PROJECT

Interstate 5 over 26th Avenue

A creative solution results in added value for the Oregon Department of Transportation and the public

by Joel Tubbs, David Evans and Associates Inc., and Robert DeVassie, Oregon Department of Transportation

Only a single 56-hour closure was required for replacement of the Interstate 5 bridge over SW 26th Avenue in Portland, Ore. Photo: David Evans and Associates Inc.

After decades of deck performance issues and a recent realization that a seismic retrofit would be cost prohibitive due to the need for full replacement of the timber pile foundations, the Oregon of Department of Transportation (ODOT) determined that the Interstate 5 (I-5) bridge over SW 26th Avenue in Portland, Ore., was reaching the end of its service life. ODOT then partnered with a consultant design team to find an innovative solution that would improve long-term safety for the traveling public. ODOT decided that the best option would be to replace the existing, maintenance-intensive, and seismically insufficient, three-span bridge with a new, single-span, steel-pile-supported structure designed to current static and seismic standards. To mitigate freight mobility concerns and avoid scheduling conflicts with other large infrastructure projects, construction completion was targeted for summer of 2024.

Several factors—limited right-of-way; residential, commercial, and environmental elements; and topographic constraints—would have made it challenging and expensive to use traditional bridge-replacement methods. The original concept included an on-site detour structure and five construction stages. ODOT anticipated that this concept would cost more than $19 million and affect I-5 traffic for two years. The temporary detour alignment would require easements in adjacent parcels and conflict with a critical, existing stormwater treatment facility. Any impact on the performance of that facility would require redesigning it to current federal standards. The staged construction, right-of-way process, and stormwater design and permits of this original concept posed significant cost, schedule, and safety risks for the project.

To determine the best use of public funds, ODOT implemented a value-engineering (VE) process for the project. The VE team recommended a concept that incorporated a new, single-span structure erected under the in-service, existing I-5 bridge, without shifting the alignment and without affecting I-5 traffic. The adopted VE alternative required closing both directions of I-5 for a 56-hour window so the existing superstructure could be demolished, and a new flexible pavement section could be constructed. This solution provided not only cost and schedule savings but was better aligned with ODOT's goals to minimize impacts to the traveling public, adjacent properties, and the environment. Throughout the design process, the design team worked as partners with ODOT staff to develop solutions to the unique and complex issues the project presented.

Replacement Structure

The constructed bridge has a 55-ft span length, is constructed with twenty-eight 30-in.-deep, 48-in.-wide prestressed concrete voided slabs that accommodate a maximum roadway width of approximately 105 ft. The bridge is buried under about 4 to 6 ft of roadway embankment fill and asphalt concrete pavement. ODOT standard prestressed concrete voided slabs were selected because they have a proven

profile

INTERSTATE 5 OVER SW 26TH AVENUE BRIDGE REPLACEMENT / PORTLAND, OREGON

BRIDGE DESIGN ENGINEER: David Evans and Associates Inc., Portland, Ore.

GEOTECHNICAL ENGINEER: Shannon and Wilson Inc., Lake Oswego, Ore.

PRIME CONTRACTOR: HP Civil Inc., Salem, Ore.

CONCRETE SUPPLIER: Wilsonville Concrete Products Inc., Wilsonville, Ore.

PRECASTER: Knife River, Harrisburg, Ore.—a PCI-certified producer

OTHER MATERIAL SUPPLIER: Low-density cellular concrete: The Conco Companies, Concord, Calif.

Because vertical access is limited, workers use specialized, low-overhead equipment to construct micropiles. Photo: Shannon and Wilson Inc.

history of performance and strict quality control standards, and could maximize the clearances across the full width of SW 26th Avenue.

Multipronged Strategy for Success

To successfully realize the benefits of the VE concept for all users and affected parties, the team implemented a combination of key design and construction strategies.

