

Seattle Fire Facilities and Emergency Response Program Neighborhood Fire Station Projects

Advanced Training and Eco-Charrette Results



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Seattle Neighborhood Fire Stations serve a critical role in localized emergency response, binding neighborhoods together and reflecting the local culture. With the Mayor's environmental priorities and Seattle's commitments to achievement of LEED certification, sustainable design is also an important criterion for the Fire Station projects.

In 2006, DPD and FFD worked together to support a series of group workshops and trainings focused on sustainable design for the Neighborhood Fire Station Program. A set of Guiding Principles, design integration strategies, and implementation ideas were created through this effort. This report summarizes the workshop results and serves as a guide for FFD and design teams pursuing sustainably designed fire stations.

Ultimately it is up to these design teams to determine the best LEED approach for their circumstances. Eventually, these projects will provide a basis for measuring performance of the neighborhood fire stations portfolio wide, to demonstrate the cost/benefits of green building and to highlight specific strategies that support the Mayor's environmental priorities.

EXECUTIVE SUMMARY

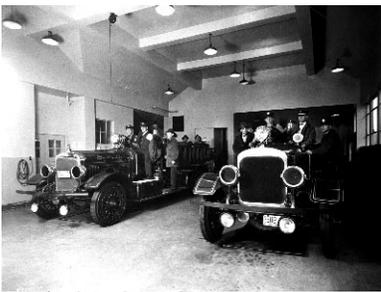
OVERVIEW

I. Neighborhood Fire Stations

This report addresses the Seattle neighborhood fire stations, all of which were built between 1918 and 1974. The Fire Service has changed dramatically over the years, with the introduction of new technology, emergency medical services and a changing work force. Once, fire stations needed to accommodate only horse-drawn apparatus and crews. Now, some also house apparatus for other emergency services—such as medical, hazardous materials response, marine, technical rescue and sophisticated communication equipment. The City has not significantly expanded or renovated any of its fire stations to keep current with modern seismic codes, facility design, or new technical and safety requirements. In 2003, the citizens of Seattle voted to

approve the Fire Facilities and Emergency Response Levy, designed to improve and upgrade the entire fire and emergency response system in Seattle. Levy proceeds will be used to make improvements in four areas to better prepare the community for all types of emergencies.

This 9-year program will seismically strengthen stations and standardize and enhance station to station functionality for firefighter operations and equipment storage. Fleets and Facilities oversees and manages the capital program for the Fire Levy Program to upgrade, renovate or replace 31 neighborhood fire stations. The Seattle Fire Department (SFD) provides operational expertise to FFD and the Design teams and is the tenant and end user of the facilities.



Fire Station 14, Seattle Municipal Archives Photograph Collection, 1927.

II. Fire Facilities Program Goals

The Program goals are to seismically upgrade and modernize the fire stations to ensure operational requirements are met and all apparatus can be deployed at any fire station at any time. Station improvements will maintain or improve firefighter response times to neighborhood response areas. Specific goals include:

- Modernize and seismically strengthen the City's fire and emergency response facilities.
- Build capacity and flexibility within the current fire system to address the continuing increased demand on the City's "First Responder" fire and emergency services to match Seattle's changing demographics and growing populations.
- Improve firefighter operations (including medic response, hazardous material response, apparatus support) and major emergency coordination/response.

- Enhance firefighter training.

These goals were then translated into station-by-station facility upgrade recommendations through a station programming process. The neighborhood stations plan that resulted from this process includes:

- Building four replacement stations on new sites (not including Fire Station 10);
- Demolishing and replacing seven stations on their existing sites;
- Completely reconfiguring, expanding and remodeling four stations, including seismic upgrades;
- Seismic upgrades, minor remodels and small additions in 14 stations.

Of the 31 neighborhood fire station projects, six are historic landmark buildings that will be reviewed by the City's Landmarks Preservation Board and fourteen will be reviewed by the Seattle Design Commission during design.

FFD developed prototype station concepts and operational programming for each project prior to the Levy vote. A *City of Seattle Fire Station Program* has been developed and includes detailed descriptions of the City's universal fire station programming requirements, how

the City's fire stations should be organized, and the general standards the City has adopted regarding its fire stations. The manual is available for consultants hired to provide pre-design work including program verification and interior functional planning, in addition to architectural design work.



Photo: © Farr Associates Architecture | Planning | Preservation, Chicago, IL.

III. Integration with City Sustainability Objectives

The City is committed to achieving a LEED Silver rating for all rebuilt and major renovation projects over 5,000 square feet, which is the City's standard for sustainable design. In keeping with the spirit of the

City's sustainable building policy and goals, sustainable design strategies will be integrated as much as possible into the seismic and safety upgrades and minor interior remodels.

The Center for Neighborhood Technology demonstrated that a green renovation of a historic building can be cost effective and aesthetically pleasing, achieving a LEED Platinum Rating using simple, "state-of-the-shelf" technologies. In 2003, the renovation was completed for \$82 per square foot.

City of Seattle LEED Portfolio Status Report as of April 2007

Project Name	Department	Final LEED Plaque Award
Completed Projects with Certification Level		
1 Seattle City Hall	Fleets & Facilities	Gold
2 Carkeek Park Environmental Learning Center	Parks & Recreation	Gold
3 Airport Way Center Building C	Fleets & Facilities	Gold
4 Cedar River Treatment Facility Operations Building	Seattle Public Utilities	Gold
5 Yesler Community Center	Parks & Recreation	Gold
6 Seattle Justice Center	Fleets & Facilities	Silver
7 Central Library	The Seattle Public Library	Silver
8 Airport Way Center Building A	Fleets & Facilities	Silver
9 Fisher Pavilion	Seattle Center	Certified
10 High Point Community Center	Parks & Recreation	Certified
Completed Projects with Certification Status		
1 Southwest Precinct	Fleets & Facilities	Pending
2 North Cascades Environmental Learning Center	Seattle City Light	Pending
3 Northgate Community Center & Library	Parks & Recreation/ The Seattle Public Library	Pending
4 SPU Operations Control Center	Seattle Public Utilities	Pending
5 Marion Oliver McCaw Performance Hall	Seattle Center	No Rating

"I'm increasingly concerned about the impacts that climate disruption will have on the sources of water we rely on."

