Bridge Bent System for Seismic Regions

Highways for LIFE Partnerships 2009 Award $400,397

HIGHWAYS FOR LIFE

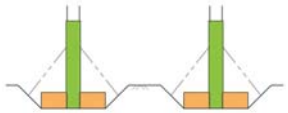
Accelerating Innovation for the American Driving Experience.

Rapid Construction Sequence

1) Excavate and prepare ground.

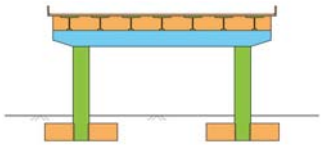
2) Position and brace precast columns.

3) Place footing reinforcement and cast.



4) Position precast cap-beam over column bars. Grout ducts.

5) Place girders, diaphragms and deck.



Contact Information

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Need for Innovation

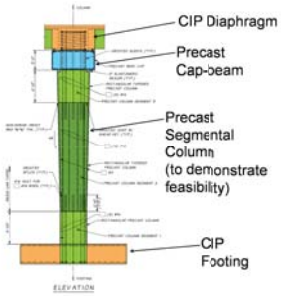
Prefabricated bridge bents, also known as piers, have not been used in seismic regions because accepted methods of making connections that are both structurally robust and quick to assemble were not known and were not addressed in design specifications. This new technology allows the main elements of 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 Berger/ABAM project team will demonstrate, 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 will be the first project in the U.S. to use such precast, segmental construction for bridge bents in high seismic regions.

Project Status

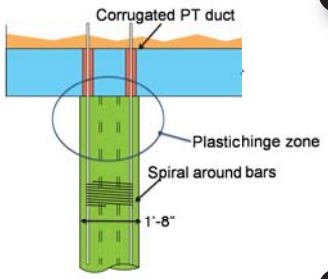
Laboratory testing of the column-to-footing connections is set to begin in early January 2010. Testing of the column-to-cap-beam connections was completed previously. The design of the demonstration bridge is scheduled for completion in March of 2010, and the advertisement date for construction bids is set for June of 2010. Development of draft design specifications and design examples is progressing on a parallel schedule with testing and construction.



Precast Center Pier System

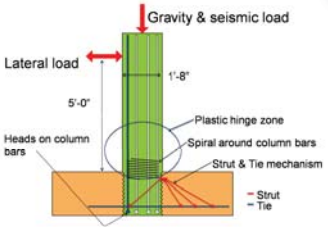
- Large-bar grouted connection to cap-beam.
- Socket connection to footing.
- Make columns segmental. (Not needed for this site, but do it to verify constructabililty).

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.

Demonstration Project

Existing Bridge To Be Replaced On New Alignment

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

Column Cage

Column in Forms

Tests will evaluate cyclic response of the column-footing connection and gravity load-carrying capacity of shear friction interface.

Project Team

Berger/ABAM
University of Washington
Washington DOT
Concrete Technology Corporation
Tri-State Construction