ABC – UTC Webinar 2-15-18
Northeast Extreme Tee (NEXT) Beam with Rochester VT Case Study

Speakers:
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Montpelier, VT

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Background

PCINE Bridge Tech. Committee was established in 1990. Members included Department of Transportation Engineers from Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont and New York, Consultants and Precastors.

Focus since 2004 has been on Developing and Updating Regional Standards for ABC. Begin Development of the NEXT Beam in 2006.
“Guidelines for Accelerated Bridge Construction using Precast/Prestressed Concrete Elements”

First Edition Posted 2006
Second Edition December 2014

- Section 1: Application Overview
- Section 2: General Requirements
- Section 3: Precast Components
- Section 4: Joints
- Section 5: Grouting
- Section 6: Seismic
- Section 7: Fabrication & Construction
Substructure Details are linked

- **Section 1**: Application Overview
- **Section 2**: General Requirements
- **Section 3**: Precast Components
- **Section 4**: Joints
- **Section 5**: Grouting
- **Section 6**: Seismic
- **Section 7**: Fabrication & Construction
Based on experience in Utah and the NE region
Why Develop the NEXT Beam

Concept to Reality - PCINE and CME

Advantages of the New Shape

- Accommodation of **Utilities**
- Ease of **Fabrication**
- **Reduced** Shipping and Installation Cost
- Works well for **Accelerated Construction**
- **Alternative** to box beam for mid span bridges

- **2008** - NEXT “F” (for Form) – 1st Bridge 2010
- **2010** – NEXT “D” (for Deck) Beam
- **2016** – NEXT “E” (combination of F and D) Beam
## Development of the NEXT beam

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Span Length</th>
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<tbody>
<tr>
<td>Adjacent Deck Beams</td>
<td>30 40 50</td>
</tr>
<tr>
<td>Adjacent Box Beams</td>
<td>60 70 80 90</td>
</tr>
<tr>
<td>NEXT Beams</td>
<td>100 110</td>
</tr>
<tr>
<td>Bulb Tees</td>
<td>120 130 140</td>
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</tbody>
</table>

### Span Length

- **Adjacent Deck Beams**: 30, 40, 50
- **Adjacent Box Beams**: 60, 70, 80, 90
- **NEXT Beams**: 100, 110
- **Bulb Tees**: 120, 130, 140
Implemented Advanced Technologies

https://abc-utc.fiu.edu

NEXT Beam Info
Guidelines are available at www.pcine.org

Northeast Extreme Tee (NEXT) Beam

Guidelines

Bridge Guideline: Updated March 2016
Northeast Extreme Tee (NEXT) Beam Guidelines (2.09 mb PDF File)

Bridge Guidelines for the Northeast Extreme Tee (NEXT) Beam (NEXT). These guidelines are for NEXT "F" , "D" and "E" beams. The guide includes section properties and design details.

Bridge Design Manual (4.5 mb PDF file)

Preliminary Design Charts including NEXT beams.
Resources

Free Download at the PCI Bookstore

Span and Section Property Charts for NEXT Beam are available in the PCI Bridge Design Manual

Transportation Research Board Project
**SHRP 2** - Innovative Bridge Designs for Rapid Renewal ABC Toolkit

Design Examples
Development of the NEXT beam

Depth 24” – 36” in 4” increments

Typical Span Range  50 – 80’

Width will vary 8’-0” – 12’-0”
**NEXT Beam Shapes**

**NEXT F 4” Flange plus 8” CIP Deck**
- No Forming between Flanges
- Easily accommodates Vertical Curves w/CIP Topping
- Easily Handles Camber Variations between Members

**NEXT E plus 4” CIP Deck**
- Uses Less Topping & Reinforcement
- Flange Connection Made with CIP
- Accommodates Vertical Curve
- Easily Accommodates Camber Variations between members

**NEXT D - 8” Flange no CIP Deck**
- Heavy Section
- No CIP Topping/Deck
- Best Section For ABC
- Special Concrete for Flange Conn
- Harder to match adjacent members
  Skew/Design
NEXT Beam

Design Information

Beam Profile Sheets for D, E and F
NEXT Beam Variations

GENERAL NOTES

1. The top flange is intended to act as a deck form only. A reinforced cast-in-place concrete deck should be designed to span between beams. The flush rebars are shown in the example, and should be used to support the cast in-place concrete deck. The reinforcing shown is based on an 8" thick cast-in-place deck. Designers should verify this reinforcing for each design based on the actual deck thickness.

