Index 21800 Series Post-Tensioning (Rev. 07/15)

Design Criteria

AASHTO LRFD Bridge Design Specifications; ***Structures Design Guidelines (SDG)***; ***Specifications*** Sections 452, 453, 462, 938 and 960.

Design Assumptions and Limitations

Indexes 21801, 21802 and 21803 depict various details and requirements for post-tensioning systems used on Department projects. Use these Standards with ***Specifications*** Sections 452, 453, 462, 938 and 960 and the Approved Post Tensioning Systems List on the SDO website.

Plan Content Requirements

In the Structures Plans:

Design and detail post tensioning tendons and include quantity, geometry, anchorage protection and stressing information on the plans in accordance with these Standards. In cases where the tendon types and anchorage protection details shown in the Standards are not sufficient to meet project specific requirements, obtain Department approval to supplement the drawings with project specific details.

Design and detail using the following standard tendon sizes utilizing 0.6 inch diameter strands: 4, 7, 12, 15, 19, 27 and 31.

For projects on which permanent post tensioning bar tendons are utilized, complete the "Post-Tensioning Bar Tendon Data Table" shown in Figure 1 and include it in the plans.

Bar Tendon Designation: Indicate the bar tendon designation using a number or letter and number combination.

No. Required: Indicate the total number of required bar tendons of a given designation.

Bar Size: Indicate the bar diameter.

Bar Length: Indicate the bar tendon length measured from anchorage to anchorage (front face of bearing plate).

Stressing Force/Bar: Indicate the stressing force per bar.

Stressing End: Indicate the stressing end as follows:

Ahead Station - Live/stressing end is at the ahead station anchorage for horizontally oriented tendons or at the top anchorage of vertically oriented tendons.

Back Station - Live/stressing end is at the back station anchorage for horizontally oriented tendons or at the bottom anchorage of vertically oriented tendons.

Elongation: Indicate the total theoretical elongation due to stressing.

Tendon Profile: Indicate the tendon profile as shown on Index 21801. Include the geometric effects of the profile grade and cross slope on tendon geometry when determining the appropriate vertical profile.

Filler Material: Indicate the use of grout or flexible filler.

Anchorage Protection Type: Indicate the anchorage protection type using the requirements stated below.

For projects on which strand post tensioning tendons are utilized, complete the "Post-Tensioning Strand Tendon Data Table" shown in Figure 2 and include it in the structures plans.

Strand Tendon Designation: Indicate the strand tendon designation using a number or letter and number combination.

No. Required: Indicate the total number of required strand tendons of a given designation.

Tendon Size: Indicate the number and size of strands, e.g. 12-0.6.

Tendon Length: Indicate the strand tendon length measured from anchorage to anchorage (front face of anchorage).

Ahead Station Stressing Force per Tendon: Indicate the stressing force per tendon at the ahead station.

Back Station Stressing Force per Tendon: Indicate the stressing force per tendon at the back station.

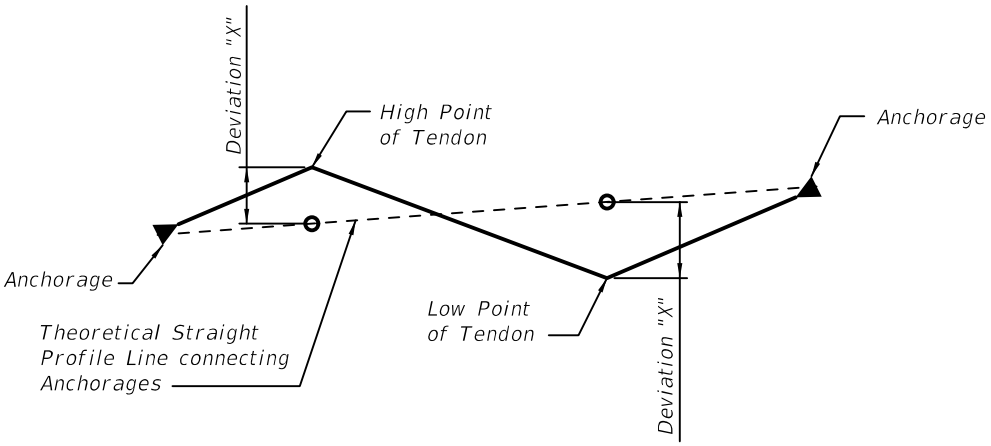
Stressing End: Indicate the stressing end as follows:

Ahead Station - Live/stressing end is at the ahead station anchorage for horizontally oriented tendons or at the top anchorage of vertically oriented tendons.

