I N T E R O F F I C E M E M O

TECHNICAL SERVICES
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DATE: August 2, 2016

TO: Alex Lim
Bridge Design Standards Engineer

FROM: Alex Lim
Bridge Design Standards Engineer
ODOT
Phone: 503-986-3402

SUBJECT: Proposed Revision to Bridge Design & Drafting Manual

RE: BDDM Section 1.5.1 – Concrete, General
BDDM Section 1.5.5.1.7 – *Tension Development Length - GRADE 60 – Uncoated Bars
BDDM Section 1.5.5.1.8 – *Compression Development Length - GRADE 60 – Uncoated Bars
BDDM Section 1.5.5.1.9 – *Tension Development Length of Hooks - GRADE 60 – Uncoated Bars
BDDM Section 1.5.5.1.10 – Welded Splices and Mechanical Connections
BDDM Section 1.5.5.1.12 – *Lap Splices – GRADE 60
BDDM Section 1.9.1 – Design and Detailing

Problem Statement:

Modify class of concrete for bridge deck and end panel to encourage the use of 80ksi reinforcing, and use 1 ½" aggregate for bridge deck for long term durability. Modify/update all related sections.

Proposal:

Modify Sections 1.5.1, 1.5.5.1.7-10, 1.5.5.1.12 and 1.9.1 as follows:

1.5 CONCRETE

1.5.1 Concrete, General

Designate the concrete class by the minimum compressive strength at 28 days followed by the maximum aggregate size (e.g., Class 4000 – 3/4). Unless otherwise specified, Class 3300 – 1-1/2, 1 or 3/4 is called for by the Standard Specifications. The maximum ultimate strength on which allowable stresses are based is 5000 psi, except for prestressed concrete. Use High Performance Concrete (HPC) in all cast-in-place concrete decks and end panels, with the exception of pedestrian bridge decks. Pedestrian bridge decks do not require HPC unless they are at a location using significant amounts of deicing chemicals.

Classes of Concrete
(For design and to be shown on plans)

HPC4500 – 1-1/2~~, or 1~~	All poured decks [except Box Girder decks that require greater strength and Pedestrian Bridge decks] Note: This concrete strength works well with both Grade 80 and Grade 60 rebar and therefore would facilitate use of Grade 80 rebar, but still allow Contractors to consider Grade 60 rebar without the need to change to a different concrete mix. The use of more coarse aggregate is to achieve more durable decks.
HPC4~~0~~500 – 1-1/2~~, or 1~~	End Panels
4000 – 3/8	Drilled Shafts
XXXX – 3/4	Prestressed members [Does not include poured deck on prestressed members, see above]
XXXX – 1/2 or 3/8	Post-tensioned box girder bottom slab and stem walls
XXXX – 3/4	Compression Members
3300 – 1-1/2, 1, or 3/4	All other concrete

Modulus of Elasticity

The modulus of elasticity of concrete may be taken as $E_c = 33{,}000\, w_c^{1.5} \sqrt{f'c}$, for $w_c = 0.145$ kcf

Concrete Strength f'c (ksi)	E_c (ksi)	$n=E_s/E_c = 29{,}000/E_c$
3.300	3300	9
4.000	3650	8
4.500	3865	8
5.000	4050	7
5.500	4250	7
6.000	4450	6
6.500	4650	6
7.000	4800	6
7.500	5000	6
8.000	5150	6
8.500	5300	5
9.000	5450	5

In the chart above, the modulus of elasticity (E_c) is rounded to the nearest 50 ksi and the modular ratio (n) is rounded to the nearest integer. The designer may choose to calculate these values using standard formulas rather than using the rounded values above.

1.5.5.1.7 *Tension Development Length - GRADE 60 – Uncoated Bars

Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	1'-0"	1'-0"	1'-0"	1'-0"
4	1'-0"	1'-0"	1'-0"	1'-0"
5	1'-3"	1'-~~0~~3"	1'-3"	1'-~~0~~3"
6	1'-7"	1'-6"	1'-6"	1'-6"
7	2'-1"	1'-11"	1'-10"	1'-9"
8	2'-9"	2'-6"	2'-4"	2'-3"
9	3'-6"	3'-2"	3'-0"	2'-10"
10	4'-5"	4'-0"	3'-9"	3'-7"
11	5'-5"	4'-11"	4'-8"	4'-5"
14	7'-6"	6'-9"	6'-5"	6'-1"
18	9'-8"	8'-9"	8'-3"	7'-10"

* Note: Increase lengths for epoxy coated bars per LRFD 5.11.2.1.2.

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Figure 1.5.5.1.7

1.5.5.1.8 *Compression Development Length - GRADE 60 – Uncoated Bars

Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	8"	8"	8"	8"
4	11"	10"	9"	9"
5	1'-1"	1'-0"	1'-0"	1'-0"
6	1'-4"	1'-3"	1'-2"	1'-2"
7	1'-7"	1'-5"	1'-4"	1'-4"
8	1'-9"	1'-7"	1'-6"	1'-6"
9	2'-0"	1'-10"	1'-9"	1'-9"
10	2'-3"	2'-0"	1'-11"	1'-11"
11	2'-6"	2'-3"	2'-2"	2'-2"
14	3'-0"	2'-8"	2'-7"	2'-7"
18	3'-11"	3'-7"	3'-5"	3'-5"

* Note: Increase lengths for bundled bars per LRFD 5.11.2.2.3.

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Figure 1.5.5.1.8

1.5.5.1.9 *Tension Development Length of Hooks - GRADE 60 – Uncoated Bars

Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	8"	8"	7"	7"
4	11"	10"	9"	9"
5	1'-1"	1'-0"	1'-0"	11"
6	1'-4"	1'-3"	1'-2"	1'-1"
7	1'-7"	1'-5"	1'-4"	1'-3"
8	1'-9"	1'-7"	1'-6"	1'-5"

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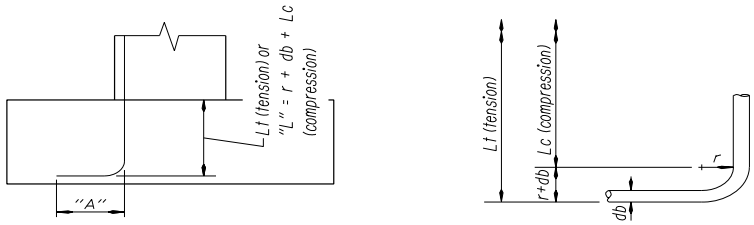
9	2'-0"	1'-10"	1'-9"	1'-8"
10	2'-3"	2'-1"	1'-11"	1'-10"
11	2'-6"	2'-3"	2'-2"	2'-0"
14	3'-0"	2'-9"	2'-7"	2'-5"
18	4'-0"	3'-7"	3'-5"	3'-3"

* Note: Increase lengths 20% for epoxy coated bars per LRFD 5.11.2.4.2.

