Seattle Department of Transportation

SDOT Policy Memorandum

To: Sam Zimbabwe, SDOT Director

From: Adiam Emery, Transportation Operations Division Director; Dongho Chang, City Traffic Engineer; Dusty Rasmussen, SDOT Signal Operations Manager

Date: January 27, 2021

Subject: SDOT Policy for Traffic Signal Cycle Time, and Pedestrian Signal Timing and Actuation

STATEMENT OF INTENT

The purpose of this document is to establish a unified policy on traffic signal timing to support mobility and access while minimizing delay to pedestrians. It includes policy guidance on:

- maximum traffic signal cycle time
- pedestrian crossing timing, and
- pedestrian actuation (push button pedestrian crossings)

This policy reflects current best practices and Americans with Disabilities Act (ADA) requirements. This policy sets forth conditions and requirements for pedestrian access at signalized intersections and speaks specifically to signal timing and pedestrian actuation.

BACKGROUND

SDOT's mission is to deliver a transportation system that provides safe and affordable access to opportunities and places. SDOT is committed to Vision Zero and our Complete Streets Ordinance. We do this in service of our vision of a Seattle that is a thriving, equitable community powered by dependable transportation.

PURPOSE

To advance our mission and vision, SDOT has developed updated policies for pedestrian access at signalized intersections that encompass overall traffic signal cycle time, pedestrian signal timing, and pedestrian actuation. Working with a broad range of stakeholders through the Policy and Operations Advisory Group, consisting of modal board members and advocacy organizations, SDOT has defined thresholds in alignment with Streets Illustrated to provide guidance for practitioners and city staff related to the following variables:

- Overall traffic signal cycle time addresses the overall cycle length.
- Pedestrian crossing time addresses how much time a pedestrian has available to cross a signalized intersection.

- Pedestrian actuation refers to whether the pedestrian crossing movement is automatically part of the signal timing cycle (pedestrian recall) or whether a person must push a button to request a pedestrian crossing movement (pedestrian actuation)

For many decades, national transportation engineering practices emphasized personal vehicle travel needs over those of other users, including people walking, biking, riding transit, and driving freight vehicles. Vehicle through-put has traditionally been valued at the expense of vulnerable users, such as people walking and riding bikes. We now understand that cities are made great not by their ability to prioritize and accommodate personal vehicle needs, but rather by their ability to prioritize streets for people in a manner that supports safety, equity, connectivity, public life, community health, and environmental resiliency. We are setting out to better align our transportation policies with these values.

SDOT's policy establishes maximum traffic signal cycle lengths. The maximum signal cycle time policy is focused on supporting multimodal access, aligned with the goal of prioritizing the movement of people and goods. This policy also incorporates increased pedestrian crossing signal timing which increases the time allocated to pedestrian a street and improves access to a larger portion of the population. This policy also includes specific guidance on the use of pedestrian signal actuation at many locations, with decisions regarding actuation based on pedestrian-focused operations that maximize pedestrian safety.

Within the regulatory context, and to better align with our City and Department mission and vision, we have developed new policies to give guidance and establish requirements for practitioners and the public alike. The focus of this policy is to state our current practice and our process for updating signal timing and actuation.

The following are the key changes to our current practices proposed in this policy:

- Set maximum cycle lengths by corridor type and Comprehensive Plan designation (e.g. Urban Village, Manufacturing/Industrial Center)
- Reduce walk speed calculation base on Manual on Uniform Traffic Control Devices (MUTCD) guidance from 3.5 feet per second to 3 feet per second
- Establish additional criteria regarding where and when to implement pedestrian recall

IMPLEMENTATION OF THIS POLICY

This policy proposes several changes to signal timing and pedestrian actuation. SDOT will work within constraints to implement this policy citywide. SDOT will be evaluating and implementing these policies when:

- New signalized intersections are installed
- Existing signalized intersections are modified
- Existing corridors are optimized as part of our ongoing optimization program
- Community members request traffic signal changes

1 TRAFFIC SIGNAL CYCLE TIME

The traffic signal cycle time is the time required to complete one entire sequence of all movements at an intersection, equal to the maximum amount of time a pedestrian will have to wait to get a walk signal.

