NORTHEAST EXTREME TEE (NEXT) BEAM GUIDE DETAILS

These guidelines and guide details have been developed for the purpose of promoting a greater degree of uniformity among owners, engineers and industry with respect to planning, designing, fabricating and constructing the Northeast Extreme Tee (NEXT) Beam for bridges.

In response to needs determined by Northeast Transportation Agencies, and Prestressed Concrete Producers, the PCI Northeast Bridge Technical Committee prepared these guidelines and guide details to promote uniformity of design and details throughout the region.

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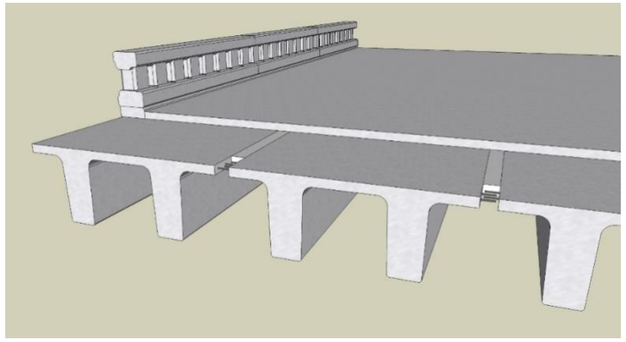

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NEXT Beam Frequently Asked Questions

General Questions

1. **Is the NEXT Beam Proprietary?**
   The NEXT Beam is a regional standard that was developed by the northeast state departments of transportation, consultants, and fabricators. Similar to other standard bridge sections, it is available from multiple fabricators and it is not proprietary.
2. **Who supplies the NEXT Beam?**
   The NEXT Beam is produced by many PCI Certified precast producers. Contact your local PCI Regional Association or local producer.
3. **Is the NEXT Beam acceptable to bridge owner agencies?**
   Yes. The NEXT Beam was developed by a consortium of state bridge engineers from all six New England states and New York and members of the Northeast region of PCI. In addition, many other DOT bridge offices in the United States are using the beam.
4. **Is the NEXT Beam more economical than other bridge systems?**
   The NEXT Beam is efficiently designed to minimize labor in both the manufacturing plant and at the job site. The lack of draped (harped) strands is a significant benefit during fabrication. The elimination of deck forming in the field saves significant time during construction, and also provides an instant platform for work, making for a much safer project. NEXT beam bridges are a cost-effective structure and have reduced the overall cost of building bridges in the Northeast.
5. **What is the difference between the D, E and F Beam?**
   - The ***D Beam (Deck Beam)*** is a beam with an integral full-depth flange that acts as the structural bridge deck. This allows the bridge to be ready for traffic soon after the beams are erected.
   - The ***F Beam (Flange Beam)*** is a beam with a partial-depth flange, which serves as the formwork for a conventional cast-in-place reinforced concrete deck. This results in a monolithic deck surface at the expense of a few extra days of site construction. The top flange of the F Beam eliminates the need for deck forming (including the overhang), which is a tremendous time saver.
   - The ***E Beam (Deck/Flange Beam)*** is a beam that has a top flange that is intended to act as the bottom portion of the structural deck. A reinforced cast-in-place concrete topping is used to complete the structural deck, which will reduce the amount of CIP deck concrete in the field from approximately 8” to 4”. The top flange of the NEXT Beam eliminates the need for deck forming (including the overhang),
6. **How do I handle utilities on my bridge?**
   One of the main reasons the NEXT beam was developed was to handle multiple utilities, unlike the box beam, which can only accommodate a few. Utility supports can be coordinated with the Manufacturer and be cast into the beam at the time of fabrication to expedite installation time out in the field.
7. **Are diaphragms required?**
   Intermediate diaphragms are not required for the NEXT Beams. AASHTO LRFD Bridge Design Specifications require diaphragms at the supports where there is a joint in the deck.
8. **What is the recommended bearing type?**
   NEXT Beams are typically supported on reinforced elastomeric bearing pads. Details have been developed and are found on Detail Sheet NEXT 15 of the guidelines. Bearings that can be adjusted vertically may be beneficial for complex geometries. For example, on a skewed bridge with a vertical curve, the support points are out of plane, creating the need for a variable 4-point support system. The adjustable bearing will solve this problem.

