Indexes D20350 & D20360 Series Prestressed Slab Units

Design Criteria

AASHTO LRFD Bridge Design Specifications, 6th Edition; ***Structures Detailing Manual (SDM)***; ***Structures Design Guidelines (SDG)***

Design Assumptions and Limitations

Index D20350 is the lead standard for the 12" and 15" Prestressed Slab Units standard series which includes Developmental Design Standards Indexes D20350 through D20365. Use these Developmental Design Standards with Developmental Design Standards Index D20399.

The use of these Developmental Design Standards will typically be restricted by the SDO to off system bridges with a low ADT and truck volume.

When using these Developmental Design Standards, the designer must request, from the District Specifications Office, the Developmental Specification Dev346FRC which includes provisions for fiber reinforced concrete.

The standard 12" and 15" Prestressed Slab Units (PSU) are applicable for spans with skewed end conditions less than or equal to 30 degrees. For spans with skewed end conditions greater than 30 degrees the EOR shall develop a custom design and details using the standards as a basis.

Use the same thickness of slab units within each span.

Avoid placing slab units within the limits of superelevation transitions, because the cross slope for individual and adjacent slab units must be constant from begin span to end span. Slight superelevation transitions may be accommodated by increasing the slab overlay thickness across the width of the bridge.

The PSUs in these Developmental Design Standard Drawings act as simple spans under both Dead Load and Live Load even where the overlay is detailed to be continuous across the intermediate supports. The overlay is to be considered to act composite with the precast slab units under Live Load.

Slab units are typically placed parallel to the cross slope of the bridge deck.

To limit horizontal splitting forces, the maximum prestress force at the slab unit ends from fully bonded strands must be limited to the following:

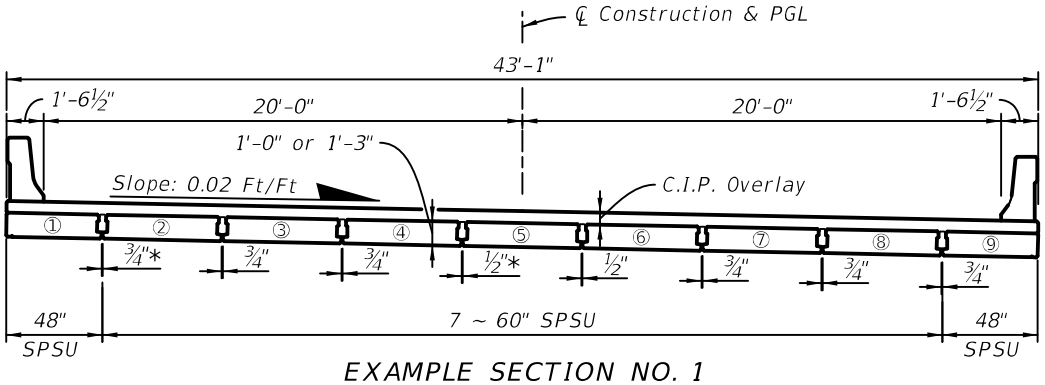
Index No.	Slab Unit Type	Max. Bonded Prestress Force	Last Revision Date
D20353	12” x Custom Width	910 kips	01/01/09 or later
D20354	12” x 48”	1110 kips	01/01/09 or later
D20355	12” x 60”	1440 kips	01/01/09 or later
D20363	15” x Custom Width	910 kips	01/01/09 or later
D20364	15” x 48”	1110 kips	01/01/09 or later
D20365	15” x 60”	1440 kips	01/01/09 or later

No losses shall be applied when calculating the Bonded Prestress Force. The reinforcing in the ends of the slabs must not be modified without the approval of the State Structures Design Engineer.

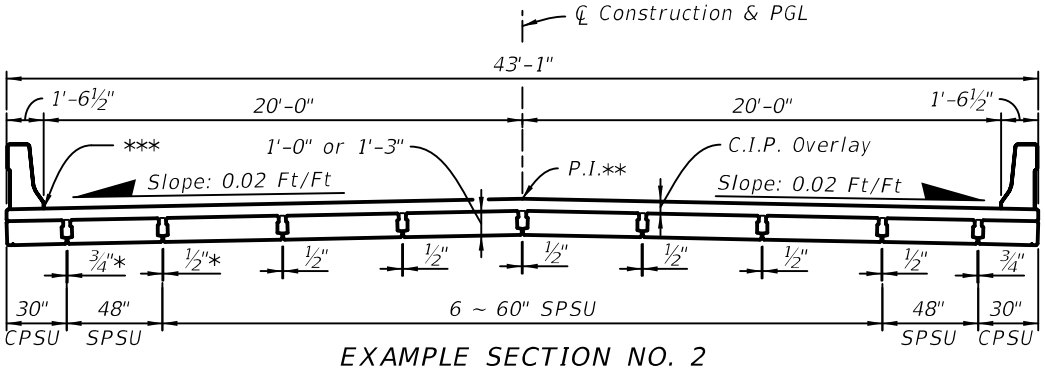
Unless otherwise specified on the plans, the design camber must be computed for 120-day-old slab concrete. The design camber shown on the plans is the value of camber due to prestressing minus the dead load deflection after all prestress losses.

