials Laboratory, Department of Highways, Olympia, Washington.

As listed in the Materials Laboratory specifications the physical properties of the joint sealer, when mixed in accordance with the manufacturer's recommendations, are as follows:

(a) Color: Gray or black.
*(b) Viscosity: Must be pourable and self-leveling at 50 degrees F.
*(c) Application Life: Not less than 3 hours at 72 degrees F. and 50% relative humidity.
(d) Set to Touch: Not more than 24 hours at 72 degrees F. and 50% relative humidity.
(e) Curing Time: Not more than 96 hours at 72 degrees F. and 50% relative humidity.
(f) Non-Volatile Content: Not less than 92%.
(g) Hardness Rating (Durometer "Shore A"): 5-35.
(h) Resiliency: Not less than 80%.
(i) Bond Extension Test: Shall pass four cycles of the bond extension test at 0 degrees F., using surface-dried test blocks, and two cycles using soaked blocks and specimens.

*Viscosity and Application Life may be waived, provided that the material is mixed and placed by pump and mixer approved by the Engineer.

Joint sealer primer is described in the Materials Laboratory specifications as follows:

Suitable primer, if required by the manufacturer, shall be furnished with each joint sealer. The primer shall be suitable for brush or spray application at 50 degrees F. or higher, and shall cure sufficiently at 50 degrees F. to pour the joint within 24 hours. It shall be considered as an integral part of the sealer system. Any failure of the sealer in the test described herein attributable to the primer shall be grounds for rejection or retesting of the sealer.

Acceptance of joint sealing compound for use on a project shall be on the basis of laboratory tests of samples representative of each batch of material to be used on the job. A period of at least two weeks shall be allowed for completion of tests. Each container of the compound shall be clearly identified as to batch number. A one-quart sample shall be taken from each batch in the shipment delivered to the job site. A one-half pint sample of the accelerator and of the primer, if any to be used, shall accompany each of the quart samples of sealer.

The expansion joint shall be thoroughly cleaned by sand blasting prior to installing the joint filler and sealer. No joint sealer shall be poured when the ambient temperature is less than 50° F. except when the Contractor elects to heat the joint and the sealer prior to installation to ensure a cure within 7 days. Any expansion joint sealer which does not cure within 7 days after installation under the existing field conditions shall be rejected and removed from the structure.

107–2.16 EPOXY RESIN MORTAR

The Contractor shall exercise care in the application and use of epoxy resins and comply with all precautionary measures recommended by the manufacturer of the epoxy materials.

The epoxy resin mortar specified on the plans shall conform to the following specifications:

General: The specification shall establish the composition for a two-component, mineral filled, thixotropic, flexible epoxy resin base compound for general use as a bonding and repair compound for concrete. The components and finished compound shall conform to the requirements described herein.

Depending upon the temperature of the atmosphere, pavements and materials, the compound shall be furnished in two types:

Type I—for temperatures between 68° and 104° F.
Type II—for temperatures between 40° and 68° F.

Requirements

I. **Compound Description:** The epoxy bonding compound, furnished as a two-component system for combining immediately before use, shall be of the epoxy resin-polysulfide polymer type with a suitable curing agent. The ratio of epoxy resin to polysulfide polymer shall be approximately 2:1 by weight. A suitable non-settling mineral filler shall be incorporated not to exceed 50 percent by weight of the total mixture. The final compound for application shall be thixotropic. The compound shall be essentially a 100% solids system and no diluents, wetting agents, or volatile solvents will be incorporated.

II. Materials

Base Polymer: The base polymer shall be thermosetting resin of the epoxy type, and shall be composed on 100 percent reactive constituents which are a condensation product of the reaction of epichlorohydrin with bisphenol A. This product shall be essentially pure liquid diglycidyl ether or bisphenol A, containing only trace amounts of hydrolyzable chlorine and no reactive diluents.

Color (Hellige)	5 max
Epoxide Equivalent	175–210
Viscosity (Brookfield) poises at 25° C.	100–180
Specific Gravity at 25/25° C.	1.15–1.18

Polysulfide Polymer: The polysulfide polymer flexibilizer shall be a dichlorethylformal polysulfide in the 1000 molecular weight range with the following properties:

Color (Hellige)	9–12
Water (%)	0.1 max
Specific Gravity at 20/20° C.	1.24–1.30
Viscosity	700–1200
p^H of Water Extract	6.0–8.0
Flashpoint, °F Cleveland Open Cup	410 Min.
Fire Point, °F Cleveland Open Cup	460 Min.
Sulphur Content %	36–40

Accelerator: The accelerator or hardening agent shall be a tertiary amine type which, when incorporated in the system, is unaffected by moisture on the surface where the compound is used or that present in the plastic portland cement concrete applied over it. These agents shall be a combination of 2, 4, 6-tridimethyl-aminomethyl phenol and dimethylaminomethyl phenol. The 2, 4, 6-tridimethylaminomethyl phenol may be used alone when conditions warrant.

Mineral Filler: The inert filler or extender shall be a finely divided quartz silica flour with essentially 100% passing the 325 mesh sieve, free of acid or alkali salts, or other trace substances having a deleterious effect on the compound. The mineral filler shall be non-settling when incorporated. The total quantity permitted in the compound shall be such that the minimum compressive shear strength is exceeded.

III. Mixed Compound

The mixed compound, ready for application, shall have the following properties:

Thixotrophy: The degree of gellation shall be such that a ⅛ inch thick film can be maintained on the surface of a 2-inch round rod or tube.

Pot Life: The compound mixed, ready for use, shall remain spreadable and retain full bonding power for at least 30 minutes at 74± 2° F. The end of pot life shall be defined as the point at which a 200 gram sample in a 400 ml highform beaker reaches 85,000 cps (Brookfield).

Compressive Shear Strength: Specimens prepared and tested in a double shear shall have a minimum strength as follows:

(1) Cured at 75+ 7° F for 96 to 120 hours and tested at 75± 7° F = 400 psi min.
(2) Cured at 75± 7° F for 96 to 120 hours and a final cure of 3 hours at 200± 10° F and tested at 75± 7° F = 400 psi min.

Shear strength under test (2) shall equal or exceed that in test (1).

IV. Standards and Methods of Testing

The epoxy bonding compound referred to in this specification is of the quality and type available under U. S. Army Corps of Engineers Specifications for "Grout, (Adhesive) Epoxy Resin Base, Flexible, Filled" as revised May, 1959. The specification is designed to set standards for proprietary formulations commercially available for bonding portland cement concrete. The methods of test used for evaluation will be as set forth in the Corps of Engineers specifications.

V. General Conditions for Use

Surfaces to be bonded need not be dry but should be essentially free of standing water and completely free of dust, spalled concrete, surface dirt and all oily

or wax-like materials. Broken surfaces will normally require hand cleaning only. Trowelled surfaces and those exposed for considerable periods to surface wear or industrial contaminants may require cleaning and etching with hydrochloric acid or sand blasting.

The cleaned surface shall be given an application of bonding compound 40 to 60 mils in thickness and scrubbed onto the surface. The plastic concrete should be poured while the compound is still tacky.

Mortar may be made by use of dry, clean and uniformly graded aggregates for filling holes and patching. A ratio of approximately 1 part mixed compound to 4 or 5 parts of ¼ inch minus aggregate should be applied to the surface to be patched and the mortar applied against this. Trowels and finishing tools may be dipped in aromatic solvents to yield a smooth surface in finishing operations. Soapy water may also be used as an expedient in finishing.

Equipment should be cleaned immediately in aromatic type solvents.

Under normal summer conditions, curing of the epoxy is completed in approximately 24 hours. It may be accelerated by the use of heat lamps or radiant type heaters, but temperatures should not exceed 200° F. at the epoxy surface.

VI. Approval and Acceptance

Approval of source of material shall be on the basis of certified test reports from an independent laboratory showing the material meets the specifications above. Test values shall be listed in the certified report.

Acceptance of a batch lot of the material for use on the project shall be on the basis of laboratory tests of samples representing the particular batch or batches of materials supplied. These tests may be performed at the Materials Laboratory, Department of Highways, Olympia, Washington. A one-quart kit of the bonding compound shall be taken from each batch. A period of 10 days should be allowed for testing after receipt of samples at the laboratory. All costs in connection with furnishing materials for and applying the epoxy resin mortar shall be considered as incidental to the construction where used, and shall be included in the unit contract prices for the various pay items of work involved in this project.

107–3 CONSTRUCTION DETAILS

107–3.01 CLASSIFICATION—CONCRETE MIXES FOR STRUCTURES

Concrete for structures shall be of nine classes depending on the strength, workability and maximum size of aggregates required in various parts of the structure.

Classes of concrete for the several parts of the structure shall be as shown on the plans or as outlined below:

(a) Classes A, AX and E concrete shall be used in thin and heavily reinforced members, in all floor slabs subject to the abrasive action of traffic, and in all beams and girders. They shall be used, also, in all railings, arch ribs and arch rings.

(b) Classes B and F concrete shall be used in all reinforced sections other than those covered by Classes A, AX and E concrete.

(c) Classes C and G concrete shall be used only in unreinforced sections of footing blocks, pier shafts and webs, heavy walls and other mass construction.

(d) Classes D and H concrete shall be used where concrete is deposited under water.

Unless otherwise specified, portland cement shall be used for all of the above classes of concrete. When high-early-strength cement is required, it will be specified in the plans and in the proposal by the suffix (HES). Thus, when Class A concrete using high-early-strength cement is required, it will be designated as "Concrete Class A (HES)."

107–3.02 PROPORTIONS FOR STRUCTURE CONCRETE MIXES

–3.02A Cement Concrete

The classes of concrete referred to in Section 107-3.01 are designed on the following assumptions regarding minimum ultimate compressive strength at the age of 28 days an the amount of mixing water required for satisfactory placement:

CLASS OF CONCRETE	A and E	B and F	C and G	D and H	AX
Compressive strength pounds per square	3,600	3,000	2,800	3,600	4,000
Maximum total water in gallons per ninety-four (94) pound sack cement	5.0	5.75	6.75	5.0	5.0

The design strength of Class D and Class H concrete is 3600 pounds per square inch. However, due to the manner of placing, the assumed strength of Class D and Class H concrete is 2200 pounds per square inch.

Concrete mixes shall be proportioned as specified in the following tables. The weight of each size of aggregate is the estimated quantity to be used with one sack of cement (94 lbs.).

TABLE I

(Proportions by weight 1¼" Maximum Size Aggregate)

CLASS OF CONCRETE	A	B	C	D	*AX
Sacks of cement per cubic yard	6.5	5.75	5.0	6.5	7.0
Pounds of dry fine aggregate	210	265	267	180	154
Pounds of dry No. 2 coarse aggregate	280	315	333	310	266

*If the aggregate used in the concrete develops 95 percent or more of the strength of washed sand and gravel from Steilacoom, Washington when tested, in accordance with Section 37-2.02C, the following proportions of cement and aggregates may be used in Class AX concrete:

Sacks of cement per cubic yard	6.5
Pounds of dry fine aggregate	210
Pounds of dry No. 2 coarse aggregate	280

TABLE II

(Proportions by Weight 2½" Maximum size Aggregate)

CLASS OF CONCRETE	E	F	G	H
Sacks of cement per cubic yard	6.0	5.25	4.5	6.0
Pounds of dry fine aggregate	214	264	283	188
Pounds of dry No. 2 coarse aggregate	224	267	318	245
Pounds of dry No. 3 coarse aggregate	112	128	159	122

The essential requirement for each class and design age of concrete shall be the cement content in sacks per cubic yard of concrete as specified in the above tables. The proportions of the various sizes of aggregate are given as a guide to show the approximate quantities required to produce concrete with the stated cement content. The Engineer will compare the actual cement content of the mixed concrete with the quantity required for concrete of the class that is being produced. In case there is a difference, the quantities of aggregates shall be altered so that the correct amount of cement will be present in the mixed concrete.

If, in the judgment of the Engineer, the workability and finishing characteristics of the concrete can be improved by altering the relative proportion of fine to coarse aggregate as given in tables of this section, such changes shall be made when so ordered by the Engineer.

The weights shown for each size of aggregate are based on an assumed bulk specific gravity of 2.67 for each size of aggregate. In case the actual bulk specific gravity of any aggregate differs from this value the weights shall be adjusted in proportion.

Correction of weights shall also be made for the quantity of water held by the aggregates at the time of weighing.

The volumes of the fine aggregate shown above are based on measurements in a dry condition. In case the fine aggregate contains moisture, proper correction shall be made for the bulking effect.

The above mixtures using portland cement are designed to produce the desired compressive strength at the end of twenty-eight (28) days. The above mixtures using high-early-strength cement are designed to produce the desired compressive strength at the end of ten (10) days. Concrete having the desired compressive strength at intermediate periods may be designed by the Engineer, using mixtures of portland cement and high-early-strength cement.

The quantity of water shown in the tables is estimated to be the maximum required to produce a satisfactory consistency. The quantity is the total water entering into the mix, including both the water added at the mixer and the free water held by the aggregate.

The various materials entering into and composing the concrete shall be such as to satisfy the requirements specified above.

–3.02B Air-entrained Concrete

Air-entrained concrete shall be used unless otherwise provided for in the special provisions.

Either air-entrained portland cement or an air-entrained admixture shall be added at the mixer. Both the air-entrained cement and the air-entraining admixture shall conform to requirements of Section 37-2.01E.

The volume of air in freshly mixed concrete shall conform to that specified in Table III which follows:

TABLE III

AIR CONTENT OF FRESHLY MIXED CONCRETE

Maximum Size of Coarse Aggregate (inches)	Air Content Percent by Volume
1½, 2, and 3	5 ± 1
¾ and 1	6 ± 1
⅜ and ½	7½ ± 1

If the measured air content is found above or below the values contained in Table III, the Contractor shall immediately make changes in mixing or materials as will be necessary to comply with the requirements for air content.

An automatic dispenser, accurate to 10%, which will introduce the specified amount of air-entraining agent into the mixing water for each cycle of mixing, shall be connected to the mixer.

Aggregates shall be adjusted to compensate for increased yield resulting from air-entrainment so that the specified amount of cement is contained in each cubic yard of concrete. Adjustment shall be made by decreasing the weight of fine aggregates only, unless otherwise directed by the Engineer.

Other admixtures: Calcium chloride or any other admixture for any purpose other than air-entrainment may be added only upon approval of the Engineer and under his supervision.

–3.02C Concrete Admixtures

Concrete admixtures may be used only with the approval of the Engineer.

The additive as approved by the Engineer shall retard the setting time of the concrete, reduce the total mixing water required to obtain the specified slump, and increase the compressive strength of the concrete at 28 days by at least five (5) percent. The drying shrinkage of concrete containing the additive shall not exceed 110% of the shrinkage of the concrete without the additive mixed at the same slump and using the same aggregates and the same cement content. Drying shrinkage shall be measured on 3" x 3" x 11¼" prisms which are moist-cured for 7 days, followed by drying for 14 days at 73.4° F. ± 2° F. in air with a relative humidity of 50 + 2%. Change in length of the specimens during the 14-day curing period, measured to the nearest 0.0001", is defined as the drying shrinkage. Details of the test procedure may be obtained from the State Materials Laboratory. The air content of the concrete containing the additive shall not exceed six (6) percent.

The additive shall be used at the rate recommended by the manufacturer and as directed by the Engineer. It shall be in liquid form, and shall be introduced by means of an automatic dispensing device approved by the Engineer, or it may be added manually by pouring it on the aggregates in the skip of the mixer. In case the additive is added manually, a quantity shall first be diluted with water in proportions as directed by the Engineer, such that a volume of not less than one (1) quart of the diluted solution is measured and added to each batch of concrete.

If required by the laboratory tests, the additive shall be tested before use. A one-quart sample shall be submitted for test. The sample shall be accompanied by a detailed data sheet from the manufacturer giving the following information:

1. Recommended amount of additive to be used at a temperature between 70° F. and 110° F.
2. Approximate amount of air-entrained in a 6½ sack concrete mix per unit of additive added.
3. Recommended reduction in total mixing water in a 6½ sack concrete mix per unit of additive in terms of gallons of water per sack of cement or percentage of total mixing water.
4. Average compressive strength of concrete containing the additive at 7, 28 and 90 days compared to the same mix without the additive.
5. Volume of change of concrete containing the additive compared to the same mix without the additive.
6. Effect on setting time of concrete per unit of additive with complete description of method used to determine setting time.
7. Effect of using the additive at two and four times the recommended rate on setting time, air content, drying shrinkage and compressive strength of the concrete.
8. The test shall be made using the actual materials to be used on the job.

When the Engineer requires that an additive be used, the Contractor will be reimbursed for the actual cost of the additive plus a sum equal to 15% thereof in accordance with Section 9.04. The actual cost of the material plus 15% shall be full compensation for all cost in connection with furnishing the additive and incorporating it in the concrete, as outlined herein.

For the purpose of providing a common proposal for all bidders and for that purpose only, when additives are required the Engineer will estimate the cost of the item of work above described and will arbitrarily enter the amount in the bid proposal to become a part of the total bid by the Contractor.

107–3.03 CARE AND STORAGE OF CONCRETE AGGREGATES

Fine and coarse aggregates for concrete shall not be stored upon the work site where passing traffic, vehicles or contractor's equipment will cause foreign matter to contaminate the aggregates. Whenever aggregates are deposited in piles directly upon the ground, the ground around and alongside the piles shall be kept moist by sprinkling. Coarse and fine aggregates that have become coated with foreign matter prior to use shall be rejected.

The distribution of aggregates shall be so made that a clear space will be left between the foot of the piles of the fine and the coarse aggregate.

Aggregates shall be handled at all times so as to prevent segregation of coarse and fine particles.

107–3.04 STORAGE OF CEMENT

The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment. Bulk cement for municipal use shall not be stored in the same bin with cement which is to be used for other purposes. Cement shall be adequately protected from rain and dampness at all times. Any cement which in the opinion of the Engineer contains lumps that will not be pulverized in the mixer shall be rejected.

High-early-strength cement stored by the Contractor for a period longer than 30 days, or portland cement stored by the Contractor for a period longer than 60 days shall be held for retest. If the cement has lost strength during the period of storage, as shown by tests of a competent laboratory, sufficient additional cement shall be added to the mix at Contractor's expense to overcome such loss of strength, or the cement may be rejected by the Engineer. The amount of cement to be added to the mix shall be determined by the Engineer and his decision shall be final and binding upon the Contractor.

107–3.05 MEASURING MATERIALS

Cement shall be measured by the sack of 94 pounds net. Unless specifically authorized by the Engineer in each case, batches of concrete shall be so adjusted that fractional sacks of cement are not required. When permitted by the Engineer, the addition of fractional sacks shall be accomplished by actual weight. For this purpose the Contractor shall provide suitable scales and shall station a workman whose sole duty is to make such weights.

If cement is handled in bulk it shall be weighed on scales meeting the requirements of Section 21, Weighing Equipment.

Proportions of fine and coarse aggregates shall, unless otherwise provided in the special provisions, be measured by weight, making proper corrections for the free water held by the aggregates.

The weighing of the fine aggregate and each size of coarse aggregate shall each be a separate and distinct operation, the weight for the particular aggregates being proportional to their respective bulk specific gravities. The equipment for weighing aggregates shall comply with the requirements for weighing equipment in Section 21.

107–3.06 MIXING CONCRETE

–3.06A Machine Mixing

Concrete shall be thoroughly mixed in a batch mixer of an approved size and type and in one so designed as to positively ensure a uniform distribution of the materials throughout the mass. Batches shall be proportioned on the basis of integral sacks of cement.

In general, all concrete shall be mixed for a period of not less than one (1) full minute after all materials including water are in the mixer, except for classes D and H concrete, which shall be mixed one and one-half (1½) minutes. Less mixing time may be allowed by the Engineer for special types of mixing equipment if tests indicate that equal or better results are obtainable.

During the period of the mixing, the drum shall operate at the speed for which it has been designed. Such speed, preferably, shall be not less than one hundred seventy-five (175), nor greater than two hundred twenty-five (225) feet per minute at the periphery of the drum, and not less than fourteen (14), nor more than twenty (20) revolutions per minute. The entire contents of the mixer shall be removed from the drum before materials for the succeeding batch are placed therein, and the mixer preferably shall be equipped with mechanical means for preventing the addition of aggregates after mixing has commenced.

The mixer shall be equipped with a water measuring device conforming to the requirements of Section 37-3.03C2 and shall preferably be equipped with a batch meter or other device for accurately recording the number of revolutions for each batch, and an attachment for automatically locking the charging device so as to prevent the emptying of the mixer until the materials have been mixed the minimum specified time. No mixer shall be operated above its rated capacity and no mixer shall be used which has a rated capacity of less than a 2-sack batch.

The first batch of concrete materials placed in the mixer shall consist of a mixture of sand, cement and water sufficient to cover the inside surface of the mixing drum with a coating of cement mortar. Upon the cessation of mixing for any considerable length of time the mixer shall be thoroughly cleaned. Cost of materials used for coating the mixer shall be considered as incidental to the work and no compensation will be made for it.

–3.06B Hand Mixing

Hand mixing will not be permitted except in case of emergency and under written permission from the Engineer. When permitted, it shall be done only on water-tight platforms. The sand shall be spread evenly over the platform and the cement spread upon it. The sand and cement shall then be thoroughly mixed while dry by means of shovels until the mixture is of a uniform color, after which it shall be formed into a "crater" and water added in an amount necessary to produce mortar of the proper consistency. The material upon the outer portion of the "crater" ring shall then be shoveled to the center and the entire mass turned and sliced until a uniform consistency is produced. The coarse aggregate shall then be thoroughly wetted and added to the mortar and the entire mass turned and re-turned at least six (6) times and until all of the stone particles are thoroughly covered with mortar and the mixture is of a uniform color and appearance. Hand-mixed batches shall not exceed one-half (½) cubic yard in volume. Hand mixing will not be permitted for concrete to be placed under water.

–3.06C Ready-Mixed Concrete

Ready-mixed concrete may be used if approved by the Engineer. Approval will be given if investigation of the plant and delivery system indicates that concrete delivered to the site of the project will conform in all respects with the applicable requirements of Section 37-3.08, and the Standard Specification for Ready Mix Concrete ASTM C 94.

–3.06D Retempering

Concrete shall be mixed only in such quantities as are required for immediate use, and shall be used while fresh before initial set has taken place. Any concrete in which initial set has begun shall be wasted and not used in the work. No retempering of concrete will be allowed.

107–3.07 CONSISTENCY

The quantity of mixing water to be used in each case shall be determined by the Engineer, and no changes shall be made without his consent. In general, a mixture shall be used which contains the minimum amount of water consistent with the required workability.

A wetter consistency will be required in Class D concrete than with other classes of concrete. With this exception, the consistency of concrete mixtures shall be such that:

1. The mortar will cling to the coarse aggregate.
2. The concrete will not be so fluid that it will segregate when transported to the place of deposit.
3. The concrete, when dropped directly from the discharge chute of the mixer, will flatten out at the center of the pile but will stand up and not flow at the edges.
4. The mortar will show no free water when removed from the mixer.
5. The upper layer of the set concrete will show a cement film upon the surface but will be free from laitance.

107–3.08 PLACING CONCRETE

Concrete placing operations for concrete structures or parts thereof shall not be started by the Contractor without first obtaining approval from the Engineer, and the concrete placing shall proceed continuously, after starting, until the structure or portion of structure being placed has been completed between expansion joints, construction joints, or such other limits as required and shown on the plans, or directed by the Engineer in accordance with these specifications.

Mixed concrete shall be placed as soon as possible after mixing and before initial set has occurred. In no case shall concrete be used which does not reach its final position in the forms within one and one-half (1½) hour after water is first added to the mix. If concrete which is mixed and then transported to the job is too stiff to be properly worked after it has been placed in its final position in the forms, the time between mixing and placing the concrete in the forms shall be reduced. The method and manner of placing concrete shall be such as to avoid the possibility of segregation or separation of the aggregates, or the displacement of the reinforcing steel.

All concrete shall be placed in continuous horizontal layers and so compacted that there will be no line of separation between succeeding batches or layers. Special care shall be taken to fill each part of the forms by depositing concrete directly as near the final position as possible, to work the coarse aggregates back from the face and to force the concrete under and around the reinforcing bars without displacing them, and to avoid sand or rock pockets. When necessary, openings shall be provided in the forms, or equivalent provided, to permit the placing and consolidation of concrete in such a manner as to avoid accumulation of spattered concrete from setting hard on the forms or reinforcing steel surfaces prior to their final contact with plastic concrete.

Dropping concrete more than five (5) feet, or in large quantities and running it down long inclined slopes in the forms will not be permitted.

–3.08A Sequence of Placing Concrete

The sequence of placing shall be according to the placing diagram or notes, or as directed by the Engineer.

Copings of piers shall not be placed for at least twenty-four (24) hours after shafts and webs are placed.

Before concrete bridge floors are placed on steel spans the centering under the bridge shall be released and the span swung free on its supports.

Concrete in slabs and stems of T-beam or deck girder spans when stem of girder or beam is over 3'-0" in depth shall be placed in separate operations, i.e., the beams or girders shall be first placed to the bottom of slab fillets. Sufficient time shall elapse between placing of beam or girder stems and deck slab to allow shrinkage to occur. This time shall, in general, be approximately 12 hours.

Suitable shear keys shall be provided in the top of beam or girder stems to secure a positive and mechanical bond between the stem and the slab. The size of these keys shall be shown on the plans. In general, suitable shear keys may be formed by the use of timber blocks 2" x 8" in cross section and having a length of 4" less than the width of the stem. These keys shall be placed in the concrete along the top of beam or girder stems as required, but the spacing shall not be greater than 16" center to center. The blocks shall be slightly beveled in such manner as to ensure their ready removal. Shear keys shall be depressions in the concrete. Raised keys will not be allowed.

Concrete in slabs and stems of T-beam or deck girder spans when the depth of stem is 3'-0" or less may be placed in one continuous operation subject to approval of the Engineer and provided that completion of placing and finishing of the deck slab will be done during daylight hours.

Concrete in cross beams, bulkhead walls, brackets, etc., shall be placed either with the girders or the slabs as indicated on the plans. Shear keys shall be provided at all construction joints, and where the size of keys is not shown on the plans they shall be approximately one-third of the area of the joint and not less than 1½ inches deep.

Shear keys shall be provided at all construction joints for piers, columns, walls, etc., whether or not they are shown on the plans. The area of the depressed part of the key shall be approximately one-third (⅓) of the area of the joint.

Roadway curb and sidewalk curb to bottom of rail web shall be placed with the sidewalk slab unless otherwise provided on the plans or directed by the Engineer.

Rail posts, in general, shall be first placed and railing between posts then placed continuously. Stopping of the concreting operation at intermediate points between posts will not be allowed except when specifically shown on the plans. Whenever practicable, railing for the full length of one side of the roadway shall be placed in one operation.

The concrete in arch rings shall be placed in such a manner as to load the centering symmetrically and uniformly.

In filled spandrel arches, the arch ring shall be placed either by monolithic method, or in transverse sections. In long spans the Contractor may be required to load the crown in order to guard against unequal distortion of the forms during the process of placing. In placing the arch ring a key shall be cast, either inverted or outstanding to take the shear of the spandrel walls. Shear steel may be substituted in place of keys if approved by the Engineer, but the steel shall be furnished by the Contractor at his own expense and shall be placed in the manner and amount directed.

In open spandrel arches the arch ribs shall be placed in sections in accordance with the pouring diagrams, leaving small key sections between large sections to be filled after the shrinkage has taken place in the large sections.

All concrete shall be placed in the sequence given in the placing notes or diagram, and each numbered or lettered section shall require continuous placing until its completion.

Wherever possible, all foundation excavations shall be completely dewatered and the concrete be deposited in the open. If it is not possible to proceed in this manner, a seal of concrete of sufficient thickness to resist any possible uplift shall be deposited under water in accordance with the requirements of Section 107-3.08C, Placing Concrete in Water.

–3.08B Placing Concrete in Cold Weather

Concrete for structures shall not be placed on frozen ground nor be mixed or placed while the atmospheric temperature is below 35 degrees Fahrenheit unless adequate means are employed to heat the aggregates and water and unless satisfactory provision has been made for protecting the work.

Concrete shall be effectively protected from cold temperatures for a period of five (5) days after placing. In addition to heating the aggregates and water prior to mixing the concrete, it shall be the responsibility of the Contractor to provide suitable means for protecting the concrete for the five-day curing period. The Contractor shall have the option of providing suitable methods of heating the concrete in the forms, insulating the forms, or using such other methods or procedures as he may devise to effectively protect the concrete from cold temperatures.

The Contractor shall assume all risks in connection with the placing of concrete during cold weather. Permission by the Engineer to place concrete during a cold weather period will in no way assure acceptance of the work by the Owner. If the concrete placed under such conditions proves unsatisfactory in any way, the Engineer shall have the right to reject the work although the plan and the work was carried out with his tacit permission.

–3.08C Placing Concrete in Water

In no case shall concrete be placed in running water. Whenever permission is given to place concrete under water it shall be so placed within the confines of a watertight compartment, such as a cofferdam, tube or caisson.

Concrete placed under water shall be mixed with more water than is ordinarily permissible in order to make it more flowable, and shall be placed by means of a tremie, or by a closed bottom dump bucket. The width of section of footing being poured shall not exceed eighteen (18) feet for each tremie or bucket used.

When the concrete is to be placed by a tremie, the method of construction shall comply with the following requirements:

(1) The tremie shall consist of a tube having a diameter not less than ten (10) inches, and a hopper which will hold at least one (1) batch.

(2) A satisfactory method of expelling the water and first filling the tremie shall be used.

(3) The tremie tube shall be kept full to the top. In placing concrete through a tremie, two distinct handling devices shall be used; (a), raise, lower and place the tremie and (b), deliver concrete to the tremie. When a batch is dumped into the hopper at the top the tremie shall be raised slightly, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper or the top of the tremie tube. The flow shall then be stopped by lowering the tremie.

(4) The seal shall be completed by placing full thickness as the seal advances from one end of cofferdam to the other, keeping the finished surface of the concrete as nearly level as possible.

(5) The concrete shall be placed continuously until the required seal is completed.

Concrete shall not be placed in water by a bucket without the written approval of the Engineer.

When concrete is to be placed by means of a closed

bottom dump bucket, the method of construction shall comply with the following requirements:

(1) The bucket shall be full and completely closed before being lowered into the water.

(2) The bucket shall be lowered slowly through the water until it rests on the bottom.

(3) The bucket shall be raised very slowly during the discharge travel, the purpose being to keep the water as still as possible at the point of discharge and to agitate the mixture as little as possible.

In either method, a tremie or closed bottom dump bucket, if for any unavoidable reason it becomes necessary to discontinue the placing before the required seal is completed, the Contractor may be required to remove all concrete placed in the seal at his own expense.

When concrete is to be placed under water, the Contractor may, if he so elects, use methods whereby the aggregates are preplaced within the cofferdam before the introduction of the cement grout, provided however, that prior approval of the proposed method and procedure is obtained from the Engineer.

107–3.09 CONCRETE EXPOSED TO SEA WATER

Concrete structures that will be affected by action of sea water shall be constructed to provide maximum resistance to the deteriorative effects.

Reinforcement bars shall be stored in such manner as to avoid the formation of rust and shall be placed in the concrete in a clean and rust-free condition.

Sharp corners in concrete work exposed to sea water shall be avoided.

The concrete shall be mixed not less than two (2) minutes. The water content shall be carefully controlled and so regulated as to produce concrete of maximum impermeability. When placing the concrete it shall be thoroughly consolidated to the extent necessary to form a dense concrete disclosing no coarse aggregate pockets at the surface when forms are removed. The original surface of concrete after removal of the forms shall be left undisturbed. In order to secure a thick and dense surface film the surfaces of forms shall be heavily coated with shellac or approved form oil.

The range of possible deterioration of the concrete from an elevation below that of extreme high tide shall be determined by the Engineer and, except with his special permission, no construction joints shall be located within this range. In the determination of this range due consideration shall be given to wave action and other conditions affecting the extreme limits of possible deterioration and disintegration.

Concrete in sea water within the range as above described shall, in all cases, be deposited in the dry.

Forms shall not be removed for a period of thirty (30) days, or longer if required by the Engineer, so that the sea water will not come in direct contact with the concrete until it is thoroughly hardened.

When concrete piles are to be used in sea water special care shall be exercised to avoid slight deformation cracks caused by handling. Concrete piles for use in sea water shall be cured for not less than thirty (30) days before being used.

107–3.10 CONCRETE EXPOSED TO ALKALINE SOILS OR WATER

In general, the same requirements as above specified for concrete in sea water shall govern the construction of concrete in alkaline soils or water.

Concrete shall not be allowed to come in direct contact with alkaline soil or alkaline water until it shall have been allowed to set at least thirty (30) days, and longer if possible.

No construction joint will be permitted below an elevation two (2) feet above the ground line. The surface cement film shall be left intact as it comes from the form. To secure a heavy and dense surface film the form surface shall be heavily coated with shellac or an approved form oil.

Concrete piles for use in alkaline soils, unless otherwise specified, shall be subject to the same requirements as are provided hereinbefore for concrete piles in sea water.

107–3.11 VIBRATION OF CONCRETE

The Contractor shall provide suitable vibrating tampers for use in placing and compacting all concrete except that which is placed under water. The vibrators shall be of the type designed to be placed directly in the concrete and their frequency of vibration shall be not less than 4,500 impulses per minute when in actual operation. The type of vibrator and its method of use shall be subject to the approval of the Engineer.

Vibrators shall be inserted to a depth sufficient to vibrate the bottom of each layer effectively but not deep enough to affect partially hardened concrete. Care shall be taken not to apply the vibrator directly to steel which extends into partially hardened concrete.

External vibrators may be used on steel forms for precast members, but shall be supplemented as necessary by internal vibration.

In general, vibration required shall be limited to an amount necessary for concrete that is uniformly plastic and dense and free of pools of grout as a result of excessive vibration. The Contractor shall provide enough vibrators and operators necessary to obtain the required objectives, and if needed for satisfactory work he shall also do hand tamping and spading with suitable tools.

107–3.12 FINISHING STRUCTURE ROADWAY AND SIDEWALK SLABS

Surface finish of the roadway slabs in a structure shall conform to these specifications and with Section 39-3.19 for cement concrete pavement, unless otherwise shown on the plans or provided in the special provisions.

Concrete for roadway slabs shall not be placed until the Engineer is satisfied that the rate of producing and placing concrete will be sufficient to complete the proposed pour and the finishing operations within the scheduled time, that experienced concrete finishers will be employed to finish the deck, and that all necessary finishing tools and equipment are on hand at the site of the work and in satisfactory condition for use.

Concrete shall be placed at such a time that finishing operations can be completed during daylight hours unless adequate lighting facilities are provided by the Contractor and approval is given by the Engineer.

Any low area shall be corrected with an approved epoxy grout which will not be higher than the surrounding finished deck surface and shall have dry portland cement applied to give it a concrete-like appearance.

High spots shall be corrected by cutting down the high areas of concrete with a diamond-faced saw type machine. The machine shall be capable of cutting through mortar and aggregate without breaking or dislodging the aggregate or causing spalls. Where the areas of concrete to be removed are less than ⅛ inch in depth, other types of grinding machines will be permitted.

Lowered or built up areas shall have substantially the same surface texture as the rest of the deck.

Concrete for sidewalk slabs shall be well compacted, then struck off with a strikeboard and floated with a wooden float. An edging tool shall be used on all edges and at expansion joints as shown in Section 39-3.19C unless otherwise authorized by the Engineer. The surface shall not vary more than ⅛ inch under a 10-foot straightedge. The surface shall have a granular texture which will not be slick when wet, i.e., Class 7 finish, as specified in Section 107-3.17D.

107–3.13 CURING CONCRETE

All freshly finished concrete surfaces, such as roadway and sidewalk slabs of structures, shall be cured by one of the applicable methods described in Section 39-3.20 for cement concrete pavement until the concrete has attained the design strength of Section 107-3.02A for the class of concrete, as determined by the Engineer; it is excepted, however, that curing time shall not be less than seven (7) days for concrete made with portland cement, and not less than three days when high-early-strength cement is used. Curing shall start as soon as the fresh concrete has set to a degree that will allow application of the curing agents without damage to the finished surface.

Curing of structure concrete surfaces, protected from drying out by the forms, will not be required provided

the forms remain in place the necessary time for the concrete to attain sufficient design strength. It will be required, however, that when wood forms, except for plywood, are used they shall be periodically wetted with water to prevent excessive drying.

White pigmented curing compound shall conform to the specifications outlined in Section 37-2.08.

All costs in connection with curing of concrete shall be included in the unit prices for concrete in place.

107–3.14 CONSTRUCTION JOINTS

Construction joints for structures shall be made only where shown on the plans. Approval by the Engineer must be obtained before making construction joints other than where shown on the plans. All construction joints shall be either horizontal or vertical, or if the main reinforcement is inclined, the joints shall be normal to the direction of the main reinforcement.

If the section is subject to shear, sufficient material as a key, or shear steel, or both, shall be provided to transmit the shear across the construction joint.

Before placing fresh concrete against existing concrete and construction joints, the existing concrete face shall be thoroughly cleaned of all scum, laitance, honeycomb and high spots, and the surface wetted with water.

All material and labor required for the construction of construction joints shall be included in the unit contract price per cubic yard for concrete in place.

107–3.15 EXPANSION JOINTS

Expansion joints for bridge structures shall be constructed to detail shown on the plans, and only where designated on the plans.

Open joints shall be placed at location designated on the plans and shall be formed by the insertion and subsequent removal of a template of timber, metal or other suitable material. The method of insertion and removal of joint templates shall be such as to avoid the possibility of chipping or breaking down at the edges and the template shall be so constructed that removal may be readily accomplished without injury to the concrete.

The joint sealer material shall be applied to the joints by means of liquid pressure pumps or guns. Caulking grade joint sealer (non-flow type) meeting all above requirements except viscosity, may be used on vertical curb facings. On all applications, the manufacturer's instructions with regard to mixing and installation shall be rigidly followed.

When an expansion joint is offset so that part of the joint lies in a position parallel to the direction of expansion, this part of the joint shall have positive clearance between the two surfaces of at least one-half (½) inch. The clearance shall be obtainecd by inserting a strip at least one-half (½) inch thick in such a way that it may be removed after the concrete has set. Care shall be exercised to make these surfaces parallel to the direction of the expansion in order that no wedging action will take place during natural expansion and contraction.

Special types of expansion joints may be used when specified on the plans or ordered by the Engineer.

All costs in connection with furnishing and placing the joint filler and joint sealer material, including all necessary equipment, tools, and labor, as outlined herein, shall be considered as incidental to the construction, and shall be included in the unit contract price per cubic yard for "Concrete Class A," or "Concrete Class AX."

107–3.16 FINISHING FORM-FINISHED CONCRETE SURFACES

Formed surfaces of structure concrete shall, after the removal of forms, show a smooth dense concrete face. Any surface which does not show a dense concrete surface, is porous or is otherwise defective shall be corrected to the requirements of the specifications by whatever means as may be necessary, and at the expense of the Contractor. Surfaces formed using oiled plywood panels and properly controlled concrete will generally provide a satisfactory surface for the finishing operations. All formed surfaces shall be finished in accordance with one of the classes that follow unless otherwise indicated on the plans or in the special provisions.

–3.16A Class 1 Surface Finish

Class 1 finish shall be applied to all formed surfaces of structures prominently exposed to the public inspection for which accurate alignment and evenness of the formed surfaces are of paramount importance for appearance. Included in this category are curbs, parapets, railings and decorative features on dams, bridges and permanent buildings. Class 1 finish shall be essentially the same finish as specified for a Class 2 surface finish except that the surface smoothness tolerance shall be not more than one-eighth (⅛) inch when tested for smoothness with a ten (10) foot straightedge, or the equivalent template for curved surfaces.

–3.16B Class 2 Surface Finish

Class 2 surface finish, except as otherwise provided herein, shall be applied to all formed surfaces of structures that are exposed to public inspections. For this class of finish, the surface shall be such as to have no abrupt irregularities that exceed one-fourth (¼) inch when tested with a ten (10) foot straightedge, or an equivalent template for curved surfaces.

After removal of forms to obtain a Class 2 surface, all lips and edgings where form boards have met shall be removed with a sharp tool or stone. Form ties shall be removed to a depth not less than one-half (½) inch below the surface and the holes filled with 1:2 mortar and floated to an even and uniform surface. The surface of the concrete shall be thoroughly washed with water and a 1:1 mortar applied with brushes and well worked into the small air holes and other crevices in the face of the concrete. As soon as the mortar has taken its initial set it shall be rubbed off, using a sack or piece of carpet for that purpose. The mortar paint shall not be allowed to take its final set before being rubbed off.

Only that amount of surface that can be finished during one day shall be painted. Mortar allowed to set too hard to be rubbed off as above described, shall be removed with a carborundum stone and water. As soon as the mortar paint has set sufficiently hard, water shall be sprayed over the finished surface as a curing agent and the surface shall be kept damp for not less than two days.

The use of stones to rub all of the surfaces, thereby breaking the protective film on the face of the concrete, will not be allowed. The same brand of cement shall be used for finishing as was used in the concrete. The work shall be performed to the satisfaction of the Engineer.

Class 2 finish shall be applied to the following surfaces:

(a) Highway Structures:

1. All surfaces of superstructures for highway grade separation structures and railroad undercrossing structures except the under surfaces of slab spans, box girders, filled spandrel arches, floor slabs between girders and inside vertical surfaces of girders.
2. All surfaces above finished ground line of bridge piers, columns, abutments, retaining walls, and culvert head walls within one hundred fifty (150) feet of any traveled roadway or pedestrian walkway.
3. The outside vertical surfaces of the superstructure of all structures, including the under surfaces of cantilever floor slabs overhanging outside girders or box girders.
4. All surfaces of open spandrel arch rings, spandrel columns and abutment towers.
5. The top surface of the bottom flange of prestressed girders.

(b) All concrete surfaces of structures that are exposed to public view, such as for sewer, water and treatment works, power stations, dams, et cetera, unless otherwise exempted by the special provisions.

–3.16C Class 3 Surface Finish

Class 3 surface finish applies to all formed surfaces upon or against which backfill or concrete will be placed or which will not be exposed to public view. The finish, in addition to the removal and repair of defective concrete and the specified curing, will require correction of

surface irregularities when they exceed one-half (½) inch under a 10-foot straightedge. All form ties shall be removed and the holes be filled as specified for Class 2 finish, except that the removal of tight form ties below the surface of the concrete will not be required for surfaces buried underground or covered by fill or concrete.

Class 3 surface finish shall be applied to the following surfaces:

(a) The under surfaces of floor and roof slab spans not critical as to appearance.

(b) The inside surfaces of structures such as underground pumping plants for sewer works that are entered through small circular manhole openings not larger than three (3) feet in diameter.

(c) Surfaces which will be buried underground or covered with fill.

(d) Upstream surfaces of dams which will be under water.

(e) For the following surfaces Class 3 finish will include the removal of all lips and edges, and all air bubble holes larger than ¾ inch in diameter or ⅜ inch deep shall be filled as specified under Class 2 finish.

1. The under surfaces of slab spans, box girders, filled spandrel arches and floor between girders for all structures.
2. The inside vertical faces of girders for all structures.
3. Surfaces of bridge piers, columns, abutments, retaining walls and culvert head walls which are more than one hundred fifty (150) feet from any traveled roadway or pedestrian walkway.

107–3.17 FINISHES FOR FLOOR SLABS AND SIDEWALK SLABS

The finished surface of floor slabs for structures shall be one of the finishes described below as may be shown on the plans. Sidewalk slabs shall be finished to a Class 7 finish unless otherwise shown on the plans, in special provisions, or as directed by the Engineer.

–3.17A Class 4 Float Floor Finish

After the concrete for a floor slab has been placed and consolidated to the required thickness, it shall be finished with a suitable wood float so as to produce a uniform and finely textured surface having an overall smoothness tolerance that does not exceed one-eighth (⅛) inch when tested with the standard ten (10) foot straightedge in any direction at overlapping intervals.

–3.17B Class 5 Sweat Floor Finish

After the floor has received a Class 4 finish, it shall be given sufficient time to set up so that a steel trowel can be used. The surface shall then be troweled one or more times until the surface layer of the concrete has a dense surface, even in texture and free of any irregularities. The surface when stroked with the steel trowel shall have a sweaty appearance.

–3.17C Class 6 Hard Trowel Floor Finish

This finish is in addition to a Class 5 finish. After the sweaty effect has been attained, steel troweling shall continue until a hard, dense and polished effect is obtained and no trowel marks are evident.

–3.17D Class 7 Sidewalk Slab Finish

Finish for sidewalk slabs shall be similar to Class 4 except that at the proper time the surface shall be steel troweled to produce a dense surface. The surface shall then be broomed to produce a suitable non-skid texture satisfactory to the Engineer. Before brooming, all joints and edges shall be neatly tooled with a trowel of proper shape and type.

107–4 MEASUREMENT

All concrete, except that in railings, shall be measured by the cubic yard in place for the various classes of concrete. Measurements shall be to the neat lines of the structure as shown on the plans or as authorized in writing by the Engineer, except in the case of concrete in cofferdam seals. Class D and Class H concrete used in the seals of underwater cofferdams will be paid for on the basis of the actual volume deposited as determined by the average cross sectional area of the inside of the cofferdam, excepting however, that no payment will be made for concrete outside of an area which is bounded by vertical planes one foot outside of the neat lines of the seal as shown on the plans, and parallel thereto.

No payment will be made for concrete below the established elevation of the bottom of the footing or seal. No deduction in pay concrete will be made for pile heads, reinforcing steel, structural steel or bolts enclosed in the pour.

107–5 PAYMENT

All concrete, except in railings, will be paid for at the unit contract price per cubic yard in place for the various classes of concrete.

The contract price shall be full compensation for furnishing all materials, equipment, tools, falsework, forms, expansion joint material, labor and all items required to complete the concrete work. Unless otherwise provided, the contract price shall include the furnishing and placing of scuppers and drains.

All costs incurred in construction with the furnishing of and the applying of air-entraining agents into the concrete as specified, shall be considered as incidental to the construction and shall be included in the unit contract prices per cubic yard for the various classes of concrete, and the unit contract price per linear foot for "Reinforced Concrete Bridge Railing."

If, at any time, the Contractor is ordered by the Engineer to furnish concrete requiring the use of high-early-strength cement, payment will be made at the unit contract price for the particular class of concrete with portland cement, plus an allowance consisting of the differential between the price of high-early-strength cement and portland cement, as expressed by the contract price per barrel for "Extra for Furnishing High-early-strength Cement," for the quantity of high-early-strength cement so used. If no such price is included in the schedule of unit contract prices, payment for concrete mixed with high-early-strength cement will be made at the unit contract price for the particular class of concrete involved plus an extra allowance agreed upon in writing between the Engineer and the Contractor.

Section 111—Reinforcing Steel

111–1 DESCRIPTION

Reinforcing steel shall consist of round or square deformed bars or wire mesh. Square twisted bars shall not be used.

111–2 MATERIALS

111–2.01 DEFORMED STEEL BARS

Deformed steel bars for concrete reinforcement sizes No. 3 through 11 shall conform to the requirements of ASTM Designation A-15, Billet Steel Bars for Concrete Reinforcement, intermediate grade, except as noted on the plans, and except that the bars shall be made only by the open-hearth process or the electric furnace process.

The form of the deformed bars shall conform to ASTM Designation A 305, Minimum Requirements for Deformations of Deformed Steel Bars for Concrete Reinforcement.

Deformed bars size No. 14 and size No. 18 for concrete reinforcement shall conform to the requirements of ASTM Designation A-408, Special Large Size Deformed Billet Steel Bars for Concrete Reinforcement, Intermediate Grade.

111–2.02 WIRE MESH

Wire mesh for concrete reinforcement shall conform to the requirements of the standard specifications of ASTM Designation A 185, Welded Steel Wire Fabric for Concrete Reinforcement. All wire mesh shall be of an approved kind and quality of manufacture.

111–2.03 COLD DRAWN WIRE

Cold drawn wire shall conform to the requirements of ASTM Designation A 82, Cold-Drawn Steel Wire for Concrete Reinforcement.

111–3 CONSTRUCTION DETAILS

111–3.01 ORDERING

In general, a bar list and bending diagram will be included in the plans but the Contractor shall use them at his own risk and should check his order from the plans. The Contractor shall furnish the Engineer a bar shipping list including shipping weights.

111–3.02 INSPECTION

–3.02A Notice of Rolling

The Contractor shall give ample notice to the Engineer of the beginning of work at the mill in order that mill inspection may be provided. No material shall be rolled or fabricated before the Engineer has been notified with whom the orders have been placed and where the material will be rolled.

–3.02B Facilities for Inspection

The Contractor shall furnish all facilities for the inspection of material and workmanship in the mill, and inspectors shall be allowed free access to the necessary parts of the premises.

—3.02C Inspector's Authority

The Inspector shall have the authority to reject materials or workmanship which do not fulfill the requirements of these specifications, but in cases of dispute the Contractor may appeal to the Engineer, whose decision shall be final.

Mill inspection is intended to be only a means of facilitating work and avoiding errors. It shall be understood that mill inspection will not relieve the Contractor from responsibility for material and workmanship or from the obligation to replace material found to be defective for any reason after delivery from the mill.

–3.02D Rejections

Rejected materials shall be replaced, corrected, or repaired promptly. Any materials accepted by the Engineer, including those corrected or repaired, shall be subject to subsequent rejection if found to be defective.

111–3.03 BENDING

Steel reinforcing bars shall be cut and bent by careful and competent workmen. They shall be bent cold to templates, which shall not vary appreciably from the shape and dimension shown on the plans.

Hooks and bends of steel reinforcing bars shall be bent to the following inside diameters unless shown otherwise on the plans:

Stirrups and ties:

Size No. 2 and No. 3	1½ inches
Size No. 4	2 inches
Size No. 5	2½ inches
Size No. 6	3 inches

All other bars:

Size No. 2 through No. 7	6 bar diameters
Size No. 8 and No. 9	8 bar diameters
Size No. 10 through No. 18	10 bar diameters

In forming hooks on the ends of bars, the bar shall extend at least four (4) diameters beyond the bend.

–3.03A Lengths

Net lengths of bent bars shown in the "Length" column of the bar list on the plans are rounded to the nearest inch. Net length is the length of bar after all bend deductions are subtracted from the gross length.

The following bend deductions per 90° bend have been subtracted from the gross length:

	Stirrups or ties	*All other bars*
Size No. 2	½ inch	½ inch
Size No. 3	¾ inch	1 inch
Size No. 4	1 inch	1½ inches
Size No. 5	1¼ inches	1½ inches
Size No. 6	1¾ inches	2 inches
Size No. 7		2 inches
Size No. 8		3 inches
Size No. 9		3½ inches
Size No. 10		4½ inches
Size No. 11		5 inches
Size No. 14		6 inches
Size No. 18		7½ inches

For bends other than 90°, a direct proportion of these deductions will be used. The bend deductions listed will apply, except where bending radii are shown on the plans.

