Eleven bridges were required for the project

THE I-5 SOUTH MEDFORD Interchange

by Keith Kaufman, Knife River Corporation—Northwest
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Interstate 5 is a major transportation corridor that is parallel to the Pacific Ocean coastline and links California, Oregon, and Washington. Motorist traveling north from California cross the Siskiyou Summit in Oregon and descend into the Rogue River Valley and the cities of Ashland, Medford, and Grants Pass. Interstate 5 also parallels Bear Creek from Ashland to just north of Medford where the creek flows into the Rogue River. Medford is the southern gateway to the famous Crater Lake National Park.

The South Medford Interchange (SMI) links I-5 and East Barnett Road and is only one of two freeway interchanges in Medford. The existing interchange did not meet current design standards and was severely congested during peak traffic periods. Projections of future traffic demands showed worsening congestion with levels of service far below reasonable driver expectations.

The Oregon Department of Transportation (ODOT) elected to construct a new South Medford Interchange about 0.4 miles south of East Barnett Road. It eliminated I-5 access at East Barnett Road. Instead, Highland Drive, which runs north-south, would be extended south from East Barnett Road, curve west to I-5, and meet with the eastward extension of Garfield Street. The new interchange would then be at the Garfield Street and Highland Drive intersection with I-5. The South Medford Interchange improves the safe and efficient movement of goods, people, and services to the rapidly growing community.

Design Challenges

The Bear Creek Greenway and pedestrian-bicycle pathway are located just east of the interchange and then pass under I-5 just south of the project. The proximity of Bear Creek limited ramp access to the new interchange. Therefore, all traffic movements on and off I-5 had to be held close to I-5. ODOT selected a single-point urban interchange (SPUI) to minimize the right of way required and impacts to the existing neighborhoods, businesses, and sensitive environmental area. The SPUI improves the primary function of the interchange including safe and efficient travel, accommodating planned land use and growth, improving multimodal connectivity, and improving interchange operations. ODOT has previous experience with this type of interchange. It constructed a SPUI at the intersection of Market Street and I-5 in Salem, Ore., in the late 1990s. That SPUI was under I-5. The SMI SPUI, however, needed to be constructed above the I-5 alignment.

Another unique challenge for the designers was the need for a mechanically stabilized earth (MSE) island on the east edge of the interchange. This island incorporates four abutments: the main bridge over I-5, on and off ramps for I-5 northbound, and the Highland Drive Bridge spanning Bear Creek to the east. The island was sized and located to allow each of the four bridges to remain independent and provide a stable base to obtain maximum vertical bridge clearance with the smallest footprint. The existing bridges carrying I-5 over Bear Creek were replaced. The longest bridge over Bear Creek with a 172-ft-long span, replaced an existing bridge over Bear Creek on East Barnett Road. Other structures were required to span local creeks on the project. A total of 11

This is a view looking south where Highland Drive crosses I-5 at the South Medford Interchange. Four bridges over Bear Creek are shown south of the overpass. All photos: Wildish Construction Co.

profile

SOUTH MEDFORD INTERCHANGE BRIDGES / MEDFORD, OREGON

BRIDGE ENGINEER: H.W. Lochner Inc., Salem, Ore.

GENERAL CONTRACTOR: Wildish Construction Co., Eugene, Ore.

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

bridges were needed for the interchange and associated realignments.

To meet the 75-year service life requirement with limited maintenance, and to minimize impacts to Bear Creek, precast, prestressed concrete girders with high-performance, cast-in-place concrete decks were chosen. The elevation of Medford is about 1400 ft and the area experiences some snow accumulation. Epoxy-coated reinforcement was used in the bridge decks but uncoated reinforcement was used in the beams and substructures. This solution will require less total maintenance throughout the service life.

The Highland Drive Bridge over Bear Creek is on a horizontal curve with a 700-ft radius. Straight precast, prestressed concrete girders were placed with varying spacings to provide the framework for the cast-in-place concrete horizontally curved and superelevated deck. This is the only curved bridge in the interchange and this girder layout permitted the project to use only concrete girders.

The East Barnett Road Bridge over Bear Creek created special challenges for the design and construction of the final bridge on the project. Originally, the design concept had temporary towers in the creek. That meant the construction schedule was dependent on reduced-work windows allowing for the protection of salmon. The towers were required to splice and post-tension precast, prestressed concrete girder segments to achieve the 172-ft-long simple span. During the advance plan design phase, ODOT adopted and used 90-in.-deep bulb-tee girders on a different project. The spliced girder plan was replaced with single-span BT90 girders that eliminated the need for towers in the creek. These long-span girders reduced the overall construction time to complete the bridge.

Long-span girders reduced the overall construction time to complete the bridge.

Construction

The project was bid in March 2006 with a bid value of $59.7 million and was completed in 2010. The 4-year-long project of 11 bridges included many stages of construction, and intricate traffic staging. Detour structures were constructed using multiple spans of adjacent precast concrete voided slabs. These detour bridges allowed traffic switching while maintaining the two lanes of I-5 traffic in each direction. Nighttime erection and single-lane

Looking toward the southeast shows the roadway structures approaching from the east and the bridge over Bear Creek. That bridge, the bridge over I-5, and the structures of the on and off ramps of northbound I-5 bear on abutments embedded in the MSE island constructed between the Interstate and the creek. The girders spanning over I-5 are not evenly spaced. Two groups of girders are more closely spaced to support the large pedestals and signal posts on the SPUI.

Looking to the north, Bear Creek crosses under I-5 at the location of the construction of the four bridges. The structure for the off ramp of northbound I-5 is nearly complete on the right. Northbound I-5 has been detoured to a temporary bridge. Southbound I-5 is using the finished northbound bridge. Work is ongoing on the bridges for southbound I-5 and the southbound on ramp. A portion of the original Barnett Road interchange can be seen at the top edge of the photo.