Use a fiber reinforced concrete deck overlay which is 6" (min) thick for Short Bridges and 6 1/2" (min.) thick for Long Bridges. See ***SDG*** 4.2 for definitions of Long Bridges and Short Bridges. Provide a single mat of reinforcing steel in the overlay. Class II (Bridge Deck) or Class IV concrete with fiber reinforcing admixtures is required for the deck overlay.

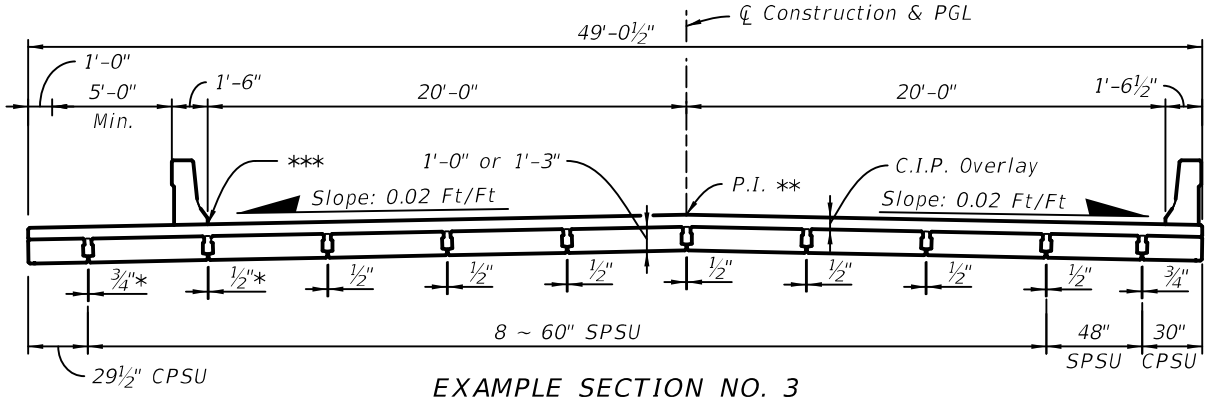
Select and position slab units of various widths to accommodate project-specific bridge widths as shown in the following example sections:



EXAMPLE SECTION NO. 1
(BRIDGE SECTION WITH CONSTANT CROSS SLOPE – SEE EXAMPLE PROBLEM)



EXAMPLE SECTION NO. 2
(SYMMETRICAL CROWNED BRIDGE SECTION)



EXAMPLE SECTION NO. 3
(ASYMMETRICAL BRIDGE SECTION WITH CROWN AND SIDEWALK)
(exterior and first interior slabs require additional detailing for parapet and traffic railing reinforcing layouts)

LEGEND:
(#) = Slab Unit Number
SPSU = Standard Prestressed Slab Units
CPSU = Custom Prestressed Slab Units
** Gaps between slab units shall be ½" minimum to ¾" maximum to accommodate the total bridge width. Show gap width dimensions in the plans.*
*** Where possible, locate slab unit keyway joints under cross slope break points in the deck overlay. It is ideal for the slab cross slopes to match adjacent overlay cross slopes to minimize overlay heights and rebar lengths for traffic railing anchorage reinforcement.*
**** Locate slab unit keyway joints outside the limits of traffic railing anchorage reinforcement.*

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:

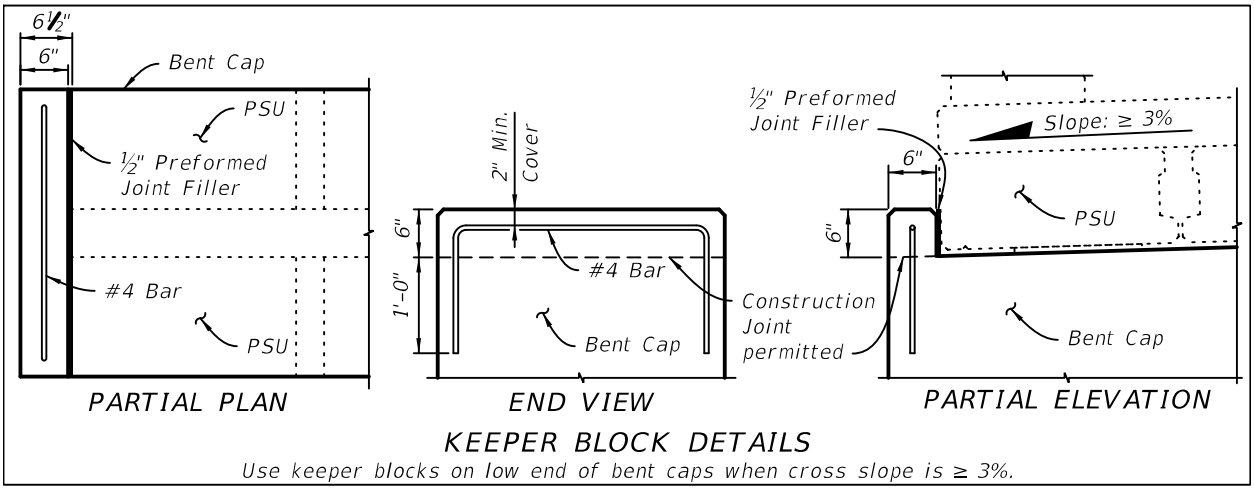
These Developmental Design Standards must be supplemented with project specific information in the plans. These developmental standards, along with the supplemental project specific information that is included in the plans, provide sufficient information to permit slab unit fabrication without the submittal of shop drawings.

Show details and/or cross-sections as required in the Plans. Include cross references to traffic/pedestrian railings heights and shapes, but do not reference the traffic/pedestrian railing Index numbers.

Commentary: Standard bridge traffic/pedestrian railings, when installed on Prestressed Slab Units require modification to the reinforcement; therefore, do not include a reference to the associated traffic/pedestrian railing Index number, but instead, reference the DDS for the traffic railing within Index D20350. This DDS shows the appropriate cross references to the bridge traffic railings and details for the modified reinforcing steel.

If the cross slope of the slab is greater than or equal to 3%, provide a keeper block detail to prevent slab units from sliding transversely. See Figure 1 for preferred Keeper Block Details. Provide project specific keeper block details in the substructure plans.

Figure 1: Keeper Block Details



If the grade of the finished bridge deck exceeds 3%, provide a project specific design in the Structures Plans to prevent slab units from sliding longitudinally.

For simple span PSUs where the overlay is cast continuous over intermediate piers or bents, provide supplemental longitudinal reinforcement in the overlay as follows:

> No. 5 Bars placed between the continuous, longitudinal reinforcing bars, a minimum of 10 feet in length, and placed symmetrically about the centerline of the pier or bent, with alternating bars staggered 2 feet.

A data table for associated Index D20399 must also be completed and included in the plans.

Complete the following "PRESTRESSED STANDARD SLAB UNITS - TABLE OF VARIABLES" and/or "PRESTRESSED CUSTOM WIDTH SLAB UNITS - TABLE OF VARIABLES" and include with the plans where applicable. Use additional sheets when the actual number of slab units or strand patterns exceeds the capacity of a single plan sheet using the standard tables. Supplemental details and modifications to Standard Drawings and Tables are permitted if special conditions require changes to dimensions, details or notes. Include supplemental details and modifications with the plans. However, the "PRESTRESSED STANDARD SLAB UNITS - TABLE OF VARIABLES" and "PRESTRESSED CUSTOM WIDTH SLAB UNITS - TABLE OF VARIABLES" themselves should not be modified when using Standard Drawings. 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 slab unit @ 120 days. The average of the calculated values for the top and bottom of the slab unit may be used.

Round Angle Φ, as defined in Index D20350, up to the nearest degree.

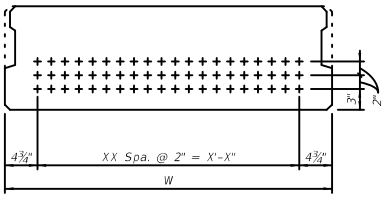
Specify shear stirrup spacings V1, V2 and V3 to the nearest inch.

Data Table D20350A - Prestressed Custom Width Slab Units - Table of Variables:

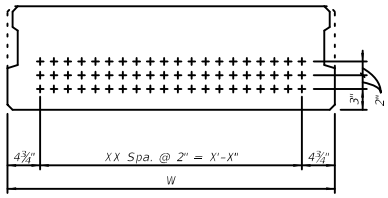
TABLE OF VARIABLES - PRESTRESSED CUSTOM WIDTH SLAB UNITS — Table Date 01-01-16

LOCATION		CONCRETE PROPERTIES			STND.	PLAN VIEW		END OF UNIT **					DIM	UNIT DIMENSIONS *		REINFORCING STEEL															
SPAN	SLAB UNIT	CLASS	STRENGTHS (psi)		PTRN.	CASE		ANGLE Ø		DIM J	DIM K1	DIM K2	W			4D1	4D2	4D3		5Y1	5Y2	4K	NO. OF BAR SPACES			BAR SPACING *			RAILING REINF. ***		
NO.	NO.(S) / TYPE		28 Day	Release	TYPE	END 1	END 2	END 1	END 2					DIM L	DIM R	DIM D	DIM D	NO.	DIM C	DIM B	DIM B	NO.	S1	S2	S3	V1	V2	V3	INDEX NO.	CASE	DIM X_1

NOTE: Work this sheet with Developmental Design Standard Index Nos. D20350, D20353 and D20363.