It is the City's intent to balance all competing modal needs to ensure equitable and safe operations at traffic signals while being in alignment with the City's commitment to move people and goods efficiently. Traffic signal cycle lengths vary based on several factors including:

- Complexity of the intersection geometry, such as at 5-legged intersections or offset intersections
- Length of the pedestrian crosswalk (and associated crossing time required)
- Traffic volumes (all modes)
- Land use surrounding the intersection
- Existence of exclusive transit phases
- Existence of exclusive pedestrian and bike phases; and
- Adjacent intersection cycle lengths to operate signals in coordination

1.1 SDOT Cycle Timing Policy

The City provides the shortest cycle length possible, based on these factors. The following provides target and maximum cycle lengths based on the street type designation. Cycle lengths will often be shorter than these maximums. These cycle lengths will not be exceeded unless required based on the factors noted above. Target and maximum cycle lengths by street type are shown in the table below:

Street Type Designation	Cycle Length (seconds)	
	Target	Maximum*
• Downtown • Downtown Neighborhood	50-90	90
• Urban Village Neighborhood • Neighborhood Corridor	60-100	120
• Urban Village Main • Urban Center Connector	60-120	150
• Industrial Access	80-160	180

**For special events, construction detours, and incidents, we may increase cycle lengths beyond these thresholds.*

When applying this policy, SDOT staff should seek to implement the lowest possible cycle length necessary to safely achieve all movements and to minimize corridor travel time delay for transit and freight. Cycle lengths below the target are also acceptable if these conditions can be met. The street type designations are defined by the City and reviewed and updated periodically. This policy applies to the most current designation which can be found in Streets Illustrated.

1.2 Impact of Cycle Time Policy

This policy documents SDOT's updated practice for signal timing and may reduce cycle lengths at many locations throughout the City, increasing access and mobility. Target cycle lengths have been set based on Street Type Designations which will allow us to implement the policy equitably throughout the city. Implementing this policy should reduce wait times and provide more frequent opportunities for pedestrians to cross the street. Overall, this policy will provide better access and encourage safety for people crossing the street. Limiting the cycle length comes with some trade-off in that could mean reduced coordinated time along transit and freight corridors. This could result in an increase in delay and travel time for those modes but will also provide increased access and safety for people crossing the street.

2 PEDESTRIAN PHASE TIMING

Pedestrian crossings timing is based on a standard practice that follows regulatory law which identifies two specific components or phases. The pedestrian phase is made up of two components, the walk time/or interval and the pedestrian clearance time/interval (flashing don't walk, yellow signal, and all-way red signal).

- The walk interval is the time period a person can step off the curb and start to cross the intersection.
- The pedestrian clearance interval is the time for a person to cross the intersection, from curb to curb.

The Manual on Uniform Traffic Control Devices (MUTCD, Section 4E.06) sets minimums for these values and allows for adjustments that are discussed below.