Bridge Geometry Questions

1. **What are the typical span lengths and widths?**
   The NEXT Beam can range from a length of 30’ to 80’ and a nominal width of 8’ to 12’ for the NEXT F beams, 8’ to 10’ for the NEXT D Beams and 8’ to 9.5’ for NEXT E. These span ranges are approximate since they are based on certain design parameters such as parapet weight and overlay options. Actual span capabilities should be checked for each situation based on the actual design parameters. Please consult the attached Detail Sheets.
2. **Can NEXT Beam be used for a skewed bridge?**
   Yes. PCI Northeast recommends a maximum skew for each beam type (AASHTO skew convention) but it may be possible to exceed this value (the largest skew built has been 45 degrees). The concern is with regard to cracking at release in the fabrication plant. Experience with double tee beams has shown the potential for longitudinal cracking in the top flange near the interior stem surfaces. Additional reinforcement has been placed in this region; however, the potential for the development of these cracks is still present and larger skews would mean longer cracks in the end zone. Skewed NEXT D beams general have less cracking than NEXT F or E beams due to the 8” flange and two layers of flange reinforcement. Skewed beams may require special bearing details. See General Question Number 8.
3. **Can the NEXT Beam be used for a curved bridge?**
   The widths of the NEXT Beams can be adjusted readily in fabrication to accommodate gentle curves. The flanges of the exterior NEXT Beams can be curved (in plan) to produce a curved roadway geometry, provided that the flanges fall within the design envelope shown on Detail Sheet NEXT 01.
4. **Can the NEXT Beam be used for a variable width bridge?**
   The widths of the NEXT Beams can be adjusted readily in fabrication to accommodate roadways that are tapered in plan. The flange width of the NEXT Beams can be tapered, creating a slightly ‘pie shaped’ beam that would be used for splayed layouts.
5. **How do you accommodate roadway profiles with a cambered NEXT Beam?**
   The accommodation of roadway profiles with a cambered NEXT beam can be handled in several ways. The thickness of the deck topping concrete on NEXT E and F Beam bridges can be varied. The thickness of the top flange on Next D Beams can be varied; however, this comes at a higher cost due to the need for more complex forming in the fabrication plant. Another option is to vary the thickness of the overlay (if allowed by state standards) to provide the desired profile. See Profile Details on Detail Sheets NEXT 03 through 05.
6. **How do you accommodate roadway cross slopes and crowns?**
   The beams can be set to match the roadway cross slope. This is not normally done with prestressed I-Beams due to issues with stability. The large lateral stiffness of the NEXT Beam allows for this approach, which greatly simplifies the installation. Roadway crowns can be accommodated at the joints between the beams, or within the topping or overlay. See Detail Sheet NEXT 08.
7. **Is it possible to design NEXT Beam that is narrower than the 8-foot minimum?**
   The 8-foot minimum was set to provide relatively equal stem spacing (within 2 feet), to provide room for inspection access of the stems between the beams, and to avoid impacting the curved fillet on the underside of the top flange. A minor reduction from this minimum can be used with permission from the owner.
8. **Is it possible to design half section single tee using the NEXT Beam Form?**
   It is possible to use a half section for cases where a specific bridge width is required or for bridges were staged construction does not permit full width sections.
9. **Is it possible to step (dap) the bottom of the stem at the support?**
   This should only be done for special situations where the height of the bridge seat must be raised (i.e. low clearance straddle bent). Special care should be exercised in the design to prevent cracking in this critical area. The PCI Design Handbook contains a recommended design procedure for this situation.

