


**STATE OF NEW HAMPSHIRE**  
**BRIDGE DESIGN MEMORANDUM**

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**FROM:**  Mark W. Richardson, PE  
Administrator

**DATE:** March 17, 2011  
**AT (Office):** Bureau of Bridge Design

**SUBJECT:** Design Memorandum 2011-01  
Prestressed Concrete Deck Beams and Box Beams

**TO:** In-House Design Staff, Consultant Review Staff, Bridge Design Consultants, FHWA

The Department has modified the Bridge Design Manual and the NHDOT Standard Specifications for Road and Bridge Construction as follows:

**A. Delete Section 620.4.10 of the Bridge Design Manual in its entirety and replace with the following:**

620.4.10 Deck Beams and Box Beams:

- A minimum 5-in. thick (130 mm), reinforced cast-in-place concrete composite overlay with a minimum concrete compressive strength of 4000 psi (30 Mpa), a waterproofing membrane, and bituminous pavement shall be placed on top of the beams.
- The concrete composite overlay should extend transversely to be approximately 6-in. (150 mm) from the outside edge of the exterior beam, so that the end of the overlay is located under the curb section. The reinforcing in the concrete overlay shall be #5 (16) epoxy coated reinforcing bars spaced at 12-in. (300 mm) on center in both the transverse and longitudinal directions. The top reinforcing bars in the concrete overlay shall have a clear cover of 2.5-in. (65 mm) minimum.
- The top surface of the beams shall be raked transversely to a 0.25-in. (6 mm) amplitude.
- Provide #4 (13) hairpin epoxy coated reinforcing bars at 12-in. (300 mm) on center as the minimum interface shear reinforcing to incorporate a composite structural section of the overlay and beam.
- Use a single transverse post-tensioning tie, 0.6-in. (150 mm) diameter unbonded strands tensioned to 44 kips per strand (196 kN), at each diaphragm, located mid height of the beam.
- Use 14-in. (356 mm) wide diaphragms [7-in. (178 mm) each side of the duct centerline] without additional hoop reinforcing.
- For spans less than 50 ft. (15 m), the transverse ties are located at the ends [1 ft. (300 mm) in front of the abutment] and mid span. For spans greater than 50 ft. (15 m), the ties are located at the ends [1 ft. (300 mm) in front of the abutment], quarter points, and mid span.
- The precast beams shall have a full-depth shear key that is grouted prior to post-tensioning, according to Section 528, Appendix A of the NHDOT Standard Specifications for Road and Bridge Construction.
- In single-stage construction, all beams shall be connected transversely at one time.
- Provide #4 (13) reinforcing bars, 12-in. (300 mm) on center as the minimum shear reinforcing in both the interior and exterior beam units.
- For confinement reinforcing at the end of box beams, provide standard design shear reinforcing.

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- For end block reinforcing, provide vertical and horizontal reinforcing at 6-in. (150 mm) on center (maximum) at the end of the beam, and if necessary, with shear reinforcing within h/4 from the end of the member.
- The superstructure curb hoop reinforcing bars shall be cast into the precast beams. To provide adequate development of the hoop bar inside leg, the horizontal portion of the rebar leg shall be placed **below** the precast beam top longitudinal steel and shall be tied. The precast beam top longitudinal steel shall be placed **below** the precast beam top hoop bar.
- The beams should be placed to follow the roadway cross-slope as much as practicable. On crowned roadways, the Designer may consider placing the beams on the roadway cross-slope to eliminate a variable thickness of the concrete overlay. This design concept requires the approval of the NHDOT Design Chief.
- Provide a single layer of #5 (16) hoop reinforcing bars, 12-in. (300 mm) on center in the transverse direction of the box beam top slab, for traffic loads. If #4 (13) hoop reinforcing bars are used in the bottom slab of the box, detail the top slab #5 (16) hoop reinforcing bars with only a minimum lap length of the vertical legs and the #4 (13) hoop reinforcing bars with a longer vertical leg to the top of the box, to reduce confusion of the bars during placement.