Figure 1.5.5.1.9

1.5.5.1.10 Minimum Column Bar Lengths in Footings – GRADE 60 Bars & f'c = 3.3 ksi



Note:
Increase Lt or Lc 20 percent or epoxy coated bars
"A" and r + db are standard 90° hook dimensions
Lc is the compression development length
Lt is the tension development length for standard hooks

COMPRESSION DEVELOPMENT LENGTH - HOOKED BARS						
BASIC COMPRESSION DEVELOPMENT (length for hooked bars ℓdh	BAR SIZE	"A"	r + db	COMPRESSION "L" * (single bar)	COMPRESSION "L" * (two bar bundle)	COMPRESSION "L" * (three bar bundle)
1'-4"	6	1'-0"	3"	1'-2"	1'-4"	1'-5"
1'-7"	7	1'-2"	3½"	1'-4"	1'-6"	1'-8"
1'-9"	8	1'-4"	4"	1'-6"	1'-9"	1'-10"
2'-0"	9	1'-7"	6"	1'-10"	2'-1"	2'-3"
2'-3"	10	1'-10"	7"	2'-3"	2'-7"	2'-9"
2'-6"	11	2'-0"	7½"	2'-8"	3'-1"	3'-4"
3'-0"	14	2'-7"	11"	3'-10"	4'-5"	4'-10"
3'-11"	18	3'-5"	1'-3"	6'-3"	7'-6"	8'-2"

*Note:
Lc + (r + db) and including 0.75 modification factor for reinforcement enclosed within a spiral per LRFD 5.11.2.2.2

TENSION DEVELOPMENT LENGTH HOOKED BARS			
BAR SIZE	"A"	BASIC TENSION DEVELOPMENT (length for hooked bars ℓdh	MODIFIED TENSION "L" ** 0.7 ℓdh
6	1'-0"	10"	7"
7	1'-2"	1'-1"	9"
8	1'-4"	1'-5"	1'-0"
9	1'-7"	1'-9"	1'-3"
10	1'-10"	2'-3"	1'-7"
11	2'-0"	2'-9"	1'-11"
14	2'-7"	3'-11"	2'-9"
18	3'-5"	7'-0"	4'-11"

**Note:
#11 bars and smaller, adequate side and hook extension cover per LRFD 5.11.2.4.2

Figure 1.5.5.1.10

1.5.5.1.12 *Lap Splices – GRADE 60

Ratio of A_s provided/ A_s required	Percent of A_s Spliced with Required Lap Length		
	50	75	100
≥ 2	A	A	B
< 2	B	C	C

	* Class A splices (1.0 l_d)			
Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	1'-0"	1'-0"	1'-0"	1'-0"
4	1'-0"	1'-0"	1'-0"	1'-0"
5	1'-3"	1'-3"	1'-3"	1'-3"
6	1'-7"	1'-6"	1'-6"	1'-6"
7	2'-1"	1'-11"	1'-10"	1'-9"
8	2'-9"	2'-6"	2'-4"	2'-3"
9	3'-6"	3'-2"	3'-0"	2'-10"
10	4'-5"	4'-0"	3'-9"	3'-7"
11	5'-5"	4'-11"	4'-8"	4'-5"

* Note: Increase lengths for epoxy coated bars per LRFD 5.11.2.1.2.

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	* Class B splices (1.3 l_d)			
Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	1'-0"	1'-0"	1'-0"	1'-0"
4	1'-4"	1'-4"	1'-4"	1'-4"
5	1'-8"	1'-8"	1'-8"	1'-8"
6	2'-0"	2'-0"	2'-0"	2'-0"
7	2'-9"	2'-6"	2'-4"	2'-4"
8	3'-7"	3'-3"	3'-1"	2'-11"
9	4'-6"	4'-1"	3'-10"	3'-8"
10	5'-9"	5'-2"	4'-11"	4'-8"
11	7'-0"	6'-4"	6'-0"	5'-8"

* Note: Increase lengths for epoxy coated bars per LRFD 5.11.2.1.2.

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	* Class C splices (1.7 l_d)			
Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	1'-4"	1'-4"	1'-4"	1'-4"
4	1'-9"	1'-9"	1'-9"	1'-9"
5	2'-2"	2'-2"	2'-2"	2'-2"
6	2'-7"	2'-7"	2'-7"	2'-7"
7	3'-7"	3'-3"	3'-0"	3'-0"
8	4'-8"	4'-3"	4'-0"	3'-9"
9	5'-11"	5'-4"	5'-1"	4'-9"
10	7'-6"	6'-9"	6'-5"	6'-1"
11	9'-2"	8'-4"	7'-10"	7'-5"

* Note: Increase lengths for epoxy coated bars per *LRFD 5.11.2.1.2*.

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Figure 1.5.5.1.12

1.5.5.1.12a *Lap Splices – GRADE 80

Ratio of A_s provided/ A_s required	Percent of A_s Spliced with Required Lap Length		
	50	75	100
≥ 2	A	A	B
< 2	B	C	C

	* Class A splices (1.0 l_d)			
Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	1'-0"	1'-0"	1'-0"	1'-0"
4	1'-4"	1'-4"	1'-4"	1'-4"
5	1'-8"	1'-8"	1'-8"	1'-8"
6	2'-1"	2'-0"	2'-0"	2'-0"
7	2'-9"	2'-6"	2'-5"	2'-4"
8	3'-8"	3'-4"	3'-2"	3'-0"
9	4'-7"	4'-2"	4'-0"	3'-9"
10	5'-10"	5'-4"	5'-0"	4'-9"
11	7'-2"	6'-6"	6'-2"	5'-10"

* Note: Increase lengths for epoxy coated bars per LRFD 5.11.2.1.2.

	* Class B splices (1.3 l_d)			
Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	1'-4"	1'-4"	1'-4"	1'-4"
4	1'-9"	1'-9"	1'-9"	1'-9"
5	2'-2"	2'-2"	2'-2"	2'-2"
6	2'-8"	2'-8"	2'-8"	2'-8"
7	3'-7"	3'-3"	3'-1"	3'-1"
8	4'-9"	4'-4"	4'-1"	3'-10"
9	6'-0"	5'-5"	5'-2"	4'-11"
10	7'-7"	6'-11"	6'-6"	6'-2"
11	9'-4"	8'-6"	8'-0"	7'-7"

* Note: Increase lengths for epoxy coated bars per LRFD 5.11.2.1.2.

	* Class C splices (1.7 l_d)			
Bar #	f'c =3.3 ksi	f'c =4.0 ksi	f'c =4.5 ksi	f'c =5.0 ksi
3	1'-9"	1'-9"	1'-9"	1'-9"
4	2'-4"	2'-4"	2'-4"	2'-4"
5	2'-10"	2'-10"	2'-10"	2'-10"
6	3'-6"	3'-5"	3'-5"	3'-5"
7	4'-9"	4'-3"	4'-0"	4'-0"
8	6'-2"	5'-8"	5'-4"	5'-0"
9	7'-10"	7'-1"	6'-9"	6'-4"
10	9'-11"	9'-0"	8'-6"	8'-1"
11	12'-2"	11'-1"	10'-5"	9'-11"

* Note: Increase lengths for epoxy coated bars per *LRFD 5.11.2.1.2.*

Figure 1.5.5.1.12a

1.9 DECKS

1.9.1 Design and Detailing

Design

Design decks according to AASHTO *LRFD Bridge Design Specifications (LRFD)*.

Do not use the empirical design method for deck reinforcing steel. Excessive deck cracking, apparently due to under reinforcement, precludes the use of this method until further notice.

For additional deck requirements on Precast Prestressed elements, see *BDDM 1.5.6.1*.
For deck protective practice requirements, such as cover and reinforcement type, see *BDDM 1.26.3*.

For cast-in-place decks, discount ½ inch deck thickness when calculating composite properties for girder/slab systems. For a typical 8 inch deck, 7½ inch would be considered structural and 1/2 inch would be considered a sacrificial wearing surface and included as non-composite dead load.

The preferred orientation of the top mat of deck steel will have the transverse bars on top when the direction of primary loading is transverse.

For skewed decks, orient transverse bars according to *LRFD 9.7.1.3*. In skewed box girders, orient bottom slab transverse bars the same as the deck transverse bars. See *BDDM 1.5.7.8* for additional bottom slab requirements. Note the intended bar placement on the bridge contract plans.

