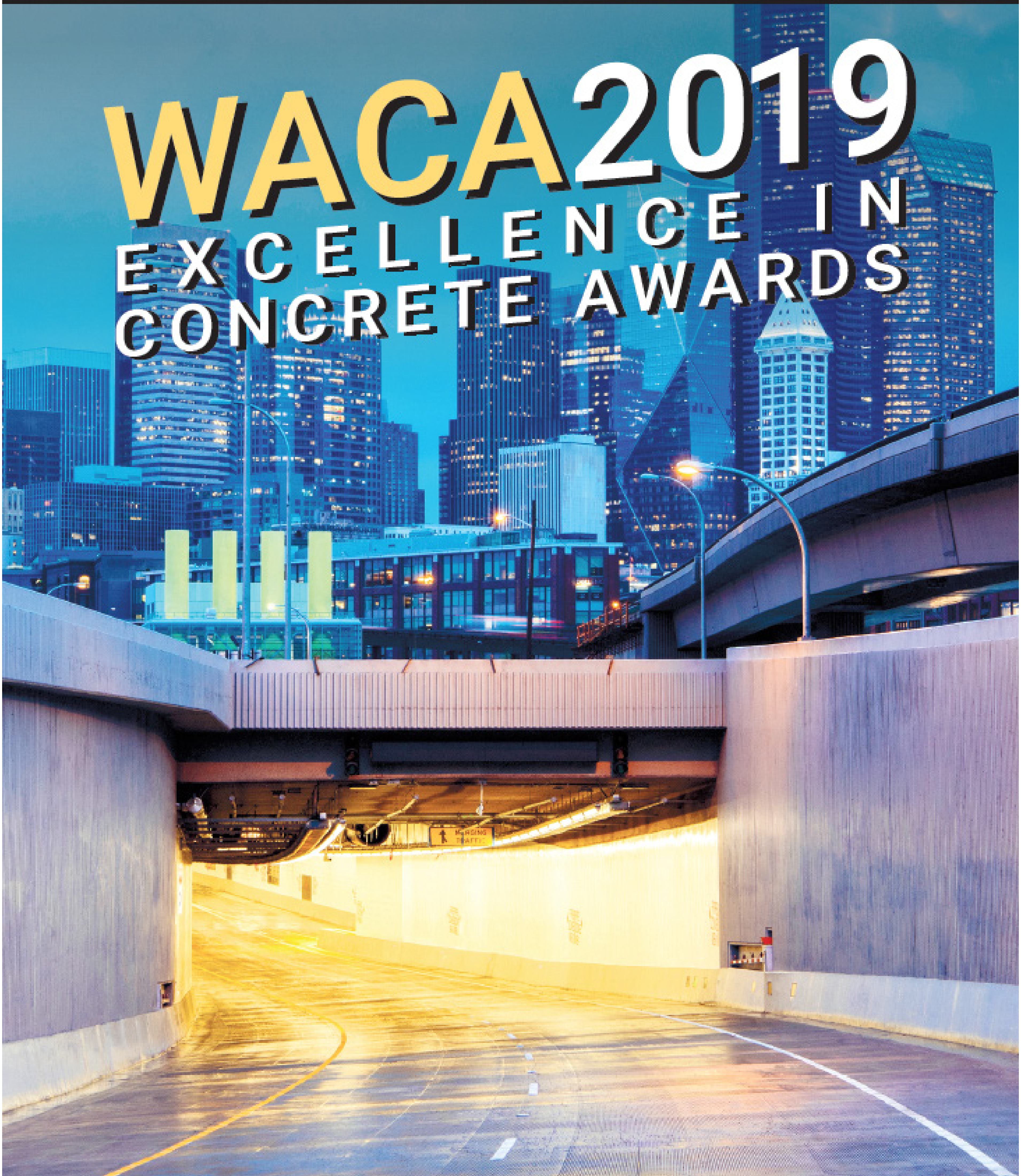
Seattle Daily Journal of Commerce

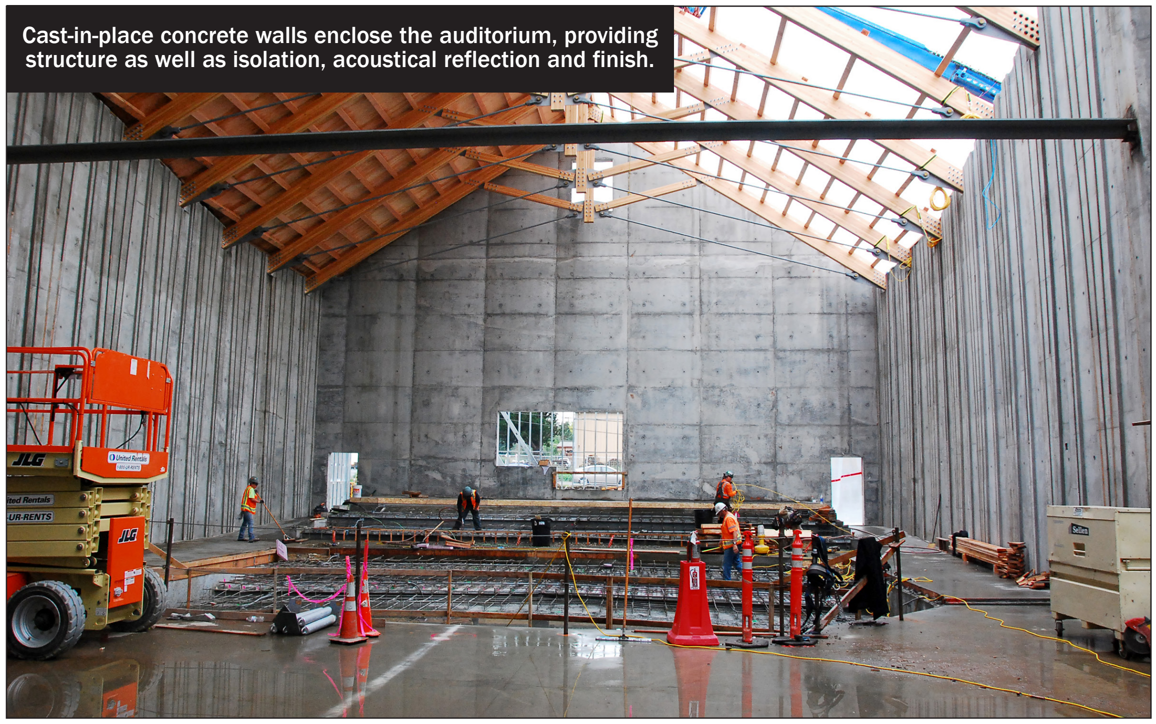
WACA 2019
EXCELLENCE IN CONCRETE AWARDS



September 27, 2019

LOW-RISE STRUCTURES

VASHON CENTER FOR THE ARTS



Cast-in-place concrete walls enclose the auditorium, providing structure as well as isolation, acoustical reflection and finish.

PHOTO PROVIDED BY WACA

Location: Vashon
Owner/developer: Vashon Center for the Arts
Team: Sellen Construction, general contractor; LMN Architects, architect; Lund Opsahl, structural engineer; CalPortland, ready-mix supplier

The design of the Vashon Center for the Arts focused on embracing the island's rural setting. A classic barn design structure, use of rustic materials, and mix of concrete elements reflect its Pacific Northwest character.

Modern design touches greet visitors with a north-facing glass wall mixed with high-gloss, polished concrete flooring in the reception area, offering a flood of daylight to interior spaces and a welcoming night beacon for evening performances.

Cast-in-place concrete walls enclose the auditorium, providing structure but also isolation, acoustical reflection and finish. The concrete walls support a 60-foot span, utilizing a heavy timber aesthetic. Roof weight and long spans were addressed by setting trusses with slotted holes to allow for sliding, housed within the concrete walls. The walls were finished with a matte-black concrete stain to reduce reflections in the performance space. The result is responsive to architectural aesthetics and developed with the integration of concrete, wood and steel.

Acoustical considerations included two distinct criteria for the structure's development: shield outside noise and provide responsive theater acoustics to performance type. Situated on the island's main road, outside transient sound includes sirens, traffic and jet noise. Exterior noise solutions included the use of concrete walls for mass that also served as shear wall.