Back Station - Live/stressing end is at the back station anchorage for horizontally oriented tendons or at the bottom anchorage of vertically oriented tendons.

Elongation: Indicate the total theoretical elongation due to stressing.

Tendon Profile: Indicate the tendon profile as shown on Index 21801. Include the geometric effects of the profile grade and cross slope on tendon geometry when determining the appropriate vertical profile. Designate top slab transverse tendons and top slab cantilever tendons with Deviation "X" less than or equal to 20" as shown in the sketch below as a Profile 12 tendon.



TENDON PROFILE DEVIATION

Filler Material: Indicate the use of grout or flexible filler.

Anchorage Protection Type: Indicate the anchorage protection type using the requirements stated below.

If necessary, the note(s) below the Data Tables may be modified by the EOR on a project by project basis to better clarify a unique tendon profile or arrangement.

Indicate the anchorage protection type using the following descriptions in conjunction with the following figure and the details shown on Index 21802.

Type 1 - Anchorage protection used for exposed surfaces for strand or bar tendons on Segmental Box Girder Superstructures, Integral or Straddle Pier Caps, Footings, etc.

Type 2 - Anchorage protection used for strand tendons anchoring in top flange blockouts or end of spliced Girder Segments.

Type 3 - Top inspected anchorage protection used for strand or bar tendons on Segmental Box Girder Superstructures constructed using the balanced cantilever method.

Type 4 - Anchorage protection used for strand tendons on the top surfaces of Piers.

Type 5 - Anchorage protection used for strand or bar tendons with interior blisters on Segmental Box Girder Superstructures.

Type 6 - Anchorage protection used for strand tendons on Flat Slab Superstructures.

Type 7 - Anchorage protection used for transverse strand tendons (generally 4 strands or less) on Segmental Box Girder Superstructures and other transversely post-tensioned superstructures.

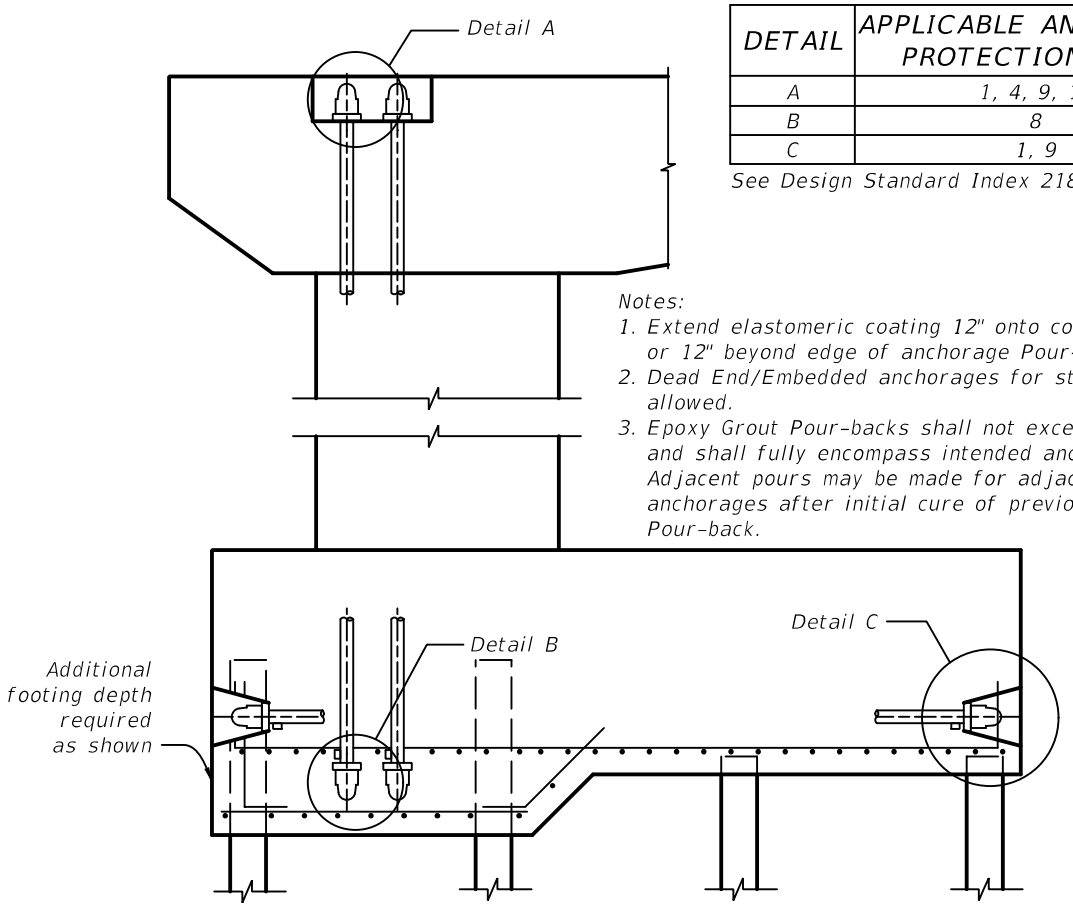
Type 8 - Dead end anchorage protection used for vertical bar tendons.

