Report No:
PCINER-98-PCGCC
Title:
Prestressed Concrete Girder Continuity Connection
Developing Organization:
Precast/Prestressed Concrete Institute New England Region Technical Committee Phone - 888-700-5670 Email – contact@pcine.org Website- www.pcine.org
Report Date: **Revision Date:**
May 1998
Status of Report:
Final
Abstract:
Guidelines for simple span members made continuous in Multi-span bridges. This guideline and its sample details may be used when designing for continuity. The PCI New England Technical committee has recommended that strand extensions be used to make the positive moment connection in beams. If a State Standard exists it will take precedence over these guidelines and details.
Number of Pages: 6

Prestressed Concrete Girder Continuity Connection

The design of simple-span members made continuous in multiple span bridges shall be in accordance with the following:

1. Application of Loads: Members shall be assumed to act as simple-spans for the application of the prestressing forces, member dead load and non-composite dead loads. Continuous members shall be assumed to carry the superimposed dead loads, live loads and time-dependent effects (creep and differential shrinkage).

2. Positive Moment Connection: Provide a positive connection at interior supports sufficient to develop, as a minimum, a moment equal to 1.2* Mcr (+) of the composite section. The positive moment connection shall be made by extending the prestressing steel beyond the member ends. Diaphragm ties within 6" of the bottom bulb shall be assumed to contribute to the positive moment connection if properly engaged by transverse ties. The connection capacity shall be determined using the method outlined in Chapter 4 of FHWA-RD-77-4, "End Connections of Pretensioned I-Beam Bridges". This method is summarized below.

The connection shall be designed by the working stress method with an ultimate strength check.

Working Stress Design:

$$f_{ps} = \frac{L_e - 8.25}{0.228} \leq 150 \text{ ksi, for } L_{pb} \leq 8.25"$$

$$f_{ps} = \frac{L_e - L_{pb}}{0.228} + \frac{L_{pb} - 8.25}{0.472} \leq 150 \text{ ksi, for } L_{pb} > 8.25"$$

$$A_{ps} = \frac{M - A_s f_y (j d_{ps} + d - d_{ps})}{f_{ps} j d_{ps}}$$

Ultimate Strength Check:

$$f_{pu} = \frac{L_e - 8.25}{0.163} \quad \text{for } L_{pb} \leq 8.25"$$

$$f_{pu} = \frac{L_e - L_{pb}}{0.163} + \frac{L_{pb} - 8.25}{0.337} \quad \text{for } L_{pb} > 8.25"$$

$$a = \frac{A_{ps} f_{pu} + A_s f_y}{0.85 f'_c b}$$

$$M_u = 0.9 \left[A_{ps} f_{pu} (d_{ps} - {}^{a}/_{2}) + A_s f_y (d - {}^{a}/_{2})\right]$$