For standard hooks on the ends of bars the following hook lengths, in addition to the out to out detailed dimension, have been provided:

	Length Added for One Hook		
	180° Hook All Bars	*90° Hook Stirrup or Tie*	*90° Hook All Other Bars*
Size No. 2	4″	3½″	3½″
Size No. 3	5″	3¾″	5″
Size No. 4	6″	4″	7½″
Size No. 5	7″	4¾″	9½″
Size No. 6	8″	5¼″	11″
Size No. 7	10″		1′-1″
Size No. 8	1′-1″		1′-2″
Size No. 9	1′-3″		1′-4½″
Size No. 10	1′-7½″		1′-6½″
Size No. 11	1′-9½″		1′-9″
Size No. 14			2′-1″
Size No. 18			2′-9½″

111–3.04 PROTECTION OF MATERIALS

Reinforcing steel shall be protected at all times from injury and, when placed in the structure, shall be free from dirt, loose mill scale and rust scale, paint, oil or other defects affecting the strength or bond with the concrete.

111–3.05 PLACING AND FASTENING

Reinforcing steel shall be placed in the exact positions shown on the plans and held securely during the pouring of the concrete. All reinforcement shall be put in proper position, then be securely wired and blocked before concrete is poured in any section. All abrupt bends shall be avoided except where one steel member is bent around another. Vertical stirrups shall always pass around the main tension members or be securely attached thereto, unless otherwise shown on the plans.

All reinforcing steel shall be securely blocked from the forms by means of small mortar blocks not more than one and one-half (1½) inches square, or by other approved devices. The blocks shall be constructed of mortar mixed with the proportions of two parts of sand and one part of cement. If metal chair supports are used as supports for steel reinforcing bars, they shall be hot-dipped galvanized for all surfaces not covered by at least ½ inch of concrete.

Reinforcing steel which interferes with bridge drains shall be bent in the field as may be required to clear the drains.

The minimum clear space in inches between reinforcing bars shall be as follows:

Between adjacent bars in a layer	2½″
Between adjacent layers	2 ″

Except as otherwise shown on the plans, the thickness of concrete cover over reinforcing bars shall be as follows:

Between main bars and surface of concrete (except in slabs and walls)	2 ″
Between main bars and surface of concrete in retaining walls	1½″
Between main bars and surface of concrete deposited against earth (without intervening forms)	2½″
Between slab bars and bottom of slab	1 ″
Between slab bars and top of slab	1½″
Between stirrups and ties and surface of concrete	1 ″

In concrete exposed to the action of salt or alkaline water the minimum cover over main reinforcing bars

shall be three (3) inches, unless otherwise shown on the plans.

Just prior to placing concrete, all mortar, mud, loose rust, scale or other coatings that will weaken the bond with concrete shall be cleaned from the reinforcement.

In the construction of roadway and sidewalk slabs, special attention shall be given to the placing of reinforcing steel to ensure that proper cover and wearing surface is provided.

No concrete shall be deposited until the Engineer has inspected the placing of the reinforcing steel and has given permission to pour concrete. All concrete placed in violation of this provision shall be rejected and removed.

111–3.06 SPLICING

–3.06A Steel Bars

All Steel bars for concrete reinforcement shall be furnished in the full lengths indicated upon the plans. No splicing of bars, except where shown on the plans, will be permitted without the written approval of the Engineer.

Splices which are permitted shall have lengths each not less than thirty-five (35) times the nominal diameter of the reinforcement unless otherwise specified on the plans, and shall be well distributed or else located at points of low tensile stress.

No splices will be permitted at points where the section is not sufficient to provide a minimum distance of two (2) inches between the splice and the nearest adjacent bar or the surface of the concrete. The bars shall be rigidly clamped or wired at all splices in a manner approved by the Engineer.

–3.06B Wire Mesh

Sheets of wire mesh used as reinforcement in structural slabs shall be spliced in accordance with the following provisions:

(1) Lapped splices of wires in regions of maximum stress (where they are carrying more than one-half of the permissible stress) shall be avoided wherever possible; such splices where used shall be so made that the overlap measured between outermost cross wires of each sheet is not less than the spacing of the cross wires plus two (2) inches.

(2) Splices of wires stressed at not more than one-half the permissible stress shall be so made that the overlap measured between the outermost cross wires is not less than two (2) inches.

Sheets of wire mesh reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges.

–3.06C Welding

Where shown on the plans, butt welding of steel reinforcing bars shall be accomplished by the shielded metal arc process and by the direct butt method using low-hydrogen electrodes.

Steel suitable for welding shall be furnished for bars which are to be welded. Steel which is to be welded shall have a maximum carbon equivalent of 0.60 percent. The carbon equivalent shall be determined by the following formula:

$$\text{Carbon Equivalent} = \frac{\text{percent Carbon}}{} + \frac{\text{percent Manganese}}{6} + \frac{\text{percent Chromium}}{10} + \frac{\text{percent Molybdenum}}{50} + \frac{\text{percent Vanadium}}{10} + \frac{\text{percent Copper}}{40} + \frac{\text{percent Nickel}}{20}$$

The carbon shall not exceed 0.40 percent and the manganese content shall not exceed 1.30 percent.

Preheat and interpass temperatures of A-15, A-408 and A-432 steel shall be not less than 250°F.

The coatings of the low-hydrogen type electrodes shall be in satisfactory condition at the time of use in accordance with the requirements outlined in Section 112-3.33 of the standard specifications.

Welds shall be made by welders qualified by the following procedure:

Under supervision of an approved Welding Inspector, the welder shall weld 4 test welds on each size of bar to be welded and in the same positions as will be used on the project. The test welds shall be submitted to a Materials Laboratory for testing; 3 of the 4 test welds shall develop the full strength of the bar welded. No welding on the project will be permitted until the test welds have been completed and tested to the satisfaction of the Engineer.

Preparation for welding and welding procedure shall be in accordance with good practice and with the current "Standard Specifications for Welded Highway and Railway Bridges" of the American Welding Society. Butt welding shall be done in accordance with "Recommended Practice for Welding Reinforcing Steel, Metal Inserts, and Connections in Reinforced Concrete" of the American Welding Society.

The following procedure for welding steel reinforcing bars is recommended, but if the Contractor elects to use a different procedure it shall be submitted to the Engineer for approval:

1. Welding rod shall be low-hydrogen E 7016 or E 7018 class electrode.
2. Welding machine shall be D.C. current, reverse polarity and in good working condition.
3. For welding vertical steel reinforcing bars, cut the top of the lower rebar off flat. Shearing ruptures the material in the sheared area; therefore, one-half inch must be burned off even if the bar has been sheared flat. Bevel the upper re-bar at 45° both sides, leaving not over ⅛ inch landing in the center as shown on the plans. Remove all burning slag from the upper and lower re-bars.

   Line up the upper and lower bars. Space the bars ⅛ inch apart and tack weld runoff plates 1½" x 3/16" x 1½" in place on both sides. First complete one-half of the weld on one side then change to the other side. Inspect to see that slag is removed from the first pass welded. Complete the weld on the second side and then complete the weld on the first side.
4. For welding horizontal steel reinforcing bars, bevel both bars at 30° and space ends ⅛ inch apart as shown on the plans, so the weld metal will penetrate back-up bar on first weld pass. Use a back-up bar on the bottom side, made up from black steel pipe. Conduit or galvanized pipe shall not be used. Back-up bar (made from pipe) should come up on re-bar about ⅓ of the bar diameter, then tack the run-off plates on. Run-off plates should be about 1½" x 3/16" x 1½".
5. The run-off plates may be left on the re-bar after welding.
6. The welding arc shall be started at least ¾ inch out on the run-off plates. Run the weld bead continuously across the re-bar to ¾ inch out on the run-off plate on the other side. Slag shall be removed completely before each weld pass.
7. Each completed weld shall be to the full size of the re-bar being welded.

Elimination of welds shown on the plans or the addition of welds in other locations will not be permitted without the written approval of the Engineer.

All costs in connection with butt welding of steel reinforcing bars as detailed on the plans and in accordance with these specifications shall be included in the unit contract price per pound for "Steel Reinforcing Bars."

111–4 MEASUREMENT

All reinforcing steel will be measured by the computed weight of all metal actually in place as shown on the plans, or as ordered by the Engineer. No allowance will be made for spreaders, form blocks, wire clips or other fastenings which must be furnished by the Contractor. When splices are made other than those shown on the plans, no allowance will be made for the extra steel required. When shear steel is required at construction joints which are not shown on the plans, and which are permitted for the Contractor's convenience, no allowance will be made for the additional steel required.

For the purpose of computing weights of reinforcing steel, the following table shall be used:

BAR REINFORCING STEEL

Deformed Bar Designation Number	*Nominal Diameter Inches*	*Unit Weight, Pounds per Foot*
2	0.250	0.167
3	0.375	0.376
4	0.500	0.668
5	0.625	1.043
6	0.750	1.502
7	0.875	2.044
8	1.000	2.670
9	1.128	3.400
10	1.270	4.303
11	1.410	5.313
14	1.690	7.650
18	2.250	13.600

111–5 PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract:

1. "Steel Reinforcing Bars, per pound.
2. "Wire Mesh . . . Gage . . . Inch Mesh" per square yard.

The unit contract prices shall include the cost of furnishing, fabricating and placing the reinforcement. In structures of reinforced concrete where there are no structural steel bid items, such minor metal parts as expansion joints and bolts will be paid for at the unit contract price for reinforcing steel, unless otherwise specified.

Section 112—Structural Steel

112-1 DESCRIPTION

Structural steel shall be of two classes: structural carbon steel and high-strength low-alloy structural steel. Those parts which are fabricated of steel other than structural carbon steel, ASTM Designation A-36, will be shown on the plans or specified in the special provisions by their ASTM Designations. All structural parts not so designated shall be fabricated of structural carbon steel, ASTM Designation A-36.

For steel structures, unless otherwise provided in the special provisions, structural steel as a bid item shall include all metal parts required for permanent connections of the component parts of the structural steel and all metals otherwise shown on the plans for use in conjunction with the completed structure, even though they are made of metal other than structural steel.

For a concrete or timber structure, unless otherwise provided in the special provisions, structural steel, other steel, cast steel, cast iron, and other metal materials shown on the plans or described in the specifications for the structure and for which payment is not specifically provided in the proposal, shall be considered as miscellaneous metals for the purpose of payment.

Payment for structural steel and miscellaneous metal will be made as specified in Section 112-5.

112–2 MATERIALS

112–2.01 STRUCTURAL CARBON STEEL

Structural carbon steel shall conform to the following ASTM specifications:

(1) Steel for Bridges and Buildings, ASTM A 7.

(2) Structural Steel for Welding, ASTM A 373 or ASTM A 36.

(3) Structural Steel, ASTM A 36.

The classes of carbon steel shall, if required, be marked at the mill to distinguish them and the fabricator shall keep them carefully separated.

112–2.02 HIGH-STRENGTH LOW-ALLOY STRUCTURAL STEEL

High-strength and low-alloy structural steel shall conform to the following ASTM specifications:

(1) High-Strength Structural Steel, ASTM A 440.

(2) High-Strength Low-Alloy Structural Manganese Vanadium Steel, ASTM A 441.

(3) High-Strength Low-Alloy Structural Steel, ASTM A 242.

The classes of high-strength and low-alloy steel shall, if required, be marked at the mill to distinguish them and the fabricator shall keep them carefully separated.

112–2.03 STRUCTURAL RIVET STEEL

Structural rivet steel as required by the plans shall conform to the following ASTM specifications:

(1) Structural Rivet Steel, ASTM A 141.

(2) High-Strength Structural Rivet Steel, ASTM A 195.

(3) High-Strength Structural Alloy Rivet Steel, ASTM A 406.

112–2.04 RIVET BOLTS

Rivet bolts shall be manufactured from steel containing 0.18 percent to 0.24 percent carbon, and 0.75 percent to 1.00 percent manganese, and having tensile strength of 70,000 pounds per square inch.

112–2.05 BOLTS

–2.05A Unfinished Bolts

Unfinished bolts (ordinary machine bolts), shall conform to the specification requirements of ASTM Designation A 307, Steel Machine Bolts and Nuts and Tap Bolts. They shall be Grade A unless otherwise specified on the plans or in the special provisions.

–2.05B Turned Bolts

Turned bolts or other special bolts shall be made from structural carbon steel as defined in Section 112-2.01, unless otherwise specified on the plans or in the specifications.

–2.05C High-strength Steel Bolts

Refer to Section 112-3.17.

112–3 CONSTRUCTION DETAILS

112–3.01 MILL AND SHOP INSPECTION

–3.01A Notice of Rolling

The Contractor shall give ample notice to the Engineer of the beginning of work at the mill and shop so that inspection may be provided. No material shall be rolled or fabricated before the Engineer has been notified with whom the orders have been placed and where the material will be rolled.

–3.01B Facilities for Inspection

The Contractor shall furnish all facilites for the inspection of material and workmanship in the mill and shop, and inspectors shall be allowed free acess to the neecessary parts of the premises.

–3.01C Inspector's Authorty

The Inspector shall have the authority to reject materials or workmanship which do not fulfill the requirements of these specifications, but in cases of dispute the Contractor may appeal to the Engineer, whose decision shall be final.

Inspection at the mill and shop is intended as a means of facilitating the work and avoiding errors, and it is expressly understood that it will not relieve the Contractor from any responsibility in regard to defective material or workmanship and the necessity for replacing the same.

The Inspector may stamp or tag each individual piece as it is accepted with a private mark previously registered with the Owner (City). The mark or tag shall be in plain view on the steel. Any piece not so marked or tagged may be rejected.

–3.01D Rejections

Any materials accepted by the Engineer, including those corrected or repaired, shall be subject to subsequent rejection if found to be defective. Rejected materials shall be replaced, corrected, or repaired promptly.

112–3.02 FIELD INSPECTION

The erection of structural steel shall be subject to the inspection of the Engineer. He shall be given free access to the site of the project, and the Contractor shall

cooperate with the Engineer in making possible a thorough examination of the field work while it is in progress.

Material and fabrication not previously inspected will be inspected after delivery of the fabricated material to the site of the work.

112–3.03 MILL ORDERS AND SHIPPING STATEMENTS

The Contractor shall furnish the Engineer with as many copies of mill orders and shipping statements as the Engineer may direct.

112–3.04 WEIGHING

Structural steel need not be weighed unless specified on the plans or in the special provisions.

In the event the weight of structural steel is required, the weight may be either calculated or obtained by scales, and as many copies of the calculations or weight slips shall be furnished as specified or directed by the Engineer. Calculated weights shall be made in compliance with the latest code of American Code of Standard Practice by American Institute of Steel Construction, Inc.

If scale weights are furnished, the weights of all tools, erection material and dunnage shall be kept separate.

112–3.05 LOADING AND UNLOADING

The loading, transporting, unloading and piling of the structural material shall be so conducted that the metal will be kept clean and free of injury from rough handling.

112–3.06 SHOP PLANS

The Contractor will be required to submit to the Engineer, for approval, all shop detail plans required for fabrication of the steel.

Two sets of prints shall first be submitted to the Engineer for checking, except that for grade separation structures which carry a railroad over the highway, five (5) sets of prints shall be submitted. Only drawings which have been checked by the Contractor or his agent will be accepted. One set of prints of the shop plans will be returned to the Contractor, either without change or with corrections marked thereon. After the required revisions have been made by the Contractor, additional sets of prints from five to thirteen in number, as requested, shall be furnished to the Engineer for final approval. No material shall be fabricated until the plans have been given final approval by the Engineer.

Provision for attachment of other types of materials to steel members shall be shown on the shop plans.

The approval of shop plans shall be understood to be an acceptance of the character and sufficiency of the details, and not a check of the dimensions.

No changes shall be made in any drawing after it has been approved except by the consent or direction of the Engineer in writing.

Prior to the completion of the project, the Contractor or his agent shall furnish to the Engineer the original tracings, or acceptable reproductions of the original drawings of the shop plans. All drawings shall be on sheets each twenty-two (22) inches wide by thirty-six (36) inches long in overall dimensions, or on smaller sheets that are multiples of eight and one-half (8½) inches by eleven (11) inches.

112–3.07 SUBSTITUTIONS

Substitutions of sections having different dimensions than those shown on the plans shall be made only when approved in writing by the Engineer. Should the substitution of heavier members be allowed upon the Contractor's request, no extra weight over the original design section will be allowed in payment.

112–3.08 SHOP STORAGE OF MATERIALS

All material stored at a steel fabricating plant shall be stored in a manner to prevent distortion, or damages from rusting. Material which shows any signs of pitting due to rust will not be accepted.

All fabricated material stored prior to shipment shall be subject to the same requirements of storage as the unfabricated material.

All structural steel shall be delivered to the job in good condition. Steel transported by salt water and which, in the opinion of the Engineer, has been damaged by salt water, shall be sandblasted and repainted with the shop coat specified on the plans after it has been unloaded from the ship.

Structural low alloy steel shall be marked at the mill to distinguish it from structural carbon steel, and the fabricator shall keep the two classes of material carefully separated.

112–3.09 STRAIGHTENING MATERIAL

All deformed structural material shall be properly straightened by methods which are non-injurious prior to being laid out, punched or otherwise worked in the shop. Sharp kinks and bends will be cause for rejection.

112–3.10 WORKMANSHIP AND FINISH

The workmanship and finish shall be first class and equal to the best practice in modern structural steel fabricating shops or plants. Welding, shearing, burning and chipping shall be neatly and accurately done and all portions of the work exposed to view shall be neatly finished.

112–3.11 RIVET HOLES

–3.11A General Requirements

All stringer and floor beam connections, connections of main members, and any other members indicated on the plans, shall have sub-punched and reamed rivet holes, or shall be drilled from the solid. It shall be understood that this requirement does not apply to rivet holes in lateral bracing, portals, sway bracing and other secondary members, nor to their connections to the main members.

For holes where reaming is not required, material three-fourths (¾) inch or less in thickness may be punched full size. All holes in steel more than three-fourths (¾) inch in thickness shall be sub-punched and reamed, or drilled from the solid.

–3.11B Punched Holes

Full size punched holes shall be one-sixteenth (1/16) inch larger than the nominal diameter of the rivet. The diameter of the die shall not exceed the diameter of the punch by more than three-thirty-seconds (3/32) inch. Holes must be clean cut, without torn or ragged edges. If any holes must be enlarged to admit the rivets, they shall be reamed.

The punching of holes shall be so accurately done that, after assembling the component parts of a member, a cylindrical pin one-eighth (⅛) inch smaller than the nominal diameter of the punched hole may be passed through at least 75 of any group of 100 contiguous holes in the same surface, or in like proportion for any group of holes. If this requirement is not fulfilled, the badly punched pieces shall be rejected. If any holes will not pass a pin three-sixteenths (3/16) inch smaller than the nominal diameter of the punched hole, it shall be cause for rejection.

–3.11C Drilled Holes

Drilled holes shall be one-sixteenth (1/16) inch larger than the nominal diameter of the rivet. Burrs on the outside surfaces shall be removed with a tool producing a one-sixteenth (1/16) inch fillet around the edge of the hole.

–3.11D Sub-Punched and Reamed Holes

Sub-punched and reamed holes for rivets having diameters greater than three-fourths (¾) inch shall be punched three-sixteenths (3/16) inch less than the nominal diameter of the rivet, and for rivets having diameter three-fourths (¾) inch or less, the holes shall be punched one-sixteenth (1/16) inch less than the nominal diameter of the rivet. The punch and die shall have the same relative sizes as specified for full size punched holes. After punching, the holes shall be reamed to a diameter one-sixteenth (1/16) inch larger than the nominal diameter of the rivet.

–3.11E Reaming

Reaming of rivet holes shall be done with twist drills or with short taper reamers. Reamers preferably shall not be directed by hand. No oil or grease shall be used as lubricant.

Burrs resulting from reaming shall be removed with a tool producing a one-sixteenth (1/16) inch fillet around the edge of the hole.

Reaming of the holes in a built member shall be done only after its component parts are assembled and firmly bolted together, and no interchange of reamed parts will be permitted. Holes through assembled material shall not consist of both sub-punched or sub-drilled holes, and holes punched or drilled full size.

Holes for field connections in main truss members shall be reamed with the entire truss assembled.

All stringer and floor beam connections shall be reamed to a steel template. The template shall be not less than one (1) inch thick, made from a single thickness of steel, or may be from two steel plates of one-fourth (¼) inch steel rigidly spaced with hardened steel bushings, or may be other template if approved by the Engineer.

–3.11F Accuracy of Reamed and Drilled Holes

Reamed or drilled holes shall be cylindrical and perpendicular to the member and their accuracy shall be the same as specified for punched holes except that, after reaming or drilling, 85 of any group of 100 contiguous holes in the same surface, or in like proportion for any group of holes, shall not show an offset greater than one-thirty-second (1/32) inch between adjacent thickness of metal.

–3.11G Drifting of Holes

The drifting done during assembling shall be only such as to bring the parts into position, and not sufficient to enlarge the holes or distort the metal.

112–3.12 SHOP ASSEMBLING

Surfaces of metals that will be in contact when shop assembled shall not be painted. These surfaces shall be thoroughly cleaned of rust, loose mill scale, dirt, oil or grease and all other foreign substances.

The component parts of built members shall be assembled, drift pinned to prevent lateral movement, and firmly bolted to draw the parts into close contact before reaming, drilling or riveting is begun. At least 25 percent of the holes shall be bolted up and the Engineer may require as much as 50 percent. Assembled parts shall be taken apart if necessary for the removal of burrs and shavings produced by the reaming operation.

The member shall be free from twists, bends or other deformations.

Preparatory to shop riveting where the rivet holes are punched full size, they shall be cleared for the admission of the rivets by reaming.

End connection angles, stiffener angles, etc., shall be carefully adjusted to correct locations and be rigidly bolted, clamped, or otherwise firmly held in place until riveted.

After the built-up members have been riveted, the entire truss or girder shall be fully assembled, properly aligned and set to camber, pinned and bolted together before drilling or reaming the holes in the field connections.

112–3.13 MATCH MARKING

Connecting parts assembled in the shop for the purpose of reaming or drilling holes in field connections shall be match-marked, and a diagram showing such marks shall be furnished to the Engineer.

112–3.14 SANDBLASTING

After fabrication has been completed and immediately before the first or shop coat of paint is applied, all structural steel shall be thoroughly cleaned by sand blasting. The sand blast shall be applied to an extent necessary to remove all rust, mill scale, dirt, oil, grease and other foreign substance. The resultant steel surface shall be free from all red or yellow iron rust. Small stained areas may, with approval of the Engineer, be left in place. After sandblasting, all loose dust and dirt remaining on the steel shall be removed before paint is applied.

112–3.15 PAINTING

After being thoroughly cleaned by sandblasting as specified above, all structural steel shall be painted within eight (8) hours of sandblasting with one shop coat of the paint specified on the plans. The paint and its manner of application shall be as specified in Section 116, and be applied in a location sufficiently removed from the cleaning operations to avoid contamination of the cleaned steel surface or the fresh paint by the cleaning operations.

112–3.16 RIVETS

The diameter of rivets indicated upon the plans shall be understood to mean their diameter before heating.

Heads of driven rivets shall be of approved shape, concentric with the shanks, true to size, full, neatly formed, free from fins and in full contact with the surface of the member.

Field rivets, for each size and length shall be supplied in excess of the actual number to be driven to provide for losses due to misuse, improper driving or other contingencies. Rivets shall be free from furnace scale on their shanks and from fins on the under side of the machine formed heads.

112–3.17 BOLTS AND BOLTED CONNECTIONS

Where bolted connections are shown on the plans or are specifically authorized, all bolts, nuts and washers shall conform to the specifications for material and assembly of structural joints using high strength steel bolts as provided in articles 1.4.3, 2.10.3 and 2.10.20 of the current AASHO Standard Specifications for Highway Bridges. Contact surfaces shall fit solidly together and the contact surfaces of the joint shall be free of dirt, oil, scale, paint or lacquer and other deposits that would prevent a solid setting of the parts.

When bolted joints are used, all mill scale and rust shall be removed from the contact surfaces by sandblasting immediately prior to erection.

112–3.18 RIVET BOLTS

Rivet bolts shall be used only where specified on the plans or authorized by the Engineer in writing. The design of shank, nut and thread shall be subject to the approval of the Engineer and the holes in which they are placed shall meet the requirements of Section 112-3.11.

No additional payment will be made for rivet bolts used in place of rivets.

112–3.19 RIVETING

Rivets shall be heated uniformly to a light cherry red color and shall be driven while hot. The heating of the points of rivets more than the remainder will not be permitted. When ready for driving the rivet shall be free from slag, scale and other adhering matter and when driven it shall completely fill the hole. Burned, burred or otherwise defective rivets, or rivets which throw off sparks when taken from the furnace or forge shall not be driven.

Loose, burned, badly formed or otherwise defective rivets shall be cut out. Caulking and recupping of rivet heads will not be allowed. In cutting out defective rivets care shall be taken not to injure the adjacent metal and, if necessary, the rivet shanks shall be removed by drilling.

Countersinking shall be neatly done and countersunk rivets shall completely fill the holes.

Shop rivets shall be driven by direct-acting riveters where practicable. The riveting machines shall retain the pressure for a short time after the upsetting is complete.

Pneumatic hammers shall be used for field riveting.

112–3.20 EDGE FINISHING

Sheared edges of material more than five-eighths (⅝) inch in thickness shall be planed to a depth of not less than one-eighth (⅛) inch when so required by the Engineer. All sheared and flame-cut edges shall be true to line and shall be free from rough corners or projections. When required by the Engineer, they shall be ground to remove the objectionable defects. Re-entrant cuts shall be filleted as large as practicable, but never less than one (1) inch radius, except when otherwise shown on the plans. Gusset plates with curved edges shall be cut to the exact radius shown on the plans and shall be ground to remove any rough corners.

112–3.21 PLANING BEARING SURFACES

Ends of columns taking bearing upon base and cap

plates shall be milled to true surfaces and correct bevels after the main section of these members and the end connection angles have been fully riveted.

Caps and base plates of columns and the sole plates of girders and trusses shall have full contact when assembled. The plates, if warped or deformed, shall be hot-straightened, planed or otherwise treated to secure an accurate and uniform contact. After being riveted in place, the excess metal of countersunk rivet heads shall be chipped smooth and flush with the surrounding metal, and the surfaces which are to come in contact with other metal surfaces shall be planed, or milled if necessary, to enable proper contact. Correspondingly, the surfaces of base and sole plates which are to come in contact with masonry shall be rough finished, if not free from warps or other deformations.

In planing the surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.

112–3.22 ABUTTING JOINTS

Abutting ends of compression members shall be accurately faced to secure an even bearing when assembled in the structure. Facing or milling of the ends of built-up members shall be done after they have been riveted.

Ends of tension members at splices shall be rough finished to secure close and neat but not necessarily contact fitting joints.

112–3.23 END CONNECTION ANGLES

End connection angles of floor beams and stringers shall be flush with each other and accurately set as to position and length of member. In general, end connection angles shall not be finished unless required by the Engineer. Faulty assembling and riveting, however, may be cause for requiring them to be milled, in which case their thickness shall be reduced not to exceed one-sixteenth (1/16) inch, nor shall their rivet bearing value be reduced below design requirements.

112–3.24 BUILT MEMBERS

The several pieces forming one built member shall be straight and close fitting. Such members shall be true to detailed dimensions and free from twists, bends, open joints or other defects resulting from faulty fabrication and workmanship.

112–3.25 HAND HOLES

Hand holes may be either punched or cut with burning torches. In either case they shall be true to the size and shape shown on the plans. Edges shall be true to line and shall be ground smooth.

112–3.26 LACING BARS

The ends of lacing bars shall be neatly rounded unless otherwise indicated.

112–3.27 PLATE GIRDERS

–3.27A Web Plates

Web plates of girders having no cover plates may be detailed with the top edge of the web flush with the backs of the flange angles. Any portion of the plate projecting beyond the angles shall be chipped flush with the backs of the angles. Web plates of girders having cover plates may be one-half (½) inch less in width than the distance back to back of flange angles. When web plates are spliced, not more than three-eighths (⅜) inch clearance between ends of plates will be allowed.

–3.27B Web Stiffeners

End stiffener angles of girders and stiffener angles intended as supports for concentrated loads shall be milled or ground to secure a uniform and even bearing against the flange angles. Intermediate stiffener angles shall fit sufficiently tight to exclude water after painting.

–3.27C Web Splices and Fillers

Web splice plates and fillers under stiffeners shall fit within one-eighth (⅛) inch at each end.

112–3.28 EYEBARS

Eyebars shall be straight and true to size, and shall be free from twists, folds in the neck or head, or any other defect affecting their service strength. Heads shall be made by upsetting, rolling or forging. Welds in the body portions or in the head of bars will not be permitted. The form of the heads may be determined by the dies in use at the works where the eyebars are to be made, if satisfactory to the Engineer. The thickness of head and neck shall not overrun more than one-sixteenth (1/16) inch.

Before boring, each eyebar shall be properly annealed and carefully straightened. Pinholes shall be located on the center line of the bar and in the centers of the heads. The holes in the ends of bars shall be so accurately located that when the bars of the same truss panels are placed in a pile, the pins may be completely inserted in the pinholes without driving. All eyebars intended for the same locations in the trusses shall be interchangeable.

112–3.29 ANNEALING

All eyebars shall be annealed by heating uniformly to the proper temperature, followed by slow and uniform cooling in the furnace. The temperature of the bars shall be under full control at all stages.

Slight bends on steel members of secondary importance may be made without heating the metal. Crimped web stiffeners need not be annealed.

112–3.30 PINS AND ROLLERS

Pins and rollers shall be of forged steel of the class specified on the plans, accurately turned to detailed dimensions and shall be smooth, straight and free from flaws. The final surface shall be produced by a finishing cut.

Pins and rollers seven (7) inches or less in diameter may be either forged and annealed or cold-finished carbon steel shafting.

Pins larger than eight (8) inches in diameter shall have a hole not less than two (2) inches in diameter bored longitudinally through their centers. Pins showing defective interior conditions will be rejected.

Pilot nuts and driving nuts shall be furnished for each size of pin, unless otherwise specified.

112–3.31 BORING PIN HOLES

Pin holes shall be bored true to detailed dimensions, smooth and straight, at right angles with the axis of the member and parallel with each other, unless otherwise required. A finishing cut shall always be made.

The length outside to outside of holes in tension members and inside to inside of holes in compression members shall not vary from detailed dimensions more than one-thirty-second (1/32) inch. Boring of holes in built-up members shall be done after the riveting is completed.

112–3.32 PIN CLEARANCES

The difference in diameter between the pin and the pin hole shall be one-fiftieth (1/50) inch. All pins shall be fitted to their respective pin holes in the assembled member and numbered.

112–3.33 WELDS

Welding of structural steel will be permitted only to the extent shown on the plans or for the preliminary attachment of small parts to facilitate assembling. Welding, when required, shall be by qualified welders certified as specified in Section 111-3.06C. Welding will not be accepted as a substitute for riveting. When specified all welds, welding procedure, welding materials and preparation of welded surfaces for painting shall conform to the current issue of Standard Specifications for Welded Highway and Railway Bridges by the American Welding Society, and to the following:

1. Electrodes for manual welding shall be low-hydrogen type conforming to ASTM Designation A 316, and ASTM Designation A 233. The coatings of the low-hydrogen electrodes shall be thoroughly dry when used. Electrodes, including those from hermetically sealed packages, shall be dried for at least two hours at temperature between 450° F. and 750° F. before they are used. After drying, all electrodes shall be stored in an oven at 250° to 350° F. until used. Electrodes with coatings that have deteriorated and cracked, or that have been rained on or thoroughly wetted in any manner shall be discarded and not used.

No welding will be permitted when the ambient temperature is below 20° F.

2. Flux and wire for submerged arc welding shall be selected to provide a weld with physical characteristics equal to or better than the base metal. Welding flux shall be free from dirt, slag, rust or other foreign material and shall be kept dry in accordance with good industry practice.
3. Preheat may be required where indicated by the thickness of the metal and/or presence of alloying elements in sufficient quantity to so require.
4. Welding procedure shall be submitted for approval with shop drawings. This procedure shall specify the type of equipment to be used, electrode selection and preheat requirements.
5. All tension butt welds of structural steel, including the tension area of plate girder webs for a minimum length of 15 inches from the point of maximum tension, shall be subject to 100 percent X-ray inspection in accordance with the American Welding Society Standards, and the Contractor shall furnish radiographs of the specified joints to the Engineer for approval. The acceptability of the welded joints will be determined by the Engineer.

All costs in connection with furnishing radiographs to the Engineer as outlined herein shall be included in the lump sum contract price for "Structural Low Alloy Steel," or "Structural Carbon Steel."

Radiographic inspection of butt welds which reveal the presence of any of the following defects in excess of the limits indicated shall result in rejection of the weld as being defective:

a. Cracks—No cracking will be allowed regardless of length or location.
b. No overlaps, lack of penetration, or incomplete fusion will be allowed.
c. Inclusions, including slag, porosity and other deleterious material, if less than 1/16 inch in dimension will be allowed provided the inclusions are so well dispersed that the sum of the greatest dimensions of the inclusions in any linear inch of welded joint shall not exceed 3/16 inch plus ¼T (where "T" is the thickness of the thinner plate) for groove welds or ½ the weld size for fillet welds, and there shall be no inclusion exceeding 1/16 inch in length within 1 inch of the edge of a joint.

The Contractor is referred to "Welding Handbook" of the American Welding Society, fourth edition, Section 1, page 8.38 and the American Welding Society Inspection Handbook for Manual Arc Welding B 1.1-45, Part C, page 114.

Radiographic procedure, equipment and materials shall conform to the requirements of ASME Boiler Code, Section VIII, paragraph UW-51. Radiographs shall be made by X-ray and shall be clear and of good workmanship. Two or more penetrameters shall be used, as directed by the Engineer. Layout of radiographs shall conform to the requirements as shown on the Standard Plan for Identification of Radiographs of Welds.

Radiographic operators shall be experienced and capable personnel, and shall submit a report interpreting the radiographs to the Engineer without recommendation.

The welds which are to be radiographed shall be ground or prepared by other suitable mechanical processes to a degree that the resulting radiographic contrast, due to any remaining surface irregularities, cannot be confused with that of any objectionable defect. The weld surface shall merge smoothly into the plate surface.

The welds shall be radiographed with a technique which will produce films having a sensitivity of 2 percent. As a check on the radiographic technique, suitable thickness gages or penetrameters shall be used. The material of the penetrameter shall be substantially the same as that of the plate under examination. In addition to other markings, weld areas and film must be suitably marked to allow for physically matching the radiograph with the examined metal at any time after film has been processed. Film exposed by more than one radioactive source for a single exposure will not be accepted. The minimum conditions given in the paragraph on Geometric Factors, page 8.51 of Section 1 of the Welding Handbook shall be observed.

All costs of furnishing radiographs to the Engineer for approval, as described herein, shall be considered as incidental to the construction and shall be included in the contract prices for the type of structural steel involved.

–3.33A Corrections in Welding

In lieu of the rejection of an entire piece or member containing welding which is unsatisfactory or indicates inferior workmanship, the following corrective measures may be permitted by the Engineer, whose specific approval shall be obtained for making each correction.

Where the following requirements prescribe the removal of part or all of the weld or a portion of the base metal, such removal shall be done by chipping, grinding, oxygen cutting, oxygen gouging, or air-arc gouging.

Defective or unsound welds shall be corrected either by removing and displacing the entire weld, or as indicated below.

(a) *Excessive convexity:* Reduce to size by removal of excess weld metal.
(b) *Shrinkage cracks, cracks in base metal, craters, and excessive porosity:* Remove defective portions of base and weld metal down to sound metal, and deposit additional sound weld metal.
(c) *Undercutting, undersize, and excessive concavity:* Clean and deposit additional sound weld metal.
(d) *Overlapping and incomplete fusion:* Remove and replace the defective portion of the weld.
(e) *Slag inclusions:* Remove the parts of the weld containing slag, and fill with sound weld metal.
(f) *Removal of adjacent base metal during welding:* Clean and form full size by depositing additional weld metal.

Where corrections require the depositing of additional weld metal, the electrode used shall preferably be smaller than the electrode used for making the weld. Electrodes larger than 5/32 inch diameter preferably shall not be used for repairing undercut base metal. Surfaces shall be cleaned thoroughly before welding.

A cracked weld shall be removed throughout its length unless, by the use of acid etching, magnetic inspection, or other equally positive means, the extent of the crack can be ascertained to be limited, in which case sound weld metal two (2) inches or more beyond each end of the crack shall not be removed.

Defective parts of a weld shall be cut out without substantial removal of the base metal unless cracks or other defects remain which require further removal. The weld or base metal shall not be nicked or undercut in chipping, grinding or gouging.

Where work performed subsequent to the making of a deficient weld has rendered the weld inaccessible or has caused new conditions which would make the corrections of the deficiency dangerous or ineffectual, the original conditions shall be restored by removal of welds, or members, or both, before making the necessary corrections; or else the deficiency shall be compensated by additional work according to a revised design approved by the Engineer.

Caulking of welds shall not be done. Improperly fitted and misaligned parts may be cut apart and rewelded. Members distorted by the heat of welding shall be straightened by mechanical means or by the carefully supervised application of a limited amount of localized heat. For hot-rolled steels, heated areas shall not exceed 1200° F. (a dull red color). Parts to be heated for straightening shall be substantially free of stress from external forces, except when mechanical means are used in the application of heat.

112–3.34 SCREW THREADS

Screw threads shall make close fits in the nuts and shall be U. S. Standard except that for diameters greater than one and one-half (1½) inches they shall be made with six (6) threads to the inch.

112–3.35 MEASURING CAMBER

A camber diagram shall be furnished the Engineer showing the camber at each panel point for each truss, taken from actual measurements while the truss is assembled.

112–5 MEASUREMENT AND PAYMENT

Payment will be made for such of the following bid items as are included and shown in any particular contract:

1. "Structural Carbon Steel," per lump sum.
2. "High-strength Low-alloy Structural Steel," per lump sum.
3. "Miscellaneous Metals," per lump sum.

112–5.01 STRUCTURAL STEEL

Structural carbon steel and high-strength low-alloy steel will be paid for at the lump sum contract prices for "Structural Carbon Steel," and "High-strength Low-alloy Structural Steel," respectively. The lump sum prices for each shall be full compensation for all costs in furnishing materials, labor, tools and equipment necessary for the manufacture, fabrication, transportation, erection and painting of the steel as specified for the completed structure.

For steel structures, the estimated weight of the structural carbon steel and high-strength low-alloy structural steel in the project will be shown on the plans or in the special provisions. In the event any change in plans is made which will effect the weight of material to be furnished, payment for the additional structural carbon steel or high-strength low-alloy structural steel required as a result of the change in plans will be made at a unit price per pound obtained by dividing the Contractor's lump sum bid for the steel by the total estimated weight therefor as shown on the plans, or in the special provisions. The weight will be established by the Engineer upon the basis of 490 pounds per cubic foot of steel.

Reductions in weight due to a change in plans will be made at the same rate as described above and reduced payment will be made in accordance therewith.

The prospective bidder shall verify the estimated weight of structural carbon steel and high-strength low-alloy structural steel before submitting a bid. No adjustment other than for approved changes will be made in the lump sum bid even though the actual weight may deviate from the stated estimated weight.

Where used in conjunction with structural steel, such minor items as bearing plates, pedestals, forced steel pins, anchor bolts, field rivets, shims, ladders, stairways, sleeves, pipe, fittings and fastenings that are used in handrails on structures, et cetera, unless otherwise provided, shall be considered as structural carbon steel for the purpose of payment even though made of other material.

Any change in plans which affects the weights of materials to be furnished as provided herein will be subject to the provisions of Section 4.03.

112–5.02 MISCELLANEOUS METALS

For concrete and timber structures, where structural steel is a minor item, such details as bearing plates, guard angles, expansion dams, etc., for which no provisions are made elsewhere herein, or in the special provisions, will be paid for as "Miscellaneous Metals," even though they be made out of other materials.

Miscellaneous metals will be paid for at the lump sum price bid for "Miscellaneous Metals," which price shall be full compensation for all costs in connection with furnishing all materials, labor, tools and equipment necessary for the manufacture, fabrication, transportation, erection and painting as required, including the providing and placing of such other protective coatings as may be shown on the plans or specified in the special provisions.

No estimated weight will be given for miscellaneous metals. In event any change in plans is necessary which will affect the weight of the material to be furnished, the payment for the revised quantity will be made at a unit price per pound obtained by dividing the Contractor's lump sum bid for the miscellaneous metal by the calculated weight of the original material. The calculated weight will be established by the Engineer and be based on an estimated weight of 490 pounds per cubic foot for steel.

Section 113—Castings, Steel Forgings

113–1 DESCRIPTION

These specifications shall cover all castings, steel forgings and miscellaneous metals required in the completed structure as shown on the plans.

113–2 MATERIALS

113–2.01 STEEL CASTINGS

Steel castings shall conform to the requirements of ASTM Designation A 27, Mild to Medium Strength Carbon-Steel Castings for General Application, Grade 65-30, unless otherwise designated on the plans or in the special provisions.

113–2.02 GRAY-IRON CASTINGS

Gray-iron castings shall conform to the requirements of the standard specifications of ASTM Designation A 48 for Gray-iron Castings. The class of castings to be furnished shall be that designated on the plans or in the special provisions.

113–2.03 MALLEABLE IRON CASTINGS

Malleable iron castings shall conform to the requirements of the standard specifications ASTM Designation A 47 for Malleable Iron Castings.

113–2.04 STEEL FORGINGS AND STEEL SHAFTING

Steel forgings shall conform to the requirements of the standard specifications for Carbon-Steel Forgings for General Industrial Use, ASTM Designation A 235. The classes of forgings to be furnished shall be those shown on the plans or called for in the special provisions.

Steel shafting shall conform to the specifications of ASTM Designation A 108-52 T, Grade Designation 1016-1030 inclusive for Cold-Finished Carbon Steel Bars and Shafting, unless otherwise specified.

113–2.05 BRONZE CASTINGS

Bronze castings shall conform to the requirements of ASTM Designation B 22 Alloy B, Bronze Castings for Bridges and Turntables.

113–2.06 COPPER SEALS

Copper sheets for seals shall conform to the requirements of ASTM Designation B 152, Copper Sheet, Strip, Plate and Rolled Bar. They shall be Type FRTP, light cold rolled, and furnished in flat sheets each not less than 0.018 inch in thickness.

All splices or joints shall be carefully brazed or soldered to produce a continuous watertight seal for the full length of each unit.

113–2.07 NODULAR IRON CASTINGS

Nodular iron castings shall conform to the requirements of ASTM Designation A 339, Grade 60-45-10, unless otherwise designated on the plans or in the special provisions.

113–3 CONSTRUCTION DETAILS

113–3.01 GENERAL

The provisions outlined in Section 112 for structural steel and which are applicable, including painting, shall apply to castings, steel forgings and miscellaneous metals.

Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength, appearance and value for the service intended.

Castings shall be cleaned of scale and sand to present a smooth, clean and uniform appearance.

Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect. The surfaces shall have a workmanlike finish.

Iron and steel castings and forgings shall be annealed prior to any machine work unless otherwise specified.

Surfaces of cast pedestals and shoes which will come in contact with metal surfaces shall be planed, and those which will bear on concrete shall be rough finished.

In planing the surfaces of expansion bearings, the cut of the tool shall be in the direction of expansion.

113–5 MEASUREMENT AND PAYMENT

Payment will be made at the lump sum price, or by the unit price per pound for the cast or forged metal (kind) or copper seals, as shown on the plans or in the proposal.

In case no bid item is included in the proposal and payment is not otherwise provided, the castings, forgings, and miscellaneous metal shall be considered as incidental to the construction and all costs therefor shall be included in the unit contract prices for other payment items involved and shown in the proposal.

Section 114—Timber and Lumber

114– DESCRIPTION

All timber and lumber in permanent structures except guard rail posts and guide posts, or as otherwise specified, shall be Douglas fir or larch. Guard rail posts and guide posts shall be Douglas fir, Western red cedar, West Coast hemlock, or larch, as specified on the plans.

114–2 MATERIALS

114–2.01 GRADE REQUIREMENTS

Unless otherwise noted on the plans or in the special provisions, all timber and lumber shall be graded as shown on the following table:

Structural Purpose	Tabular Working Stresses: Extreme fibre in bending or tension parallel to grain, psi	Horizontal shear, max., psi	Compression perpendicular to grain, psi	Compression parallel to grain, psi	Modulus of elasticity in bending, psi	*West Coast Lumber Inspection Bureau	*Western Pine Association
Timber and Lumber in Permanent Structures							
Douglas Fir (except 4" laminated decking)	1500	120	390	1000	1,600,000	"Construction Stress Grade" Beams and Stringers	"Construction Stress Grade" Beams and Stringers
Douglas Fir 4" laminated decking	1900	120	415	1400	1,760,000	"Select Structural" Light Framing Stress Grade	"Select Structural" Light Framing Stress Grade
Guard Rail Posts							
Douglas Fir ..	1200	120	390	1200	1,600,000	"Construction Stress Grade" Posts and Timbers	"Construction Stress Grade" Posts and Timbers
West Coast Hemlock	1200	100	365	1100	1,400,000	"Construction Stress Grade" Posts and Timbers	"Construction Stress Grade" Posts and Timbers
Larch	1200	120	390	1200	1,600,000		"Construction Stress Grade" Posts and Timbers
Guide Post							
Douglas Fir ..	1500	120	390	1200	1,700,000	"1500f Industrial" Light Framing	"1500f Industrial" Light Framing
West Coast Hemlock	1500	100	365	1000	1,540,000	"1500f Industrial" Light Framing	"1500f Industrial" Light Framing
Larch	1500	120	390	1200	1,700,000		"1500f Industrial" Light Framing
Western Red Cedar	1300	120	145	900	1,000,000	"Select Merchantable" Joists and Planks	"Select Merchantable" Joists and Planks
Other Timber and Lumber							
All Species ...	1200	120	390	1200	1,600,000		

†Hit or miss pieces with a minus tolerance of one-sixteenth (1/16) inch will be allowed on laminated decking.

*The indicated timber and lumber grades specified in the 1961 Standard Grading and Dressing Rules of the respective associations meet the Tabulated Working Stress Requirements for the various specified stress grades. In the event the grading and dressing rules of either Association are revised, equivalent grades meeting the tabulated working stress requirements will be required on the contract unless otherwise stated in the special provisions.

114–3 CONSTRUCTION DETAILS

114–3.01 SURFACING AND SEASONING

All lumber shall be sized as indicated on the plans, except that lumber which is to be painted shall in all cases be surfaced on four sides.

Lumber to be painted shall be thoroughly air dried or kiln dried to an equivalent moisture content, and shall be stored in such a manner as to remain in a thoroughly dry condition until placed in the work.

114–3.02 PROTECTION AGAINST END CHECKING

Immediately upon acceptance by the inspector at the mills, all ends of sticks 3 x 3 inches and larger (except decking), which are to be used without preservative pressure treatment, shall be treated with a gloss oil or other effective protective end coating.

114–3.03 INSPECTION

All timber and lumber purchased or used under these specifications shall meet the tabulated working stress requirements specified in Section 114-2.01. Lumber graded under the applicable paragraph numbers of the current grading and dressing rules of the West Coast Lumber Inspection Bureau or the Western Pine Association, as defined in Section 114-2.01, will be accepted provided the lumber is certified by a certificate of inspection executed by one of the above named associations, or by the Pacific Lumber Inspection Bureau.

Certificates of inspection shall identify the destination or job for which the material is intended and, if specified, each piece inspected and certified shall be marked to indicate such inspection. Such certification or grade marking, however, shall not constitute an acceptance of the material, and the Engineer may reject any and all lumber or timber that does not comply with the specifications. In event of a rejection of any timber or lumber by the Engineer, and if the Contractor shall dissent therefrom, the Contractor may request reinspection of the rejected material by whichever of the inspection agencies as may be satisfactory to the Engineer. The reinspection, when made, shall be in the presence of the Engineer or his inspector and shall otherwise be conducted under the reinspection provisions in the rules of the inspection agency for the materials specified in the contract.

Beams, stringers and posts that are specified to be free of heart center shall be stamped "FOHC" on each piece in close proximity to other grade marks.

114–3.04 HEWN AND ROUND TIMBER

Hewn and round timbers may be substituted for sawed timber, subject to the approval of the Engineer, and shall be of the same cross section and conform to the grading rules for structural timber.

114–4 MEASUREMENT

For the purpose of measurement of timber and lumber, the nominal thickness and width shall be used; also the actual lengths of the individual pieces in the finished structure shall be used without deduction for daps, cuts or splices. In the measurement of laminated timber decking, the number of pieces shall be the required number of the size specified, after dressing, and the length of each lamination shall be the length remaining in the finished structure.

114–5 PAYMENT

Payment will be made at the unit contract price per thousand feet board measure (M.B.M.) for "Timber and Lumber (untreated or name treatment)," which price shall be full compensation for all materials, including hardware, and for all labor, tools and equipment necessary for the manufacture, fabrication, preservative treatment, seasoning, transportation, erection and painting of the timber and lumber used in the completed structure.

Section 115—Preservative Treatment for Timber, Lumber and Piles

115–1 DESCRIPTION

Preservative treatment of the type specified shall be applied to timber, lumber or piles as shown on the plans, or as required by the special provisions.

115–2 MATERIALS

115–2.01 CREOSOTE OIL

Creosote for both pressure treatment and surface treatment shall meet the requirements of the standard specifications for Creosote, ASTM Designation D 390.

115–2.02 CHROMATED ZINC ARSENATE (Boliden Salts)

Chromated Zinc arsenate shall have the following composition:

Arsenic acid (H_3AsO_4)	20%
Sodium arsenate (Na_2HAsO_4)	21%
Sodium dichromate ($Na_2Cr_2O_7.2H_2O$)	16%
Zinc sulfate ($ZnSO_4.7H_2O$)	43%

subject to the following tolerances:

The composition of the solid preservative, or of the preservative present in a treating solution, may vary within the following limits:

Pentavalent arsenic calculated as total H_3AsO_4 plus Na_2HAsO_4 in a ratio of 20 to 21	37% Min.
Hexavalent chromium calculated as $Na_2Cr_2O_7.2H_2O$	14% Min.
Zinc calculated as $ZnSO_4.7H_2O$	41% Min.

The ratio of arsenic acid to sodium arsenate shall be deemed to fall within the prescribed limits if the percentage of arsenic, as As_2O_5, in the solid preservative or in the salts in solution lies between 26.4 and 31.1 and the pH of a solution containing 25 grams of the preservative per liter of solution at 25° C. lies between 2.90 and 3.50.

The solid preservative shall contain at least 95 percent of the active ingredients listed above.

115–2.03 TANALITH (Wolman Salts)

Tanalith shall have the following composition:

Sodium fluoride (NaF)	22% to 25 %
Sodium arsenate (Na_2HAsO_4)	22% to 25 %
Sodium chromate (Na_2CrO_4)	34% to 37.5%
Dinitrophenol ($(NO_2)_2.C_6H_3.OH$)	5% to 12.5%

The solid preservative shall contain at least 95 percent of the active ingredients listed above.

The pH of a treating solution shall be not less than 7.2 nor more than 7.8.

115–2.04 AMMONIACAL COPPER ARSENITE (Chemonite)

Ammoniacal copper arsenite shall have the following composition:

Copper hydroxide ($Cu(OH)_2$)	55.7% to 57.7%
Arsenic trioxide (As_2O_3)	38.7% to 40.7%
Acetic acid CH_3COOH)	1.6%

The above shall be dissolved in a solution of ammonia (NH_3) in water. The weight of ammonia contained in a treating solution shall be from 1.5 to 2.0 times the weight of the copper hydroxide.