Accelerated Bridge Construction

The project team leveraged accelerated bridge construction methods, such as the use of prefabricated bridge elements, lateral translation technology, and pressure-grouted concrete connections, to facilitate construction of the bridge superstructure without traditional vertical (that is, overhead) construction access. A key element of this strategy was a scheme to perform the staged lateral translation of the prestressed concrete voided slabs to mitigate issues related to space and right-of-way constraints. With only about 50 ft of space available for temporary supports on the southbound side of the existing bridge, a maximum of 10 slabs per stage could be set at one time. For each stage, each slab was placed onto the lateral slide system, which was supported on temporary falsework; then, each slab was connected to the previous slab with tie rods, the keyways between slabs were grouted, and waterproofing membrane was applied. All slabs that had been connected by the end of each stage were moved under the existing bridge to accommodate setting and connecting the next stage of slabs. The first and second stages connected 10 slabs each, and the third stage connected 8 slabs. Therefore, the first translation included only the 10 slabs connected in the first stage, the second translation involved 20 slabs, and the final translation was for all 28 slabs and ended with the slabs in their final positions. The lateral slide system included the jacking beam that directly supported the slabs, rollers that accommodated the translation from pulling on the jacking beam, and a slide track that provided the smooth surface the rollers ran on.

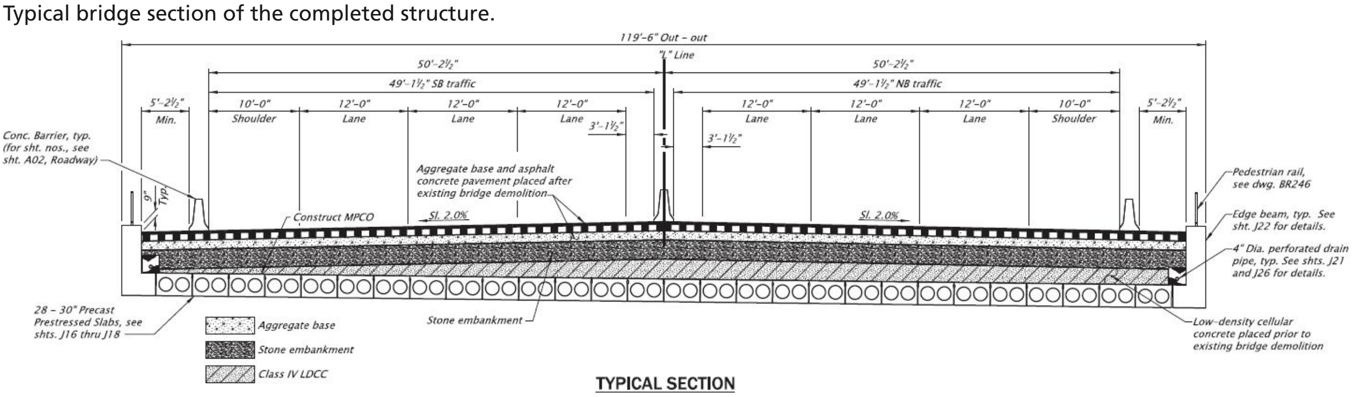
Specialized Equipment

Because of the depth of soft soils at the site, the existing and new bridges were required to be supported on deep foundations. To install deep foundations, crews typically need vertical access for pile driving or drilled shaft equipment. However, with the existing bridge overhead, this type of access was not an option. Additionally, the required horizontal clearance under the new bridge and the presence of existing foundations imposed constraints on the available width of the new bridge foundation. To address these issues, micropiles—built with specialized, low-overhead equipment, anchored into the underlying rock, and with narrow pile caps—were constructed.

Innovative Materials

Low-density cellular concrete (LDCC) was used behind the new abutments as a self-leveling, self-consolidating, retained fill under the existing bridge end spans. To mitigate settlement issues due to the weight of the fill under these end spans, the LDCC and associated

Typical bridge section of the completed structure.