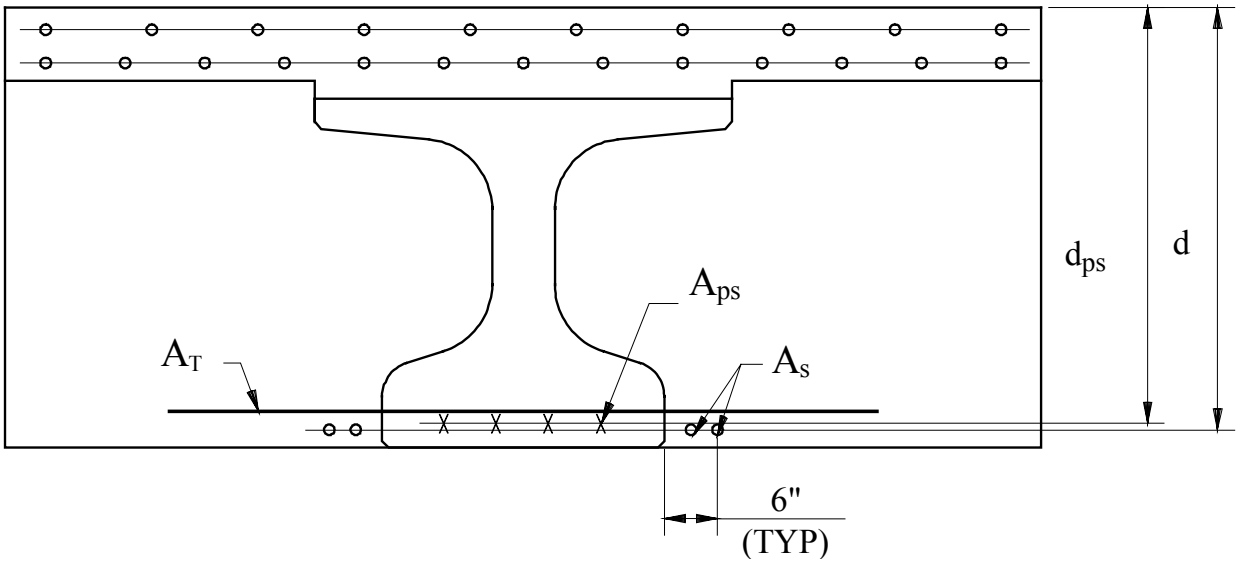


Figure 1 Connection Reinforcement Location

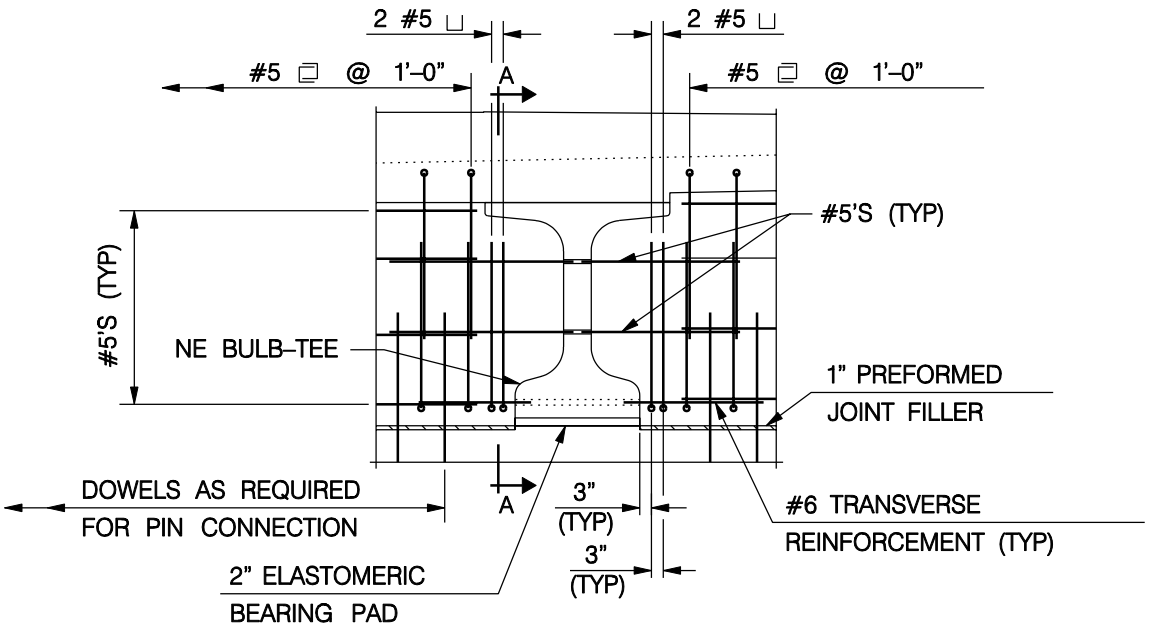
For the diaphragm ties to be effective in determining the positive moment capacity, it is necessary for transverse reinforcement, A_T, to be extended into the diaphragm from the girder section at the lower corners and enclosed by the diaphragm ties. The required transverse reinforcement shall be determined by AASHTO 8.16.6.4, Shear Friction.