The solid preservative shall contain at least 95 percent of the active ingredients listed above.

The net retention of the preservative shall be calculated as pounds of Cu O plus As_2O_5 deposited in the wood in the proportion of 1.5 parts of the former to 1.3 parts of the latter. An excess of either ingredient above this proportion shall not be counted in the net retention.

115–2.05 PENTACHLOROPHENOL

Pentachlorophenol shall conform to the requirements of AASHO Designation M 133. Solvents used in pentachlorophenol solutions shall be petroleum oils complying with the following requirements:

	(*) HEAVY PETROLEUM SOLVENT		LIGHT PETROLEUM SOLVENT	
	Max.	Min.	Max.	Min.
Specific Gravity at 60° F/60° F.	.....	0.85 (API 35 Max.)	0.934 (API 20 Min.)	0.825 (API 40 Max.)
Water and Sediment, percent	0.5	.....	0.5	.....
Flash Point, Pensky-Martens closed tester, ° F.	.....	190	.....	145
Distillation: Total distillate in percent by volume to 500° F.	50	.....	60	.....
625° F.	.....	.....	.....	90
(**) Viscosity, Saybolt Universal at 210° F., seconds	60	.....	.....	10
Solvency for pentachlorophenol, 75° F., percent by weight	.....	10	.....	10
Wood staining characteristics	Brown to Black	.....	Light Brown to none	.....

(*) Unless otherwise called for in the special provisions, heavy petroleum solvent shall be used.

(**) Petroleum of higher viscosity may be used provided that penetration requirements are met.

The preservative solution used in the treatment shall consist of not less than four and one-half (4½) percent, nor more than five and one-half (5½) percent by weight of pentachlorophenol dissolved in the proper petroleum solvent.

115–3 DETAILS OF PRESERVATIVE TREATMENT

115–3.01 GENERAL REQUIREMENTS

–3.01A Seasoning Before Treatment

Timber, lumber or piling may be air seasoned or kiln dried before treatment until the moisture remaining in the wood will not prevent the injection and proper distribution of the specified amount of preservative. For air seasoning, the materials shall be stored in the following manner: Lumber shall be segregated by at least one (1) inch strips with an air space of one (1) inch or more between pieces of lumber in any layer; for caps, stringers, posts or larger timbers, at least two (2) inch strips shall be used to separate the layers. Alleys at least three (3) feet wide shall be left between rows of stacks, and the material shall be at least twelve (12) inches off the ground on concrete or treated timber sills. Piles shall be stored in like manner, placing as nearly as practicable only one (1) length in a stack, using at least two (2) inch strips or saplings of equal size between each layer and reversing butt ends of all piling in every other layer in order to keep the stacks level. The space under and between the rows of stacks shall be kept free at all times of rotten wood, weeds and rubbish. The yard shall be drained so no water will stand under the stacks or in the proximity of the storage.

–3.01B Placing in Treating Cylinders

Each cylinder charge shall consist of pieces approximately equal in size and moisture and sapwood content, into which approximately equal quantities of preservative fluid can be injected. Pieces shall be so separated as to ensure contact of steam and preservatives with all surfaces.

Timber and lumber shall be framed, bored, incised, or chamfered before treatment, whenever possible.

–3.01C Incising

In order to secure a more uniform penetration, sawed timber and lumber measuring two (2) inches or over in thickness and four (4) inches or over in width shall be incised by a machine having power driven rolls designed to incise to a uniform depth and continuity of predetermined pattern. Timber or lumber three (3) inches or over in the least dimension shall be incised on all four sides. Timber or lumber less than three (3) inches in the least dimension shall be incised on the wide faces only.

The shape of the teeth shall conform to a type so designed that the points are sharp and the edges wedge-shaped, so that, upon entering and leaving the wood, a spreading of the fibers is accomplished.

–3.01D Plant Equipment

Treating plants shall be equipped with thermometers and gauges necessary to indicate and record accurately the conditions at all stages of treatment, and all equipment shall be maintained in condition satisfactory to the Owner (city). The apparatus and chemicals necessary for making the analyses and tests required by the Owner (city) shall be provided by the operators and shall be kept in condition for use at all times.

115–3.02 PRESSURE PROCESSES

–3.02A Creosote Treatments:

–3.02A1 Oil Seasoning for Douglas Fir

Green Douglas fir timber or piling shall be seasoned by boiling in oil under a vacuum until the moisture remaining in the wood will not prevent the injection and proper distribution of the specified amount of preservative.

The material shall be boiled in creosote under a vacuum at temperatures not less than 180° F., and not more than 200° F. for lumber nor 220° F. for piling.

A minimum vacuum of twenty (20) inches shall be maintained during boiling. The seasoning period shall be maintained until condensation passing off from the timber is at the rate of approximately one-tenth (1/10) of a pound per cubic foot of timber per hour.

–3.02A2 Penetration and Retention

The range of temperature, pressure and time duration shall be controlled so as to result in a maximum penetration by the quantity of preservative injected. The vacuum requirements stipulated are in inches of mercury at sea level and necessary corrections shall be made for altitude.

The minimum requirements for process type, retention and penetration for each class of material are given in the following table:

MATERIAL	*Process Type and Min. Net Retention of Preservative Per Cu. Ft. of Wood*	*Penetration*
Struct. Timber for Gen. Bridge Const. 5" or Less in Thickness	10 lb. Empty Cell	⅜" Min.
Struct. Timber for Gen. Bridge Const. More Than 5" in Thickness	10 lb. Empty Cell	½" Min.
Struct. Timber in Salt or Fresh Water 5" or Less in Thickness	14 lb. Full Cell	⅜" Min.
Struct. Timber in Salt or Fresh Water More Than 5" in Thickness	14 lb. Full Cell	½" Min.
Timber Piling Gen. Bridge Const.	10 lb. Empty Cell	1" Min.
Timber Piling in Fresh or Salt Water	14 lb. Full Cell	1" Min.

The penetration of the preservative shall be based on black or dark oil and in no case will light discoloration of the wood due to treatment be taken into consideration in measuring the depth of penetration.

Tests for penetration shall be made by taking borings with an increment borer or a five-eighths (⅝) inch augur. All holes so bored shall be plugged by the Contractor with tight-fitting creosoted plugs.

As many penetration tests of lumber and piling shall be made as may be considered necessary by the Inspector. In case of piling, the holes shall be bored midway between the ends. In case of timber and lumber, every fourth stick of the charge may be bored.

–3.02A3 Amount of Preservative

Covered in Section 115–3.02A2, above.

–3.02A4 Heating With Oil

Air seasoned or kiln dried Douglas fir shall be heated in oil prior to the pressure treatment. The preservative shall be introduced to the timber at a temperature of 160° F. to 180° F., and the temperature shall be gradually raised to 200° F. and held at that temperature for a period of from three (3) to five (5) hours, or sufficient time to obtain an even temperature throughout the material.

–3.02A5 Full-Cell Process

Following the heating period in the case of air seasoned or kiln dried material, and the seasoning under vacuum period in the case of material that is oil seasoned, the cylinder shall be filled with creosote and the pressure shall be applied as required to a maximum limit of one hundred seventy-five (175) pounds per square inch and maintained—taking into consideration the quantity of creosote absorbed during the heating with oil—until the specified absorption of creosote has been obtained.

Temperature of the creosote during the pressure period shall be as high as possible, with a minimum limit of 160° F. and a maximum limit of 200° F. After pressure is completed, the cylinder shall be emptied of creosote and a vacuum of at least twenty (20) inches be promptly created and maintained for a sufficient period of time to free the material from dripping creosote.

–3.02A6 Empty-Cell Process

Following the heating period, in the case of air seasoned of kiln dried material, and the seasoning under vacuum period in the case of material that is oil seasoned, the material shall be subjected to an air pressure of sufficient intensity and duration that, in the judgment of the operator, is sufficient to accomplish the final retention of creosote specified. The preservative shall then be introduced, the air pressure being maintained constant, until the cylinder is completely filled.

Creosote shall then be pressed from the measure tanks into the wood in a quantity sufficient, in the opinion of the operator, to provide the required retention at the completion of the process herein described. Maximum pressure shall in no case exceed two hundred (200) pounds per square inch. The temperature of the creosote during the pressure period shall be as high as possible, within a minimum limit of 160° F. and a maximum of 200° F.

After pressure is completed, the cylinder shall be quickly emptied of creosote and a vacuum of at least (20) inches created and maintained for such period of time as may be required to remove dripping creosote from the material.

–3.02B Chromated Zinc Arsenate (Boliden Salts) Treatment

The following pressure process shall be used for the treatment of timber and lumber with chromated zinc arsenate:

The treating solution shall be of uniform concentration and of the minimum strength necessary to obtain the required retention of preservative with the largest volumetric absorption possible.

Before treatment all timber and lumber shall be air seasoned or kiln dried until the moisture content is below twenty (20) percent. Timber containing more than twenty (20) percent moisture shall be classed as green timber and shall be given an artificial seasoning in an airtight retort by a bath of live steam at from ten (10) to fifteen (15) pounds per square inch pressure for a period of four (4) to ten (10) hours, followed by a vacuum of at least twenty-two (22) inches for one (1) hour, or with alternating periods of vacuum and pressure as may be necessary to put the timber into condition for treatment. The cylinder shall be relieved continuously or frequently enough to prevent condensate from accumulating in sufficient quantity to reach the wood.

After the seasoning process has been completed, the material shall be subjected to a vacuum of not less than twenty-two (22) inches for at least thirty (30) minutes, either before the cylinder is filled or during the period of heating in the preservative. If not already full, the cylinder shall then be filled without breaking the vacuum. The pressure shall then be raised to not more than 150 pounds per square inch. The temperature of the preservative shall not exceed 100° F. at any time during the process. The material shall be held under pressure until there is obtained the volumetric injection that will ensure the specified retention, or until the wood is treated to refusal.

After the pressure period is completed, the cylinder shall be emptied speedily of preservative and a vacuum of not less than twenty-two (22) inches be created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

Unless otherwise stated on the plans or in the special

provisions, the minimum net retention of chromated zinc arsenate shall be as follows:

Timber and lumber for use under moderate leaching conditions	1.00 lb. per cu. ft.
Timber and lumber for use not in contact with the ground nor in water	0.50 lb. per cu. ft.
Posts	1.00 lb. per cu. ft.

The minimum penetration of preservative shall be three-eighths (⅜) inch or 90 percent of sapwood for timber under five (5) inches thick, or one-half (½) inch or 90 percent of sapwood for timber over five (5) inches thick.

All timber and lumber, after treating with chromated zinc arsenate, shall be seasoned by kiln drying or air drying under cover before placing in the structure.

Penetration shall be determined by sampling each charge as may be desired. Any holes which may be bored shall be filled with tight-fitting treated plugs.

All timber and lumber, after treatment with chromated zinc arsenate, shall be seasoned by kiln drying or air drying under cover before being erected in the structure. After seasoning, the average moisture content of material six (6) inches or more in thickness shall not exceed eighteen (18) percent for the outside one and one-half (1½) inch zone and the average moisture content of material less than six (6) inches in thickness shall not exceed eighteen (18) percent for the outside one (1) inch zone.

The moisture content shall be determined by the "oven-drying" method from samples collected by increment cores or borings to the depth of the zone prescribed above for the two (2) size classes of material. Samples shall be taken from the centers of the wide faces midway between the ends of the pieces, and sufficient pieces shall be sampled to provide a truly representative test. A minimum of twelve (12) cores shall be taken for each size class in each kiln drying charge, or in each lot of air seasoned lumber.

All cores shall be combined into one composite sample if the material is all of one size class, or into two samples if both size classes are represented. The moisture content as determined from these samples shall be considered to be the moisture content of the lot of materials tested. Material having a moisture content in excess of eighteen (18) percent shall be subjected to further seasoning before it is used. All timber and lumber seasoned under this specification shall be subject to the grading rules pertaining to checks, after undergoing the seasoning process.

All holes bored for sampling timber and lumber to determine the moisture content after seasoning shall be filled with tight-fitting treated and seasoned plugs.

–3.02C Tanalith (Wolman Salts) Treatment

The following pressure process shall be used for the treatment of timber and lumber with Wolman Salts:

The treating solution shall generally have a strength of concentration in water of 1.8 percent to 2 percent of Wolman Salts in 98.2 percent to 98 percent of water; the solution shall be no stronger than necessary to obtain the required retention of preservative specified below, with the greatest volumetric absorption practicable.

All timber and lumber treated with this process shall be seasoned before treatment as described in Secton 115-3.02B.

The treatment process and drying after treatment shall be as specified in Section 115-3.02B except that the temperature of the preservative during the treating process shall not exceed 140° F.

Unless otherwise stated on the plans or in the special provisions, the minimum net retention of tanalith shall be as follows:

Timber and lumber for use under moderate leaching conditions	0.55 lb. per cu. ft.
Timber and lumber for use not in contact with ground nor in water	0.35 lb. per cu. ft.
Posts	0.55 lb. per cu. ft.

The minimum penetration shall be as specified in Section 115-3.02B.

Penetration shall be determined by sampling each charge, as may be desired. Bored holes shall be filled with tight-fitting treated plugs.

–3.02D Ammoniacal Copper Arsenite (Chemonite) Treatment

The pressure process which follows shall be used for treatment of timber and lumber with ammoniacal copper arsenite.

The treating solution shall be of uniform concentration and of the minimum strength necessary to obtain the required retention of preservative with the greatest volumetric absorption possible.

Seasoning of timber, treatment and drying after treatment shall be as specified in Section 115-3.02B, except that the temperature of the preservative shall not exceed 150° F. at any time during the treating process.

Unless otherwise stated on the plans or in the special provisions the minimum net retention of ammoniacal copper arsenite shall be as follows:

Timber and lumber for use under moderate leaching conditions	0.45 lb. per cu. ft.
Timber and lumber for use not in contact with ground nor in water	0.30 lb. per cu. ft.
Posts	0.45 lb. per cu. ft.

The minimum penetration of preservative shall be as specified in Section 115-3.02B.

Penetration shall be determined by sampling each charge as may be desired. Bored holes shall be filled with tight-fitting treated plugs.

–3.02E Pentachlorophenol Treatment

Pentachlorophenol pressure treatment process shall be in accordance with the current standards of the American Wood Preserver's Association for Pressure Preserved Wood for Highway Construction. The minimum net retention of the dry salt shall be 0.50 pound per cu. ft. of wood, except as noted elsewhere in the specifications. Treatment shall be by the empty-cell process.

115–4 MEASUREMENT

Preservative treatment of timber, lumber and piles shall not be considered as a separate contract item and no method of measurement is provided apart from the material to which the treatment is applied.

115–5 PAYMENT

Payment for the preservative treatment of timber, lumber and piles shall be included in the unit contract price per thousand feet board measure (M.B.M.) for "Timber and Lumber (treatment)" and per linear foot for "Furnishing Timber Piling (treatment)."

Whenever any untreated material is required by the specifications or special provisions to receive brush treatment of a kind therein described, the cost of such treatment shall be included by the Contractor in his unit contract price per thousand feet board measure (M.B.M.) for "Timber and Lumber (untreated)."

Section 116—Paints and Painting

116–1 DESCRIPTION

Steel and timber structures, or particular parts thereof, and such concrete surfaces as may be specified, shall be coated with an appropriate paint as hereinafter set forth, or as described under the particular section dealing with the surfaces to be painted.

116–2 MATERIALS

116–2.01 RAW MATERIALS

Raw materials for paints shall conform to the requirements of the specifications listed below. The acceptance of particular lots of raw materials by the Engineer shall in no way obligate him to accept lots of finished paint that do not conform to the requirements of these specifications. When not specifically detailed herein, the raw materials shall meet the requirements of the applicable Federal specification.

Red lead pigment and paste, ASTM Designation D 83, ninety-seven (97) percent grade.

Basic carbonate white lead pigment and paste, ASTM Designation D 81.

Titanium pigments, ASTM Designation D 476. Titanium dioxide for use in exterior white paints shall conform to the requirements of ASTM Designation D 476, Type 1. Titanium pigments used in tinted paints and enamels shall be of the exterior chalk resistant type.

Chrome oxide green, ASTM Designation D 263. The tinting properties shall be such that the standard color of the formulas using chrome oxide green can be produced without departing from the limits of composition given in those formulas.

Iron-Blue pigment and paste, ASTM Designation D 261.

Lampblack pigment and paste, ASTM Designation D. 209.

Ochre pigment and paste, ASTM Designation D 85.

Aluminum paste, ASTM Designation D 962, Type II, Class B. Paints made with the paste shall be smooth and highly lustrous.

Chrome yellow pigment and paste, ASTM Designation D 211.

Zinc oxide pigment and paste, ASTM Designation D 79.

Flaked metallic lead paste shall consist of pig lead in the form of fine flakes combined with mineral spirits (ASTM Designation D 235) and a fatty acid to form a paste suitable for use as an ingredient in paint. It shall contain no fillers or adulterants. The paste shall conform to the following requirements:

Nonvolatile matter at 105° C to 110° C, percent	90 to 92
Easily extracted fatty and oily matter, percent	2 maximum
Total impurities, other than fatty and oily matter, percent	1 maximum
Coarse particles:	
Retained on a No. 100 sieve, percent	2 maximum
Retained on a No. 200 sieve, percent	11 maximum
Retained on a No. 325 sieve, percent	20 maximum

The paste, when added to paint of the following formula in the proportion of three (3) pounds of paste to one (1) gallon of paint, shall cause a marked reduction in the gloss of the dried paint, a substantial improvement in spreading properties, and shall eliminate "crawling" of a succeeding coat of Formula B-1-57 paint applied twenty-four hours later.

Dry red lead	100 pounds
Raw linseed oil	3 gallons
Liquid drier	1.5 pints
Aromatic petroluem thinner—water white low aniline petroleum solvent Kauri-Butanol value	70 (Min.)

Raw linseed oil, ASTM Designation D 234.

Boiled linseed oil, ASTM Designation D 260.

Heat bodied linseed oil, Federal TT-L-201, Type II, Z to Z6 viscosity, shall be prepared by heat treating pure linseed oil. The treated oil shall be soluble in all proportions in turpentine and mineral spirits.

Turpentine shall be gum spirits of turpentine, ASTM Designation D 13.

Mineral spirits, ASTM Designation D 235.

Liquid drier, Federal TT-D-651c.

Spar varnish shall meet the requirements of Federal TT-V-119 except that the test liquid for hydrocarbon resistance shall be white gasoline, and in addition thereto a dried film of the varnish after immersion for twenty-four (24) hours in a two (2) percent solution of sodium hydroxide shall show no blistering, whitening or loss of film when subjected to the following test:

Immerse a clean glass test tube, one-half inch by six inches (½" x 6") into the varnish so as to coat the closed end to a depth of three (3) inches. Remove from the varnish and allow to dry, mouth downward, for forty-eight (48) hours. Immerse the tube in sodium hydroxide solution and examine at the end of twenty-four (24) hours. This varnish shall be used as a mixing varnish for aluminum paint and in the manufacture of concrete primer.

Zinc yellow (zinc chromate), ASTM Designation D 478.

Red iron oxide, ASTM Designation D 84, Class I, except that the minimum total iron oxide, calculated as Fe_2O_3, shall be 85.0%.

Yellow iron oxide, hydrated, ASTM Designation D 768.

Fibrous magnesium silicate (asbestine), ASTM Designation D 605.

Silica shall be finely ground amorphous or crystalline material. It shall have a maximum oil absorption of 50 when tested in accordance with ASTM Designation D 281.

Alkyd vehicle, Federal TT-R-266a, Type II, Class A.

Anti-skinning agent shall have no deleterious effect on the drying time of the finished paint. It shall effectively prevent skinning when added in the amounts specified in each formula and tested in accordance with Federal TT-P-141b, Method 414.1.

Aluminum stearate, Military MIL-A-15206A.

Naphthenate driers, Federal TT-D-643b.

Soya elcithin shall be pure Soya lecithin.

116–2.02 PAINT FORMULAS

–2.02A General

All paints shall be made from materials meeting the requirements specified in Section 116-2.01. The paint shall be made in accordance with the formulas that follow, and shall meet the requirements set forth above as well as the special requirements set forth for each formula. The formulas are stated in terms of dry pigment. Each formula shall contain the specified raw materials which shall be proportioned to give the compositions in percentages by weight or parts by weight, as shown in the subsections that follow.

–2.02B Formula No. A-1-57—Red Lead Shop Coat for Steel

Metallic lead paste shall be supplied by the paint manufacturer as a part of this formula, to be added to the paint at the time of use at the rate of three (3) pounds of paste added to one (1) gallon of paint. A unit shall consist of a one gallon container of paint and a separate container of three (3) pounds of paste or a 5-gallon container of paint and a separate container of 15 pounds of paste.

Red lead (dry pigment)	80.2%
Raw linseed oil	18.9%
Liquid drier	0.9%
Total	100.0%
Weight per gallon (minimum)	26.7 pounds
Drying time (for test purposes)	24 hours
Grind (minimum)	3.0
Viscosity at 70° F.	85 ± 3 K.U.

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Volatile thinner (turpentine or mineral spirits) will be added at the factory to obtain the specified viscosity.

–2.02C Formula No. A-2-57—Shop Coat for Steel (Alkyd-Linseed Vehicle)

Zinc chromate (dry pigment)	36.5 parts
Red iron oxide (dry pigment)	9.8 parts
Magnesium silicate (dry pigment)	4.8 parts
Silica (dry pigment)	4.2 parts
Alkyd vehicle	20.8 parts
Raw linseed oil	14.8 parts
24% Lead napthenate drier	0.6 parts
6% Cobalt napthenate drier	0.3 parts
Soya lecithin	0.2 parts
Aromatic petroleum thinner	5.3 parts
Mineral spirits (approximately)	2.7 parts
Weight per gallon (minimum)	12.70 pounds
Grind (minimum)	3.0
Drying time (for test purposes)	18.0 hours
Viscosity at 70° F.	80 ± 3 K.U.
Hiding power (maximum scale reading)	17
Nonvolatile content (minimum)	85.0%

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Mineral spirits to be adjusted at the time of manufacture to achieve the specified viscosity.

–2.02D Formula No. A-3-57—Red Lead Sealing Paste

Red lead (dry pigment)	84.0%
Metallic lead paste	9.0%
Raw linseed oil	7.9%
Liquid drier	0.1%
Weight per gallon (minimum)	41.0 pounds
Drying time—surface dry for recoating	24 hours

This material shall be ground to a smooth, uniform paste of putty-like consistency. Additional linseed oil may be added at the time of use to reduce the paste to workable consistency for spatula or brush. This material hardens in storage and should be used within 15 days of the date of manufacturing.

–2.02E Formula A-4-59—Phenolic-Red Lead Primer

This primer shall meet the requirements of Federal

Specification TT-P-86b, Type IV Paint: Red-Lead Base, Ready Mixed. The viscosity of the finished paint shall be 83 ± 3 K.U. at 70° F.

–2.02F Formula A-5-61—Vinyl Pretreatment

The primer shall meet the requirements of Federal Specification MIL-P-15328B Primer Pretreatment (Formula 117 for Metals).

–2.02G Formula A-6-61—Zinc Dust-Zinc Oxide Primer

The primer shall meet the requirements of Federal Specification TT-P-641b Primer-Paint: Zinc Dust-Zinc Oxide, Type II or Type III, except that the viscosity shall be 85 ± 5 K.U. at 70° F.

–2.02H Formula B-1-57—First Field Coat for Steel (Red Lead)

Metallic lead paste will be supplied by the manufacturer as a part of this formula to be added to the paint at the time of use at the rate of three (3) pounds of paste added to one (1) gallon of paint. A unit shall consist of a one-gallon container of paint and a separate container of 3 pounds of paste, or a 5-gallon container of paint and a separate container of 15 pounds of paste.

Read lead (dry pigment)	76.8%
Lampblack (dry pigment)	0.7%
Raw linseed oil	21.6%
Liquid drier	1.0%
Total	100.0%
Weight per gallon (minimum)	24.5 pounds
Viscosity at 70° F.	85± 3 K.U.
Drying time (for test purposes)	24 hours
Grind (minimum)	3.0

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Volatile thinner (turpentine or mineral spirits) may be added at the factory to attain the desired viscosity.

–2.02I Formula B-2-57—First Field Coat for Steel (Alkyd Linseed Vehicle)

Zinc chromate (dry pigment)	36.5 parts
Yellow iron oxide (dry pigment)	9.8 parts
Magnesium silicate (dry pigment)	4.8 parts
Silica (dry pigment)	4.2 parts
Alkyd vehicle	20.8 parts
Raw linseed oil	14.8 parts
24% Lead napthenate drier	0.6 parts
6% Cobalt napthenate drier	0.3 parts
Soya lecithin	0.2 parts
Aromatic petroleum thinner	5.3 parts
Miner spirits (approximate)	2.7 parts
Weight per gallon (minimum)	12.70 pounds
Grind (minimum)	3.0
Drying time (for test purposes)	18 hours
Viscosity at 70° F.	80 ± 3 K.U.
Hiding power (maximum scale reading)	17
Nonvolatile content (minimum)	85.0%

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Mineral spirits to be adjusted at the time of manufacture to achieve the required viscosity.

–2.02J Formula B-4-59—Phenolic First Field Coat for Steel

The phenolic first field coat for steel shall meet the requirements of Federal Specification TT-P-86b, Type IV-Paint: Red-Lead-Base Ready Mixed, except that 0.7% of the red lead content shall be replaced with lamp-black to give a resultant brown color. The viscosity of the finished paint shall be 83 ± 3 K.U.

–2.02K Formula C-1-57—Black Second Field Coat for Steel

Red lead (dry pigment)	32.5 parts
Lampblack (dry pigment)	5.5 parts
Iron blue (dry pigment)	2.8 parts
Raw linseed oil	58.0 parts
Liquid drier	1.2 parts
Weight per gallon (minimum)	11.4 pounds
Grind (minimum)	3.0
Drying time (for test purposes only)	24 hours
Viscosity at 70° F.	85± K.U.

Test Requireents: Prior to manufacture.

Mineral spirits may be added at the factory to meet the specified viscosity.

–2.02L Formula C-2-57—Gray Second Field Coast for Steel (Linseed Vehicle)

Basic carbonate of white lead (dry pigment)	62.2 parts
Lampblack (dry pigment)	0.1 parts
Ochre (dry pigment)	0.2 parts
Raw linseed oil	13.9 parts
Z_4 bodied linseed oil	13.8 parts
Varnish (TT-V-119)	2.7 parts
Liquid drier	0.5 parts
Mineral spirits	6.5 parts
Weight per gallon (minimum)	16.3 pounds
Grind (minimum)	3.0
Viscosity at 70° F.	85± 3 K.U.
Nonvolatile content (minimum)	91.0%

Color: The amounts of lampblack and ochre are approximate and must be adjusted to match a standard color sample for Formula No. C-2-57.

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Mineral spirits content will be adjusted at the factory to meet the specified viscosity.

–2.02M Formula C-3-57—Gray Second Field Coat for Steel (Alkyd Vehicle)

Titanium-calcium (dry pigment)	31.9 parts
Ochre (dry pigment)	2.6 parts
Lampblack (dry pigment)	0.3 parts
Alkyd vehicle	52.5 parts
Raw linseed oil	2.1 parts
Anti-skinning agent	0.2 parts
24% Lead naphthenate drier	0.6 parts
6% Cobalt naphthenate drier	0.3 parts
6% Manganese naphthenate drier	0.1 parts
Mineral spirits	9.4 parts
Weight per gallon (minimum)	10.1 pounds
Viscosity at 70° F.	85± 3 K.U.
Grind (minimum)	3.0
Nonvolatile content (minimum)	74.0%

Dry Color Match: The amounts of lampblack and ochre are approximate and must be adjusted to match a standard color sample for Formula No. C-3-57 when dry.

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Mineral spirits content will be adjusted at the factory to meet the specified viscosity.

–2.02N Formula C-4-57—Green Second Field Coat for Steel (Alkyd Vehicle)

Titanium-calcium (dry pigment)	19.7 parts
Zinc oxide (dry pigment)	6.5 parts
Chrome yellow (dry pigment)	1.8 parts
Chrome green oxide (dry pigment)	11.2 parts
Alkyd vehicle	47.0 parts
Raw linseed oil	2.0 parts
Anti-skinning agent	0.2 parts
24% Lead naphthenate drier	0.5 parts
6% Cobalt naphthenate drier	0.2 parts
6% Manganese naphthenate drier	0.1 parts
Mineral spirits	10.8 parts
Weight per gallon (minimum)	10.3 pounds
Viscosity at 70° F.	85± 3 K.U.
Grind (minimum)	3.0
Nonvolatile content (minimum)	74.5%

Dry Color Match: The amounts of chrome yellow and chrome green oxide are approximate and must be adjusted to match a standard color sample of Formula No. C-4-57 when dry.

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Mineral spirits content will be adjusted at the factory to achieve the specified viscosity.

–2.02O Formula C-5-57—Green Second Field Coat for Steel (Linseed Vehicle)

Basic carbonate of white lead (dry pigment)	42.6 parts
Zinc oxide (dry pigment)	10.5 parts
Chrome green oxide (dry pigment)	6.4 parts
Chrome yellow	1.6 parts
Z_4 bodied linseed oil	18.3 parts
Varnish (TT-V-119)	2.9 parts
Raw linseed oil	18.3 parts
Liquid drier	0.7 parts
Mineral spirits	9.3 parts
Weight per gallon (minimum)	14.6 pounds
Viscosity at 70° F.	85± 3 K.U.
Drying time (for test purposes)	24 hours
Nonvolatile content (minimum)	89.0%

Dry Color Match: The chrome green oxide and the chrome yellow content are approximate and must be adjusted to match the color of a standard color sample of Formula No. C-5-57.

Test Requirements: Prior to Manufacture.

Viscosity Adjustment: Mineral spirits content will be adjusted at the factory to achieve the desired viscosity.

–2.02P Formula C-6-59—Green Phenolic Finish Coat for Steel

Zinc chromate (dry pigment)	13.8 parts
Chrome green oxide (dry pigment)	16.1 parts
Titanium dioxide (dry pigment)	16.7 parts
Yellow iron oxide (dry pigment)	1.3 parts
Fibrous magnesium silicate (dry pigment)	5.0 parts
Aluminum stearate (dry pigment)	0.2 parts
Varnish (TT-V-119)	22.1 parts
Raw linseed oil	21.4 parts
Driers	1.0 parts
Anti-skinning agent	0.1 parts
Mineral spirits	2.8 parts
Weight per gallon (minimum)	12.5 pounds
Viscosity at 70° F.	85± 3 K.U.
Grind (minimum)	6.0
Set to touch	4 hours
Dry hard	18 hours

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Mineral spirits content to be adjusted at the factory to achieve the specified viscosity.

The proportions of tinting pigments may be varied to achieve the desired color. The color of the paint when dry must match the color of a standard C-5 color chip. Additional tinting pigments may be required.

–2.02PP Formula C-7-66—Concrete Gray Finish Coat (New Formula)

Basic carbonate of white lead (dry pigment)	42.8 parts
Zinc oxide (dry pigment)	10.5 parts
Titanium dioxide (dry pigment)	7.4 parts
Tinting pigments	0.7 parts
Raw linseed oil	14.6 parts
Bodied linseed oil	18.9 parts
Varnish (TT-V-119)	2.7 parts
24% Lead drier	0.6 parts
6% Manganese drier	0.2 parts
6% Cobalt drier	0.1 parts
6% Zirconium drier	0.1 parts
5% Calcium drier	0.1 parts
Anti-skinning agent	0.1 parts
Anti-sagging agent	0.6 parts
Mineral spirits	5.9 parts
	100.0 parts
Weight per gallon (minimum) (Fed. test method 141 – 4184)	15.3 pounds
Viscosity (Fed. test method 141 – 4281)	85± 3 K.U.
Drying time (maximum) (Fed. test method 141 – 4062)	24 hours
Grind N.S. (minimum) (Fed. test method 141 – 4411)	4
Sag index (minimum) (As determined by use of Lenceta Sag Meter	7.0

Minor adjustments of tinting pigments, solvents and chemical additives may be made at the factory to achieve the desired color and physical characteristics.

The color of the paint must match the color sample for Formula C-7-66 when dry.

Test Requirements: Prior to manufacture.

–2.02Q Formula D-4-57—Black Enamel

The enamel shall meet the requirements of Federal TT-E-529 Black Enamel, Synthetic, Semi Gloss.

Test Requirements: This enamel will be sampled and tested in the ready-mixed form. No factory inspection will be required.

–2.02R Formula D-5-57—White Guard Rail Paint (Alkyd Vehicle)

Titanium dioxide (dry pigment)	28.1 parts
Zinc oxide (dry pigment)	10.9 parts
Fibrous magnesium silicate (dry pigment)	4.3 parts
Aluminum stearate (dry pigment)	0.5 parts
Alkyd vehicle	37.0 parts
24% Lead naphthenate drier	0.4 parts
6% Cobalt naphthenate drier	0.2 parts
6% Manganese naphthenate drier	0.2 parts
Anti-skinning agent	0.2 parts
Mineral spirits	18.2 parts
Weight per gallon (minimum)	11.0 pounds
Viscosity of 70° F.	85± 3 K.U.
Nonvolatile content (minimum)	70.2%
Grind (minimum)	4
Hiding power (maximum scale reading)	30
Set to touch	4 hours
Dry hard	18 hours

Test Requirements: Prior to manufacture.

Viscosity Adjustment: Mineral spirits content will be adjusted at the factory to achieve the specified viscosity.

This formula is not intended for use on unpainted wood.

–2.02S Formula D-6-57—White Guard Rail Paint (Linseed Vehicle)

Basic carbonate of white lead (dry pigment)	19.1 parts
Zinc oxide (dry pigment)	16.4 parts
Titanium dioxide (dry pigment)	9.3 parts
Fibrous magnesium silicate (dry pigment)	9.0 parts
Diatomaceous silica (dry pigment)	8.9 parts
Raw linseed oil	23.2 parts
Z_4 bodied linseed oil	7.6 parts
Mineral spirits	6.4 parts
Liquid drier	1.1 parts
Weight per gallon (minimum)	14.0 pounds
Drying time (for test purposes only)	18 hours
Viscosity at 70° F.	85± 3 K.U.
Hiding power (maximum scale reading)	30
Grind (minimum)	4

Test Requirements: Prior to manufacture.

Primer: This formula is intended for use on previously painted surfaces. When applied to unpainted wood, turpentine shall be added as required by the character of the surface in the proportion of not to exceed one (1) quart per gallon of the above paint.

Viscosity Adjustment: Mineral spirits content will be adjusted at the factory to give the specified viscosity.

–2.02T Formula D-1-57—Aluminum Paint

Aluminum paste	2 pounds
Varnish (TT-V-119)	1.0 gallon

Aluminum paint shall be mixed on the work, and only enough for one day shall be mixed at a time. The weighed amount of paste shall be placed in a suitable mixing container and the measured volume of vehicle then poured over it. The paste shall be incorporated by vigorous stirring with a paddle.

Test Requirements: Prior to mixing.

–2.02U Formula E-1-57—White for Wood Structures

The material shall conform to Federal TT-P-102, Class A, except that the viscosity shall be 85 ± 3 K.U. at 70° F.

Test Requirements: This paint will be sampled and tested in the ready-mixed form.

Primer: Turpentine may be added to the above paint in quantities not to exceed 1½ pints per gallon of paint for use as a primer.

–2.02V Formula E-2-62—Primer for Wood

The primer shall be a ready-mixed priming paint for use over unpainted wood surfaces. It shall meet the requirements of Federal Specification TT-P-25a Primer Paint, Exterior, except that the viscosity shall be 85 ± 3 K.U. at 70° F.

Test Requirement: This paint shall be sampled and tested in the ready-mixed form.

–2.02W Formula F-3-64—Orange Equipment Enamel

The enamel shall meet the requirements for Enamel, Alkyd, Gloss Federal Specification TT-E-489C. The color, when dry, shall match that of Federal Standard No. 595 color 12246.

Test Requirements: When manufactured on contract or purchase order for maintenance use, the enamel will be sampled and tested in the ready-mix form. No factory inspection will be required; however, a one-pint sample representing the batch must be submitted to the Engineer for approval before use.

For factory application to individual items of new equipment, samples of the enamel will not be required; however, the equipment manufacturer must match the color and certify the quality of enamel used.

–2.02X Formula H-1-57—Primer for Concrete

Titanium calcium pigment	24.7 parts
Fibrous magnesium silicate	6.8 parts
Silica	6.8 parts
Varnish (TT-V-119)	52.3 parts
Mineral spirits	9.4 pounds
Weight per gallon (minimum)	9.8 pounds
Drying time (for testing purposes only)	18 hours
Viscosity at 70° F.	70± 5 K.U.

Consistency: The paint shall not thicken after manufacture to an extent sufficient to impair its brushing qualities.

Test Requirements: Prior to manufacture.

–2.02Y Formula H-2-62—White Masonry Paint for Precast Curbs

Titanium dioxide (dry pigment)	11.9 parts
Calcium carbonate (dry pigment)	25.6 parts
Mica (dry pigment)	7.4 parts
Diatomaceous silica (dry pigment)	7.0 parts
Thixin (body agent)	0.5 parts
Pliolite S5-A	8.0 parts
Chlorinated paraffin 40%	4.0 parts
Chlorinated paraffin 70%	4.0 parts
Aromatic brushing thinner	31.6 parts
Viscosity at 70° F	95± 5 K.U.
Weight per gallon (minimum)	12.1 pounds
Drying time (for testing purposes only)	18 hours

Test Requirements: Prior to manufacture.

–2.02Z Formulas J-1-57, J-2-57, J-3-57—Enamels for Signs

Formulas J-1-57 white, J-2-57 yellow, and J-3-57 black shall be water-resisting enamels made with synthetic gums. They shall be suitable for brush application to vertical metal surfaces and shall have the following characteristics:

	J-1-57	*J-2-57*	*J-3-57*
Coarse particles and skins retained on No. 325 sieve, not over	0.50%	0.50%	0.50%
Nonvolatile matter, not less than	85 %	80 %	50 %
Set to touch at room temperature, not over	5 hrs.	5 hrs.	5 hrs.
Dry hard at room temperature, not over	24 hrs.	24 hrs.	24 hrs.
Toughness, Kauri reduction test at 75° F., not less than	150 %	150 %	120 %
Hiding power, square feet per gallon by Pfund cryptometer, Model E, black plate, not less than	300	450	.....

Water Resistance: The dried films must withstand cold water for 18 hours and boiling water for 15 minutes without whitening, dulling, or change in color.

Working Properties: The enamels shall have good brushing, flowing, covering and leveling properties and must not cake in the container. When applied to vertical steel surfaces they shall dry without running, streaking or sagging.

The properties enumerated above shall be determined in accordance with Federal TT-P-141b.

Colors: Formula J-1-57 shall be pure white equal in brightness to that obtainable with rutile titanium-calcium pigment (ASTM Designation D 476-48). Formula J-2-57 shall match a standard color sample for "Standard Interstate Yellow." Formula J-3-57 shall be jet black and hide completely in one coat.

–2.02AA Formula J-4-57—Brilliant Green Sign Enamel

This formula shall be a ready-mixed exterior paint meeting the requirements of Federal TT-P-71b, except that a blend of titanium dioxide and tinting pigments shall be used instead of chrome green oxide. The paint shall match the color of a "Standard Interstate Green." The paint, when reduced with an equal weight of linseed oil, shall have a hiding power of not less than 750 square feet per gallon when measured on the Pfund Cryptometer, Model E, white plate, viewed in a light of approximately 50 foot-candle intensity.

–2.02AB Formula J-5-57—Green Stain for Wood Posts and Poles

Formula J-5-57, Green Stain for Wood Posts and Poles, shall be a "permanent" green color meeting the requirements of Federal TT-S-706. The green color shall be obtained by the use of Phthalocyanine green, chrome yellow, lampblack, and titanium dioxide with zinc oxide and calcium carbonate to complete the required pigmentation. The stain when dry shall match a standard color sample of J-4-57 green sign paint, "Standard Interstate Green." The stain will be sampled and tested in ready-mixed form.

–2.02AC Traffic Signal Yellow Enamel

Traffic signal yellow enamel shall meet the provision of Federal Specification TT-E-489c—Enamel, Alkyd, Gloss—and shall match the color of "Standard Interstate Yellow."

–2.02AD Exterior Acrylic Latex Paint—White

The paint shall meet the requirements of Federal Specification TT-P-0019a Paint, Acrylic Emulsion Exterior, except that the viscosity shall be 80-85 K.U.

The paint may be used self-primed in multiple coats over salts treated wood and on interior and exterior masonry surfaces.

Test Requirements: Paint will be sampled and tested in the ready-mixed form.

116–2.03 INSPECTION REQUIREMENTS

–2.03A General

Paints are classified into those requiring sampling and testing of raw materials prior to manufacture of the paint with inspection during manufacture, and paints which will be accepted on tests of the completely manufactured product. The type of test procedure required is indicated with the requirements for each formula under the heading "Test Requirements."

When the expression "prior to manufacture" is used in connection with a given formula, the manufacturer shall notify the Engineer when sufficient quantities of the necessary raw materials are on hand at the factory. The Engineer will then sample and seal each lot of material, and the lots so sealed shall be reserved for use until the Engineer notifies the manufacturer of the acceptance of the lots sampled.

The manufacturer shall notify the Engineer of the date on which manufacture will be started and the Engineer shall have the right to inspect all details of the manufacturing process and to assure himself that none but accepted lots of raw materials are used. The term "raw material" shall apply to each separate ingredient given in the formula, except that varnish and single pigments ground to paste form in the specified vehicle shall be considered as "raw material."

Quantities of 20 gallons or less of the above formulas will be accepted without inspection upon the manufacturer's notarized certificate. This certificate shall contain a statement by the manufacturer to the effect that the material meets the specified formula specification, and it shall include a list of materials and quantities used. One copy of the certificate shall accompany the paint when shipped and one copy with a sample of the paint shall be sent to the Engineer. The paint may be used at once without further release from the Engineer.

–2.03B Process of Manufacture

The following process of manufacture shall be used for each paint except aluminum paint. Pigments shall be thoroughly ground in appropriate portions of the specified vehicle to form a paste meeting the requirements set forth in Section 116-2.03H under "Fineness of Grinding." The grinding shall be done in a mill of a type approved by the Engineer. The use of the "colloid" type of mill will not be approved. Weighed quantities of the paste and weighed or measured quantities of the vehicles shall then be thoroughly mixed and strained, if necessary, to form a paint free from skins, lumps and foreign materials.

–2.03C Viscosity Adjustment

The volatile thinner content of the paint shall be adjusted at the factory to meet the required viscosity, but in no case shall the resultant weight per gallon and nonvolatile content of the paint be below that specified in the formula.

–2.03D Weight Variations

The average weight per gallon of the paint in any lot shall not be less than that stated in the formula. The paint in any container shall not vary more than two (2) percent from the specified weight per gallon.

–2.03E Drying Time and Quantity of Drier

The paint shall dry within the length of time stated in each formula but shall not contain sufficient quantities of drier to cause the paint to dry to a non-uniform or non-elastic film. The manufacturer will be permitted to vary the quantity of drier given in the formula to accomplish the above results.

–2.03F Working Properties

The paint shall contain no caked material that cannot readily be broken up by stirring with a paddle. When applied to a clean vertical surface the paint shall dry without running, streaking or sagging.

–2.03G Storage Properties

Paints manufactured under these specifications shall show no skin over the surface after 48 hours in a partially filled container, when tested as outlined in Federal Test Method Standard No. 141, Method 4141. A slight amount of skin or gel formation, where the surface of the paint meets the side of the container, may be disregarded. Variable percentages of "anti-skinning agents" are shown in those formulas that are susceptible to undersirable skin formation. The manufacturer will be allowed to vary the amount of "anti-skinning agent" given in the formulas, provided the above results are accomplished and provided the paint does not dry to a non-uniform or non-elastic film.

–2.03H Fineness of Grinding

The paint shall be ground so that all particles of pigment will be dispersed and be coated with vehicle, and so that the residue on a 325 sieve will not exceed one (1) percent by weight of the pigment when tested in accordance with ASTM Designation D 185, Standard Method of Test for Coarse Particles in Pigment, Pastes and Paints. Those paints made under formulas specifying special requirements for fineness of grind shall likewise be tested for fineness of grind as described in Federal Test Method Standard No. 141, Method 4411.

–2.03I Standard Colors

When the paint is required to match a standard color the manufacturer may obtain a sample of the required color without cost upon application to the Engineer.

–2.03J Containers

Each container shall be substantially filled with paint and sealed airtight. Each container shall be filled with the amount of paint required to yield the specified quantity when measured at 70° F.

All paint shall be shipped in new suitable containers, each having a capacity of not more than five (5) gallons. Each container shall be marked with a suitable number to identify the particular batch from which it was filled.

–2.03K Test Methods

As specified in Section 116-2.02A, all paints shall meet the special requirements set forth for each formula. The test methods used to check those special requirements shall be as specified below.

Weight per gallon: Federal Test Method Standard No. 141, Method 4184.

Set to touch: Federal Test Method Standard No. 141, Method 4061.

Dry hard (Varnishes, Lacquers and Enamels): Federal Test Method Standard No. 141, Method 4061.

Dry hard (Oil base paints): Federal Test Method Standard No. 141, Method 4062.

Viscosity (Krebs-Stormer Viscosimeter): Federal Test Method Standard No. 141, Method 4281.

Fineness of Grind: Federal Test Method Standard No. 141, Method 4411.

Non volatile content: Federal Test Method Standard No. 141, Method 4041.

Hiding power: The hiding power of the finished paint shall be such that when tested with the Pfund Cryptometer, Model E, black plate, wedge constant 0.0035 inch, and viewed in light of approximately 50 foot-candle intensity, the specified scale readings are not exceeded.

116–3 CONSTRUCTION DETAILS

–3.01 PAINTING NEW STEEL STRUCTURES

–3.01A Scope of Work

The painting of metal structures shall include, unless otherwise provided in the contract, the proper preparation of all metal surfaces, the application, protection and drying of the paint coatings, the protection of pedestrian, vehicular or other traffic upon or underneath any structure from contact with fresh paint, the protection of all portions of the structure (superstructure and substructure) against disfigurement by spatters, splashes and smirches of paint or of paint materials. It shall include, also, the supplying of all tools, tackles, scaffolding, labor, workmanship and materials necessary for the entire work.

–3.01B Number of Coats

All new structural steel work, unless otherwise especially provided upon the plans or in the contract, shall be painted three coats of paint. The first coat shall be applied before erection and immediately after the steel has been cleaned by sandblasting. The second and third coats shall be applied after all erection is complete, excepting however, that immediately following the field riveting of the members, the heads of field rivets and all abrasions of the shop coat due to handling at the shop, shipment, erection, etc., and all field erection marks shall be thoroughly covered with one coat of shop paint and be permitted to become thoroughly dry before the first field coat is applied.

–3.01C Colors of Coats

The color of each succeeding coat shall be sufficiently different from that previously applied to enable the discovery of an incomplete application of the paint coat. The colors of the coats shall be as specified on the plans or as directed by the Engineer.

–3.01D Weather Conditions

Paint shall be applied only when the air and metal temperatures are at or above 40° F. It shall not be applied upon damp surfaces, nor shall it be applied when the air is misty or otherwise unsatisfactory for the work, in the opinion of the Engineer.

Materials painted under cover in damp or cold weather shall remain under cover until dry or until weather conditions permit its exposure in the open. Painting in open yards or upon erected structures shall not be done when the metal is of a such high temperature as will cause the paint to blister and produce a porous paint film.

–3.01E Application

All paint shall be applied by brushing unless other methods are specifically stated in the special provisions or authorized in writing by the Engineer. Painting shall be done in a workmanlike manner by competent painters.

Brushes shall be either round or oval in shape, except that flat brushes four inches or less in width may be used to apply aluminum paint. The paint shall be so manipulated under the brush as to produce a uniform and even coating in close contact with the metal or with previously applied paint. In general, the primary movement of the brush shall describe a series of small circles to thoroughly fill all the irregularities in the surface, after which the coating will be smoothed and thinned with a series of parallel strokes. On all surfaces which are inaccessible for brushes the paint shall be applied with sheepskin or other approved daubers especially provided for the purpose.

Particular care shall be taken to apply a heavy paint film on rivet heads, edges of plates, angles and other rolled shapes. Paint shall also be well worked into all joints and crevices. Such areas shall be given a light coating shortly ahead of the general painting, and then a second covering when the general coat is applied.

If spraying machines are permitted, they shall be capable of satisfactorily applying paint mixed strictly in accordance with the formulas given in these specifications. Volatile thinners or other substances shall not be added in excess of the amounts permitted by the formulas to make it possible to operate the spraying machines. The equipment shall be subject to the approval of the Engineer, and if satisfactory work is not obtained, the use of such equipment may be prohibited and brushing required.

Special care shall be taken in the protection of traffic and all portions of the structure as outlined in Section 116-3.01A. The Contractor shall furnish and install sufficient canvas or other covering to screen and protect traffic and the various portions of the structure adjacent to areas from damage or disfigurement from wind-blown or dripping paint.

If traffic cannot be properly safeguarded and protected against damage from wind-blown or dripping paint by installing canvas or other covering, the Contractor shall provide watchmen, when directed by the Engineer, and the painting operation shall be interrupted intermittently for the passage of vehicles.

Paint shall be thoroughly stirred by means of mechanical mixers or other means before it is removed from the containers. It shall be kept stirred while being applied in order to keep the pigments in suspension.

–3.01F Removal of Improper Paint

All metal not properly cleaned before painting, or metal coated with impure or improper paint shall be thoroughly cleaned and repainted to the satisfaction of the Engineer at the expense of the Contractor.

–3.01G Thinning

Paint shall be shipped from the factory at brushing consistency and the use of additional thinner will not be permitted, unless authorized in writing by the Engineer.

–3.01H Shop Cleaning

All surfaces of metal to be painted shall be thoroughly cleaned of rust, loose mill scale, dirt, oil, grease and other foreign substances. Oil and grease may be removed by the use of suitable solvents. The removal of rust, scale and dirt shall be done by sandblasting as specified in Section 112-3.14. Bristle or wood fibre brushes or air blast may be used for removing loose dust.

–3.01I Shop Painting

After the structural steel has been fabricated and thoroughly cleaned as specified above, all surfaces shall be painted immediately with one coat of the paint specified on the plans, except that on those surfaces which will be in contact in the finished structure, the shop coat of paint shall be only heavy enough, but not less than one (1) mill (.001 inch) in dry thickness to prevent the metal from rusting before the structural steel is erected and painted in the field. It is the intent of this specification that as little paint as possible be applied to contact surfaces.

The paint used for covering field contact surfaces shall be the same as specified for the shop coat. The addition of volatile thinner in excess of the amount allowed by the formulas will not be permitted. The light application of paint shall be confined to those surfaces which will be in contact after erection. Other surfaces which will not be in contact but which may have received only the light application of paint, shall be touched up with a normally thick coating of the shop paint and be allowed to become thoroughly dry before the first coat of paint is applied.

Structural steel shall not be loaded for shipment until after the shop coat of paint has thoroughly dried. No painting shall be done after steel has been loaded for shipment.