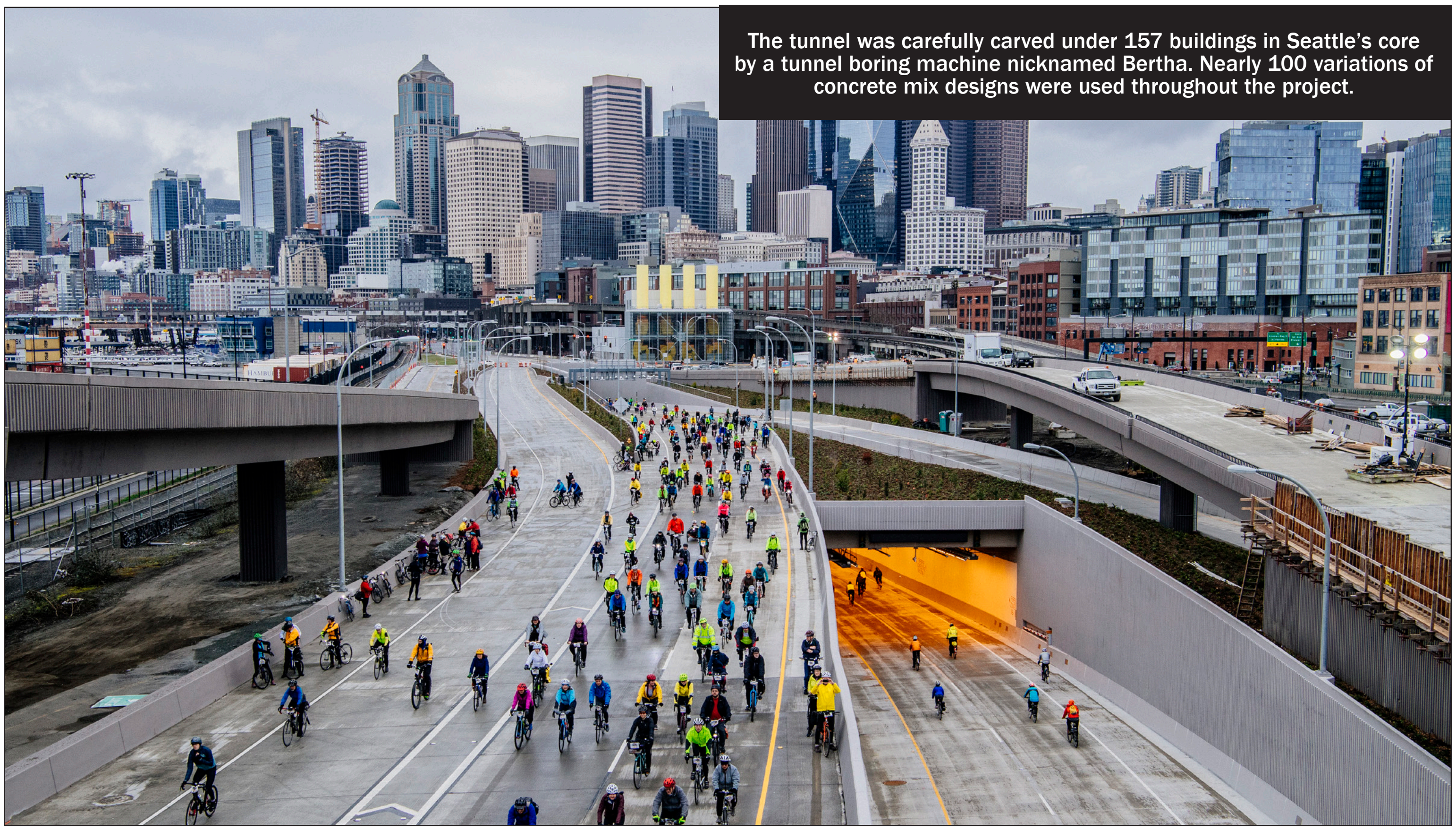
Inside the theater, the acousticians wanted to create a degree of surface roughness on the side walls to scatter high frequency sound and reduce its strength. The concrete walls were built utilizing forms liners to create deep, vertical lines and wide surface variations to provide micro-reflections when sound approached the walls from oblique angles. Wood slats were added to the vertical grooves in the concrete walls to further enhance high-frequency diffusion while supporting the natural aesthetic. The thoughtful integration of concrete and wood provides high-quality acoustics for single performers to large musical productions. Stepped seating areas over a full air plenum below the seats completes the concrete auditorium floor system, which also encloses the orchestra pit. The design provided the ability to step the concrete floor while maintaining the curvature and steps for seating rows.

Because of the cost of ferrying construction materials to Vashon, sourcing concrete with a local concrete supplier proved to be the most cost-effective solution for the owner. Owner advocacy throughout the project was a primary focus for the team.

