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751.15 SDCL Steel Superstructure

Simple for Dead Load, Continuous for Live Load (SDCL) design for steel superstructures is an alternative design approach to conventional continuous steel girder bridges and prestressed concrete bridges. Similar to prestressed design methodology, girders are placed on substructure units as simple spans and then made continuous over the intermediate bents. For SDCL steel bridges, the ends of the girders are cast into a concrete diaphragm and continuity is achieved through tensile reinforcement in the slab and contact between steel blocks welded to the bottom flanges to transfer compressive forces². This design approach has been used in conventional and accelerated construction methods.

SDCL steel girder design methodology offers several benefits over conventional steel or prestressed design that make it a competitive option:

- eliminates the need for bolted splices that are typical of conventional continuous steel superstructures²,
- simpler girder detailing¹ allowing for lower levels of AISC fabricator certification,
- reduced negative moment demand at int. bents due to simple behavior of girders prior to achieving full continuity²,
- increased stability during construction due to partial casting of girder ends²,
- simplified casting sequences compared to continuous multi-span structures²,
- increased protection at girder ends against rust and corrosion from concrete encasement²,
- potential for reduced construction time from simplified girder detailing, fabrication, and installation,
- reduced movement in seismic scenarios due to lighter superstructures,
- lower substructure vertical load demand,
- potential for shipping/transport savings due to smaller section sizes and smaller required cranes⁵,
- a uniform cross section can be used for an entire span¹,
- and lower inspection and maintenance costs from encased girder ends compared to conventional steel bridge systems⁴.

751.15.1 General

Steel SDCL design may be used if the criteria below are satisfied, or with approval of the SPM or SLE.

- Seismic Design Category (SDC) A or B*
 - Skews less than or equal to 45 degrees
 - Non-curved girders⁴
 - Fixed intermediate bents**
 - Maximum span length of 120 feet. Longer spans require approval of the SPM or SLE.
 - Other considerations can be used to justify longer spans like the elimination of splices over roadways, railroads, accelerated bridge construction, and site constraints.
- * Refer to EPG 751.15.2.3 Seismic Application
- ** Refer to EPG 751.22.3.7 Closed Concrete Intermediate Diaphragms

751.15.1.1 Materials and Selection of Steel

Reinforcing Steel Yield Strength (F_y) and Tensile Strength (F_u)

ASTM A615 Grade 60 (SDC A and all rehab/redeck)	$F_y = 60$ ksi	$F_u = 80$ ksi
ASTM A706 Grade 60 (SDC B, C, and D)	$F_y = 60$ ksi	$F_u = 80$ ksi

[Refer to the *Omissions* section of the document. This section will be similar to 751.14.1.1, except with the removal of field splices, and revisions as shown in the *Omissions* section.]

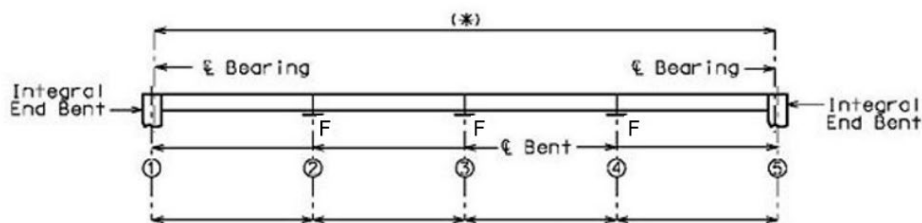
751.15.1.2 Girder Limits and Preferences

Consideration should be given to the use of galvanization or painting over the use of weathering steel for wide flange shapes when projects depend on the availability and rolling schedules of the girders, particularly smaller rolled shapes. Galvanizing is recommended for girder sections under 60' to increase longevity and reduce maintenance. Rolled girder weights may vary by span as availability allows but it is recommended to use the same rolled girder section size for weathering steel due to minimum mill order requirements and rolling schedules.

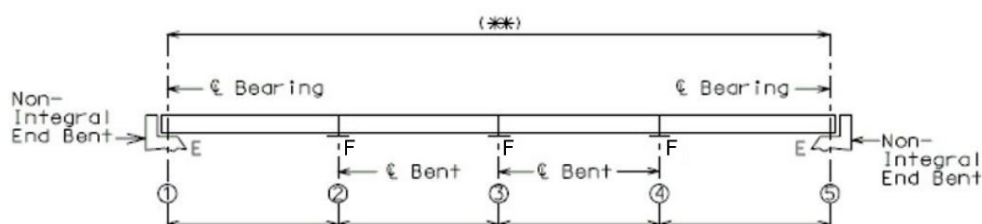
Consideration should be given to use of a vibratory screed for deck finishing, provided that the requirements of EPG 751.10.1.15 are satisfied or with approval of the SPM, SLE, or owner's representative for a particular bridge.

If varying the girder size at the intermediate bent, the overall girder depth shall remain constant. The bottom flange widths need not be identical, but design of the compression blocks shall be for the smaller girder section.

Typical SDCL steel structure – integral and non-integral end bents:



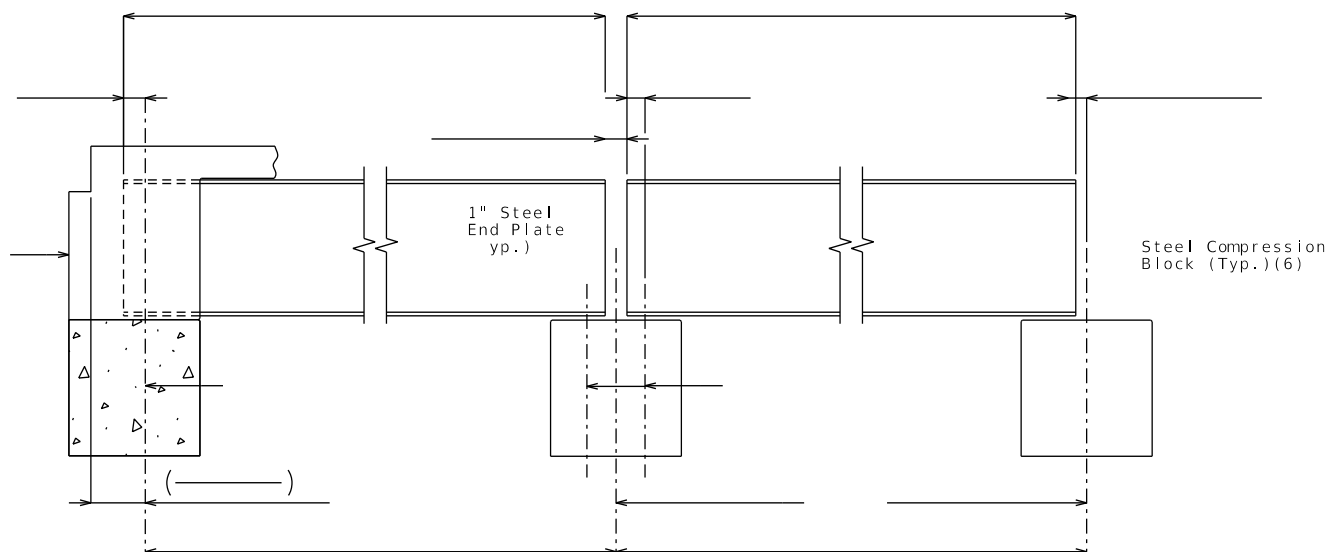
Structure with Integral End Bents



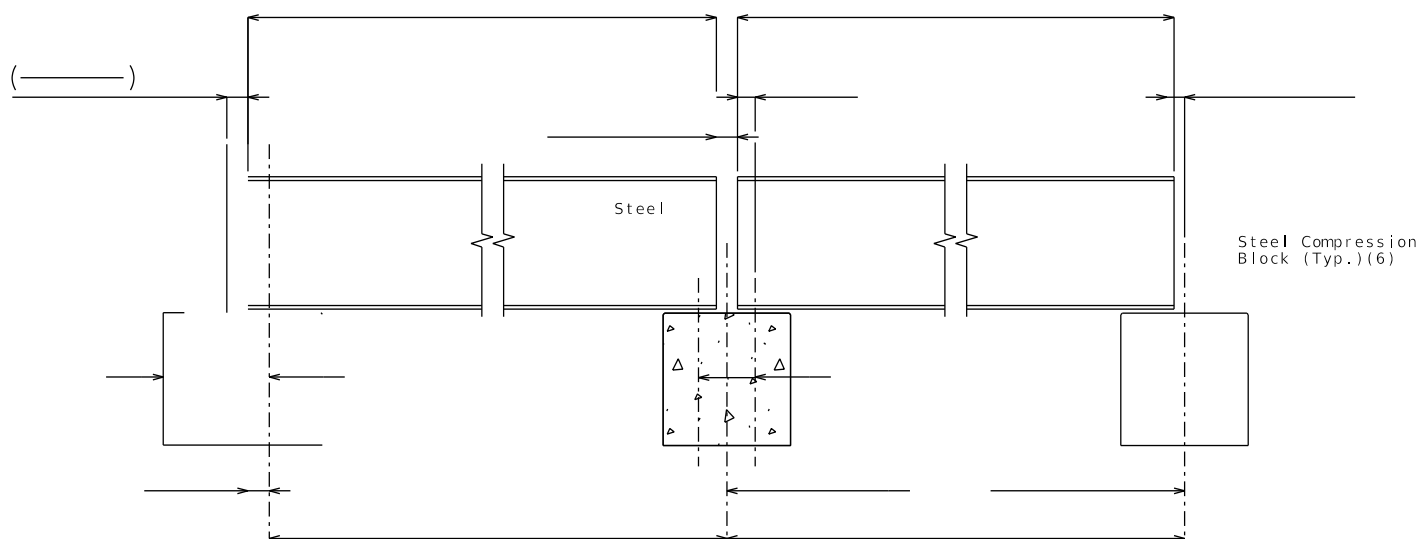
Structure with Non-Integral End Bents

Tangent Bridges

Girder lengths of exterior spans (i.e., end spans) and interior spans shall be computed using the requirements shown below:



Layout Length with Integral End Bents



Layout Length with Non-Integral End Bents

- (1) Minimum dimension from edge of bearing pad to end of girder equals one inch.
- (2) Design layout lengths are horizontal lengths. Girder lengths should be adjusted according to grade and shall be specified to the nearest 1/8 inch.
- (3) For large skews, end bent beam caps may need to be larger to provide edge distance.
- (4) Horizontal distance along centerline of girder.
- (5) = 1" (minimum) + 1/2 bearing pad length which equals 5" min. for Steel I-girders.
- (6) Minimum compression block length, parallel to girder length, = 2". Refer to 751.15.2.3.

Curved Bridges

The use of the SDCL methodology has not been evaluated for bridges on curves or using curved girders. All girders shall be tangent from end to end.

[The remainder of this section will be similar to 751.14.1.2 -- refer to the Omissions section of the document for changes to 751.14.1.2 in creation of 751.15.1.2.]

751.15.1.3 Optimizing Girder Spacing on Non-Standard Roadways

[Same as 751.14.1.3.]

751.15.2 Design

751.15.2.1 Limit States and Load Factors

[Same as 751.14.2.1.]

751.15.2.2 Analysis Methods

Design Analysis Software

Design software used for Simple for Dead Load, Continuous for Live Load steel superstructures must have the ability to evaluate the girder under the girder weight and deck dead load acting as simple spans prior to deck hardening and establishing continuity for DC2, DW and live loads at the intermediate bent. This is typically accomplished by utilizing hinges (or other release mechanisms) at the intermediate bent for DC1 loads and then establishing continuity with the reinforcement in the deck at the intermediate bents for the remainder of the applied structure loading.

The following design software is capable of modeling and analyzing SDCL structures⁶:

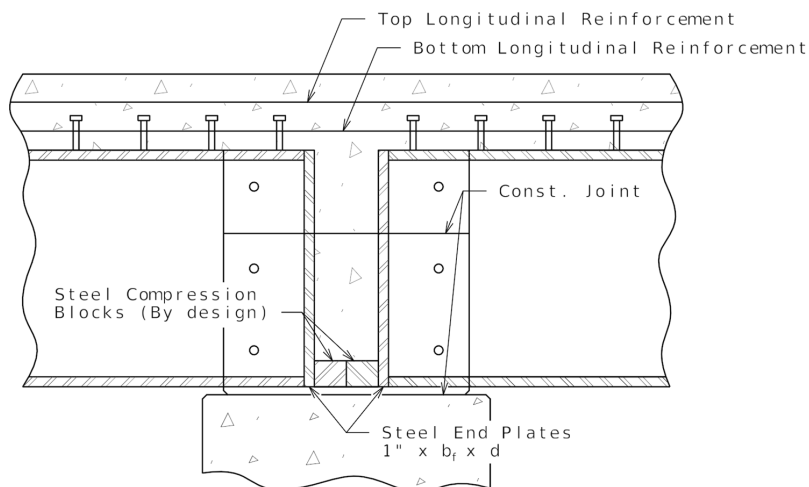
- AASHTOWare BrD/BrR
- MDX Software
- LEAP Bridge Steel
- Merlin-DASH

[Remainder of section same as 751.14.2.2, refer to the *Omissions* section of the document.]

751.15.2.3 Compression Blocks

General

Steel blocks are used to transfer compressive forces from the bottom flange of one steel girder to the bottom flange of an adjacent steel girder without relying on the concrete in the diaphragm².



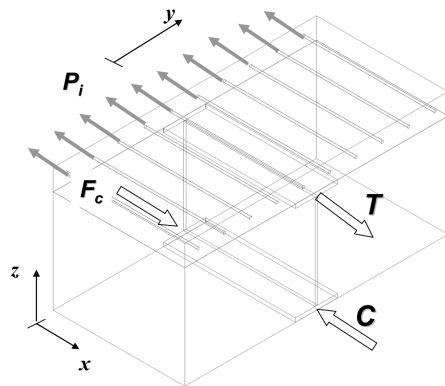
Part Elevation

Dimensions

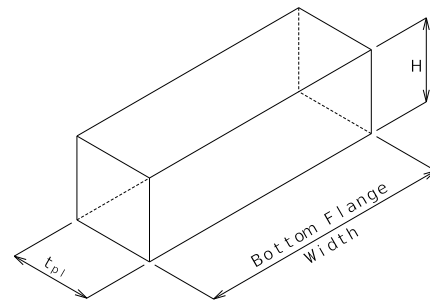
The width of the compression block shall match the bottom flange width of the narrower flange if there is a shape transition.. The thickness of the compression block, measured parallel to the girder length, shall be a minimum of 2 inches² (1/4" increments). The height of the compression block, measured parallel to the girder depth, shall be determined by design. Not required, but preferred for fabrication, is to use a block height equivalent to the block thickness where design criteria are satisfied. See EPG 751.15.4.1 for details.

Connection Capacity

The flexural capacity of the connection is primarily driven by the force couple created by the tensile reinforcement placed in the slab and the compression blocks attached to the bottom flanges².



Force Couple Diagram



Compression Block Dimensions

The flexural capacity is calculated as follows²:

$$M_n = A_s f_y \left(d - \frac{H}{2} \right)$$

Where:

M_n = nominal moment capacity of the connection, k – in.

A_s = area of tensile reinforcement, in.²

f_y = yield strength of reinforcing steel, ksi

d = distance between bottom of the girder and centroid of the tensile reinforcement, in.