–3.01J Erection Marks

Erection marks for the field identification of members shall be painted upon previously painted surfaces.

–3.01K Machine Finished Surfaces

Machine finished surfaces, including abutting chord splices, column splices and column bases, shall be covered with red lead paint, Formula A-1-57 as soon as practicable after acceptance and before removal from the shop.

Surfaces of iron and steel castings, milled for the purpose of removing scales, scabs, fins, blisters or other surface deformations, shall also generally be covered with red lead paint.

–3.01L Field Cleaning

When the erection work is completed, including all riveting, straightening of bent material, etc., all metal surfaces shall be thoroughly cleaned of rust, scale, dirt, oil or grease and all other foreign substances. The removal of rust, scale and dirt shall generally be done by the use of metal brushes, scrapers, chisels, hammers, sandblasting, or other effective means, as approved by the Engineer. Oil and grease may be removed by the use of gasoline or benzine. Bristle or wood fibre brushes may be used for removing loose dust.

Pressure flushing as specified in Section 116-3.02C may be required if the structure is covered with dirt deposits or residue from concreting work.

Damage to the shop coat caused by shipping or by handling in erection, and to rivets and welds placed during erection shall normally be cleaned by thorough wire brushing prior to painting. All dirt, oil, grease and foreign materials shall be removed from the structure by use of solvents, scrapers, brushes or pressure flushing prior to the application of each coat of paint, as may be approved by the Engineer.

–3.01M Field Painting

As soon as the field cleaning is done to the satisfaction of the Engineer, the heads of field rivets and bolts, all surfaces from which the shop coat of paint has been worn off or which is otherwise defective, and all shipping and erection marks shall be thoroughly covered with one coat of the same paint as used for the shop coat. This paint shall be allowed to become thoroughly dry before the first field coat is applied.

When the paint applied for "touching up" rivet heads and abraded surfaces has become thoroughly dry, the first and second field coats may be applied. In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the paint film.

All small cracks and cavities that have not become sealed in a watertight manner by the first field coat shall be filled with red lead sealing paste applied by brush or spatula before the second field coat is applied.

116–3.02 REPAINTING EXISTING STEEL STRUCTURES

3.02A Scope of Work

Unless otherwise provided, maintenance painting shall consist of the removal of the rust, scale, dead paint, dirt, grease or other foreign matter from the metal parts or portions of existing bridge structure, and the application of paint thereto.

All metal surfaces not in close contact with other metal surfaces or with wooden floor or truss members, concrete, stone masonry, etc., shall be considered as exposed to deterioration by rusting and shall be thoroughly cleaned and painted. The number of coats shall be as shown on the plans or as specified in the special provisions.

–3.02B Number of Coats

Unless otherwise provided, metal after being cleaned to the bare substrate shall be painted with three coats of paint.

–3.02C Cleaning and Painting

The requirements and methods for cleaning and repainting existing steel structures shall be the same as specified for field cleaning and painting of new structures unless otherwise specified on the plans or in the special provisions.

Rust removal shall be by means of sandblasting. The spots that are sandblasted shall be blasted to a uniform metallic gray appearance with only small areas of stain and gray mill scale permitted. There shall be no evidence of red or yellow rust at the edges of the clean area, and the sound paint edges shall be feathered to give a smooth surface.

Pressure flushing, when called for, shall be by means of water, or water and detergents. The pumping system shall operate at a minimum nozzle pressure of 150 pounds per square inch. The nozzle shall have an orifice of not less than one-fourth (¼) inch diameter and shall be so designed as to give a high pressure stream rather than a spray. The nozzle shall be operated not more than six (6) feet from the surface being cleaned.

All cracks and crevices in the cleaned areas that are not sealed by the spot coat of paint shall be sealed by use of red lead sealing paste, applied by brush or spatula before the finish coat of paint is applied.

Whenever roadway or sidewalk planking is laid too closely in contact with the metal to permit free access for proper cleaning and painting, the planks shall either be removed or shall be cut to provide at least a one (1) inch clearance for that purpose. The removal or the cutting of planks shall be done as directed by the Engineer. All planks removed shall be satisfactorily replaced and if any are broken or otherwise injured to an extent rendering them unfit for use, they shall be renewed at expense of the Contractor.

116–3.03 PAINTING TIMBER STRUCTURES

–3.03A Number of Coats

Unless otherwise specified, rails and railposts on timber bridges shall be given two coats of paint. The color shall be as shown on the plans, specified in the special provisions, or as designated by the Engineer. Unless otherwise indicated, the wheel guard shall be painted only on the top edge and roadway side.

Other timber work of structures, fences, stairways and other timber appurtenances above ground elevation shall be given three (3) coats of paint of the color specified or as designated by the Engineer, unless otherwise shown on the plans or specified in the special provisions.

–3.03B Application

All wood surfaces to be painted must be thoroughly dry and free from oil or dirt. All paint for wood shall be applied with brushes and shall be evenly spread and thoroughly worked into all seasoning cracks, corners and recesses. In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the paint film. In applying aluminum paint with a brush, care shall be taken that all final strokes are made in the same direction in order that the particles of powder may "leaf" uniformly in the paint film.

Paint shall not be applied on creosoted surfaces. Painted surfaces stained from the presence of creosote shall be given one or more coats of approved shellac and the surfaces be repainted.

–3.03C Painting Treated Timber

Timber treated with creosote or oil-borne penetachlorophenol preservatives will not ordinarily be painted.

Timber treated with water-borne preservatives must be clean and dry and shall have the moisture content reduced to the 18 percent or less specified in Section 115-3.02B. Visible salt crystals on the surface of the wood must be removed by washing and brushing and the moisture content again reduced to specification level. Timbers in storage awaiting painting must be under cover and properly stacked with spreaders to ensure circulation of air.

The paint schedule shall consist of one (1) full coat of primer Formula E-2-62 and two (2) full coats of Formula D-5-57 applied to all surfaces. Each coat of paint shall be thoroughly dry before the next coat is applied. Three full coats of Exterior Acrylic Latex Paint may be used as an alternate schedule at the option of the Contractor.

116–3.04 PAINTING BEAM GUARD RAIL

–3.04A Preparation and Preliminary Coats

Cleaning and types of paint applied to beam guard rail shall be as specified in Section 116-3.04C. All but the final field coat of paint may be applied in the shop if the Contractor so elects. Guard rail posts will not be painted.

All punching, shearing, riveting, rolling and other operations required for fabrication will be completed prior to cleaning and painting. Paints may be applied by brush or spray at the option of the Contractor; however, the requirements for the number of coats, film thickness per coat and total film thickness must be met regardless of the method of application. Forced drying of all paint coats will be permitted provided the dry film is free from blisters, bubbles and other damage and is equal in quality to an air dried film.

Before applying any paint to the beam rail, the surface shall be thoroughly clean and dry and all loose paint or scale shall be removed. No exterior painting shall be done in wet or freezing weather.

Galvanized guard rail shall be painted on the roadway face only.

–3.04B Spotting and Final Field Coat

Depending upon the option chosen by the Contractor as stated in Section 116-3.04C, the necessary coat or coats of paint shall be applied by brush or spray after all erection has been completed. After erection and prior to application of the final field coat all abrasion damage and erection damage shall be spotted to replace lost coats of paint. Areas scarred to the metal surface or left unpainted until after erection shall be cleaned and spotted with the required number of coats of each paint to bring all painted surfaces of the rail up to the same number of coats. Formula A-6-61—Zinc-Rich Primer—may be used to spot in place of the formulas A-5-61 and A-2-57 regardless of the original system applied to the rail.

After the spot coats have dried, the surface dirt shall be removed by brushing, wiping or pressure flushing as specified by the Engineer at the job site, and be dried and given a full coat of Formula D-5-57—Alkyd Guard Rail Paint.

–3.04C Painting Galvanized Rail

All galvanized surfaces to be painted shall have all oil and grease removed by solvents. Remaining deposits may be removed by any required method which does not damage the galvanizing.

The clean and dry rail may be painted according to either of the following schedules, at the option of the Contractor:

Schedule A: First coat—Formula A-5-61
Second coat—Formula A-2-57
Third coat—Shop Finish Coat D-5-57
Fourth coat—Field Finish Coat D-5-57.

Schedule B: First coat—Formula A-6-61
Second coat—Shop Finish Coat D-5-57
Third coat—Field Finish Coat D-5-57.

The primer and shop finish coats may be force dried, if desired. Each coat must be dry before application of the next coat and all coats applied in the shop must be dried hard prior to shipment of the rail.

116–3.05 PAINTING STEEL RAIL

Steel rail and fittings shall have all oil and grease removed by use of solvents. Corrosive products and other foreign materials shall be removed by sandblasting or a pickling process. Power wire brushing may be permitted at the option of the Engineer.

As soon as possible after cleaning and drying and in any event during the same working day on which cleaning takes place, the surface shall be primed with a full coat of Formula A-2-57—Shop Coat for Steel—followed by two (2) full coats of Formula D-5-57—Guard Rail Paint.

116–3.06 PAINTING MISCELLANEOUS GALVANIZED SURFACES

The general procedures as outlined in Subsection 116-3.04C shall be followed with regard to surface preparation and painting of galvanized surfaces.

116–3.07 PAINT FILM THICKNESS

Formula A-5-61—Vinyl Pretreatment has such rapid solvent release that wet film thickness readings are difficult to obtain; however, a full wet coat free from runs and sags yields proper film thickness. All other coatings, regardless of the method of application, shall be applied at a minimum wet thickness of 2.0 mills per coat.

The dry film thickness of Formula A-5-61—Vinyl Pretreatment shall be 0.4-0.7 mills. All other coatings, regardless of the method of application, shall yield a minimum dry film thickness of 1.5 mills per coat.

The minimum total dry film thickness for the specified paint system on any surface shall be the sum of the individual dry film thicknesses of the individual coats. In the event that the minimum total dry film thickness requirement is not met, the Engineer may specify an additional full coat of finish paint.

Wet film thickness shall be measured by a suitable gauge immediately after the paint is applied. Dry film thickness measurements shall be made by use of a suitable gauge after the coating has become thoroughly dry and hard.

116–5 MEASUREMENT AND PAYMENT

116–5.01 GENERAL

No separate payment item will be included in the proposal for painting except as otherwise provided hereinafter.

116–5.02 PAINTING NEW STEEL STRUCTURES

Painting new steel structures shall be considered as incidental to the construction and all costs in connnection

with cleaning and painting the metal surfaces, as specified herein, shall be included in the various unit contract prices for the materials specified to be painted.

116–5.03 REPAINTING EXISTING STEEL STRUCTURES

Payment for repainting existing steel structures will be made as provided in the special provisions and proposal.

116–5.04 PAINTING TIMBER STRUCTURES

Painting timber structures shall be considered as incidental to the construction and all costs in connection with painting the timber surfaces, as specified herein, shall be included in the unit contract price per thousand feet board measure (MBM) for "Timber and Lumber."

116–5.05 PAINTING GUARD RAILS

Painting guard rails shall be considered as incidental to the construction and all costs in connection with painting the guard rails, as specified herein, shall be included in the unit contract price per linear foot for guard rail of the type specified.

Section 117—Bridge Railings

117–1 DESCRIPTION

Concrete handrailing shall consist of that portion of the railing above the roadway curb or above the sidewalk curb and shall include the rail web, cap and posts. Timber railing shall include the timber wheel guards, rail posts and horizontal railing members. Metal railing shall include posts, web members and horizontal members of sidewalk and roadway railing and, unless otherwise shown on the plans or specified in the special provisions, may be constructed either of aluminum alloy or steel.

Detailed specifications for metal railing are not included in this supplement to Standard Specifications for Municipal Public Works Construction. For any municipality not having its own design and specifications, reference is made to design drawings E 24 and E 25, which may be obtained by request to Plans and Contracts Division, Department of Highways, Highways-Licenses Bldg., Olympia, Washington. The design drawings carry complete specifications of metal materials required for metal railing.

117–2 MATERIALS

All materials shall conform to the specifications contained herein or shown on the plans for the various classes of materials from which the railings are constructed.

The fine aggregate used for concrete in bridge railings shall be as specified in Section 37-2.02B. Coarse aggregate shall comply with the table of "Grading No. 2" in Section 37-2.02C3 and with other related subsections of Section 37-2.02.

The use of high-early-strength cement will not be permitted unless specifically authorized in the special provisions.

117–3 CONSTRUCTION DETAILS

117–3.01 CONCRETE RAILINGS

–3.01A General

Concrete railing shall be constructed in accordance with the specifications of Section 101—Concrete Structures, Section 107—Portland Cement Concrete for Structures, and Section 111—Reinforcing Steel. Railing, insofar as possible, shall be constructed after the roadway and sidewalk slabs are completed for the entire structure.

–3.01B Forms for Concrete Railings

Railing and curb forms shall be carefully constructed of steel, finished lumber and/or plywood conforming to the requirements for forms in Section 101-3.03, unless the special provisions provide otherwise. When completely assembled and in place above the curb sections, forms shall have interior dimensions and be of such rigidity as to accurately shape and contain the concrete to produce the railing according to the dimensions shown on the plans. The maximum allowable inside surface deviation of the forms shall be one-eighth (⅛) inch.

Rail forms in place ready for placement of concrete shall be of uniform height and be of such alignment and grade that the finished rail will present a pleasing appearance with no abrupt changes.

Wherever the height of the railing must vary from the grade of the structure to have a pleasing appearance, such as at vertical or horizontal curves or other grade points, the variation to be made shall be taken in the curb section forms and a uniform height throughout be maintained for the railing. Structure grade humps followed by sags shall be avoided in the railing by varying the curb height.

All joints and corners shall be carefully fitted. Exposed corners, except the rail web openings, shall be chamfered one-half (½) inch. Expansion and construction joints, except the top surface of rail caps, shall have one-half (½) inch chamfers on each side of the joint.

All cost to the Contractor for adjusting curb height to meet approval of the Engineer shall be considered as incidental to the railing construction, excepting however, that if the Engineer shall require forms to be again reset after once having been erected and accepted to a final elevation by him, then the additional readjustment shall be considered as extra work and will be paid for in accordance with Section 9.03.

3.01C Removal of Forms

Forms for concrete railings shall not be removed for at least three (3) days after the placing of concrete. Curb forms may be removed as soon as practicable after the concrete is placed, upon approval of the Engineer. Forms shall be removed without injury to the concrete. After removal, all forms intended for re-use shall be cleaned and freshly coated with form oil.

–3.01D Finishing and Curing

Initial placement of concrete in forms shall be to an elevation slightly above the required top grade for the railing. The surface shall then be smoothed off to true grade, troweled and edged in a workmanlike manner to form the surface to the cross section shown on the plans. The troweled railing top shall then be lightly brushed transversely with an approved fine bristle brush.

At expansion joints in rail caps, an edger tool having a radius of one-fourth (¼) inch shall be used on each side of the joint on the top surface of the cap. Particular care shall be taken at each joint to maintain the true lines of the cap and avoid a short, unsightly incline on each side of the joint.

At all expansion joints in the railing, special care shall be employed when troweling and edging to obtain joint edges on both sides of the joint that will be true to the longitudinal grade of the railing. The finished railing top across expansion joints shall meet the requirements for surface smoothness specified for a Class 1 Surface Finish in Section 107-3.16. Upon completion of final brushing, the concrete surface shall be protected for curing by an approved method specified in Section 39-3.20.

Concrete railing shall be cured for a period of ten (10) days following the day concrete was placed and the forms shall remain in place for a minimum of three (3) days of this curing period. When forms are removed by the Contractor before the ten (10) day curing period has elapsed, the exposed railing shall be recovered immediately with the approved curing method and be kept so covered for the remaining curing time.

At the end of the curing period, the railing shall be thoroughly washed with water, all form oil shall be removed and the railing shall be given a Class 1 Surface Finish. The completed surface of the railing shall be of uniform color and texture.

When liquid membrane curing compound is to be used, each surface to which it will be applied shall receive the specified class of surface treatment, and this finish shall be accepted by the Engineer before the liquid membrane is applied. All adjacent or nearby surfaces which are to receive a surface finish shall be protected from the application of the membrane until after the specified finish is accomplished and accepted.

117–3.02 TIMBER RAILINGS

Wheel guards and railings shall be accurately framed in accordance with the plans and be erected true to line and grade. On structures having horizontal or vertical curves, the heights of railings or wheel guards shall be varied at points of change in grade if, in the opinion of the Engineer, such variations will be necessary to produce the desired appearance.

Unless otherwise specified, wheel guards shall be beveled on the roadway face. Wheel guards shall be surfaced on all sides (S4S) unless the plans or special provisions specify that they be surfaced on the top edge and roadway face. Wheel guards shall be laid in sections, each not less than twelve (12) feet in length. All material for rails and rail posts shall be surfaced four sides (S4S).

Railing members shall be securely fastened together as shown on the plans. Bolts shall be tightened when they are installed and shall be retightened immediately prior to final acceptance of the contract.

Rails and rail posts shall be painted in accordance with the specifications of Section 103-3.06 and Section 116-3.03A.

All construction methods not outlined in this section of the specifications, shall be in accordance with specifications of Section 103—Timber Structures, and Section 114—Timber and Lumber.

117–3.03 METAL RAILINGS

Metal railings shall be erected and fastened true to line and grade, or camber. Railings on steel spans may be erected at the same time the trusses or girders and floor systems are erected but shall not be completely fastened until after the roadway slab is in place. On spans having concrete sidewalks, the railings shall be aligned and fastened in place and strutted and tied to the trusses or girders before placing concrete in sidewalk slabs. Struts and ties shall remain in place for at least five (5) days after the slab is placed.

Top rails, usually of pipe, and all other horizontal elements shall be aligned and fastened after all dead load has been applied to the span.

Bolts shall be placed with heads of bolts facing the roadway, and all bolt heads shall have top and bottom edges parallel to the grade.

On multiple span bridges the rail and wheel guard heights at the ends of each span shall be varied a sufficient amount to produce a uniform camber or grade from end to end of the bridge.

After the metal railing has been set initially, the Contractor shall readjust the entire railing or any sections thereof, if necessary, to secure a continuous line and grade of pleasing appearance.

Section 8, part (b) of the Aluminum Association Standard Specifications for Aluminum Railing Posts Alloy A 344-T4 is hereby revised to provide that no X-ray inspection will be required after a foundry technique has been established for each mold which will assure production of castings that are free from harmful defects. Inspection for approval of castings will be made by the Engineer after the finished castings have been anodized as noted on the plans.

117–5 MEASUREMENT AND PAYMENT

117–5.01 CONCRETE RAILINGS

Payment for concrete railings will be made at the unit contract price per linear foot for "Reinforced Concrete Bridge Railing" and the unit contract price per pound for "Steel Reinforcing Bars," which prices shall be full compensation for all materials, labor, tools and equipment necessary to construct and finish the railings as shown on the plans and as specified herein.

117–5.02 TIMBER RAILINGS

Payment for timber handrailings will be made at the unit contract price per thousand (MBM) for "Timber and Lumber," which price shall be full compensation for all materials, including hardware, labor, tools and equipment necessary to construct and paint the railings as shown on the plans and specified herein.

117–5.03 METAL RAILINGS

Payment for metal railings will be made for such of the following bid items as are included and shown in any particular contract:

1. "Standard Bridge Railing, Type...," per linear foot.

The unit contract prices per linear foot for metal railings shall be full compensation for all materials, labor, tools and equipment necessary to construct the railings as shown on the plans and as specified herein, including fastenings, anchor bolts, galvanizing, and painting if specified.

In case no item is included in the proposal for "Standard Bridge Railing, Type ...," and payment is not otherwise provided, the costs of all metal railings and necessary accessories shall be included by the Contractor in the lump sum contract price for "Structural Carbon Steel."

Section 118—Waterproofing

118–1 DESCRIPTION

The waterproofing shall be a firmly bonded membrane composed of two (2) layers of fabric and three (3) moppings of asphalt, together with a coating of primer. The waterproofing shall be applied to those surfaces and construction joints noted on the plans, or directed by the Engineer in writing. When specified on the plans, a protective layer of portland cement mortar shall be laid over the entire surface of the waterproofing membrane.

118–2 MATERIALS

118–2.01 ASPHALT FOR WATERPROOFING

Asphalt for waterproofing shall conform to the requirements of ASTM Designation D 449, Asphalt for Dampproofing and Waterproofing. Type A asphalt shall be used for application below ground and Type C for application above ground.

The material used as primer shall conform to the requirements of ASTM Designation D 41, Primer for Use with Asphalt in Dampproofing and Waterproofing.

118–2.02 WATERPROOFING FABRIC

Waterproofing fabric shall be a saturated cotton fabric meeting the requirements of ASTM Designation D 173, Woven Cotton Fabrics Saturated with Bituminous Substances for Use in Waterproofing.

118–2.03 PORTLAND CEMENT MORTAR

Portland cement and sand for the mortar protection course shall conform to the requirements for portland cement, and fine aggregate as described in Section 37-2.02B.

118–3 CONSTRUCTION DETAILS

118–3.01 STORAGE OF FABRIC

The fabric shall be stored in a dry and protected place. The rolls shall not be stored on end.

118–3.02 PREPARATION OF SURFACE

All concrete surfaces which are to be waterproofed shall be reasonably smooth and free from imperfections which might damage the membrane. The surface to be waterproofed shall be dry and shall be thoroughly cleaned of all dust and loose material. No waterproofing shall be done in wet weather, nor when the temperature is below thirty-five (35) degrees F., without authorization in writing by the Engineer.

118–3.03 APPLICATION OF WATERPROOFING

The asphalt shall be heated to a temperature not lower than 300° F., and not higher than 350° F., with frequent stirring to avoid local overheating. The heating kettle shall be equipped with thermometers.

In all cases, the waterproofing shall begin at the low point of the surface to be waterproofed so that water will run over and not against or along the laps.

The application of the waterproofing shall be as follows:

Beginning at the low point of the surface to be waterproofed, a coating of primer shall be applied and allowed to dry before the first coat of asphalt is applied.

A section about twenty (20) inches wide and the full length of the surface shall then be mopped with the hot asphalt, and immediately following the mop there shall be rolled into it the first strip of fabric of half width, which shall be carefully pressed into place so as to eliminate all air bubbles and obtain close conformity with the surface. This strip and an adjacent section of the surface of a width equal to slightly more than half the width of the fabric being used, shall then be mopped with hot asphalt and a full width of the fabric shall be rolled into this, completely covering the first strip, and be pressed into place as before.

The second strip and an adjacent section of the concrete surface shall then be mopped with hot asphalt and the third strip of fabric shingled on so as to lap the first strip by not less than two (2) inches. This process shall be continued until the entire surface is covered, each strip of fabric lapping at least two (2) inches over the last strip. The entire surface shall then be given a final mopping of hot asphalt.

Under no circumstances shall one (1) layer of fabric touch another layer at any point or touch the surface, as there must be at least three (3) complete moppings of asphalt.

In all cases the mopping shall be so thoroughly done that the surfaces will be completely covered. The asphalt must be so heavily and uniformly applied that no gray spots will appear on the concrete and the weave of the cloth will be entirely concealed. On horizontal surfaces, not less than twelve (12) gallons of asphalt shall be used for each one hundred (100) square feet of finished work, and on vertical surfaces not less than fifteen (15) gallons shall be used for each one hundred (100) square feet. The work shall be so regulated that, at the close of the work day, all cloth laid that day will have received the final mopping of asphalt. Special care shall be taken to see that all laps are thoroughly sealed down.

At the edges of the membrane and at all locations where the surface is penetrated or disturbed by drains, pipes or other interferences, the Contractor shall make suitable improvisations that will effectively prevent any water or moisture getting between the waterproofing and the surface of the concrete.

All flashing at curbs and against girders, spandrel walls, etc., shall be done with separate sheets lapping the main membrane not less than twelve (12) inches. Flashing shall be closely sealed either with full metal flashing or by imbedding the upper edges of the flashing in a groove poured full of an acceptable joint cement.

There shall be no break in the waterproofing membrane at expansion joints. The fabric shall be folded so as to allow for expansion movement. At the ends of the structure the membrane shall be carried well down on the abutments and suitable provision made for the movement due to expansion and contraction.

118–3.04 PROTECTION COURSE

When specified on the plans, a protective layer of portland cement mortar not less than one and one-half (1½) inches in thickness shall be laid over the entire surface of the waterproofing membrane. The protective coating shall be placed immediately after the membrane has cooled to normal temperature. The protective coating shall be composed of one part portland cement to two parts sand. The protective coating shall be uniformly distributed over the surface, gently tamped into place and finished by hand to present a smooth, hard surface. The protective coating shall be covered and kept moist for a period of one (1) week.

118–5 MEASUREMENT AND PAYMENT

Payment for "Waterproofing" will be made at the unit contract price per square yard of completed surface, which price shall be full compensation for all labor, materials, tools, and equipment required to complete the work.

The waterproofing of construction joints not shown on the plans and protective improvisations at interference of pipes, drains, etc., shall be considered as incidental to the construction and the costs thereof shall be included in the unit contract price per square yard for "Waterproofing.

PROCEDURES AND PLANS FOR LOCATIONS OF UNDERGROUND UTILITY INSTALLATIONS

(As recommended by the Utility Standardization Committee)

PREFACE

The rapid growth in population and industry in Washington requires a greater degree of standardization of underground locations for utilities within public rights of way to provide proper planning for the future and avoid interminable confusion.

The Utility Committee of the Washington State Chapter of American Public Works Association submits these recommendations for utility coordination on streets, roads and highways. It is necessary to say that the procedures recommended herein, however good, are not to be considered as APWA specifications. The drawings and procedures have, however, met with so much favor by those engineers who have examined them as to merit space in this edition for use of those municipalities that will endeavor to put the provisions in effect.

It is expected that most future locations of utilities, and the inspection, control and coordination between the utilities and municipalities can be made in accordance with the recommendations.

The term "Owner" is defined as the public or corporate agency (city, county, municipality) having jurisdiction to issue permits or franchises. The term "Utility" is defined as the permittee or franchise holder. The term "Contractor" is defined as the person or firm under contract to perform certain utility construction within a public right of way.

Locations for Utilities

GENERAL

This section consists of proposed locations, new or existing, within rights of way for underground utilities such as sanitary sewers, storm drains, watermains, gas mains, power and telephone cables, and related conduit structures. The material hereinafter described and referred to in this section offers the Owner proposed zone locations for underground utilities.

PROPOSED LOCATIONS

It is not the intent of this proposal to specify **exact** locations of utilities within rights of way, but rather to define zones for utility occupancy as shown on zone location drawings. The owner will determine the exact location for each type of utility within the zone specified on the drawing.

If existing utilities or other conditions prevent the use of a drawing, the proposed deviation must be approved by the Owner.

Drawings of recommended locations follow on pages 175 and 176.

Inspection and Control

GENERAL

The intent of this proposal is to prescribe the method of inspection and control necessary to ensure that the work will be accomplished in accordance with the requirements of the Owner.

INSPECTION AND CONTROL

Prior to beginning work, the Owner will arrange a preconstruction conference to be attended by the Contractor and/or Utility, the Owner's inspector, representatives of utilities that may be in conflict with the proposed work, and a representative of the traffic enforcement agency if the work will interfere with traffic on a street, road, or highway.

The pertinent points to be discussed at this conference shall include safety, traffic control, utility location and/or relocation, method of construction, restoration of streets, roads or highways, and other related items. A written report of this conference will be made by the Owner as suggested and shown on Pre-construction Conference Form, shown later on, and will be included as a portion of the permanent records of the project.

Inspection

The Owner will assign an inspector to ensure that the work is done in full compliance with the provisions and requirements of the franchise or permit. The inspector will be required to keep a daily diary as suggested and shown later on upon the Daily Diary Form, which will be included as a portion of the permanent records of the project.

Traffic Control

The Owner will advise the Contractor and/or Utility of the traffic control to be maintained when the work is done on or adjacent to streets, roads, and highways. Plans showing traffic control devices and their placements will be given the Contractor and/or Utility and full compliance without deviation will be required. Hours of work will be determined by the Owner and strictly adhered to by the Contractor and Utility.

Method of Construction

Work will be governed by the contract, franchise, or permit provisions and any deviation from the approved permit or franchise shall in all cases be determined and approved by the Owner. The Contractor and/or Utility shall be supplied with a set of approved plans, specifications, and special provisions and shall be present either in person or by a duly authorized representative on the work site continually during its progress.

Pre-construction Conference Form

PERMIT NUMBER .....DATE.....
LOCATION OF CONFERENCE .....
REPRESENTATIVES OF OWNER .....
REPRESENTATIVES OF UTILITY .....
REPRESENTATIVES OF CONTRACTOR .....

OTHERS ATTENDING:
STATE PATROL .....SHERIFF.....
POLICE .....
COUNTY .....CITY.....
STATE ..... OWNER.....
OTHERS .....

POINTS TO BE DISCUSSED: (Record what Owner stipulated at this meeting after each item where pertinent)

I. INSPECTION
- a. Fees and charges by Owner.
- b. Notification by Utility of beginning or resuming work.
- c. Owner's record of existing conditions.
- d. Deviations.
- e. Owner's work through Utility's inspector where possible.

II. TRAFFIC CONTROL
- a. Hours of work.
- b. Signing, coning, flagging, barricades, flashing lights.
- c. Blocking of lanes.
- d. Use of sweeper.

III. PHASES OF CONSTRUCTION
- a. **Boring and Jacking**
  1. No pulling.
  2. No jetting.
  3. No excavation closer than ——— from edge of pavement.
  4. Minimum cover.
- b. **Trenches**
  1. Cribbing.
  2. Backfilled each night or use of flush planking.
  3. Final backfill material and compaction.

c. **Restoration**
   1. Shoulders.
   2. Ditches.
   3. Drainage.
   4. Pavement.

IV. OTHER ITEMS
   a. As-built plans.
   b. Procedure for release of bond.
   c. Other contractors in area.

Records

GENERAL

As-built records will be maintained by the Owner unless otherwise determined at the pre-construction conference. These records shall include all pre-construction reports, records, photographs, inspector's field notes and diaries.

If the Owner requires as-built plans at the conclusion of the project, the Owner will so stipulate in the contract, franchise, or permit. In this event, the Utility shall furnish such plans within ninety (90) days following the conclusion of the work.

Diary and Time, and Equipment Record

Permit No. .....

Sheet No. .....

Inspector ..... Owner.....

DATE	LABOR HOURS	EQUIP. MILES	COMMENTS
			To be filled in after each date, even if only to record that the Contractor or Utility was not working. All accidents and other incidents where claims might be filed should be recorded here.

Underground Construction Coordination

GENERAL

These provisions relate to the coordinating measures necessary in the installation of underground utilities such as sanitary sewers, storm drains, water mains, gas mains, power, telephone and television cables, and any other underground utility in public rights of way.

Coordination, in the sense used herein, shall apply to the actions necessary for all parties to perform their work in the most economical manner and with as little interference as possible from others working in the same roadway, easement, or plat. These requirements are similar to those outlined in Section 5.04 of the APWA standard specifications.

At the discretion of the Owner, an overall utility coordinator will be appointed by the developer to supervise the installation of the utilities in an orderly manner in a roadway, easement, or plat.

Each Utility shall have its own engineer or supervisor readily available. The engineer or supervisor shall be responsible for the work of his Utility and shall also be responsible to the overall utility coordinator for the performance of his Utility's work in a timely workmanlike manner.

Priority for starting construction shall be given normally to the utility to be constructed at the greatest depth under a proposed roadway, or surface to be concreted, black-topped, or other. All scheduling shall be determined by the overall utility coordinator.

CONSTRUCTION DETAILS

Main Line Construction

Construction of the main or secondary lines of all utilities shall be parallel or nearly parallel to the center line of the roadway or proposed roadway and in accordance with applicable requirements outlined in the APWA standard specifications.

Service Line Construction

Service lines to individual homes or buildings shall be installed perpendicular to the main or secondary lines installed in the roadway area, and in accordance with applicable requirements outlined in the APWA standard specifications.

Developer's Responsibility in New Plats

It shall be the developer's responsibility to deliver to all utilities concerned, a preliminary or recorded plat or plan which has been approved by the Owner. A copy of this plat or plan shall be available for all concerned utilities at least three months prior to actual construction.

The approved copy of the plat or plan shall indicate the location of the utilities on public rights of way as approved by the Owner.

The developer shall, within a reasonable time after delivery of the copy of the recorded plat or approved plan, call a meeting of representatives of interested utilities to discuss mutual problems and preliminary schedules.

Prior to actual construction, property line or offset stakes shall be set, and the developer shall have rough graded the area in which the utilities are to be installed. No utility construction shall commence where there are obstructions such as mounds of dirt, lumber, etc., or in areas where fills are required.

Elevations of the final grade of various component parts such as roadway, curb, sidewalk, and other pertinent data shall be established as the overall utility coordinator may deem necessary.

After the roadway subgrade is completed, sufficient time shall be allowed the utilities to install their facilities along and under the future road surface except those utilities required to be installed prior to subgrading. The utilities shall then trench and install their system, backfill and tamp to specifications. If settlement does occur after the above precautions have been taken, the necessary corrections can be made before the final surfacing is applied.

Utilities' Responsibility in New Plats

Within a reasonable time after the developer has delivered his recorded plat or plan to the utilities involved, it shall be the responsibility of the utilities to commence drawing of the construction plans.

The approved construction plans of a utility for a project shall be distributed to the other interested parties for review before actual construction begins.

Each Utility shall be responsible for obtaining necessary easements and permits as may be required prior to construction.

Each Utility shall have the material and equipment available for construction at the time notice is given to commence work.

The Utility representative shall have as-built plans available within 90 days after completion of construction for distribution to other utilities, the developer, F.H.A., and the Owner.

Overall Utility Coordinator's Responsibility

The overall utility coordinator shall have a preconstruction conference with representatives of interested utilities to establish a work schedule.

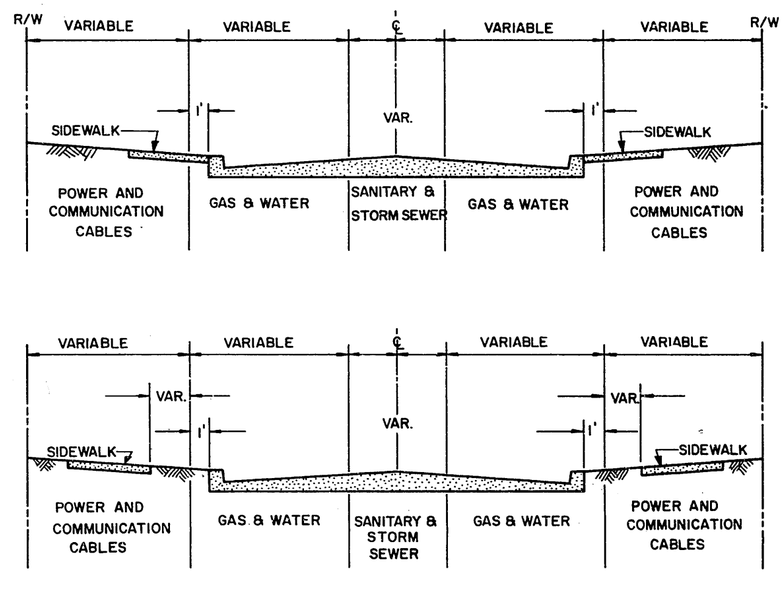
The overall utility coordinator shall verify that the provisions of the second paragraph of utilities' responsibility in new plats has been complied with.

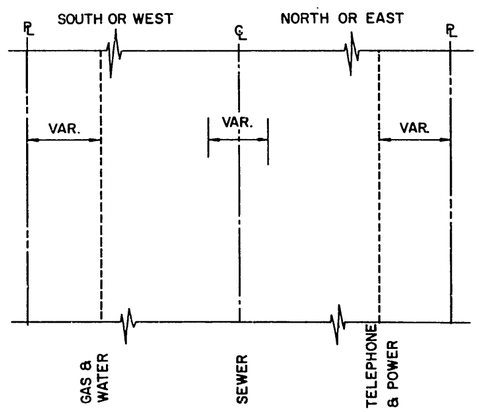
The overall utility coordinator shall be responsible in conjunction with the developer, for the initial layout of the job, setting of property or offset stakes, and the establishment of center line and roadway grades.

The overall utility coordinator shall have temporary markers placed on the site to identify the various utility locations and depths. This responsibility shall be coordinated with each Utility representative.

The overall utility coordinator shall make certain after all utilities have completed their work, that the area is left in satisfactory condition by all parties concerned in the installations.

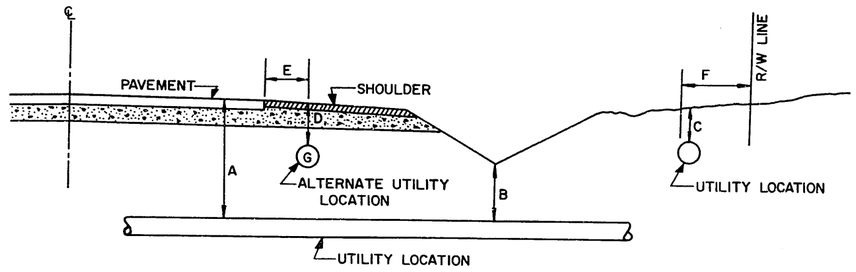
Drawings of recommended zone locations follow on pages 175 and 176.





TYPICAL UTILITIES LOCATION IN ALLEY

ZONE LOCATIONS FOR UNDERGROUND UTILITIES



A	60"	
B	42"	
C	30" 24"	Desirable (Position "C" is the preferred Minimum location of longitudinal lines)
D	30"	When impossible to construct in accordance with "C"
E	24" 36"	Desirable. If open trench method is used for placement.
F	8"	Maximum from Right of Way line
G	6"	Maximum Diameter allowed in shoulder

ZONE LOCATIONS FOR UNDERGROUND UTILITIES

DIVISION VI—STANDARD FORMS

(STANDARD FORM NO. 1)

PROPOSAL

....., Washington, ..., 19.....

To the City Clerk (or other)
Anywhere, Washington

Project No. .....
L.I.D. No. .....
W.O. No. .....

The undersigned hereby certif..... that ..... ha..... personally examined the location and construction details of work as outlined on the plans and specifications for Project No....., ...
(Job description and location)
.....
.....

and ha..... read and thoroughly understand..... the plans and specifications and contract governing the work embraced in this improvement and the method by which payment will be made for said work and hereby propose..... to undertake and complete the work embraced in this improvement in accordance with said plans, specifications, and contract and at the following schedule of rates and prices:

(NOTE: Unit prices for all items, all extensions and total amount of bid must be shown. Show unit prices in both words and figures and where conflict occurs the written or typed words shall prevail.)

ITEM NO.	APPROX. QUANTITY	ITEM WITH UNIT PRICED BID (Unit prices to be written in words)	UNIT PRICE Dollars	UNIT PRICE Cts.	AMOUNT Dollars	AMOUNT Cts.
1.	1011 Cu. Yds.	Unclassified Excavation including haul, at SEVENTY-FIVE CENTS Per Cu. Yd.		75	758	25
2.	1053 Cu. Yds.	Bankrun Gravel for streets, at ONE DOLLAR Per Cu. Yd.	1	00	1053	00
3.	297 Cu. Yds.	Crushed Stone Top Course, at THREE DOLLARS Per Cu. Yd.	3	00	891	00
4.	3860 Cu. Yds.	Trench Excavation and Backfill Class A (Sanitary) ONE DOLLAR Per Cu. Yd.	1	00	3860	00
5.	200 Lin. Ft.	10-Inch Diameter Class C. Sewer Pipe (Sanitary), at FOUR DOLLARS Per Lin. Ft.	4	00	800	00

*Owner's tentative statement of items subject to 4% retail sales tax to be paid by Owner—Items 4 and 5 (subject to final determination) See Sec. 7.09, of standard specifications.

Total Bid $7362.25
*Sales Tax 186.40
Grand Total $7548.65

FORM FURNISHED BY POLITICAL SUBDIVISION.

(STANDARD FORM NO. 2)

PROPOSAL SIGNATURE SHEET

.....
(Job Description and Location)

.....

.....

.....

Project No. .....

L.I.D. No. .....

W.O. No. .....

....., 19.....
(Date)

.....
(Bidder)

by .....
(Authorized Official)

.....
(Address)

NOTE: (1) If the bidder is a co-partnership, so state, giving firm name under which business is transacted.

(2) If the bidder is a corporation, this proposal must be executed by its duly authorized officials.

(3) If no bid is submitted, kindly mark "NO BID" and return to .....
(City clerk, or other)

.....
(Address)

FORM FURNISHED BY POLITICAL SUBDIVISION.

(STANDARD FORM NO. 3)

BID BOND FORM

Herewith find deposit in the form of a certified check, cashiers check, cash, or bid bond in the amount of $..... which amount is not less than five percent of the total bid.

SIGN HERE .....

BID BOND

KNOW ALL MEN BY THESE PRESENTS:

That we, ..., as Principal,

and ....., as Surety,

are held and firmly bound unto the (Political Subdivision) , as Obligee, in the penal sum of

..... Dollars, for the

payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by these presents.

The condition of this obligation is such that if the Obligee shall make any award to the Principal for

according to the terms of the proposal or bid made by the Principal therefor, and the Principal shall duly make and enter into a contract with the Obligee in accordance with the terms of said proposal or bid and award and shall give bond for the faithful performance thereof, with Surety or Sureties approved by the Obligee; or if the Principal shall, in case of failure so to do, pay and forfeit to the Obligee the penal amount of the deposit specified in the call for bids, then this obligation shall be null and void; otherwise it shall be and remain in full force and effect and the Surety shall forthwith pay and forfeit to the Obligee, as penalty and liquidated damages, the amount of this bond.

SIGNED, SEALED AND DATED THIS .....DAY OF ....., 19.....

.....
Principal

.....
Surety

....., 19.....

Received return of deposit in the sum of $.....

FURNISHED BY POLITICAL SUBDIVISION. .....

(STANDARD FORM NO. 4)

BIDDER'S CHECK LIST

The bidder's attention is especially called to the following forms which must be executed in full as required:

(a) Proposal.

The unit prices bid must be shown in the space provided. Show unit prices in both words and figures.

(b) Proposal Signature Sheet.

To be filled in and signed by the bidder. Non-collusion Affidavit must be subscribed to and sworn before a notary public.

(c) Bond accompanying bid.

This form is to be executed by the bidder and the surety company unless bid is accompanied by a certified check. The amount of this bond shall be not less than 5% of the total amount bid and may be shown in dollars or on a percentage basis.

The following forms are to be executed after the contract is awarded:

(a) Contract.

This agreement to be executed by the successful bidder.

(b) Performance Bond

To be executed by the successful bidder and his surety company.

FORM FURNISHED BY POLITICAL SUBDIVISION.

(STANDARD FORM NO. 5)

CONTRACT

THIS AGREEMENT, made and entered into in triplicate, this ..... day of ....., 19..... by and between (Political Subdivision) , hereinafter called the Owner, and .....

.....

hereinafter called the Contractor,

WITNESSETH:

That in consideration of the terms and conditions contained herein and attached and made a part of this agreement, the parties hereto covenant and agree as follows:

I. The Contractor shall do all work and furnish all tools, materials, and equipment for

.....

.....

.....

.....

in accordance with and as described in the attached plans and specifications and the Standard Specifications for Municipal Public Works Construction, which are by this reference incorporated herein and made a part hereof, and shall perform any alterations in or additions to the work provided under this contract and every part thereof.

Work shall start within ..... days after execution of contract and be completed in ..... (calendar, working) days.

If said work is not completed within the time specified, the Contractor agrees to pay to the Owner the sum of ..... dollars for each and every day said work remains uncompleted after expiration of the specified time, as liquidated damages.

The Contractor shall provide and bear the expense of all equipment, work and labor of any sort whatsoever that may be required for the transfer of materials and for constructing and completing the work provided for in this contract and every part thereof, except such as are mentioned in the specifications to be furnished by the ..... (Owner).

II. The ..... (Owner) hereby promises and agrees with the Contractor to employ, and does employ the Contractor to provide the materials and to do and cause to be done the above described work and to complete and finish the same according to the attached plans and specifications and the terms and conditions herein contained and hereby contracts to pay for the same according to the attached specifications and the schedule of unit or itemized prices hereto attached, at the time and in the manner and upon the conditions provided for in this contract.

III. The Contractor for himself, and for his heirs, executors, administrators, successors, and assigns, does hereby agree to the full performance of all the covenants herein contained upon the part of the Contractor.

IV. It is further provided that no liability shall attach to the ..... (Owner) ..... by reason of entering into this contract, except as expressly provided herein.

IN WITNESS WHEREOF the parties hereto have caused this agreement to be executed the day and year first hereinabove written.

Countersigned:

this ..... day of ..... 19.....

..... (Owner)

By .....

(Authorized Official)

Approved as to legality:

..... (Legal Officer)

..... (Contractor)

By .....

FURNISHED BY POLITICAL SUBDIVISION.

(STANDARD FORM NO. 6)

PERFORMANCE BOND

BOND TO (Political Subdivision)

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned, ...

.....

.....

as principal, and ....., a corporation organized and existing under the laws of the State of ....., as a surety corporation, and qualified under the laws of the State of Washington to become surety upon bonds of contractors with municipal corporations, as surety, are jointly and severally held and firmly bound to the (Political Subdivision) in the penal sum of $..... for the payment of which sum on demand we bind ourselves and our successors, heirs, administrators or personal representatives, as the case may be.

This obligation is entered into in pursuance of the statutes of the State of Washington, the Ordinances of the (Political Subdivision)

Dated at ....., Washington, this ..... day of ....., 19.....

Nevertheless, the conditions of the above obligation are such that:

WHEREAS, under and pursuant to Ordinance (or Resolution) No. ..... of the (Political Subdivision) , passed ....., 19....., the (Authorized Official) of said (Political Subdivision) has let or is about to let to the said ..... the above bounden Principal, a certain contract, the said contract being numbered ....., and providing for .....

.....

.....

(which contract is referred to herein and is made a part hereof as though attached hereto), and

WHEREAS, the said Principal has accepted, or is about to accept, the said contract, and undertake to perform the work therein provided for in the manner and within the time set forth;

NOW, THEREFORE, if the said ..... shall faithfully perform all of the provisions of said contract in the manner and within the time therein set forth, or within such extensions of time as may be granted under said contract, and shall pay all laborers, mechanics, sub-contractors and material men, and all persons who shall supply said principal or sub-contractors with provisions and supplies for the carrying on of said work, and shall hold said (Political Subdivision) harmless from any loss or damage occasioned to any person or property by reason of any carelessness or negligence on the part of said principal, or any sub-contractor in the performance of said work, and shall indemnify and hold the (Political Subdivision) harmless from any damage or expense by reason of failure of performance as specified in said contract or from defects appearing or developing in the material or workmanship provided or performed under said contract within a period of one year after its acceptance thereof by the (Political Subdivision) , then and in that event this obligation shall be void; but otherwise it shall be and remain in full force and effect.

Approved as to legality: .....

.....

Approved: .....

.....

.....

FURNISHED BY POLITICAL SUBDIVISION.

This form may be used with an attached list, or may be printed on back of payroll.

(STANDARD FORM NO. 7)

MINIMUM WAGE AFFIDAVIT FORM

(POLITICAL SUBDIVISION) .....

ss.

COUNTY OF .....

I, the undersigned, having been duly sworn, depose, say and certify that in connection with the performance of the work, payment for which this voucher is submitted, I have paid the following rate per hour for each classification of laborers, workmen, or mechanics, as indicated upon the attached list, now referred to and by such reference incorporated in and made an integral part hereof, for all such employed in the performance of such work; and no laborer, workman or mechanic so employed upon such work has been paid less than the prevailing rate of wage or less than the minimum rate of wages as specified in the principal contract; that I have read the above and foregoing statement and certificate, know the contents thereof and the substance as set forth therein is true to my knowledge and belief.

.....

CONTRACTOR

Subscribed and sworn to before me on this .....day of

....., 19.....

.....

Notary Public in and for the State of Washington residing at

.....

FURNISHED BY POLITICAL SUBDIVISION.

This form to be used, if required, for requesting permission to employ a subcontractor.

(STANDARD FORM NO. 8)

LETTER FOR EMPLOYMENT OF SUBCONTRACTOR

(Date) , 19.....

Mr. ..... ← NOTE: To be addressed to authorized official.

Dear Sir: Re: Contract No. .....

We, the undersigned, request permission of the (Political Subdivision) to employ a subcontractor in order to fully perform the work covered by the terms of that written contract made and executed by and between the (Political Subdivision) and ourselves on the ..... day of ....., 19....., designated as Contract No. .....

We intend to employ the firm of

a.

b.

c.

for the purposes of performing the following described work, ...

.....

and represent and warrant that the work will be performed by said subcontractors in a good and workmanlike manner and under our direct supervision. We further represent and warrant that the work to be performed by them constitutes approximately ..... percent of the total dollar value of said contract.

Very truly yours,

....

(Signature of Surety) (CONTRACTOR)

TO BE FURNISHED BY CONTRACTOR.

(STANDARD FORM NO. 9)

(POLITICAL SUBDIVISION)

CONTRACT CHANGE ORDER AGREEMENT

Contract.....

Contractor.....

Summary of Proposed Change: .....

.....

.....

.....

Plan Revisions: Dwg. # Rev. #

Specification Revisions: Page # Paragraph #

New Plans or Specs:

Price Change:

Lump Sum Increase $..... or Decrease $.....

or

Item	Quantity	Unit Price	Price	Increase	or	Decrease
.....	.....		.....	.....		.....
.....	.....		.....	.....		.....
.....	.....		.....	.....		.....
			Total	$.....	or	$.....

Signatures: Contractor ..... Date .....

Engineer ..... Date .....

Approved By .... 19..... .....
(Municipal Authority) (Date) (Authorized Official)

FURNISHED BY POLITICAL SUBDIVISION.

(STANDARD FORM NO. 10)

Sample form letter to be used for Submission of Force Account statements for Public Road construction work.

GENERAL CONTRACTORS, INC.
1946 South Alaska St.
Tacoma, Washington

January 2, 1962

NOTE: To be Addressed to Authorized Official

Dear Sir:

Re: Job No. 99999—Force Account Performed—Removing and replacing 8″ wood culvert pipe with standard culvert pipe across roadway on "B" St. at station 12 + 39 on Dec. 28, 1961.

This extra work was required because the existing wood pipe was deteriorated and had to be replaced before asphalt could be placed, and was ordered by Mr. ....., ... (Name) (Title) of ..... (Political Subdivision).

Labor (Health and Welfare Included)				
Foreman	2 hrs. at $3.86	$7.72		
Pipe Layer	4 hrs. at 3.22	12.88		
Laborer	8 hrs. at 3.00	24.00	$44.60	
Materials				
40 Lin. Ft. 8″ Culvert	$0.90	36.00	36.00	
Equipment				
Pickup Truck 4 hrs.	at $1.50	6.00	6.00	$ 86.60
Profit and Overhead				
18% of Labor, Equipment, and Materials				15.59
Payroll Taxes				
Industrial Insurance				
14 hrs. at $0.35	$0.49			
½ Medical Aid				
14 hrs. at $0.0085	$0.12			0.61
				$102.80
*4% State Sales Tax on Materials ($36.00)				1.44
TOTAL FORCE ACCOUNT				$104.24

*Percentage to be in accordance with current rates prescribed by law.