Do not use deck reinforcement larger than a #6 bar in typical deck steel, except when needed to resist negative moment for continuous-span girders. If necessary, larger bars may be used in distinct sections such as joints and post tensioned anchorage areas. When the top mat has longitudinal bars on top, any longitudinal reinforcement larger than a #6 bar will need to be placed in the bottom mat.

Unless a project specific deck reinforcement design is developed, for design and detailing use the "Concrete Deck Reinforcement (LRFD Design)", *Figure 1.9.1A* or *1.9.1B* for Grade 60 reinforcement and Concrete Class HPC 4500, or *Figure 1.9.1C* or *1.9.1D* for Grade 80 reinforcement and Concrete Class HPC 4500.

Use of Grade 80 rebar is expected to reduce construction cost and potentially reduce rebar congestion therefore better quality concrete. However, designer should calculate the quantity of deck steel to determine if Grade 80 rebar is appropriate:

- When the quantity of deck steel using Grade 80 rebar exceeds 30 tons, the designer will provide details only for Grade 80 rebar.
- When the quantity of deck steel using Grade 80 rebar is less than 30 tons, the designer will provide details for both Grade 80 and Grade 60 rebar. The primary details will use Grade 80 with Grade 60 shown as an alternate.

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Ensure project specific deck design conforms to the following minimum requirements:

- *LRFD Section 4.6.2.1*
- Concrete Class: HPC4500 – 1-1/2~~, or 1~~ (except box girder decks that require greater strength)
- Reinforcement: Grade 60 or Grade 80
- Reinforcement no larger than #6 bar (except in distinct areas)
- Reinforcement spacing ≥ 5 inches and ≤ 8 inches (applies to top mat only)
- Surface wear allowance = 1/2 inch
- Limit top of concrete compressive service stress due to positive moment in the deck (between girders) to 0.4f'c~~.~~

Note that *LRFD 5.7.3.4* (Control of Cracking by Distribution of Reinforcement) is applicable for negative moment steel for bridges made continuous for live load, but is not applicable to bridge deck slab reinforcement. The 8 inch maximum bar spacing is adequate to control cracking in bridge decks.

Submit a design deviation request to the State Bridge Engineer for any concrete bridge deck designs not meeting any one of the minimum requirements listed above and in *Figures 1.9.1A 1.9.1B,–1.9.1C or 1.9.1D*. With the request, include the following:

- Design loading assumptions (dead, live, and future wearing surface)
- Documentation of which minimum requirements were met and which were not met
- Orientation of the top mat (longitudinal on top or transverse on top)
- Deck thickness
- Maximum service stress in the top of the deck due to positive moment in the deck (between girders)
- Maximum service stress in the bottom of the deck due to negative moment in the deck (over a girder)

Use cast-in-place HPC concrete for all decks. Full-depth precast deck panels may be considered on a case by case basis. An exception letter from the State Bridge Engineer will be required before full-depth precast deck panels can be used. Partial-depth precast deck panels will not be permitted.

maintain deck thickness to be the same as the grade 60 bar

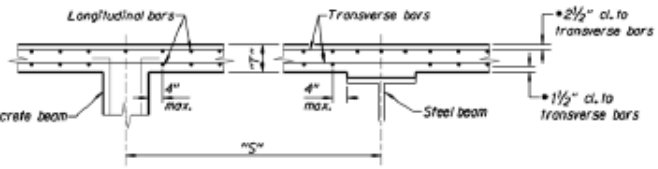
ge Design and Drafting Manual – April 2015
Oregon Department of Transportation
Section 1 - Design

checked by Alex
8/18/2016

update the table, the modification is not just based on the strength tab but also based on crack size and stress

MENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP
Steel Girders & Cast-in-Place Concrete box Girders - Simple Spans

LRFD Section 4.6.2.1



Assumptions
Specifications: AASHTO (Section 4.6.2.1)

Concrete Class: HPC 4500

Reinforcement: Grade 60

Top Mat Orientation: Transverse bars on top

Dead Load: 150 pcf + 50 psf future wearing surface

S^2

Deck DL moments: Negative $-0.10w\frac{S^2}{2}$
Positive $+0.08wS^2$

Live Load: Table A4-1 using 6" from ℄ of girder to the negative moment design section

Design Moment: 1.25•DL + 1.5•DW +1.75•LL
(Impact included in Table A4-1 live loads)

Surface wear: ½" allowance for surface wear subtracted from positive moment "d"

Steel Girders: Top flange width not less than 24". Project specific design is required when top flange is less than 24".

Concrete Box Girders: Girder stem width not less than 12". For girder stem greater than or equal to 16", use Deck Design Chart for Precast P/S Concrete Members

Note:
Additional reinforcement to accomodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.

Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.

Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not necessary for all bottom mat bars to be directly below a top mat bar.

• For coastal locations, specify 2" clear top and bottom. See also Section 1.1.25.3 for additional corrosion protection recommendations.

1.26.3

Steel Girders & CIP Concrete Box Girders

Girder Spacing	Deck Thickness	Transverse Bars	Longitudinal Bars
5'-0"	8"	#4 @ 6½"	#4 @ 8"
5'-3"	8"	#4 @ 6½"	#4 @ 8"
5'-6"	8"	#4 @ 6½"	#4 @ 8"
5'-9"	8"	#4 @ 6½"	#4 @ 8"
6'-0"	8"	#4 @ 6"	#4 @ 8"
6'-3"	8"	#4 @ 6"	#4 @ 8"
6'-6"	8"	#4 @ 6"	#4 @ 8"
6'-9"	8"	#4 @ 6"	#4 @ 8"
7'-0"	8"	#4 @ 5½"	#4 @ 8"
7'-3"	8"	#4 @ 5½"	#4 @ 8"
7'-6"	8"	#4 @ 5½"	#4 @ 8"
7'-9"	8"	#5 @ 7½"	#5 @ 8"
8'-0"	8"	#5 @ 7½"	#5 @ 8"
8'-3"	8"	#5 @ 7"	#5 @ 8"
8'-6"	8"	#5 @ 7"	#5 @ 8"
8'-9"	8"	#5 @ 7"	#5 @ 8"
9'-0"	8¼"	#5 @ 7"	#5 @ 8"
9'-3"	8¼"	#5 @ 7"	#5 @ 8"
9'-6"	8½"	#5 @ 7"	#5 @ 8"
9'-9"	8½"	#5 @ 6½"	#5 @ 8"
10'-0"	8¾"	#5 @ 6½"	#5 @ 8"
10'-3"	8¾"	#5 @ 6"	#5 @ 8"
10'-6"	8¾"	#5 @ 6"	#5 @ 8"
10'-9"	9"	#5 @ 6"	#5 @ 8"
11'-0"	9"	#5 @ 6"	#5 @ 8"
11'-3"	9"	#5 @ 5½"	#5 @ 8"
11'-6"	9¼"	#5 @ 5½"	#5 @ 8"
11'-9"	9¼"	#5 @ 5½"	#5 @ 8"
12'-0"	9½"	#5 @ 5½"	#5 @ 8"
12'-3"	9½"	#5 @ 5½"	#5 @ 8"
12'-6"	9¾"	#5 @ 5½"	#5 @ 8"
12'-9"	9¾"	#5 @ 5"	#5 @ 8"
13'-0"	10"	#5 @ 5"	#5 @ 8"
13'-3"	10"	#5 @ 5"	#5 @ 8"
13'-6"	10¼"	#5 @ 5"	#5 @ 8"
13'-9"	10¼"	#5 @ 5"	#5 @ 8"
14'-0"	10½"	#5 @ 5"	#5 @ 8"
14'-3"	10½"	#5 @ 5"	#5 @ 8"
14'-6"	10¾"	#5 @ 5"	#5 @ 8"
14'-9"	10¾"	#5 @ 5"	#5 @ 8"
15'-0"	11"	#5 @ 5"	#5 @ 8"