a = depth of compression stress block
b = compression flange width per AASHTO 8.10
d = distance from the extreme compressive fiber to the centroid of the diaphragm tie
d_{ps} = distance from the extreme compression fiber to the centroid of the strand
f'_c = compressive strength of deck concrete
f_{ps} = allowable working stress per strand
f_{pu} = stress of strand at general slip (defined as measureable slip)
f_y = diaphragm tie yield stress
jd_{ps} = internal moment arm = $0.94d_{ps}$ (approximates T-Beam with low percentage of reinforcing steel)
A_{ps} = required area of embedded strand
A_s = area of diaphragm ties within 6" of the bottom bulb
A_T = area of transverse reinforcement
L_e = total embedment length of strand
L_{pb} = prebend length of embedded strand (9")
M = design moment $\geq 1.2\ M_{cr}$
M_u = ultimate moment capacity of connection

3. Negative Moment Connection: The amount of negative moment reinforcing steel required in the deck shall be determined by assuming the member to be a rectangular section with a compression block width equal to the bottom flange width of the member. Both top and bottom mats of deck slab reinforcing steel within the effective flange width shall be included in calculating the moment capacity of the section.

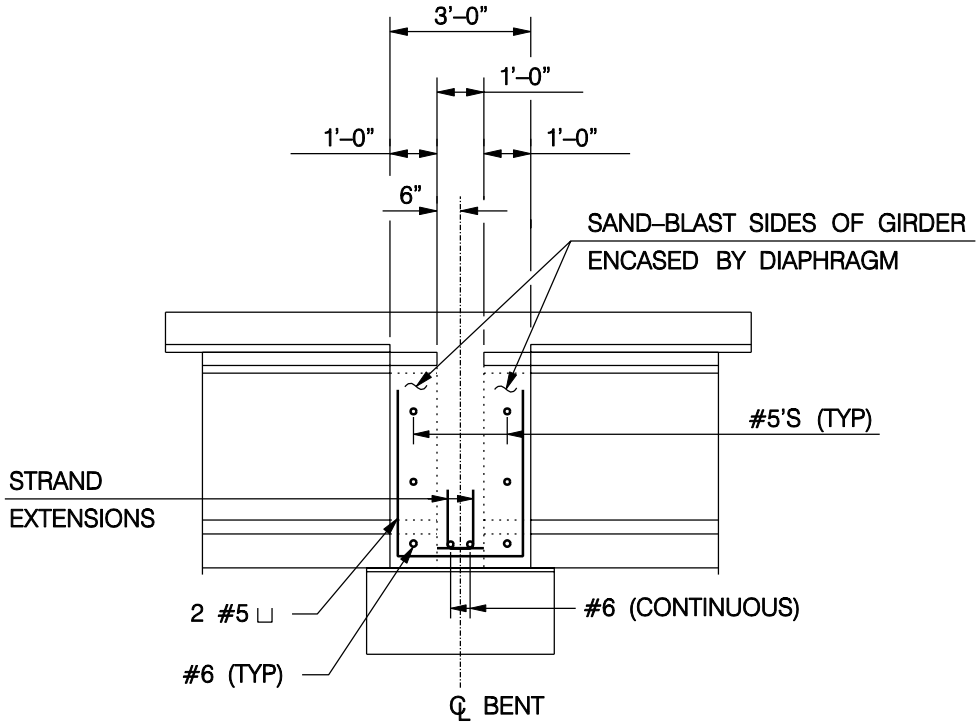
4. Time-Dependent Effects: Time-dependent effects shall be accounted for using the method outlined in the PCI Journal, April 1969, "Design of Continuous Highway Bridges with Precast, Prestressed Concrete Girders". These effects may be neglected if provisions are made in the contract to ensure that the concrete members cure for a minimum of 60 days prior to the application of additional dead loads, and only with the approval of the Design Chief.

For simple-span members made continuous in multiple span bridges, consideration shall be given to the placement of temporary diaphragms near the ends of members at piers in order to provide stability until the final end diaphragms are cast-in-place at the same time as the deck slab.



