

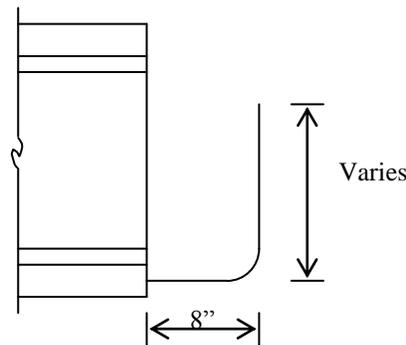
### **5.14.1.4 SIMPLE SPAN PRESTRESSED GIRDERS MADE CONTINUOUS**

The following design criteria shall apply for the design of simple span prestressed girder bridges constructed with a continuous concrete deck (no expansion joints at the piers).

#### **Case 1 Girders Designed As Simple Spans & Top Deck Reinforcement Added To Control Cracking.**

(This is the typical design case for new bridges)

- The top longitudinal deck reinforcement over the piers, in addition to the standard empirical design reinforcement, shall be #6 bars at 12" spaced between the standard top deck bars. The full area of the additional reinforcement shall extend either direction from the bearing centerlines a distance of at least 10 feet or 15% of the longer span whichever is greater. At least half the area of the additional reinforcement shall extend to a distance from the pier of at least 15 ft or 20% of the longer span whichever is greater.
- The bottom longitudinal deck reinforcement shall be per the empirical design method, Article 9.7.2.
- A positive moment connection at the piers shall be provided. This shall entail extending the required number of prestressing strand beyond the end of each girder 8" horizontally then bent vertical and anchored in the pier diaphragm. See details on standard drawing for Prestressed AASHTO Girder Details B5.2D or Prestressed Bulb Tee Girder Details B5.3O.



#### **Case 2 Girders Designed Fully Continuous For Live Load**

(This case may be used for new bridges where Case 1 is not feasible and approved by the Bridge Engineer)

- The weight of the parapet may be distributed evenly to all the girders.
- The negative moment reinforcement shall be determined based on the maximum negative moment taken at the face of the support.
- Longitudinal reinforcement shall be anchored in accordance with Article 5.14.1.4.8.
- The section shall meet Strength 1 limit state requirements as follows:
  - 1.25\*DC<sub>noncomposite</sub>, acting as simply supported and
  - 1.25\*DC<sub>composite</sub> + 1.5\*DW + 1.75\*LL, acting as a continuous beam.
- Both layers of steel in the deck may be used in resisting the negative moments.
- Only structures with fully effective construction joints at the piers, per Article 5.14.1.4.3, shall be designed as continuous for the Service III limit state. The requirements of Article 5.14.1.4.3, may be considered satisfied if the girder age is at least 90 days at the time the continuity diaphragm is placed.
- A positive moment connection at the piers shall be provided with a minimum capacity, Mn, of 1.2M<sub>cr</sub> in accordance with NCHRP Report 519.

#### **Case 3 Girders Designed As Simple Spans And The Deck Is Replaced To Eliminate Joints.**

(This case is used for existing bridges that are retrofitted)

- No design is required. Use #5 bars in the top mat at approximately 12" spacing over the piers and carry them at least a development length beyond the centerline of bearing of the girders but not beyond the 1/4 pt. of the span.

### **Commentary**

Case 1 – The additional reinforcement in the top of the deck is based on providing enough steel over the piers to meet the requirements for control of cracking in the deck per Article 5.7.3.4 assuming the total Service 1 live load is distributed equally to all girders. This additional deck steel may not supply enough negative moment capacity to resist the full negative moments that would be required in a continuous girder design for Strength 1 loading, however it will provide enough reinforcement to limit the steel stress requirements for crack control for spans up to 130' and girder depths up to 73.5". Girders not specifically designed for continuous action should still be provided with a positive moment connection in order to prevent possible cracking in the diaphragm and also to securely anchor the girders in the diaphragm. The number of prestressing strands that are extended into the pier diaphragm is based on the area of steel required to provide a moment capacity,  $M_n$ , sufficient to resist  $0.6M_{cr}$  for the composite girder section in positive bending based on  $M_{cr} = S f_r$  where  $S$  is the composite section modulus and  $f_r$  is the modulus of rupture equal to  $0.24\sqrt{f_c}$  where  $f_c$  is the strength of the diaphragm concrete. ITD's maximum slab thickness and the maximum effective composite slab width per Article 4.6.2.6.1 were used to establish the number of strands required for the various girder depths as well as development length. However, the number of strand and the development length shown on the standard drawing may be considered adequate.

Case 2 – Since the effects due to creep and shrinkage are highly dependent on conditions beyond the control or knowledge of the designer, it is more practical to allow the girders to age for 90 days before continuity is established in order to negate the effects of creep and shrinkage rather than attempting to calculate these effects based on assumed conditions and material properties that can vary significantly.

#### **Revisions:**

June 2006 Revised Article to conform to approved 2006 Ballot Item #13.

May 2014 Revised reference for anchorage of longitudinal reinforcement for Case 2 to 5.14.1.4.8.