#4 @ 5 1/2"
#4 @ 8"

#4 @ 5
#4 @ 7"

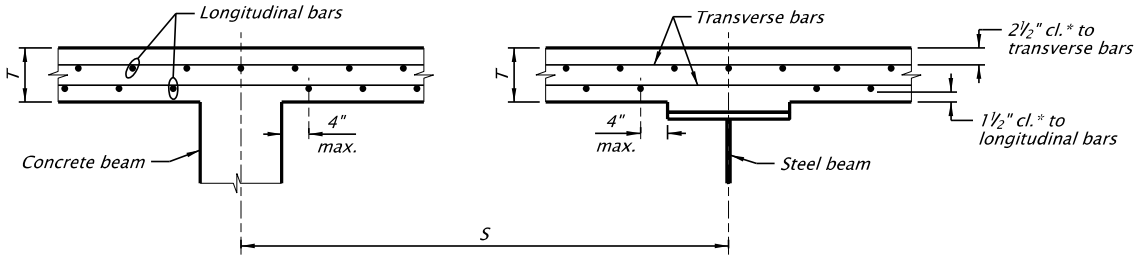
#5 @ 6 1/2"

7"

Figure 1.9.1A

Figure 1.9.1A

CONCRETE DECK REINFORCEMENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP
Steel Girders & Cast-In-Place Concrete Box Girders - Simple Spans



Assumptions:
Specifications: *LRFD 4.6.2.1*

Concrete Class: HPC 4500

Reinforcement: Grade 60

Top Mat Orientation: Transverse bars on top

Dead Load: 150 pcf + 50 psf future wearing surface

Deck DL moments: Negative $-0.10wS^2$
Positive $+0.08wS^2$

Live Load: *LRFD Table A4-1* using 6" from ℄ of girder to the negative moment design section

Design Moment: 1.25*DL + 1.5*DW +1.75*LL
(Impact included in *LRFD Table A4-1* live loads)

Surface Wear: 1/2" allowance for surface wear subtracted from positive moment "d".

Steel Girders: Top flange width not less than 24". Project specific design is required when top flange is less than 24".

Concrete Box Girders: Girder stem width not less than 12" For girder stem greater than or equal to 16", use Deck Design Chart for Precast P/S Concrete Members.

> Note:
> Additional reinforcement to accommodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.

Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.

Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not necessary for all bottom mat bars to be directly below a top mat bar.

* For coastal locations, specify 2" clear top and bottom. See also *BDDM 1.26.3* for additional corrosion protection recommendations.

Steel Girders & CIP Concrete Box Girders

Girder Spacing	Deck Thickness	Transverse Bars	Longitudinal Bars
5'-0"	8"	#4 @ 6½"	#4 @ 8"
5'-3"	8"	#4 @ 6½"	#4 @ 8"
5'-6"	8"	#4 @ 6½"	#4 @ 8"
5'-9"	8"	#4 @ 6½"	#4 @ 8"
6'-0"	8"	#4 @ 6"	#4 @ 8"
6'-3"	8"	#4 @ 6"	#4 @ 8"
6'-6"	8"	#4 @ 6"	#4 @ 8"
6'-9"	8"	#4 @ 6"	#4 @ 8"
7'-0"	8"	#4 @ 5½"	#4 @ 8"
7'-3"	8"	#4 @ 5½"	#4 @ 8"
7'-6"	8"	#4 @ 5½"	#4 @ 8"
7'-9"	8"	#4 @ 5½"	#4 @ 8"
8'-0"	8"	#4 @ 5"	#4 @ 7"
8'-3"	8"	#4 @ 5"	#4 @ 7"
8'-6"	8"	#4 @ 5"	#4 @ 7"
8'-9"	8"	#5 @ 6½"	#5 @ 8"
9'-0"	8¼"	#5 @ 6½"	#5 @ 8"
9'-3"	8¼"	#5 @ 6½"	#5 @ 8"
9'-6"	8½"	#5 @ 6½"	#5 @ 8"
9'-9"	8½"	#5 @ 6½"	#5 @ 8"
10'-0"	8¾"	#5 @ 6½"	#5 @ 8"
10'-3"	8¾"	#5 @ 6"	#5 @ 8"
10'-6"	8¾"	#5 @ 6"	#5 @ 8"
10'-9"	9"	#5 @ 6"	#5 @ 8"
11'-0"	9"	#5 @ 6"	#5 @ 8"
11'-3"	9"	#5 @ 5½"	#5 @ 8"
11'-6"	9¼"	#5 @ 5½"	#5 @ 8"
11'-9"	9¼"	#5 @ 5½"	#5 @ 8"
12'-0"	9½"	#5 @ 5½"	#5 @ 8"
12'-3"	9½"	#5 @ 5½"	#5 @ 8"
12'-6"	9¾"	#5 @ 5½"	#5 @ 8"
12'-9"	9¾"	#5 @ 5"	#5 @ 7"
13'-0"	10"	#5 @ 5"	#5 @ 7"
13'-3"	10"	#5 @ 5"	#5 @ 7"
13'-6"	10¼"	#5 @ 5"	#5 @ 7"
13'-9"	10¼"	#5 @ 5"	#5 @ 7"
14'-0"	10½"	#5 @ 5"	#5 @ 7"
14'-3"	10½"	#5 @ 5"	#5 @ 7"
14'-6"	10¾"	#5 @ 5"	#5 @ 7"
14'-9"	10¾"	#5 @ 5"	#5 @ 7"
15'-0"	11"	#5 @ 5"	#5 @ 7"