H = compression block height measured parallel to the girder depth, in.

t_{pl} = thickness of the compression block measured parallel to the girder length, in.

The area of tensile reinforcement present in the slab shall be determined in accordance with EPG 751.10.1.5 similar to Prestressed Structures.

Compression Block Design Steps

Step 1 – Assume compression block height

The compression block height is assumed to determine an area of tensile reinforcement required to balance the force couple².

$$A_{s,required} = \frac{M_u}{\phi f_y (d - \frac{H}{2})}$$

Where:

$A_{s,required}$ = minimum area of tensile reinforcement required, in.²

M_u = factored ultimate moment demand, k – in

ϕ = resistance factor for tension – controlled concrete sections [AASHTO 5.5.4.2]

Step 2 – Calculate minimum block height

The compression block is designed to carry a force equal to 1.7 times that carried by the tensile reinforcement, or $1.7f_y$, to ensure its behavior remains elastic². Compare H_{min} with the block height, H , used in Step 1 to ensure the assumed block height is adequate.

$$H_{min} = \frac{1.7f_y A_{s,provided}}{b_f F_{ypl}}$$

Where:

H_{min} = minimum height of the compression block parallel to the girder depth, in.

b_f = girder bottom flange width, in.

F_{ypl} = yield strength of the steel compression block, ksi

Step 3 – Calculate capacity of connection

Once the minimum height of the compression block and required area of tensile reinforcement is determined, the nominal flexural capacity, M_n , of the connection can be calculated. If the provided area of tensile reinforcement is greater than the required area, the height of the compression block should be determined based on the actual arrangement of tensile reinforcement.

$$M_n = A_s F_y (d - \frac{H}{2})$$

Seismic Application

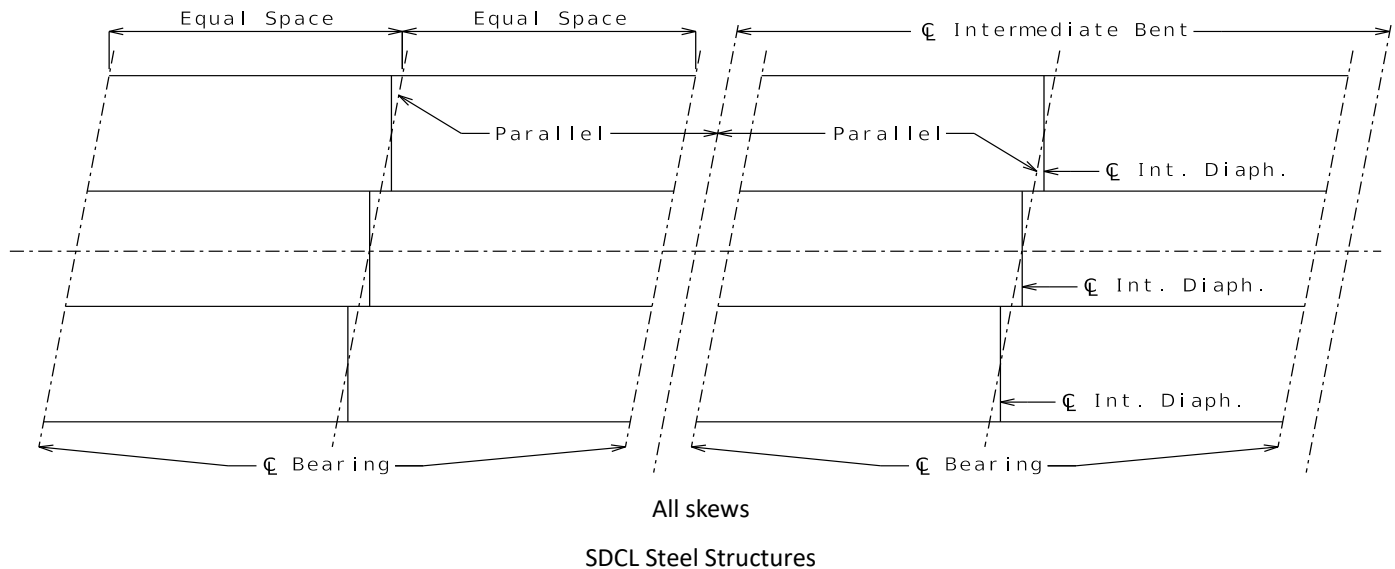
The SDCL connection design and details for non-seismic zones have been investigated both numerically and experimentally and numerous standing SDCL bridges have been monitored for field performance. The suggested SDCL connection design and details for moderate-to-high seismic areas are very similar to non-seismic zones⁶; however, SDCL bridges in highly seismic regions have not been constructed and monitored to the same extent as bridges in non-seismic zones. For SDCL design in moderate-to-high seismic areas,

consult with the State Bridge Engineer, Structural Project Manager, or District. Refer to EPG 751.9 for the Seismic Design Flowchart and see the *ABC-UTC Guide for Superstructure to Pier Connection in SDCL Steel Bridge Systems* for seismic SDCL connection information⁴.

751.15.2.4 Intermediate Diaphragms and Cross Frames

Straight Girder Layout

For W24x and shallower rolled shapes, consideration should be given to providing intermediate diaphragms and cross frames at smaller spacings to increase stability during construction, prior to deck curing.



Diaphragm Layout for SDCL Steel Structures

A note on the plans is required, see EPG 751.50 Standard Detailing Notes for note (H6.20):

"The Contractor shall provide bracing necessary for lateral and torsional stability of the girders to remain plumb during construction of the concrete slab and remove the bracing after the slab has attained 75% design strength. Contractor shall not weld on or drill holes in beam without Engineer's written approval."

Remainder of section same as 751.14.2.3, refer to the *Omissions* section of the document.

751.15.2.5 End Diaphragms

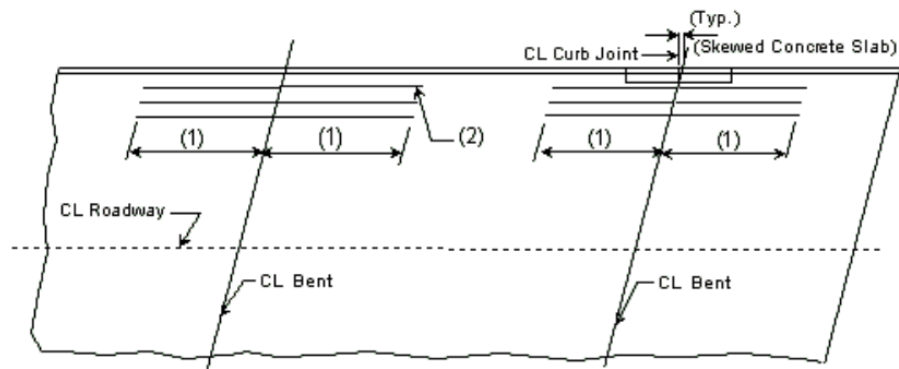
Steel end diaphragms shall be located at all non-integral end bents where continuity of the slab is broken (i.e., expansion joints). Integral end bents shall use a concrete diaphragm. See EPG 751.14.5.3 and 751.14.5.4 for details of end diaphragms for wide flange beams and plate girders, respectively.

Remainder of section same as 751.14.2.4, refer to the *Omissions* section of the document.

751.15.2.6 Other Requirements

Minimum Negative Flexure Reinforcement

Modify EPG 751.10.1.5



Prestressed Structures

- (1) Bar length by design and Simple for Dead Load Continuous for Live Load Steel
- (2) Reinforcement placed between longitudinal temperature reinforcing in top.

Bar size: #5 bars at 7 1/2" cts. (Min.)

#8 bars at 5" cts. (Max.)