OREGON DEPARTMENT OF TRANSPORTATION, OWNER

BRIDGE DESCRIPTION: 55-ft single-span, prestressed concrete slab bridge

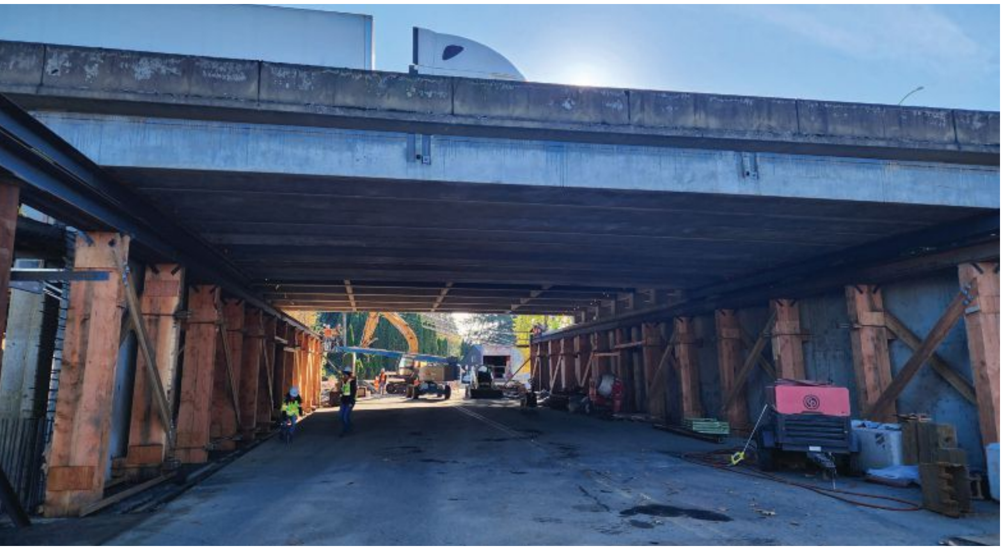
STRUCTURAL COMPONENTS: Twenty-eight 30-in.-deep × 48-in.-wide prestressed concrete voided slabs, cast-in-place concrete portal frame, abutment walls, pile footings

BRIDGE CONSTRUCTION COST: $4.75 million

AWARDS: 2025 PCI Design Award: Bridge with a Main Span Up to 75 Feet; 2025 American Council of Engineering Companies (ACEC) Oregon Project of the Year; 2024 Institute of Transportation Engineers (ITE) Oregon Project of the Year; 2025 ITE Western District Project of the Year; 2025 ACEC National Recognition Award

First group of prestressed concrete slabs are ready for lateral translation. Photo: David Evans and Associates Inc.

Translation of the first stage of precast concrete slabs under the existing bridge. Photo: David Evans and Associates, Inc.



The first stage slabs have been moved under the bridge and the temporary falsework and lateral translation system are ready for setting the second stage of prestressed concrete slabs. Photo: David Evans and Associates Inc.

excavation were designed to achieve a near net-zero overburden pressure on the excavated surface. ODOT had not previously used LDCC as the reinforced backfill for mechanically stabilized earth bridge walls on a project of this scale, so special authorization was required.

Industry Review and Input

To ensure confidence in the feasibility of the design and construction costs, ODOT led a contractor constructability review workshop when about 60% of the design was completed. The workshop included one-on-one sessions with any interested contractor. Ultimately, seven contractors reviewed and commented on in-progress design plans and exhibits. To ensure a fair and transparent bidding process, notes from each of the sessions were posted on ODOT's Electronic Bidding Information Distribution website, which all contractors can view and anyone is free to join.

Sustainability Enhancements

To improve sustainability on the project, the general contractor and ODOT agreed to reuse the demolished bridge waste as roadway fill during the closure. Using the demolished material kept material out of the landfill, reduced costs, and eliminated truck emissions associated with importing fill and transporting waste to the landfill.

