Bridge Bent System for Seismic Regions

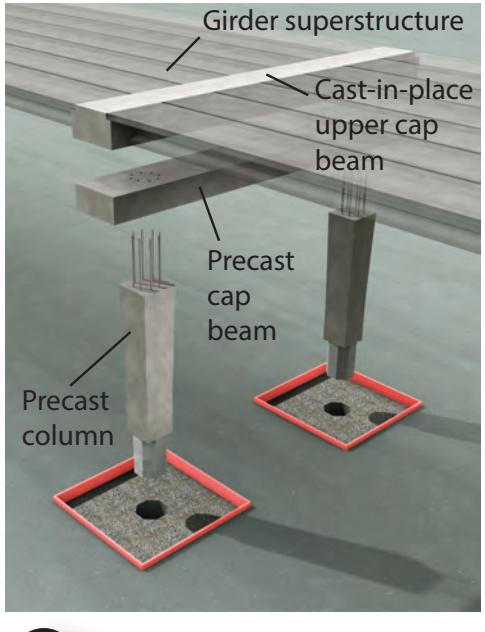
Highways for LIFE Technology Partnerships 2009 Award $400,397

U.S. Department of Transportation
Federal Highway Administration
HIGHWAYS FOR LIFE
Accelerating Innovation for the American Driving Experience.

Completed HFL Precast Bent

Completed precast bent system demonstration project bridge over I-5 in Washington State.

Precast Bent Exploded View



Contact Information

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Need for Innovation

Prefabricated bridge bents, also known as piers, have not been used in seismic regions because accepted methods of making connections that are both structurally robust and quick to assemble were not known and were not addressed in design specifications. This new technology allows the main elements of bridge bents to be prefabricated off site. Then the segments are moved into place and assembled to form the bents, greatly reducing construction time and traffic delays.

Project Overview

The BergerABAM project team has demonstrated, on a bridge in Washington State, a totally precast concrete bridge bent system, including precast columns and beams, that can be used in seismic regions. To construct precast elements in high seismic zones requires ductile detailing, which permits the structure to deform rather than to experience sudden unexpected brittle failure. The connections are made with a small number of large-diameter reinforcing bars that are grouted into larger-diameter ducts. This is the first project in the U.S. to use such precast, segmental construction for bridge bents in high seismic regions.

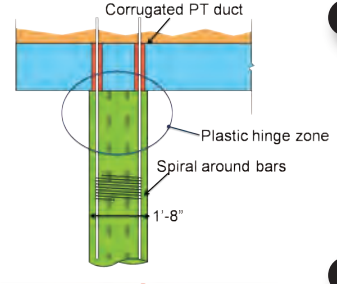
Project Status

Laboratory testing of both column-to-spread footing connections and column-to-drilled shaft connections have been completed. The demonstration project, a new bridge over Interstate 5 in Washington state is now complete and open to traffic. The final reports, draft design specifications and design examples are currently being completed.

Drilled shaft foundation option

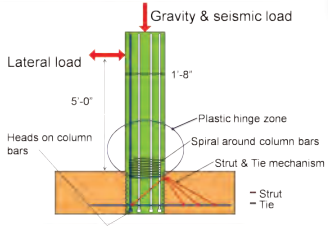
- Large-bar grouted connection to cap-beam.
- Socket connection of column to foundation, either spread footing or drilled shaft.

Critical Components of System: Two Connections



1 Large-Bar Connection to Cap-Beam

- Use few, large bars in grouted ducts to connect column to cap-beam. Erection is easy and rapid.
- Bars extend into cap-beam for moment continuity with superstructure in longitudinal and transverse directions.
- Column can be made in segments to limit weights of precast element for handling.



2 Socket Connection to Footing

- Socket connection can be constructed rapidly.
- Aggressive roughness provides shear friction interface.
- Heads on bottom of column bars provide direct load path and positive bar development in foundation.
- Both spread footing and drilled shaft foundations are being considered and tested.

Additional Information

- **Final Report** with design specifications and examples at *http://www.fhwa.dot.gov/hfl/partnerships/bergerabam/index.cfm*
- **Video** on project at *http://www.fhwa.dot.gov/hfl/partnerships/bergerabam/index.cfm*
- **Webinar:** Initial testing and early construction, recorded November 18, 2010 at *www.fhwa.dot.gov/hfl/commtool.cfm*
- **Webinar:** Final testing and completed structure, recorded on August 22, 2013 at *https://connectdot.connectsolutions.com/n134083201308/*

Previous Test Results

Large-Bar Pullout Tests

Large-Bar Connection Tests

Pullout Tests

Tests on individual bars proved anchorage capacity. (Fracture with $l_d = 10d_b$).

Beam-Column Connection Tests

Demonstrated that the precast system has the same strength and ductility as a comparable cast-in-place connection.

Socket Footing Testing

Both spread footing and drilled shaft connections have been validated by testing in the laboratory. Both types were able to restrict seismic damage to the column.

Spread Footing Specimen After Testing

Drilled Shaft Specimen After Testing

Project Team

BergerABAM
University of Washington
Washington DOT
Concrete Technology Corporation
Tri-State Construction