- MAYOR GREGORY NICKELS

In 2005, FFD hired Davis Langdon to provide an updated cost estimate for the Fire Levy Program in response to a dramatic and unanticipated increase in construction costs. The estimate included the cost for achieving LEED Silver certification. Davis Langdon estimated the cost of new construction as of September 2005 at \$270 - \$300 per square foot, depending upon whether the construction is an addition (\$300/SF) or a brand new building (\$270/SF). The estimated most likely premium cost for ensuring a LEED Silver certification of \$10.00/SF or approximately 3.5%, but within a range of \$2.00 - \$25.00/SF (0.7% - 9%). Construction costs have continued to escalate rapidly since 2005.

DPD partnered with FFD to identify opportunities for working together to support the neighborhood fire station projects. Three specific activities were identified, and DPD and FFD dedicated staff and financial resources to:

1. Coordinate LEED Training for Project Managers - held in June 2006 with 37 attendees.
2. Develop and present Advanced Training for LEED Fire Facilities - held in October 2006 with 40 attendees. Identify common sustainable design strategies incorporated into LEED certified fire station and historic renovation projects, and lessons learned from project teams.
3. Host an eco-charrette to identify key sustainable design strategies that are appropriate for the majority of projects and may reduce overall costs for delivering LEED Silver fire stations through some level of standardization of green methods, materials and strategies - held in October 2006 with 45 attendees.

Environmental Priorities for 2007

Substantial progress has been made since the City of Seattle first launched energy and water conservation programs in the 1970s. In 2000, Seattle became the first city in the nation to formally adopt a Sustainable

Building Policy. Coupled with the biggest capital improvement program since the Seattle fire of 1888, the policy provided a unique leadership opportunity to create change in the building industry. Today, Seattle has the strongest green building market in the nation with 26 LEED certified buildings. Of those, ten are City-owned and four were delivered by FFD including: Seattle Justice Center, Seattle City Hall, Airport Way Center Building A, Airport Way Center Building C.

In 2007 project teams have new goals to consider when developing projects. Each new City-owned capital facility is encouraged to innovate and contribute to the Mayor's Environmental Priorities: Climate Protection, Green Seattle and Sustainable Forests, Restore Our Waters, and Healthy People and Communities.

Climate Protection Initiative

Global climate change is a profoundly local issue - both cause and effect. On September 27, 2006, Mayor Nickels released the Seattle Climate Action Plan, the most comprehensive set of investments and programs in the city's history for fighting climate change. Neighborhood fire station projects can support this priority with strategies that encourage alternative transportation choices, promote use of bio-fuels, and increase energy efficiency (electric and natural gas) and use of on-site renewable energy systems.

Green Seattle and Urban Forest Initiative

Seattle's urban trees add value to our community in many ways; they beautify our surroundings, absorb stormwater and climate-disrupting gases, clean the air, reduce erosion and increase property values. The Mayor has implemented a plan to increase the City's tree canopy cover, establish more open space and green space, and remove invasive species to restore the health of our urban forests. He will accomplish this with the help of

an informed and involved community of citizens. Neighborhood fire stations can support this priority by demonstrating green infrastructure strategies such as pedestrian-friendly green streets and natural drainage systems, and featuring native landscapes with increased tree canopy.

Restore Our Waters Strategy

Seattle is defined by water - our creeks, lakes, Puget Sound, the Duwamish River and other water bodies make the city a great place for people and for fish and other wildlife. Mayor Nickels' has launched his Restore our Waters strategy to protect these incredible assets, directing City departments to improve water quality and habitat through a combination of capital projects, new city programs, and citizen outreach. Neighborhood fire station projects can support this priority by improving stormwater management and erosion control practices, adopting

innovative strategies for managing stormwater on-site, and harvesting rainwater and greywater to use for truck washing, irrigation and toilet flushing.

Healthy People & Communities

This initiative was launched to create healthy, livable neighborhoods by promoting sustainable practices and addressing environmental justice. The City is accomplishing this goal by demonstrating the cost/benefits for green building and green infrastructure strategies on publicly funded projects; improving indoor air quality in affordable housing; and, making investments in historically underserved neighborhoods. Neighborhood fire stations can support this initiative by promoting green building and green infrastructure through an interpretive program, increasing open space and design it as a community amenity, and strengthening neighborhood character and vitality.



High Point Community Center, LEED Certified, Seattle Parks and Recreation. The landscape features native trees and shrubs that help to restore our urban forest, while reducing the need for irrigation.



Rendering: Mike Kowalski.

Fire Station 10 will feature 7,338 square feet of open space featuring public art, native landscaping and exterior lighting designed to minimize light pollution. Light is directed toward the building façade instead of into the sky and illuminates the art installation Sentinels, designed by artist Gloria Bornstein, without escaping the site.



Seattle Housing Authority and Seattle Public Utilities partnered on the High Point Redevelopment to manage stormwater through a variety of innovative strategies.

A Natural Drainage System consisting of a network of connected vegetated and grass-lined swales and porous concrete sidewalks in the street right-of-way filters and cleanses stormwater runoff on-site helping to restore the health of Longfellow Creek.

ECO-CHARRETTE RESULTS

I. Overview of Process

On October 11, 2006, DPD and FFD hosted an eco-charrette for the neighborhood fire station projects to stimulate a creative and collaborative approach for delivering high performance fire stations that meet departmental goals, SFD operational criteria and achieve a LEED Silver rating.

In addition, FFD will identify strategies that support the Mayor's environmental priorities. As the long-term owner of the facilities, FFD is interested in discovering opportunities where initial costs can be balanced against the potential for increased long-term benefit and a total lower cost of ownership over time.

Meeting these challenges within time, quality, and budget limits will require a highly integrated team approach.

Objectives for the Eco-charrette were to:

- Identify guiding principles for the neighborhood fire station program
- Characterize sustainable design strategies that follow the principles
- Identify and remove barriers to ensure successful implementation
- Provide a set of recommended approaches to optimize cost/benefits

A team of 45 people came together to participate in the full-day eco-charrette. The attendees included representatives from city departments including: Fleets and Facilities, Seattle Fire Department,

Planning and Development, Seattle Public Utilities, Seattle City Light, Seattle Dept. of Transportation, and Executive Administration. Other attendees included representatives from the Lighting Design Lab, architects and engineers selected for fire stations 2, 17, 28 and 31, and sustainable design consultants. A full list of attendees is located in Appendix A.

