FORTERRA

I-15 BECK STREET OVERPASS

CS 2

CASE STUDY

GROUNDED IN STRENGTH.

Forterra Structural & Specialty Products

Forterra Provides Longest Girders in UDOT History

Project Description

The Beck Street I-15 Overpass in Salt Lake County, Utah, is the first Utah Department of Transportation (UDOT) bridge to meet the standard of seismic design designation of "Operational." Bridges classified as operational are critical to the transportation system and need to be functioning after a designed seismic event-earthquake. These critical bridges must meet the requirements for Seismic Design Category D with a ductility demand equal to the maximum allowed, following UDOT Seismic Design Criteria.

At 198 feet, 10 inches in length, the bridge also features the longest prestressed concrete bulb 'T' girders used up to that time by UDOT. The girders were produced by Forterra at their Salt Lake City facility.

In addition to accomplishing these "firsts," the project had to overcome numerous design and construction challenges.

A replacement bridge, the Beck Street structure replaced an existing six-lane bridge over Interstate 15 south of Salt Lake City. It was replaced with twin 600-feet, four-span bridges that accommodate a total of 10 lanes of traffic. The new bridge had to be completed in an area with a high water table, loose silt and sandy soil. Further, it was built in close proximity to Union Pacific Railroad (UPRR) tracks, Utah Transit Authority (UTA) commuter rail tracks, residential and commercial structures, pressurized natural gas and hydrogen lines, two 10-inch crude oil pipelines and a 125kv power line. Besides the seismic requirements, it also had to meet construction time constraints.

To meet these challenges, and to speed completion, the design-build team utilized a number of innovative components and Accelerated Bridge Construction (ABC) technologies.

Designed to meet seismic requirements

The project's biggest challenge was developing a seismic design that would meet the owner's requirement for an 'Operational' structure. The Beck Street bridge is classified as 'Operational' because of the vital connection I-15 provides between Salt Lake and Davis Counties. North and South mobility is constricted at the Beck Street bridge location by I-15, US-89, and the UPRR and UTA tracks.

Project Type:	Bridge
Location:	Salt Lake County, Utah
Owner:	UDOT (Utah Dept. of Transportation)
Architect:	
Structural Engineer:	Parsons Engineering, South Jordan, Utah
General Contractor:	Kewitt/Clyde, Salt Lake City, Utah (a joint venture of W.W. Clyde & Co. and Kiewit Southwest Co.)
Precaster:	Forterra Structural & Specialty Products Mountain Region, Salt Lake City Facility
Precast Products:	Bridge Girders

Multiple concepts were examined to find the most effective design solution, including evaluating whether to use concrete or steel girders. It was determined that prestressed concrete girders would be the most effective, and Forterra was selected to provide them.

The bridge utilized the longest "bulb T" precast girders ever used by UDOT. Produced by Forterra, the 2400 Metric Bulb Tee girders are nearly 200 feet long and have a depth of 7 feet, 10-1/2 inches. The girders were prestressed and heavily reinforced with 10,000 psi concrete in order to reach the desired span. There are 92 girders on the structure, and they were shipped to the site on special trailers constructed specifically for them. They were then pulled in parallel to their final location, lifted off the trailers and walked into place by two crawler cranes. The long girders allowed the bridge to be four spans instead of five, minimized impact to the railroad and cut costs.

Forterra partial-depth precast panels were also used for the composite bridge deck. These allowed the project to avoid false work over the railroad and helped accelerate the project schedule. The thin, 3-1/2-inch thick, prestressed concrete panels span between the girders and serve as stay-in-place forms for the bridges' cast-in-place concrete deck. Prestressing strands in the panels served as the bottom layer of reinforcing steel in the bridge deck. Choosing precast concrete girders rather than steel girders also cut the construction schedule for the project, according to Lee Wegner, Forterra Project Manager. "Forterra was able to deliver the girders to the contractor a full six months earlier than the quoted fabrication time for steel girders. Also, the use of half-depth deck panels reduced the amount of forming time required to construct the bridge deck."

Soil mixing, oscillation drilling

To overcome the site's poor soil conditions, several innovative systems were employed.

Cement deep-soil mixing was utilized to stabilize the soil and prevent disturbing nearby railroad tracks or utilities. A portland cement grout was injected into and blended with the soil using a crane supported auger. The mixture cured into hardened pillars 48 inches in diameter and 60 to 65 feet deep. The unusual procedure provided soil stability, mitigated lateral spread and met the project's seismic requirements while disturbing only a limited area in the restricted space. It also reduced settlement, cut surcharge settlement time in the deep sedimentary soil and helped speed foundation work.

These innovations allowed the overall EXPRESSLink project to be completed 60 days ahead of schedule.

The project also featured the biggest drilled shafts in Utah. These were done under extreme conditions using the oscillator method for the first time. The shafts are wedged between the railroad tracks. Pile driving or conventional drilling would have been risky given the site and soil conditions. Instead, an oscillator was used to drill a 2.8 meter diameter shaft to depths of 15 to 120 feet. Reusable, bolted together casing segments were pushed into the ground, and soil was excavated from within the casings with a clamming shell. A steel rebar cage was placed in the excavation and concrete poured as the casings were removed.

As opposed to pile driving, oscillator drilling reduced vibration and sound during construction that would have impacted utilities, the railroads and nearby homes and businesses.

The drilled, large diameter shafts used at the bent foundations of the bridge, combined with tip base grouting, also provided the axial capacities needed to support the bridge. These were effective in handling bridge seismic loads and in resisting liquefaction and lateral spreading movement that could be caused by a major earthquake.

The southbound section of the Beck Street Overpass was constructed first, adjacent to the existing bridge. Once completed and traffic had been shifted, the existing bridge was demolished and the new northbound structure was built. In addition, a movable barrier was used so that the peak direction of travel always had three lanes. The barrier was moved twice a day.

Additional bridges feature Forterra girders

The Beck Street Overpass was part of UDOT's $125-million EXPRESSLink project, which required total reconstruction of Interstate 15 in the 4.1-mile stretch from 500 North in Salt Lake County to the Interstate 215 connection in Davis County and the addition of an express lane in each direction. Goal of the project was to help ease the commute between Salt Lake and Davis counties.

In addition to the Beck Street bridge, the UDOT EXPRESS/Link project included replacement of bridges at the southbound US-89 overpass and at 1100 North in Salt Lake City, as well as earthwork, storm drainage, retaining walls, signing, lighting, barriers, Prestressed Concrete Cylinder Pipe (PCCP) structures and the reconstruction of Advanced Traffic Management System (ATMS) infrastructure to accommodate the construction.

The US-89 and 1100 North bridges were replaced with two-span rapid bridges—the first two-span ABC structures to be completed in the country. The US-89 Bridge was constructed using self-propelled modular transports to move the two bridge spans into place while minimizing traffic disruptions. Both bridges also use 1850 Metric Bulb Tee precast concrete girders provided by Forterra.