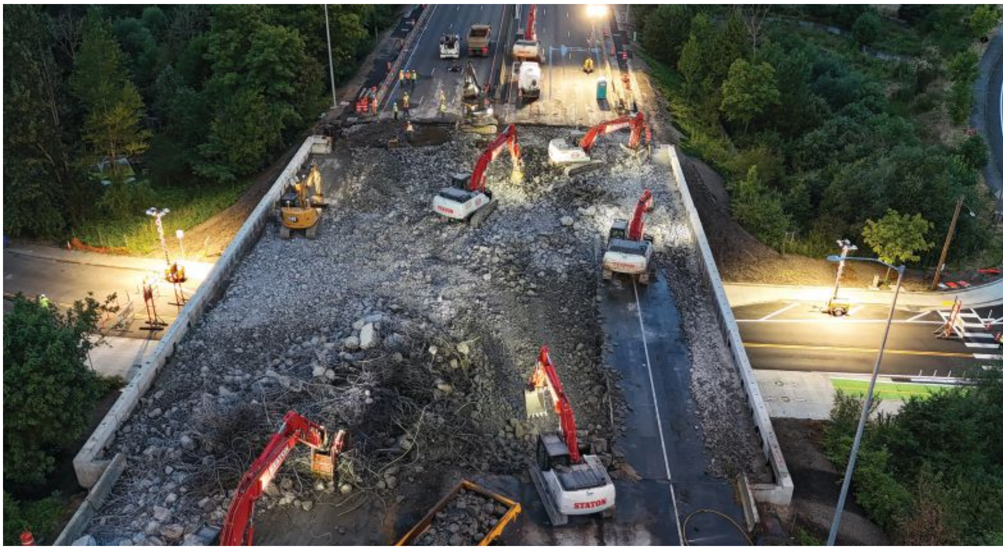
Collaborative Closure Planning

Planning for the weekend closure of the full-width of I-5, which was critical to the success of the entire project, was a lengthy and complex process. During the design phase, ODOT and the design team secured buy-in for the full closure from the ODOT-led Mobility Advisory Committee, which includes representatives from the trucking industry, mobile home industry, oversize load freight, automobile users, general contractors, paving contractors, bicycle users, and pedestrians. ODOT initiated early coordination with interested parties two years in advance of the start of construction. Also, during the design phase, the team used risk-based analysis to provide flexibility in the contract to help minimize contractor risk. The execution of the 56-hour weekend closure then required careful planning, hour-by-hour scheduling, backup resources, and extensive coordination among ODOT, the design team, and the contractor.

Low-density cellular concrete (LDCC) backfill is placed behind the new abutments. LDCC backfill was used to achieve a near net-zero overburden pressure on the excavated surface. Photo: David Evans and Associates Inc.

Effective Outreach

The project team's public outreach strategy sought to not only convey the project's cost- and time-saving benefits but also generate awareness of the unique engineering concepts being applied to replace the deteriorating structure. By telling the story of not just the "what" but also the "why" and the "how," the team helped people relate to the project and understand the benefits that engineering can bring to their communities. Social media was key for communicating with audiences who are usually not reached by typical advertising and outreach methods, and it also enabled live updates during the closure.



Demolition of the existing superstructure during the weekend closure. The debris was used as roadway fill, which kept the material out of the landfill. Photo: Oregon Department of Transportation.