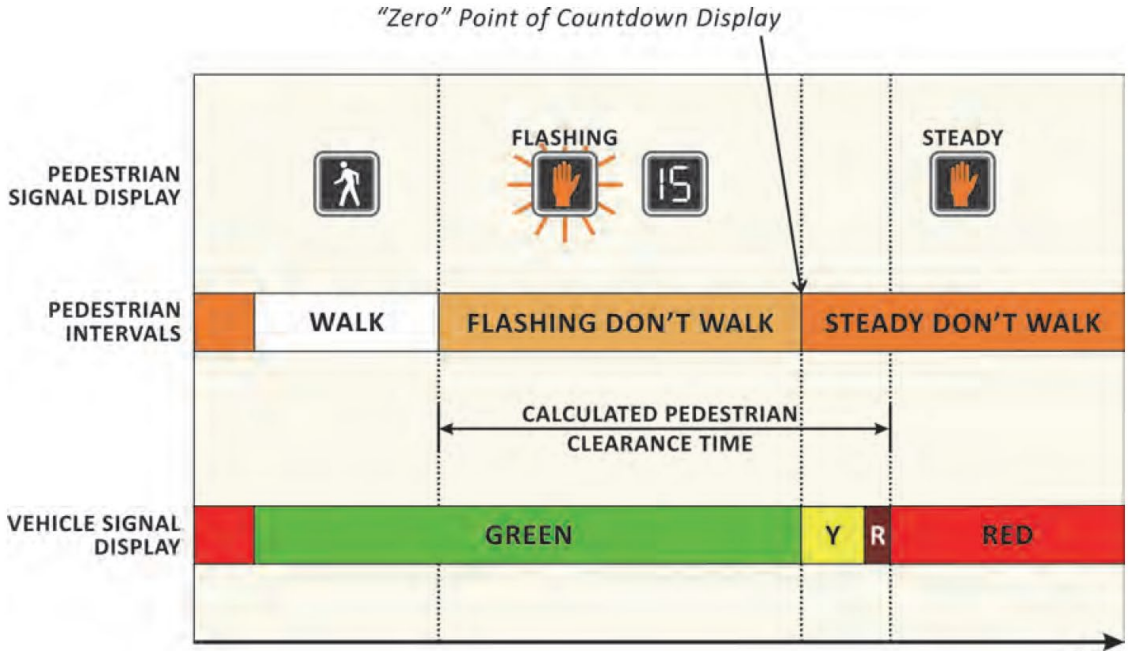

Figure 1 Pedestrian Interval (NCHRP Report 812-Signal Timing Manual 2nd Edition)

2.1 Pedestrian Walk Interval

The MUTCD standard pedestrian walk interval is 7 seconds to allow a person to step off the curb. The value can be adjusted to as low as 4 seconds, based on engineering judgment and conditions set forth below. SDOT's policy continues to follow this guidance.

Typical reasons to decrease the walk interval are to run a shorter cycle length at an intersection and/or to maintain signal timing coordination primarily to benefit transit along a corridor where low pedestrian volumes exist. A typical reason to increase the walk interval is to serve heavy volumes of pedestrians, for example near a school or downtown. The walk time could be increased to accommodate the MUTCD secondary calculation used to ensure enough time for a person at the push button or 6 feet from the curb ramp to cross to the other side of the intersection at a specific speed within the walk and pedestrian clearance intervals.

For a coordinated movement at an intersection the walk time will extend beyond the 7 seconds so the pedestrian phase will clear with the vehicle phase. In this case, the 7 seconds of walk becomes the minimum amount of walk. At most locations, the side street pedestrian phase will also clear with the adjacent vehicle phase.

2.2 Pedestrian Clearance Time (Interval)

The pedestrian clearance time is made up of the Flashing Don't Walk (FDW) and the yellow plus all-red time for the concurrent vehicle movement. The pedestrian clearance time is based on the crossing distance and the pedestrian walking speed. The calculations are shown below.

Crosswalk Length distance is measured from curb to curb at the parallel to the pedestrian crosswalk as shown in Figure 2.

Pedestrian Clearance Time (PCT) is the time it takes to cross the street from curb to curb.

$$PCT = \frac{Crosswalk\ Length}{Pedestrian\ Walk\ Speed}$$

Flashing Don't Walk (FDW) time is calculated as the pedestrian clearance interval, less the yellow and all-red clearance times.

$$FDW = \frac{Crosswalk\ Length}{Pedestrian\ Walk\ Speed} - Y - AR$$

where: $Y = Yellow\ Clearance\ Time$
$AR = All\ Way\ Red\ Clearance\ Time$

Countdown signal heads display the remaining Flashing Don't Walk time, followed by a steady Don't Walk sign.