Yours very truly,

.....
GENERAL CONTRACTORS, INC.

TO BE FURNISHED BY CONTRACTOR.

(STANDARD FORM NO. 11)

Sample form letter to be used for submission of Force Account statements on all projects other than Public Road construction work.

GENERAL CONTRACTORS, INC.
1946 South Alaska St.
Tacoma, Washington

February 18, 1959

Mr. ..... ← NOTE: To be addressed to authorized official.

Re: Force Account. L.I.D. No. 4444—Lowering Existing Sanitary Sewer at 3714 So. Cushman Ave. (Sta. 46 + 10, on the left). January 5, 1959.

Dear Sir:

This work was necessary because the sanitary line was in the subgrade of the roadway. This extra work was ordered by Mr. ....., ... (Title) (Political Subdivision)

Labor (Health and Welfare Incl.)				
Foreman	1 hr. at $ 3.86	$ 3.86		
Pipe Layer	1 hr. at 3.22	3.22		
Laborer	8 hrs. at 2.91	23.28		
Flagman	4 hrs. at 2.80	11.20	$41.56	
Materials				
40 Lin. Ft. 6-inch Sewer Pipe	$0.342	$13.68		
1 Only, 6-inch ⅛ Bend	0.765	0.77		
Mortar		0.40	14.85	
Equipment				
Pickup Truck	1 hr. at $1.50		1.50	$ 57.91
Profit and Overhead				
18% of Labor, Equipment and Material				8.69
Payroll Taxes				
Industrial Insurance				
14 hrs. at $0.035	$ 0.49			
½ Medical Aid				
14 hrs. at $0.0085	0.12			0.61
				2.69
*4% State Sales Tax on $67.21				$69.90

*Percentage to be in accordance with current rates prescribed by law.

Very truly yours,

.....
GENERAL CONTRACTORS, INC.

TO BE FURNISHED BY THE CONTRACTOR.

(STANDARD FORM NO. 12)

(POLITICAL SUBDIVISION)

WEEKLY STATEMENT OF WORKING DAYS

Contract No. .....

.....

Date .....

Statement No. .....

TO: ....., (Contractor)

The following statement shows the number of working days charged to your contract for the week ending ....., 19.....

Date	Day	Weather Condition	Working Day	Unworkable Day Caused By Weather Conditions
	Monday			
	Tuesday			
	Wednesday			
	Thursday			
	Friday			

Working days this week .....

Working days previously reported .....

Total working days to date .....

Starting date specified in special provisions .....

Working days specified in contract .....

Computed date for completion (if all days are workable) .....

Total unworkable days to date .....

Revised date for completion .....

Working days remaining to complete contract .....

Project completed on .....

REMARKS:

.....

(Authorized Official)

NOTE: The contractor will be allowed 10 days from date of this report in which to protest in writing the correctness of this statement, otherwise it shall be deemed to have been accepted as correct.

FURNISHED BY POLITICAL SUBDIVISION.

(STANDARD FORM NO. 13)

NON-COLLUSION AFFIDAVIT

STATE OF WASHINGTON }
COUNTY OF ..... } ss.

NON-COLLUSION AFFIDAVIT

....., being first duly sworn, on his oath says ..... that the bid above submitted is a genuine and not a sham or collusive bid, or made in the interest or on behalf of any person not therein named; and he further says that the said bidder has not directly or indirectly induced or solicited any bidder on the above work or supplies to put in a sham bid, or any other person or corporation to refrain from bidding; and that said bidder has not in any manner sought by collusion to secure to ..... self an advantage over any other bidder or bidders.

.....

(Contractor)

Subscribed and sworn to before me this ..... day of ....., 19.....

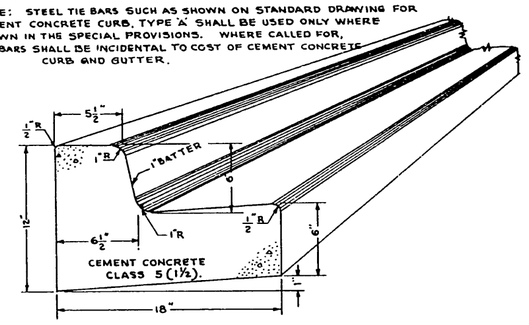
.....

Notary Public in and for the State of Washington, residing at .....

FURNISHED BY THE POLITICAL SUBDIVISION WHENEVER A NON-COLLUSION AFFIDAVIT IS REQUIRED.

DIVISION VII—STANDARD PLANS (DRAWINGS)

NOTE: STEEL TIE BARS SUCH AS SHOWN ON STANDARD DRAWING FOR CEMENT CONCRETE CURB, TYPE 'A' SHALL BE USED ONLY WHERE SHOWN IN THE SPECIAL PROVISIONS. WHERE CALLED FOR, TIE BARS SHALL BE INCIDENTAL TO COST OF CEMENT CONCRETE CURB AND GUTTER.

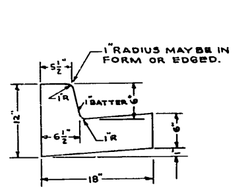


NOTES:

FORMS SHALL BE TRUE TO LINE & GRADE AND SECURELY STAKED.

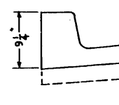
THE 1" RADIUS ON UPPER FACE OF CURB MAY BE FORMED BY EDGER OR BUILT INTO FACE FORM. 1" RADIUS ON LOWER FACE OF CURB WILL BE FORMED BY THE FACE FORM.

TYPICAL SECTION FOR CURB & GUTTER TYPE A

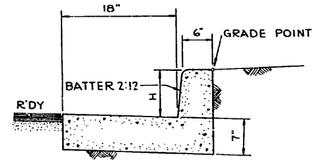


FULL DEPTH DIVISIONS PLATE
TO BE USED ONLY WHERE THRU JOINTS ARE TO BE PLACED, OR AS DIRECTED BY THE ENGINEER. SEE NOTE BELOW FOR THRU JOINTS.

DIMENSIONS OTHER THAN THOSE SHOWN SHALL BE INDENTICAL TO FULL DEPTH DIVISION PLATE.



PARTIAL DIVISION PLATES
TO BE USED AT 10' MINIMUM 15' MAXIMUM SPACING AND USED WITH DUMMY JOINTS, IF SO DIRECTED BY ENGINEER. SEE NOTE BELOW FOR DUMMY JOINTS.

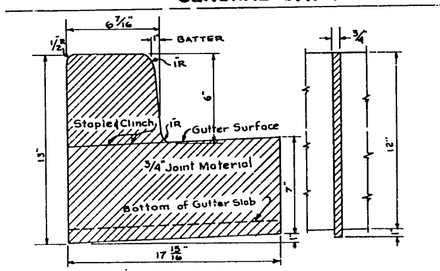


H= HEIGHT OF CURB ABOVE PAVEMENT SPECIFIED

NOTE:
DIVISION PLATES & JOINTS TO BE SIMILAR TO THAT SHOWN, ONLY THE DIMENSIONS SHALL VARY AS NECESSARY FOR TYPE A-1.

TYPICAL SEC. TYPE A-1

GENERAL DATA



JOINT DETAILS

NOTE:
DUMMY JOINTS OF NOT LESS THAN 3/16 THICKNESS SHALL BE OF THE SAME DIMENSIONS AS THE CURB & GUTTER EXCEPT THAT IT SHALL EXTEND ONLY 2¼" INTO GUTTER SECTION.

GENERAL NOTES

JOINTS: DUMMY JOINTS SHALL BE PLACED NOT TO EXCEED 15' C/C NOR LESS THAN 10' C/C. THRU JOINTS SHALL BE PLACED ONLY AT POINTS OF TANGENCY ON STREETS, ALLEY AND DRIVEWAY RETURNS. ALL JOINTS SHALL BE CLEAN AND IN THE GUTTER SECTION THEY SHALL BE EDGED. ALL COSTS SHALL BE INCIDENTAL TO COST OF THE CONTRACT.

FORMS SHALL BE STEEL.

MATERIAL SHALL MEET REQUIREMENTS OF THESE SPECIFICATIONS.

CONCRETE SHALL BE CEMENT CONCRETE CLASS 5(1½) OR 5(¾)

PROCEDURES: FOR FURTHER REQUIREMENTS FOR FORMS, FORM SETTING, PLACING, FINISHING AND CURING SHALL BE AS OUTLINED IN THESE SPECIFICATIONS.

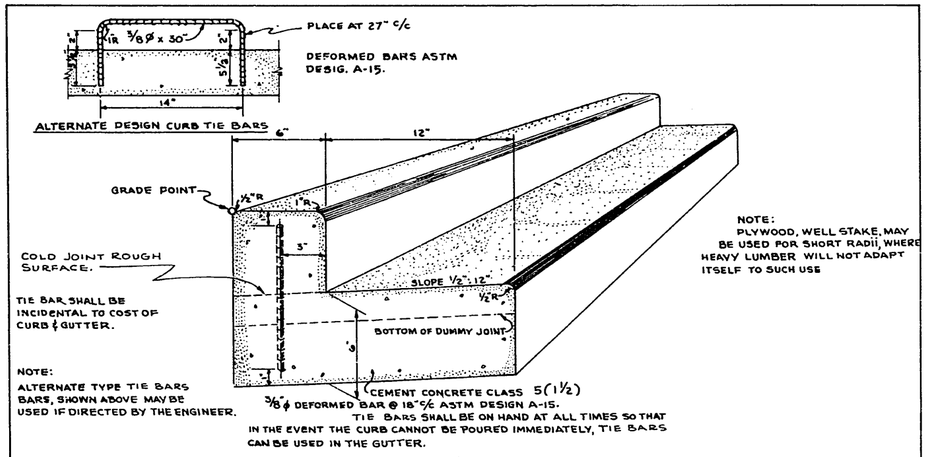
– PAYMENT –

'CEMENT CONCRETE CURB & GUTTER, TYPE 'A' OR TYPE 'A-1', PER LINEAR FOOT.

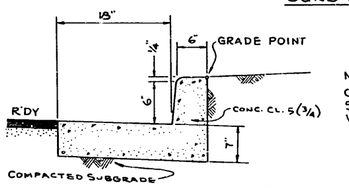
Do Not Scale

Cement Concrete Curb & Gutter Type "A" & Type "A-1"

Standard Plan No. 1

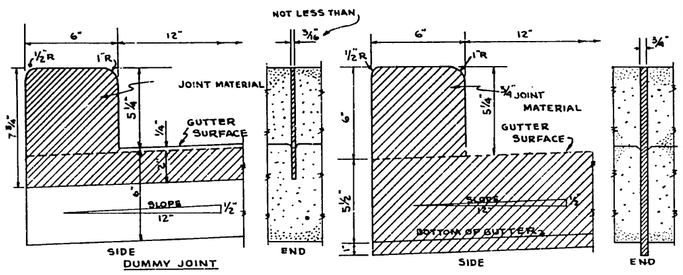


Curb & Gutter Type "B"



Note: Construction & Joints Are Similar For Type 'B-1', Dimensions Vary As Shown.

Curb & Gutter Type "B-1"



GENERAL NOTES

DUMMY JOINTS SHALL BE PLACED NOT TO EXCEED 15' C/C
THRU JOINTS SHALL BE PLACED ONLY AT POINTS OF TANGENCY ON STREETS, ALLEYS & DRIVEWAYS RETURNS. ALL JOINTS SHALL BE CLEAN & IN THE GUTTER SECTION THEY SHALL BE EDGED. ALL COSTS SHALL BE INCIDENTAL TO THE CONTRACT.

FORMS SHALL BE WOOD AS SHOWN
MATERIAL SHALL MEET REQUIREMENTS OF THESE SPECIFICATIONS.
CONCRETE SHALL BE CEMENT CONCRETE CLASS 5(1 1/2) OR 5(3/4).
PROCEDURES: FOR FURTHER REQUIREMENTS FOR FORMS, FORM SETTING, PLACING, FINISHING AND CURING SHALL BE AS OUTLINED IN THESE SPECIFICATION.

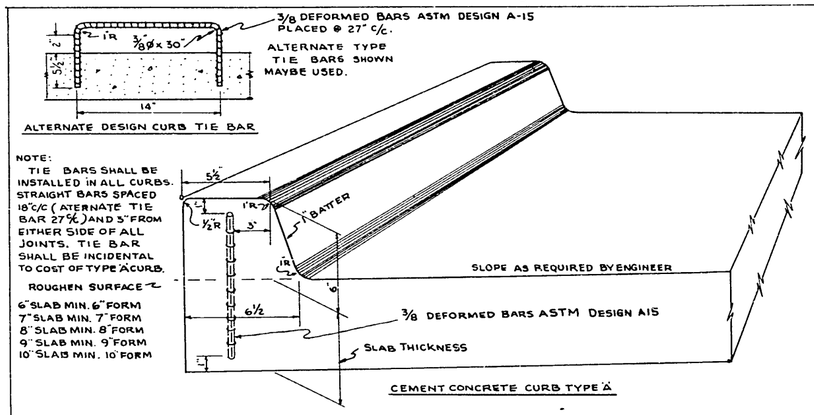
PAYMENT

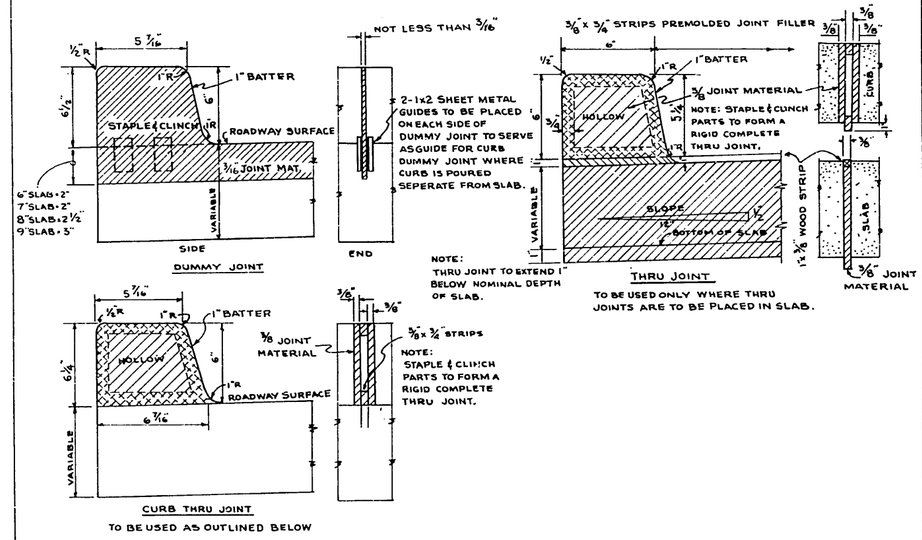
"CEMENT CONCRETE CURB & GUTTER TYPE 'B', OR 'B-1'" PER LINEAL FOOT

DO NOT SCALE

Cement Concrete Curb & Gutter Type "B" & Type "B-1"

Standard Plan No. 2





GENERAL NOTES

JOINTS: DUMMY JOINTS SHALL BE PLACED NOT TO EXCEED 15' C/C.
THRU JOINTS SHALL BE PLACED ONLY AT POINTS OF TANGENCY ON STREET, ALLEY AND DRIVEWAY RETURNS, WHERE THRU JOINTS OCCUR IN THE PAVEMENT SLAB. CURBS THRU JOINTS SHALL BE PLACED ONLY WHERE THRU JOINTS DO NOT OCCUR IN THE PAVEMENT SLAB.
MATERIAL SHALL MEET REQUIREMENTS OF THESE SPECIFICATIONS.

CONCRETE SHALL BE CEMENT CONCRETE CLASS 5(1 1/2). OR 5(3/4)
PROCEDURES: FOR FURTHER REQUIREMENTS FOR FORMS, FORMS SETTING, PLACING, FINISHING & CURING SEE THESE SPECIFICATIONS.

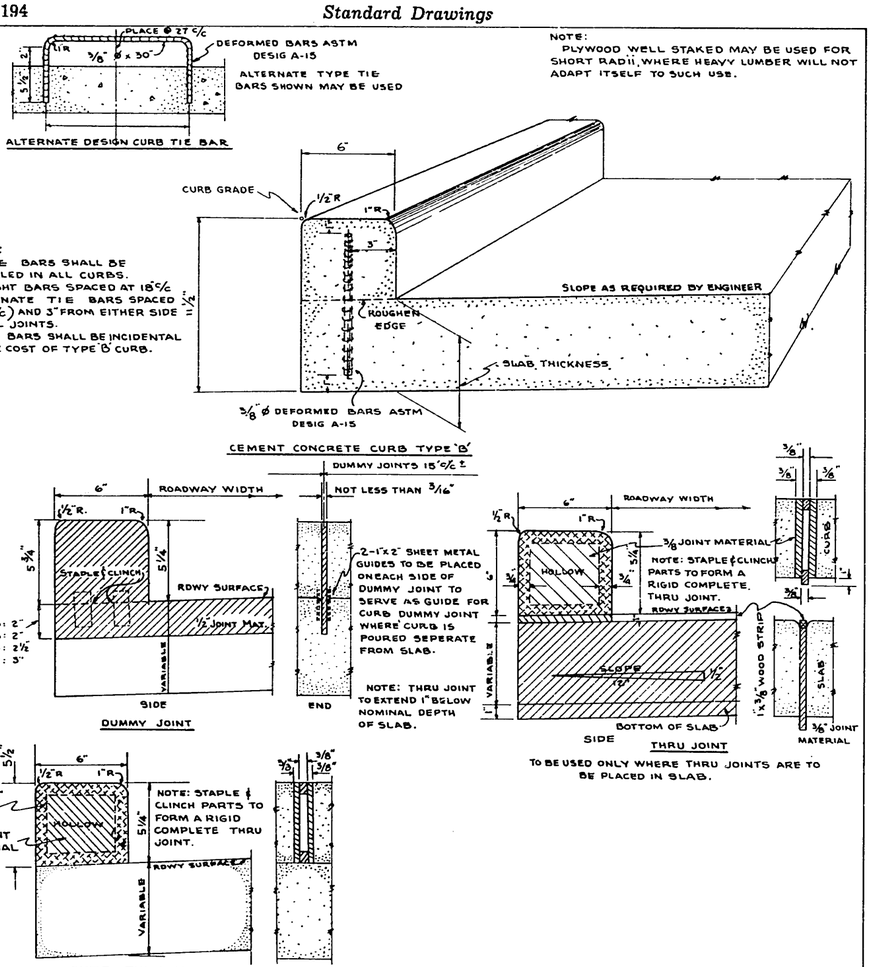
PAYMENT

"CEMENT CONCRETE CURB, TYPE 'A'," PER LINEAR FOOT.

DO NOT SCALE

Cement Concrete Curb Type "A"

Standard Plan No. 3



GENERAL NOTES

JOINTS: DUMMY JOINTS SHALL BE PLACED NOT TO EXCEED 15 c/c. THRU JOINTS IN CURB SHALL BE PLACED ONLY AT POINTS OF TANGENCY ON STREET ALLEY & DRIVEWAYS RETURNS, AND WHERE THRU JOINTS OCCUR IN THE PAVEMENT SLAB.

THRU JOINTS IN PAVEMENTS SHALL BE POURED WITH AN APPROVED TYPE OF JOINT SEALANTS & ALL COSTS SHALL BE INCIDENTAL TO THE COST OF THE CONTRACT.

MATERIAL SHALL MEET REQUIREMENTS OF THESE SPECIFICATIONS.

CONCRETE SHALL BE CEMENT CONCRETE CLASS 5(1½) OR 5(¾).

PROCEDURES: FOR FURTHER REQUIREMENTS FOR FORMS, FORM SETTING, PLACING, FINISHING & CURING SEE THESE SPECIFICATIONS.

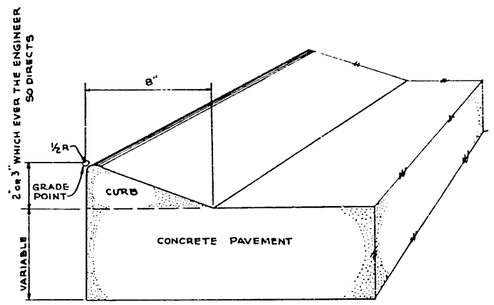
PAYMENT

"CEMENT CONCRETE CURB, TYPE 'B'," PER LINEAR FOOT.

Do Not Scale

Cement Concrete Curb
Type 'B'

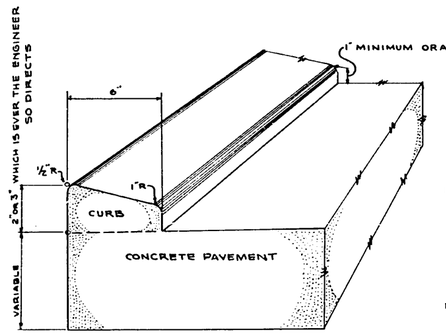
Standard Plan No.4



TYPE 'C' LOW INDUSTRIAL CURB

NOTE:
TYPE 'C' LOW CURB IS PRIMARILY USED IN INDUSTRIAL AREAS AND ALLEY CONSTRUCTION.

NOTE:
LOW CURBS SHALL BE POURED INTEGAL WITH ROADWAY SLAB.

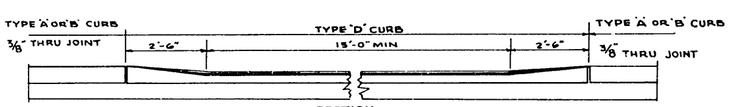


TYPE 'D' LOW CURB

NOTE:
TYPE 'D' LOW CURB IS PRIMARILY USED IN INDUSTRIAL AREAS AND IN SOME CASES USED IN DRIVEWAYS.

NOTE: WHERE TYPE 'D' LOW CURB IS PLACED ON A CURB AND GUTTER PROJECTS, IT SHALL BE AS SHOWN ON STANDARD PLAN NO. 10 AND SHALL BE PAID FOR AS "CEMENT CONCRETE CURB, TYPE 'D', PER LINEAR FOOT.

NOTE:
DOWELS SHALL NOT BE USED UNLESS OTHERWISE SPECIFIED IN THE SPECIAL PROVISIONS.



SECTION

NOTE:
CONCRETE PAVEMENT UNDER LOW CURB SHALL BE PAYED FOR AS PER SQ. YARD OF PAVEMENT TO BACK OF CURB.

GENERAL NOTE

JOINTS:
DUMMY JOINT SHALL BE PLACED NOT TO EXCEED 15 c/c.
THRU JOINT SHALL BE PLACED AT POINT OF TANGENCY ON STREET, ALLEY AND DRIVEWAY RETURNS

MATERIAL SHALL MEET REQUIREMENTS OF THESE SPECIFICATIONS.

CONCRETE SHALL BE CEMENT CONCRETE CLASS 5(1½).

PROCEDURES: FOR FURTHER REQUIREMENTS FOR FORMS, FORM SETTING, PLACING, FINISHING, AND CURING SEE THESE SPECIFICATIONS.

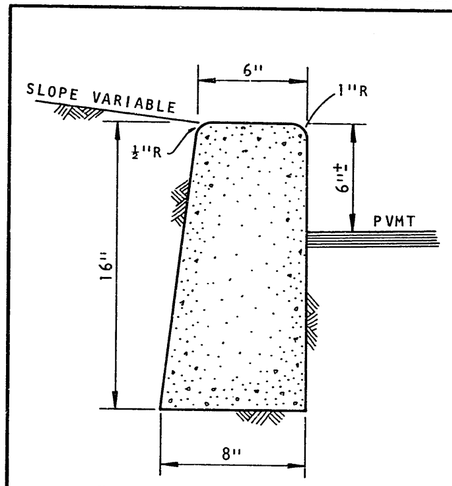
PAYMENT

"CEMENT CONCRETE CURB, TYPE 'C'," PER LINEAR FOOT.
"CEMENT CONCRETE CURB, TYPE 'D'," PER LINEAR FOOT.

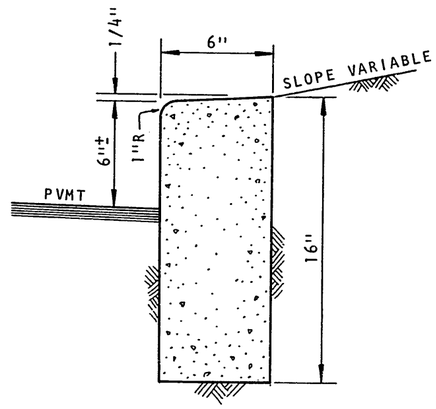
Do Not Scale

Cement Concrete Curb
Type 'C' & Type 'D'

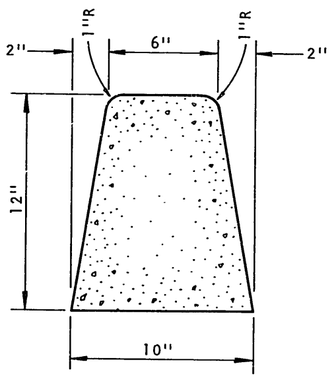
Standard Plan No.5



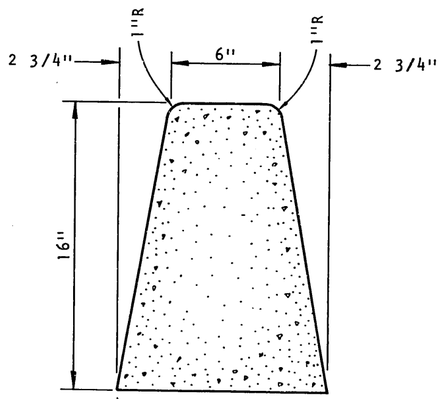
TYPE E-1 CURB



TYPE E-2 CURB



TYPE E-3 CURB



TYPE E-4 CURB

GENERAL NOTES

-DUMMY JOINTS Shall be placed not to exceed 15' C/C, they shall be not less than 3/16" in thickness and shall extend 2" below the gutter line.
-THRU JOINTS 3/4" Thru Joints shall be placed at all cold joints or as directed by the engineer and shall extend 1" below bottom of concrete.
-MATERIALS shall meet the requirements of these specifications.
-CONCRETE shall be cement concrete class 5(1½) or 5(3/4).

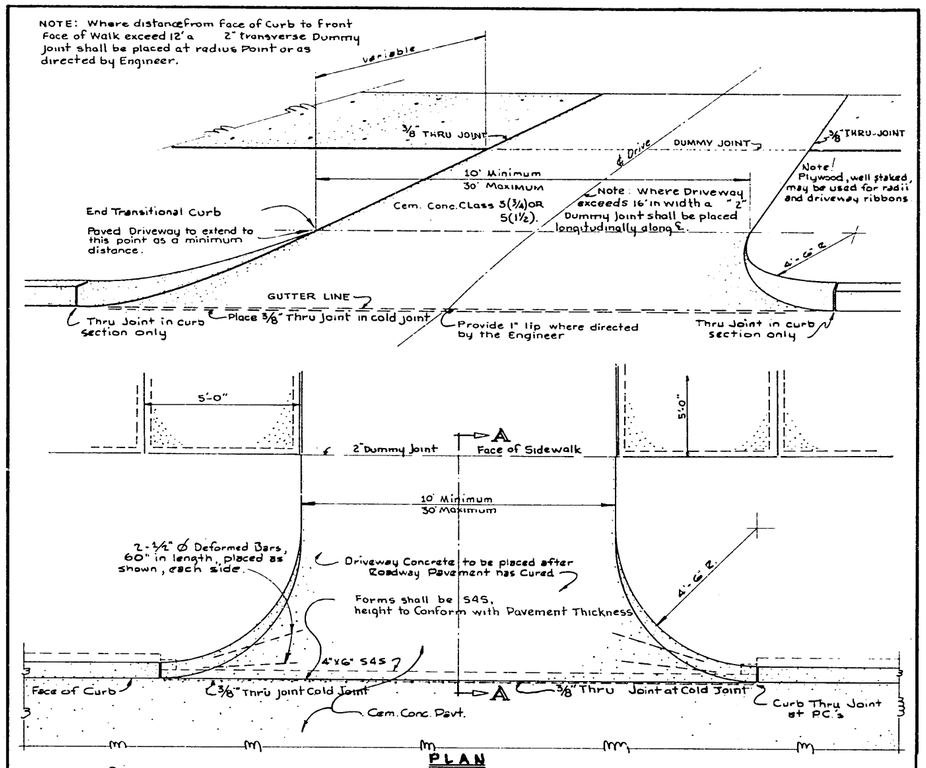
PAYMENT

"Cement concrete curb, type ( )", per linear foot. Excavation required shall be incidental to the cost of curb.

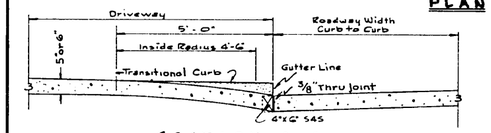
CEMENT CONCRETE CURB

TYPE: E-1, E-2, E-3, & E-4

NOTE: Where distance from face of Curb to Front Face of Walk exceed 12' a 2" transverse Dummy Joint shall be placed at radius Point or as directed by Engineer.



PLAN



SECTION A-A

NOTE:
Thru Joints shall be of such dimensions as shown on Standard Plans No's 314.

GENERAL NOTES

Joints in paving slab shall not be extended into driveways. All joints shall be clean edged. Transverse driveway joints shall be as shown or as directed by the Engineer.
Material shall meet requirements of these Specifications.
Concrete shall be Cement Concrete Class 5(¾) or 5(1½)
Procedures: for further requirements for forms, form setting, placing, finishing stripping & curing see these Specifications.
Reinforcing steel shall be incidental to cost of Cement Concrete Pavement.

MEASURMENT

Measurement For "Cement Concrete Driveway" Shall Be That Area Behind The Face Of The Curb, Including The Area Under The The Transitional Curb, From Thru Joint To Thru Joint.

PAYMENT

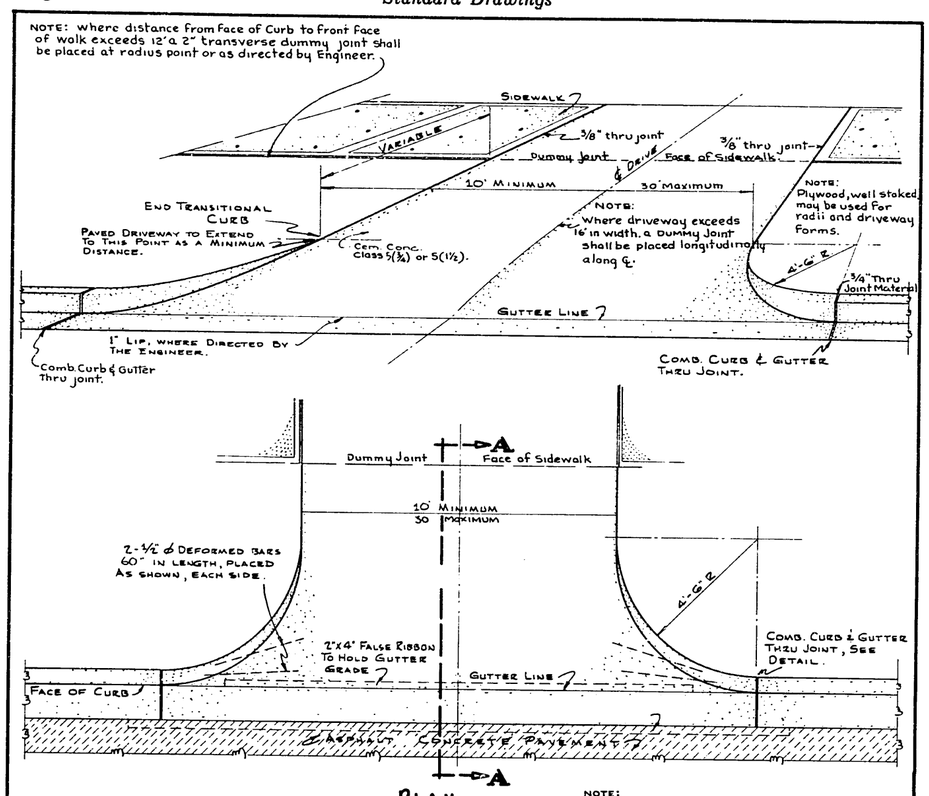
"Cement Concrete Driveway (thickness and class)," per square yard.
"Cement Concrete Transitional Curb," per linear foot.

NOTE:
This driveway to be used with Cement Concrete pavement.

DO NOT SCALE

Cement Concrete Driveway
Type "A"

Standard Plan No. 7



NOTE:
Thru joints shall be of such dimensions as shown on Standard Plans Nos 1 & 2.

Driveways to be placed before Asphalt Concrete Pavement or Bituminous Plant Mix Pavement.

NOTE:
This driveway to be used with Asphalt Concrete Pavement or Bituminous Plant Mix Pavement.
DO NOT SCALE

GENERAL NOTES

JOINTS:
All joints shall be cleaned & edged. Transverse driveway joints shall be as shown or as directed by Engineer.
MATERIAL shall meet requirements of these Specifications.
CONCRETE shall be Cement Concrete Class 5(3/4) or 5(1 1/2).
PROCEDURES: For futher requirements for forms, form setting, placing, finishing, and curing shall be as outlined in these specifications.
REINFORCING steel shall be incidental to cost of Cement Concrete Driveway

MEASUREMENT

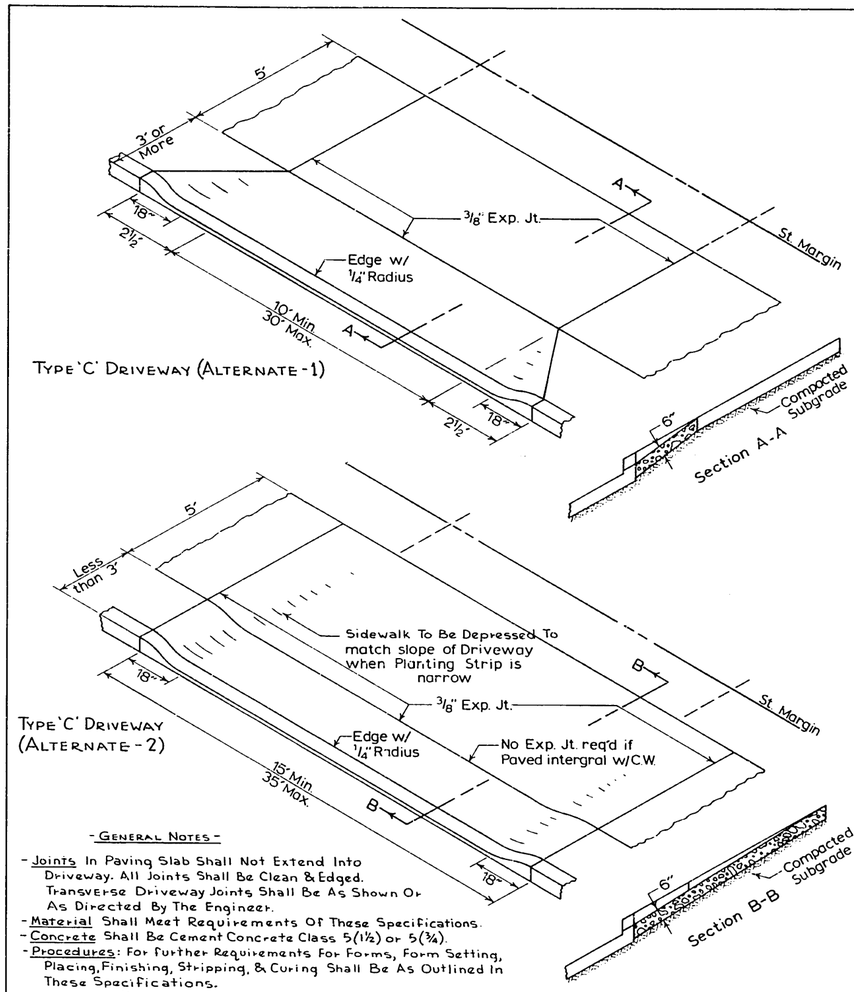
Measurement For "Cement Conc Driveway" Shall Be The Entire Area Shown & Include The Area Under The Transition Curb & That Portion 1' Out From The GUTTER Line.

PAYMENT

"Cement Concrete Driveway (thickness and class)," per square yard.
"Cement Concrete Transitional Curb," per linear foot.

Cement Concrete Driveway Type "B"

Standard Plan No. 8



-GENERAL NOTES-

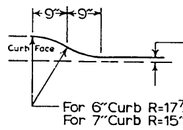
- Joints In Paving Slab Shall Not Extend Into Driveway. All Joints Shall Be Clean & Edged. Transverse Driveway Joints Shall Be As Shown Or As Directed By The Engineer.
- Material Shall Meet Requirements Of These Specifications.
- Concrete Shall Be Cement Concrete Class 5(1½) or 5(¾).
- Procedures: For Further Requirements For Forms, Form Setting, Placing, Finishing, Stripping, & Curing Shall Be As Outlined In These Specifications.

-MEASUREMENT-

Measurement For "Cement Conc. Driveway" Shall Be That Area Behind The Street Curb.

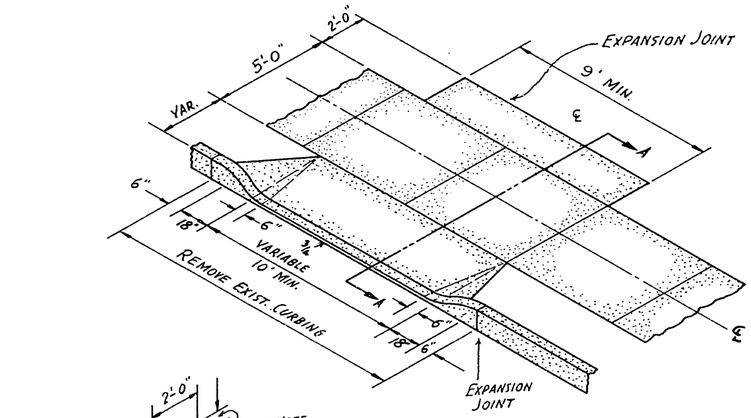
-PAYMENT-

"Cement Conc. Driveway (Thickness & Class) Per Square Yard.

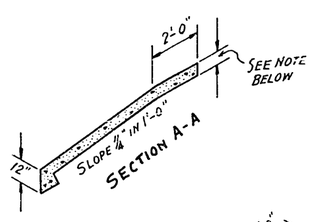


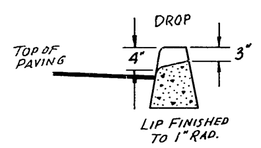
Cement Concrete Driveway Type "C"

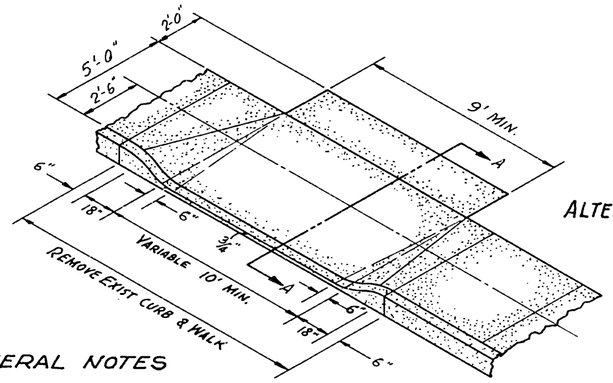
Standard Plan No. 9



ALTERNATE 1







ALTERNATE 2

GENERAL NOTES

JOINTS :
Where driveway exceeds 16' width, a 2' dummy joint shall be placed longitudinally along ℄. Clean and edge all joints. Transverse driveway joints, as shown or directed by Engineer.

MATERIALS : Shall meet specifications.

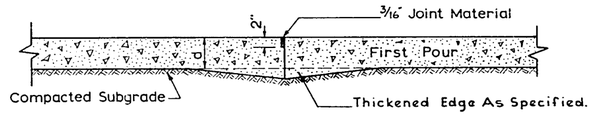
CONCRETE : Shall be Class 5 (3) or 5 (1½).

PROCEDURES : Forms, placing, finishing and Curing, per Specifications.

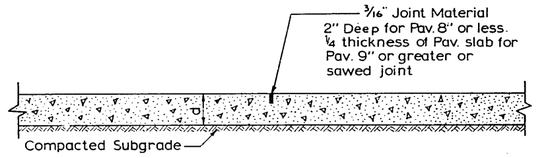
MEASUREMENT : For Conc. driveway that area placed behind street curbing.

PAYMENT : "Cement Concrete Driveway (thickness, class)" per Sq. Yd.

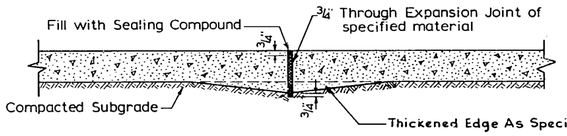
CEMENT CONCRETE DRIVEWAY
TYPE 'D'



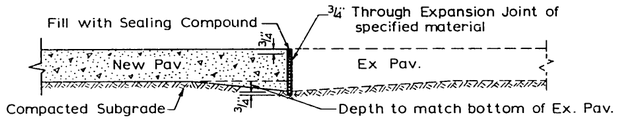
Construction Joint
Longitudinal or Transverse



Contraction Control Joint
Longitudinal or Transverse

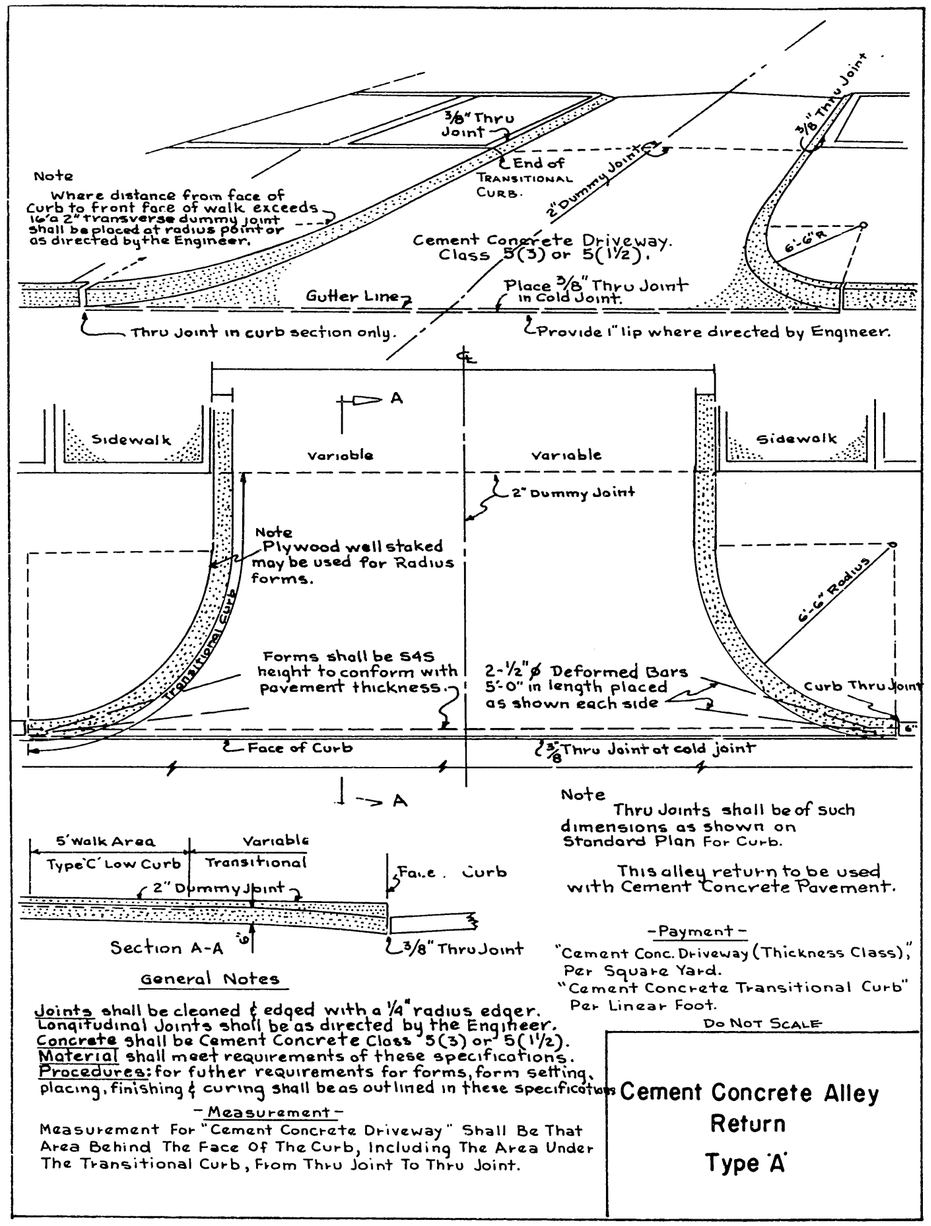


Expansion Joint
New Construction



Expansion Joint
Between Old & New Construction

Types of Joints
for Concrete Pavement



Note
Thru Joints shall be of such dimensions as shown on Standard Plan For Curb.

This alley return to be used with Cement Concrete Pavement.

-Payment-
"Cement Conc. Driveway (Thickness Class)," Per Square Yard.
"Cement Concrete Transitional Curb" Per Linear Foot.

DO NOT SCALE

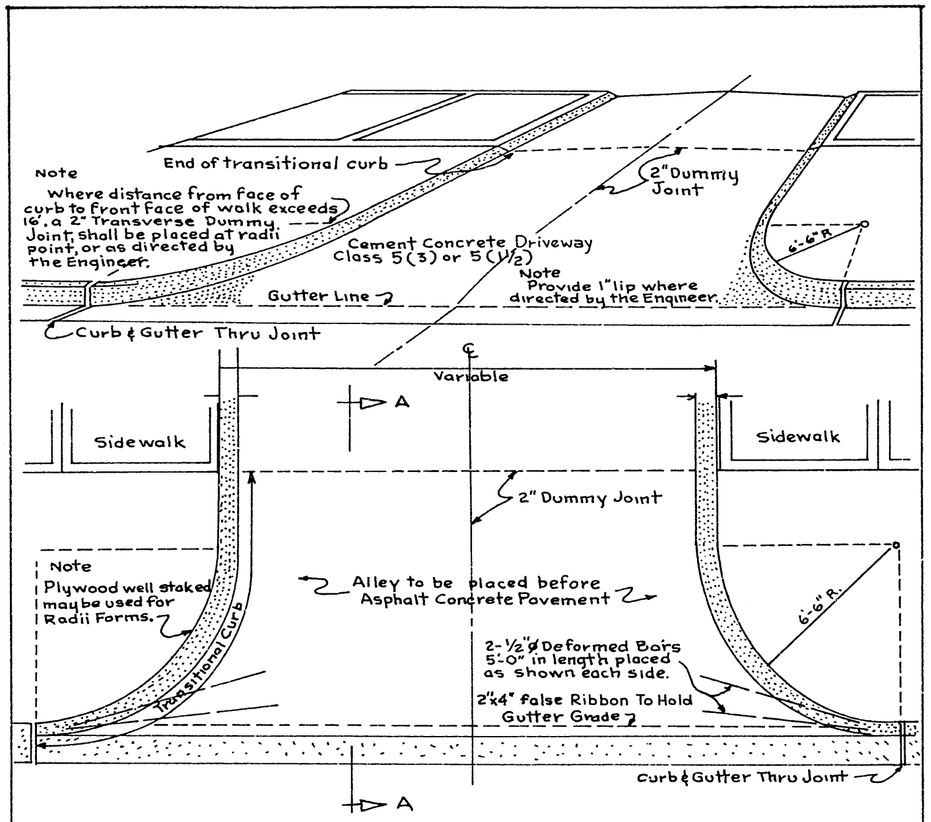
General Notes

Joints shall be cleaned & edged with a ¼" radius edger.
Longitudinal Joints shall be as directed by the Engineer.
Concrete shall be Cement Concrete Class 5(3) or 5(1½).
Material shall meet requirements of these specifications.
Procedures: for futher requirements for forms, form setting, placing, finishing & curing shall be as outlined in these specifications.

-Measurement-
Measurement For "Cement Concrete Driveway" Shall Be That Area Behind The Face Of The Curb, Including The Area Under The Transitional Curb, From Thru Joint To Thru Joint.

Cement Concrete Alley Return Type 'A'

Standard Plan No. 12



Note:
Thru Joints shall be of such dimensions as shown on Standard Plans For Curb & Gutter.

Note:
This alley return to be used with Asphalt Concrete Pavement or Bituminous Plant Mix Pavement.

DO NOT SCALE

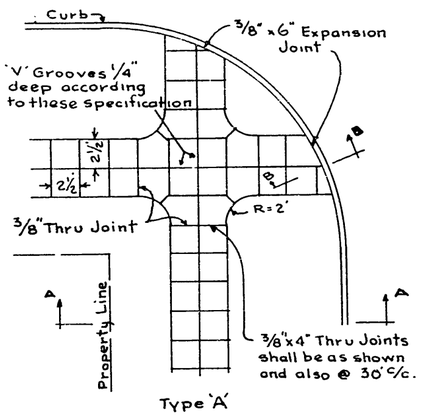
General Notes

Joints shall be cleaned & edge with a ¼" radius edger.
Longitudal Joints shall be as directed by the Engineer.
Material shall meet requirements of these Specifications
Concrete shall be Cement Concrete Class 5(3) or 5(1½).
Procedures: for further requirements for forms, form setting, placing, finishing, stripping & curing shall be as outlined in these Specifications.

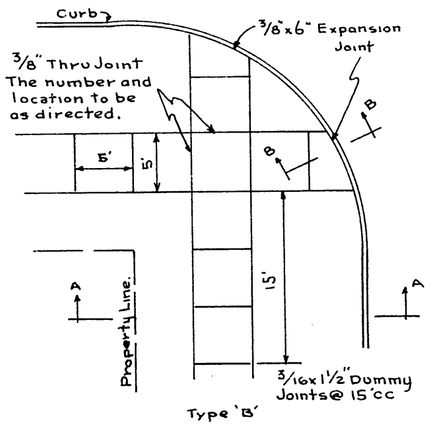
-Measurement-
Measurement For "Cement Conc. Driveway Shall Be The Entire Area Shown & Include The Area Under The Transition Curb & That Portion 1' Out From The Gutter Line.

Cement Concrete Alley Return Type 'B'

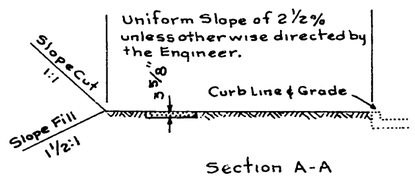
Standard Plan No. 13



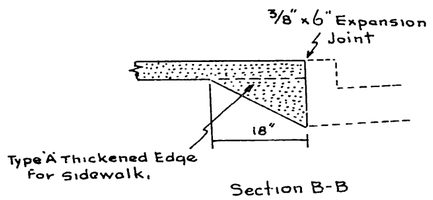
Type 'A'



Type 'B'



Section A-A



Section B-B

General Notes

Joints thru & dummy joints shall be as shown above. Thru Joints shall also be placed in the sidewalk Section at driveway & alley returns as shown on Standard Plans Nos 7 to 13. All joints shall be clean & edged with an edger having a ¼" Radius. Joints shall be flush with the Finished surface.

Forms shall be either wood or steel and shall meet all requirements of these Specifications.

Concrete shall be class 5(1½) or 5(¾)

Procedures: for further requirements for forms, form setting, placing, finishing & curing shall be as outlined in these Specifications.