Type 9 - Anchorage protection used for bar tendons on Segmental Box Girder Pier Diaphragms, Footings, top surfaces of Piers, Integral or Straddle Pier Caps, etc.

Type 10 - Anchorage protection used for bar tendons on the top surfaces of Piers.

Types 11 & 12 - Anchorage protection used for bar tendons primarily on Integral or Straddle Pier Caps.

Anchorage Protection Types for Footing and Pier Post-Tensioning Applications



DETAIL	APPLICABLE ANCHORAGE PROTECTION TYPE
A	1, 4, 9, 10
B	8
C	1, 9

See Design Standard Index 21802.

Notes:
1. Extend elastomeric coating 12" onto concrete edges or 12" beyond edge of anchorage Pour-back.
2. Dead End/Embedded anchorages for strand are not allowed.
3. Epoxy Grout Pour-backs shall not exceed 16 CF and shall fully encompass intended anchorage(s). Adjacent pours may be made for adjacent anchorages after initial cure of previous Pour-back.

FOOTING/PIER SCHEMATIC

Payment

Item number	Item description	Unit Measure
462-2-AA	Post Tensioning Tendons	LB
462-3	Additional Post Tensioning in Segmental Box Span *Note: Use for rehabilitation projects only*	EA

Figure 1 Post-Tensioning Bar Tendon Data Table

POST-TENSIONING BAR TENDON DATA TABLE										Table Date 07-01-15
BAR DESIGNATION	NO. REQUIRED	BAR SIZE	BAR LENGTH (Ft-in)	STRESSING FORCE PER BAR (kips)	*** STRESSING END	ELONGATION (in)	* TENDON PROFILE	FILLER MATERIAL	**ANCHORAGE PROTECTION TYPE	
									AHEAD STA.	BACK STA.

For non-longitudinal bars, ahead-station denotes left anchorage, back-station denotes right anchorage (looking ahead-station). For mostly vertical bars, ahead-station denotes top anchorage, back-station denotes bottom anchorage.
* See Post-Tensioning Vertical Profiles, Design Standards Index 21801.
** See Post-Tensioning Anchorage Protection, Design Standards Index 21802.
*** Stressing End Definitions:
- Ahead Station: Bar Live/Stressing End is ahead-station anchorage.
- Back Station: Bar Live/Stressing End is back-station anchorage.

Figure 2 Post-Tensioning Strand Tendon Data Table

POST-TENSIONING STRAND TENDON DATA TABLE														Table Date 07-01-15
TENDON DESIGNATION	NO. REQUIRED	TENDON SIZE	TENDON LENGTH (Ft-in)	AHEAD-STATION STRESSING FORCE PER TENDON (kips)	BACK-STATION STRESSING FORCE PER TENDON (kips)	FORCE @ AHEAD-STATION END AFTER ANCHOR SET (kips)	FORCE @ BACK-STATION END AFTER ANCHOR SET (kips)	*** STRESSING END	THEORETICAL ELONGATION @ AHEAD-STATION END (in)	THEORETICAL ELONGATION @ BACK-STATION END (in)	* TENDON PROFILE	FILLER MATERIAL	**ANCHORAGE PROTECTION TYPE	
													AHEAD STA.	BACK STA.

In general, for non-longitudinal tendons, ahead-station denotes left anchorage, back-station denotes right anchorage (looking ahead-station). For mostly vertical tendons, ahead-station denotes top anchorage, back-station denotes bottom anchorage.
* See Post-Tensioning Vertical Profiles, Design Standards Index 21801.
** See Post-Tensioning Anchorage Protection, Design Standards Index 21802.
*** Stressing End Definitions:
- Ahead Station: Tendon Live/Stressing End is ahead-station anchorage.
- Back Station: Tendon Live/Stressing End is back-station anchorage.
- Alternate (ahead/back): Tendon Initial Live/Stressing End is ahead-station anchorage with associated elongation.
  Tendon Subsequent Live/Stressing End is back-station anchorage with associated elongation.
- Alternate (back/ahead): Tendon Initial Live/Stressing End is back-station anchorage with associated elongation.
  Tendon Subsequent Live/Stressing End is ahead-station anchorage with associated elongation.
- Double: Tendon Live/Stressing End is simultaneously the ahead-station and back-station anchorage with respective elongations.