2.3 SDOT Pedestrian Phase Timing Policy

Pedestrian Walking Speed: To ensure that most users have access to and across intersections the City has adopted a standard walking speed to meet the needs of our most vulnerable users. *The standard walking speed for pedestrians will be calculated at 3.0 feet/second.* This is the recommended walking speed in the MUTCD for areas with slower pedestrians, and SDOT will use the 3.0 feet/second standard to calculate the pedestrian clearance interval **at all intersections**. *An optional Pedestrian Walking Speed of 2.5 feet/second will be considered, based on community request*. The implementation of this standard will follow the implementation guidelines presented at the beginning of this document. This differs from past practice in that we have historically used 3.5 feet/second in alignment with the MUTCD.

Secondary Calculation: Once the walk and pedestrian clearance interval are calculated, the secondary calculation will be completed as shown in Figure 2 to verify and/or adjust total time given to cross the intersection. The secondary calculation ensures enough time for a pedestrian standing at the push button or 6 feet from the curb ramp to cross to the other side of the intersection within the walk and pedestrian clearance intervals. *The secondary calculation will use a speed of 2.5 feet/second, and, if a longer crossing time is needed, additional time shall be added to walk portion of the pedestrian interval.* This differs from past practice in that we have historically used 3.0 feet/second in alignment with the MUTCD.

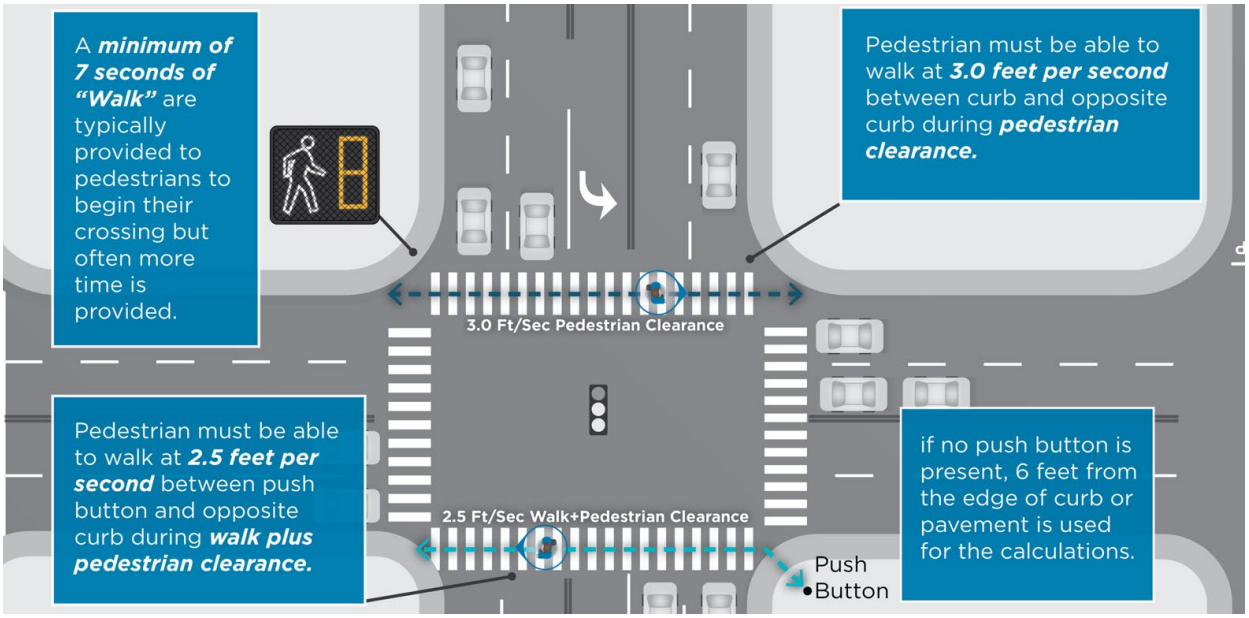

Figure 2Figure 2: Pedestrian Interval Requirements Based on Walking Speed

Flashing Don't Walk: A minimum of five (5) seconds of FDW, is required even if the calculation returns a lower value.