Note all utility poles, meter boxes, etc, in sidewalk area shall have 3/16" joint material (full depth) placed around them before placing concrete.

Payment

"Type 'A', Cement Concrete Sidewalk," per square yard.

"Type 'B', Cement Concrete Sidewalk," per square yard.

"Type 'A', Thickened Edge for sidewalk," per linear foot.

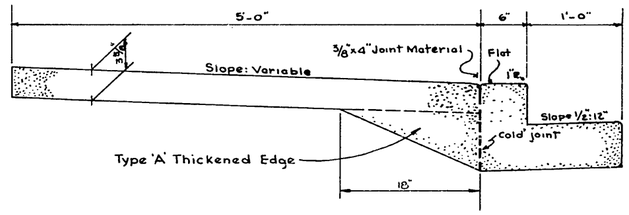
DO NOT SCALE

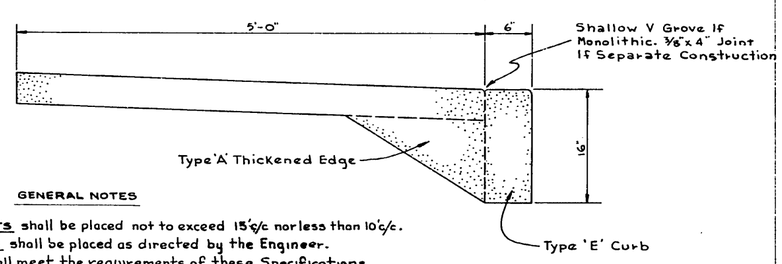
Cement Concrete Sidewalk Type 'A' & Type 'B'

Standard Plan No. 14

Note:
Thru and Dummy Joints details are the same as Shown on Standard Plan

Note: This section may be either Curb or Curb & Gutter Type 'A or Type 'B'





GENERAL NOTES

Dummy Joints shall be placed not to exceed 15'c/c nor less than 10'c/c.
Thru Joints shall be placed as directed by the Engineer.
Material shall meet the requirements of these Specifications.
Concrete shall be cement concrete class 5(1½) or 5(¾).
Procedures: for further requirements for forms, form setting, placing, finishing, and curing shall be as outlined in these Specifications.

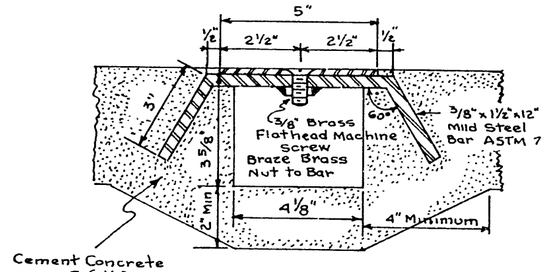
PAYMENT

"Cement Concrete Curb & Gutter, Type( ) per linear foot.
"Cement Concrete Curb Type ( ).
"Type 'A' Thickened Edge for Sidewalk," per linear foot.
"Cement Concrete Sidewalks, Type__," per Square Yard.

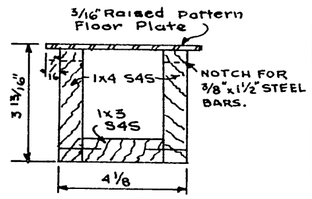
DO NOT SCALE

Cement Concrete Combined Walk, Curb, Curb & Gutter

Standard Plan No. 15

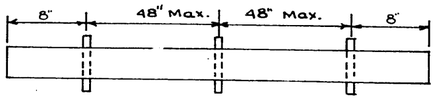


SECTION A-A



Note: Forms to be removed.

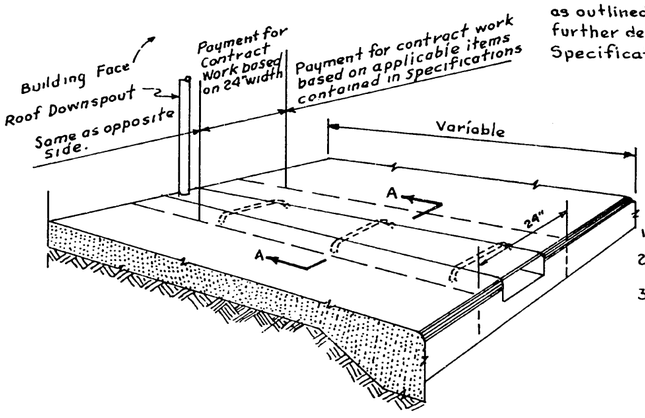
FORMING DETAIL



NOTE
For walks 6' and less use only 2 bars,
for walks 6' to 10' use 3 bars,
for walks over 10' use 4 bars.

BAR SPACING

Material: Shall meet requirements as outlined on this plan and as further described in these Specifications.



Note:
1. Steel plate to end ½" from face of curb.
2. Provide space between bldg. & plate for downspout.
3. When drain is placed in existing sidewalk the sidewalk shall be saw cut as specified in section 52.

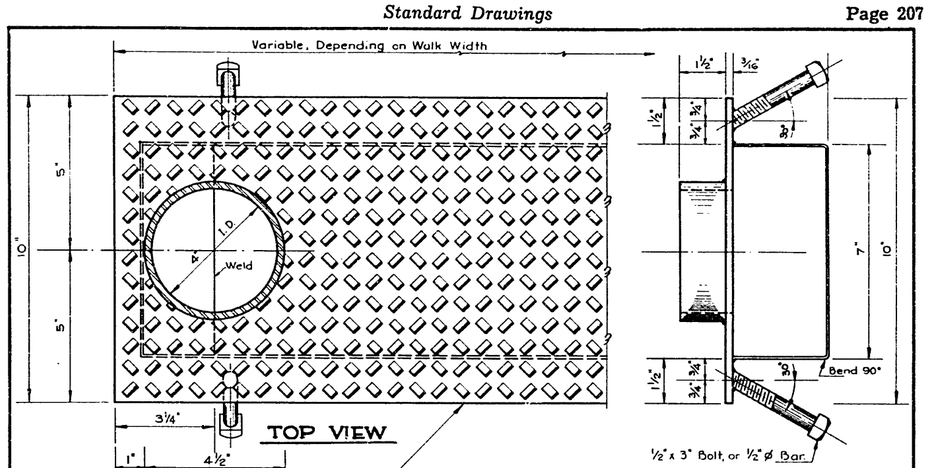
Payment

"Sidewalk Drain for Bldg. Downspout, Type I", per linear foot.

Do Not Scale

Sidewalk Drain For Building Downspout Type "I"

Standard Plan No. 16



SIDE VIEW

GENERAL NOTES

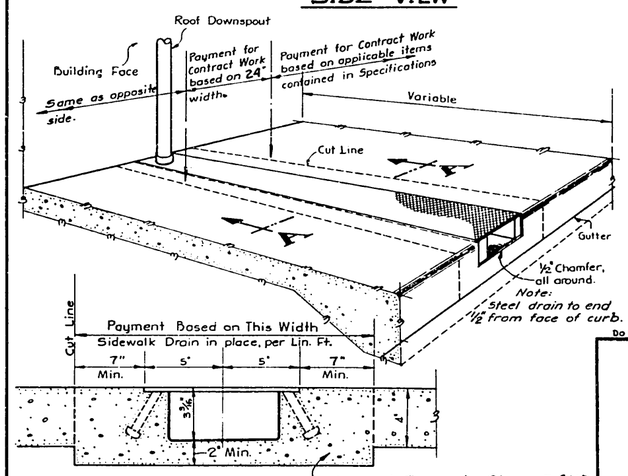
Material

Materials shall meet requirements as outlined on this plan, and as further described in these Specifications.

PAYMENTS

"Sidewalk Drain for Building Downspouts, Type II," per linear foot

NOTE:
When Drain Is Placed In Existing Sidewalk The Sidewalk Shall Be Saw Cut As Specified In Sec. 52.

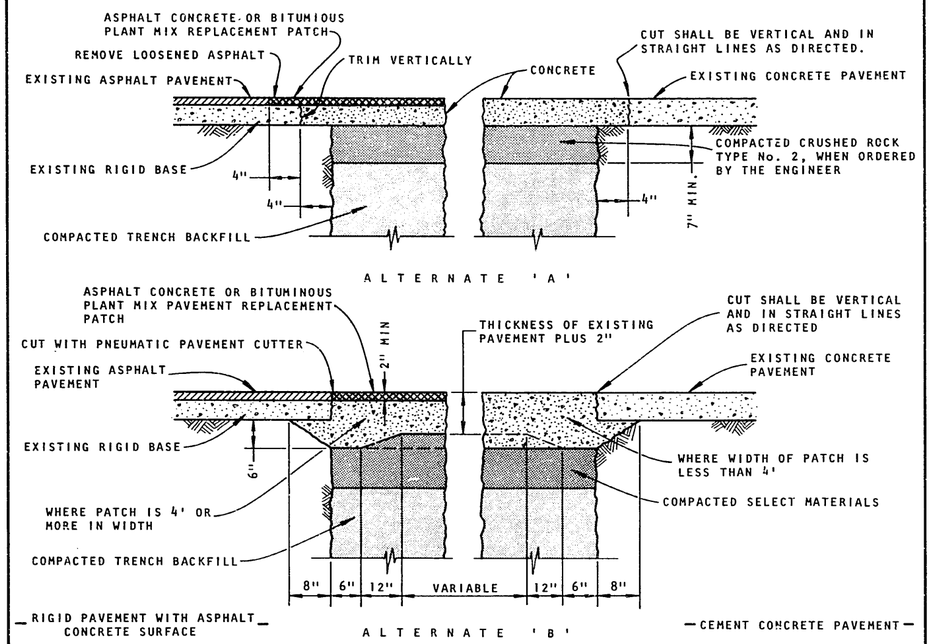


SECTION A-A

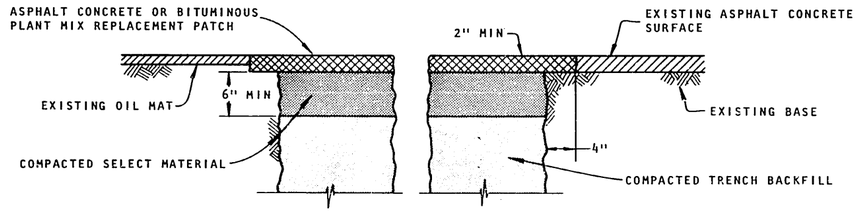
Do Not Scale

Sidewalk Drain For Building Downspout Type II

Standard Plan No 17



TYPICAL PATCH FOR RIGID PAVEMENT



TYPICAL PATCH FOR FLEXIBLE PAVEMENT

GENERAL NOTE:

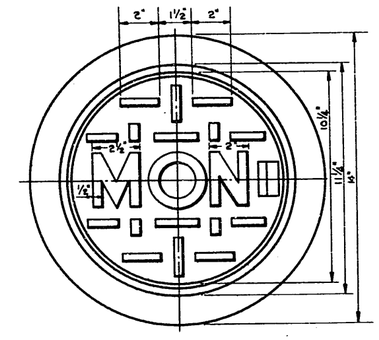
CONCRETE MIX SHALL BE CLASS 6.5(1-1/2)H.E.S. OR CLASS 5(1-1/2) WHICHEVER IS SPECIFIED.

PAYMENT

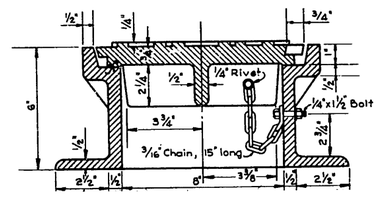
"CEMENT CONCRETE CLASS ( ) FOR PAVEMENT PATCH", PER CUBIC YARD.
"ASPHALT CONCRETE CLASS 'B' FOR PAVEMENT PATCH", PER TON
"BITUMINOUS PLANT MIX FOR PAVEMENT PATCH", PER TON

DO NOT SCALE

Pavement Patching



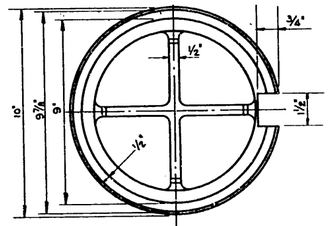
TOP VIEW - FRAME & COVER



Note: Machine Bearing Faces of Cover & Case to insure Positive Fit.

Castings shall be gray iron, A.S.T.M. Designation A-48, Class 30, and shall conform together to applicable Section of these Specifications.

SECTION - FRAME & COVER



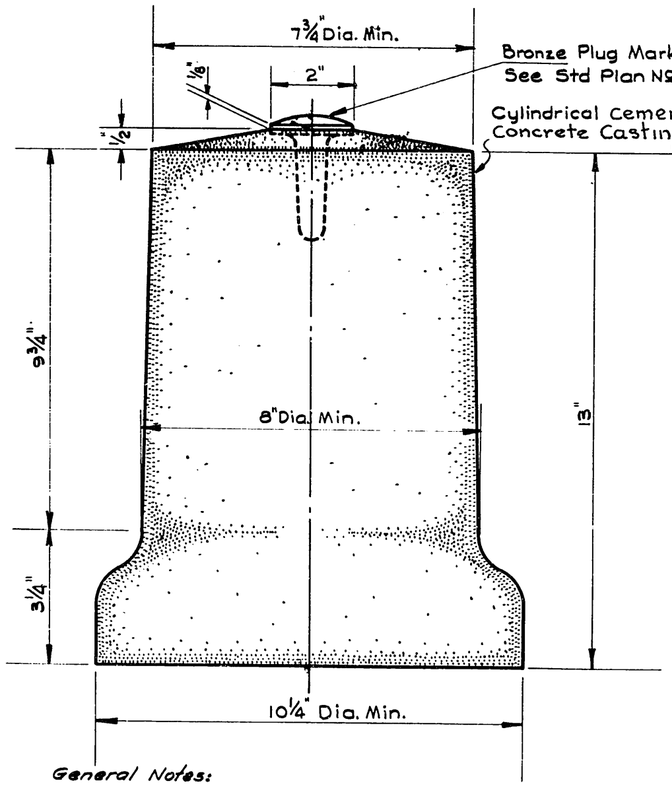
BOTTOM VIEW OF COVER

DO NOT SCALE

Payment

"Furnishing and Placing Monument Frame and Cover", per each

Monument Frame And Cover



General Notes:

Minimum ultimate compressive strength of concrete casting at 28 days = 3000 #.
Maximum aggregate size to be 1".
Monument to be furnished by Contractor

DO NOT SCALE

Precast
Concrete Monument

Payment

"Precast Monument," per each.

Note:
This section to be used primarily on Bituminous or Asphalt Concrete Pavement.

General Notes:

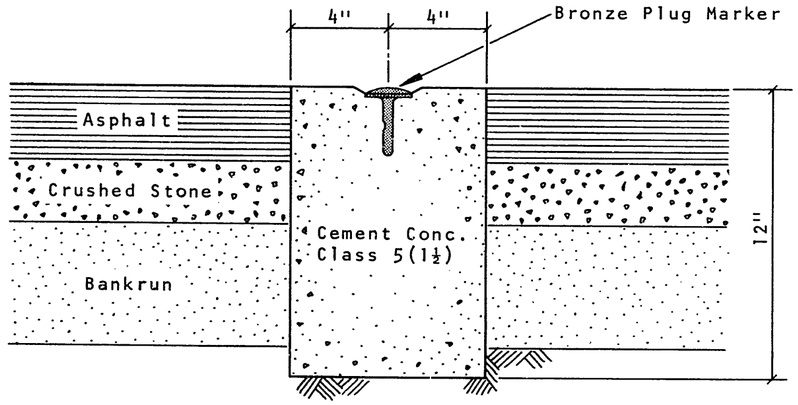
Concrete base dimensions shown are minimum.
Concrete base need not be formed.
City will furnish Bronze Plug Marker free of charge.

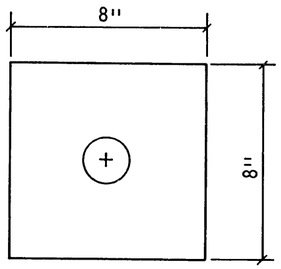
DO NOT SCALE

Payment

"Poured Monument," per each.
"Furnish and place Monument Frame and Cover," per each.

Poured Monument
In Place
TYPE 'B'





NOTE:

This section to be used primarily on bituminus or asphalt conc. pavement.

GENERAL NOTES:

Concrete base dimensions shown are minimum.
Concrete base need not be formed.
Owner will furnish bronze plug marker free of charge.
For resurfacing projects, the existing pavement structure may differ from that as shown on this standard plan.
The removal of any existing monuments and all pavement removal shall be incidental to the construction of the monument.

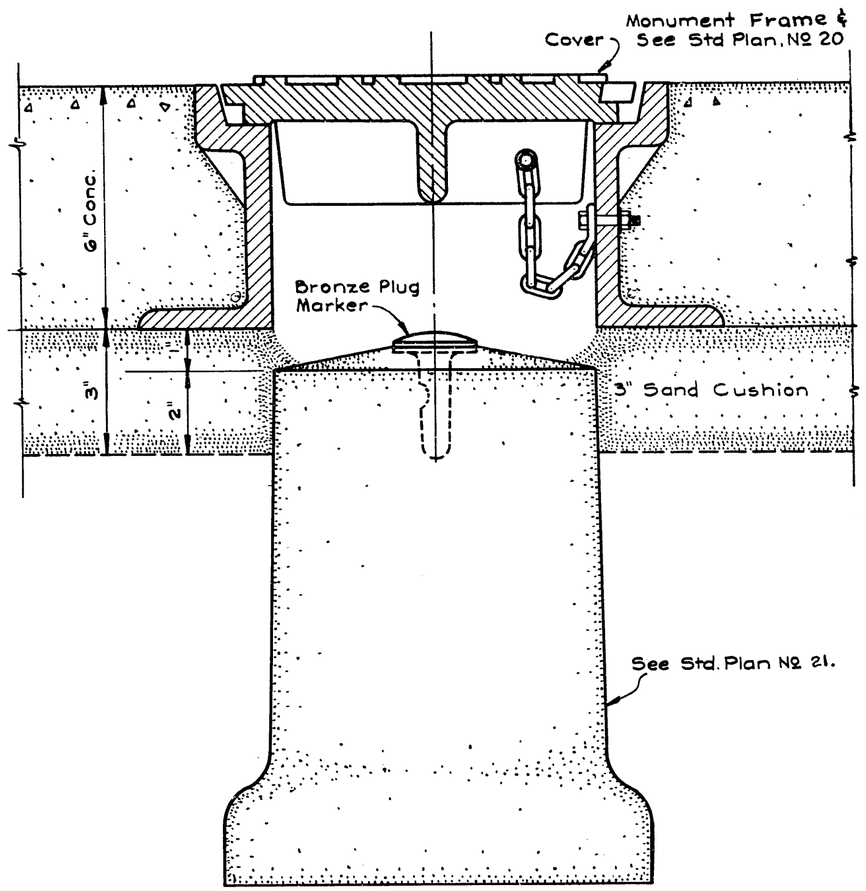
PAYMENT

"Poured Monument, Type 'A'" Per Each.

Do not scale

POURED MONUMENT
IN PLACE
T Y P E 'A'

Standard Plan No. 22



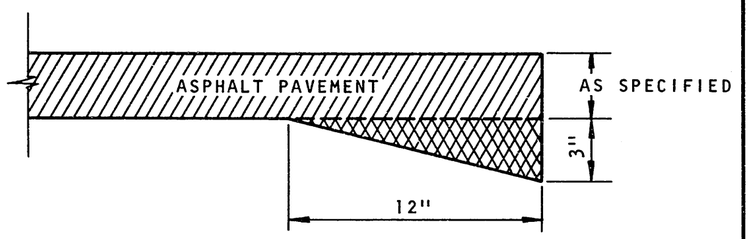
General Notes:

This section to be used primarily on Cement Concrete Pavement.

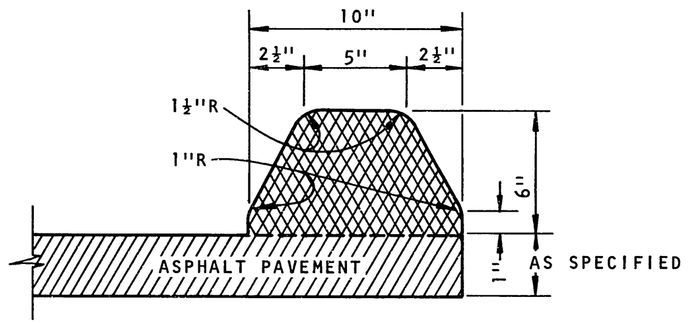
Payment

"Precast Monument," per each.
"Furnish and Place Monument Frame and Cover," per each.

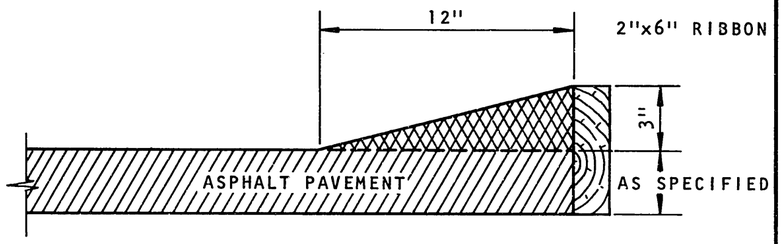
Special Installation of Monument For Concrete Pavement



THICKEND EDGE FOR ASPHALT PAVEMENT



EXTRUDED ASPHALT CONCRETE CURB



ASPHALT WEDGE CURB

PAYMENT

"THICKEND EDGE FOR ASPHALT PAVEMENT", Per Lineal Foot.

"2"x6" RIBBON FOR ASPHALT WEDGE CURB" Per Lineal Foot.

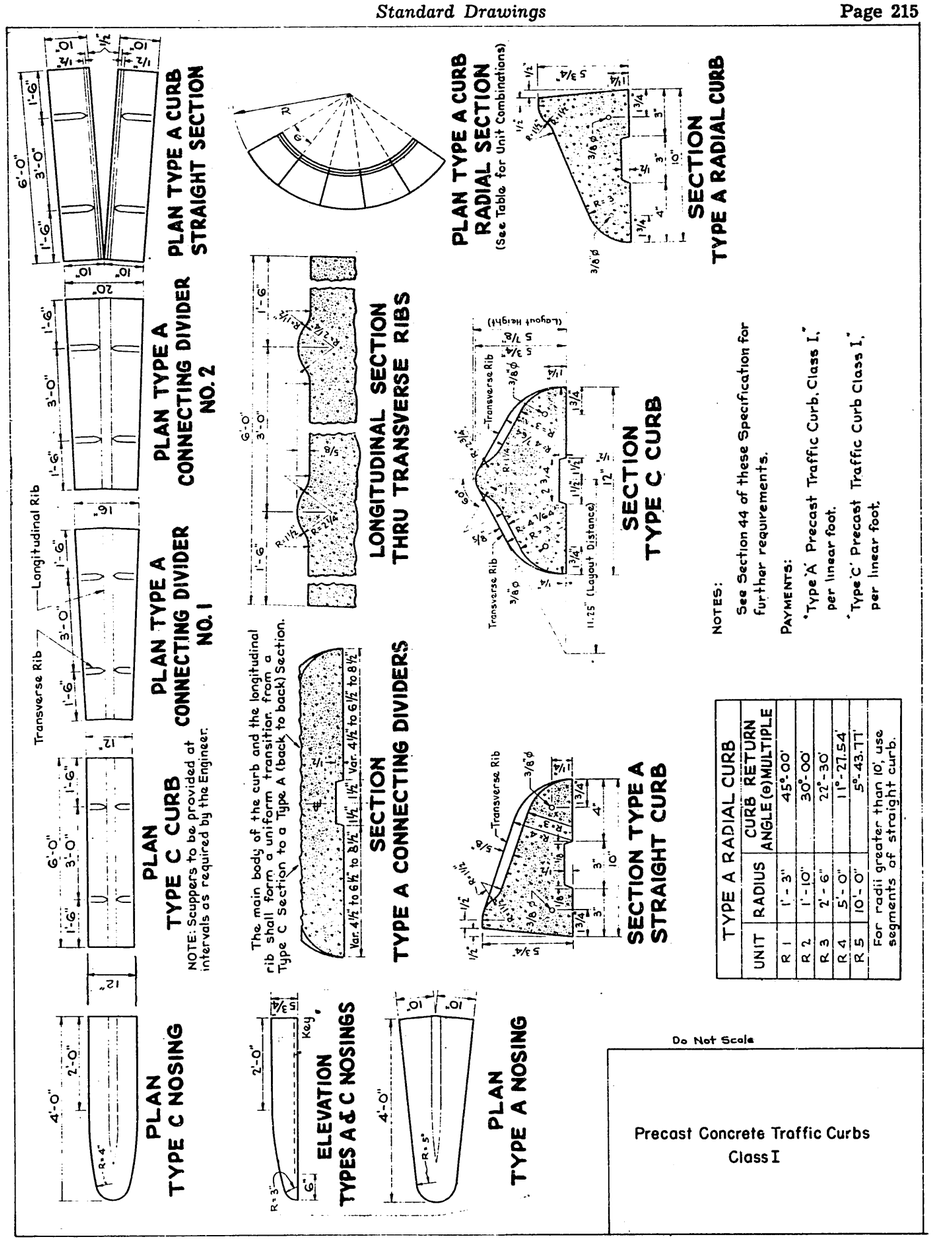
"EXTRUDED ASPHALT CONCRETE CURB", Per Lineal Foot.

"ASPHALT WEDGE CURB", Per Lineal Foot.

DO NOT SCALE

EXTRUDED ASPHALT CONCRETE SECTIONS

Standard Plan No. 24

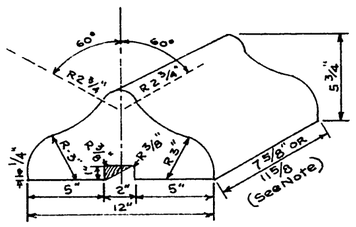


Do Not Scale

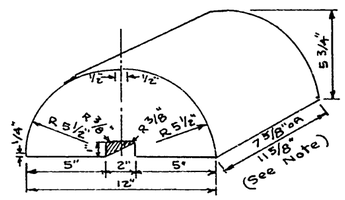
Precast Concrete Traffic Curbs Class I

A.P.W.A.—STANDARD PLANS—1963

Standard Plan No. 25

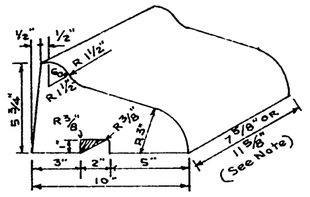


TYPE 'C' BLOCK

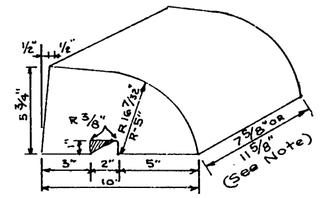


TYPE 'C' REFLECTOR BLOCK

BLOCK TYPE 'C' PRECAST TRAFFIC CURB



TYPE 'A' BLOCK



TYPE 'A' REFLECTOR BLOCK

BLOCK TYPE 'A' PRECAST TRAFFIC CURB

PAYMENT

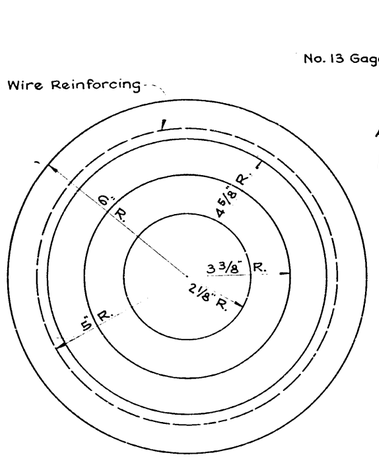
"Block Precast Traffic Curb, Class II, Type 'A'," per linear foot.
"Block Precast Traffic Curb, Class II, Type 'C'," per linear foot.

NOTE

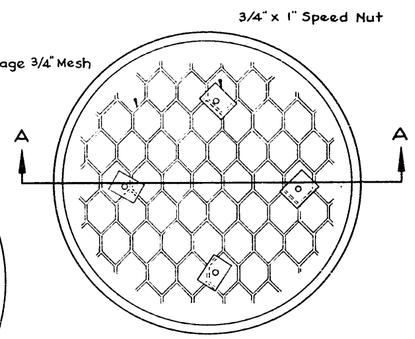
With 7 5/8" blocks every sixth block shall be a reflector block.
With 11 5/8" blocks every fourth block shall be a reflector block.
See Section 45 of these Specification for further requirements.

Do Not Scale

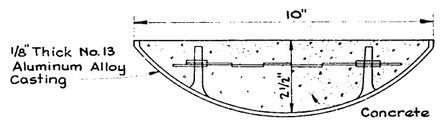
Block Precast Traffic Curbs
Class II



PLAN

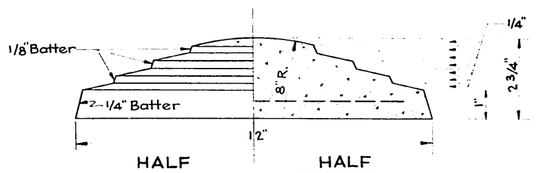


BOTTOM VIEW



SECTION A-A

ALUMINUM-COVERED TRAFFIC BUTTON



HALF ELEVATION HALF SECTION

PRECAST CONCRETE TRAFFIC BUTTON

NOTE

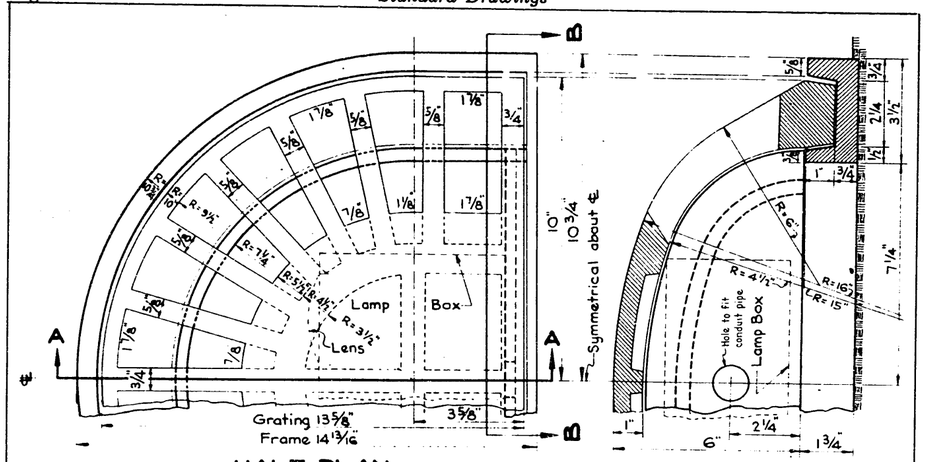
See Section 44 of these Specification for further requirements.

PAYMENT

"Precast Concrete Traffic Button," per each.
"Aluminum-Covered Traffic Buttons," per each.

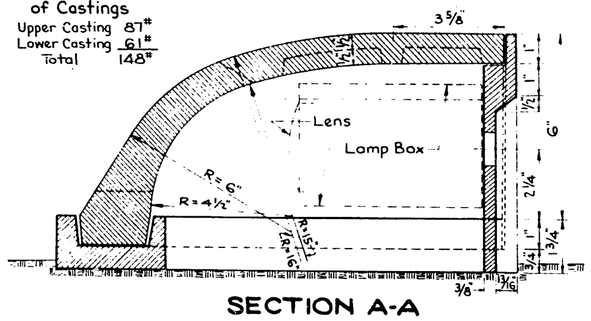
Do Not Scale

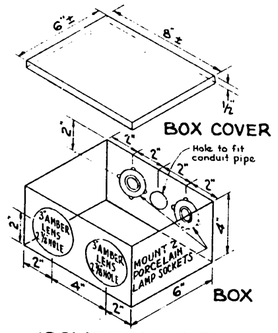
Traffic Buttons



Approximate Weight of Castings

Upper Casting	87#
Lower Casting	61#
Total	148#





NOTES:

The castings shall be Malleable Iron Castings, ASTM Designation No. A47 or Steel Castings, ASTM Designation No. A27, Grade 60-30.

The lamp box and cover shall be No. 16 gauge Galvanized Sheet Metal or Aluminum Sheeting of equivalent thickness.

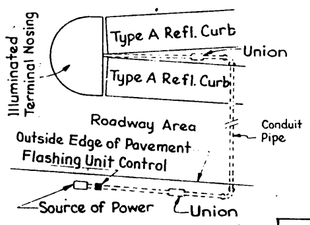
The terminal nose casting together with the lamp box and fittings will be furnished to the Contractor at no cost to him.

See Section 46 of these Specifications for further construction details.

PAYMENT

"Illuminated Terminal Nosing Type No. 1," per each.

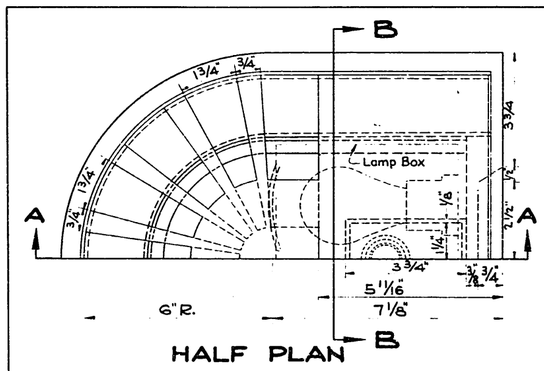
"Galv. Conduit Pipe (of the diameter specified)," per lin. ft.

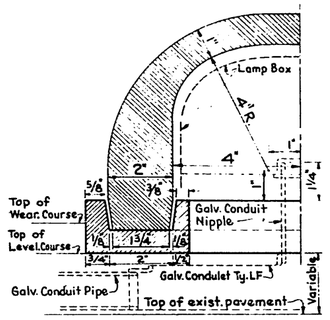


Do Not Scale

Illuminated Terminal Nosing

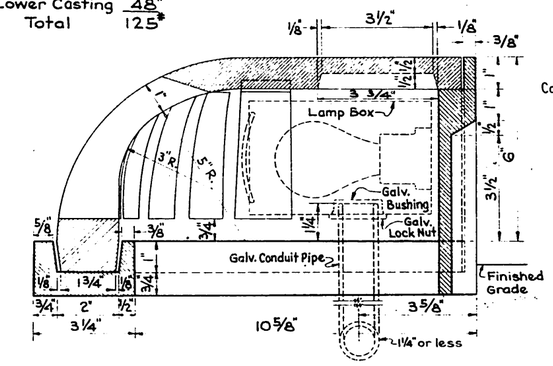
Type I

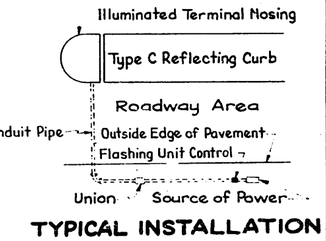


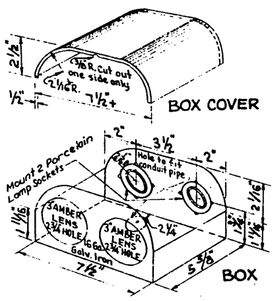


Approximate Weight of Castings

Upper Casting	77#
Lower Casting	48#
Total	125#







NOTES:

The castings shall be Malleable Iron Castings, ASTM Designation No. A 47 or Steel Castings, ASTM Designation No. A27, Grade 60-30.

The lamp box and cover shall be No. 16 gauge Galvanized Sheet Metal or Aluminum Sheeting of equivalent thickness.

See Section 46 of these Specifications for further construction details.

PAYMENT:

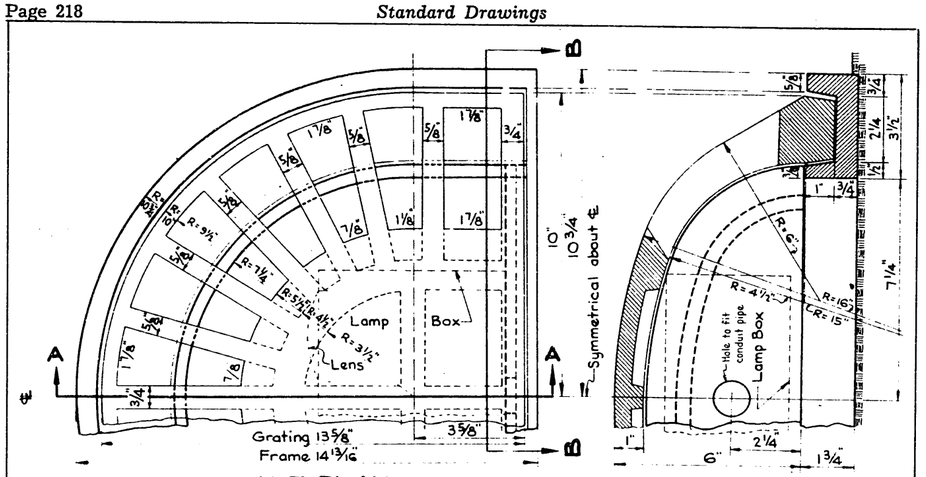
"Illuminated Terminal Nosing, Type No. 2," per each.

"Galvanized Conduit Pipe (of the diameter specified)," per linear foot.

Do Not Scale

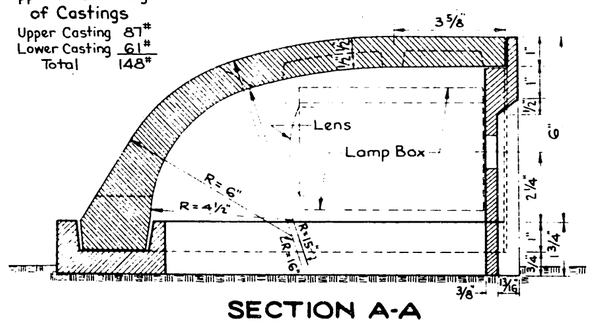
Illuminated Terminal Nosing

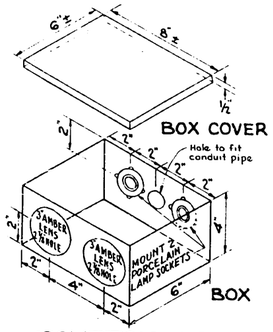
Type II

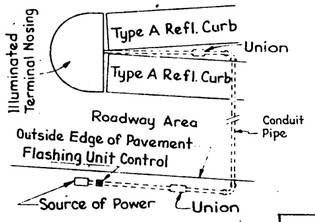


Approximate Weight of Castings

Upper Casting	87#
Lower Casting	61#
Total	148#







NOTES:

The castings shall be Malleable Iron Castings, ASTM Designation No. A47 or Steel Castings, ASTM Designation No. A27, Grade 60-30.

The lamp box and cover shall be No. 16 gauge Galvanized Sheet Metal or Aluminum Sheeting of equivalent thickness.

The terminal nose casting together with the lamp box and fittings will be furnished to the Contractor at no cost to him.

See Section 46 of these Specifications for further construction details.

PAYMENT

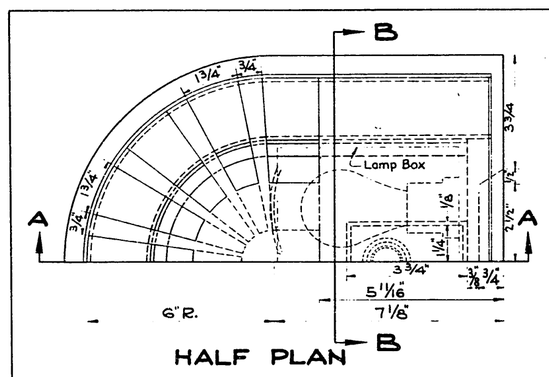
"Illuminated Terminal Nosing Type No. 1," per each.

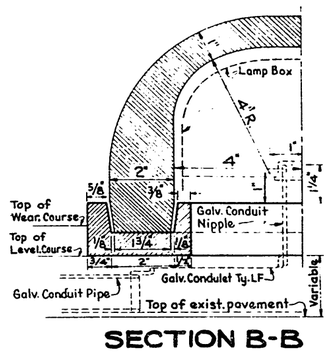
"Galv. Conduit Pipe (of the diameter specified)," per lin. ft.

Do Not Scale

Illuminated Terminal Nosing

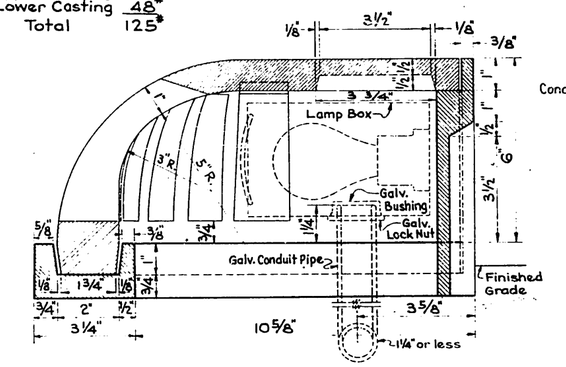
Type I

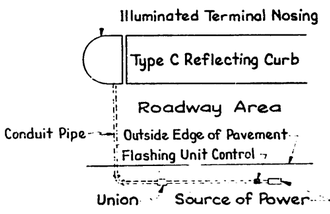


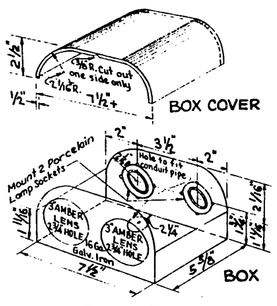


Approximate Weight of Castings

Upper Casting	77#
Lower Casting	48#
Total	125#







NOTES:

The castings shall be Malleable Iron Castings, ASTM Designation No. A47 or Steel Castings, ASTM Designation No. A27, Grade 60-30.

The lamp box and cover shall be No. 16 gauge Galvanized Sheet Metal or Aluminum Sheeting of equivalent thickness.

See Section 46 of these Specifications for further construction details.

PAYMENT:

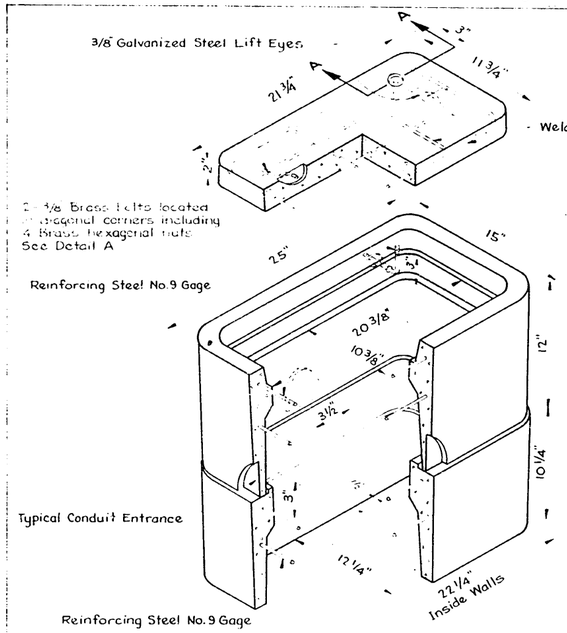
"Illuminated Terminal Nosing, Type No. 2," per each.

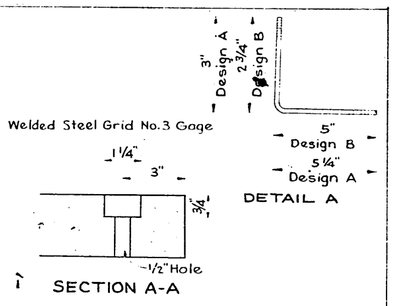
"Galvanized Conduit Pipe (of the diameter specified)," per linear foot.

Do Not Scale

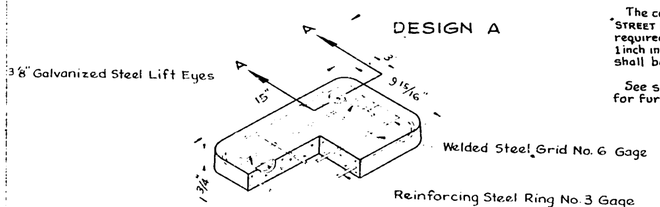
Illuminated Terminal Nosing

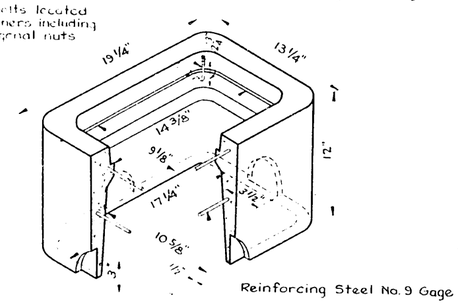
Type II





DESIGN A





DESIGN B

TYPE NO. I

NOTES:

The contractor may have the option of furnishing Type I or Type II Concrete Junction Boxes; however, only the one type shall be furnished on any one project.

All Concrete Junction Boxes shall be Design 'B' unless they are to house a ballast or transformer, when they shall be Design 'A'. Type I, Design 'A' concrete Junction Boxes shall be fitted with an extension as detailed.

Concrete Junction Boxes shall be finished in a neat, workman like manner, with all concrete conforming to applicable specifications.

Type No. I boxes shall be reinforced as noted.

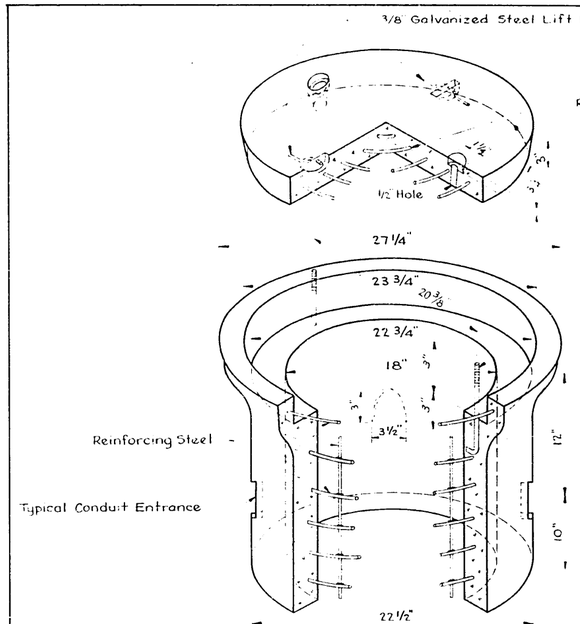
The covers of all boxes shall be inscibed, "STREET LIGHTING" unless otherwise required. The letters shall be approximately 1 inch in height and 1/8 inch in depth and shall be neatly formed.

See section 46 of these specifications for further requirements.

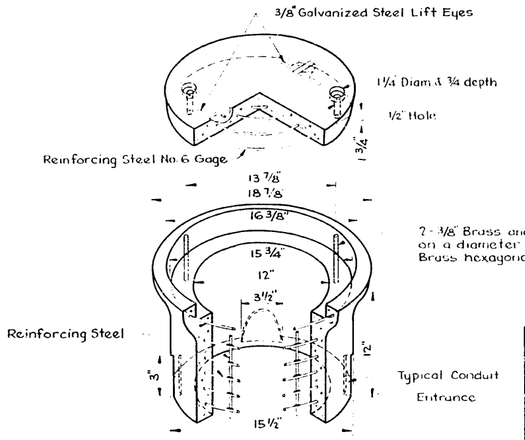
Do Not Scale

Concrete Junction Box
Type .I

Standard Plan No. 30



DESIGN A



DESIGN B

TYPE NO. II

NOTES:

The Contractor may have the option of furnishing Type I or Type II Concrete Junction Boxes; however, only the one type shall be furnished on any one project.

All Concrete Junction Boxes shall be Design 'B' unless they are to house a ballast or transformer, when they shall be Design 'A'. Type I, Design 'A' Concrete Junction Boxes shall be fitted with an extension as detailed.

Concrete Junction Boxes shall be finished in a neat, workman like manner, with all concrete conforming to applicable Specifications.

Type No. II boxes shall meet the requirements for Standard Reinforced Concrete Culvert Pipe.

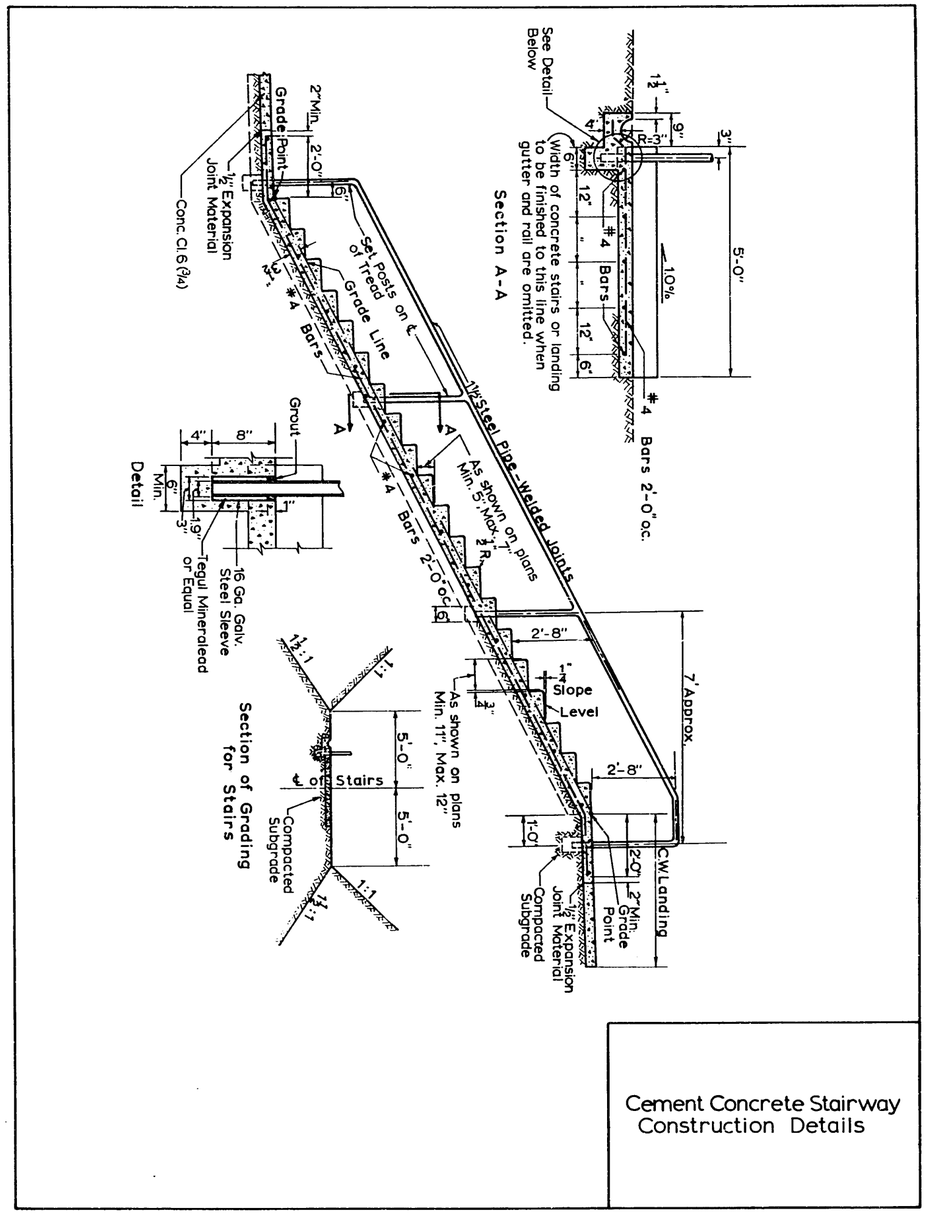
The covers of all boxes shall be inscibed, "STREET LIGHTING" unless otherwise required. The letters shall be approximately 1 inch in height and 1/8 inch in depth and shall be neatly formed.