INFRASTRUCTURE (TRANSPORTATION)

ALASKAN WAY VIADUCT REPLACEMENT/SR 99 TUNNEL

Location: Seattle
Owner/developer: Washington State Department of Transportation
Team: Seattle Tunnel Partners, general and concrete contractor; HNTB Corp., architect and structural engineer; CalPortland, ready-mix supplier



The tunnel was carefully carved under 157 buildings in Seattle's core by a tunnel boring machine nicknamed Bertha. Nearly 100 variations of concrete mix designs were used throughout the project.

PHOTOS PROVIDED BY WACA

GRAND AWARD

The Alaskan Way Viaduct replacement program known as the state Route 99 tunnel is the largest soft-ground bored tunnel in North America.

The 2-mile state Route 99 tunnel, with a 57.5-foot excavated diameter, replaced the aging Alaskan Way Viaduct as a critical part of one of the largest infrastructure projects in the United States.

Inside the tunnel, which winds under downtown Seattle, stacked 32-foot-wide roadways carry two southbound lanes atop two northbound lanes. The tunnel features state-of-the-art fire detection, fire suppression and ventilation systems and a security system with closed-circuit TVs.

After the magnitude 6.8 Nisqually earthquake in 2001, the Alaskan Way Viaduct revealed its vulnerability to seismic damage. As a result, the new SR 99 tunnel is designed to withstand roughly a magnitude 9.0 seismic event off the coast of Washington state.

To help optimize the tunnel's durability and longevity, concrete was the primary material used throughout the project. Many forms of concrete were used, including precast tunnel segments for the tunnel liner, precast panels for the northbound roadway decks, precast bridge girders at the north cut-and-cover structure, and cast-in-place concrete for drilled shafts and roadway structures.

A total of 220,000 cubic yards of cast-in-place concrete were delivered and placed on the project. That quantity of concrete placed under the logistical constraints of working underground, under a tight schedule and with high quality expectations is a true triumph.

The tunnel was carefully carved under 157 buildings in Seattle's core by a tunnel boring machine nicknamed Bertha. Normally, tunnel roadway construction would start after tunnel excavation. In the case of SR 99, construction of the southbound roadway was done concurrently, starting approximately 500 feet behind the tunnel boring machine, sequenced to keep both tunnel construction and road construction operations in sync.

Part of this sequence included the planning and execution of the tunnel roadway concrete pours. A custom-designed traveler form system was developed to construct the roadway walls and upper deck inside the tunnel, allowing the team to meet the aggressive construction schedule for all forming operations and concrete pours, while also considering factors including the winding tunnel route, lateral inclinations of the slab and accommodating doorway, plenum and other custom blockouts.

Producing and placing that much concrete also required the coordination of equipment and activities, which kept overall emissions below the applicable threshold. Mixer trucks were retrofitted with equipment to reduce emissions. Given the sheer size of the tunnel, as well as myriad applications of concrete inside the structure (including supporting walls and roadways), nearly 100 variations of concrete mix designs were used throughout the project.

As a result of detailed planning and continual communication among personnel, all pours were completed as scheduled.

Key metrics regarding SR 99 tunnel concrete elements were 220,000 cubic yards of cast-in-place concrete; 130,000 cubic yards of structural foundations, roadways, walls and decks inside the portals, tunnel and buildings; 90,000 cubic yards of shoring piles, excavation support and temporary structures; more than 1,500 secant piles; and 14,266 concrete precast segments, 2 feet in diameter, 6.5 feet wide and 18.2 feet radial length, composing the 9,273 feet of tunnel.

WASHINGTON AGGREGATES AND CONCRETE ASSOCIATION 2019 EXCELLENCE IN CONCRETE AWARD WINNERS

GRAND AWARD
Infrastructure (transportation)
Alaskan Way Viaduct replacement/ SR 99 tunnel
Seattle

Low-rise structures
Vashon Center for the Arts
Vashon

Low-rise structures (tilt up)
Georgetown Crossroads
Seattle

Mid-rise structures (nonresidential)
Building Cure
Seattle

High-rise structures
W Hotel tower
Bellevue

Infrastructure (non-transportation)
Amtrak railroad maintenance facility
Seattle

Concrete paving
Eighth Street cross-dock facility
Everett

Architectural and artistic
Grant Street Pier
Vancouver

Sustainable and resilient
Helen Sommers Building
Olympia

ON THE COVER

The Alaskan Way Viaduct replacement/SR 99 tunnel project in Seattle won the grand award at the Washington Aggregates and Concrete Association's annual Excellence in Concrete Awards, held in Seattle on Sept. 26. The project was also the category winner for transportation infrastructure.