For many in the building industry, understanding performance benefits, setting design targets, and identifying critical tasks for green building are new steps. Shaping this process is the single most critical aspect of developing a green building approach. Paladino and Company, Inc led the attendees through a series of discovery exercises that drew upon peer experience and expertise while focusing on the neighborhood fire stations program.

The charrette began with an overview of the City's priorities followed by a facilitated dialogue held to establish guiding principles. Using these guiding principles, a second brainstorming session was held to identify sustainable design strategies. The identified strategies were categorized according to the guiding principles, and obstacles were discussed and tactics to overcome them. Lastly, the strategies were distilled to a set of six recommended approaches that were deemed appropriate for the majority of fire station projects.

II. FFD Sustainable Design Objectives

The event began with an overview of FFD's sustainable design objectives. FFD's first objective is to align sustainable strategies for Fire Levy projects with the Mayor's environmental priorities.

FFD has a desire to integrate sustainability with tenant operations. Sustainable strategies for fire stations should take

advantage of the opportunities that are unique to Fire Operations such as water use for hose drilling and truck washing. Sustainable strategies should respond to the needs of building tenants in the areas of thermal comfort due to a higher level of physical activity, the need for stress reduction, the need for durability of finishes, and the 24/7 nature of the job.



Eco-charrette participants discuss appropriate sustainable design strategies for neighborhood fire stations.

FFD would also like to balance construction costs with long-term operations and maintenance costs leading to a lower total cost of ownership. If component construction costs are slightly higher but support lower operations and maintenance costs over the life of the component, the design team should consider the overall cost of ownership in the decision making.

Because there are different project types included in the Fire Levy Program, some of the projects will not meet the 5,000 SF threshold for attaining the LEED Silver rating. These projects may wish to aim at a 'light green' status by adopting no-cost and low-cost strategies as budgets allow. Projects aiming at LEED Silver rating should

III. Guiding Principles

The facilitators then described the concept of guiding principles to the workshop participants. A guiding principle should be a simple statement that identifies either a clear outcome to strive for, or boundary to stay within. Development of guiding principles will help FFD prioritize the Mayor's guidelines and focus on environmental attributes that make sense for neighborhood fire stations.

The Eco-charrette attendees were then divided into four teams. Each team was tasked with establishing 1 - 3 guiding principles to inform decision-making during the design process. Each team presented their guiding principles, which were posted on the wall. All attendees were asked to rank the guiding principles in order of importance. Then, through discussion with the whole group, a single overarching principle emerged as well as four supporting principles:

Overarching Principle: Invest Up-Front

Design and deliver durable high-performance fire stations that reduce

adopt no-cost and low-cost strategies as standard practice.

The group was charged with focusing on strategies that reduce operating and maintenance costs, improve firefighter and employee health and productivity, and that enhance the value of these assets over time. It was further explained that other City projects have achieved this goal by involving all parties such as FFD maintenance personnel and Seattle Fire Department tenants early in the process, encouraging team collaboration and effective communication, and using an integrated design approach to meet operational and performance goals within project budget.

operations and maintenance costs over the life of the buildings. To complete a successful fire station that achieves the project's requirements within the multiple constraints facing FFD, careful, creative, and competent planning is required. This principle recognizes that planning requires an investment - in people, analysis, and resources. Projects that employ durable high-efficiency systems with lower long-term operations and maintenance costs can have higher first costs. Up-front investment includes analysis early in the design phase that is fundamental to foster an integrated approach that will deliver to the Seattle Fire Department buildings that will endure through 21st Century. The eco-charrette participants felt that investment should be targeted to support the following guiding principles:

Celebrate Place

The neighborhood fire stations should represent their unique culture, integrate into and enhance their neighborhoods' fabric, and provide an amenity while maintaining their primary mission as



Photo: DKA Architecture | Planning | Interior Design.

Fleets and Facilities and the Seattle Police Department were awarded a LEED Gold Rating on Airport Way Center, Building C. The team's dedication to producing a high-performance green building engendered a high level of collaboration and design integration among its members leading to 31% water savings and 18% energy savings.

“Firehouses function as integral part of the neighborhood fabric - and will serve as educational models of environmental stewardship.”

**- LIEUTENANT JIM DAWS,
ATLANTA FIRE DEPARTMENT.**



Firefighters are exposed to contaminants and particulates as a result of major fire events that are carried into the building on gear and clothing.

24-hour, emergency service facilities. In addition to the civic context and place, this principle urges FFD and design teams to deliver facilities that contribute to the neighborhoods unique sense of place, respond to the natural environment, and that improve the everyday lives and work of first responders.

Promote Health, Safety and Wellness

Design beyond typical building code requirements to provide facilities that offer a refuge for their occupants. This principle is not only a keystone of the Seattle Fire Department; it is echoed around the country as the need to keep fire facilities up-to-date with rapidly changing technology while supporting staff that literally live in the fire stations. Design teams should understand emerging best practices from the emergency responder industry in order to deliver neighborhood fire stations that are comfortable and enhance occupant health.

IV. Design Ideas

After guiding principles were established, the full group was lead through a facilitated brainstorming process to generate a large number of design ideas. After the initial sets of ideas were organized under a specific

Let Nature Work For You

Seattle’s abundant natural resources include rainwater, moderate temperatures, summer sunshine, regular breezes, and persistent cloud cover. These resources offer a wealth of services that can be utilized on each fire station site. This principle establishes the understanding of and use of natural services as the basis for reducing the environmental impact of buildings, and integration into the local ecology. Capitalizing on and enhancing the unique natural services of each site can result in multiple cascading benefits for facility design, construction, and operation.

Enhance Operations

Design facilities to accommodate the evolving role of first-responders. This principle stresses the need to design facilities both for flexibility and for smooth day-to-day operation. Completed projects must balance environmental impacts, operating costs, maintenance requirements, and future modifications.

principle, potential gaps were identified. In addition, obstacles were raised and solutions to each obstacle presented. Below lists the ideas organized by guiding principle:

The Atlanta Fire Department will build 15 new fire stations over the next ten years. An eco-charrette helped identify innovative solutions to design challenges and create high performance buildings with a focus on energy efficiency given 24/7 operations; large, unconditioned apparatus bays; interior durability; low maintenance; and, delivering a LEED Silver buildings within 2% of the budget.