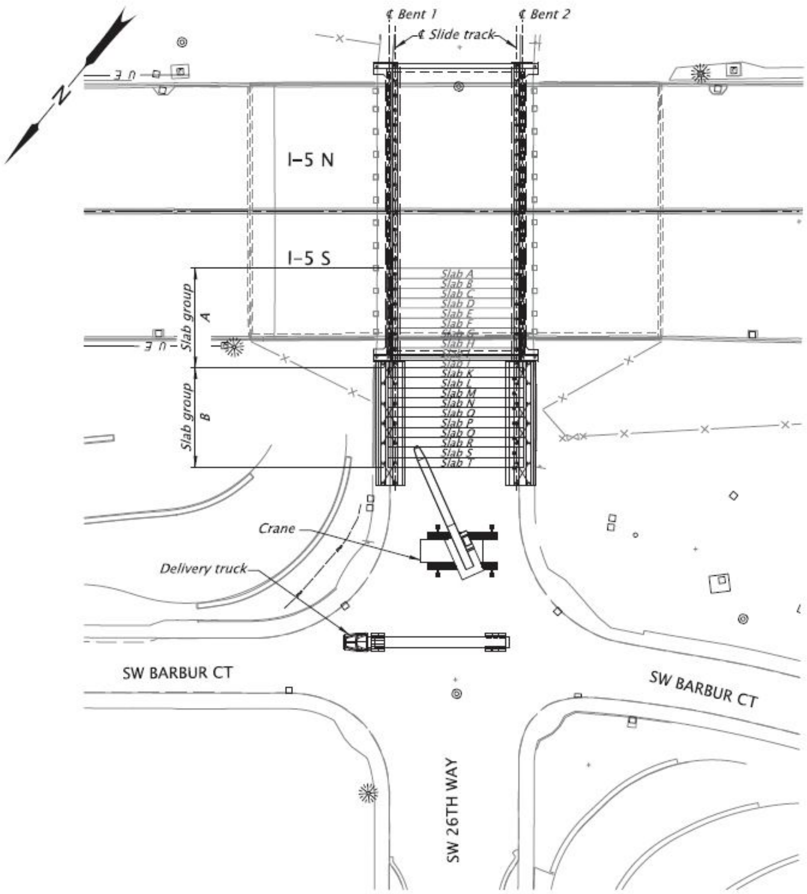
Balanced Multimodal Impacts

The project's impact on local vehicular, bicycle, and pedestrian traffic on SW 26th Avenue was a crucial consideration. The local vehicular detour was relatively short, but it was still too long for bicycle and pedestrian traffic. Also, the Portland Bureau of Transportation (PBOT) was ready to construct a multiuse path between neighborhoods on either side of the bridge, and it was important to ensure that the bridge project would not unnecessarily impede pedestrian and bicycle traffic along that path. Fortunately, the project team was able to maintain bike and pedestrian access except during the weekend closure.

Efficient Contracting

The design of PBOT's multiuse path under the bridge and through the adjacent intersection with SW Barbur Court included enhanced striping, bicycle lanes, and accessible curb ramps. ODOT, PBOT, and the design team worked together to optimize multimodal connectivity along SW 26th Avenue under I-5 in the following ways: coordinating design details between the two design projects, implementing temporary bicycle and pedestrian routes that tied into PBOT's neighborhood improvements, and incorporating the construction of the multiuse path into the project's ODOT contract. This streamlined approach avoided a lengthy permitting process for both agencies, eliminated potential interface risks associated with multiple contractors working in the same area, and removed the potential need to reconstruct PBOT-completed elements on SW 26th Avenue

Aerial view of the completed structure showing the multimodal improvements. Photo: Oregon Department of Transportation.



SLAB ERECTION - STEP 2

The 10 slab beams of the second stage are placed on the lateral translation system after the first stage beams have been moved under the existing bridge.

after the bridge construction was complete.

Conclusion

The combination of design and construction strategies helped solve several complex issues surrounding the project. The closure was successful, finishing two hours early with no reported incidents on the detour routes. Compared with the original concept, the project eliminated two years of work-zone impacts to more than 100,000 commuting, freight, and transit vehicles per day on I-5. Because bridge construction occurred completely on SW 26th Avenue and bridge demolition and highway construction happened during the weekend I-5 closure, freeway traffic never needed to travel through an active I-5 work-zone.

The success of the project and the lessons learned during implementation demonstrate that variations of this concept could be readily scaled to solve different problems. Local agencies with limited funds could use this concept to save on costs for smaller scale, but still expensive bridge replacements, or to rapidly perform emergency repairs.

The I-5 over SW 26th Avenue bridge replacement project required a collaborative team that could work together to adapt new techniques and applications, address high-risk elements, and ultimately provide a project that maximizes the return on investment for taxpayers. ODOT and the design team collaborated to find solutions through frequent meetings between agency and consultant subject matter experts, including experts in structures, materials, geotechnical, traffic, and risk management, leading to a final product that accomplished the original project goals with added value. The bridge design was delivered approximately 20% under budget and was constructed by its target completion date of summer of 2024. The team achieved nearly 30% savings relative to the original estimate based on traditional bridge construction.

Joel Tubbs is a senior bridge engineer and project manager for David Evans and Associates, Inc., in Portland, Ore. Robert DeVassie is a resident engineer and project manager for the Oregon Department of Transportation in Portland.