TYPE ① __ STRANDS



TYPE ② __ 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 slab units with skewed ends the debonded length shall be measured along the debonded strand.

DIMENSION NOTES

* All longitudinal slab unit dimensions shown on this sheet with a single asterisk (*) are measured along the top of unit at the centerline of slab unit. Dimension "R" is calculated at mid-height of the slab unit.

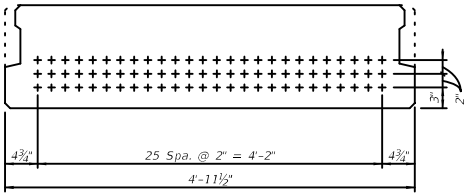
** End of slab unit bearing dimensions "J" and "K" are measured perpendicular to ℄ Bearing along the bottom of the slab unit.

*** See Index No. D20350, Sheet 2 for "CASE" and modified Traffic Railing reinforcement. See "Prestressed Slab Units – Traffic Railing Reinforcing Layout Table" for railing placement on horizontal curves.

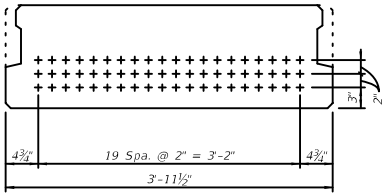
Data Table D20350B - Prestressed Standard Slab Units - Table of Variables:

TABLE OF VARIABLES - PRESTRESSED STANDARD SLAB UNITS — Table Date 01-01-16

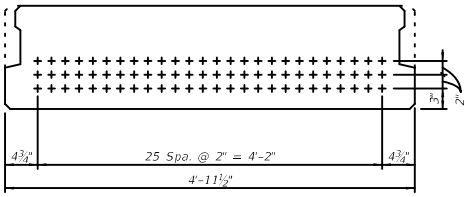
LOCATION		CONCRETE PROPERTIES			STND.	PLAN VIEW		END OF UNIT **					UNIT		REINFORCING STEEL															
SPAN	SLAB UNIT	CLASS	STRENGTHS (psi)		PTRN.	CASE		ANGLE Ø		DIM J	DIM K1	DIM K2	DIMENSIONS *		4D1	4D2	4D3	Y1	Y2	4K	NO. OF BAR SPACES			BAR SPACING *			RAILING REINF. ***		
NO.	NO.(S) / TYPE		28 Day	Release	TYPE	END 1	END 2	END 1	END 2				DIM L	DIM R	DIM D	DIM D	NO.	DIM B	DIM B	NO.	S1	S2	S3	V1	V2	V3	INDEX NO.	CASE	DIM X_1



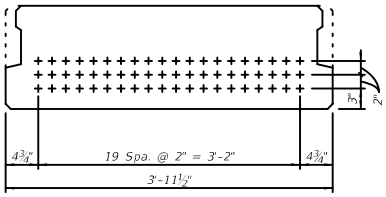
TYPE ① __ STRANDS



TYPE ③ __ STRANDS



TYPE ② __ STRANDS



TYPE ④ __ STRANDS

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

STRAND PATTERNS

NOTE: Work this sheet with Developmental Design Standards Index Nos. D20350, D20354, D20355, D20364 and D20365.

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 slab units with skewed ends the debonded length shall be measured along the debonded strand.

DIMENSION NOTES

* All longitudinal slab unit dimensions shown on this sheet with a single asterisk (*) are measured along the top of unit at the centerline of slab unit. Dimension "R" is calculated at mid-height of the slab unit.

** End of slab unit bearing dimensions "J" and "K" are measured perpendicular to ℄ Bearing along the bottom of the slab unit.

*** See Index No. D20350, Sheet 2 for "CASE" and modified Traffic Railing reinforcement. See "Prestressed Slab Units – Traffic Railing Reinforcing Layout Table" for railing placement on horizontal curves.