2. The welded wire fabric may be cut to facilitate the installation of the stirrups. Provided that equivalent bars are added adjacent to the cut ends. Equivalent weld reinforcement may also be used in place of the WWF if there is no adverse effect to performance.

3. The additional top steel in the beam overhang should only be used where the welded wire fabric cannot support the spanning loads.

4. Shear reinforcement should be kept to #4 bars in order to maximize the cover on the side of the stem.

5. See sheet 14 for utility support details.

NEXT F BEAM

1. The top flange is intended to act as a structural deck.

2. Shear reinforcement should be kept to #4 bars in order to maximize the cover on the side of the stem.

3. See sheet 14 for utility support details.

4. Hanger adjustment of the spacing of the top longitudinal reinforcement is allowable to facilitate the installation of the stirrups.

DESIGN NOTES

1. The reinforcing shown is preliminary and not guaranteed. Designers must verify the reinforcing for each design based on the required load bridge specifications or state standards.

2. The step method specified in AASHTO Load and Resistance Article 4.6.2.1 is recommended for the design of the reinforcing in the next D beam.

3. The reinforcing bars extensions shown on the next E and F beams should be designed to resist the positive bending moment at the center of the beam. The extensions are determined by the AASHTO Design Method of Design Section. The welded mesh bars can be considered a lap splice with the bars fully developed. The design provisions, as shown in AASHTO Article 5.1.1.2.5, should also be checked for these bars.

4. Additional reinforcement may be required for deck overhangs and barriers.

5. The designer shall detail the additional top longitudinal reinforcing in the top flange. The top flanges of this beam are designed with the AASHTO Load Bridge Design Specifications. The reinforcing is for shear with the beam. It is recommended that full welded mesh top bars are included in the design. They should not be used to meet these AASHTO provisions. All bars are used to control crack propagation in the top flange at release.

6. The reinforcing shall be designed in accordance with the AASHTO Load Bridge Design Specifications. This reinforcing is for shear with the beam. It is recommended that full welded mesh top bars are included in the design. They should not be used to meet these AASHTO provisions. All bars are used to control crack propagation in the top flange at release.

7. All reinforcing shall be designed in accordance with the AASHTO Load Bridge Design Specifications. This reinforcing is for shear with the beam. It is recommended that full welded mesh top bars are included in the design. They should not be used to meet these AASHTO provisions. All bars are used to control crack propagation in the top flange at release.

STRAND LAYOUT NOTES

1. Denotes straight strand. Stranded strands are not permitted.

2. Debering of strands is allowed. No more than 5% of the total number of strands shall be debered. The spacing between strands is to vary from 1.0" to 1.5" in any direction. The restrictions outlined in the AASHTO Load Bridge Design Specifications shall also be followed.

3. It is recommended that approximately 50% of all strands be debered for the first 4" from the end in order to prevent cracking. Debered strands are used to control crack propagation in the top flange at release.

4. Strands shall be placed within the 2.5" grid. The pattern may be varied in 2" increments for designs that require precision at a higher elevation. The number and location of strands shall be as required by design.

5. The pattern shown depicts the maximum number of strands allowed (50 strands including the top strand). This is based on the capacity of typical casting setups.

6. The two bottom corner strands in each stem are dedicated to provide room for the shear reinforcement bar bands.

7. All Debered Strand shall be 0.60" diameter, undercut slip wire, low-relaxation strands conforming to AASHTO M167, the ultimate load of the strands shall not be in excess of 16 tons.

8. Additional strand tensioned to a normal value may be added to the top flange to support the top flange reinforcing.
NEXT Beam Section Properties

**NEXT Beam - Section Properties**

<table>
<thead>
<tr>
<th>Beam Designation</th>
<th>Beam Width Inches</th>
<th>Beam Depth Inches</th>
<th>Base Step Width Inches</th>
<th>Area $\text{in}^2$</th>
<th>$\text{in}^2$</th>
<th>$\text{in}^3$</th>
<th>$\text{in}^4$</th>
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**NEXT Beam - Section Notes**

1. The widths of beams shown are the minimum and maximum beam widths. Variation between these limits is allowed in order to construct a bridge to the required width. The variation in width is accomplished by varying the flange dimensions. The designer will need to calculate beam properties for beams that do not equal to the widths listed.

