Accelerated Bridge Construction using Precast Concrete

Rita Seraderian, PE LEED AP
• PCINE Technical Committee was established in 1990
• Members included State Department of Transportations Engineers from New England and New York, Consultants and Precastors
• Focus is on Updating and Developing Regional Standards for ABC Bridge Construction since 2004
PCINE Bridge Technical Committee

State DOT
- Joseph Cancelliere - CTDOT
- Robert Bulger - Maine DOT
- Duane Carpenter - New York State DOT
- Michael Twiss - New York State DOT
- Matthew Royce - New York State DOT
- Jason Tremblay - New Hampshire DOT
- David Scott - New Hampshire DOT
- Mike Savella - Rhode Island DOT
- Jonathan Griffin – Vermont AOT

Precasters

Consultants
- Ernie Brod - J. P. Carrara & Sons
- Chris Fowler - Oldcastle Precast
- Eric Schaffrick - Dailey Precast
- Scott Harrigan – Fort Miller
- Matthew Royce - New York State DOT
- Jason Tremblay - New Hampshire DOT
- Mike Savella - Rhode Island DOT
- Jonathan Griffin – Vermont AOT
Accelerated Bridge Construction
Reports Developed by the Technical Committee

- NEBT Preliminary Design Charts
- NEBT Post-Tensioned Design Guidelines
- High Performance Concrete for Prestressed Concrete Bridges
- Prestressed Concrete Girder Continuity Connection
- Precast Deck Panel Guidelines
- Full Depth Precast Concrete Deck Slabs Guidelines
- Bridge Member Repair Guidelines
- Accelerated Bridge Construction Guidelines
- NEXT Beam Details and Design Charts
Accelerated Bridge Construction

Reports are available at www.pcine.org
# Accelerated Bridge Construction

## Development of the NEXT beam

### PCI Northeast Bridge Beam Sections

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Span Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjacent Slabs/Deck Beams</td>
<td>100 - 150</td>
</tr>
<tr>
<td>Adjacent Box Beams</td>
<td>100 - 150</td>
</tr>
<tr>
<td>NEXT Beams</td>
<td>100 - 150</td>
</tr>
<tr>
<td>Gubl Tee Beams</td>
<td>100 - 150</td>
</tr>
</tbody>
</table>

![PCI logo](image)
Accelerated Bridge Construction

Development of the NEXT beam

Depth 24” – 36” in 4” increments
Typical Span Range 50 – 75’
Width will vary 8’-0” – 12’-0”
Used for bridges with utilities
Works very well for Accelerated Construction.
NEXT Beam
Preliminary Design Charts

- 6000 psi
- 8000 psi
- 10000 psi

Beam Depth
- 24” – 36”

Beam Width 8’-0” – 12’-0”
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NEXT Beam Example

Existing Bridge

Proposed New Bridge
Accelerated Bridge Construction

Bridge Section

EXISTING BRIDGE SECTION

PROPOSED BRIDGE SECTION
Accelerated Bridge Const

Beam Design

- Preliminary Beam Sizing
  - Use PCI NEXT Beam Standards
“Guidelines for Accelerated Bridge Construction using Precast/Prestressed Concrete Components”

- Section 1: Application overview
- Section 2: General Requirements
- Section 3: Precast Components
- Section 4: Joints
- Section 5: Grouting
- Section 6: Seismic
- Section 7: Fabrication and Construction
New FHWA Manual – Connection Details for Prefabricated Bridge Elements and Systems

• Availability
  – Published June 2009
  – DOT’s will receive copies
    • Others will be given out at conferences
  – Available at:
    www.fhwa.dot.gov/bridge/prefab/
    – Data Exchange
      knowledge.fhwa.dot.gov

Project Goals
Gather details of Connections that have been used on accelerated bridge construction projects.
Upcoming FHWA ABC Manual

Accelerated Bridge Construction Experience in Design, Fabrication and Erection of Prefabricated Bridge Elements and Systems
Precast Pier

- Column to cap connection (3.2.4.1)
- Column to footing connection (3.2.3)
- Footing to subgrade connection (3.2.1)
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Schematic Pier Design

- Column to Cap Beam connection
  - Sections 3.2 and 4.3
  - Detail used by the Florida DOT
  - Similar to footing connection
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Schematic Abutment Design

Figure 3.2.2-1 Placement of an abutment segments.