Yellow Clearance Time: SDOT calculates the change interval based on the Institute of Transportation Engineers (ITE) equation for eliminating a "dilemma zone," which is a condition that occurs when yellow and red times are too short for a driver to either stop or clear an

intersection before the beginning of a conflicting signal phase. Times are shown in the table below for different speeds.

SDOT Yellow Clearance Time

Speed Limit (mph)	20	25	30	35	40	45+
Yellow Time (s)	3	3	3.5	4	4	4.5

All-Way Red Clearance Time: All-red clearance time is an optional parameter that provides time between the yellow signal phase in one direction and a green one in an opposing direction. *One (1) second of all-red clearance time shall be used in all new signal installations and when signals are upgraded.* Longer times may be use at intersections with unusual geometry or complexity and are based on engineering judgement.

2.4 Other Pedestrian Traffic Signal Phases and Timing

SDOT may use an All Walk, or Leading Pedestrian Interval Phase, as described below.

All Walks

There are two types of All Walk Phases:

- All Walk: allows pedestrians to cross in all directions in marked crosswalks perpendicular to traffic, while all vehicle traffic is stopped.
- All-Way Walk: allows pedestrians to cross in all directions including diagonally across the intersection, while all vehicle traffic is stopped. This type of phase is also known as a “Barnes Dance” or “Pedestrian Scramble.”

Separating vehicle and pedestrian traffic at signalized intersections has been shown to improve safety and, in some cases, increase efficiency (heavy pedestrian and turning vehicles); however, all walk signal timing also creates added delay for all users at intersections, which may increase the potential for signal violations.

All walk signal operation will be considered at high pedestrian volume locations if conditions can be met in alignment with maximum cycle length policy and the all walk provides for a minimum of overall pedestrian delay. Timing for all walk phases follows the same approach as for typical pedestrian phases noted above.

Leading Pedestrian Interval (LPI)

A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter an intersection before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn across a crosswalk. Refer to the Leading Pedestrian Interval Policy for more details.

2.5 Impact of Pedestrian Phase Timing Policies

This policy proposes to decrease the walking speed used to calculate pedestrian crossing timing, which will result in increases in the total pedestrian crossing time, providing improved pedestrian access, and supporting persons across a broader range of mobility. This policy aligns with our Vision Zero and equity goals by providing adequate time for most people to cross the street safely without having to make a special request for extra time. This may require increased cycle lengths and result in increased delay for all users at some locations; however, the trade-off is reasonable to ensure equitable access and improved safety for people crossing the street.

3 PEDESTRIAN ACTUATION

There are three types of operations that the City of Seattle uses to provide opportunity for pedestrians to cross streets at signalized intersections; Total Recall, Partial Recall, and No Recall; all are associated with the signal term recall. Recall is when a pedestrian phase automatically comes up (is "recalled") without any actuation or detection (typically push buttons for pedestrians).

SDOT's Accessible Pedestrian Signal (APS) policy may result in the installation of an APS push button at an intersection where all pedestrian phases are in recall. At these locations, the APS does not function as detection but will still provide audible and tactile information for pedestrians that are blind or have low vision to safely cross the intersection.

3.1 Recall Types

The following table defines the recall types.

Type	Pedestrian Operation	Vehicle Operation
Total Recall (pre-timed)	• All pedestrian movements automatically served	• All or most vehicle movements automatically served for a set amount of time.
Partial Recall (semi-actuated)	• Pedestrian movement along main street served automatically • Pedestrian movement across main street requires pedestrian detection	• Main street vehicle movement served automatically • Side street vehicle movement requires vehicle detection
No Recall (fully actuated)	• All pedestrian movements require pedestrian detection	• All vehicle movements require vehicle detection
No Recall (pedestrian half-signal)	• Pedestrian movement across main street requires pedestrian detection	• Main street vehicle movement served automatically • Side street vehicle traffic controlled by stop sign

3.2 Pedestrian Total Recall Policy

Total Recall shall be implemented in all Urban Centers and Urban Villages, which accounts for roughly 65 percent of signalized intersections in the city:

Potential exceptions include:

- The traffic signal is under the jurisdictional authority of the State, which includes some intersections at or near access to states highways.
- The implementation would not be in alignment with the City's multimodal access, safety, and mobility goals, for example:
  - Locations with very low pedestrian volumes (less than 25 per hour)
  - Significant delay and impact to transit (greater than 20 seconds per cycle)
  - Locations where low pedestrian and side street volumes allow cycle length shorter than 70 seconds if we maintain actuation.

