The innovative bridge features include the following:

- Unique socket connection of precast concrete column to footing
- Precast concrete columns fabricated in segments and joined by bars grouted in ducts
- Precast concrete cap beam made in two segments that were joined by a cast-in-place concrete closure
- Precast concrete superstructure with cast-in-place concrete closure at intermediate pier
- Precast concrete end and intermediate diaphragms

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Washington State Department of Transportation

March 2014

Highways for LIFE Projects

From research to practice

Highways for LIFE Projects are collaborations between the Washington State Department of Transportation and the Federal Highway Administration. Quickly adopting innovations and technologies improve highway safety while reducing congestion caused by construction. Washington State receives incentive funding to implement these state-of-the-art technologies.

Final Report with design specifications and examples at:

http://www.fhwa.dot.gov/hfl/partnerships/bergerabam/index.cfm

Video at:

http://www.fhwa.dot.gov/hfl/partnerships/bergerabam/index.cfm

Webinars for initial testing, early construction and final testing and completed construction recorded 2010 and 2013 at:

www.fhwa.dot.gov/hfl/commtool.cfm

www.fhwa.dot.gov/hfl/n134083201308/

Accelerated Bridge Construction (ABC)

Bridge construction frequently leads to traffic delays. These incur costs that can be measured in terms of time, wasted fuel, and emotional distress. Transportation agencies are therefore seeking methods for accelerated bridge construction (ABC). Use of precast concrete elements for bridge substructures offer potential time savings on- site and represent promising use for this technology. Also, limiting the amount of on-site work improves safety for both the motoring public and highway workers while reducing environmental impacts. For these reasons, transportation agencies are gradually embracing ABC for many of their urban construction projects.

Connections in precast concrete substructures are usually made at the beam-to-column and the column-to-foundation elements. However, for structures in seismic regions, those connections represent vulnerabilities. Devising connections that minimize vulnerability is the focus of much university research. The I5 Grand Mound Interchange is a Highways to LIFE project to implement research into construction practice.

Benefits of ABC

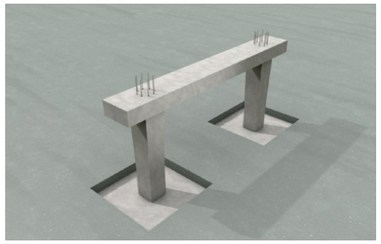
The primary benefits of ABC are a savings in construction time. Conventional construction induces traffic congestion. This affects air quality due to increased vehicle emissions as well as the quality of life due to personal time delays. Also, untimely service due to delays for the workforce, suppliers and customers can impose significant costs on the traveling public and regional businesses. Prefabrication of structural elements is the essence of accelerated construction since prefabrication can decrease total contract time.

Design

Prefabricated parts consist of concrete columns and cap beams. The footing-to-column and column-to-cap beam connections are the critical elements that ensure the system's strength.

The footing-to-column connection is made by placing the precast concrete column in the excavation with the footing steel. Then the footing concrete is cast. A footing for a highway bridge is usually too heavy for prefabrication. So it is likely to be cast in its final location.

The column-to-cap beam connection is made with vertical bars projecting from the column that are place with a grout mixture into the ducts of the cap beam. The connection's advantage is lower construction time. It allows a footing and a column to be cast in little more time than is needed to cast a footing alone.



University research

University of Washington researchers investigated the strength of the connections in their laboratory.

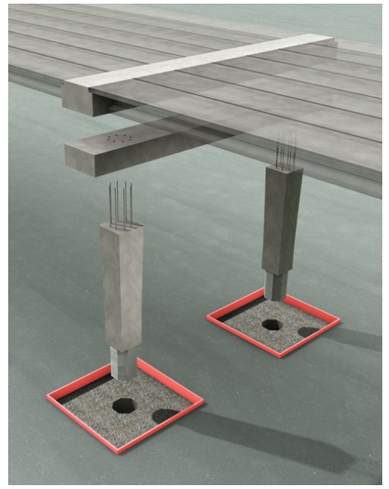
The goal of the laboratory tests was to evaluate the connection's reaction to combined cyclic sideways loads and constant vertical loads. This duplicated the behavior of an earthquake.

The connecting stress between the elements was shown to be consistently strong and seismically resistant. Electronic measurement and visual observations supported that finding.

Construction

The demonstration project was successfully built. The columns used in this project were fabricated in segments and spliced together on-site.

Although the columns of the demonstration project were small enough to be handled as a single piece, the segmented concept was used to demonstrate the technology. For instance use on other projects may require the columns be larger, and they cannot be transported or lifted as a single piece.



Technical Overview

Precast concrete bridge bent systems are conceptually simple. They can be constructed rapidly and offer excellent seismic performance.

- Seismic performance and constructability are blended using the transfer of research knowledge to design and construction practice. This is accomplished through cooperation between research, design, fabrication, and construction.
- Precast concrete bridge systems are an economical and effective means for rapid bridge construction.
- Prefabrication lessens construction traffic disruptions.
- Precast cap beams result in time and cost savings by eliminating the need for elevated concrete forms.
- Worker safety is improved since steel reinforcement bars and concrete can be placed at ground level.
- Column-to-cap beam connections are made with a small number of large bars grouted into ducts in the cap beam. Their small number and the correspondingly large ducts sizes provide connections that can be assembled easily on-site.
- Connections between cast-in- place spread footings and prefabricated concrete columns provide excellent seismic performance.