Bearings

Plain and laminated elastomeric pads are preferred for SDCL steel structures; see EPG 751.11. Expansion bearings shall not be used for SDCL steel structures as the ends of the compression blocks need to remain in contact and testing/research have not explored the effects of expansion bearings on the performance of the SDCL connection.

Bearing Stiffeners

Bearing stiffeners are not required for SDCL steel structures: one-inch-thick steel plates are welded to the girder ends at intermediate bents and the ends of the girders are encased in a concrete diaphragm. For details of bearing stiffeners for rolled shapes at non-integral end bents and for plate girders, refer to EPG 751.14.5.1.

Remainder of section same as 751.14.2.6, refer to the *Omissions* section of the document.

751.15.3 Composite Design

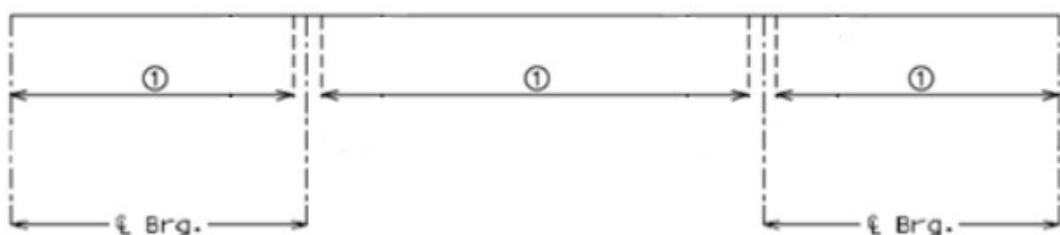
751.15.3.1 General

Same as 751.14.4.1, refer to the *Omissions* section of the document.

751.15.3.2 Shear Connector Limits

Shear Connector Spacing

Shear connectors for SDCL steel structures shall be provided along the entire length of the span. For a typical 3-span SDCL steel bridge, the shear connectors can be approximately arranged as below:



① Shear connector units at pitch as indicated by design, providing total shear connectors satisfy both fatigue stress and ultimate strength.

Remainder of section same as 751.14.4.4, refer to the *Omissions* section of the document.

751.15.3.3 Fatigue Design

Same as 751.14.4.3, refer to the *Omissions* section of the document.

751.15.3.4 Strength Design

Same as 751.14.4.4, refer to the *Omissions* section of the document.

751.15.3.5 Shear Connector Details

Same as 751.14.4.5, refer to the *Omissions* section of the document.

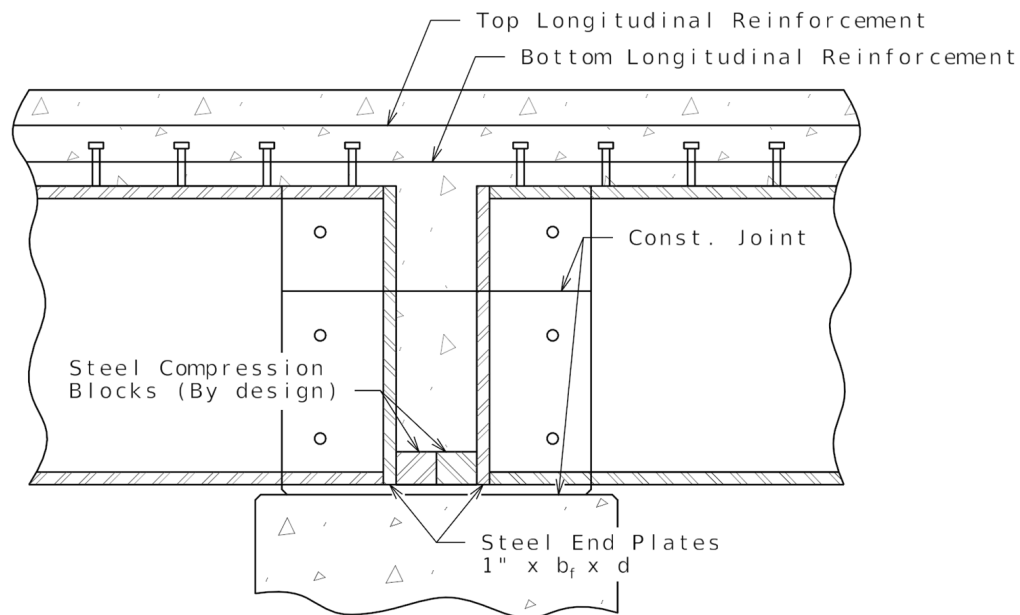
751.15.4 Details

751.15.4.1 Compression Blocks (New Design or Superstructure Replacements)

General

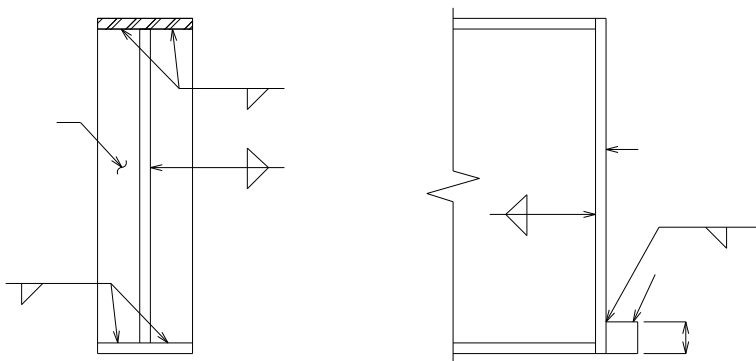
Compression block dimensions shall be determined by design, see EPG 751.15.2.3.

After beam erection, the vertical faces of the compression blocks shall be in partial-to-full contact. Full contact throughout block height is not necessary². Vertical faces of adjacent blocks shall overlap a minimum of $0.75H$.



Part Elevation

Welding



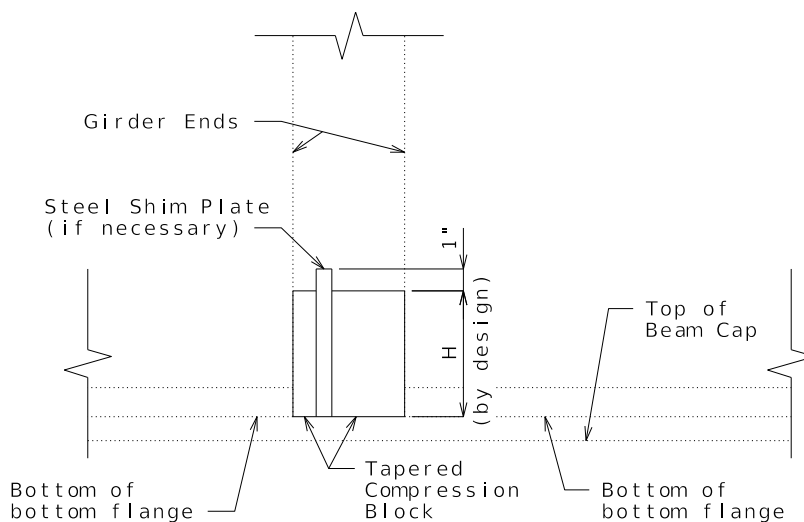
End Plate and Compression Block Welding Details

Where:

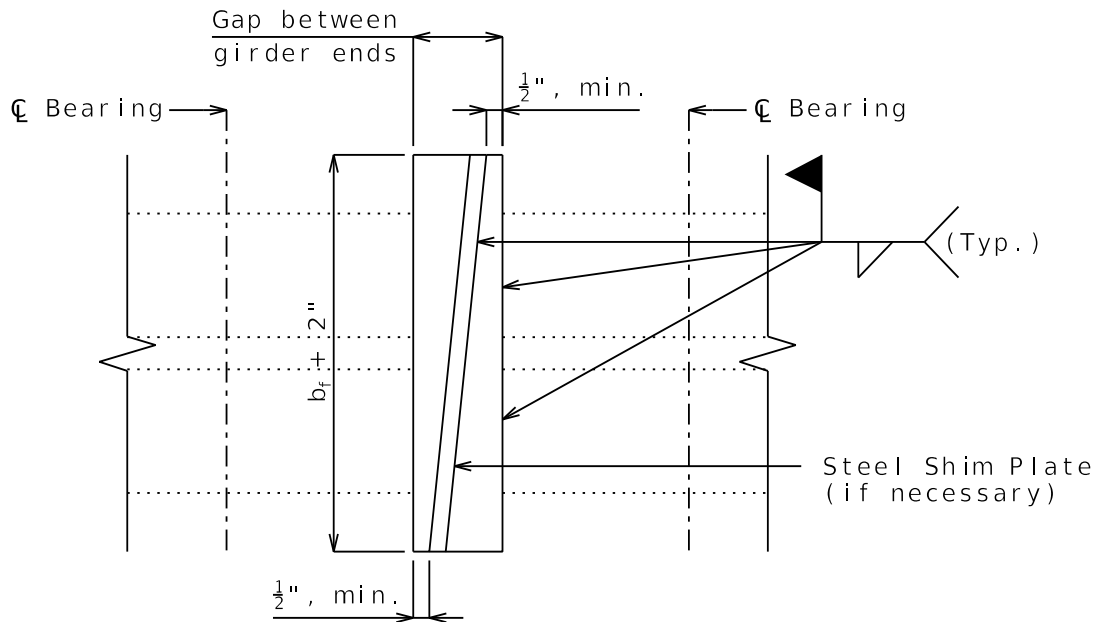
- b_f = girder bottom flange width, in.
- d = girder depth, in.
- H = compression block height measured parallel to the girder depth, in.
- t_{pl} = thickness of the compression block measured parallel to the girder length, in.

Compression Blocks for SDCL Redecking

For redecks involving conversion of a multi-simple span structure to continuous using SDCL, the compression block design shall follow EPG 751.15.2.3 with modifications to the block dimensions as shown using tapered blocks:



Tapered Compression Block and Shim Plate Part Elevation



Tapered Compression Block and Shim Plate Part Plan

The material of the tapered compression blocks and shim plate shall be in accordance with EPG 751.15.1.1. The shim plates shall not be less than 1/4" in thickness for welding.

The tapered block dimensions are based on design requirements and existing plan dimensions at the Intermediate Bent(s). Prior to fabrication, the contractor shall measure each gap at all beams and make necessary adjustments.

Field Adjustment of Blocks for Varying Gap Widths

For narrower gaps, the tapered blocks can be uniformly slid away from each other provided that the narrow end of the tapered block extends past the web by a minimum of 0.4 times the larger bottom flange width. If the design criteria per EPG 751.15.1.1 are met, the contractor may have the option to reduce the thicker end dimension to allow the narrower end of the tapered block to extend as required beyond the web.

For wider gaps, the tapered blocks can be uniformly slid toward each other provided the thicker end of the tapered block extends past the web by a minimum of 0.4 times the larger bottom flange width. If the design criteria per EPG 751.15.1.1 are met, the contractor may have the option of adjusting the tapered block dimensions or using a shim plate of uniform thickness between the tapered blocks.

751.15.4.2 Closed Concrete Intermediate Diaphragms

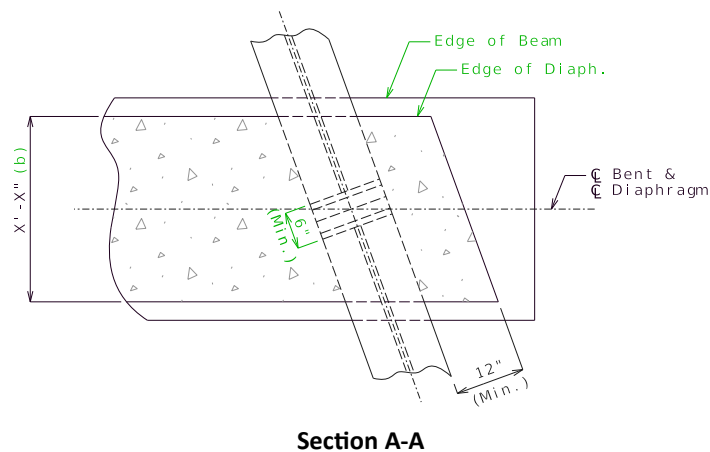
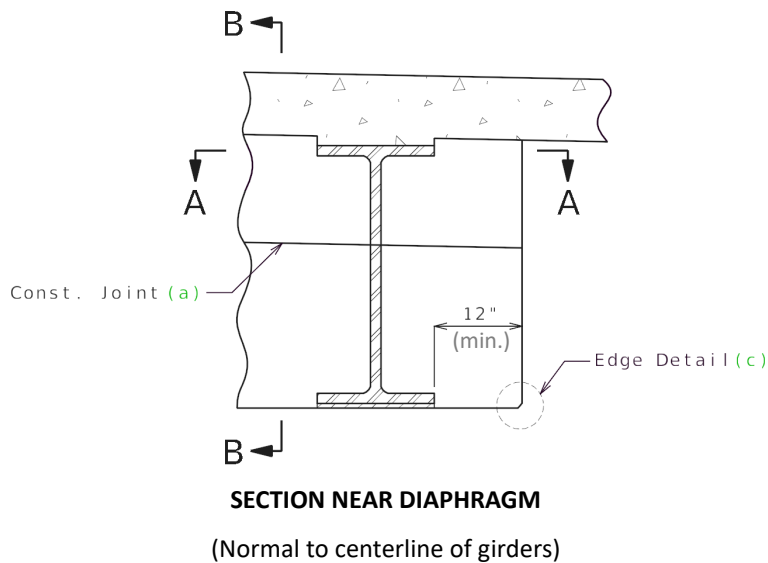
Concrete intermediate diaphragms are cast between the ends of SDCL steel girders at interior supports and make the girders continuous for loads applied after continuity is established.

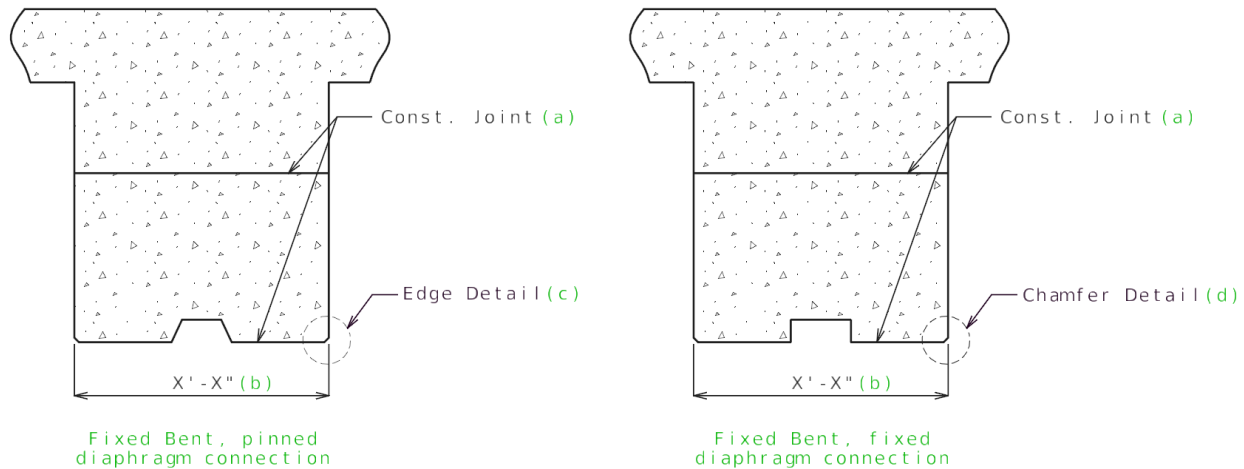
The diaphragm at bents shall be cast to $\frac{2}{3}$ of its full depth to ensure stability of the girders and reduce unintended moment continuity and cracking during deck pours². The concrete diaphragm shall be poured a minimum of 12 hours before the slab and remainder of the diaphragm is poured.