DJC TEAM

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LOW-RISE STRUCTURES (TILT UP)

GEORGETOWN CROSSROADS

The warehouse offers second-story access to full-size trailers on a constrained urban site.

PHOTO PROVIDED BY WACA

Location: Seattle
Owner/developer: Prologis
Team: Sierra Construction, general and concrete contractor; Nelson, architect; DCI Engineers, structural engineer; Stoneway Concrete, ready-mix supplier

Georgetown Crossroads, a multilevel industrial facility, is the first of its kind in the United States.

What was a former shipping container storage site south of downtown Seattle is now a modern warehouse in a land-constrained urban area that gives commercial tenants a competitive edge for shortening delivery times to the end customer.

The three-level warehouse, at 589,000 square feet, offers more than double the capacity of what would have been possible for a one-story building. The truck courts and docks provide distribution center-type functionality. The floor layout is sized for material distribution via forklifts. The warehouse stands at about the height of a nine-story building and includes two levels of 130-foot semi-truck loading courts.

Level 1 can receive delivery trucks from both sides of the building (42 dock doors on the east side of the building and 24 dock doors on the west side); Level 2 includes two ramps designed for additional full-size trailer access (37 dock doors on the west side of the building). Level 3 is designed for light manufacturing or production space.

The structural engineer of record designed and detailed the warehouse's floor framing, roof framing, column and wall framing, lateral force resisting system, truck court framing and the structural transition to the bridge ramps.

An estimated 27,000 cubic yards of concrete was supplied for the project. The engineering team achieved the 50-by-45-foot and 60-foot speed bay column spacing and tall floor-to-floor heights (32 feet at Level 1). To accommodate the structural loads, the structural engineer designed member sizes comparable to those found in a tower structure. Built-up steel girders and custom beam-to-beam connections provided economy for the large bay dimensions and warehouse loading criteria.

The building's construction category is Type IB, which guided the project designers to build the facility with exterior tilt-up concrete panels. At 7.75 inches thick, the panels achieve a three-hour fire rating and reduced the cost of cladding compared with that of metal framing. They also provide a robust finish for the dock doors and distribution activity of the lower two levels.

To maximize the bays of dock doors, the structural engineer used the perimeter tilt panels in lieu of steel braced frames for the lateral force resisting system. The tilt panels could not extend practically to the 85-foot tall roof, so the engineering team developed an additional seismic load transfer from the braced frames above to the lower-level tilt panels.

Another design challenge was the floor truck court, which has a 4-foot elevation difference from the interior space. To achieve the elevation difference, the engineers worked with the general contractor to design specific connections through the steel framing and tilt panels that accommodated the construction sequencing at this complex area of the project.

The project team's effort for these connections enabled full seismic load transfer through the elevation step and avoided a costly seismic joint and extra shear walls or braced frames, which would have reduced the number of dock doors for the truck court.

MID-RISE STRUCTURES (NONRESIDENTIAL)

BUILDING CURE

Location: Seattle
Owner: Seattle Children's Research Institute
Team: Lease Crutcher Lewis, general and concrete contractor; Aedas, architect; KPFF Consulting Engineers, structural engineer; Stoneway Concrete, ready-mix supplier

At the 13-story Building Cure, Seattle Children's Research Institute will develop cures to childhood diseases and provide cutting-edge cell therapy to cure 1,000 child cancer patients per year.

The team's goals for 63,000 cubic yards of mild-reinforced structural and architectural concrete were far-reaching — continuously placed obround columns up to 39 feet, columns that sloped to match the plane of the exterior enclosure, suspended flat slabs, vibration isolation, seamless joints, transfer beams, unique radii, one of Seattle's steepest speed ramps and very high finish standards with no sacking.

Lease Crutcher Lewis' in-house concrete team — McClone (horizontal formwork), EFCO (core/column formwork), Pacer Steel (rebar), Stoneway Concrete (ready-mix) and Brundage Bone (pumping) — built outstanding quality, saved the client money on the core/column/decks and finished the structure ahead of schedule.

Cost and schedule were priorities, since every dollar or day saved would help cure childhood disease.