At other locations outside of Urban Centers and Urban Villages, total recall will be considered when an evaluation finds any of the thresholds below are met:

- Push buttons crossing the main street are actuated during 50% of cycles for the majority of the day (6 AM-7 PM)
- Push buttons crossing the main street are actuated during 75% of the cycles during the peak hours (7 AM-9 AM, 4 PM-6 PM)
- Pedestrians volumes crossing the main street exceed 100 pedestrians per hour for at least 4 hours a day
- At intersections adjacent to a school where pedestrian volumes crossing the main street exceeding 50 pedestrians per hour for at least 2 hours a day
- Where the overall average vehicle green time for the associated vehicle phase at a signal, between 6 AM-7 PM, is within 5 seconds of the minimum needed pedestrian time (walk time + pedestrian clearance time)

The consideration of Total Recall will be given more weight at the following locations:

- Within ½ mile of light rail station entrances and transit hubs
- Intersections adjacent to transit bus stops
- Within ¼ mile of a public or private school
- Within ¼ mile of access points to public parks

Recall types will be implemented using the following guidelines:

<u>Total Recall Operations</u>

- Implement Total Recall 24 hours a day, 7 day of the week, unless near a school or other location based on engineering judgement.
- Near schools, implement Total Recall 1 hour before and after school start and end times, and evaluate additional Total Recall opportunities based on school schedule and activities.

Partial Recall Operations

- Display the main street pedestrian walk or countdown signal in coordinated operations and have the pedestrian signal end with the vehicle phase.
- Respond immediately to side street detection by starting the mainline pedestrian flashing don't walk phase once the main street phase length has been completed.

Pedestrian Half-Signal Operations

- Pedestrian half-signals will operate on an actuated (No Recall) basis.
- Implement shorter cycle lengths at pedestrian half-signals to limit pedestrian and bike delay. Where feasible, cycle lengths will be half of adjacent intersection's cycle lengths to maintain coordination while providing access.
- Half signals will run the half the cycle length of adjacent signals except where there are very closely spaced intersections and where the adjacent intersections already run a short cycle length.

3.3 Impact of the Pedestrian Total Recall Policy

Two-thirds of the city's signals are in Urban Centers and Urban Villages and this policy will result in an increase in the number of traffic signals operating in Total Recall. This policy aligns with the City's vision for Urban Villages and Urban Centers, with a priority placed on pedestrian access and mobility. It will provide more reliable operations for pedestrians by guaranteeing a walk signal without having to push the button. Providing reliable operations for pedestrians aligns with our Vision Zero and Equity goals.

The trade-off of implementing total recall may result in additional delay at intersections and an increase in travel time for all users traveling along a corridor in urban centers, including transit, pedestrians, freight and cyclist. These trade-offs support our City mission, vision and goals including increase access, mobility and equity while meeting our commitment to Vision Zero.

4 DEVIATIONS

Any deviation from this policy shall be documented and approved by the City Traffic Engineer.

Dongho Chang
Dongho Chang (Jan 28, 2021 09:53 PST)

Dongho Chang, City Traffic Engineer — Date: 01/28/2021

Adiam Emery
Adiam Emery (Jan 28, 2021 10:32 PST)

Adiam Emery, Transportation Operations Division Director — Date: 01/28/2021

Attachments

- Leading Pedestrian Interval Policy (April 2019)
- Accessible Pedestrian Signal Policy (October 2017)