Sample Tables:

POST-TENSIONING BAR TENDON DATA TABLE — Table Date 07-01-15

BAR DESIGNATION	NO. REQUIRED	BAR SIZE	BAR LENGTH (Ft-in)	STRESSING FORCE PER BAR (kips)	*** STRESSING END	ELONGATION (in)	* TENDON PROFILE	FILLER MATERIAL	**ANCHORAGE PROTECTION TYPE	
									AHEAD STA.	BACK STA.
PT-1	6	1 1/4 Ø	21'-9"	131	AHEAD STA.	0.940"	12	GROUT	10	10
PT-2	8	1 3/8 Ø	16'-6"	165	BACK STA.	0.713"	12	GROUT	10	10
PT-3	24	1 3/4 Ø	80'-0"	280	BACK STA.	3.540"	17	FLEXIBLE	9	8

For non-longitudinal bars, ahead-station denotes left anchorage, back-station denotes right anchorage (looking ahead-station). For mostly vertical bars, ahead-station denotes top anchorage, back-station denotes bottom anchorage.
* See Post-Tensioning Vertical Profiles, Design Standards Index 21801.
** See Post-Tensioning Anchorage Protection, Design Standards Index 21802.
*** Stressing End Definitions:
- Ahead Station: Bar Live/Stressing End is ahead-station anchorage.
- Back Station: Bar Live/Stressing End is back-station anchorage.

POST-TENSIONING STRAND TENDON DATA TABLE — Table Date 07-01-15

TENDON DESIGNATION	NO. REQUIRED	TENDON SIZE	TENDON LENGTH (Ft-in)	AHEAD-STATION STRESSING FORCE PER TENDON (kips)	BACK-STATION STRESSING FORCE PER TENDON (kips)	FORCE @ AHEAD-STATION END AFTER ANCHOR SET (kips)	FORCE @ BACK-STATION END AFTER ANCHOR SET (kips)	*** STRESSING END	THEORETICAL ELONGATION @ AHEAD-STATION END (in)	THEORETICAL ELONGATION @ BACK-STATION END (in)	* TENDON PROFILE	FILLER MATERIAL	**ANCHORAGE PROTECTION TYPE	
													AHEAD STA.	BACK STA.
1	6	12-0.6	650'-0 7/8"	562.5	562.5	454.9	468.9	Alt. (back/ahead)	10.9	32.2	15	FLEXIBLE	1	1
2	6	12-0.6	650'-1 3/4"	562.5	562.5	456.3	456.3	Alt. (back/ahead)	10.8	31.6	15	FLEXIBLE	1	1
3	6	12-0.6	650'-3 5/8"	562.5	562.5	458.4	459.8	Alt. (back/ahead)	10.6	31.0	15	FLEXIBLE	1	1
4	6	12-0.6	650'-6 1/4"	562.5	562.5	465.4	465.4	Alt. (back/ahead)	10.6	30.3	15	FLEXIBLE	1	1

In general, for non-longitudinal tendons, ahead-station denotes left anchorage, back-station denotes right anchorage (looking ahead-station). For mostly vertical tendons, ahead-station denotes top anchorage, back-station denotes bottom anchorage.
* See Post-Tensioning Vertical Profiles, Design Standards Index 21801.
** See Post-Tensioning Anchorage Protection, Design Standards Index 21802.
*** Stressing End Definitions:
- Ahead Station: Tendon Live/Stressing End is ahead-station anchorage.
- Back Station: Tendon Live/Stressing End is back-station anchorage.
- Alternate (ahead/back): Tendon Initial Live/Stressing End is ahead-station anchorage with associated elongation. Tendon Subsequent Live/Stressing End is back-station anchorage with associated elongation.
- Alternate (back/ahead): Tendon Initial Live/Stressing End is back-station anchorage with associated elongation. Tendon Subsequent Live/Stressing End is ahead-station anchorage with associated elongation.
- Double: Tendon Live/Stressing End is simultaneously the ahead-station and back-station anchorage with respective elongations.