Concrete columns were sloped to match the plane of the exterior enclosure.

PHOTO BY TIM RICE

HIGH-RISE STRUCTURES

The W Hotel tower's innovations included the use of high-strength steel fiber reinforced concrete in the shear wall coupling beams, the largest use ever in North America.

PHOTO PROVIDED BY WACA

W HOTEL TOWER

Location: Bellevue
Owner/developer: Kemper Development Co.
Team: GLY Construction, general contractor; HKS Architects, architect; Cary Kopczynski & Co., structural engineer; McClone Construction Co., concrete contractor; Cadman, ready-mix supplier

The 41-story W Hotel tower features luxury hotel rooms and upscale apartments atop a three-level podium, with six subterranean parking levels below. The retail podium includes boutique shops, an upscale theater and a wide variety of restaurants.

The subterranean parking provides 2,200 spaces and connects to the adjacent Lincoln Square parking via a tunnel.

The W Hotel tower incorporated numerous innovative design features. These included the use of high-strength steel fiber reinforced concrete (SFRC) in the shear wall coupling beams, the largest use ever in North America. The building also incorporated a unique long-span framing system throughout the subterranean garage, 14,000 pounds per square inch column concrete to minimize the number and size of columns and Grade 80 rebar to reduce steel tonnage and improve constructability.

The W Hotel tower is fully constructed of cast-in-place concrete, with two-way flat plates in the hotel and residential tower, and a combination of one-way and two-way post-tensioned slabs in the podium and subterranean parking.

Concrete shear walls resist seismic loads for both the tower and podium. In the tower, flat-plate post-tensioned slabs enabled the use of long perimeter cantilevers, as well as generous balconies that were cast integral with the slabs, the most efficient system for balcony construction.

The subterranean parking utilizes one-way post-tensioned slabs with wide-shallow beams to create expansive open space and user-friendly parking. The placement of the concrete basement walls were delayed and taken off the critical path, which allowed the concrete frame of the tower to advance ahead with greater speed.

This also allowed the shrinkage of the concrete deck to essentially complete prior to the placement of the basement walls, resulting in parking slabs that are virtually crack free. In addition to creating longer spans, the use of post-tensioned slabs reduced the subterranean floor-to-floor height, which minimized the excavation and shoring depth.

The use of SFRC in the shear wall coupling beams streamlined construction by eliminating all diagonal beam reinforcing bars, the most difficult bar in a concrete frame to install. In addition, SFRC significantly reduced the quantity of the remaining horizontal beam bar and stirrups.

The W Hotel tower is the largest-ever use in North America of SFRC for shear wall coupling beams in high seismic regions. SFRC, a new method of designing and constructing shear wall coupling beams, reduces total beam rebar by up to 40% and improves shear wall constructability. This creates an overall cost savings and accelerates construction, compared with traditional coupling beam design.

INFRASTRUCTURE (NON-TRANSPORTATION)

AMTRAK RAILROAD MAINTENANCE FACILITY

Location: Seattle
Owner/developer: National Railroad Passenger Corp./Amtrak
Team: PCL Construction, general and concrete contractor; TKDA, architect; Hanson Professional Services, structural engineer; Cadman, ready-mix supplier

Amtrak's 380-by-80-foot pre-engineered metal service facility houses a 55-ton overhead bridge crane and a 125-ton drop table.

PHOTO PROVIDED BY WACA

Demolition of an existing 35,000-square-foot, asbestos-contaminated warehouse was needed in Amtrak's King Street Coach Yard in Seattle to make room for the new 31,000-square-foot locomotive service facility.

This new maintenance shop sits atop 178 steel-driven pipe piles, each with a diameter of 24 inches. These piles were driven to a depth averaging 180 feet below grade. A heavily reinforced structural system of concrete-grade beams is used to tie the pile foundations together to support this new pre-engineered metal building.

The 380-by-80-foot pre-engineered metal building houses a 55-ton overhead bridge crane and a 125-ton drop table that is used to switch out traction motors and locomotive axles (trucks) for Amtrak's maintenance needs.

This drop table is located in a 25-foot-deep concrete pit in the center of the locomotive shop, as the trucks need to be removed from the underside of the locomotives. This complex structural system of building components and equipment is amplified as the poor soil conditions, high water table, high seismic hazard zone and dynamic loading from locomotives are all considered.