Reinforcement guidance details for skewed bents are shown below and are also applicable to squared bents. Refer to EPG 751.22.3.7 for details not shown.

751.15.4.2.1 Dimensions

The following dimensions shall be detailed on the plan sheets for closed concrete intermediate diaphragms.





Section B-B (Normal)

Detailing Guidance:

Green items are guidance and shall not be shown on the plans.

- (a) Refer to EPG 751.15.4.2.2.
- (b) Diaphragm shall be 2'-6" wide unless skew requires a wider diaphragm.
- (c) Refer to EPG 751.22.3.7.3 Edge Detail for Fixed Bents.
- (d) Refer to EPG 751.35.3.4 for Chamfer Detail.

751.15.4.2.2 Reinforcement

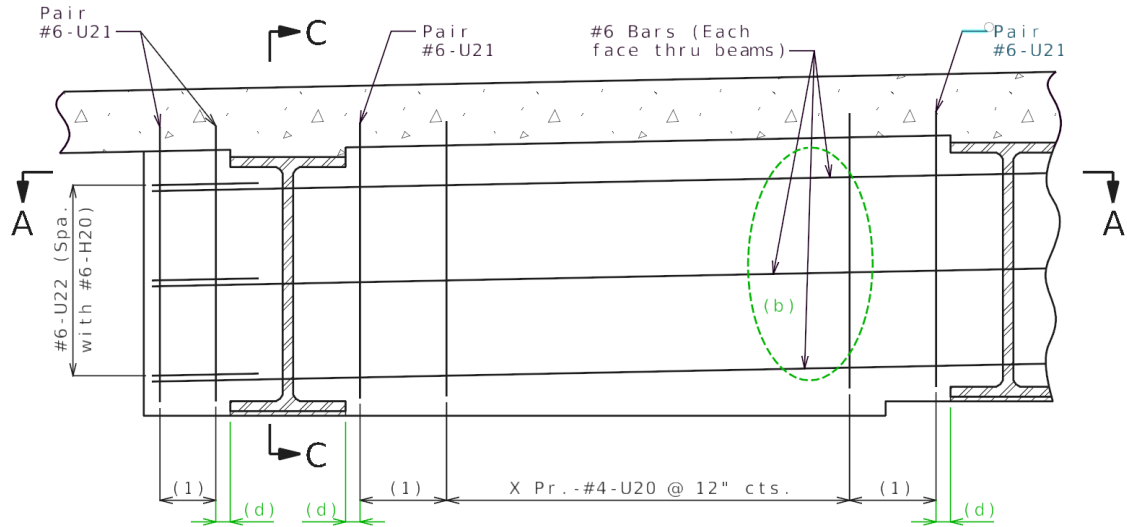
The reinforcement shall be detailed on the plan sheets for closed concrete intermediate diaphragms as shown below except:

- Bar marks revised as required.
- Abbreviations used as required.
- Add "(Typ.)" to dimensions and leader notes as appropriate.

All U bar reinforcement shall use stirrup bends.

All reinforcement in diaphragms shall be epoxy coated. Coating of dowel bars shall match the coating of intermediate bent reinforcement. Intermediate bent reinforcement shall be epoxy coated in the case that reinforcement from the intermediate bent (except dowel bars) extends into the diaphragm.

The details shown are for the same girder heights within continuous girder series and diaphragms not constructed integral with the bent cap (no reinforcement extending from cap into diaphragm). For diaphragms constructed integral with the bent cap (reinforcement extending from cap into diaphragm), refer to EPG 751.35.

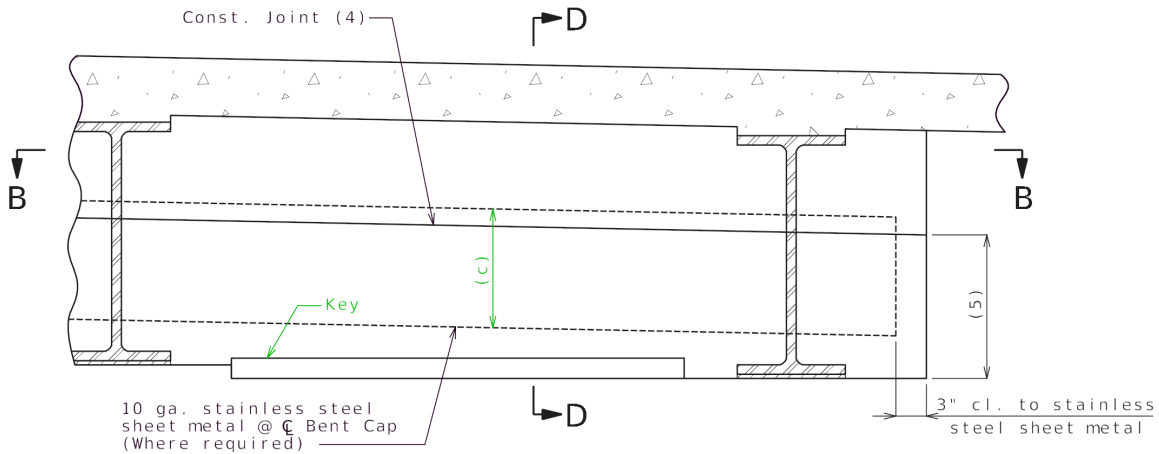


SHOWING REINFORCEMENT

SECTION NEAR DIAPHRAGM

Keys not shown for clarity.

(Normal to centerline of girders)

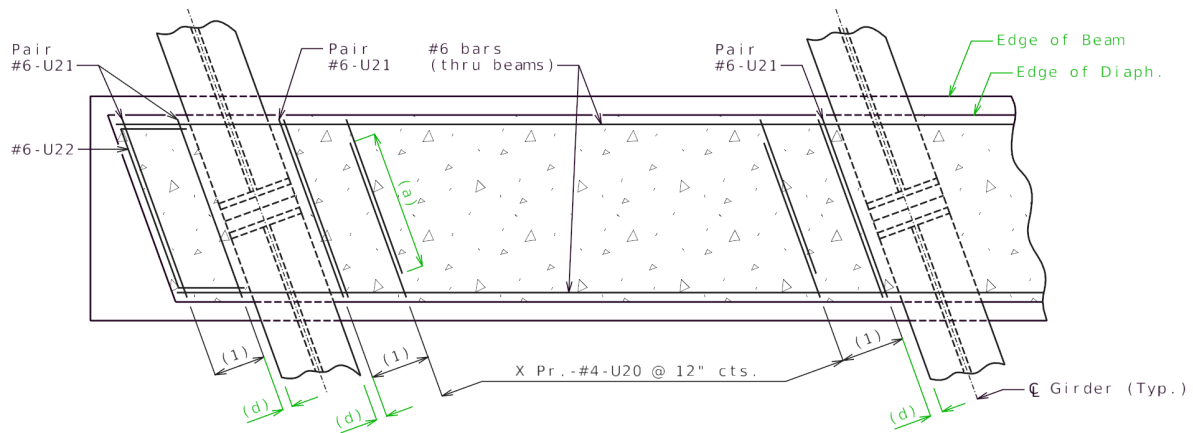


SHOWING SHEET METAL

SECTION NEAR DIAPHRAGM

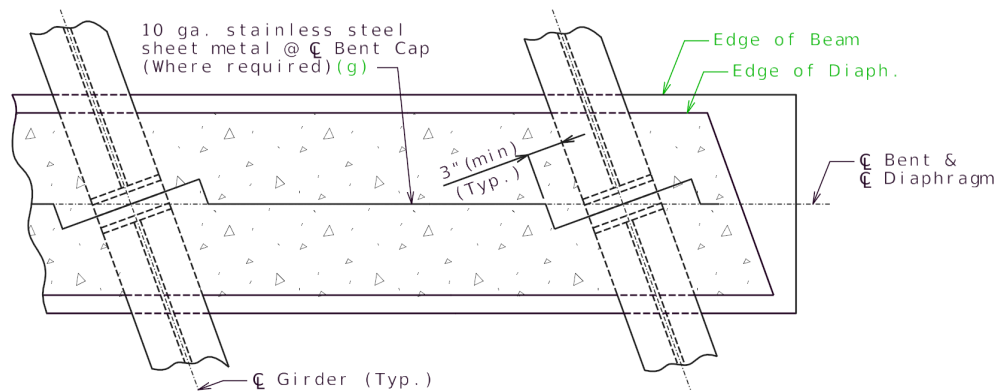
(Normal to centerline of girders)