Invest Up-front

1. Reduce total cost of ownership.

- a. Evaluate operations and maintenance costs in addition to capital costs.
- b. Identify and pursue financial incentives that support sustainable strategies.

2. Reduce energy use by 50% in new construction and major renovation projects.

- a. Specify efficient lighting fixtures and controls.
- b. Combine radiant heating with natural condition and ventilation.
- c. Design a high performance insulation package.
- d. Commission the buildings.
- e. Provide shading with trees and vegetation.

3. Reduce potable water use by 30%.

- a. Reduce indoor use by 20% by utilizing low-flow fixtures.
- b. Reduce outdoor use by 50% by harvesting rainwater and greywater for irrigation and truck washing.

4. Use durable materials.

- a. Specify timeless and traditional materials that will endure and require minimal maintenance such as brick, timber, stained and exposed concrete, concrete masonry units, slate and tile.

Celebrate Place

1. Consider the design context

- a. Respect and reflect neighborhood character.
- b. Allow form to follow function.

2. Design to reflect SFD traditions.

- a. Use durable and local materials like brick and timber.

3. Maximize visual transparency.

- a. Differentiate public and private

spaces and enhance transparency in public spaces without compromising operational needs.

4. Build community support.

- a. "Community jewel box and tool box": develop fire stations so that the neighborhood takes ownership for care.
- b. Conduct a strong communications and outreach program.
- c. Engage the community in the 1% for Arts program.

Promote Health, Safety and Wellness

1. Enhance wellness and fitness.

- a. Design living spaces as refuge for first responders.
- b. Allow for shared use of gym by firefighters and OCC staff.

2. Enhance living environments.

- a. Illuminate living spaces and apparatus bay with daylight and provide views to outdoors.
- b. Provide high-performance sound insulation.

3. Improve thermal comfort.

- a. Locate bunks on first floor where temperatures remain cooler
- b. Install operable windows in bunks to allow firefighter control over thermal comfort.

4. Prevent pollution.

- a. Capture contaminants with walk off grates.
- b. Provide separate area for arson dogs.
- c. Develop and implement a green housekeeping program.
- d. Specify non-toxic materials.



Photo: © Farr Associates Architecture | Planning | Preservation, Chicago, IL.

The Center for Neighborhood Technology (CNT) uses 52% less energy, saving nearly \$10,000 each year. Strategies included: integrated daylighting scheme with high efficiency lighting and controls, increased insulation, a hybrid HVAC - natural ventilation system with operable windows, thermal ice storage, ENERGY STAR equipment and appliances, and reflective ENERGY STAR roofing.

"By saving on building operational and maintenance costs, CNT is able to use more of its raised dollars on programming and less on its facility."



Photo: RRM Design Group, Oakland, CA.

The Livermore | Pleasanton Fire Station supported firefighter health with strategies ranging from a carbon monoxide removal system to a green cleaning program that was so successful that the city adopted the green cleaning program for all city departments.



Photo: RRM Design Group, Oakland, CA.

At the Livermore | Pleasanton Fire Station, the site was designed to be “Bay-Friendly” with stormwater managed on site using bioswales that increase groundwater infiltration, along with native and adapted plants and elimination of use of pesticides.

5. Improve ventilation.

- a. Require contractor to develop IAQ Plan.
- b. Provide natural ventilation in beanery.
- c. Locate copier in station office and ensure adequate exhaust ventilation.
- d. Ensure adequate ventilation at work bench.
- e. Utilize an exhaust collection system in apparatus bay.

Let Nature Work For You

1. Exemplify environmental stewardship.

- a. Develop environmental stewardship education and outreach program for community that explains green building strategies and benefits.

2. Utilize natural resources to satisfy functional needs.

- a. Design landscape with native and adapted plants that require minimal irrigation during and after five-year establishment period.
- b. Utilize trees and vegetation to provide shading and building cooling.

3. Infiltrate and reuse 100% of stormwater that falls on site.

- a. Infiltrate stormwater in swales and rain gardens.
- b. Use porous paving where appropriate.

4. Harvest rainwater and greywater for reuse on-site.

- a. Filter, store and reuse rainwater and greywater for: truck washing, fire drills, irrigation, and toilet flushing.
- b. Direct greywater from apron and infiltrate in swales and rain gardens.

Enhance Operations

1. Support SFD goal for “One minute out the door”.

- a. Identify adjacencies that ensure firefighter safety.
- b. Locate related functions within close proximity.
- c. Eliminate stairs and poles whenever possible.

2. Design to accommodate change.

- a. Allow for potential expansion in apparatus bay.
- b. Minimize installation of permanent partitions.
- c. Create flexible and adaptable spaces.

3. Increase ease of operations and maintenance.

- a. Standardize building fixtures, components, systems and controls through out portfolio.
- b. Allow for greater accessibility for lighting, ventilation and building systems.

4. Educate firefighters on green building strategies.

- a. Develop educational programs and materials to increase firefighter understanding of green building strategies and benefits.
- b. Identify opportunities to integrate environmental priorities into day to day operations.

- c. Promote alternative transportation by providing bicycle racks, secure bicycle storage and Flexcar stall.

5. Increase recycling (support City goal to achieve 60% recycling rate)

- a. Design recycling stations in appropriate locations including beanery.

V. Design Integration

After establishing guiding principles and the supporting ideas, attendees were asked to break out into working groups based on their area of expertise and each group was asked to focus on particular areas of building design. The four areas were:

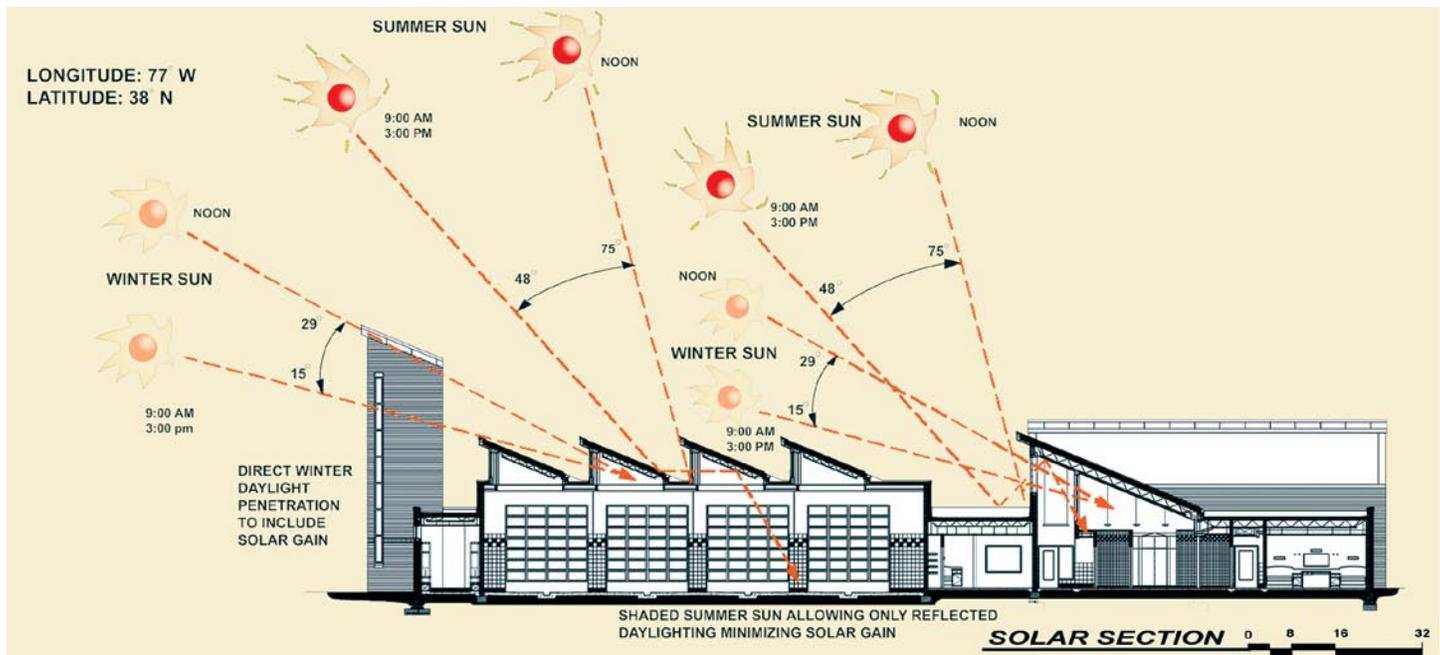
- Site / Structure
- Skin / Systems for New Construction
- Skin / Systems for Remodels
- Interiors / Fittings

The groups concentrated on developing focused design approaches and technical details including drawings. The group's priorities and technical design approaches discussed were as follows:

Site & Structure

The site and structure group addressed questions regarding the exterior environment and the building structure such as landscaping, stormwater and exterior lighting. The group developed five priority strategies, as follow:

- **Perform a site inventory and analysis** to extract maximum value from the sites natural resources, solar exposure and microclimate. Identify natural and human-built infrastructure that can be harvested and reused on- or off-site.



Rendering: Samaha Associates.

“The natural daylighting, improved indoor air quality and radiant heat from passive solar gain will create a better environment for the firefighters who use the station 24 hours a day.” TOM LEE, SAMAHA ASSOCIATES.



Photo: © Mithun.

Yesler Community Center, LEED Gold Rating, optimizes natural ventilation and the use of daylight. The ventilation system, refined through thermal modeling, brings cool air through low level louvers on one side and releases it through higher level vents and clerestory window openings, relying on the principals of thermal stacking. The high-performance design is expected to result in a 42% reduction in energy use.

- **Maximize tree planting potential** to support the Green Seattle and Urban Forestry Initiative. Retain and protect trees based upon their canopy characteristics and neighborhood context as identified in the site inventory. Consider creating a five-foot or wider right of way for trees between the sidewalk and the building.
- **Focus on water reuse** starting early in design. Create a site-water balance taking into consideration sources (rainwater, drilling, and greywater) and end-uses (irrigation, truck washing, drilling, and potable use); align the quality of the source with the quality necessary for the end-use.
- **Minimize contribution to the urban heat island** effect by creating an efficient building, limiting impervious pavement, considering green roofs, and maximizing landscaped area.
- **Reduce pollution from exterior site lighting** by using full-cutoff fixtures, mounting lights at appropriate heights, and using motions sensors and calendar-based timers to control exterior lighting.

Skin & Systems: New Construction

This group addressed questions regarding how the interior and exterior merge, how the building is conditioned, and how thermal comfort is achieved. They focused on new construction facilities only and developed four priority strategies, as follow:

- **Choose exterior materials based on context:** The building's exterior should be inspired by and reflect the materials in the local neighborhood. To celebrate place, the fire station should emphasize key aspects of local culture.
- **Configure the envelope to create daylight zones where appropriate:** Design circulation and apparatus bay support rooms to be illuminated by

daylight as a primary source during the day, with electric light as a nighttime source and a secondary daytime source. To understand how a design responds to the daylight available, first inventory the site for solar availability, including shading. Next, during design, schedule a daylighting analysis at the Seattle Daylighting Lab using a physical model. Key design components of daylit spaces include light from 2 sides and controlling incoming light to prevent glare. In the apparatus bays, ensure that any sunlight on bunker gear has UV filtered out.

- **Ensure thermal comfort:** Ensure that new facilities meet the comfort needs of the staff including the requirement that systems respond quickly (both on and off). Consider analyzing existing facilities and working with staff to develop acceptable comfort criteria. During design, provide the thermal modeling and life cycle cost analysis for different thermal comfort solutions. Consider alternates to traditional mechanical systems such as radiant conditioning, solar hot water, and ground coupled heat pumps.
- **Consider energy and security in ventilation design:** Identify whether natural services such as outdoor temperatures or breezes are available at the site for ventilation. If so, combine operable windows with secure ventilation louvers or trickle vents to balance use of natural ventilation with prevention of intruders. Analyze the proposed ventilation design with a computer simulation or physical model to verify that it will function correctly.