Other infrastructure upgrades in Amtrak's yard included an underground stormwater detention system, 12,000 lineal feet of yard track demo, realignment and new yard track installation. An underground force main for industrial waste was added and routed over 1,000 feet from the new locomotive shop to Amtrak's existing industrial waste treatment facility on site.

This line paralleled a new sanitary sewer force main that combined two existing buildings on the Amtrak site with the new locomotive shop's needs. Together, four underground lift stations with depths up to 15 feet deep were needed to route over 2,500 lineal feet of industrial waste and sanitary lines through a variety of underground unforeseen rail yard debris and obstacles.

More than 7,200 cubic yards of concrete were placed into steel piles, grade beams, deep pit walls, and slab on grade to form the foundation for the new locomotive facility. The first concrete placements started with filling the 178 steel pipe piles. Concrete activities continued for seven months to complete the foundation that spanned approximately 31,000 square feet. Structural requirements for locations of construction joints meant that over 50 individual concrete placements had to take place, adding complexity to this robust structural system.

In addition to the heavily reinforced concrete grade beams and the more than 1,300 anchor rods that were cast, a challenging portion of this project was the construction of the 25-foot-deep drop pit, which measures 30 by 60 feet. Internally braced temporary sheet piling was installed to allow construction of the 24-inch-thick concrete walls and slabs. This pit concrete has an integral crystalline waterproofing admixture that keeps this critical work space dry as the ground water table sits 19 feet above the pit slab.

CONCRETE PAVING

The pavement was placed using a new adaptive concrete placement technology.

PHOTO PROVIDED BY WACA

EIGHTH STREET CROSS-DOCK FACILITY

Location: Everett
Owner/developer: KW EVT LLC
Team: Kirtley-Cole Associates, general contractor; Reid Middleton, civil and structural engineer; LangCo NW, concrete contractor; Miles Sand & Gravel, ready-mix supplier

Along the shore of the Snohomish River on the Interstate 5 corridor is a 16-acre site that is home to a brand new distribution center with 499,900 square feet of concrete pavement for heavy loads for distributions to and from the warehouse.

All 11,685 cubic yards of concrete pavement were placed at 7.5 inches thick throughout the site, and placements utilized a new adaptive concrete placement technology and technique: the Somero S-22E laser screed equipped with a 3D profiler system and total station. It allows for automatic, accurate paving of contoured sites in dimensions of all shapes, configurations and varying slopes.

The largest single placement utilizing this equipment on this project was 150 by 360 feet, totaling 54,000 square feet. Utilizing the tool allowed LangCo NW's Somero-certified personnel and ACI-certified flatwork finishers to achieve exceptional results in sloped, contoured pavement on site with varying shapes and configurations.

This technological upgrade in the industry has revolutionized concrete paving techniques on parking lots, loading docks and service areas. It's also used to "overlay" deteriorated parking lots and streets, being utilized to white top and repair roadways, runways, taxiways and bridges.

Utilizing this equipment and technology will enable concrete contractors and ready-mix suppliers to compete in traditional asphalt parking lots being converted into concrete parking lots of varying shapes, slopes, and configurations—thus increasing its share of the marketplace.

2019 EXCELLENCE IN CONCRETE AWARDS RUNNERS-UP

Sustainable and resilient
Sharpe Avenue stormwater improvements
Location: Spokane
Owner/developer: City of Spokane

Low-rise structures
Skagit County Community Justice Center
Location: Skagit County
Owner/developer: Skagit County

Mid-rise structures
Helen Sommers Building
Location: Olympia
Owner/developer: State of Washington

High-rise structures
Kiara
Location: Seattle
Owner/developer: Holland Partner Group

Architectural and artistic (nonresidential)
Bellevue Downtown Park
Location: Bellevue
Owner/developer: City of Bellevue

ARCHITECTURAL AND ARTISTIC

GRANT STREET PIER

The Grant Street Pier is a concrete, cable-stayed structure that projects almost 100 feet over the Columbia River.

PHOTO PROVIDED BY WACA

Location: Vancouver
Owner/developer: City of Vancouver
Team: Rotschy, general and concrete contractor; Larry Kirkland, architect; BergerABAM, structural engineer; CalPortland, ready-mix supplier

The $24 million Vancouver Waterfront Park offers not only public plazas, viewpoints, a water feature, a playground and an urban beach, but it also creates public access to the Columbia River for the first time in almost a century.