NEXT Beam Frequently Asked Questions

Design Questions

1. **What bridge software can be used to design a NEXT Beam bridge?**
   Engineers in New England and New York have used PS Beam (www.lrfd.com) to design NEXT Beam bridges. ConSpan by Leap (www.bentley.com) and PG Super (www.pgsuper.com) are also viable software packages.
2. **Are the span charts on Detail Sheet NEXT 08 acceptable for preliminary design?**
   The values shown are not guaranteed and should be considered approximate. They are intended to be used as a starting point for preliminary layout. The actual maximum span lengths are affected by a number of assumptions, some of which are listed in the notes on Detail Sheet NEXT 08. Check the assumptions against your project design requirements before selecting a beam size. During preliminary design and structure type studies, the beams should be checked to ensure that a section will work.
3. **How do I distribute dead and live load to the NEXT beams?**
   Guidelines for the Live Load Distribution Factors for F, E and D Beams are found on Detail Sheet NEXT 01.
4. **Can I design the beams for continuity?**
   Yes. This would be done the same way as any prestressed concrete beams. The negative moment reinforcement can be cast into the deck on the NEXT F or E design. For the NEXT D design, mechanical couplers could be considered, or the top flange could be dapped with projecting reinforcing. Care shall be taken with dapping beams. The designer should check stresses in the dapped area. The positive moment reinforcement could be strand extensions or mild reinforcement projecting from the stem.
5. **How do I design deck reinforcement for a NEXT F Beam Bridge?**
   The design of the deck is based on a normal stringer bridge. It is recommended that the top flange not be used in the deck design. The deck can be designed by treating each stem as an individual beam with the deck spanning between stems.
6. **How do I design deck reinforcement for a NEXT D and E Beam Bridge?**
   The design of the deck is based on a normal stringer bridge. The deck can be designed by treating each stem as an individual beam with the deck spanning between stems. The reinforcing for the NEXT D is fully cast into the top flange. The bottom mat reinforcing for the NEXT E is fully cast into the beam, the top mat is placed in the topping.
7. **How do I design the connection between the NEXT D and E Beams?**
   The connections should be a reinforced moment connection. The design of the connection should be based on the moments generated using a standard AASHTO strip method. The deck can be designed by treating each stem as an individual beam with the deck spanning between stems. Once the positive moment is calculated at the joint, the section can be checked assuming that the projecting bars are fully developed. The reinforcing shown on the typical details should work for most scenarios; however, it should be checked for each design.
8. **How do I design integral abutments using the NEXT beam?**
   The design of integral abutment bridges using NEXT beams is the same as any stringer bridge. See Detail Sheets NEXT 12-14.
9. **Is post-tensioning required to connect NEXT D Beams (similar to box beams)?**
   NEXT D Beams have been developed with reinforced closure joints, which eliminates the need to use transverse post-tensioning to connect the flanges. This meets the AASHTO requirements for load distribution and is considered to be sufficient to make the beams act as a unit.
10. **Some states connect decked beams with welded ties. Is that acceptable for NEXT Beams?**
    Welded tie connections are common in parking structures but have been found to be inadequate for truck loading. Most states are changing flange connection details to one similar to those shown in these guide details.
11. **What options are available for connecting the flanges of NEXT D and E Beams?**
    The details provided allow for multiple options and fill materials. The most common reinforcing and fill materials are shown on Detail Sheets NEXT 10 and 11. There is also guidance on how to design and detail the connection with alternate materials, which is based on the AASHTO LRFD Guide Specifications for Accelerated Bridge Construction. Note that the width of the joint for NEXT D and E Beams will affect the beam spacing or top flange width.
12. **How do you accommodate top tension stresses at the beam ends after release?**
    First and foremost, the design of the beam needs to conform to individual state design requirements. Some states require a design with zero tension at release. Others limit the stress in accordance with the AASHTO LRFD Bridge Design Specifications. It is important to note that the AASHTO LRFD Bridge Design Specifications require longitudinal reinforcing in the top flange at beam ends if the top fiber stresses exceed the specified allowable values. These bars are used to “control” transverse cracking in the top flange at release. This reinforcing is for crack width and length control, not prevention. It is recommended that if fully tensioned top strand is included in the design, they should not be used to meet these AASHTO provisions.
13. **What is the purpose of the J bar in the corner of the NEXT Beam flange/web intersection?**
    These bars are used to control top flange end cracking during release and handling. The most common form of potential cracking in this area is a series of vertical hairline cracks located near the inside radius of the top flange / beam stem interface running parallel to the stem. The J bars intersect and are perpendicular to the potential crack plane. End skew of the beams has been found to exacerbate this issue. The use of a semi-integral backwall or integral end diaphragm that is cast in the shop as a secondary pour can help to prevent the growth of these cracks during shipping and erection. This is recommended for bridges with significant skew and if the recommended maximum skew is to be exceeded.
14. **Is confinement reinforcement as specified in the AASHTO LRFD Bridge Design Specifications required for NEXT Beams?**
    Most designers have chosen to use an approach similar to box beams, where they use the U-shaped stirrups in the end regions to meet this provision. Separate enclosed confinement reinforcement can be used; however, the designer should verify that there is sufficient room in this end region to accommodate the enclosed hoops.

