Index D20310 Series Inverted-T Beams

Design Criteria

AASHTO LRFD Bridge Design Specifications, 5th Edition; ***Structures Detailing Manual (SDM)***; ***Structures Design Guidelines (SDG)***

Design Assumptions and Limitations

Index D20310 is the lead standard for the Inverted-T Beam Developmental Design Standard series which includes Indexes D20310 and D20320. Use this Developmental Design Standard with Index D20320.

These Developmental Design Standards must be supplemented with project specific information including a Table of Beam Variables, Strand Pattern Details and a Strand Debonding Legend which must be completed and included in the Structures Plans. These standards and the supplemental project specific information that is included in the plans provide sufficient information to permit beam fabrication without the submittal of shop drawings.

The pretensioned beams in these Developmental Design Standard Drawings act as simple spans under both Dead Load and Live Load even where the deck is detailed to be continuous across the intermediate supports.

When the total initial tensioning force of the fully bonded strands required by design exceeds 310 kips, shield additional strands at the end of the beam when possible. The end reinforcement may only be redesigned to accommodate an increased vertical splitting force when approved by the State Structures Design Office. If approval is granted, Indexes D20310 and D20320 must then be modified for inclusion in the contract documents and signed and sealed by the EOR.

The "Optional Deck Forming Notch" as shown on the beam End View on Index D20320 is intended to accommodate the use of stay-in-place ¾" thick plywood deck forms. Note that by the use of this detail, the plywood deck form follows the cambered geometry of the top of the beam. Thus the build-up due to beam camber and deck geometry extends over the entire width of the deck between the faces of the outside webs of the fascia beams. This build-up condition is different than what is seen with I-beam and U-beam superstructures where the build-up is only present directly over the top flanges of the beams. Stay-in-place metal deck forms are typically not required for Inverted-T Beam superstructures.

The cast-in-place bridge deck thickness is 6½" for Long Bridges and 6" for Short Bridges. See ***SDG*** 4.2 for definitions of Long Bridges and Short Bridges. A single mat of reinforcing steel is typically used with these Inverted-T Beams. Beneath and adjacent to traffic railings the deck must be thickened to 8½" for Long Bridges and 8" for Short Bridges. Supplemental reinforcing steel is required in these thickened portions of the deck. The increased deck thickness must extend to the first interior beam for edge railings, and at least one full bay each side of the traffic railing for interior railings.

A Framing Plan is required for all bridges. Show the locations of the two different Optional Deck Forming Notch dimensions required due to changes in deck thickness. See the ***SDM*** for additional Framing Plan requirements for skewed or horizontally curved bridges.

When the following conditions are met for inverted T-beams, use a Live Load Distribution factor equal to 0.2 for moment and 0.27 for shear:

1. Designed in accordance with Developmental Design Standards 20310 and 20320.
2. Span lengths are 30 feet to 75 feet.
3. Span to depth ratios are 22 to 38.
4. Design Deck thickness equals 6 inches.
5. No permanent intermediate diaphragms.
6. Distance d_e = -9 inches (align barrier directly above exterior beam).
7. Nominal girder spacing equals 2 feet. Actual girder spacing equals a minimum of 2 feet.1 inch to allow for casting, sweep and erection tolerances.

Plan Content Requirements

Insert the ***Developmental Design Standards*** Index, received from the Central Office monitor, into the appropriate component plan set in accordance with ***PPM***, Volume 2, Section 3.8.

In the Structures Plans:

Complete the following "INVERTED-T BEAM - TABLE OF BEAM VARIABLES" and include it in the plans. Use additional sheets when the actual number of beams or strand patterns exceeds the capacity of a single plan sheet using the standard table. Supplemental details and modifications are permitted if special conditions require dimensions, details or notes. However, the "INVERTED-T BEAM - TABLE OF BEAM VARIABLES" itself should not be modified. See Introduction I.3 for more information regarding use of Data Tables.

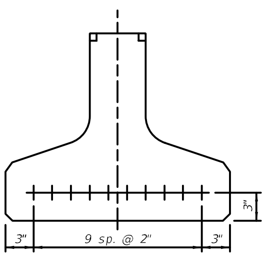
Report elastic and time dependent shortening effects (Dim R) at the top of the beam @ 120 days. The average of the calculated values for the top and bottom of the beam may be used.

Round Angle Φ up to the nearest degree.

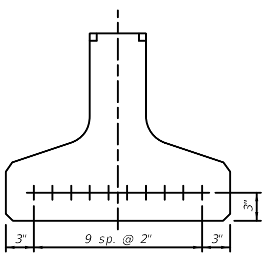
Specify shear stirrup spacings V1, V2 and V3 for Bars 4K to the nearest inch.

INVERTED-T BEAM - TABLE OF BEAM VARIABLES																												Table Date 01/01/16
LOCATION		CONCRETE PROPERTIES			STND.	PLAN VIEW		END OF BEAM AND BEARING DIMENSIONS **					BEAM DIMENSIONS *		REINFORCING STEEL													
SPAN	BEAM	CLASS	STRENGTHS (f'c)		PTRN.	CASE		ANGLE Ø		DIM J	DIM K1	DIM K2	DIM L	DIM R	5A *	3D1		3D2		4K	NO. OF SPACES BARS 4K				SPACING FOR BARS 4K *			
NO.	NO.		28 Day	Release	TYPE	END 1	END 2	END 1	END 2						Length	B	Length	B	Length	NO.	S1	S2	S3	S4	V1	V2	V3	V4

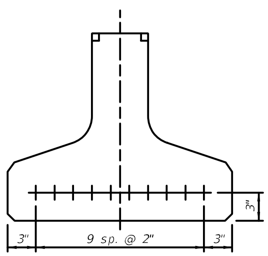
NOTE: Work this sheet with Developmental Design Standard Index Nos. D20310 and D20320.



TYPE ① __ STRANDS



TYPE ② __ STRANDS



TYPE ③ __ STRANDS

STRAND DESCRIPTION: Use ____ Diameter, Grade 270 Low-Relaxation Carbon Steel Strands stressed at ___ kips each. Area per strand equals ___ sq. in.

STRAND PATTERNS

STRAND DEBONDING LEGEND

- • - fully bonded strands.
- ⊙ - strands debonded _'-__" from end of beam.
- ⊡ - strands debonded _'-__" from end of beam.
- ▲ - strands debonded _'-__" from end of beam.
- ◈ - strands debonded _'-__" from end of beam.

NOTE: On beams with skewed ends, the debonded length shall be measured along the debonded strand.

DIMENSION NOTES

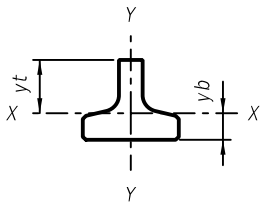
* All longitudinal beam dimensions shown on this on this sheet with a single asterisk (*) are measured along the top of beam at the centerline of beam.

** End of beam bearing dimensions "J" and "K" are measured along the bottom of the beam.

Payment

Item number	Item description	Unit Measure
450-1-250	Prestressed Beams, Inverted T, 20"	LF

Design Aids



INVERTED-T BEAM
(INDEX D20320)

SECTION PROPERTIES*	
Area (in.^{2})	256.7
Ixx (in.^{4})	7,138
Iyy (in.^{4})	8,279
yt (in.)	13.21
yb (in.)	6.79

* These section properties are based on gross section properties and neglect the 3/4" chamfers on the bottom flanges.