Skin & Systems: Remodels

This group addressed questions regarding how the interior and exterior merge on renovations; how the building is conditioned, and how thermal comfort is

achieved. They focused on neighborhood fire stations that are undergoing remodeling and seismic retrofits and developed five priority strategies, as follow:

- **Maximize the energy efficiency of the building envelope:** Investigate a double skin system that can maintain historic facades and recreate a secondary interior envelope with high-performance thermal characteristics. Consider using the interstitial air space between the historic facade and the interior envelope for circulation. Optimize roof performance through appropriate insulation, increased reflectivity, and introducing skylights.
- **Harvest free energy:** Integrate daylighting, natural ventilation; ground coupled heat pumps, building-integrated photovoltaics, and solar thermal into remodel projects.
- **Optimize HVAC through high efficiency systems:** Radiant heating and cooling should be the default supported by ground-source heat pumps. Use thermal mass, and consider using unconditioned internal areas as natural heat sinks. Design for the stack effect, using natural ventilation to draw warm air up and out of the building. Validate HVAC and thermal comfort assumptions with design-phase modeling.
- **Specify efficient plumbing:** Dual-flush toilets, low-flow showers and low-flow lavatories can increase water efficiency. Analyze the existing building for opportunities to install heat recovery on shower drains and/or equipment truck bays floor drains. Heat recovered from waste water can be used to pre-heat incoming ground water.
- **Expand the time scale for life cycle assessments:** Consider time frames of 50 to 100 years.

Interiors & Fittings

This group addressed questions regarding the interior environment, such as occupant control and interface, comfort, glare control, signage, materials and furniture. The group developed four priority strategies, as follow:

- **Provide safe, durable and easy to maintain materials:** The building's interior materials must withstand constant wear and tear from staff living in the facility and be easy to maintain at high levels of safety. The materials should be designed to last for many years. Consider the following characteristics when choosing interior materials:
 - Minimalist finishes that are easy to maintain
 - Non-porous, slip resistant surfaces in high traffic areas
 - Timeless materials such as brick or timber that won't look dated in the future
 - Natural structural materials that don't need finishes applied
 - Choose finishes that have other characteristics such as sound deadening, mechanical function, illumination, or daylight glare control
- **Reduce toxins in interior materials:** New interior materials should balance durability and maintenance with low toxicity. Many chemicals used in building materials produce fumes (VOCs) when installed, cleaned, uninstalled, or otherwise destroyed. The fire station materials should minimize off-gassing.
- **Provide safe and energy efficient illumination:** Electric lighting should be designed to complement daylighting afforded by the building's envelope. In existing buildings, consider studying the daylighting design and utilizing or enhancing it where possible. Designs for new and existing fire stations should



Photo: © Mithun.

At Yesler Community Center, Seattle Parks and Recreation needed to keep down long-term maintenance costs. Building structure and materials were selected for durability and low maintenance. Among the select materials are brick and concrete; stainless steel and galvanized steel; linoleum; and, FSC-certified wood products.

include an analysis of the illumination for the following characteristics:

- Safety - even light distribution, including daylight. Higher light levels may be needed in heavy trafficked rooms
- Natural Light - in circulation and apparatus bay support areas, provide electric lighting on switches that staff can choose to shut off
- Automatic Sensors - lighting control technology can be used to balance safe lighting levels with energy consumption

- Connection to emergency dispatch communication system

- **Furnishings to reflect fire station identity:** Part of the interior fire station “place” should include a strong sense of the station’s history and identity. Use of the fire station’s crest, logos, and insignias is one way to accomplish this. Also, consider engaging fire station staff in production or decoration of a signature piece of furniture. For example, the beanery’s main table could be customized by each station.



Rendering: Weinstein A|U.

Seattle’s Fire Station 10 employs a water capture system that will reuse fire drill water and rainwater that falls on non-driving surfaces. The system consists of integrated site drainage, cistern and treatment. The water will be used for vehicle washing and landscape irrigation. Sized to meet 100% of demand for these uses, this strategy will save nearly 1.3 million gallons of potable water each year.

VI. Key Design Focus Areas

Many of the individual design elements discussed throughout the workshop have been captured by the *City of Seattle Fire Station Program*. In addition, six major sustainable design focus areas emerged from the workshop. These areas have elements that are appropriate for most of the fire station projects, both new construction and major renovations:

1. Capture wastewater for program uses.

Potable water demand is high at fire stations. There is also a large amount of impervious surface associated with the apparatus aprons and parking areas that create stormwater runoff. There are several system strategies that can convert stormwater and greywater into usable process water. Rainwater, truck-wash water, and drill water can be captured and recycled for beneficial use in irrigation systems and toilets.

2. Manage stormwater onsite. The simplest idea dealing with stormwater is eliminating it in the first place. Site based design ideas include: natural landscape that absorb most of the rainfall; bioswales or green streets that provide direct infiltration; and increased

tree canopy and green roofs that delay stormwater generation. These features look different than conventional landscapes, offering community education opportunities through public education programs and site signage.

3. Achieve energy efficiency 50% beyond code.

Fire stations are an unusual combination of industrial and living space. This presents opportunities to share energy, such as utilizing waste heat from the apparatus loads for domestic heating. Integrating energy efficiency into every aspect of the building’s design will allow project teams to first minimize heating and cooling loads and, then, to choose energy efficient strategies to meet the loads.

4. Utilize hybrid HVAC-natural conditioning scheme.

Compared with some building types, the cooling and heating loads in fire stations are modest. In Seattle, ventilation cooling in the summer and passive solar heating and lighting in the winter are viable ways of reducing the overall complexity and cost of the thermal comfort systems.



5. Illuminate with natural daylight and integrate with electric lighting.

The large apparatus bays are good candidates for daylighting schemes that allow electric lights to be turned off most parts of the day. This provides a better luminous environment for working firefighters, and reduces the cost of electricity bills.

6. Create safe and healthy working environments. Most firefighters spend

a lot of time at the fire house, so it is not just their place of employment - it is a second home! The thermal comfort and air quality environment must be top notch, ensuring that firefighters are rested and healthy when accomplishing their incredibly dangerous job.

Detailed technical briefs are in development for each of these strategies. The technical briefs will be appended to this report as they are finished.

Rendering: Samaha Associates.

Daylight, passive solar design and building orientation improve Crosspointe Fire Station's energy performance and enhance living spaces. Energy efficiency exceeds ASHRAE 90.1 by 23.5% saving \$15,000 per year.

I. Fleets and Facilities Capital Program Division

The Fleets and Facilities Capital Programs Division (FFD) provides new construction, remodeling, tenant improvement, hazardous material abatement, and renovation services for the City's core public safety facilities, fire stations, police precinct stations, and several maintenance shop facilities; downtown City-owned buildings, including the new Justice Center and City Hall, the Seattle Municipal Tower; and several community-based facilities owned by the City. FFD Capital Programs Division

mission is "to be the providers of great environments that meet basic needs, lift the human spirit and engender public trust."