The project's focal point is the Grant Street Pier, a concrete, cable-stayed structure that projects almost 100 feet over the river. As part of the city of Vancouver's $1 billion waterfront revitalization program, the park anchors the plan for multifamily and commercial growth in the downtown Vancouver area.

The pier uses white colored concrete instead of painted steel or painted concrete. This board-finished concrete design creates a striking aesthetic between the ground and pier deck. Cast-in-place concrete was chosen for economics and environmental sustainability benefits. Concrete reduces maintenance requirements and eliminates the need for future over-water painting. The white concrete of the backstays creates a clean contrast to the blue waters of the Columbia.

The design of the Grant Street Pier's foundation faced a number of challenges, including unstable soils and a constrained site. Teams collaborated to design a system that includes drilled shafts, sheet piles, micropiles and ground anchors. Particularly innovative was the dual purposing of a portion of the work-isolation cofferdam. The site is underlain by liquefiable sand that can result in lateral spreading during an earthquake, causing the ground to move toward the river.

The most economical mitigation for lateral spreading is usually ground improvement, such as the installation of stone columns. However, the permanent foundation elements were located completely upland of the ordinary high-water mark in a very narrow right of way between the river and the private development.

The design and artistic vision of the pier was inspired by engineering. The materials chosen for the park include white cement, painted and stainless steel, basalt, timber decking and native vegetation, but it is the concrete pier that is the centerpiece of the park.

SUSTAINABLE AND RESILIENT

HELEN SOMMERS BUILDING

Concrete mixes for the project were redesigned to reduce their embodied carbon.

PHOTO PROVIDED BY WACA

Location: Olympia
Owner/developer: State of Washington
Team: Sellen Construction, general and concrete contractor; ZGF Architects, architect; KPFF Consulting Engineers, structural engineer; CalPortland, ready-mix supplier

Completed in 2017, the Helen Sommers Building is the first design-build project for the state Department of Enterprise Services. The five-story, 215,000-square-foot building covers an entire block and serves as the new home of the Washington State Patrol, the Office of Financial Management, the Office of the State Treasurer and other legislative and support agencies.

The state of Washington challenged the design-build team to deliver a new model of energy efficiency and sustainability. In addition to reducing greenhouse gases from building operations by 71%, the team focused on minimizing the embodied carbon in concrete as a complementary path to reduce overall greenhouse gas emissions.

By redesigning the concrete mixes for this project and producing environmental product declarations for almost all mixes, the team reduced the overall embodied carbon in the concrete by 27% compared with similar mixes in the Pacific Northwest. Compared to national averages, this project reduced the overall embodied greenhouse gas by 31%.

The maximum greenhouse gases reduction for a specific mix used in this project was 58% compared with the national average. By optimizing the 12,024 cubic yards of concrete placed in this project, 1,386 metric tons of greenhouse gases were saved — the equivalent of not driving 3.4 million car miles.

The requirement to limit overall building height to below the elevation of the capitol dome necessitated a thin floor structure and led the team to post-tensioned concrete decks as the preferred structural system.

The raw materials of concrete were available locally, which helped minimize transportation emissions; however, the greater challenge was to reduce the emissions associated with the cement content during concrete production.

Through a series of meetings with the concrete producer, the design team identified structural requirements, constructability needs and greenhouse gases reduction goals for the concrete mixes. To reduce the quantity of cement — the greatest source of embodied greenhouse gases in concrete — the materials engineer proposed mixes with supplementary cementitious materials such as ground granulated blast furnace slag. The maximum percentage of supplementary cementing materials used in this project's mixes was 50%.

As part of its design-build competition package, the team proposed creating new environmental production declarations for this project's concrete mixes as a way to measure the team's efforts to reduce embodied greenhouse gas impacts from the business-as-usual condition.

This project was the first publicly funded project in Washington that required environmental production declaration data for concrete mixes — 99.7% of this project's concrete has environmental production declaration data, providing a clear and quantifiable picture of the project's embodied greenhouse reduction amounts. As a result of this project, the concrete producer made environmental production declarations not only for the Helen Sommers Building, but also for 90 of its commonly used mixes in its Seattle, DuPont and Tumwater plants.

This has been catalytic for Washington's concrete industry. Prior to this project there were five environmental production declarations available for mixes in Washington state; today the number of environmental production declarations for concrete produced in Washington exceeds 2,000.