South Carolina
Department of Transportation

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STRUCTURAL DRAWINGS AND DETAILS
Instructional Memorandum 704-AASHTO
AASHTO I-Beam
June 26, 2024

General

The AASHTO I-Beam Type I modified, Type II, Type III, and Type IV are available as standard details.

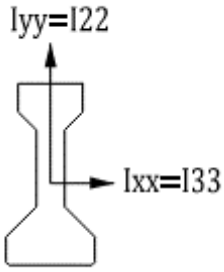
Design Criteria and Assumptions

Design Specifications: AASHTO LRFD Bridge Design Specifications, 9th Edition | 2020 (herein referred to as BDS)

Table 1 contains the section properties.

Table 1 – Section Properties for Prestressed Sections

Section	(in^2) Area	Vol / Surf	(in^4) I33=Ixx	(in^4) I22=Iyy	(in^4) J=Torsional Constant	(in) H nominal	(in) CG to bottom
Type I Mod.	331.4	3.54	26406	5179	7599	28	12.85
Type II	368.4	3.39	50842	5289	7789	36	15.85
Type III	558.9	4.08	125165	12152	17056	45	20.29
Type IV	788.4	4.76	260403	24282	32886	54	24.75



AASHTO I-Beam

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The maximum allowable number of prestressing strands to meet LRFD BDS splitting requirement within the allowable length from the end of the beam for the detailed vertical stirrup reinforcement is shown in Table 2.

Table 2 - Maximum number of strands for splitting resistance using the standard detailing.			
Section	Maximum Number of 0.6"φ Strands	Jacking Force (kips)	Total Prestress Force (kips)
Type I Modified	20	43.9	878
Type II	24	43.9	1054
Type III	24	43.9	1054
Type IV	36	43.9	1580

Note: Table is applicable to standard drawing detailing only. Maximum number of strands may be revised based on project-specific designs.

At locations where beams are made continuous for composite dead loads and superimposed live loads, the positive moment connection is detailed at the end of the beam with extended prestressed strands. The factored positive moment resistance φMn, is set equal to 1.2*Mcr (cracking moment) of the beam using the gross section properties of the composite section and the concrete strength of the continuity diaphragm (4 ksi). A 12'-0" beam spacing is assumed.

For prestressing strands to be extended to act as reinforcement in the continuity connection, a 3'-0 1/2" minimum extension is used. Extended strands are bent up after the girder is removed from the bed. For the extension length detailed, the required minimum number of extended 0.6" diameter prestressing strands per beam size is shown in Table 3.

Table 3 - Required prestressing steel strands to meet 1.2 Mcr.	
Section	Minimum Number of 0.6"φ Strands Extended for 1.2 Mcr
Type I Modified	4
Type II	4
Type III	4
Type IV	6

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Instructions to Designer

The Engineer must determine if the standard design and details are adequate for project specific use. At a minimum, consider the following items:

- Wherever “X” or “#” is used, replace with project specific values.
- Detail scales are listed in the drawing model for each detail in the sheet models for reference. If an individual detail scale is to be revised in the drawing model, the setting called “Propagate Annotation Scale” in the drawing model property settings must be set to “off”. Otherwise, every detail will change scale when the drawing scale is revised.
- “AASHTO Beam Details Span ‘X’” sheets are provided for no skew, left skew, and right skew. The sheets are further subdivided into options for (1) intermediate steel diaphragm connection, (2) location (midpoint of span or third points of span), and (3) whether the diaphragm line is continuous or discontinuous (single or multiple line of diaphragm holes).
- Once the correct “AASHTO Beam Details Span ‘X’” sheet(s) are chosen, delete “-Alt X” from the title block. This additional text is required as a placeholder because model names within a DGN must be unique.
- Strand patterns shown do not represent all possible strand locations. Designer may revise strand patterns for project-specific designs.
- Show the required locations of extended prestressing strands for positive moment at end of the beam in the “Strand Layout” on the “Prestressed Concrete Beam AASHTO Type ‘X’ Span ‘X’” sheet.
- Verify that stirrups do not conflict with stud locations of sole plate. If so, modify stirrup spacing. Do not modify stud spacing on sole plate.
- Previous standard drawings included 2” diameter holes through the beam webs to accommodate a reinforcing steel connection to an integral end bent diaphragm or interior bent continuity diaphragm, and for steel tie-bars through an end diaphragm at expansion joints. To simplify beam end zone detailing, the beam-to-web connection holes are removed from the details. For end diaphragms at expansion joints only, a positive connection of the beam web to the end diaphragm is required. The “Section At End Diaphragm” on the AASHTO Type ‘X’ General Details” sheet shows a detail of the connection using ferrule inserts with threaded reinforcing steel. Designers may propose other options, subject to SCDOT approval.
- Camber table may be expanded to include multiple beam cambers separately.
- When draped strands are not used, delete the related information from the “Intermediate Diaphragm Hole Location Detail” on the “AASHTO Beam Details Span ‘X’” sheet.
- The holes in the web shown for intermediate diaphragms are intended for steel diaphragms. If concrete diaphragms are used, revise the details accordingly.
- The “Intermediate Diaphragm Reinforcement Detail” on the “AASHTO Beam Details Span ‘X’” provides guidance for reinforcement of one vertical line of diaphragm holes. In cases where the bridge skew requires offset diaphragms, the distance between offset diaphragms may allow revision of this reinforcement detail to combine multiple lines together.
- When detailing beam end at an expansion joint, provide ferrule inserts (2 minimum) for the concrete end diaphragm at a 12” maximum spacing along the vertical face of the web for threaded reinforcing steel. Designate bars that require threads by adding a "T" suffix to the bar mark. The detail assumes a #5 threaded bar is used. To provide for threading fabrication, a usable threading diameter of ½” is assumed for a #5 bar. Using the Unified Coarse Threads criteria according to ANSI B1.1, 13 threads per inch (tpi) is specified.