NEXT Beam Frequently Asked Questions

Deck and Wearing Surface Questions

1. **How do you seal the longitudinal joints between beams?**
   Bridges using the F Beam will have a monolithic deck; therefore, there is no need for a flange edge connection. The D and E Beams have reinforced joints. The design of these joints should be in accordance with the AASHTO LRFD Guide Specifications for Accelerated Bridge Construction. In general, the joints are designed to resist the moments and shears calculated using the AASHTO strip method. The details shown are considered to fully develop the bars on the deck.
2. **Why is the side of the keyway detailed with an exposed aggregate surface?**
   The exposed aggregate surface of the faces of the keys is recommended to improve grout bond and minimize potential for leakage of the joint. This is consistent with the provisions of the AASHTO LRFD Guide Specifications for Accelerated Bridge Construction. Note that there is no amplitude requirement for the roughness of the surface, as long as the aggregate is visible on the surface. Surface profile amplitude is an AASHTO LRFD Bridge Design Specification provision for connecting a precast beam to a cast-in-place deck (interface shear). The shape of the shear keys on NEXT D Beams provides the mechanical shear transfer mechanism, therefore a specific amplitude is not required.
3. **What is the recommended wearing surface?**
   The NEXT E and F Beam has a composite concrete deck cast on top; therefore, any agency standard wearing surface treatment can be used, including bare concrete. The NEXT D Beam has an integral deck cast into the beam. While not necessarily required, a wearing surface (either thin concrete or bituminous) is recommended in order to provide the smoothest riding surface. If bituminous wearing surfaces are used, a waterproofing membrane should be applied prior to paving. Refer to agency standards for acceptable wearing surface options.

Railing Questions

1. **How are concrete railings (parapets) handled?**
   The use and details of concrete railings should conform to state standards. The deck overhang thickness shall be detailed to provide adequate dowel/anchor embedment for the barrier to deck connection. Deck overhangs supporting railings should be designed for the same provisions used for a cast-in-place deck. The required additional top reinforcing is placed in the topping for NEXT F and E beams, and within the top flange for NEXT D beams. .
2. **Can metal bridge railings be used on a NEXT D Beam without a cast in place curb?**
   The use and details of metal railings, with and without curbs, should conform to state standards. The deck overhang thickness shall be detailed to provide adequate dowel/anchor embedment for the railing and curb to deck connection. Deck overhangs supporting railings should be designed for the same provisions used for a cast-in-place deck.
3. **How is the variable height of the concrete railing or curb calculated as shown on Detail Sheet NEXT 03 through 05?**
   This is a relatively complicated calculation. The designer needs to calculate the estimated heights based on at least the following variables:
   - Roadway profile (tangent, crest vertical curve. or sag vertical curve)
   - Estimated beam camber
   - Beam seat elevations
   - Dead load deflection of the beam

   The calculations are similar to those used to calculate beam haunches on prestressed girders with cast-in-place concrete decks. As with beam haunches, the designer can specify that the beam edges be surveyed after erection and the barrier or curb heights adjusted based on camber and construction tolerances.