Figure 1.9.1A

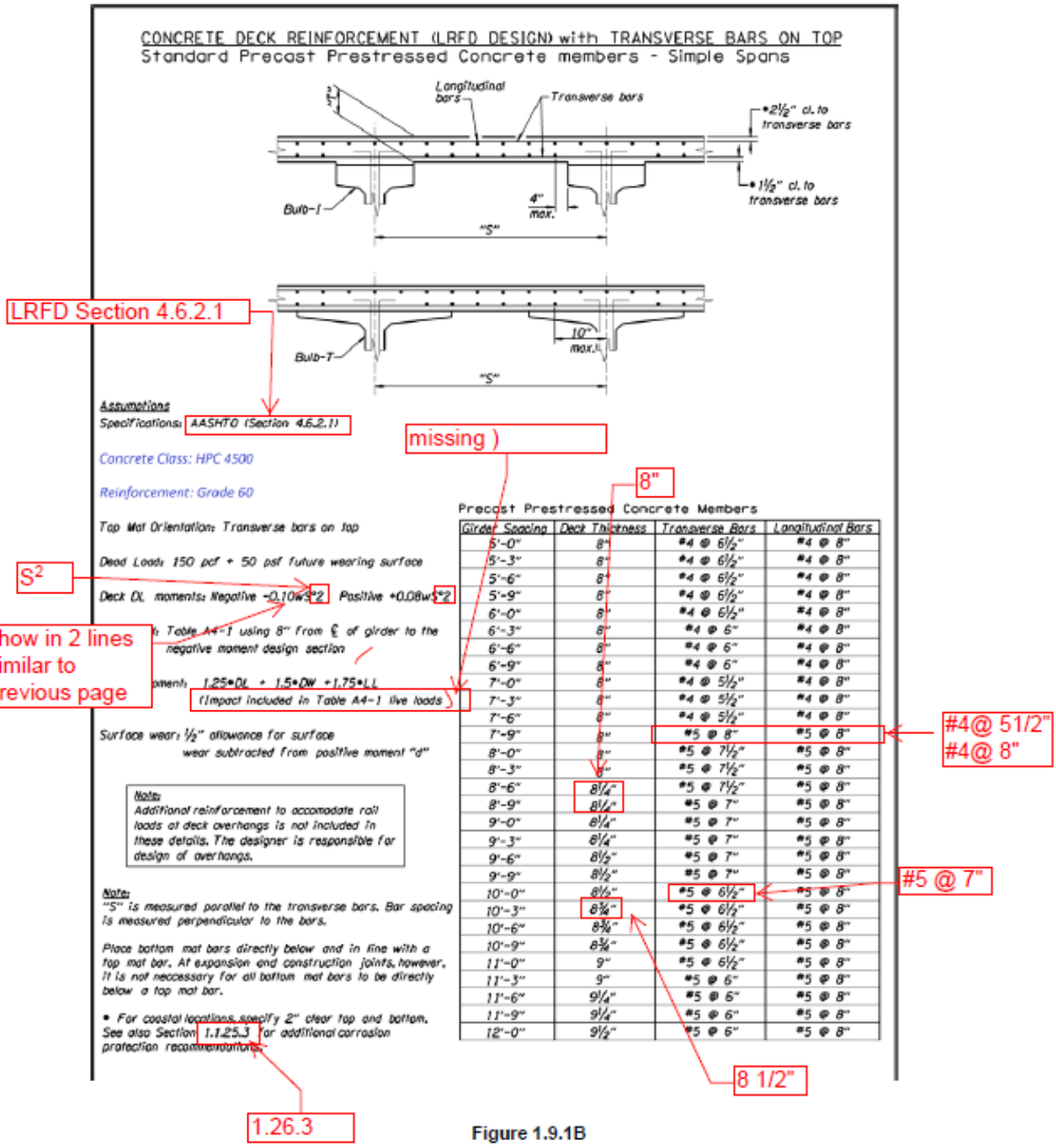
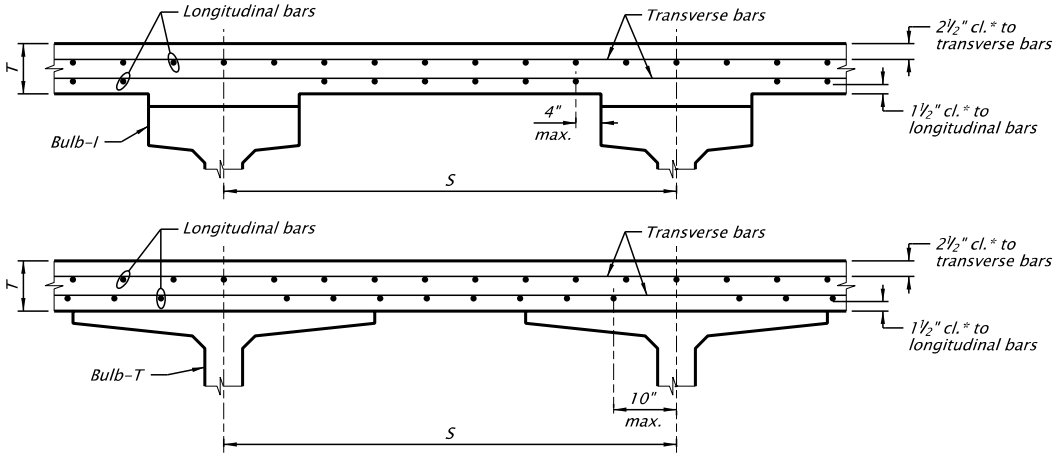

CONCRETE DECK REINFORCEMENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP
Standard Precast Prestressed Concrete members - Simple Spans
Longitudinal bars
Transverse bars
•2½" cl. to transverse bars
•1½" cl. to transverse bars
Bulb-I
4" max.
"S"
Bulb-T
10" max.
"S"
LRFD Section 4.6.2.1
Assumptions
Specifications: AASHTO (Section 4.6.2.1)
missing)
Concrete Class: HPC 4500
Reinforcement: Grade 60
8"
Top Mat Orientation: Transverse bars on top
Dead Loads: 150 pcf + 50 psf future wearing surface
S2
Deck DL moments: Negative -0.10ws*2 Positive +0.08ws*2
show in 2 lines similar to previous page
Table A4-1 using 8" from ℄ of girder to the negative moment design section
1.25*DL + 1.5*DW +1.75*LL
(Impact included in Table A4-1 live loads)
Surface wear: ½" allowance for surface wear subtracted from positive moment "d"
Note:
Additional reinforcement to accomodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.
Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.
Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not necessary for all bottom mat bars to be directly below a top mat bar.
• For coastal locations specify 2" clear top and bottom. See also Section 1.1.25.3 for additional corrosion protection recommendations.
1.26.3
Precast Prestressed Concrete Members
Girder Spacing | Deck Thickness | Transverse Bars | Longitudinal Bars
5'-0" | 8" | #4 @ 6½" | #4 @ 8"
5'-3" | 8" | #4 @ 6½" | #4 @ 8"
5'-6" | 8" | #4 @ 6½" | #4 @ 8"
5'-9" | 8" | #4 @ 6½" | #4 @ 8"
6'-0" | 8" | #4 @ 6½" | #4 @ 8"
6'-3" | 8" | #4 @ 6" | #4 @ 8"
6'-6" | 8" | #4 @ 6" | #4 @ 8"
6'-9" | 8" | #4 @ 6" | #4 @ 8"
7'-0" | 8" | #4 @ 5½" | #4 @ 8"
7'-3" | 8" | #4 @ 5½" | #4 @ 8"
7'-6" | 8" | #4 @ 5½" | #4 @ 8"
7'-9" | 8" | #5 @ 8" | #5 @ 8"
8'-0" | 8" | #5 @ 7½" | #5 @ 8"
8'-3" | 8" | #5 @ 7½" | #5 @ 8"
8'-6" | 8¼" | #5 @ 7½" | #5 @ 8"
8'-9" | 8¼" | #5 @ 7" | #5 @ 8"
9'-0" | 8¼" | #5 @ 7" | #5 @ 8"
9'-3" | 8¼" | #5 @ 7" | #5 @ 8"
9'-6" | 8½" | #5 @ 7" | #5 @ 8"
9'-9" | 8½" | #5 @ 7" | #5 @ 8"
10'-0" | 8½" | #5 @ 6½" | #5 @ 8"
10'-3" | 8¾" | #5 @ 6½" | #5 @ 8"
10'-6" | 8¾" | #5 @ 6½" | #5 @ 8"
10'-9" | 8¾" | #5 @ 6½" | #5 @ 8"
11'-0" | 9" | #5 @ 6½" | #5 @ 8"
11'-3" | 9" | #5 @ 6" | #5 @ 8"
11'-6" | 9¼" | #5 @ 6" | #5 @ 8"
11'-9" | 9¼" | #5 @ 6" | #5 @ 8"
12'-0" | 9½" | #5 @ 6" | #5 @ 8"
#4@ 51/2"
#4@ 8"
#5 @ 7"
8 1/2"
Figure 1.9.1B

Figure 1.9.1B

CONCRETE DECK REINFORCEMENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP

Standard Precast Prestressed Concrete members - Simple Spans



Assumptions:
Specifications: *LRFD 4.6.2.1*

Concrete Class: HPC 4500

Reinforcement: Grade 60

Top Mat Orientation: Transverse bars on top

Dead Load: 150 pcf + 50 psf future wearing surface

Deck DL moments: Negative $-0.10wS^2$
Positive $+0.08wS^2$

Live Load: *LRFD Table A4-1* using 8" from ℄ of girder to the negative moment design section

Design Moment: 1.25*DL + 1.5*DW +1.75*LL
(Impact included in *LRFD Table A4-1* live loads)

Surface Wear: 1/2" allowance for surface wear subtracted from positive moment "d".