2. Beams with close curvature can be built from these sections by varying the dimension of the flange beams along the centerline. Interior beam should always be symmetrical about the vertical axis. Non-symmetrical sections are possible, however the beam may require a special design with a non-symmetrical strain pattern.

3. The beam width and spacing at the flange beam should be chamfered 8 x 4 in order to minimize casting and handling damage.

4. All NEXT beam totally.

5. The actual width of the beam is based on the design load and the required beam spacing. The maximum beam spacing on a typical bridge shall be the sum of the beam plus 6.5", in order to minimize casting and handling damage.
NEXT Beam Combinations and Max Span Chart
Next Beam Details

- Extra Bars in Corners to minimize corner cracks
- Extra cover for the Strand
- Straight Strands with Debonding Only

Skews and Misc. Details
Recommend Skew 20 Degrees
NEXT "D" Beam Joints

Hoop Bar for Non Shrink Grout

UHPC
NEXT Beam Unique features

EXISTING BRIDGE SECTION

PROPOSED BRIDGE SECTION
South Worthington, MA – Total Precast Built in 60 Days
FAQ

Paper on the background and development of the NEXT Beam

20 Cases Studies
<table>
<thead>
<tr>
<th>United States</th>
<th>Massachusetts DOT (Standards)</th>
</tr>
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<tr>
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<td>Maine DOT</td>
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<tr>
<td></td>
<td>Rhode Island DOT</td>
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<td>Connecticut DOT</td>
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<td>New Hampshire DOT</td>
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<td>Georgia DOT</td>
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<tr>
<td></td>
<td>South Carolina</td>
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| Canada        | New Brunswick                 |
Frist NEXT Beam Bridge - Route 103 York Maine

Owner:
Maine Department of Transportation

Engineer:
VHB-Vanasse Hangen Brustlin, Inc. Bedford, NH

Contractor:
CPM Constructors, Freeport, ME

Structural Precast Elements:
28 NEXT Beams up to 80 ft.

7 Span Structure - 510 Ft Long
Completed Ahead of Schedule
November 2010
4” Additional Navigational Clearance
York Maine Route 103 Project
York Maine Route 103 Project
York Maine Route 103 Project
Design-Build Project
Span Length - 79’-0” With Overall Bridge Length - 790’-0”
Opened November 21, 2011
10-1/2 months ahead schedule
The bridge was designed and completed in 15 months.
Designed for 100 year Service Life.

Owner:
Maine DOT, Augusta, ME

Engineer:
Parsons Brinckerhoff, Manchester, NH

Contractor:
Lane Construction Corp., Bangor, ME

Precast Elements:
(40) NEXT 36 D beam
- Custom Gantry lifted the beams from trailers
- Rolled sideways across the new piers.
- Less costly and quicker than 2 crane pick.
- 4 Beams Erected in an 8 hour shift
- Turnaround time of 2 days/span
Sibley Pond Bridge – Canaan-Pittsfield, ME

• 10 spans - two 5 span continuous units and a single expansion at center
• Overall Bridge Length - 790’-0”
• Overall Width - 36’-0” curb to curb
• No. of Traffic Lanes - 2
# NEXT Beam Summary Conclusions

<table>
<thead>
<tr>
<th></th>
<th>Box Beam</th>
<th>NEXT Beam</th>
<th>Conclusion</th>
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</thead>
<tbody>
<tr>
<td>Fabrication</td>
<td>Multi-stage pour Draping</td>
<td>Simple Pour Straight Strand</td>
<td>NEXT Beam is more economical</td>
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<tr>
<td></td>
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<tr>
<td>Shipping</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>
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<tr>
<td></td>
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<tr>
<td>Cranes</td>
<td>Lighter picks</td>
<td>Heavier picks</td>
<td>Is a wash</td>
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<tr>
<td></td>
<td></td>
<td>Shorter erection time</td>
<td>Contractors will determine the best way to build with the bridge</td>
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<tr>
<td>Installation</td>
<td>Requires Transverse PT and grouting</td>
<td>Set it and move on</td>
<td>Much easier installation, no special grouts, no post-tensioning Safe construction</td>
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HOW PRECAST BUILDS

Route 73 Bridge 15 and 16, Rochester, VT using NEXT Beams