Figure 3.2.4.2.1-1 Concrete flow in Abutment Section
Completed Abutment

- Approach slab connection (4.3.2)
- Flying Wingwall connection (3.2.2)
- Post tensioning (5.4)
- Abutment cap connection (3.2.2) and (3.2.4)
- Pile to cap connection (3.1)
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Completed

Bridge

Composite Deck Membrane waterproofing with bit. Wearing surface

Precast Parapet

Precast Pier

Precast Integral Abutment
# Accelerated Bridge Construction

## Estimated Construction Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demo Existing Bridge</td>
<td>5 Days</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Install Foundations</td>
<td>8 Days</td>
<td>3 Days</td>
<td>3 Days</td>
<td></td>
</tr>
<tr>
<td>Erect Beams and Parapets</td>
<td></td>
<td>3 Days</td>
<td>7 Days</td>
<td></td>
</tr>
<tr>
<td>Install Deck Reinforcing</td>
<td></td>
<td>3 Days</td>
<td></td>
<td>2 Days</td>
</tr>
<tr>
<td>Cast and Cure Deck</td>
<td></td>
<td>7 Days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paving</td>
<td></td>
<td>17 Days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approach Roadway</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean-up</td>
<td></td>
<td></td>
<td></td>
<td>2 Days</td>
</tr>
</tbody>
</table>
# Accelerated Bridge Construction

## Beam Cost Considerations

<table>
<thead>
<tr>
<th></th>
<th>Box Beam</th>
<th>Next Beam</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fabrication</strong></td>
<td>Multi-stage pour Draping</td>
<td>Simple Pour Straight Strand</td>
<td>Next Beam should have significantly lower fabrication cost per SF</td>
</tr>
<tr>
<td><strong>Shipping</strong></td>
<td>One beam per truck (3’-4’)</td>
<td>One beam per truck (8’-12’)</td>
<td>Next Beam reduces the number of trucks (½ to ¼)</td>
</tr>
<tr>
<td><strong>Cranes</strong></td>
<td>Lighter picks</td>
<td>Heavier picks</td>
<td>Probably a wash</td>
</tr>
<tr>
<td></td>
<td>Shorter erection time</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td>Requires Transverse PT and grouting</td>
<td>Set it an move on</td>
<td>Much easier installation, no special grouts, no post-tensioning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Fabrication of the NEXT Beam
The NEXT Beam
The NEXT Beam
Accelerated Bridge Construction
York Maine Route 103 Project
Accelerated Bridge Construction
Queens Blvd. Interchange
Development of the NEXT Deck “D” beam

- Full Thickness Slab for low volume roads.
- Details, section properties and connections.
Development of the NEXT Deck beam
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Sibley Pond Bridge – Canaan-Pittsfield, ME

Stats:
First NEXT “D”
40 – 10’ wide - 36”
Deep
Bridge 790’ x 36’
10 Spans
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Sibley Pond
Objectives: Field performance of NEXT beam bridges through live-load field testing and long-term monitoring. Finite element modeling to evaluate live load distribution factors.

- Currently verifying FE models with LLDF.
- All six NEXT beams have been fabricated by Dailey.
- Strain readings in all beams have been taken.
- Construction scheduled to start late July.
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South Maple Street; Enfield, CT

Design/Build
4 months to complete
Precast Erected 2 ½ weeks
71 pieces
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South Maple Street; Enfield, CT
Upton - Andover Dam Bridge Replacement

Maine’s Rapid Bridge
96 hour Roadway closure
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Phase I: 4 Day Closure

Install Piles and Cover piles and re-open to traffic
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Phase II: 4 Day Closure
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Begin Day 1 - Road Closed June 15th 2004

Piles Installed
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Begin Day 2 - Road Closed June 16th 2004 5:00 AM
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End of Day 3 - Abutment #2 Pile installed
Total Elapsed Closure Time = 36 hrs
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1 ½ months later the road was closed for the final time 4:30 am August 2nd
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End of Day 4 – Bridge removal 90% Abutment #1 Installed
Total Elapsed Closure Time – 50 Hours
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Installation of Abutment Units
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Precast Abutments & PT
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End of Day 5 – Abutment #2, Riprap, and Superstructure installed
Total Elapsed Closure Time – 74 Hours
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End Day 6 – Rail installed, shear keys grouted & road opened

Total Elapsed Closure Time: 96 Hours
What Bridge Span Lengths should be considered for the use of the NEXT Beam?

Answer – 50 – 75 Feet
Why was the NEXT beam developed?

Answer: To accommodate utilities better and to be used for Accelerated Bridge Construction.
What resources are available for accelerated bridge construction?

Answer: PCI and FHWA have many documents that can be downloaded on demand.
Thank-You for your Attention Questions?