> Note:
> Additional reinforcement to accommodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.

Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.

Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not necessary for all bottom mat bars to be directly below a top mat bar.

* For coastal locations, specify 2" clear top and bottom. See also *BDDM 1.26.3* for additional corrosion protection recommendations.

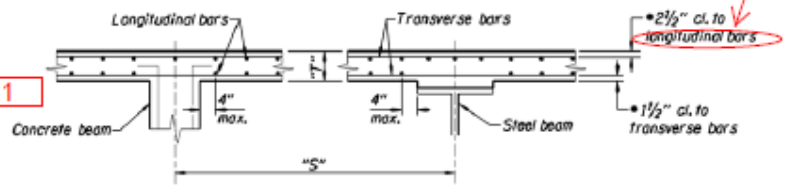
Precast Prestressed Concrete Members

Girder Spacing	Deck Thickness	Transverse Bars	Longitudinal Bars
5'-0"	8"	#4 @ 6½"	#4 @ 8"
5'-3"	8"	#4 @ 6½"	#4 @ 8"
5'-6"	8"	#4 @ 6½"	#4 @ 8"
5'-9"	8"	#4 @ 6½"	#4 @ 8"
6'-0"	8"	#4 @ 6½"	#4 @ 8"
6'-3"	8"	#4 @ 6"	#4 @ 8"
6'-6"	8"	#4 @ 6"	#4 @ 8"
6'-9"	8"	#4 @ 6"	#4 @ 8"
7'-0"	8"	#4 @ 5½"	#4 @ 8"
7'-3"	8"	#4 @ 5½"	#4 @ 8"
7'-6"	8"	#4 @ 5½"	#4 @ 8"
7'-9"	8"	#4 @ 5½"	#4 @ 8"
8'-0"	8"	#5 @ 7½"	#5 @ 8"
8'-3"	8"	#5 @ 7½"	#5 @ 8"
8'-6"	8"	#5 @ 7½"	#5 @ 8"
8'-9"	8"	#5 @ 7"	#5 @ 8"
9'-0"	8¼"	#5 @ 7"	#5 @ 8"
9'-3"	8¼"	#5 @ 7"	#5 @ 8"
9'-6"	8½"	#5 @ 7"	#5 @ 8"
9'-9"	8½"	#5 @ 7"	#5 @ 8"
10'-0"	8½"	#5 @ 7"	#5 @ 8"
10'-3"	8½"	#5 @ 6½"	#5 @ 8"
10'-6"	8¾"	#5 @ 6½"	#5 @ 8"
10'-9"	8¾"	#5 @ 6½"	#5 @ 8"
11'-0"	9"	#5 @ 6½"	#5 @ 8"
11'-3"	9"	#5 @ 6"	#5 @ 8"
11'-6"	9¼"	#5 @ 6"	#5 @ 8"
11'-9"	9¼"	#5 @ 6"	#5 @ 8"
12'-0"	9½"	#5 @ 6"	#5 @ 8"

Figure 1.9.1B

transverse bars

CONCRETE DECK REINFORCEMENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP
Steel Girders & Cast-in-Place Concrete box Girders - Simple Spans



LRFD Section 4.6.2.1

Assumptions

Specifications: AASHTO (Section 4.6.2.1)

Concrete Class: HPC 4500

Reinforcement: Grade 80

Top Mat Orientation: Transverse bars on top

Dead Load: 150 pcf + 50 psf future wearing surface

S^2

Deck DL moments: Negative $-0.10wS^2$
Positive $+0.08wS^2$

Live Load: Table A4-1 using 6" from ℄ of girder to the negative moment design section

Design Moment: 1.25•DL + 1.5•DW +1.75•LL
(Impact included in Table A4-1 live loads)

Surface wear: ½" allowance for surface wear subtracted from positive moment "d"

Steel Girders: Top flange width not less than 24". Project specific design is required when top flange is less than 24".

Concrete Box Girders: Girder stem width not less than 12". For girder stem greater than or equal to 16", use Deck Design Chart for Precast P/S Concrete Members

Note:
Additional reinforcement to accomodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.

Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.

Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not neccessary for all bottom mat bars to be directly below a top mat bar.

• For coastal locations, specify 2" clear top and bottom. See also Section 1.26 for additional corrosion protection recommendations.

1.26.3

Steel Girders & CIP Concrete Box Girders

Girder Spacing	Deck Thickness	Transverse Bars	Longitudinal Bars
5'-0"	8"	#4 @ 8"	#4 @ 8"
5'-3"	8"	#4 @ 8"	#4 @ 8"
5'-6"	8"	#4 @ 7½"	#4 @ 8"
5'-9"	8"	#4 @ 7½"	#4 @ 8"
6'-0"	8"	#4 @ 7"	#4 @ 8"
6'-3"	8"	#4 @ 7"	#4 @ 8"
6'-6"	8"	#4 @ 6½"	#4 @ 8"
6'-9"	8"	#4 @ 6½"	#4 @ 8"
7'-0"	8"	#4 @ 6"	#4 @ 8"
7'-3"	8"	#4 @ 6"	#4 @ 8"
7'-6"	8"	#4 @ 6"	#4 @ 8"
7'-9"	8"	#4 @ 5½"	#4 @ 8"
8'-0"	8"	#4 @ 5½"	#4 @ 8"
8'-3"	8"	#4 @ 5½"	#4 @ 8"
8'-6"	8"	#4 @ 5½"	#4 @ 8"
8'-9"	8"	#4 @ 5½"	#4 @ 8"
9'-0"	8¼"	#4 @ 5½"	#4 @ 7½"
9'-3"	8¼"	#4 @ 5½"	#4 @ 7½"
9'-6"	8½"	#4 @ 5½"	#4 @ 7½"
9'-9"	8½"	#4 @ 5½"	#4 @ 7½"
10'-0"	8¾"	#5 @ 6½"	#5 @ 8"
10'-3"	8¾"	#5 @ 6½"	#5 @ 8"
10'-6"	8¾"	#5 @ 6½"	#5 @ 8"
10'-9"	9"	#5 @ 6½"	#5 @ 8"
11'-0"	9"	#5 @ 6½"	#5 @ 8"
11'-3"	9"	#5 @ 6"	#5 @ 8"
11'-6"	9¼"	#5 @ 6"	#5 @ 8"
11'-9"	9¼"	#5 @ 6"	#5 @ 8"
12'-0"	9½"	#5 @ 6"	#5 @ 8"
12'-3"	9½"	#5 @ 6"	#5 @ 8"
12'-6"	9¾"	#5 @ 6"	#5 @ 8"
12'-9"	9¾"	#5 @ 6"	#5 @ 8"
13'-0"	10"	#5 @ 6"	#5 @ 8"
13'-3"	10"	#5 @ 6"	#5 @ 8"
13'-6"	10¼"	#5 @ 6"	#5 @ 8"
13'-9"	10¼"	#5 @ 6"	#5 @ 8"
14'-0"	10½"	#5 @ 5½"	#5 @ 8"
14'-3"	10½"	#5 @ 5½"	#5 @ 8"
14'-6"	10¾"	#5 @ 5½"	#5 @ 8"
14'-9"	10¾"	#5 @ 5½"	#5 @ 8"
15'-0"	11"	#5 @ 5½"	#5 @ 8"

8"

#4@5"
#4@7"