### **B. Add the following notes to Section 620.4.10 of the Bridge Design Manual:**

#### PRECAST BOX BEAM NOTES

1. The concrete compressive strength of the precast box beam units shall be 4800 psi at release and 6000 psi at 28 days.
2. Prestressing stands shall be 0.6-in. dia. uncoated seven-wire strand conforming to AASHTO M203-05 (ASTM A416) grade 270 low relaxation. All strands shall be pre-tensioned to 44 kips per strand (75% initial pull).
3. Post-tensioning strands shall be 0.6-in. dia. seven-wire strand conforming to AASHTO M203 (ASTM A416) grade 270 low relaxation. Post-tensioning strands shall be completely coated with a corrosion preventative coating such as Flo-Gard, as manufactured by Insteel Industries, Inc., Sanderson, FL., or Polystrand, as manufactured by Lang Tendons, Inc., Toughkenamon, PA. or an approved equal. If the Flo-Gard coating system is supplied, grout shall be excluded from the lateral post-tensioning ducts during grouting of the shear keys between the beams. The contractor's proposed method for excluding grout from the post-tensioning ducts shall be submitted with the shop drawings. Post-tensioning anchorage system shall be mono-strand corrosion protection system as manufactured by Hayes Industries, Inc., Houston, Texas, or approved equal.
4. Transverse post-tensioning of the precast box beams shall be performed in accordance with Section 528 of NHDOT's Standard Specifications for Road and Bridge Construction.
5. All reinforcing steel for the superstructure shall conform to AASHTO M31 (ASTM A615) grade 60 and shall be epoxy coated.
6. The precast box beam reinforcing steel shall have a minimum clear cover of 1 ¼-in. unless otherwise noted.
7. The cost of prestressing strands, post-tensioning strands and anchorages, and reinforcing steel cast into the precast box beam units shall be paid under item 528.32xx. All other steel in the superstructure shall be paid under item 544.2.
8. Lifting devices shall be within 24-in. of each end of the precast box beam units. Cost shall be paid under item 528.32xx.
9. 1-in. dia. drains shall be provided at the low end of all box beam voids.
10. The box beam shear keys shall be blast cleaned prior to shipping.
11. The top surface of the box beams shall be raked transversely to a ¼-in. amplitude.

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12. Drilling into the box beams shall not be allowed.
13. Differential camber (at erection) between adjacent members shall be limited to 1-in. Values for mid-span camber at transfer shall be detailed on the shop drawings.
14. Provide inserts to support the Contractor's overhang brackets in the top slab on exterior units at the spacing requested by the General Contractor. Inserts shall be shown on the shop drawings. All costs shall be included in item 528.32xx.

**C. Revise the NHDOT Standard Specifications for Road and Bridge Construction, Section 528, Appendix A, Sequence of Construction for Butted Box and Butted Deck Beam Superstructures (Skews <math>\leq 30^\circ</math>) as follows:**

**G) Post-Tension Transverse Ties**

- Shear key grout shall attain a minimum compressive strength of 1500 psi, based on Manufacturer's recommendations, prior to stressing.
- Using a calibrated jack operated by qualified personnel, post-tension transverse ties to 44 kips per strand, beginning with inner most ties and proceeding symmetrically about mid-span toward the member ends. Inner ties shall be re-checked to ensure that the ties have 44 kips per strand of tension.

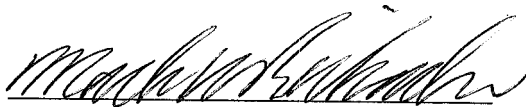
**D. Background:**

This memorandum incorporates the recommendations from PCI Journal, Winter 2011, "*Adjacent precast concrete box-beam bridges: State of the Practice*", Henry G. Russell, and unpublished PCI-NE recommendations. This memorandum revises the previous minimum thickness of 3-in. overlay. The previous overlay thickness did not provide adequate depth for a full mat of reinforcing bars, which helps to transfer the loads among the prestressed components. It also did not provide adequate protection to limit the potential for longitudinal cracking and joint deterioration between the components.

This Memorandum clarifies NHDOT's policy for the design and construction of deck beams and box beams and incorporates the updated precast box beam notes that shall be included in the contract plans.

**E. Implementation:**

The modified Section 620.4.10 to the Bridge Design Manual and Section 528, Appendix A to the NHDOT Standard Specifications for Road and Bridge Construction, shall be implemented as of the date of this memo and shall be used on all applicable projects.



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