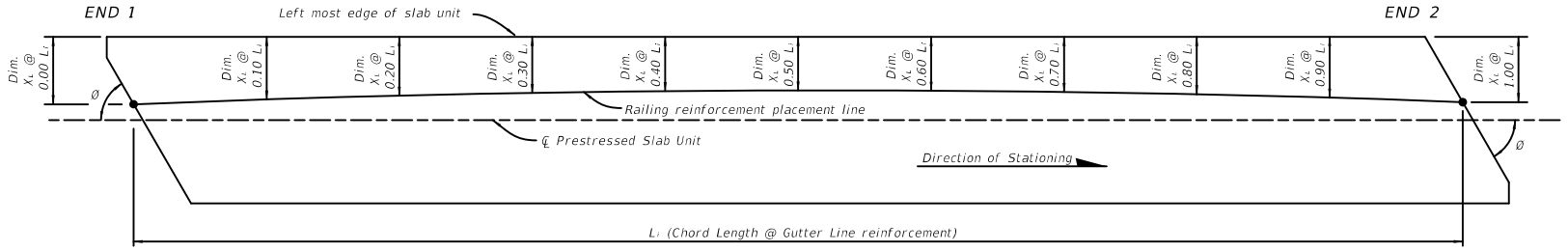
Where traffic railings are to be placed on horizontal curves, complete the following "PRESTRESSED SLAB UNITS - TRAFFIC RAILING REINFORCING LAYOUT TABLE" and include it in the plans. Use additional sheets when the actual number of slab units or strand patterns exceeds the capacity of a single plan sheet using the standard table.

Superstructure details in the plans shall show the locations and orientations of traffic railing reinforcing steel relative to slab unit numbers. These details shall show specific locations of dimension "X_L" as they correspond to the Standard Tables. Slab Units with traffic railing reinforcement shall be listed individually in the Standard Tables to accommodate specific "X_L" distances.

PRESTRESSED SLAB UNITS - TRAFFIC RAILING REINFORCING LAYOUT TABLE							Table Date 01-01-12
Span No.							
Slab Unit No.(s)/Type							
Railing Index No.							
Case (Orientation)							
Bar Mark (Mod.)							
Dim. L_t							
Dim. X_L LOCATION (Left Edge Offset to Railing Reinforcement)							
0.00 L_t (END 1)							
0.10 L_t							
0.20 L_t							
0.30 L_t							
0.40 L_t							
0.50 L_t							
0.60 L_t							
0.70 L_t							
0.80 L_t							
0.90 L_t							
1.00 L_t (END 2)							

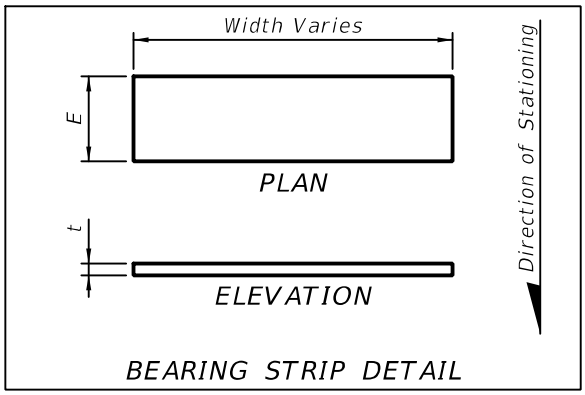
NOTES:
Work this Table with Index No. D20350, Sheet 2 and the Prestressed Slab Unit – Table of Variables in the Structures Plans.

Dim. X_L is measured perpendicular from the left most edge of the slab unit (looking from END 1 towards END 2) to the vertical leg of the Traffic Railing reinforcement. See Index No. D20350, Sheet 2 for applicable vertical leg of the Traffic Railing reinforcement which depends on the Case ("Left", "Right", or "Interior").



SCHEMATIC PLAN VIEW OF MODIFIED RAILING REINFORCEMENT PLACEMENT

Provide a bearing strip at each end of the PSU. The following table is meant as a design aid assuming Plain Elastomeric Pads (PEP) following AASHTO LRFD Design Method A. The table values assume the maximum spans of 40 ft and 50 ft with a maximum 30° skew for the 12" and 15" PSUs, respectively. Width of bearing strip is assumed as width of PSU minus 4 inches, but may be continuous. Verify selection of bearing strip with project specific design.