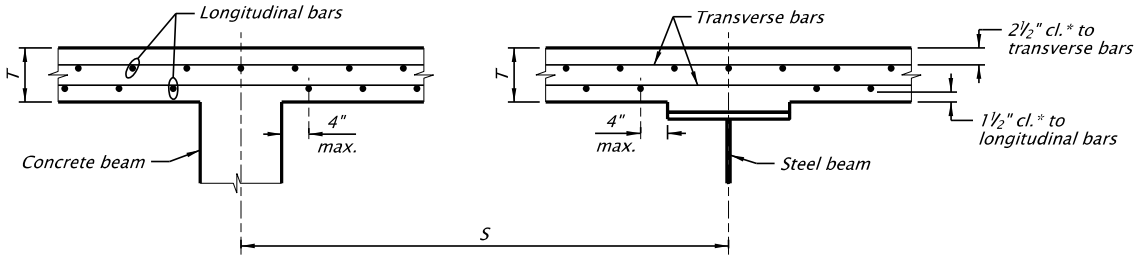
6"

5 1/2"

Figure 1.9.1C

Figure 1.9.1C

CONCRETE DECK REINFORCEMENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP
Steel Girders & Cast-In-Place Concrete Box Girders - Simple Spans



Assumptions:
Specifications: *LRFD 4.6.2.1*

Concrete Class: HPC 4500

Reinforcement: Grade 80

Top Mat Orientation: Transverse bars on top

Dead Load: 150 pcf + 50 psf future wearing surface

Deck DL moments: Negative $-0.10wS^2$
Positive $+0.08wS^2$

Live Load: *LRFD Table A4-1* using 6" from ℄ of girder to the negative moment design section

Design Moment: 1.25*DL + 1.5*DW +1.75*LL
(Impact included in *LRFD Table A4-1* live loads)

Surface Wear: 1/2" allowance for surface wear subtracted from positive moment "d".

Steel Girders: Top flange width not less than 24". Project specific design is required when top flange is less than 24".

Concrete Box Girders: Girder stem width not less than 12" For girder stem greater than or equal to 16", use Deck Design Chart for Precast P/S Concrete Members.

> Note:
> Additional reinforcement to accommodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.

Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.

Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not necessary for all bottom mat bars to be directly below a top mat bar.

* For coastal locations, specify 2" clear top and bottom. See also *BDDM 1.26.3* for additional corrosion protection recommendations.

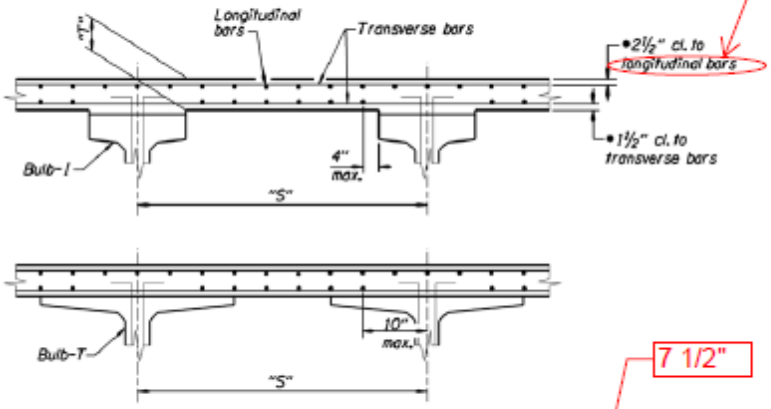
Steel Girders & CIP Concrete Box Girders

Girder Spacing	Deck Thickness	Transverse Bars	Longitudinal Bars
5'-0"	8"	#4 @ 8"	#4 @ 8"
5'-3"	8"	#4 @ 8"	#4 @ 8"
5'-6"	8"	#4 @ 7½"	#4 @ 8"
5'-9"	8"	#4 @ 7½"	#4 @ 8"
6'-0"	8"	#4 @ 7"	#4 @ 8"
6'-3"	8"	#4 @ 7"	#4 @ 8"
6'-6"	8"	#4 @ 6½"	#4 @ 8"
6'-9"	8"	#4 @ 6½"	#4 @ 8"
7'-0"	8"	#4 @ 6"	#4 @ 8"
7'-3"	8"	#4 @ 6"	#4 @ 8"
7'-6"	8"	#4 @ 6"	#4 @ 8"
7'-9"	8"	#4 @ 5½"	#4 @ 8"
8'-0"	8"	#4 @ 5½"	#4 @ 8"
8'-3"	8"	#4 @ 5½"	#4 @ 8"
8'-6"	8"	#4 @ 5½"	#4 @ 8"
8'-9"	8"	#4 @ 5½"	#4 @ 8"
9'-0"	8¼"	#4 @ 5½"	#4 @ 8"
9'-3"	8¼"	#4 @ 5½"	#4 @ 8"
9'-6"	8½"	#4 @ 5½"	#4 @ 8"
9'-9"	8½"	#4 @ 5"	#4 @ 7"
10'-0"	8¾"	#4 @ 5"	#4 @ 7"
10'-3"	8¾"	#4 @ 5"	#4 @ 7"
10'-6"	8¾"	#4 @ 5"	#4 @ 7"
10'-9"	9"	#4 @ 5"	#4 @ 7"
11'-0"	9"	#5 @ 6"	#5 @ 8"
11'-3"	9"	#5 @ 6"	#5 @ 8"
11'-6"	9¼"	#5 @ 6"	#5 @ 8"
11'-9"	9¼"	#5 @ 6"	#5 @ 8"
12'-0"	9½"	#5 @ 6"	#5 @ 8"
12'-3"	9½"	#5 @ 6"	#5 @ 8"
12'-6"	9¾"	#5 @ 6"	#5 @ 8"
12'-9"	9¾"	#5 @ 5½"	#5 @ 8"
13'-0"	10"	#5 @ 5½"	#5 @ 8"
13'-3"	10"	#5 @ 5½"	#5 @ 8"
13'-6"	10¼"	#5 @ 5½"	#5 @ 8"
13'-9"	10¼"	#5 @ 5½"	#5 @ 8"
14'-0"	10½"	#5 @ 5½"	#5 @ 8"
14'-3"	10½"	#5 @ 5½"	#5 @ 8"
14'-6"	10¾"	#5 @ 5½"	#5 @ 8"
14'-9"	10¾"	#5 @ 5½"	#5 @ 8"
15'-0"	11"	#5 @ 5½"	#5 @ 8"

Figure 1.9.1C

transverse bars

CONCRETE DECK REINFORCEMENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP
Standard Precast Prestressed Concrete members - Simple Spans



Assumptions

Specifications: AASHTO (Section 4.6.2.1) missing)

Concrete Class: HPC 4500

Reinforcement: Grade 80

Top Mat Orientation: Transverse bars on top

Dead Load: 150 pcf + 50 psf future wearing surface

Deck DL moments: Negative −0.10wS^2 Positive +0.08wS^2

Live Load: Table A4-1 using 8" from ℄ of girder to the negative moment design section

Design Moment: 1.25•DL + 1.5•DW +1.75•LL
(Impact included in Table A4-1 live loads

Surface wear: ½" allowance for surface wear subtracted from positive moment "d"

Note:
Additional reinforcement to accomodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.

Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.

Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not necessary for all bottom mat bars to be directly below a top mat bar.

* For coastal locations, specify 2" clear top and bottom. See also Section 1.1.25.3 for additional corrosion protection recommendations.

