SECTION 6 - PRESTRESSED CONCRETE

6.0 – USE CRITERIA

Details shall follow current **NYSDOT BD** Sheets. Concrete I-beams for new construction shall not be allowed on Thruway structures. The maximum desirable skew angle for a bridge using box or slab beams shall be 50°. Box or slab beams use on a bridge having a greater skew angle must be approved by the **DSD**. Span lengths between 40 and 100 feet are generally the most economical for bridges using concrete box or slab beams.

6.1 - DESIGN

The following design sequence shall be followed in selecting a beam section:

a) Straight strands, $f'c = 10{,}000psi$

b) Unbonded strands, $f'c = 10{,}000psi$

Design beams for a maximum tensile value of $3\sqrt{f'c}$, in the flexural area, unless a higher value is allowed by the **DSD**. At the beam ends, the allowable tension values are $7.5\sqrt{f'c_i}$ (initial) and $6\sqrt{f'c}$ (final).

Draped strands shall not be used. Do not use unbonded (blanketed) strands in solid slab (12 inch depth) beams. When unbonding of strands is required by design, the criteria for the maximum

number of unbonded strands is as follows:

a) 25% (max.) of the total number of strands.

b) 40% (max.) of the strands in any one horizontal row.

The minimum length between unbonded strand cut-off lengths shall be 4.0 feet. To avoid conflicts with the anchor rod, do not use center strands in box and slab beams. A minimum 9 inch vertical space between strands is required at one location on each vertical face to avoid conflict with the transverse tendon in that area of the beam, as stated in Section 6.5. The Load fraction for multi-beam precast concrete beams shall be determined by Subsection 4.6 of the **AASHTO LRFD 4th Edition**.

Approval is required by the **DSD** for the use of double rows of strands in the web and/or bottom flange of box beams (additional web width and/or flange depth is required to maintain minimum concrete cover). All multi-span box beam and slab beam structures shall be designed for continuity under live load, unless prohibited by the nature of the foundation material.

6.2 - WIDTH - BOX BEAMS AND SLAB BEAMS

Widths of beams shall be detailed as 4.0 feet and/or 3.0 feet when determining the superstructure cross section. The beam deck shall consist of: (1) multiples of 4.0 foot beams; or (2) multiples of 3.0 foot beams; or (3) a combination of 4.0 foot beams and some number of 3.0 foot beams as required for staged construction. The beam deck shall be selected in the order listed above. The overall beam deck width shall be the sum of the nominal beam widths plus a ½ inch to ¾ inch allowance per joint.

For example (to be shown on plans):

8 beams @ 4.0 feet nominal + 3 beams @ 3.0 feet nominal + 10 joints @ ½" = 41.42 feet

When mixing beam widths, consideration shall be given to the combined length of the beams of the same width chosen for the superstructure cross-section. Only beams of the same width may be cast concurrently in a single forming bed. An attempt should be made to utilize the majority of the forming bed, which is typically 200 feet wide, even if this results in a slight increase in the total superstructure width.

6.3 - CAMBER

Beam camber information shall appear on the plans and shown in inches. The information shall include the camber at prestress transfer and final camber (after losses) due to prestress force and beam dead load. Deflections for noncomposite dead loads and superimposed dead loads shall also be included on the plans.

Beams shall always be designed so that the arithmetic addition of the final beam camber due to prestress force and beam dead load and the deflections due to noncomposite dead load and superimposed dead load results in a positive (upward) camber. See Section 9 of the **NYSDOT** Bridge Manual for additional information.

6.4 - DIAPHRAGMS

Internal diaphragms shall be provided on all voided box beams. Refer to **NYSDOT** "**BD**-PA" sheets for details and Section 9 of the **NYSDOT** Bridge Manual for additional information.

