Accelerating Bridge Construction - Seismic Connections

TRB Research Proposal Webinar
Objectives

- Review and discuss connection details considered good candidates for immediate use in regions of strong to moderate seismic hazards following testing.
- Discuss proposed connection details and formulate an updated research problem statement with specific research goals and timelines at the 2009 TRB meeting.
- Once funded, work would conclude rapidly, facilitating rapid technology deployment.
- Will seek national funding through AASHTO and NCHRP or other avenues within FHWA.
- In the absence of these options, consider pooled funding project(s).
Precast Girder

Semi Integral

End Pier

Backfill

Precast Girder

Expansion joint

Elastomeric Bearing pad

Support Length for seismic movement

Girder stop to restrain transverse movement

Ductile Connection

L-shape Abutment

Shaft

Pile-to-pile cap Connection

CIP Slab

Joint-less Superstructure

Gap for seismic movement

L<450 ft (137 m)

L>450 ft (137 m)

Elevation

Joint-less Superstructure
Washington DOT - Precast System

- Precast Column
- Cast-In-Place Shaft
- Cast-in-place Diaphragm
- Support Pad
- Precast Bent Cap
- Precast Column
- Confinement Zones
- Cast-in-place Slab
- 3” thick Rubber Pad
- Cast-In-Place Shaft

- Washington DOT- Precast System
Washington DOT
Precast Bent cap
SR 202 / SR 520

Tolerances  -  Tack Weld

Duct Template

Spirals
Washington DOT
Precast Bent cap
SR 202 / SR 520

$1^{1/2}$ Hours +/-
Bent Cap Erection
Washington DOT - Fixed Intermediate Pier Connection

- Precast Girder
- Slab
- Top of Girder
- End of Girder
- Extended Strands Per Seismic Demand
- Drop Cap
- Slab Slab
Precast Substructure Research
U of Washington

- Precast Members
- ELEVATION
- Grout Tube
- 6" φ Hole in Crossbeam for 6 - #18 bars
- Extended Strands at Fixed Interior Pier
Precast Girder to CIP Bent Cap

- Used by Washington DOT
Why consider grouted couplers?

– They are very versatile
  • We can connect virtually any 2 precast elements together
– Connections can be made very quickly
– They can transfer axial, moment and shear forces
– They have been used for many years on bridges under traffic and in severe exposed environments
– Is it cost effective and easy to construct
– It is not proprietary
  • There are 3 companies that produce similar connectors
– We don’t need to change the way we design and detail bridges
Grouted Reinforcing Splice Couplers

- Emulates a reinforcing steel lap splice
- Used in precast parking garages and stadiums and bridges
Precast Cantilever Abutments
Mill Street, Epping NH
Precast Piers

- Florida DOT Detail
  - Edison Bridge
  - Highly corrosive environment
  - Excellent performance

- Also used in Georgia and Northeast PCI
Column to footing connection
Column to cap connection
Pier Types

- Single column hammerhead
- Two column bent
- Three column bent
Footings

- Full Precast
  - For smaller footings

Shim and grout under footing through ports in footing
Footings

- Partial Precast
  - For larger footings
  - Precast designed to support DL of bridge
  - CIP extensions designed for other loads

Precast Portion

CIP Extension

Shim and grout under footing through ports in footing
Previous Testing data

Q-δ Curve of Specimen No.9

\[ \begin{align*}
\sigma_B & = 345 \text{ kg/cm}^2 \\
\sigma_B & = 750* (800)** \text{ kg/cm}^2 \\
\sigma_Y & = 3,810 \text{ kg/cm}^2 \\
\sigma_Y & = 4,010 \text{ kg/cm}^2 \\
\end{align*} \]

* Cured with sealing compound.
** Cured in water.

Grouted Splice coupler @ end of column
Previous Testing Data

Control Column w/o Grouted Splice Coupler
Caltrans- San Mateo Bridge
Caltrans - San Mateo Bridge

- Precast Girder
- Precast Bent Cap
Caltrans- San Mateo Bridge
Caltrans- San Mateo Bridge
Precast Bent Cap
Caltrans- San Mateo Bridge
Precast Bent Cap-Column connections
Caltrans- San Mateo Bridge
Precast I-Girder placement
Caltrans- San Mateo Bridge
Caltrans - San Mateo Bridge
San Mateo Bridge - Mechanical Couplers
• SCDOT PCP to Pre-cast Cap Connection detail that was used for several bridges on a Design-Build project. This detail has not been adopted by SCDOT, but it is a candidate for research considerations.

• The SCDOT detail consists of 18” prestressed concrete piles used as pile extensions instead of reinforced concrete columns.

• The superstructure used is a flat slab superstructure, very common in our entire SC coastal region.
Precast Pile Cap - Carolina Bays Parkway, South Carolina
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Precast Pile Cap - Carolina Bays Parkway, South Carolina
Conway Bypass - Precast Bent Cap
Conway Bypass-
Precast Bent Cap
Conway Bypass - Precast Bent Cap
Conway Bypass-
Precast Bent Cap
Discussions

- Open Forum
- Agree on Details to be Tested
- Identify Follow-up Action Items