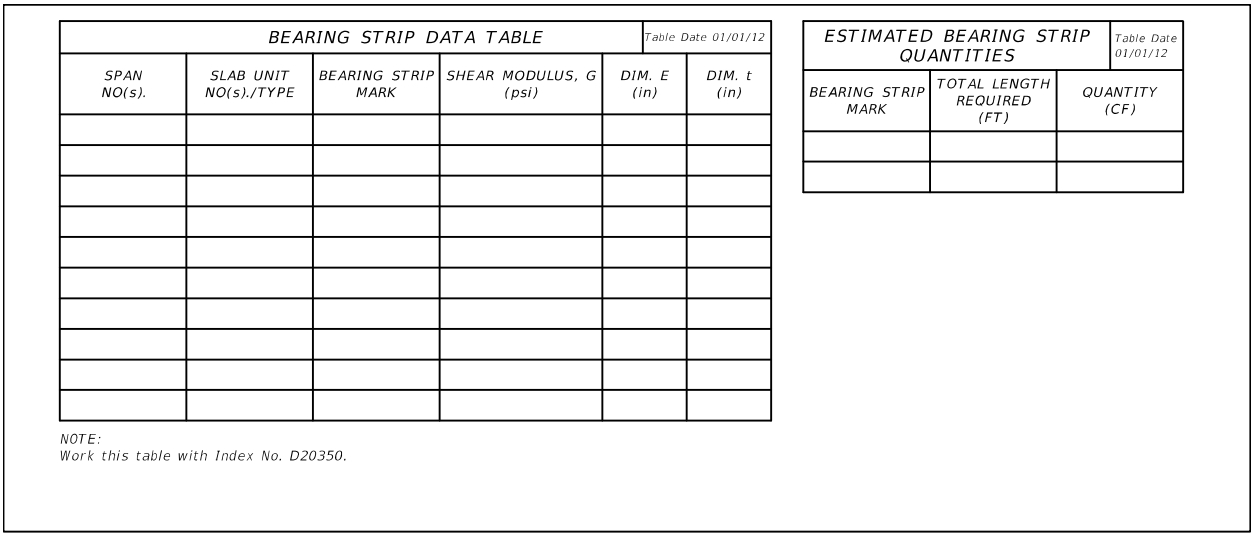


PSU Type	Max. No. of Spans*	Limiting Parameters			Bearing Strip Dimensions		Shear Modulus (G)
		Max. Total Service Load Reaction (kips)	Max. Service Live Load Reaction (kips)	Allowable Shear Deflection	E (in)	t (in)	
12"x48"	2	85	60	0.25 in	5	0.5	110
12"x60"		140	90				
15"x48"		90	55				
15"x60"		120	80				
12"x48"	2	85	60	0.375 in	6	0.75	110
12"x60"		110	80				
15"x48"		86	55				
15"x60"		110	70				
12"x48"	2	100	75	0.25 in	4.5	0.5	150
12"x60"		130	100				
15"x48"		100	65				
15"x60"		130	90				
12"xCustom	3	60	48	0.375 in	6	0.75	150
12"x48"		115	90				
12"x60"		150	120				
15"xCustom	3	70	45	0.375 in	6.5	0.75	150
15"x48"		135	100				
15"x60"		180	140				

* Between expansion joints.

Complete the following “BEARING STRIP DATA TABLE” and “ESTIMATED BEARING STRIP QUANTITIES” tables with the appropriate values for Shear Modulus (G) and Bearing Strip Dimensions (E & t) and include them in the Plans. See IDS Introduction I.3 for more information regarding use of Data Tables.

Supplement the “BEARING STRIP DATA TABLE” with additional columns or notes as required.



BEARING STRIP DATA TABLE — Table Date 01/01/12

SPAN NO(s).	SLAB UNIT NO(s)./TYPE	BEARING STRIP MARK	SHEAR MODULUS, G (psi)	DIM. E (in)	DIM. t (in)

NOTE:
Work this table with Index No. D20350.

ESTIMATED BEARING STRIP QUANTITIES — Table Date 01/01/12

BEARING STRIP MARK	TOTAL LENGTH REQUIRED (FT)	QUANTITY (CF)

Payment

Item number	Item description	Unit Measure
450-3-AB	Prestressed Slab Units	LF
400-2-41	Concrete Class II (Bridge Deck), Precast Deck Overlay	CY
400-4-41	Concrete Class IV, Precast Deck Overlay	CY

Example Problem

The following example shows the data required for completion of Prestressed Standard Slab Units - Table of Variables CADD cell for Standard Prestressed Slab Units (Indexes D20354 & D20355). The example assumes a single span bridge designed for the following conditions:

Live Load: HL-93

Future Wearing Surface: 15 PSF

Environment (Superstructure): Slightly Aggressive

Bridge Characteristics:

Length: 35'-4" (single span)

Width: 43'-1" (coping to coping)

Clear Roadway: 40'-0" with two - 32" F shape traffic railing

Superstructure: (See EXAMPLE SECTION NO. 1)

One simple span of PSUs with 6-inch composite concrete overlay and a constant cross slope of 0.02 ft/ft.