The sheet metal shall be included in the diaphragm in regions with salt exposure at grade separations or more publicly visible areas to help control cracking. The sheet metal plate may be omitted in areas such as stream crossings that are not visible to the traveling public as the potential for uncontrolled cracking may be higher. Research shows inclusion of the sheet metal does not significantly reduce the degree of continuity in the diaphragm during deck placement.



SECTION A-A

(Skewed diaphragm shown, square diaphragm similar)



SECTION B-B

(Skewed diaphragm shown, square diaphragm similar)



Detailing Guidance:

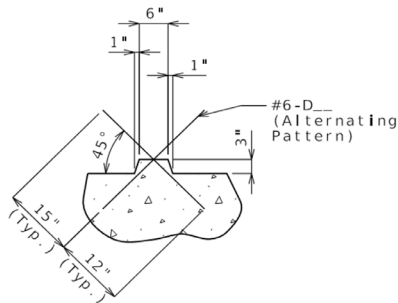
Green items are guidance and shall not be shown on the plans.

- (a) 19 inches minimum for #4 bars and full available width for #6 bars.
 - (b) Equally spaced, see EPG 751.15.4.3 for the reinforcing hole spacing through the girder web.
 - (c) The 10 ga. stainless steel sheet metal plate, where required, shall extend from the top of the bottom leg of the #6-U21 bar to 1" above the construction joint.
 - (d) Keep $1\frac{1}{2}$ " min. between the beams and the #6-U bars.
 - (e) Refer to EPG 751.35.3.4 for Section Thru Key.
 - (f) Refer to EPG 751.35.4 for reinforcement details and detailing guidance.
 - (g) See 751.50 Standard Detailing Notes for note (H1.54) required for the stainless steel sheet metal plates.
- (1) X"(6" min. & 12" max.)
 - (2) 15" (#4) & 22" (#6)
 - (3) $3\frac{1}{4}$ " (#4) & 3" (#6) cl.
 - (4) Varies, match roadway cross slope.
 - (5) Diaphragms at bents shall be poured X"min. (2/3 of total superstructure depth) from top of bent cap after all girders are in place. The remainder of the diaphragm shall be poured concurrently with the slab.

751.15.4.2.3 Bent Details

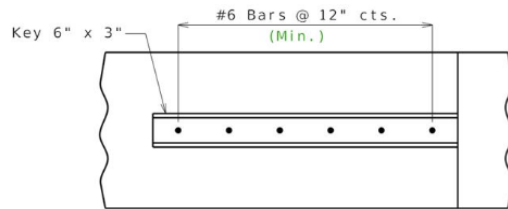
Dowel Bars and Keys

Dowel bars are by design. Where the stainless-steel plate is omitted, a straight bar can be used in lieu of the alternating X-pattern bars shown below in the "Section Thru Key" for pinned diaphragms. For details of dowel bars and keys where the stainless-steel sheet metal plate is omitted, refer to EPG 751.22.3.7.4.



Section Thru Key

(For pinned diaphragms with the stainless steel sheet metal plate)

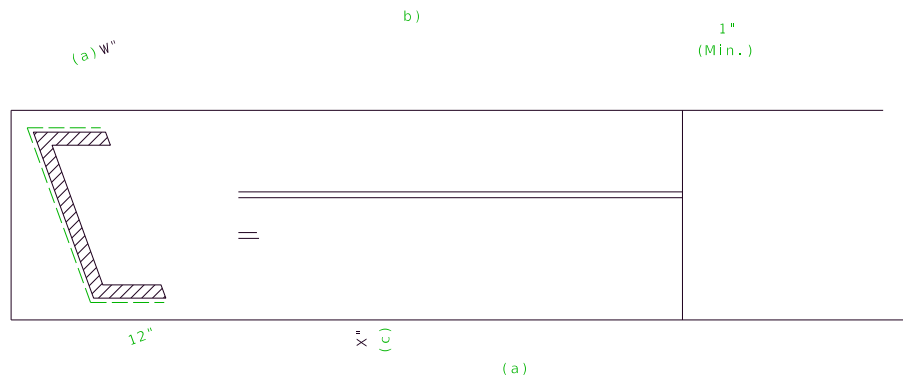


Plan of Beam Showing Reinforcement

Joint Filler and Bearings

The joint filler required for closed concrete intermediate diaphragms shall be shown in the plan of beam along with the bearings. No expansion bents nor girder chairs shall be used.

- At pinned diaphragm connections:



- At fixed diaphragm connections:

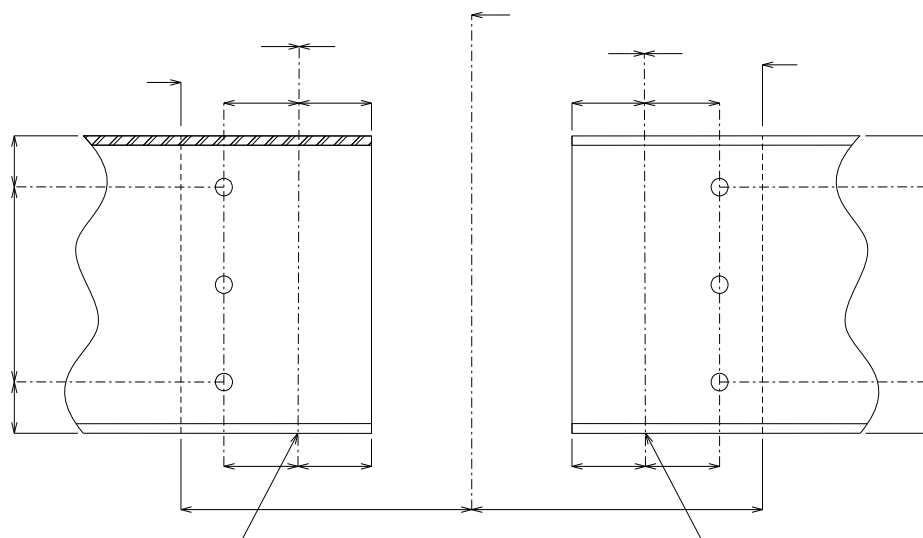


Detailing Guidance:

Green items are guidance and shall not be shown on the plans.

- (a) "W" is width of bearing. Bearing length and thickness is by design.
- (b) Remove thickness for tapered bearings.
- (c) 3 3/4" minimum. With the approval of the SPM, the diaphragm may be made flush with substructure beams not greater than three feet wide.

751.15.4.3 Reinforcing Holes



Section at End of Beams at Intermediate Bents

(End plates and steel compression blocks omitted for clarity)

- (1) 1" plus half of bearing pad length for bearing pad
- (2) 1 1/16" θ holes for skews thru 20°. For skews > 20°, use slotted holes = 1 1/16" + 2(web thickness) x (tan of the skew angle)
- (3) Line perpendicular to the bottom of the bottom flange at the intersection of CL Brg. and Point of Rotation.