6.4.1 - BOX AND SLAB BEAMS

On structures with no skew, internal diaphragms for voided boxes shall be placed normal to the length of the box beam. On skewed structures, internal diaphragms for voided boxes shall be placed parallel to the skew of the box beam. Internal diaphragms or spreaders within the precast beams shall be placed at midspan for spans up to 50 feet and at quarter points for spans over 50 feet. None are required for slab beams 20 feet or less.

6.4.2 - I-BEAMS

Concrete I-beams shall not be used on new Thruway structures. On existing structures to be rehabilitated, concrete I-beams shall have end diaphragms that are placed parallel to the skew and intermediate diaphragms that are perpendicular to the beams.

6.5 - TRANSVERSE TENDONS FOR BOX AND SLAB BEAMS

On structures with no skew, transverse tendons shall be placed normal to the length of the beam. On skewed structures, transverse tendons shall be placed parallel to the skew of the beam. Refer to **NYSDOT** "**BD-**PA" sheets for details. See Section 9 of the **NYSDOT** Bridge Manual for additional information.

6.6 - CONCRETE SLABS FOR BOX AND SLAB BEAMS

The concrete slab on prestressed concrete beams shall be a minimum of 6 inches thick (normally at centerline of span) which includes a monolithic wearing surface and shall be made composite with the beams. The top 1 inch shall be neglected in the design. The minimum concrete cover over slab reinforcement shall be 2½ inches.

Due to the desired final condition camber and/or the staging conditions, the thickness of bridge decks for prestressed concrete box and slab beams, at times, may greatly exceed the 6 inch minimum shown on the plans. Additional thickness information should be provided to avoid possible claims against the Authority for those decks whose thickness varies considerably from the minimum value. Provide maximum as well as minimum thickness and their locations if the average thickness exceeds 7½ inches for a 6 inch minimum thickness deck.

6.6.1 – SLAB REINFORCEMENT

Fabric reinforcement shall not be used in deck slabs. For simple spans, the slab shall be reinforced with galvanized #4 reinforcing bars at 8 inch centers in both directions. Galvanized bars shall be paid for under the appropriate item. Refer to Section 5 – Reinforcement, for appropriate lap lengths. All concrete slab reinforcement shall be tied to the exposed reinforcement in the tops of beams as necessary to ensure proper placement and cover. Exposed reinforcement in the tops of beams shall be detailed appropriately to ensure proper cover of the slab reinforcement.

For continuous spans, the reinforcement in the positive moment regions shall be as indicated above for simple spans. In the negative moment regions of slabs that are continuous over piers or abutments, galvanized bars shall be used in conjunction with the prestressed concrete beams to develop the negative moment. These bars shall be extended from the pier or abutment to provide initial development beyond the point where the adjacent reinforcement in the slab can provide the required reinforcement. The bars shall be placed to provide a clear cover of 2½ inches. Refer to Section 5 - Reinforcement, for additional information.

6.6.2 – STAGE CONSTRUCTION CONSIDERATIONS

On stage construction projects, particular care shall be taken so that, due to long-term camber growth on Stage II beams, the required minimum slab thickness can be achieved. The anticipated differential camber (time dependent) plus slab dead load deflection for Stage II beams shall be

considered when setting the minimum slab thickness for Stage I Construction. The maximum camber differential between Stage I and Stage II beams shall be such that the Stage II slab is at least 5½ inches.

If the anticipated camber growth of the Stage II beams exceeds ½ inch, then the minimum slab thickness of the Stage I slab shall be increased to maintain a 5½ inch minimum slab thickness for the Stage II slab. The additional slab thickness shall be considered as extra dead load in the beam design computations. For estimating the projected camber growth (time dependent), use 50% of the transfer camber (without creep correction) for this value. Example: camber at transfer (w/o creep) = 1 inch. Anticipated camber growth = .5 x 1 inch = 0.5 inch.

6.7 - SHEAR KEYS

Shear keys shall be provided in all prestressed beams. Refer to **NYSDOT** "**BD**-PA" sheets for details.