BENT DIAPHRAGM ELEVATION

SCALE: 1/4" = 1'–0"



SECTION A–A

SCALE: 1/4" = 1'–0"

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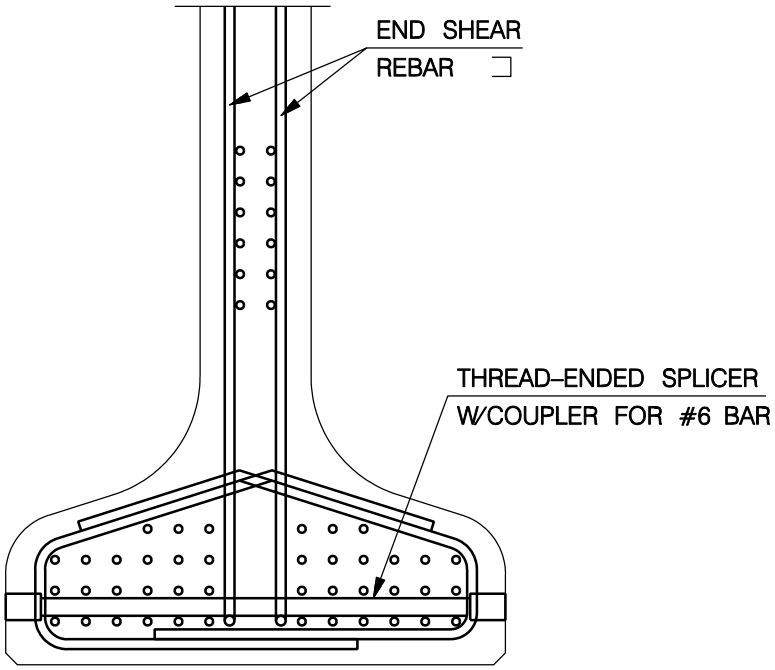
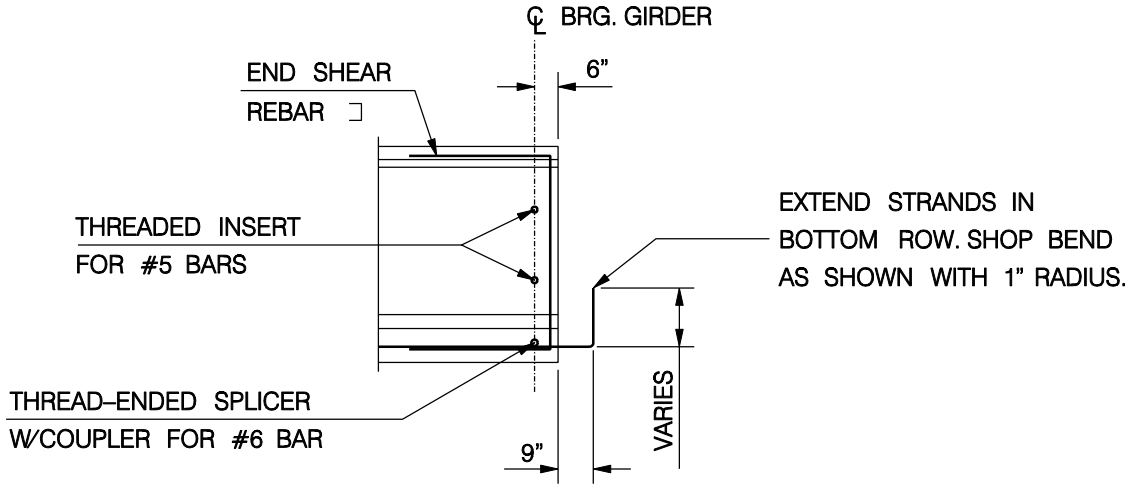


REINFORCEMENT DETAIL

SCALE: 1" = 1'–0"



GIRDER END DETAIL

SCALE: 1/4" = 1'–0"

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