For section at end of beam for integral end bents, refer to EPG 751.35.5.1 Reinforcing Holes.

WF Beam Depth	Stud Spacing *	A	Reinforcement Hole Spacing
12	1 spa. @ 4"	4"	1 space
14	1 spa. @ 6"	4"	1 space
16	2 spa. @ 4"	4"	2 equal spaces
18	2 spa. @ 5 1/2"	4"	2 equal spaces
21	2 spa. @ 4 1/2"	4"	2 equal spaces
24	2 spa. @ 6"	4"	2 equal spaces
27	2 spa. @ 7 1/2"	4 1/2"	2 equal spaces
30	3 spa. @ 6"	4 1/2"	3 equal spaces
33	3 spa. @ 7"	4 1/2"	3 equal spaces
36	4 spa. @ 6"	4 1/2"	3 equal spaces

* only at end of beam at integral end bent

751.15.4.4 Int. Diaphragms and Cross Frames

Intermediate Diaphragm and Cross Frame Details**

Shape	"D" (in)	"N"	Channel, Angle or Bent Plate	"A" (in)	"B" (in)
W12X45 THRU W12X106	6	2	C6 x 8.2	Shapes too shallow to allow for 6x6x3/8 at tension flange. Welding on both flanges required.	
W14X68 THRU W14X145	7	2	C7 x 9.8		
W16X40 THRU W16X89	8	2	C8 x 11.5		
W18X46 THRU W18X106	10	3	C10 x 15.3		
W21X48 THRU W21X93	12	4	C12 x 20.7	3	1/2
W24X68 THRU W24X103	12	4	C12 x 20.7	3	1/2
W27X84 THRU W27X129	15	4	5/16 x 23	4	1 1/2
W30X90 THRU W30X148	18	5	5/16 x 26	4	1 1/2
W33X118 THRU W33X221	21	5	5/16 x 29	4	1 1/2
W36X135 THRU W36X194	21	5	5/16 x 29	4	1 1/2
W40X149 THRU W40X215	21	5	5/16 x 29	4	1 1/2
36" thru 40" Plate Girders	21	5	5/16 x 29	4	1 1/2
42" Plate Girders	27	5	5/16 x 35	4	1 1/2
> 42" Plate Girders	Diagonal Member		L3x3x5/16	4	1 1/2
	Horizontal Member	*** S < 10'-2"	L3.5x3.5x5/16		
		other	L4x4x5/16		

** Table is applicable for diaphragms and cross frames used as bracing members. For criterion used in determining members sizes see the footnotes for the "Bottom Horizontal Members for Web Depths" and "Diagonal Members for Web Depths > 48" tables for End Diaphragms.

*** S = girder spacing along diaphragm skew

Diaphragms and cross frames used as primary members must be checked for torsion effects. (See Analysis of Horizontally Curved Girders)

ATTENTION DETAILER:

Intermediate diaphragm connection plates shall be detailed for Connection "A" for skews thru 20°. Details of Connection "A" are shown in EPG 751.14.5.1 Bearing Stiffeners.

Remainder of section same as 751.14.5.2, refer to the *Omissions* section of the document.

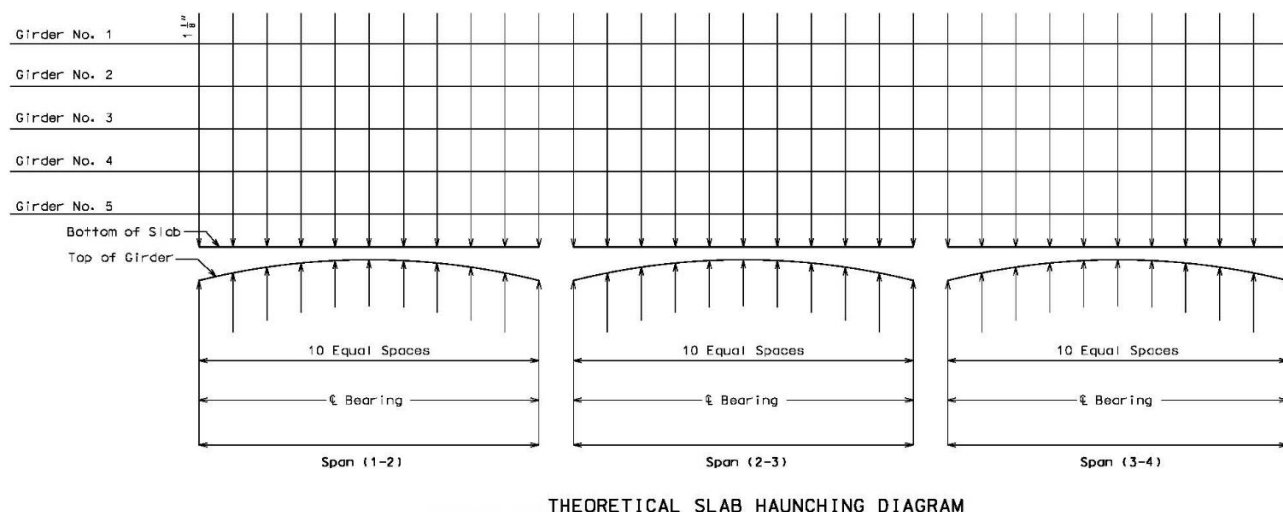
751.15.4.5 Other

For details of: transverse stiffeners, longitudinal stiffeners, lateral bracing, protecting coating requirements, weathering steel, drip bar guidance, and weld design/detail guidance, refer to EPG 751.14.5.

751.15.5 Miscellaneous Details

751.15.5.1 Girder Haunch

When variable haunching is used in lieu of cambering, the following detail shall be modified as needed and shown on the plans. There is no maximum haunch for full depth cast-in-place decks using conventional or SIP forms, but additional hairpin bars are required in accordance with EPG 751.10.1.14 Girder and Beam Haunch Reinforcement.



Remainder of section same as 751.14.6.1.

751.15.5.2 Girder Camber and Dead Load Deflection

Cambering of wide flange beams shall be utilized over roadways with a non-composite dead load deflection greater than 1". The variable haunch can be used over creek crossings for simplification and ease of girder fabrication with less than 4" of dead load deflection.

All plate girders shall be cambered.

Remainder of section same as 751.14.6.2.

Omissions and Changes to EPG 751.14, 751.11, and 751.10

References

- (1) Azizinamini, A., Yakel, A.J. and Farimani, M.R. (2005), *Development of a Steel Bridge System—Simple for Dead Load and Continuous for Live Load, Volume 1: Analysis and Recommendations*, Final Report NDOR 542, Nebraska Department of Roads, Lincoln, NE.
- (2) Azizinamini, A. (2014), "Simple for Dead Load–Continuous for Live Load Steel Bridge Systems," AISC, *Engineering Journal*, Second Quarter.
- (3) Taghinezhadbilondy, Ramin. 2016. "Extending Use of Simple for Dead Load and Continuous for Live Load (SDCL) Steel Bridge System to Seismic Areas." Ph.D. dissertation, Florida International University.
- (4) Sadeghnejad, A.; Mantawy, I.; Azizinamini, A. *ABC-UTC Guideline for Superstructure to Pier Connection in SDCL Steel Bridge Systems*; Technical Report; Florida International University: Miami, FL, USA, 2018
- (5) Wasserman, E. *Transportation Research Record: Journal of the Transportation Research Board, CD 11-S*, Transportation Research Board of the National Academies, Washington, D.C., 2005, pp. 197–202.
- (6) Azizinamini, Atorod. Simple for Dead Load - Continuous for Live Load Steel Bridge Systems. IBT/ABC-UTC, 9 Sept. 2025. Webinar.