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- When detailing skewed end diaphragms, include a note with the continuity diaphragm details to “Field bend threaded reinforcing bars to fit between reinforcing steel mats located at the faces of the end diaphragm.”
- For a jointless bridge delete “Section At End Diaphragm” and “Grouted Recess At End Of Pretensioned Strand” detail on the “AASHTO Type ‘X’ General Details” sheet.
- When a continuity diaphragm is not required delete “Half Elevation End of Beam at Interior Bent” detail on the “AASHTO Type ‘X’ General Details” sheet.
- If draped strands are specified, the designer shall verify the hold-down force does not exceed the limit specified in the Structures Design Manual.
- Extended prestressing strands:
  - Extended prestressing strands shall be placed in a pattern that is symmetrical, or as nearly symmetrical as possible, about the centerline of the cross section, and preferably in the bottom row of strands. Strands from opposing girders shall be detailed to mesh during erection without significant conflicts. Patterns that result in directly opposing strands in the continuity diaphragm are acceptable.
  - Extended strands should be spaced as far apart as practicable.
  - Debonded strands shall not be used for the positive moment connection.
  - For exterior beams at interior bent continuity diaphragms, provide a note with continuity diaphragm details on superstructure details sheet to “See “Half Elevation End Of Beam” on AASHTO Type ‘X’ General Details sheet.”.
  - Optionally, in lieu of extended prestressing strands, the designer may propose mild steel reinforcement.
  - Delete the prestressing strand extension detail (from the beam elevation on beam sheet(s)) for beam ends at integral end bents and expansion joints.
- If no strands are debonded, delete debonding notes from “AASHTO Type ‘X’ General Details” sheet.

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Applicable Drawings

DGN File Name	Drawing Number	Sheet Title
704_AASHTO	704-AASHTO.T01MOD.SPXXX	Prestressed Concrete Beam AASHTO Type I Modified Span X
	704-AASHTO.T02.SPXXX	Prestressed Concrete Beam AASHTO Type II Span X
	704-AASHTO.T03.SPXXX	Prestressed Concrete Beam AASHTO Type III Span X
	704-AASHTO.T04.SPXXX	Prestressed Concrete Beam AASHTO Type IV Span X
	704-AASHTO.D01.MIDPNTDIA.SK000.2HOLE	AASHTO Beam Details Span X – Alt 1
	704-AASHTO.D01.THIRDPNTDIA.SK000.2HOLE	AASHTO Beam Details Span X – Alt 2
	704-AASHTO.D01.MIDPNTDIA.SKLT.2HOLE	AASHTO Beam Details Span X – Alt 3
	704-AASHTO.D01.THIRDPNTDIA.SKLT.2HOLE	AASHTO Beam Details Span X – Alt 4
	704-AASHTO.D01.MIDPNTDIA.SKRT.2HOLE	AASHTO Beam Details Span X – Alt 5
	704-AASHTO.D01.THIRDPNTDIA.SKRT.2HOLE	AASHTO Beam Details Span X – Alt 6
	704-AASHTO.T01MOD.GD01	AASHTO Type I Modified General Details
	704-AASHTO.T02.GD01	AASHTO Type II General Details
	704-AASHTO.T03.GD01	AASHTO Type III General Details
	704-AASHTO.T04.GD01	AASHTO Type IV General Details

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Plan Sheet Sequence

Below is an example that illustrates the Department's recommended sequencing.

Three span 90'-110'-90' (AASHTO Type IV) with 15 degree skew left	
704-AASHTO.T04.SPXXX	Prestressed Concrete Beam AASHTO Type IV Spans A & C
704-AASHTO.T04.SPXXX	Prestressed Concrete Beam AASHTO Type IV Span B
704-AASHTO.D01.MIDPNTDIA.SKLT.2HOLE	AASHTO Beam Details Spans A & C
704-AASHTO.D01.THIRDPNTDIA.SKLT.2HOLE	AASHTO Beam Details Span B
704-AASHTO.T04.GD01	AASHTO Type IV General Details

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