FFD will oversee and manage the capital program for the Fire Facilities and Emergency Response Levy to upgrade, renovate or replace 31 neighborhood fire stations. Learn more about Fleets and Facilities at www.seattle.gov/fleetsfacilities, and the Fire Facilities and Emergency Response Levy at www.seattle.gov/fleetsfacilities/firelevy.

II. Seattle Fire Department

The Seattle Fire Department provides fire suppression and emergency medical services to a culturally diverse and vibrant population of Seattle. Since organized in 1894, the Fire Department has evolved from an organization focused only on fire fighting, to one that includes other critical services such as building inspections, fire code enforcement, tactical rescues and public education.

The Seattle Fire Department has 33 fire stations located throughout the city, with a presence in every neighborhood. With over 5,000 calls per year, every day firefighters and paramedics strive to provide the best emergency and medical services possible to the citizens of Seattle. In addition to providing for the protection of life and

property, the Seattle Fire Department supports Mayor Nickels' goal of making Seattle the most prepared city in America. It is accomplishing this through additional training for firefighters, Hazardous Materials, Marine and Technical Rescue teams.

The SFD mission is to prevent the loss of life and property resulting from fires, medical emergencies, and other disasters. They accomplish this mission through highly trained firefighters, a focus on fire prevention and education, and nationally recognized emergency medical skills.

Learn more about the Seattle Fire Department at www.seattle.gov/fire.

III. Department of Planning and Development, City Green Building

The Department of Planning and Development's (DPD) mission is to manage growth and development within Seattle in a way that enhances quality of life. DPD promotes a safe and sustainable environment through comprehensive planning, good design, and compliance with development regulations and community standards. City Green Building is a business unit within DPD that serves

City departments, Seattle's private sector and citizens to sustain Seattle's leadership in green building. The program's mission is to make green building standard practice in Seattle, through education, technical assistance and incentives.

Learn more about the Department of Planning and Development at www.seattle.gov/dpd, and City Green Building at www.seattle.gov/dpd/greenbuilding.

APPENDIX A: ATTENDEES

City of Seattle

Executive Administration

Sheila Barker

Planning and Development

Lynne Barker

Lyle Bicknell

Kathleen Petrie

Guillermo Romano

Fleets and Facilities

Dove Alberg

Kelly Bills

Nancy Bloss

Linda Colasurdo

Ellen Hansen

Joan Hitchner

Don McDermott

Jun Quan

Teresa Rodriguez

Tony White

Lighting Design Lab

Edward Bartholomew

Seattle Fire Department

Russ Cramer

Chief Molly Douce

Kim Favorite

Lt. Richard Holman

Lt. Joe Robertson

Capt. Donna Roddick

Seattle Dept. of Transportation

Shane Dewald

Seattle Public Utilities

Shirli Axelrod

David Broustis

Ellen Stewart

Tanya Treat

Seattle City Light

Bill Durland

Jim Healy

Robert Swann

Consultants

Fire Levy Program Design Team

Rich Murakami, Arai Jackson Ellison
Murakami

Greg Ransom, Arai Jackson Ellison
Murakami

Don Brubeck, Bassetti Architects

Joe Llona, CDi Engineers

Ed McManamna, Rice Fergus Miller

Jennifer Barnes, Schreiber Starling & Lane
Architects

Stephen Starling, Schreiber Starling & Lane
Architects

Laura Lenss, SHKS Architects

Brian Harris, TCA Architects

Morgan Houghland, TCA Architects

Eco-charrette Sustainable Design Experts

Robin McKennon Thaler, Mayfly Engineering
& Design

Steve Abecrombie, Paladino & Company, Inc

Tom Paladino, Paladino & Company, Inc

Treasa Sweek, Paladino & Company, Inc

Paul Anseeuw, Stantec Consulting

APPENDIX B: SUMMARY OF ADVANCED TRAINING FOR DELIVERING LEED FIRE FACILITIES

On October 5th, DPD and FFD hosted an advanced training seminar to for the neighborhood fire station teams. The goals of this training included:

- Investigating fire facility case studies throughout the US and identifying lessons learned from those projects
- Linking fire facility design issues with sustainable design strategies

- Discussing potential sustainability strategies for specific Seattle area fire stations

32 attendees participated in a 4 hour training seminar. During the first half, seven LEED case studies were presented, including five fire facilities, a historic renovation and a major renovation project, as follow:

	\$ / SF	LEED Rating	Completed
Fire Station 10 (Seattle)	\$487	Silver	2007
Fire Station 28 (Atlanta)	\$270	Silver	2007
Crosspointe Fire Station 41 (Fairfax)	\$313	Silver	2007
CNT Renovation (Chicago)	\$ 82	Platinum	2003
Livermore Pleasanton Fire Station 4	\$285	Gold	2005
Issaquah Fire Station 73	\$176	Silver	2003
Airport Way Center - C Renovation (Seattle)	\$ 95	Gold	2004

Among the seven case studies, the most commonly adopted sustainable design strategies included:

- integrating natural daylight with electric lighting,
- optimizing the building envelope and systems,
- managing stormwater on site,
- installing low maintenance finishes, and
- focusing on a healthy living and working environment.

Two case studies that exemplified sustainable fire station design and utilized the majority of these strategies were Livermore / Pleasanton Fire Station 4 and Crosspointe Fire Station 40.

The seminar also identified ways that sustainability can help overcome several

common design issues. The following *Top 5 Common Issues in Urban Fire Facility Projects* were provided by TCA Architecture and Planning. Each of these issues was presented during the seminar and then complimentary sustainable design methods were discussed.

1. **Support Operational Criteria** through efficient adjacencies of programmatic elements that allow firefighters to meet response time requirements and perform day-to-day activities. Time and distance requirements necessitate the need for clear and efficient paths of travel or “way finding”.

Sustainable design method: Meet programmatic requirements efficiently. By using an integrated design approach and establishing environmental zoning criteria, projects can meet programmatic

requirements more efficiently. For example, an integrated design team meets regularly during schematic design to review work progress and make decisions together. Integrated design teams include building and landscape architects as well as civil, structural, mechanical, electrical, lighting, and plumbing engineers. Meeting together as a team can help resolve minor questions and keep the group focused on the major programming requirements.