The three-span Highland Drive Bridge over Bear Creek is on a 700-ft-radius horizontal curve. Chorded spans with splayed girder lines accommodate the curve. Two additional bridges are shown in the background: the Highland Drive Bridge over Larson Creek and the Bike Path over Larson Creek.

SINGLE-POINT URBAN INTERCHANGE AND 10 ADDITIONAL PRECAST, PRESTRESSED CONCRETE GIRDER BRIDGES
OREGON DEPARTMENT OF TRANSPORTATION, OWNER

PROJECT CONSTRUCTION COST: $59.7 Million.

PRECAST CONCRETE BRIDGE COMPONENTS: $5.25 Million

Another view of the Highland Drive Bridge over Bear Creek. The I-5 off ramp structure is at the upper right. H piles were driven through large concrete pipe sleeves embedded in the island fill for the abutments of the I-5 Bridge.

closures were required at some of the bridge locations.

The interchange covers a large area of varying soil profiles. The foundation types for the bridges include spread footings, driven piles, and large-diameter drilled shafts. Installation of the drilled shafts within Bear Creek required temporary work platforms during short windows providing for protection of fish. The window is from June to September. As a result, installations of foundations within Bear Creek were on the critical path.

Precast Concrete Bridge Components

Bridge engineers in Oregon can select from a smorgasbord of precast concrete alternatives to satisfy their design challenges. These precast products include voided slabs that are 12, 15, 18, 21, 26, and 30 in. deep; box beams 33, 39, 42, and 48 in. deep; deck bulb-tee beams with top flanges up to 8 ft wide and depths of 36, 45, and 60 in.; bulb-I beams 51, 63, and 75 in. deep; and bulb-tee beams 48, 60, 72, 84, and 90 in. deep. Many other options are available for splice-girder construction including 9-ft-deep girders and trapezoidal tub girders.

The SMI project took advantage of many of the precast sections for the 11 bridges on the project. Over 259 pieces consisting of 5.81 miles of precast concrete bridge girders were manufactured and installed on the project. This does not include more than eight spans of voided slabs used for the detour bridges. A large number of voided slab beams were purchased by the contractor to use in temporary bridges. Some were purchased from a contractor on a different project where they had been used for the same purpose. Others were purchased from the precast concrete manufacturer to augment those reused. The voided slab beams for the detour bridges have since been sold and used in other detour bridges throughout the state.

The precast concrete manufacturer was located 190 miles north of the site and was able to supply all the various girder sizes for the bridges. Some of the girders required 9000 psi compressive strength concrete. The typical ODOT standard strength for precast, prestressed concrete girders is 7500 psi. Prestressing strands were ½-in.-diameter except those in the 90-in.-deep bulb-tee girders, which were 0.6 in. diameter. All strands were ASTM A416 Grade 270, low relaxation.

The 90-in.-deep bulb-tee girder was first introduced in Oregon during the summer of 2004 and has the capability to span 184 ft. This product was incorporated into two bridges during the design period between the type, size, and location study and the advanced plans phase. The BT90 allowed wider girder spacing, eliminated girder lines, and eliminated piers in the water.

Bridge Name	Bridge Length, ft	Bridge Width, ft	Number of Lanes	No. of Girders and Type	Girder Spacing	Span Lengths, ft
Garfield Street over I-5 (SPUI)	136	262.5	4M & 4T	(40) BT72	6′-11″	136
I-5 NB On Ramp	361	30 to 45	1M to 3T	(23) BT84	7′-10″ to 8′-4″	118, 125, 118
Highland Drive over Bear Creek	419	96.5 to 144	4M & 3T	(12) BT60 & (36) BT90	8′-8″ to 7′-9″	85, 2@167
Highland Drive over Larson Creek	102	107	4M & 3T	(14) BT60	7′-11″	102
I-5 SB On Ramp	416	38 to 31	2M to 1M	(22) BT60	6′-7″ to 6′-6″	85, 2@123, 85
I-5 NB over Bear Creek	350	54.5	2M	(33) BT48	6′-0″	59, 108, 111, 72
I-5 SB over Bear Creek	316	46.6	2M	(24) BT48	5′-11″	92, 2@112
I-5 NB Off Ramp	604	41 to 31.5	2M to 1M	(16) BT60	7′-2″ to 6′-9″	4@151
E. Barnett Road over Bear Creek	172	100	4M	(15) BT90	6′-8″	172
Highland Drive over Lazy Creek	37	80	3M	(20) 15″ Slab	4′-0″	37
Bike Path over Larson Creek	71	16	N/A	(4) 30′ Slab	4′-0″	71

M = Main Through Lanes; T = Left or Right Turn Lanes.

Keith Kaufman is chief engineer with the Knife River Corporation—Northwest in Harrisburg, Ore., and Daniel J. McIntier was the project engineer for H.W. Lochner Inc. in Salem, Ore.

The longest span on the South Medford Interchange project was the 172-ft-long single span of the East Barnett Road Bridge over Bear Creek. It was one of two bridges on the project to use 90-in.-deep bulb-tee girders.

For more information on this or other projects, visit www.aspirebridge.org.

When Bear Creek flooded during construction, the concrete structures were unaffected resulting in no setbacks to the progress of the work. Photo: Wildish Construction Co.

A 1974 photograph of the original interchange of Barnett Road with I-5. This interchange was decommissioned following completion of the new south Medford Interchange in 2010. The new interchange was constructed at the interstate shield at the right edge of the photo. Photo: Oregon Department of Transportation.