See section 46 of these Specifications for further requirements.

Do Not Scale

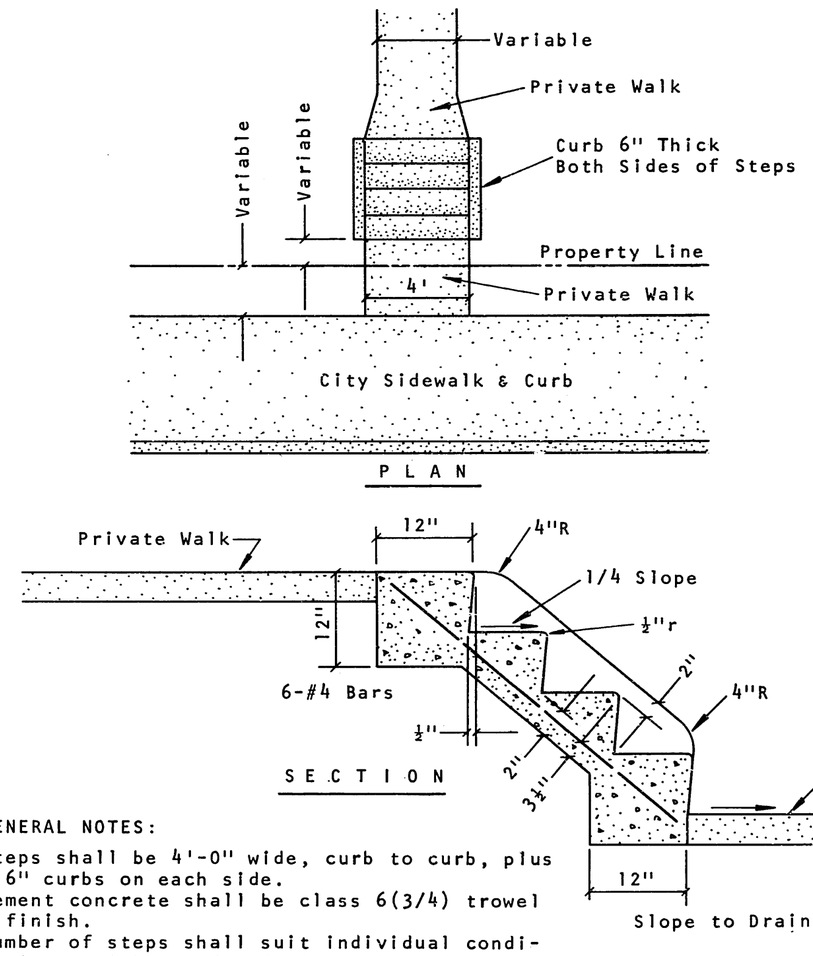
Concrete Junction Box
Type II

Standard Plan No. 31



Cement Concrete Stairway Construction Details

Standard Plan No. 32



GENERAL NOTES:

Steps shall be 4'-0" wide, curb to curb, plus 6" curbs on each side.
Cement concrete shall be class 6(3/4) trowel finish.
Number of steps shall suit individual conditions, with tread and riser dimensions to suit the grade.
Risers shall be 5" min. 7" max., tread shall be min. 11" max. 12".

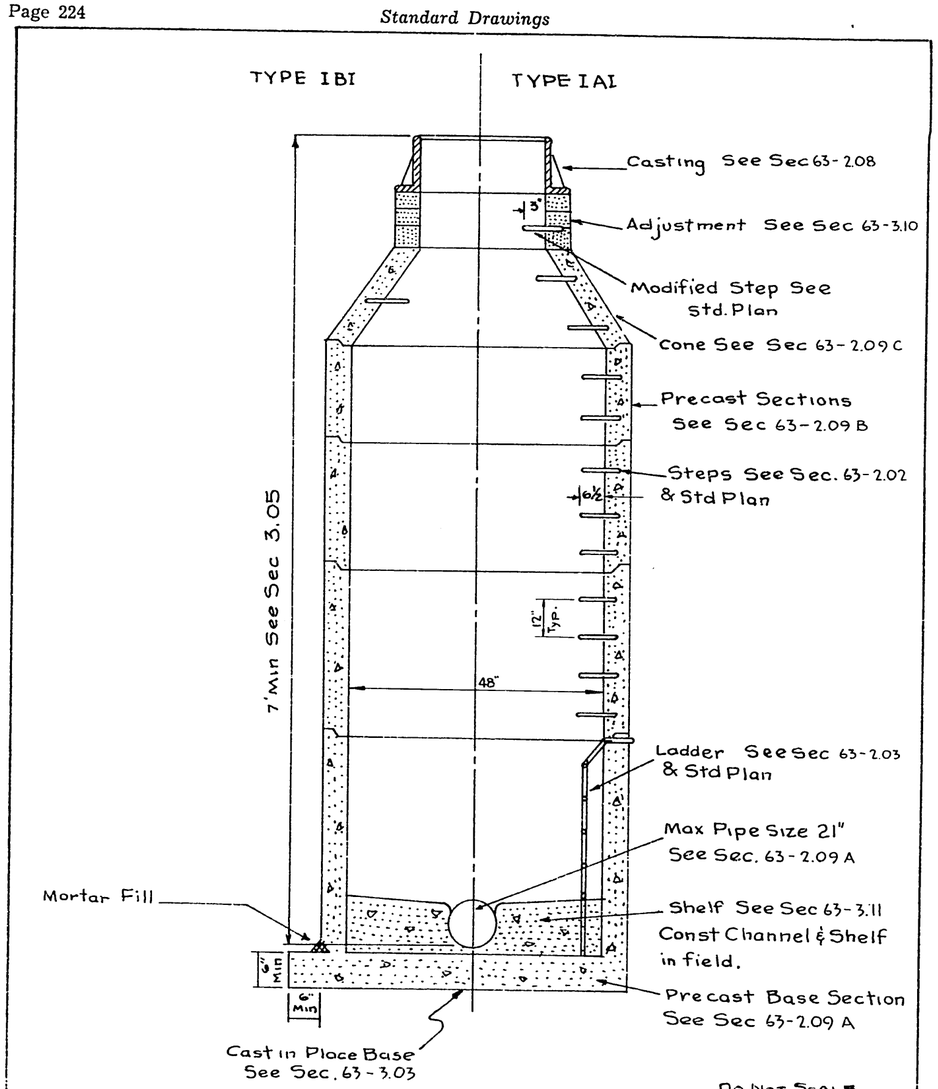
PAYMENT

"Cement Concrete Steps", per lineal foot including curbs, and shall be full compensation for furnishing all tools, materials, equiptment and labor, including all excavation necessary for the completion of steps.

Do not scale

CEMENT CONCRETE STEPS

Standard Plan No. 33



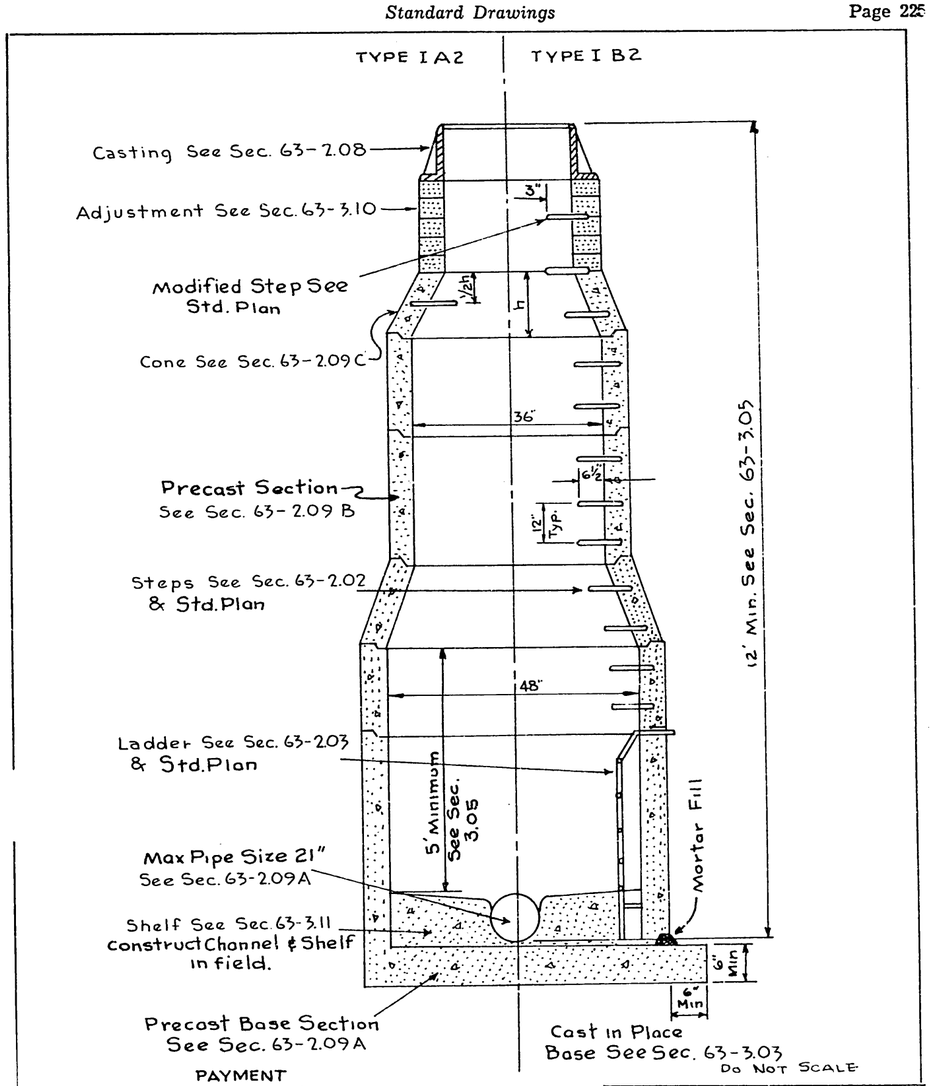
DO NOT SCALE

PAYMENT

" Type ____ Manhole, Basic Price," per each.
" Type ____ Manhole, Extra Depth," per foot.

Manhole
Type IA1 & IB1

Standard Plan No.34



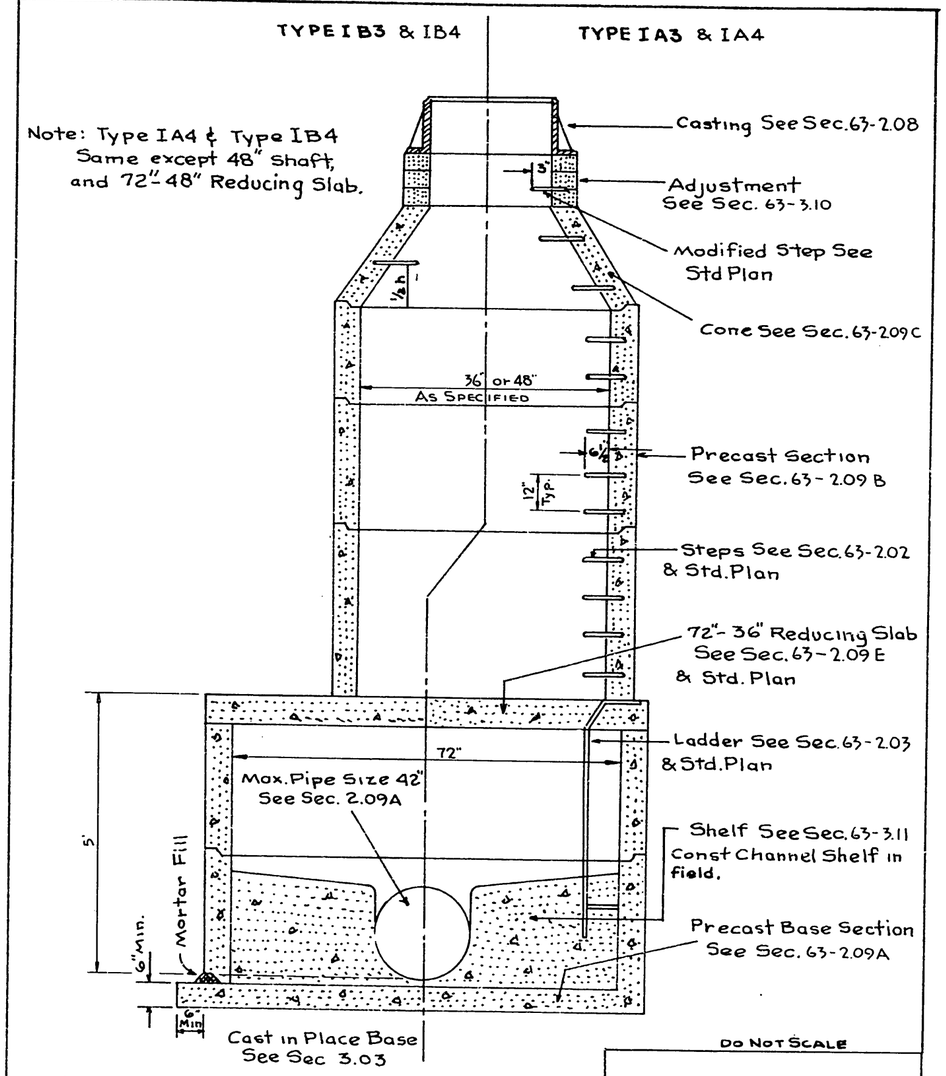
DO NOT SCALE

PAYMENT

" Type ____ Manhole, Basic Price," per each.
" Type ____ Manhole, Extra Depth," per foot.

Manhole
Type IA2 & IB2

Standard Plan No.35



Note: Type IA4 & Type IB4 not shown are similar except reduced to 48" diameter.

PAYMENT

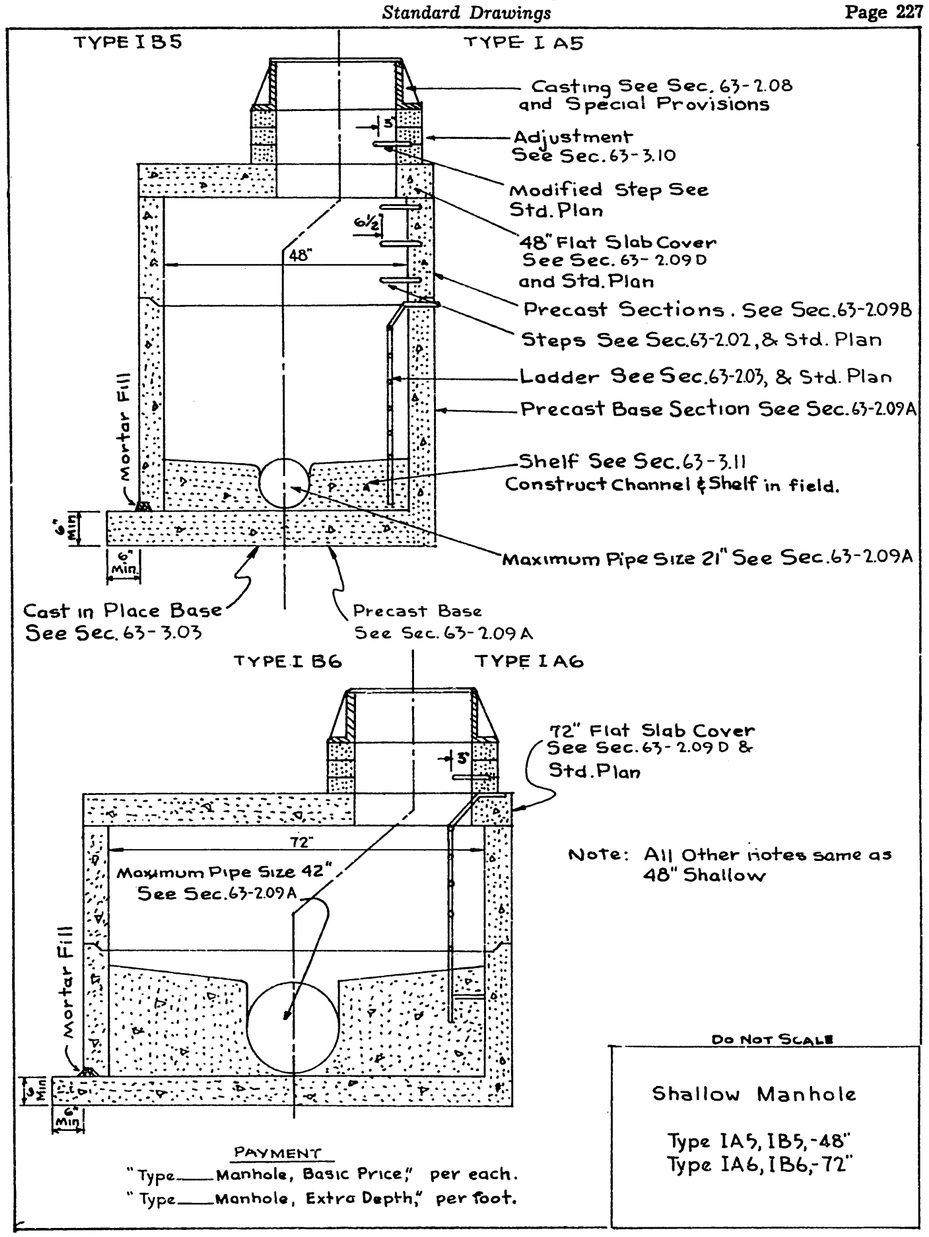
"Type___Manhole, Basic Price," per each.
"Type___Manhole, Extra Depth," per foot.

DO NOT SCALE

Manhole

Type IA3, IB3 72" Dia. To 36"
Type IA4, IB4 72" Dia. To 38"

Standard Plan No. 36



Note: All Other notes same as 48" Shallow

PAYMENT

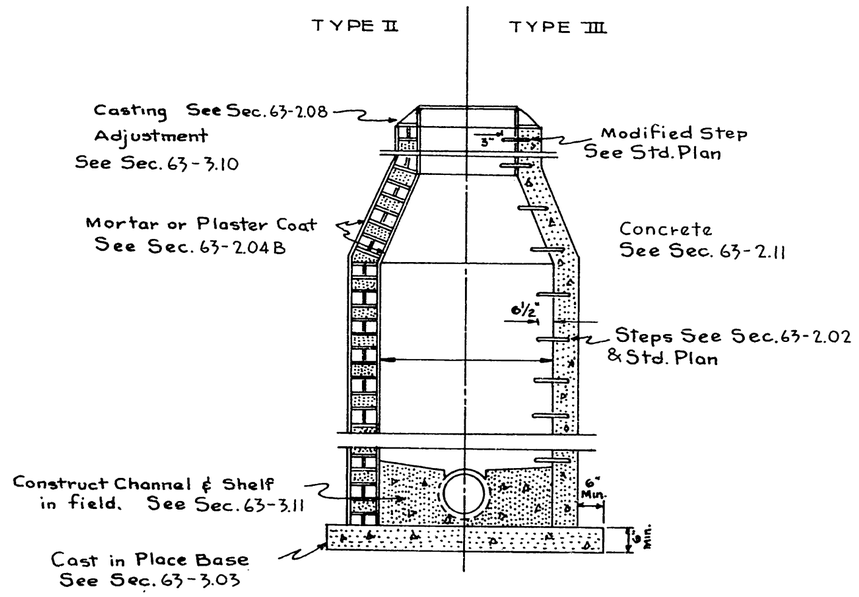
"Type___Manhole, Basic Price," per each.
"Type___Manhole, Extra Depth," per foot.

DO NOT SCALE

Shallow Manhole

Type IA5, IB5, -48"
Type IA6, IB6, -72"

Standard Plan No. 37



Note: 1. For dimensions not given See Sec. 63-3.05 & 63-3.06

2. Type II & III

A. 48" Diameter
B. 48" Reduced to 36"
C. 72" Reduced to 36"
D. 72" Reduced to 48"
E. 48" Shallow
F. 72. Shallow

NOTE:
Step Spacing To Be 16" Max. For Block Manholes & 12" Max. For Concrete Manholes.

PAYMENT

"Type___Manhole, Basic Price," per each.

"Type___Manhole, Extra Depth," per foot.

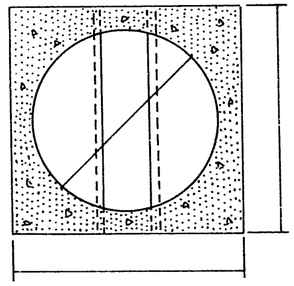
DO NOT SCALE

Manhole
Type II Concrete Block
or
Brick Masonary
Type III Monolithic Concrete
For Sub-Types See Note 2

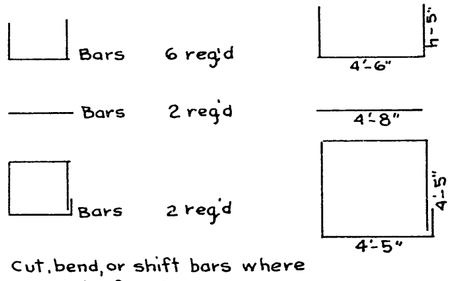
Standard Plan No. 38

TYPE IV A

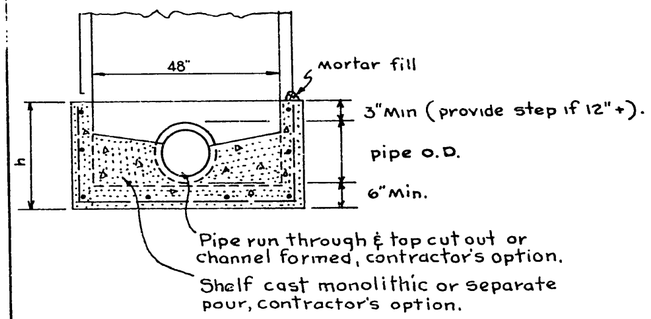
Monolithic Base Section - Pipe Sizes 36" and Smaller.



Reinforcing Schedule (all bars).



Cut, bend, or shift bars where pipe interferes.



PAYMENT

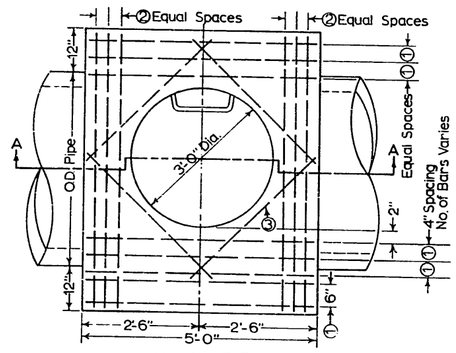
*Type___(or size) Manhole, Basic Price," per each.

*Type___(or size) Manhole, Extra Depth," per foot.

DO NOT SCALE

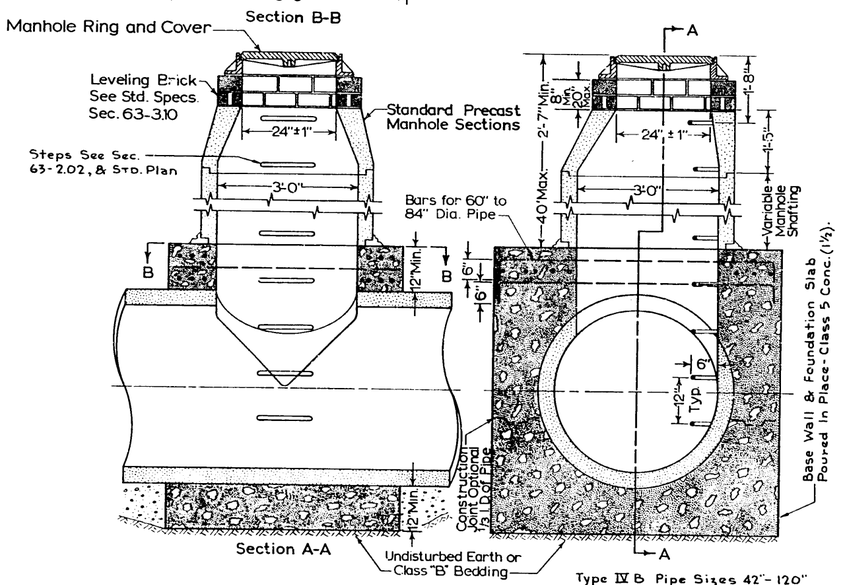
Manhole

Type IV A Monolithic Base
Type IV A1 Precast Unit Shaft
Type IV A2 Masonary Shaft
Type IV A3 Monolithic Conc. Shaft



BAR LIST

Pipe Dia.	No.	Size	Length
① Longitudinal Bars			
42"	6	5	4'-8"
48"	7	"	"
54"	8	"	"
60"	10	"	"
66"	11	"	"
72"	12	"	"
78"	14	"	"
84"	16	"	"
② Transverse Bars			
42"	6	5	2'-8"+O.D.
48"	6	6	"
54"	6	6	"
60"	12	5	"
66"	12	5	"
72"	12	6	"
78"	12	6	"
84"	12	6	"
③ Diagonal Bars			
42"-84"	4	5	3'-8"



Unit, as shown, is a cast-in-place base section above which optional construction may be brick, conc. block or cast-in-place construction at Contractor's option, unless otherwise provided in the proposal.

Construct manholes in accordance with Section 63 of the Std. Specifications.

Reinforcing steel shall have a min. cover of 2".

Eccentric Cones shall be used only where specified.

All lift holes and joints to be filled with mortar.

– PAYMENT –

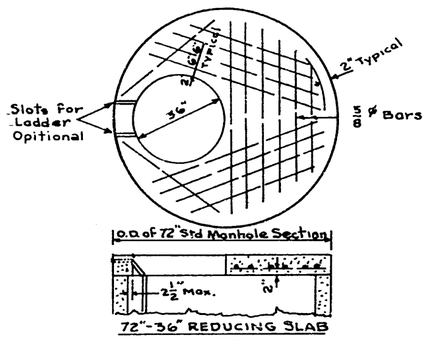
"Type ____ Manhole, Basic Price," Per Each.
"Type ____ Manhole, Extra Depth," Per Vert. Foot.

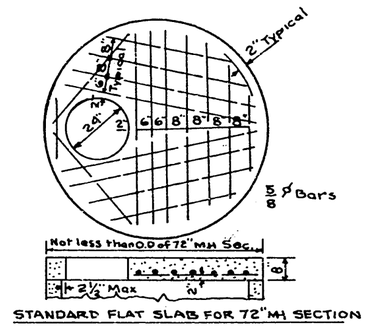
Type IV B Pipe Sizes 42"-120"
Type IV B1 Precast Sectional Shaft.
Type IV B2 Concrete Block or Brick Masonary Shaft.
Type IV B3 Monolithic Conc. Shaft.

Manhole IV B
Monolithic Base

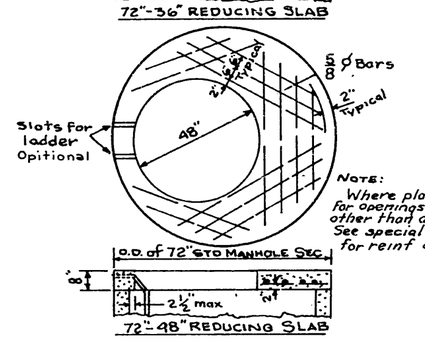
Type IV B1 Precast Unit Shaft
Type IV B2 Masonary Shaft
Type IV B3 Monolithic Conc. Shaft

Standard Plan No. 40

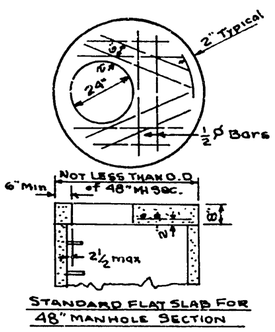




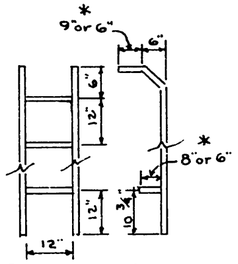
STANDARD FLAT SLAB FOR 72" MH SECTION



NOTE:
Where plans call for openings located other than as shown See special details for reinf arrangement.

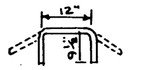


STANDARD FLAT SLAB FOR 48" MANHOLE SECTION



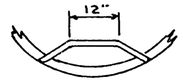
STANDARD ALUMINUM OR GALVANIZED STEEL BASE SECTION LADDER

Rungs to be deformed or non-skid as specified for steps. All parts to be 1" dia. min or equivolent section.



STANDARD ALUMINUM OR GALVANIZED DEFORMED STEEL MANHOLE STEPS

Legs may be parallel or approximately radial at option of manufacture except that all steps in any manhole shall be similar.



MODIFIED STEP FOR ADJUSTMENT RING.

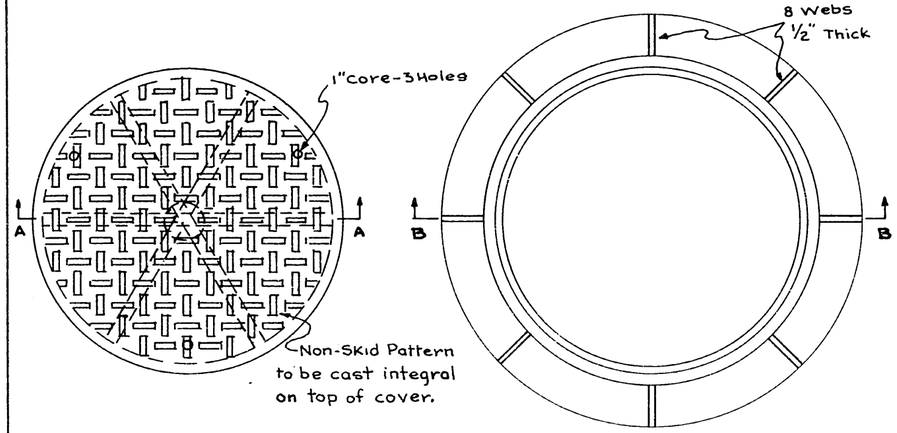
* Larger Dimension when Ladder used with reducing slab.

Do Not Scale

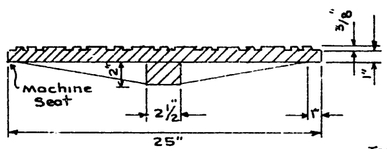
Manhole
Slab, Step & Ladder Detail

Standard Plan No. 41

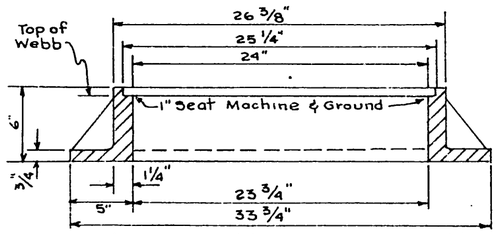
Covers shall have the word 'SEWERS' in 2" raised letters when used in connection with sanitary sewer installations, or 'DRAIN' when in connection with storm sewers installation, or 'WATER' when in connection with water distribution installation.



Frame Plan



Section A-A
Cast Iron-Non Locking Cover
Minimum weight 150 lbs.



Section B-B Cast Iron Frame-Min. Weight 210 lbs.
DO NOT SCALE

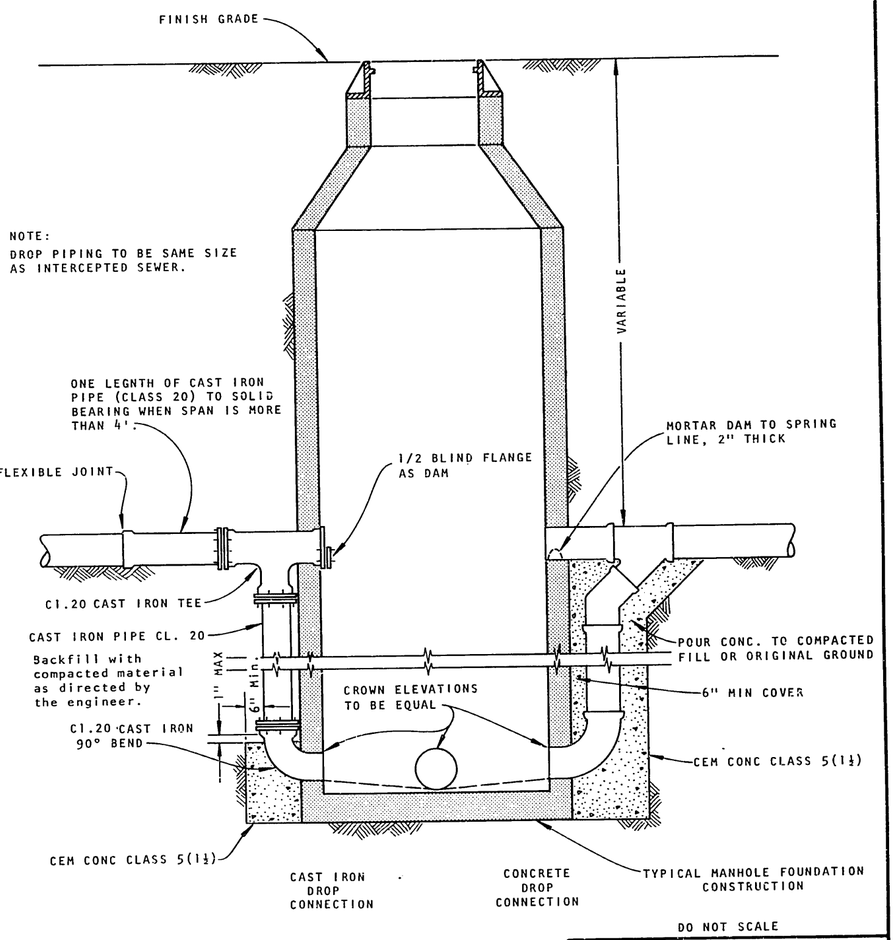
Note see section 63-2.08 for additional details.

Payment

See section 63 of these Specification.

24" Manhole
Frame With Cover

Standard Plan No.42



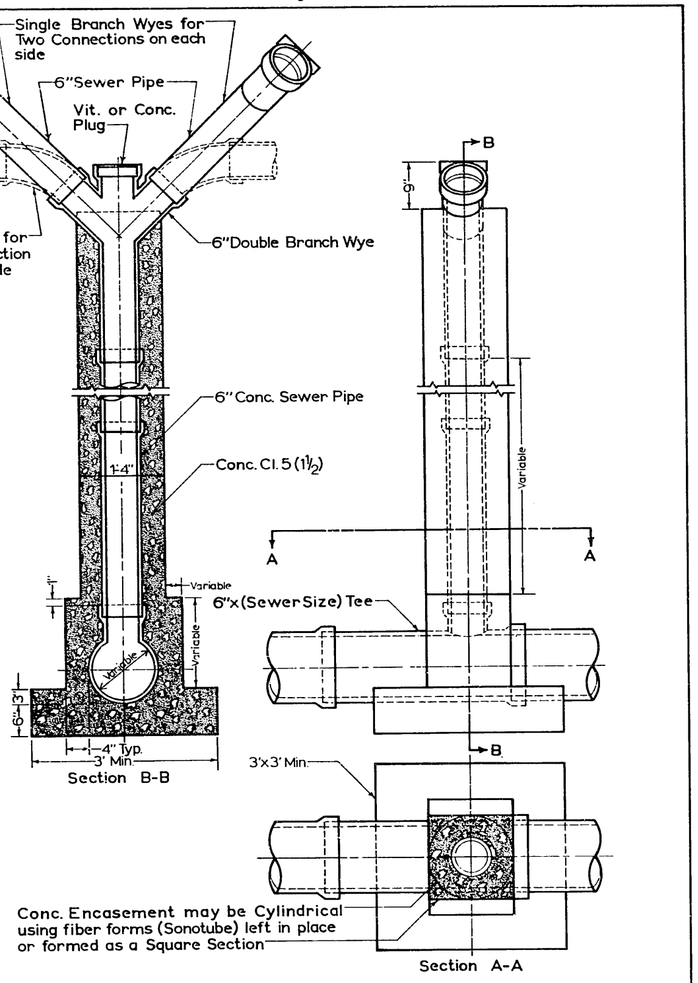
DO NOT SCALE

PAYMENT

"DROP CONNECTION", PER EACH.

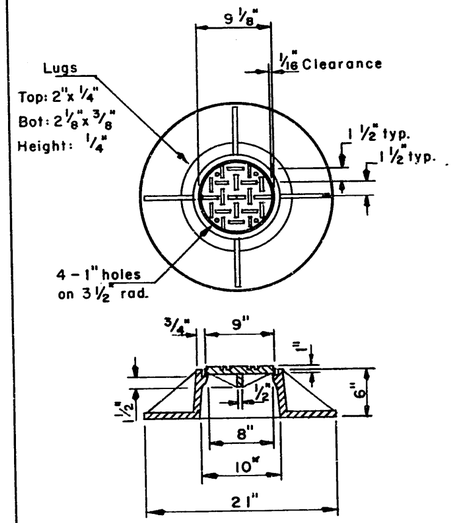
Drop Connection

Standard Plan No. 43

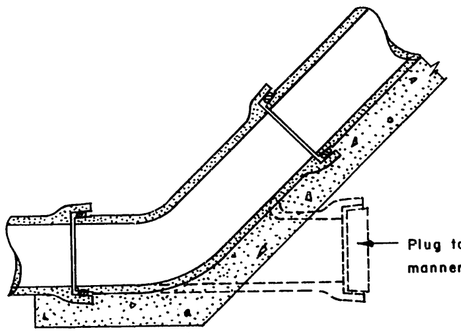


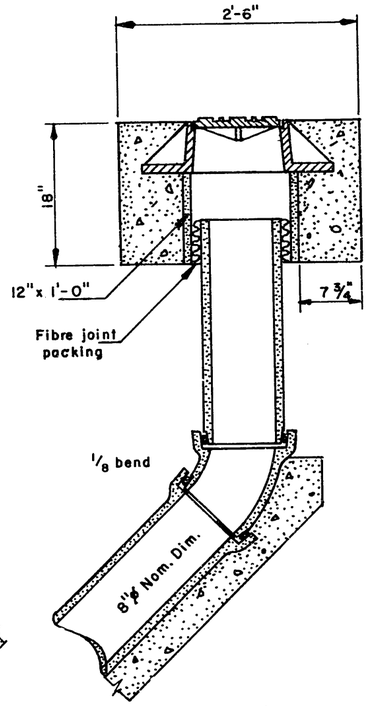
Vertical Connection

Standard Plan No. 44



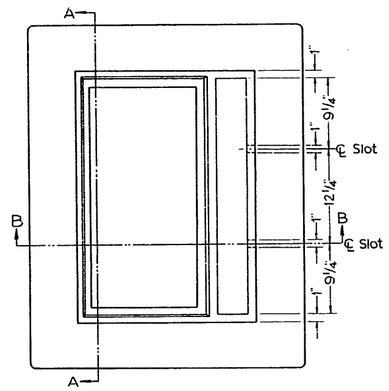
CAST IRON RING & COVER

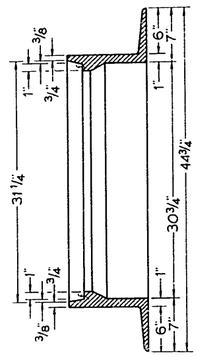




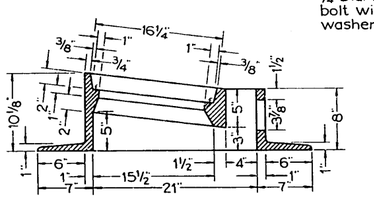
8" Clean-out

Standard Plan No. 45

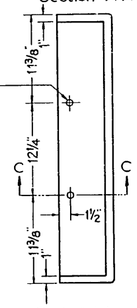




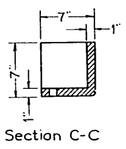
Section A-A



Section B-B

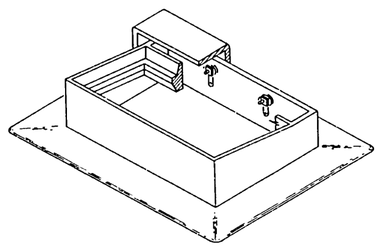


Curb Inlet



Section C-C

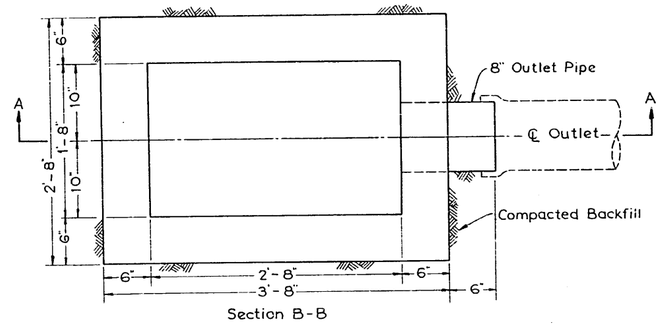
ISOMETRIC VIEW



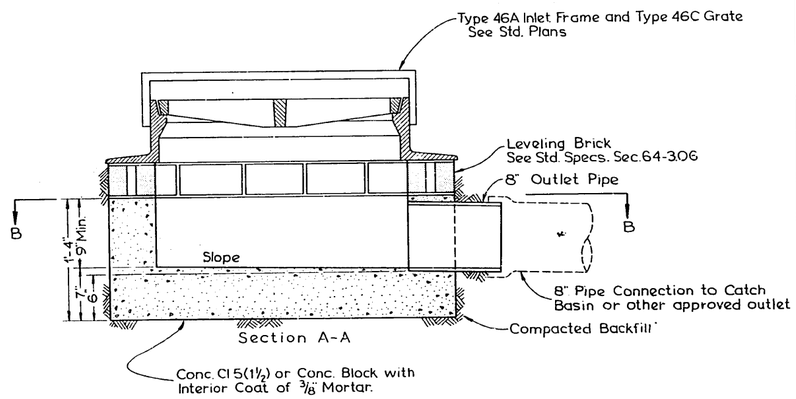
Frame and Grate shall be tested for accuracy of fit and shall be marked in sets for delivery.

Use Type 46C Inlet Grate

Type 46A Inlet Frame



Section B-B

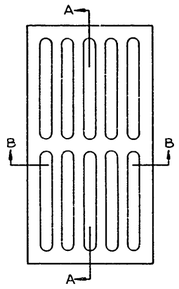


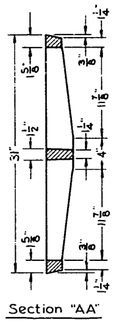
Section A-A

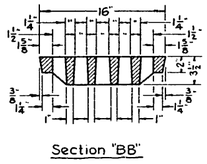
Cast Outlet Pipe of Inlet Included In Payment for Inlet.

Pipe Connection Payment Separate from Payment for Inlet. See Std. Specs. Sec. 69-3.04

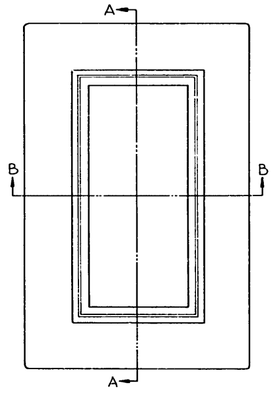
Type 46B Inlet

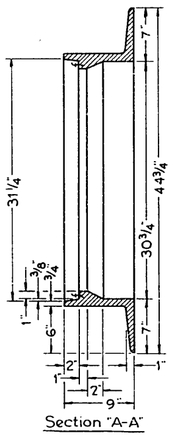


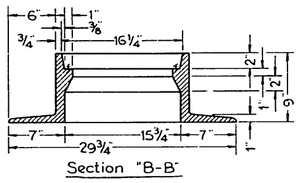




Type 46C Inlet Grate



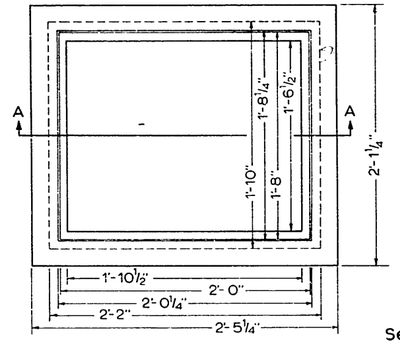




Type 46C Inlet Frame

Frame and Grate shall be tested for accuracy of fit and shall be marked in sets for delivery. See Std. Specs. Sec. 113.

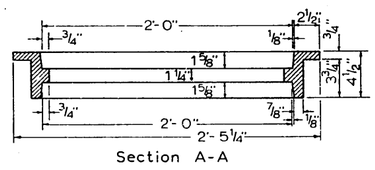
Type 46C
Inlet Frame and
Inlet Grate



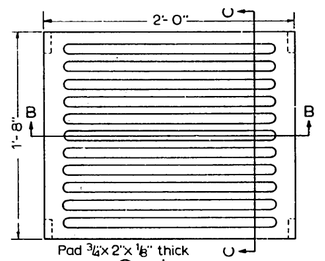
Frame

Payment

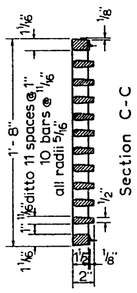
See Section 64 of these specifications.

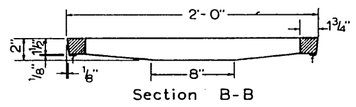


Section A-A



Grate



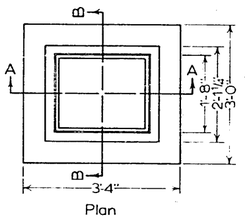


Section B-B

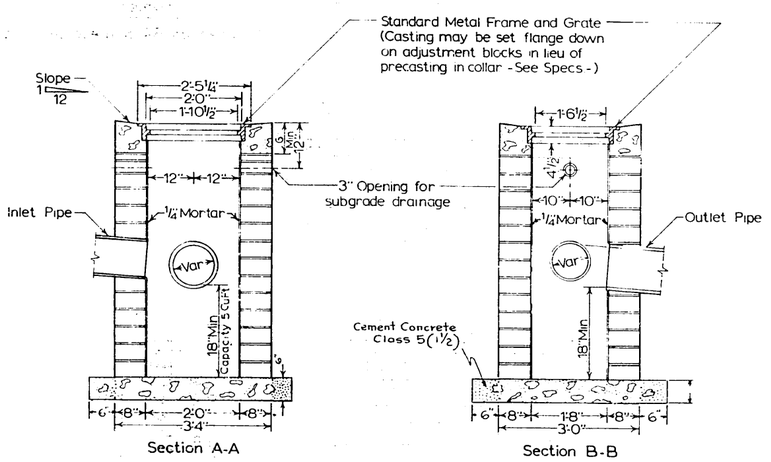
Note:
Sections through Grate. (Corner pads to be machined or ground for solid, non-rocking bearing in any of four possible positions in frame.)

Do Not Scale

Metal Frame & Grate
For Catch Basins & Inlets



Plan

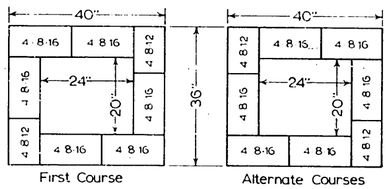


Section A-A

Section B-B

Payment

"Type I, 5 foot Catch Basin Inlet," per each.
"Additional depth 5 foot, Type I Catch Basin Inlet," per Vertical Foot.



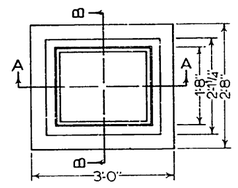
First Course Alternate Courses

Block Placement Details

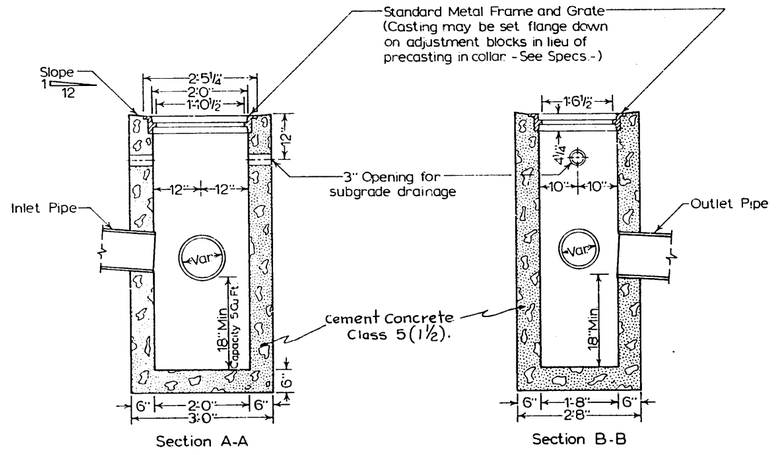
DO NOT SCALE

Type I-A Catch Basin Inlet
Masonry Construction

Standard Plan No. 50



Plan



Section A-A

Section B-B

Payment

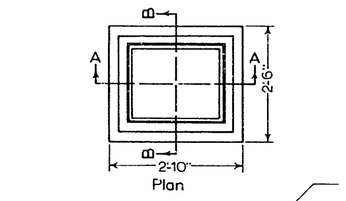
"Type I, 5 foot Catch Basin Inlet," per each.
"Additional depth 5 foot, Type I Catch Basin Inlet," per Vertical Foot.

DO NOT SCALE

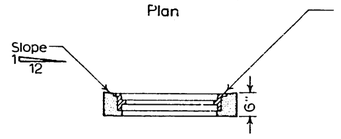
Type I-B Catch Basin Inlet
Cast in Place

A.P.W.A.—STANDARD PLANS—1963

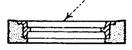
Standard Plan No. 51



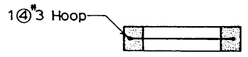
- Max. overall height of complete unit = 7'-6".
- "U" shaped openings to be cast in base section as required, for pipe sizes to 15", to provide 18" min. depth below invert of outlet pipe.
- Place one 12" "S" section immediately below top ring and lower subgrade if necessary to insure that openings intercept base course gravel.



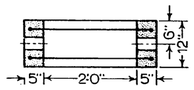
Metal Frame and Grade
(Casting may be set flange down on adjustment blocks in lieu of precasting in collar - See Specs.-)

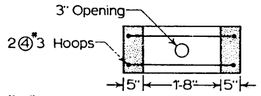


Top Unit

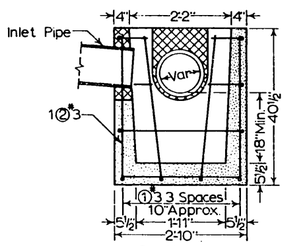


6" Unit "S"

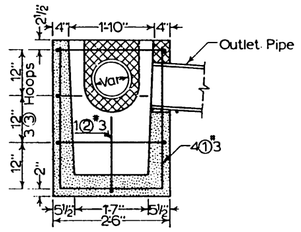




12" Unit "S"



Section A-A

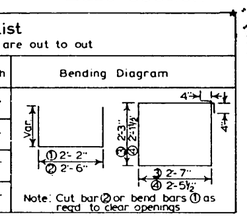


Section B-B

Base Section

Bar List
All dimensions are out to out

Mark	Location	No	Size	Length	Bending Diagram
1	Bottom Slab and Side Walls	4	3	36½"	
2	Bottom Slab and Side Walls	1	3	36½"	
3	Side Walls	3	3	10'-4"	
4	Unit "S"	2	3	9'-10"	



Note: Cut bar ② or bend bars ① as read. to clear openings

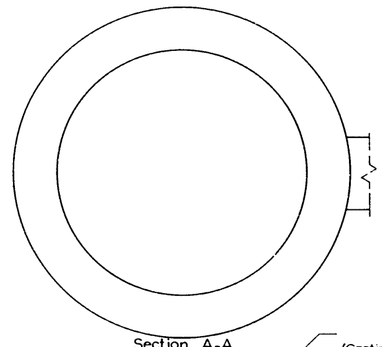
Payment

"Type I, 5 foot Catch Basin Inlet," per each.
"Additional depth 5 foot, Type I Catch Basin Inlet," per Vertical foot.

