



## 11-3 DESIGNER'S CHECKLIST FOR PRESTRESSING IN POST-TENSIONED CONCRETE BOX GIRDERS

### Design

#### Prestressing Force

- An initial value can be calculated using Bridge Design Aids (BDA) Chapter 11. Start with the charts and get the total weight of prestressing steel based on deck area and span lengths. Then use the estimating equation to solve for  $P_{jack}$  or  $P_f$ .
- Design center-of-gravity location should account for six inch fluctuation up or down at anchorages to give the contractor flexibility.
- Use Memo to Designers (MTD) 11-28 to estimate high and low points in the cable path.
- The design force should result in zero tension under  $DC + DW$ .
- For allowable tensile stresses, refer to Table 5.9.4.2.2-1 in the AASHTO LRFD Bridge Design Specifications as amended by Caltrans.

#### One-End and Two-End Stressing

- Single-span bridges shall be stressed from either end.
- Two-span structures shall be stressed from the long-span end.
- Multiple-span structures should be checked for one-end stressing. It is economical to use one-end stressing so long as  $P_{jack}$  does not exceed the two-end stressing option by more than three percent. The plans should show which end is to be stressed if one-end stressing is permitted.

#### Loss of Prestress

- Consider horizontal curvature if present.
- Friction losses are a function of  $K$  and  $\mu$ . See Table 5.9.5.2.2b-1 in the AASHTO LRFD Bridge Design Specifications for values.
- Long-term losses in prestressing can be estimated at 25 ksi for box girders.



### Concrete Strength

- Post-tensioned concrete:  $(f'_c)_{\min} = 4.0$  ksi;  $(f'_{ci})_{\min} = 3.5$  ksi
- For cast-in-place construction, report  $f'_c$  to the nearest 500 psi for strengths up to 6.0 ksi and in increments of 100 psi above 6.0 ksi.

### Hinge Reactions

- Report dead load and prestress reactions at hinges on the plans adjacent to the hinge detail sheets. Dead load should only include *DC* values. These values help the contractor design the falsework tower at the hinge.
- Report these values in tabular form. See example table below:

Hinge	Dead Load Reaction (kips)	P/S Reaction (kips)
1	1000	150
2	1500	200
3	1500	200
4	1000	150

### Miscellaneous

- Flare exterior girders to 18 inches minimum at anchorages.
- The flare length of 16 feet and duct ties shown in Standard Plan B8-5 are the minimum values to be used. We have had several unsatisfactory experiences with details that incorporated shorter flares and duct ties using a different configuration.
- Reinforce the ends of anchorage diaphragms for bursting forces (general zone and local zone).
- Consider the effects of lateral tendon force on horizontally curved girders. See MTD 11-31.
- Use a creep factor of 3.0 for camber calculations on prestressed structures. Prestress deflections should be taken after long term losses.



- Consider the effects of hinge curl at in-span hinges. See MTD 11-34.
- Provide for shortening during stressing. Use greased sheet metal on top of elastomeric pads.
- Check for special design requirements for railroad structures in MTD Chapter 17.

## Detailing

- Two - #8 “Buck Winter” bars are to be placed at the tops of the webs within the stem and soffit pour to resist excessive falsework settlement. Standard Plan B7-1 includes these bars.
- Do not show the ducts or duct-vent details on the plans.
- At supports and anchor ends, provide stirrups at 12-inch spacing minimum for eight feet.
- Concrete strength limits shall be shown on the plans. See Bridge Design Details (BDD) Chapter 9.
- For curved girders, “Detail A” may be required. See MTD 11-31.
- Prestressing notes are to be located on the girder layout sheets. Refer to BDD Chapter 9. Include all assumptions for prestress losses (assumed  $K$  and  $\mu$  as well as average long term loss stress)
- Show the path of the center of gravity of prestressing force in a longitudinal section exaggerated in the vertical direction for clarity. See BDD Chapter 9. Clearly identify the physical location of the point of no movement along the cable path.
- Avoid negative camber values especially in conjunction with flat bridge profiles. This can lead to a sag condition and water ponding on the bridge. The prestress path or force can be adjusted to ensure positive camber.

## Estimating

- Weight of prestressing steel is determined using the equation in BDA 11-66. Ignore the weight of anchorages and ducts.
- Prestressing bars shall be estimated by weight. Include the weight of all hardware.



## Shop Plans

- Refer to MTD 11-1 for shop plan checking procedure. Examples can be found in the Prestress Manual on the Structure Construction website.
- Anchorages must be tested and approved by the Caltrans Materials Engineering and Testing Services (METS). Refer to the list of approved systems on the Caltrans Materials Engineering and Testing Services (METS) website: [www.dot.ca.gov/hq/esc/approved\\_products\\_list](http://www.dot.ca.gov/hq/esc/approved_products_list). Instructions for comparing proposed systems with approved systems can also be found on this site.
- Advise the Documents Unit if more than one railroad is involved.
- Refer to Standard Specifications Section 50 and the Special Provisions.

*original signed by Tony M. Marquez*

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