One example of well-executed programming is the Crosspointe Fire Station. This facility's site and floor plan were organized with circulation patterns that allow for rapid response, as well as optimized daylight design for live and work spaces. One key component of the project's success was that the architect took an integrated design approach to meet the operational and performance goals for the project. This allowed the team to deliver a LEED Silver building within the conventional budget.

2. Enhance Firefighter Safety within Facility by preventing the risk of exposure to contaminants and communicable diseases, mitigating on the job injuries, and improving health, safety and wellness. Best practice Fire Facility design limits risk of exposure by separating pollutant sources (e.g. contaminated uniforms, apparatus exhaust) from living quarters. They also allow for fire personnel to rehabilitate and reduce their core body temperatures after an emergency response. Ultimately, as emergency facilities, these buildings must be safer to operate and live in than other building types.

Sustainable design method: Healthy working and living environments. Sustainable design can further enhance current best practices in fire facilities by further reducing contaminant sources



Rendering: Samaha Associates.

Crosspointe Fire Station was designed to function as a state of the art public facility and leader in sustainable design. Adjacencies place the corridors extending from dormitory areas directly into apparatus bay with kitchen and dayroom immediately adjacent for minimal distance and segregating quiet areas such as bunks and offices.

and by helping to ensure optimal indoor air quality. Specifying materials with low off-gassing potential and low chemical content is a great way to limit the “new car smell” of brand new construction projects. Once these contaminant sources are limited, ensuring that the building's fresh air is both clean and plentiful provides additional benefit to occupants. It is challenging to design a facility with fresh air openings that ensure clean air will be available in Seattle's urban setting. Again, integrating design teams early in schematics will give everyone the best opportunity to identify optimized layouts and discuss potential conflicts as decisions are being made.

3. Increase Durability and Lower Maintenance Costs through the use of commercial grade finishes, elimination

of hard to clean and applied finishes, reduction of soft finishes and thought toward facility maintenance. In Seattle, using common building systems amongst facilities will decrease learning curves for maintenance personnel and will increase maintenance response time via higher purchasing power and higher likelihood of on-hand replacement parts.

Sustainable design method: Minimize total cost of ownership. Designing projects to be water and energy efficient is an obvious way to conserve maintenance costs. However, saving gallons of water and kilo-Watt hours of electricity doesn't save money in the long run unless the systems themselves are durable and easy to maintain. To ensure that a facility's design will endure the test of time, a total cost of ownership study should be conducted. The study combines the first time capital costs of new projects with the on-going maintenance and replacements costs

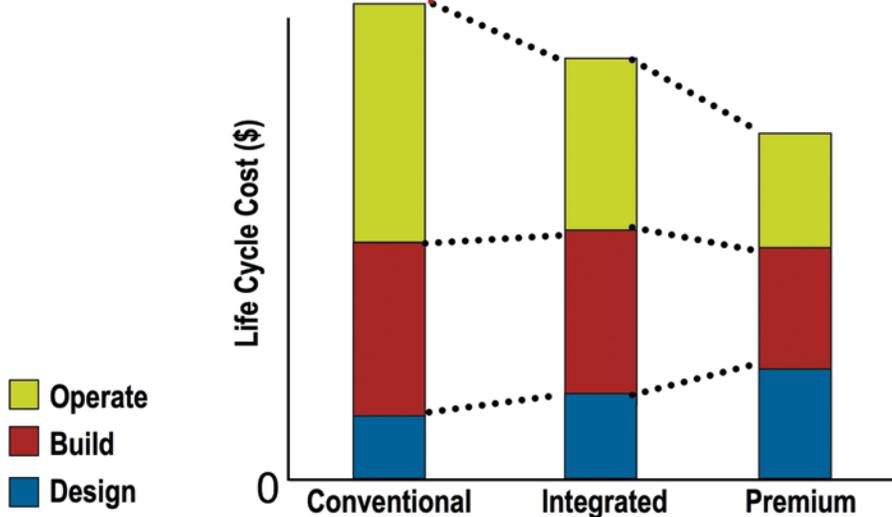
4. Allow Facilities to Accommodate Changes such as technological advances, evolving equipment and response types, and increased specialization. Although current trends have moved towards space compartmentalization in living areas, apparatus bays and equipment storage areas have become more flexible recently.

Sustainable design method: Utilize services provided by nature: passive solar, daylight, ventilation. While it may not be possible to allow 100% flexibility for any building space, providing for future changes within a fire station's living quarters and, separately, within the apparatus support areas is critical to long term sustainability. Sustainable strategies like passive solar, daylighting, and natural ventilation should be designed in a modular fashion to allow facility spaces to morph over time. For example, a natural ventilation design in one building space should not rely on a building opening in spaces with different operational criteria. To ensure that the designer's intent is understood when making future changes, teams should provide basis of design information in the final project documents.

5. Respond to Context of facility operations, community image, and community amenities. Seattle's new fire facilities must carefully consider both maneuvering apparatus around the facility and issues around integrating an emergency facility into an existing community. Contextual issues for replacement / upgrade facilities may be more focused on changes to the community context rather than siting a brand new emergency facility.

Sustainable design method: Create sense of community. Sustainable design emphasizes connecting to

Total Cost of Ownership



to determine which design solutions with the lowest overall cost. This type of study can be used to understand why it is sometimes better to invest more capital funding during construction.

the community through open space and green space, pedestrian-friendly streetscapes, and public education to raise awareness. Fire facilities can enhance the sustainability of their site's context by employing these strategies. For example, Seattle's Fire Station 10 is located adjacent to many tall buildings. To enhance the viewscapes of these buildings while improving the project's stormwater runoff and

thermal performance, two types of green roofs will cover the majority of the building. Fire Station 10 will also enhance pedestrian experiences through installation of public art and reduction of glare from building lights. The building's lighting design will minimize direct beams shining off of the site, which can reduce pedestrian night vision and views from nearby buildings.

APPENDIX C: TECHNICAL BRIEFS OF KEY CONCEPTS

- Harvest Rainwater and Greywater for Beneficial Use
- Manage All Stormwater with Rainwise Strategies
- Achieve Energy Efficiency 50% Beyond Code
- Utilize Hybrid HVAC | Natural Conditioning Scheme
- Illuminate with Natural Daylight and Integrate with Electric Lighting
- Create Safe and Healthy Environments





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