Sidewalk: None

Horizontal Alignment: Straight

Vertical Alignment: 0.0% Grade

Skew Angle: 0.0°

Slab Unit Selection: 12"x48" PSUs (exterior)

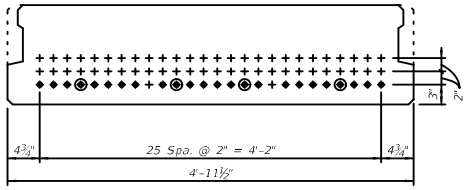
12"x60" PSUs (interior)

Design Span Length: 33'-6" (Centerline Bearing to Centerline Bearing)

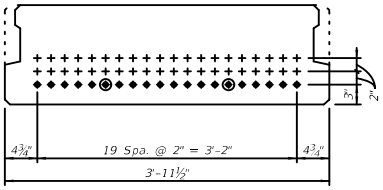
Sample Drawing

TABLE OF VARIABLES - PRESTRESSED STANDARD SLAB UNITS — Table Date 01-01-16

LOCATION		CONCRETE PROPERTIES			STND.	PLAN VIEW CASE		END OF UNIT **					UNIT DIMENSIONS *		REINFORCING STEEL														
SPAN NO.	SLAB UNIT NO.(S) / TYPE	CLASS	STRENGTHS (psi) 28 Day	STRENGTHS (psi) Release	PTRN. TYPE	END 1	END 2	ANGLE Ø END 1	ANGLE Ø END 2	DIM J	DIM K1	DIM K2	DIM L	DIM R	4D1 DIM D	4D2 DIM D	4D3 NO.	Y1 DIM B	Y2 DIM B	4K NO.	NO. OF BAR SPACES S1	NO. OF BAR SPACES S2	NO. OF BAR SPACES S3	BAR SPACING * V1	BAR SPACING * V2	BAR SPACING * V3	RAILING REINF. *** INDEX NO.	RAILING REINF. *** CASE	RAILING REINF. *** DIM X1
1	1 / 12"x48"	IV	5500	4500	2	1	1	90°	90°	6"	11"	11"	34'-6¼"	¼"	2'-9"	2'-9"	40	3'-4½"	3'-4½"	96	9	-	11	1'-6"	-	1'-6"	420	Lt.	1'-2½"
1	2-8 / 12"x60"	IV	5500	4500	1	1	1	90°	90°	6"	11"	11"	34'-6¼"	¼"	3'-3"	3'-3"	40	4'-4½"	4'-4½"	96	9	-	11	1'-6"	-	1'-6"	-	-	-
1	9 / 12"x48"	IV	5500	4500	2	1	1	90°	90°	6"	11"	11"	34'-6¼"	¼"	2'-9"	2'-9"	40	3'-4½"	3'-4½"	96	9	-	11	1'-6"	-	1'-6"	420	Rt.	2'-9"



TYPE (1) 24 STRANDS



TYPE (2) 20 STRANDS

STRAND DESCRIPTION: Use 0.5" Diameter, Grade 270, Low Relaxation Carbon Steel Strands stressed at 31.0 kips each. Area per strand equals 0.153 sq. in.

STRAND PATTERNS

NOTE: Work this sheet with Developmental Design Standards Index Nos. D20350, D20354, D20355, D20364 and D20365.

STRAND DEBONDING LEGEND

- • – fully bonded strands.
- ⊙ – strands debonded 5'-0" from end of beam.

NOTE: On slab units with skewed ends the debonded length shall be measured along the debonded strand.

DIMENSION NOTES

* All longitudinal slab unit dimensions shown on this sheet with a single asterisk (*) are measured along the top of unit at the centerline of slab unit. Dimension "R" is calculated at mid-height of the slab unit.

** End of slab unit bearing dimensions "J" and "K" are measured perpendicular to ℄ Bearing along the bottom of the slab unit.

*** See Index No. D20350, Sheet 2 for "CASE" and modified Traffic Railing reinforcement. See "Prestressed Slab Units – Traffic Railing Reinforcing Layout Table" for railing placement on horizontal curves.

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

DRAWN BY: XXX MM-YY
CHECKED BY: XXX MM-YY
DESIGNED BY: XXX MM-YY
CHECKED BY: XXX MM-YY

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO. | COUNTY | FINANCIAL PROJECT ID

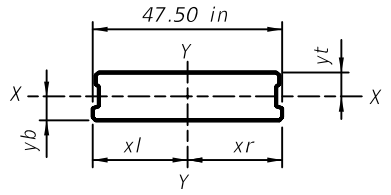
SHEET TITLE: SAMPLE

PROJECT NAME:

REF. DWG. NO.

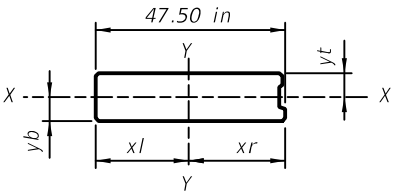
SHEET NO.