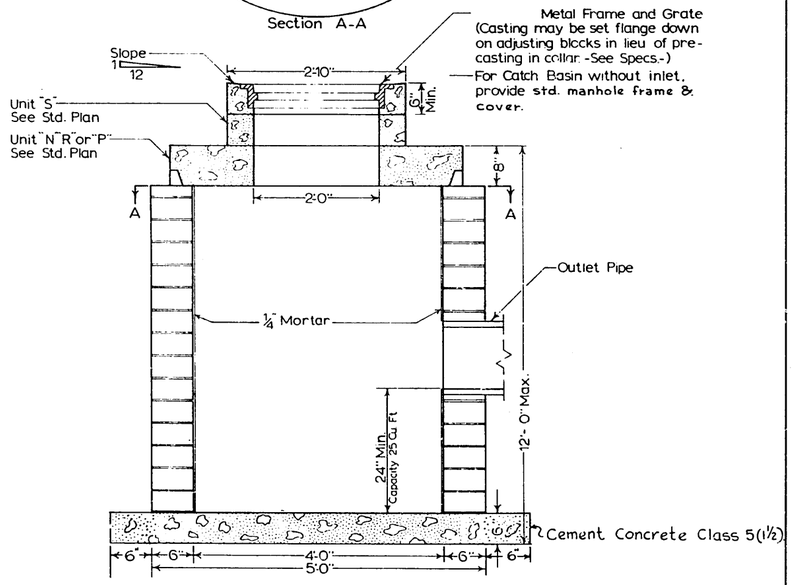
DO NOT SCALE

Type I-C Catch Basin Inlet
Precast

Standard Plan No. 52



Section A-A



Metal Frame and Grate
(Casting may be set flange down on adjusting blocks in lieu of precasting in collar - See Specs.-)

For Catch Basin without inlet, provide std. manhole frame & cover.

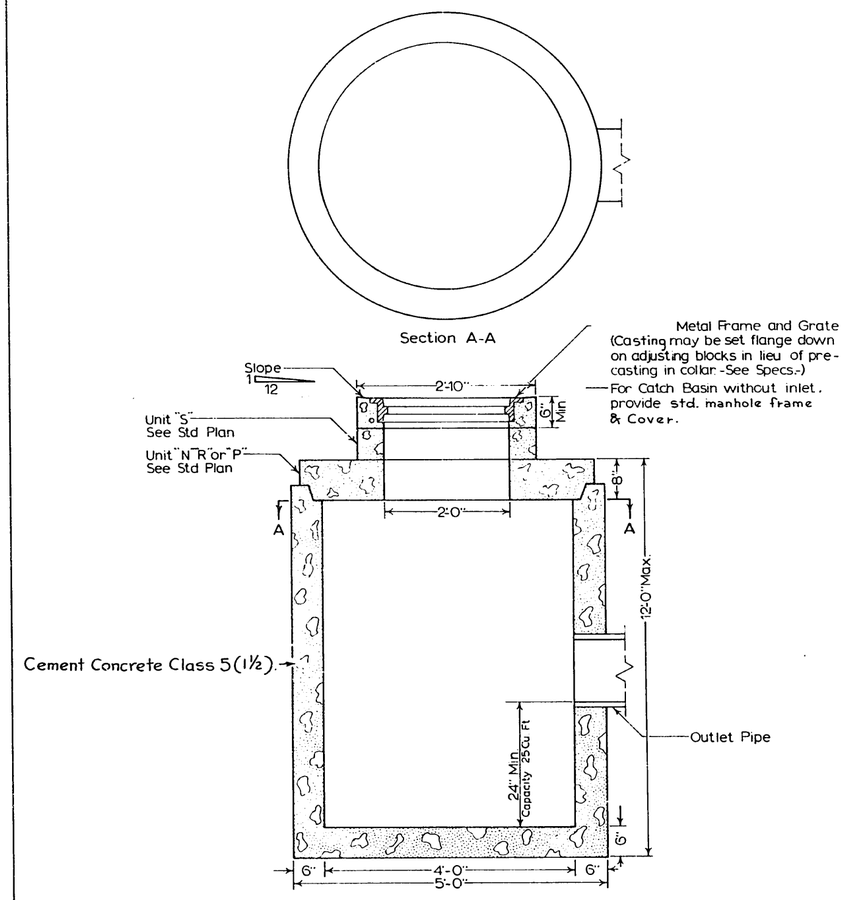
Payment

"Type II-A, 5' Catch Basin Inlet," per each.
"Additional depth 5 foot, Type II-A, Catch Basin Inlet," per Vert. Foot.

DO NOT SCALE

Type II-A Catch Basin Inlet
Masonry Construction
Or Catch Basin

Standard Plan No. 53

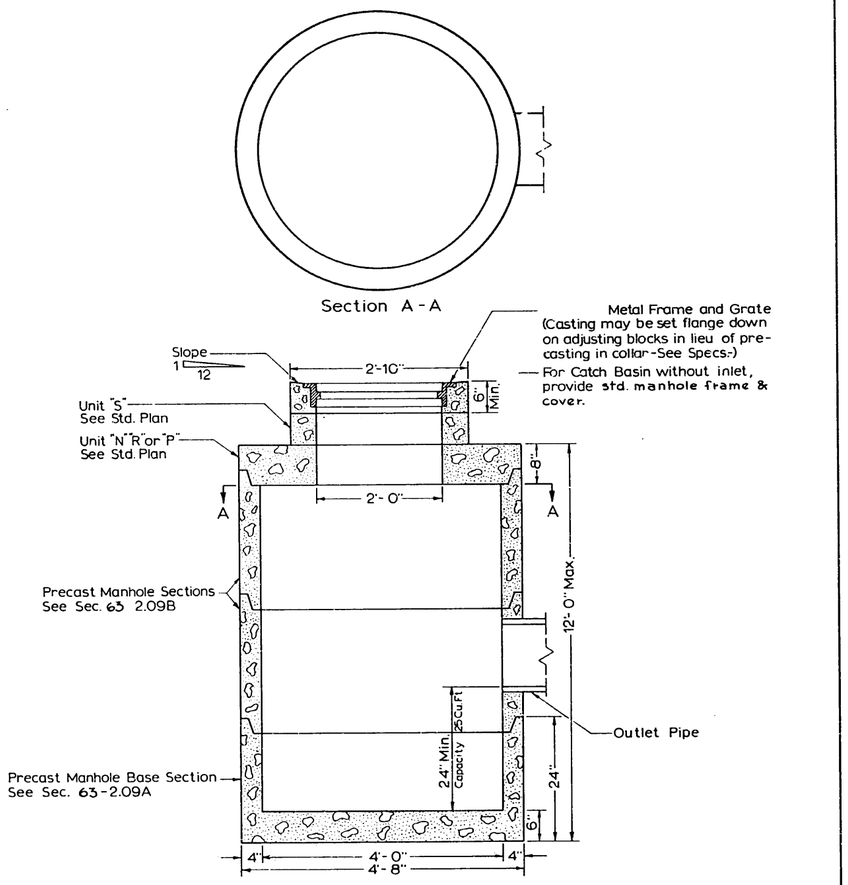


Payment

Type II-B, 5' Catch Basin Inlet", per each.
"Additional depth 5 foot, Type II-B, Catch Basin Inlet", per Vert. Foot.

DO NOT SCALE

Type II-B Catch Basin Inlet
Cast in Place
Or Catch Basin



Payment

"Type II-C, 5' Catch Basin Inlet", per each.
"Additional depth 5 foot, Type II-C, Catch Basin Inlet", per Vert. Foot.

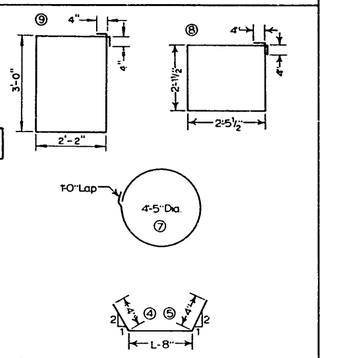
DO NOT SCALE

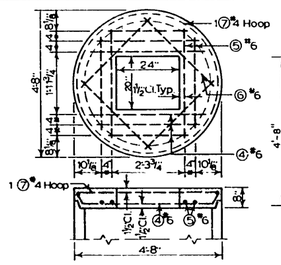
Type II-C Catch Basin Inlet
Precast
Or Catch Basin

Bar List
All dimensions are out to out

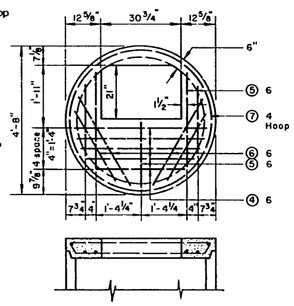
Mark	Location	No	Size	Length	Bending Diagram
4	Cover Slab Unit N Bottom-Long.	6	6	Var.	L=2ea@ 4'-5"; 4'-1" & 3'-6"
5	Cover Slab Unit N Bottom-Transv.	4	6	Var.	L=2ea@ 4'-2" & 3'-8"
6	Cover Slab Unit N Bottom-Diag.	4	6	3'-2"	Str.
7	Cover Slab Unit N Top	1	4	14'-11"	
4	Cover Slab Unit P Bottom-Long.	6	6	Var.	L=2@ 4'-9"; 1ea @ 4'-7"; 4'-3"; 3'-9"; & 3'-0"
5	Cover Slab Unit P Bottom-Transv.	5	6	Var.	L=2ea@ 4'-2"; & 3'-8"; 1@ 2'-9"
6	Cover Slab Unit P Bottom-Diag.	4	6	Var.	Str. 2ea@ 3'-9"; & 3'-2"
7	Cover Slab Unit P Top	1	4	14'-11"	
4	Cover Slab Unit R Bottom-Long.	5	6	Var.	L=1ea @ 4'-9"; 4'-8"; 4'-6"; 4'-1" & 3'-7"
5	Cover Slab Unit R Bottom-Transv.	5	6	Var.	L=2ea@ 4'-2"; 3'-8"; 1@ 2'-5"
6	Cover Slab Unit R Bottom-Diag.	4	6	Var.	Str. 2ea@ 4'-4"; & 2'-5"
7	Cover Slab Unit R Top	1	4	14'-11"	
8	Unit S	2	3	9'-10"	
4	Cover Slab Unit T Bottom-Long	5	6	Var.	L=2@4'-9" & 1ea. @ 4'-7", 4'-3", 3'-9"
9	Unit U	2	3	11'-0"	
5	Cover Slab Unit T Bottom-Transv.	5	6	Var.	L=2 ea. @ 3'-8", 2'-10" & 1 @ 2'-9"

All steel to be deformed bars conforming to ASTM-A15 and shall have a minimum cover of 2".

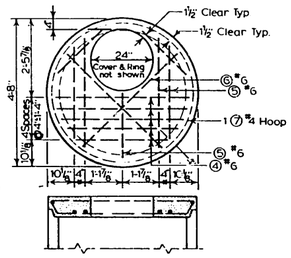




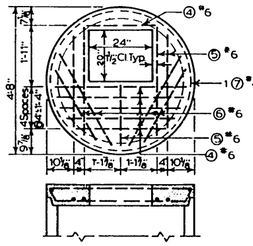
Unit N



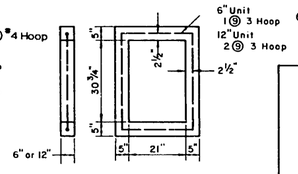
Unit T



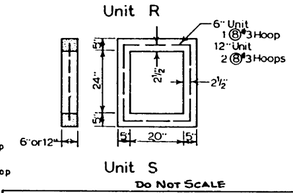
Unit R



Unit P



Unit U

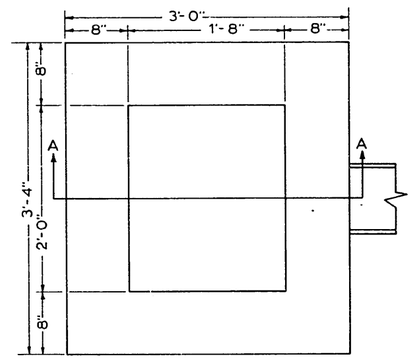


Unit S

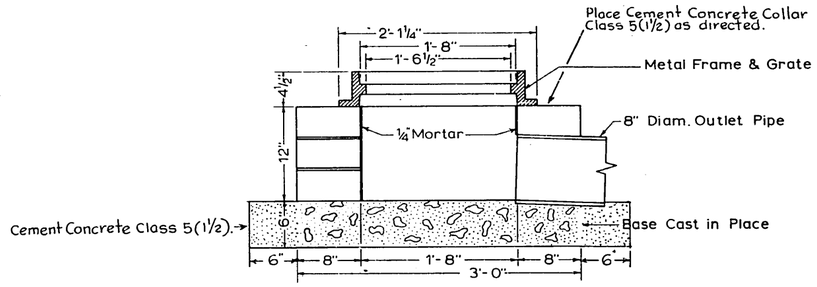
DO NOT SCALE

Catch Basin Inlet-Precast Cover and Extension Units

Standard Plan No. 56



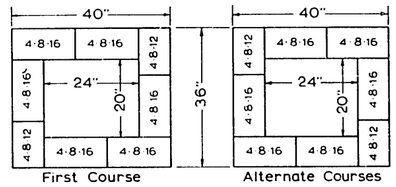
Plan



Section A-A

Payment

"Type IV Curb Inlet," per each.

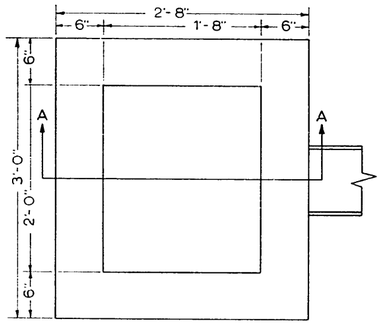


Block Placement Details

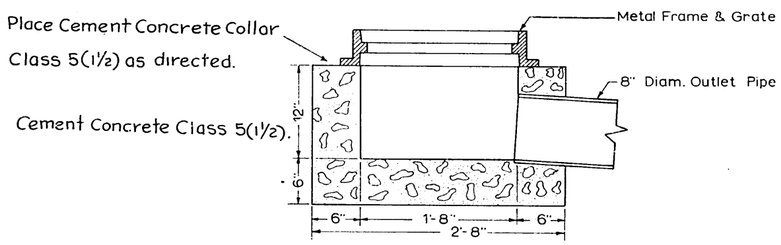
DO NOT SCALE

Type IV-A Curb Inlet Masonry Construction

Standard Plan No. 57



Plan



Section A-A

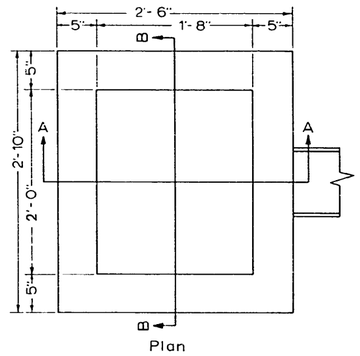
Payment
"Type IV Curb Inlet," per each.

Do Not Scale

Type IV-B Curb Inlet
Cast in Place

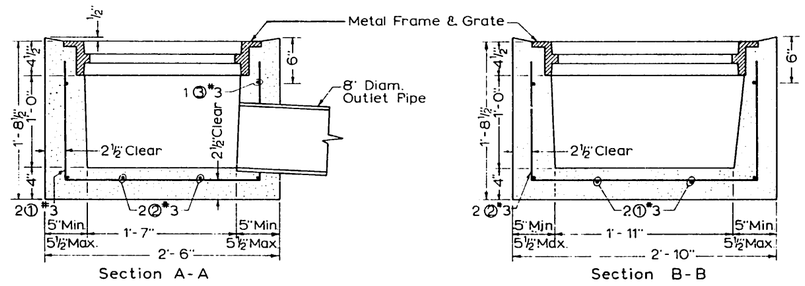
A.P.W.A.—STANDARD PLANS—1963

Standard Plan No. 58



Plan

Payment
"Type IV Curb Inlet," per each.



Section A-A Section B-B

Bar List
(For Precast Unit)
All dimensions are out to out

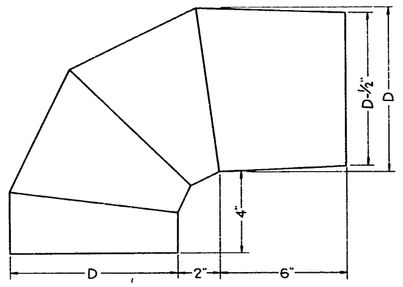
Mark	Location	No	Size	Length	Bending Diagram
1	Bottom Slab and Side Walls	2	3	4'-8"	1'-3½" ① 2'-1" ② 2'-5" 2'-0" 4" 4" 2'-4"
2	Bottom Slab and Side Walls	2	3	5'-0"	
3	Side Walls	2	3	9'-4"	

Do Not Scale

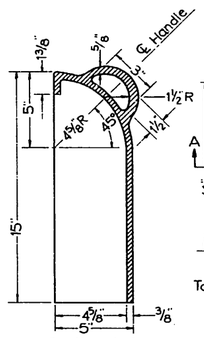
Type IV-C Curb Inlet
Precast

Standard Plan No. 59

NOTE:
Trap to be made of 22 Ga. Galvanized sheet metal.
All joints to be seamed and soldered.
All longitudinal joints to be riveted.
Dimension "D" is nominal diameter of outlet pipe.

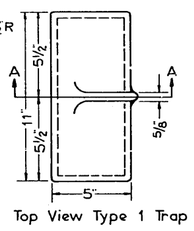


Type 60A Trap

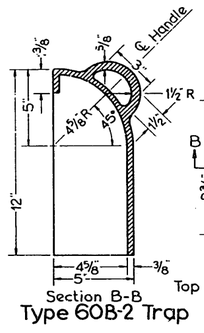


Section A-A

Type 60B-1 Trap

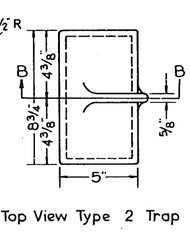


Top View Type 1 Trap

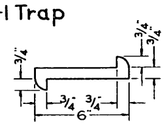


Section B-B

Type 60B-2 Trap

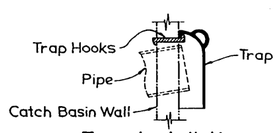


Top View Type 2 Trap



Trap Hook

Trap Hooks may be round or square in cross-section.



Trap Installation

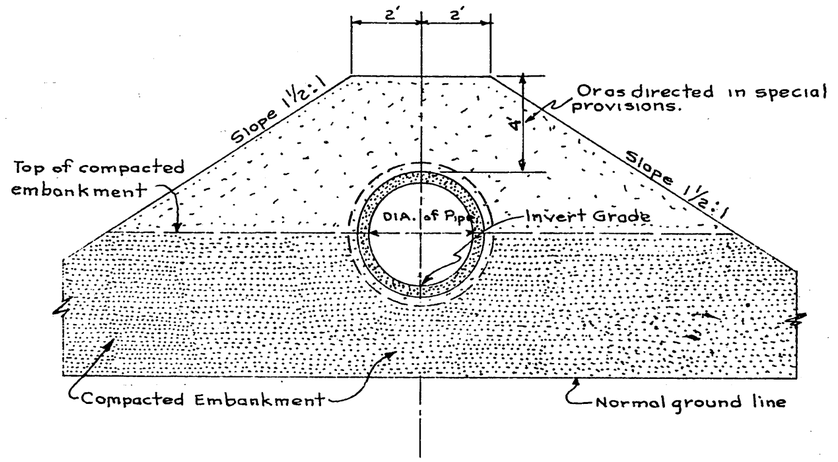
Type 60B-1 Trap to be used with 8" I.D. Outlet Pipe.

Type 60B-2 Trap to be used with 4" or 6" I.D. Outlet Pipe.

Trap may be Cast Iron ASTM Designation A48 Class 25 or Cast Steel ASTM Designation A27 Grade 70-36.

Type 60A and Type 60B Outlet Trap

Standard Plan No. 60



Note:

Where normal ground line is below invert of pipe, an embankment, compacted as outlined in section 67-2.01 of these specifications, shall be constructed to the spring line of the pipe.

Pipe shall then be placed according to specifications and covered to the lines shown on this drawing, care being taken not to disturb pipe.

Material for embankment shall be as called for in Section 67-2.01 of these specifications.

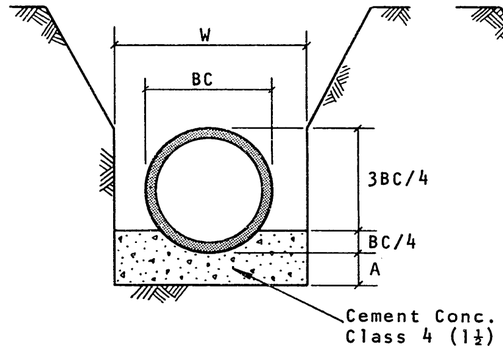
Payment

"Pipe Covering and Embankment," per cubic yard.

Do Not Scale

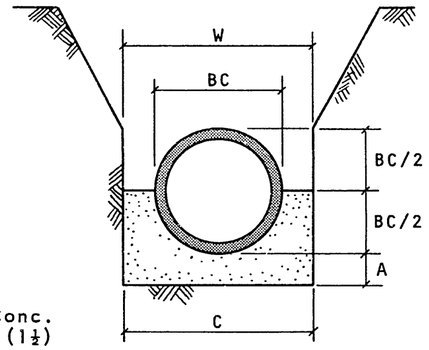
Pipe Covering & Embankment

Standard Plan No. 61



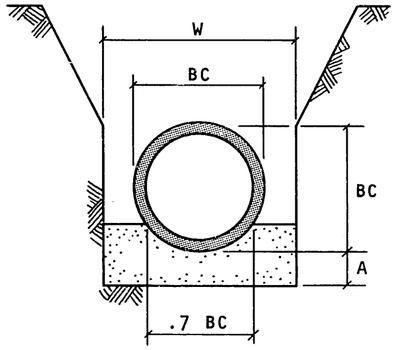
A=¼ Inside Dia. With 4" Min. & 12" Max.
C Min.= Inside Dia.+ 2ft.

C L A S S A



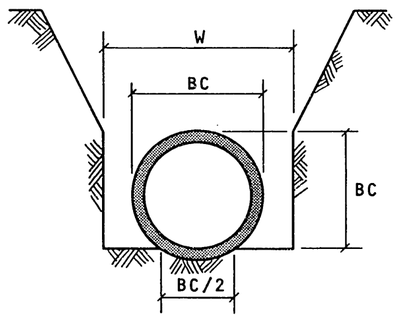
A=4" For 27" Pipe & Smaller; 6" For All Pipe 30" Dia. & Larger.

C L A S S B



A=4" For 27" Pipe & Smaller; 6" For All Pipe 30" Dia. & Larger

C L A S S C



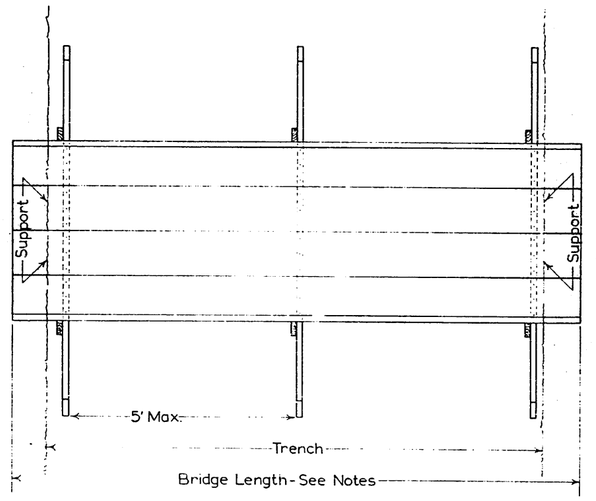
C L A S S D

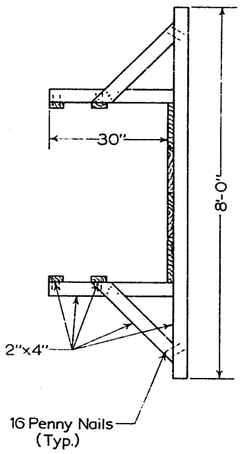
NOTES:

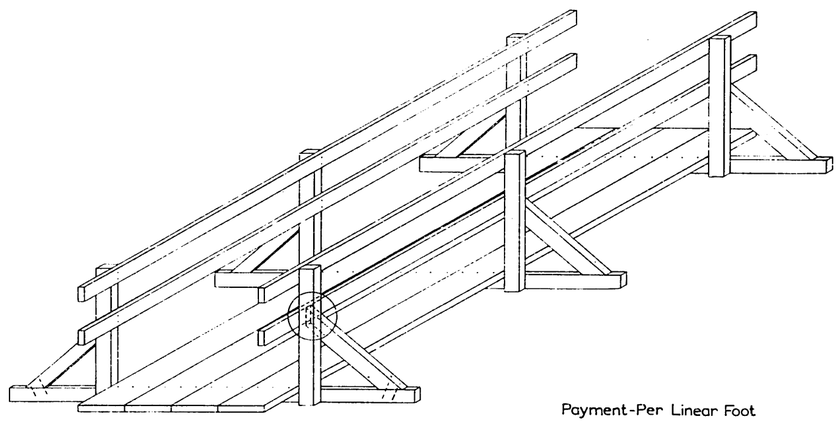
Excavate For Bells On All Classes.
W=d+24" For d Equal or Less Than 24"
W=d+36" For d Greater Than 24"
See Section 61-3.03 For Additional Details

P I P E B E D D I N G

Standard Plan No. 62







Payment-Per Linear Foot

Lumber - Construction Grade
Posts and Rails S4S
Planks - Rough

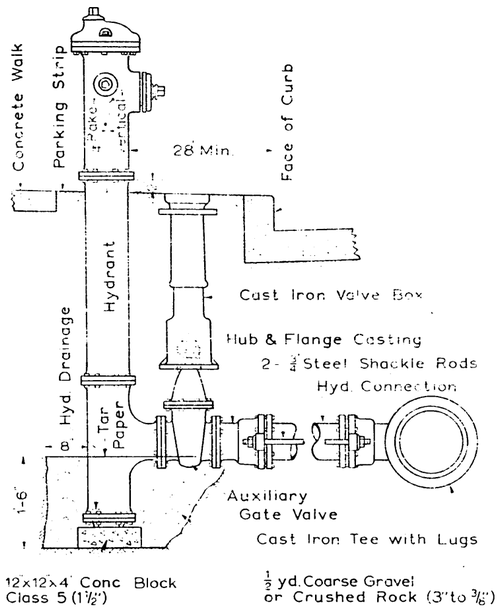
Bridge Length - Plank Size
8'-12'_____2"x 12"
13'-16'_____3"x 12"
17'-20'_____4"x 12"

Do Not Scale

Temporary Pedestrian Crossing

A.P.W.A.—STANDARD PLANS—1963

Standard Plan No. 63

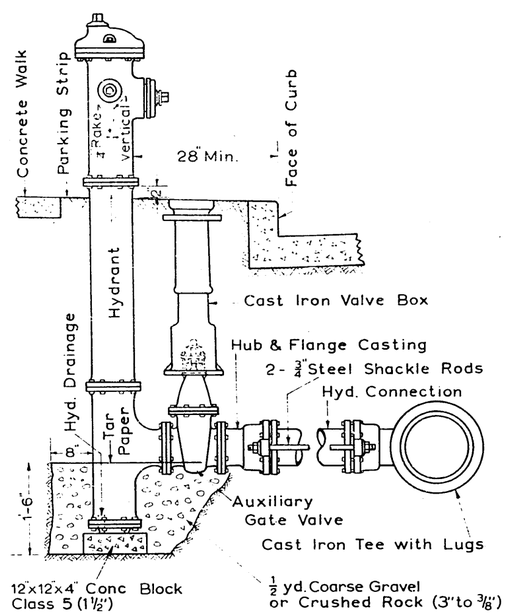


PAYMENT

"Hydrant, 6"(4") Connection," per each (See Specifications)
"6"(4") Hydrant Connection as "Watermains" per linear foot
"6"(4") Gate Valve," per each

DO NOT SCALE

Hydrant Setting, Type A

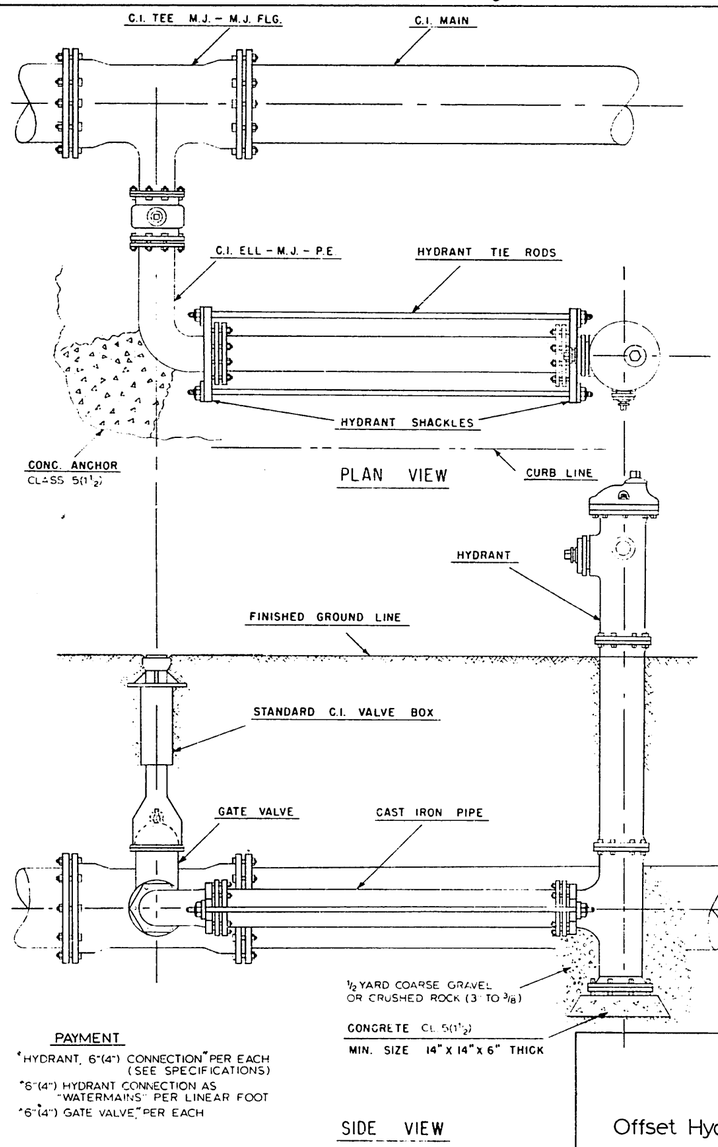


PAYMENT

"Hydrant, 6"(4") Connection," per each (See Specifications)
"6"(4") Hydrant Connection as "Watermains" per linear foot
"6"(4") Gate Valve," per each

DO NOT SCALE

Hydrant Setting, Type A

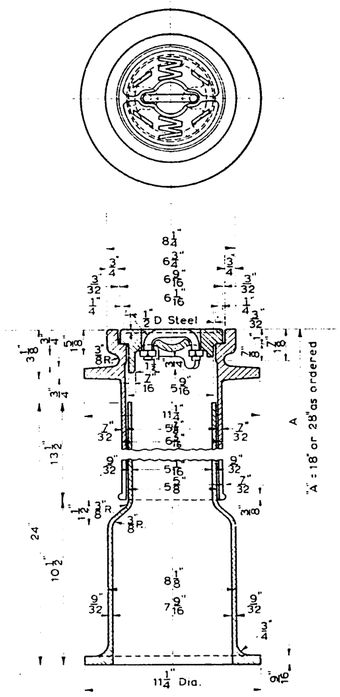


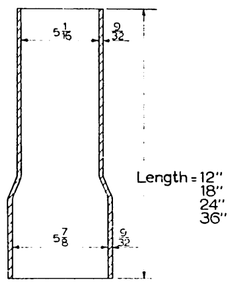
PAYMENT

"HYDRANT, 6"(4") CONNECTION" PER EACH (SEE SPECIFICATIONS)
"6"(4") HYDRANT CONNECTION AS "WATERMAINS" PER LINEAR FOOT
"6"(4") GATE VALVE" PER EACH

Do Not Scale

Offset Hydrant Setting





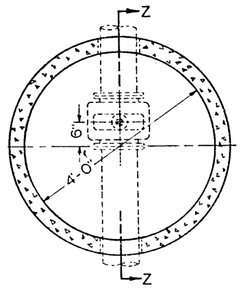
Extension Pieces

PAYMENT

"Cast Iron Valve Box" per each
"Valve Box Extension (length)" per each

Do Not Scale

Cast Iron Valve Box



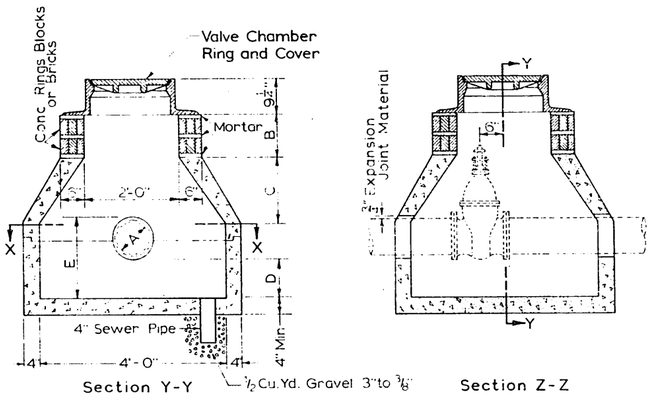
Section X-X

GENERAL NOTES

Valve Chamber Ring & Cover Standard Plan No. 43
Concrete - Compressive strength 3,000 psi at 28 days
Gravel Drain ½ Cu. Yd. Gravel (3" to ⅜")

PAYMENT

"Valve Chamber, Standard," per each.

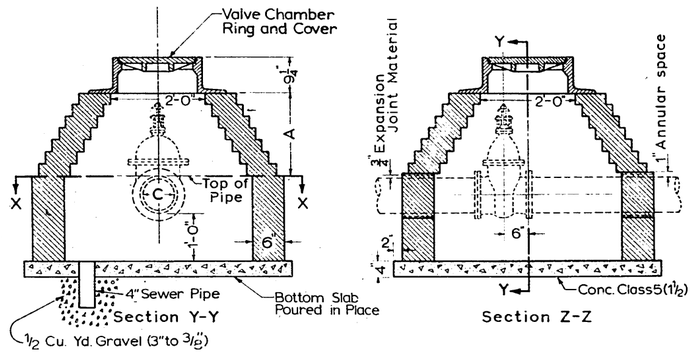


When "A"-Pipe Dia. is 4", 6", or 8"
"B"= 3" Min.
"C"= 1'-4" Max.
"D"= 10" Min.
"E"= 1'-9" Max.

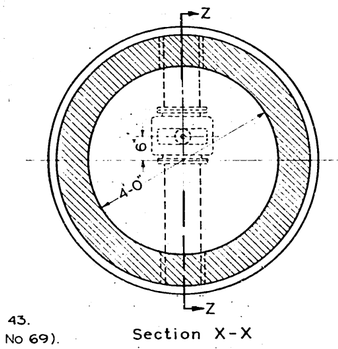
When "A"-Pipe Dia. is 12"
"B"= 11" Min.
"C"= 2'-1" Max.
"D"= 12" Min.
"E"= 2'-3" Max.

Do Not Scale

Valve Chamber, Standard
Precast



When C= 8" A= 21", not less
" C=12" A= 29," " "



Section X-X

GENERAL NOTES

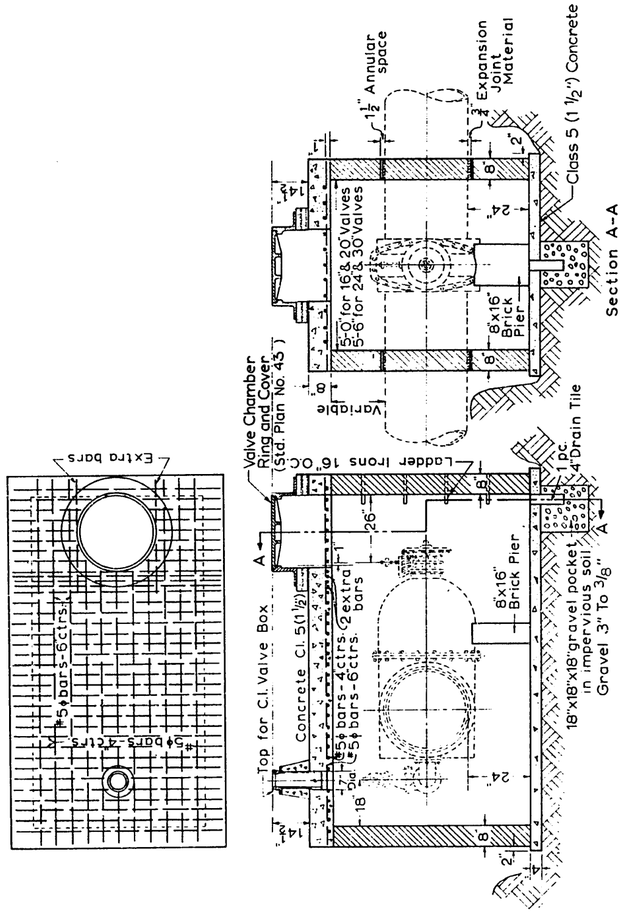
Bottom Slab Class 5 (1½") Concrete
Valve Chamber Ring & Cover Standard Plan No. 43.
Construction Alternates Precast Concrete (Plan No 69).
Cast in Place Concrete, Class 5 (1½)
Solid Concrete Blocks
Gravel Drain ½ Cu. Yd. Gravel (3" to ⅜")

PAYMENT

"Valve Chamber, Standard," per each

Do Not Scale

Valve Chamber, Standard
Masonry Construction



Do Not Scale

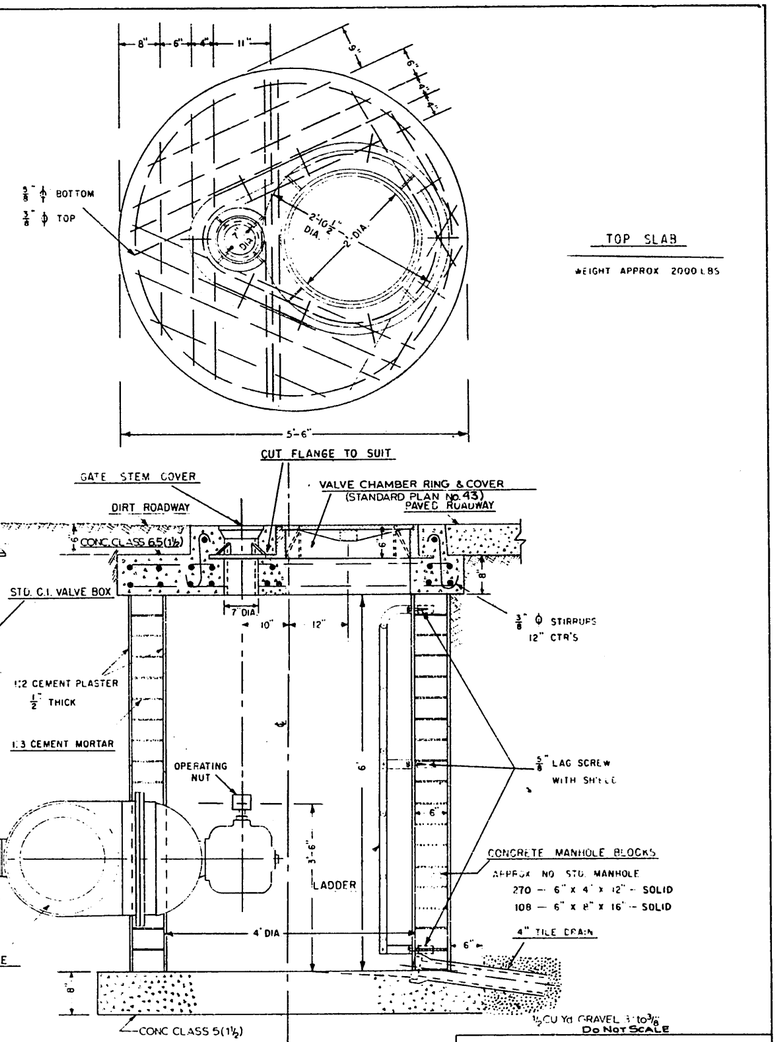
PAYMENT

"Valve Chamber, Large Type A", per each

VALVE CHAMBER, LARGE, TYPE A

A.P.W.A.—STANDARD PLANS—1963

Standard Plan No. 70



Do Not Scale

NOTE: DIA. OF VAULT MAY VARY WITH SIZE OF VALVE

NOTE: STEPS MAY BE USED UNLESS THE LADDER IS SPECIFIED

NOTE: PRE-CAST VAULT MAY BE USED IN PLACE OF BLOCK

PAYMENT

"VALVE CHAMBER, LARGE TYPE B", PER EACH

Valve Chamber Large Type B

A.P.W.A.—STANDARD PLANS—1963

Standard Plan No. 71

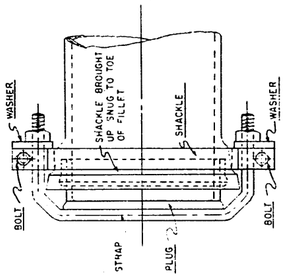
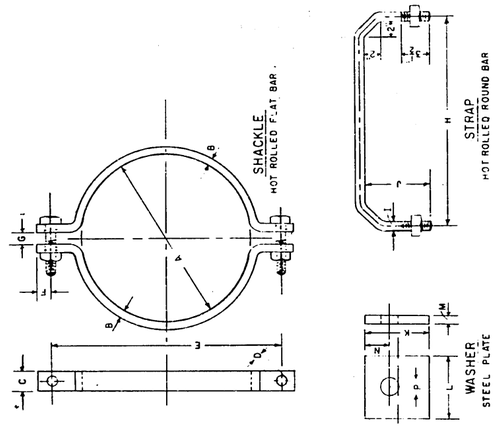


TABLE OF DIMENSIONS

SIZE OF PIPE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	BOLT
4"	7½"	7½"	1½"	1 11/16"	12¾"	1"	1"	10"	7"	2¼"	3"	2½"	⅜"	1"	⅝"	¾" X 3"
6"	9½"	9½"	1½"	1 11/16"	6"	1"	1¼"	12"	8½"	2¾"	3"	3"	⅝"	1⅛"	⅝"	¾" X 4"
8"	11¼"	11¼"	2"	1 11/16"	19"	1"	1¼"	14½"	8½"	2¾"	3"	3"	⅝"	1⅛"	⅝"	¾" X 4"
10"	14"	14"	2"	2 1/16"	22"	1"	1½"	17"	9"	3½"	3½"	3½"	¾"	1¼"	⅞"	1" X 5"
12"	16¾"	16¾"	2½"	2 1/16"	24"	1½"	1½"	19½"	9½"	3½"	3½"	3½"	¾"	1¼"	⅞"	1" X 5"
14"	18½"	18½"	2½"	2 1/16"	26"	1½"	2¼"	21½"	10"	4¼"	4"	4"	¾"	1½"	⅞"	1" X 6"
16"	21"	21"	2½"	2 1/16"	28"	1½"	2¼"	24"	11"	4¼"	4"	4"	¾"	1½"	⅞"	1" X 6"
18"	23¼"	23¼"	2½"	2 1/16"	30"	1½"	2"	26½"	12"	4½"	4½"	5"	⅞"	1⅝"	1"	1" X 7"
20"	25½"	25½"	2½"	2 1/16"	32"	1½"	2"	28½"	12"	4½"	4½"	5"	⅞"	1⅝"	1"	1¼" X 7"



PAYMENT

SEE SPECIFICATIONS

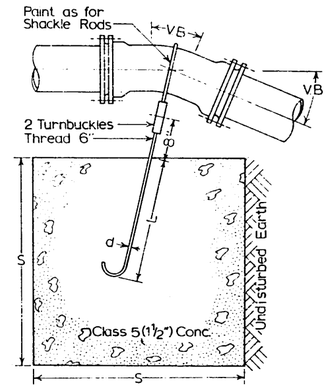
DO NOT SCALE

Plug and Shackle for Cast Iron Watermain

Type "A" Blocking
for 11¼°-22½°-30° Vertical Bends

Pipe Size Nom. Diameter-Inches	Test Pressure psi	V.B. Vertical Bend Degrees	No. of cu ft. of Conc. Blocking	S Side of Cube feet	d Diameter of Shackle Rods (2) inches	L Depth of Rods in Concrete feet
4"	300	11¼	8	2	5/8	1.5
		22½	11	2.2		2.0
		30	17	2.6		
6"	300	11¼	11	2.2	5/8	2.0
		22½	25	2.9		
		30	41	3.5		
8"	300	11¼	16	2.5	5/8	2.0
		22½	47	3.6		
		30	70	4.1	3/4	2.5
12"	250	11¼	32	3.2	5/8	2.0
		22½	88	4.5	7/8	3.0
		30	132	5.1		
16"	225	11¼	70	4.1	7/8	3.0
		22½	184	5.7	1 1/8	4.0
		30	275	6.5	1¼	
20"	200	11¼	91	4.5	7/8	3.0
		22½	225	6.1	1½	4.0
		30	330	6.9	1⅜	4.5
24"	200	11¼	128	5.0	1"	3.5
		22½	320	6.8	1⅜	4.5
		30	480	7.9	1⅞	5.5

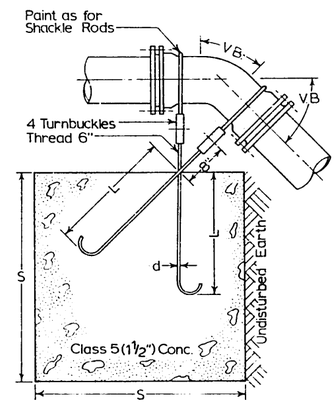
Type "A" Blocking
for 11¼°-22½°-30° Vertical Bends



Type "B" Blocking
for 45° Vertical Bends

Pipe Size Nom. Diameter-Inches	Test Pressure psi	V.B. Vertical Bend Degrees	No. of cu ft. of Conc. Blocking	S Side of Cube feet	d Diameter of Shackle Rods (4) inches	L Depth of Rods in Concrete feet
4"	300	45	30	3.1	5/8	2.0
6"			68	4.1		
8"			123	5.0		
12"	250		232	6.1	3/4	2.5
16"	225		478	7.8	1 1/8	4.0
20"	200		560	8.2	1¼	
24"			820	9.4	1⅜	4.5

Type "B" Blocking
for 45° Vertical Bends

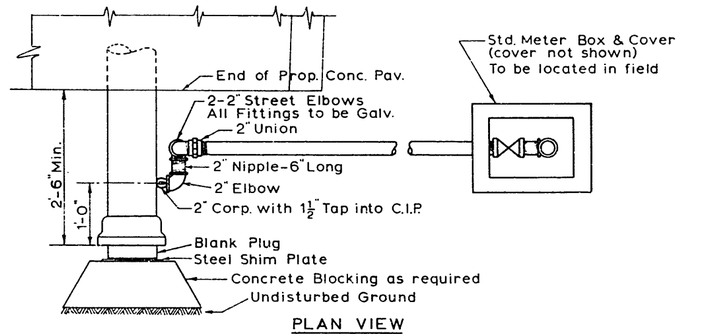


PAYMENT

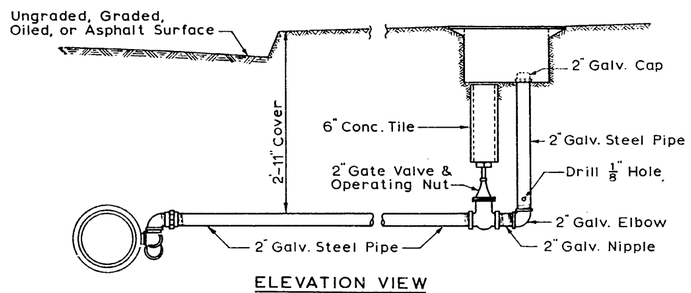
"Concrete Blocking, in place" per cu. yd.
"Shackle Rods" per pound

DO NOT SCALE

Blocking For Convex Vertical Bends

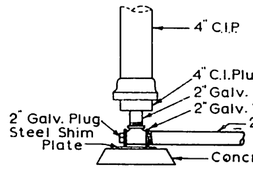


PLAN VIEW



ELEVATION VIEW

2" BLOW-OFF DETAIL FOR C.I. PIPE LARGER THAN 4 INCHES



PLAN VIEW

2" BLOW-OFF DETAIL FOR 4" C.I. PIPE

GENERAL NOTES

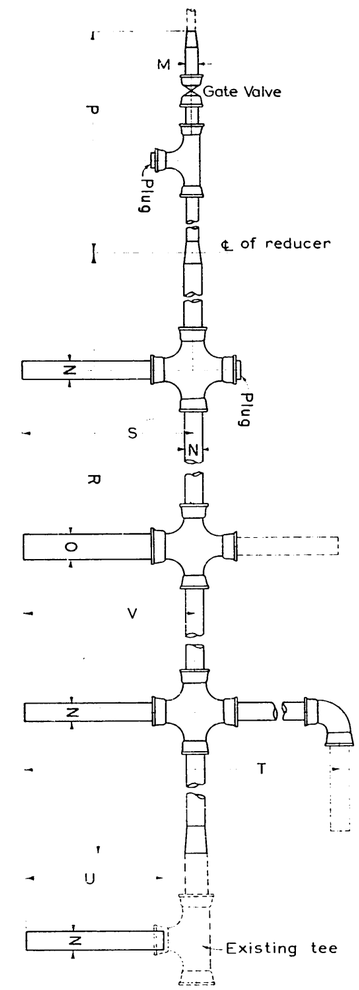
All Blocking Class 5 ($1\frac{1}{2}$) Concrete

PAYMENT

"2" Blow-off Assembly," in Place, per each

Do Not Scale

2-inch Blow-off Assembly



Payment will be made for
P- linear feet of pipe of diameter "M"
R,-S,-T, & U- linear feet of pipe of diameter "N"
V- linear feet of pipe of diameter "O"
See Specifications for Details and for Alternate Method.

Do Not Scale

Watermain Payment Diagram

INDEX TO SPECIFICATIONS

NOTE:

Obviously, this index cannot include everything in the subsections of the Standard Specifications for Public Works Construction. If the reader is unable to find the particular item or subject he seeks in the index, he should refer to the related section and title in the Table of Contents at the beginning of the book.

Pages 1 and 2 of the Table of Contents contain a complete list of all sections by titles and in the order of consecutive section numbers. Pages 3 through 16 of the Table of Contents contain complete breakdowns of all sections into subsections of related subject matter.

The heavier and bolder type interspersed throughout the index denotes the complete titles of the various sections as they occur in their alphabetic order. An incomplete listing of subjects in each section follows in most cases by indentation immediately below the section title. In the case of some sections, the reader is merely referred to a specific page in the Table of Contents for the breakdown.

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(Continued on Next Page)

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