1.26.3

Precast Prestressed Concrete Members

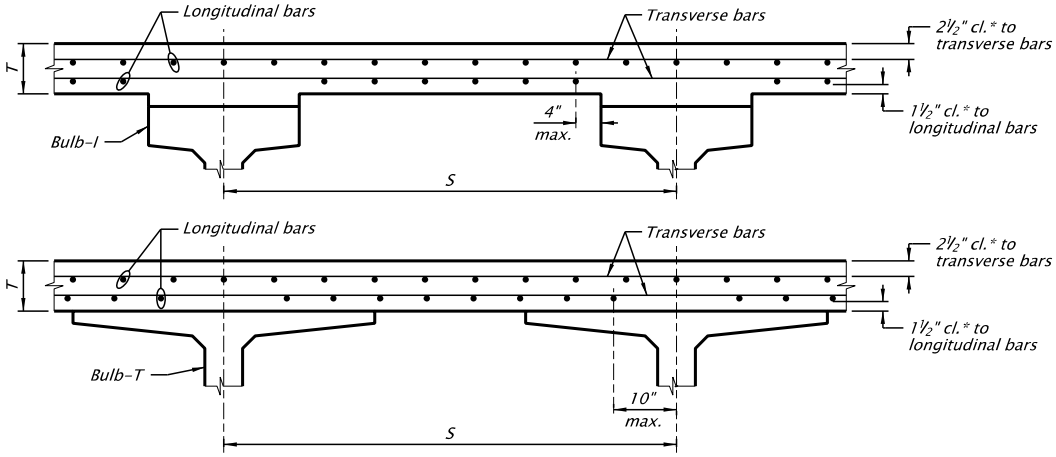
Girder Spacing	Deck Thickness	Transverse Bars	Longitudinal Bars
5'-0"	8"	#4 @ 8"	#4 @ 8"
5'-3"	8"	#4 @ 8"	#4 @ 8"
5'-6"	8"	#4 @ 8"	#4 @ 8"
5'-9"	8"	#4 @ 8"	#4 @ 8"
6'-0"	8"	#4 @ 7½"	#4 @ 8"
6'-3"	8"	#4 @ 7½"	#4 @ 8"
6'-6"	8"	#4 @ 7"	#4 @ 8"
6'-9"	8"	#4 @ 7"	#4 @ 8"
7'-0"	8"	#4 @ 6½"	#4 @ 8"
7'-3"	8"	#4 @ 6½"	#4 @ 8"
7'-6"	8"	#4 @ 6½"	#4 @ 8"
7'-9"	8"	#4 @ 6"	#4 @ 8"
8'-0"	8"	#4 @ 6"	#4 @ 8"
8'-3"	8"	#4 @ 6"	#4 @ 8"
8'-6"	8"	#4 @ 6"	#4 @ 8"
8'-9"	8¼"	#4 @ 6"	#4 @ 7½"
9'-0"	8¼"	#4 @ 6"	#4 @ 7½"
9'-3"	8¼"	#4 @ 5½"	#4 @ 7½"
9'-6"	8½"	#4 @ 5½"	#4 @ 7½"
9'-9"	8½"	#4 @ 5½"	#4 @ 7½"
10'-0"	8½"	#4 @ 5½"	#4 @ 7½"
10'-3"	8½"	#4 @ 5½"	#4 @ 7½"
10'-6"	8¾"	#4 @ 5"	#4 @ 7"
10'-9"	8¾"	#4 @ 5"	#4 @ 7"
11'-0"	9"	#4 @ 5"	#4 @ 7"
11'-3"	9"	#4 @ 5"	#4 @ 7"
11'-6"	9¼"	#4 @ 5"	#4 @ 6½"
11'-9"	9¼"	#4 @ 5"	#4 @ 6½"
12'-0"	9½"	#4 @ 5"	#4 @ 6½"

Figure 1.9.1D

7 1/2"
7"
8"
6 1/2"
6"
5 1/2"
7 1/2"
7"
6 1/2"
5"

Figure 1.9.1D

CONCRETE DECK REINFORCEMENT (LRFD DESIGN) with TRANSVERSE BARS ON TOP
Standard Precast Prestressed Concrete members - Simple Spans



Assumptions:
Specifications: *LRFD 4.6.2.1*

Concrete Class: HPC 4500

Reinforcement: Grade 80

Top Mat Orientation: Transverse bars on top

Dead Load: 150 pcf + 50 psf future wearing surface

Deck DL moments: Negative $-0.10wS^2$
Positive $+0.08wS^2$

Live Load: *LRFD Table A4-1* using 8" from ℄ of girder to the negative moment design section

Design Moment: 1.25*DL + 1.5*DW +1.75*LL
(Impact included in *LRFD Table A4-1* live loads)

Surface Wear: 1/2" allowance for surface wear subtracted from positive moment "d".

> Note:
> Additional reinforcement to accommodate rail loads at deck overhangs is not included in these details. The designer is responsible for design of overhangs.

Note:
"S" is measured parallel to the transverse bars. Bar spacing is measured perpendicular to the bars.

Place bottom mat bars directly below and in line with a top mat bar. At expansion and construction joints, however, it is not necessary for all bottom mat bars to be directly below a top mat bar.

* For coastal locations, specify 2" clear top and bottom. See also *BDDM 1.26.3* for additional corrosion protection recommendations.

Precast Prestressed Concrete Members

Girder Spacing	Deck Thickness	Transverse Bars	Longitudinal Bars
5'-0"	8"	#4 @ 7½"	#4 @ 8"
5'-3"	8"	#4 @ 7½"	#4 @ 8"
5'-6"	8"	#4 @ 7½"	#4 @ 8"
5'-9"	8"	#4 @ 7½"	#4 @ 8"
6'-0"	8"	#4 @ 7"	#4 @ 8"
6'-3"	8"	#4 @ 7"	#4 @ 8"
6'-6"	8"	#4 @ 6½"	#4 @ 8"
6'-9"	8"	#4 @ 6½"	#4 @ 8"
7'-0"	8"	#4 @ 6½"	#4 @ 8"
7'-3"	8"	#4 @ 6"	#4 @ 8"
7'-6"	8"	#4 @ 6"	#4 @ 8"
7'-9"	8"	#4 @ 6"	#4 @ 8"
8'-0"	8"	#4 @ 6"	#4 @ 8"
8'-3"	8"	#4 @ 5½"	#4 @ 7½"
8'-6"	8"	#4 @ 5½"	#4 @ 7½"
8'-9"	8"	#4 @ 5½"	#4 @ 7½"
9'-0"	8¼"	#4 @ 5½"	#4 @ 7½"
9'-3"	8¼"	#4 @ 5½"	#4 @ 7½"
9'-6"	8½"	#4 @ 5½"	#4 @ 7½"
9'-9"	8½"	#4 @ 5½"	#4 @ 7½"
10'-0"	8½"	#4 @ 5"	#4 @ 7"
10'-3"	8½"	#4 @ 5"	#4 @ 7"
10'-6"	8¾"	#4 @ 5"	#4 @ 7"
10'-9"	8¾"	#4 @ 5"	#4 @ 7"
11'-0"	9"	#4 @ 5"	#4 @ 7"
11'-3"	9"	#4 @ 5"	#4 @ 6½"
11'-6"	9¼"	#4 @ 5"	#4 @ 6½"
11'-9"	9¼"	#4 @ 5"	#4 @ 6½"
12'-0"	9½"	#4 @ 5"	#4 @ 6½"

Figure 1.9.1D

Analysis / Research / Other Supporting Data:

☐ None
☒ Attached: Excel Deck Reinforcing Calculation Deck-2016T(4_5k)pg_alex_check.xlsx

Bridge Engineering Section Response:

☐ Accepted for consideration as submitted ☐ Accepted for consideration as noted ☐ Proposal tabled, see Remarks ☐ Proposal not accepted, see Remarks		
Remarks:		
Craig Shike Bridge Design Standards Reviewer		Date
Alex Lim Digitally signed by Alex Lim DN: cn=Alex Lim, o=ODOT, ou=BDDM Standards Engineer, email=Alex.K.LIM@odot.state.or.us, c=US Date: 2016.09.29 09:49:49 -07'00'		
Alex Lim Bridge Design Standards Engineer		Date 9/29/2016

Cc: file