Design Aids



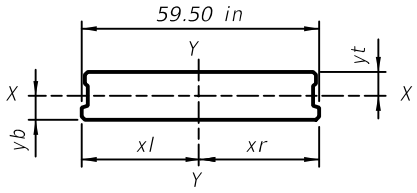
12" X 48"
PRESTRESSED SLAB UNIT
INTERIOR UNIT
(INDEX D20354)

SECTION PROPERTIES	
Area (in.^{2})	547.51
Ixx (in.^{4})	6,663
Iyy (in.^{4})	95,169
yt (in.)	6.04
yb (in.)	5.96
xl (in.)	23.75
xr (in.)	23.75



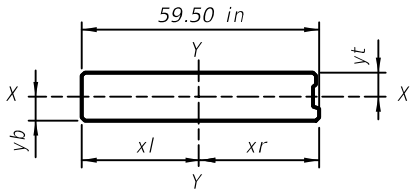
12" X 48"
PRESTRESSED SLAB UNIT
EXTERIOR UNIT
(INDEX D20354)

SECTION PROPERTIES	
Area (in.^{2})	558.20
Ixx (in.^{4})	6,733
Iyy (in.^{4})	100,753
yt (in.)	6.02
yb (in.)	5.98
xl (in.)	23.31
xr (in.)	24.19



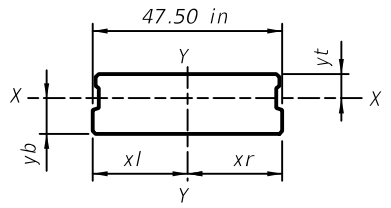
12" X 60"
PRESTRESSED SLAB UNIT
INTERIOR UNIT
(INDEX D20355)

SECTION PROPERTIES	
Area (in.^{2})	691.51
Ixx (in.^{4})	8,391
Iyy (in.^{4})	191,598
yt (in.)	6.03
yb (in.)	5.97
xl (in.)	29.75
xr (in.)	29.75



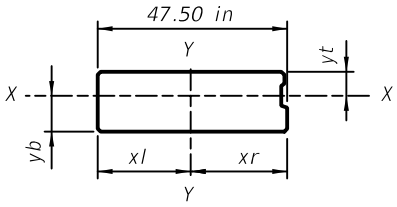
12" X 60"
PRESTRESSED SLAB UNIT
EXTERIOR UNIT
(INDEX D20355)

SECTION PROPERTIES	
Area (in.^{2})	702.20
Ixx (in.^{4})	8,461
Iyy (in.^{4})	200,488
yt (in.)	6.02
yb (in.)	5.98
xl (in.)	29.31
xr (in.)	30.19



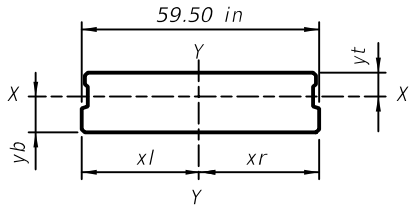
15" X 48"
PRESTRESSED SLAB UNIT
INTERIOR UNIT
(INDEX D20364)

SECTION PROPERTIES	
Area (in.^{2})	690.01
Ixx (in.^{4})	13,045
Iyy (in.^{4})	121,963
yt (in.)	7.58
yb (in.)	7.42
xl (in.)	23.75
xr (in.)	23.75



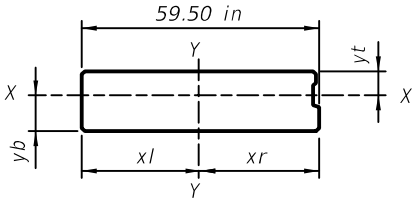
15" X 48"
PRESTRESSED SLAB UNIT
EXTERIOR UNIT
(INDEX D20364)

SECTION PROPERTIES	
Area (in.^{2})	700.70
Ixx (in.^{4})	13,174
Iyy (in.^{4})	127,570
yt (in.)	7.54
yb (in.)	7.46
xl (in.)	23.40
xr (in.)	24.10



15" X 60"
PRESTRESSED SLAB UNIT
INTERIOR UNIT
(INDEX D20365)

SECTION PROPERTIES	
Area (in.^{2})	870.01
Ixx (in.^{4})	16,421
Iyy (in.^{4})	244,262
yt (in.)	7.56
yb (in.)	7.44
xl (in.)	29.75
xr (in.)	29.75



15" X 60"
PRESTRESSED SLAB UNIT
EXTERIOR UNIT
(INDEX D20365)

SECTION PROPERTIES	
Area (in.^{2})	880.70
Ixx (in.^{4})	16,549
Iyy (in.^{4})	253,190
yt (in.)	7.53
yb (in.)	7.47
xl (in.)	29.40
xr (in.)	30.10