

APPENDIX J. Full Scale Beam Drawings

PRELIMINARY PLAN DRAWINGS FOR

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM PROJECT 18-15

**HIGH-STRENGTH/HIGH PERFORMANCE LIGHTWEIGHT
CONCRETE FOR BRIDGE GIRDERS AND DECKS**

LARGE-SCALE TEST BEAMS



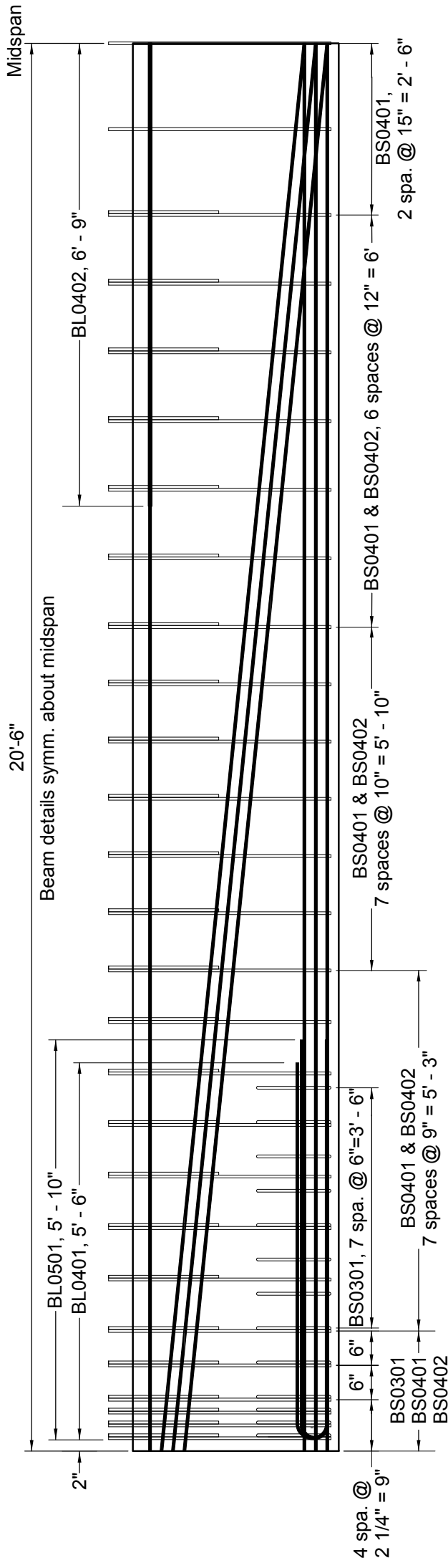
Notes to Bidders:

- 1) The girders in the following plans are for a research project; all potential contractors shall attend a mandatory pre-bid meeting (meeting time and location to be announced).
- 2) First set of beams shall be ready for delivery by June 1, 2009
- 3) The preferred order of casting stages is indicated in the Girder Production Matrix table on this sheet. Casting stages should be at least two weeks apart.
- 4) Winning bidder shall give one week notice prior to the date of beam casting.
- 5) Virginia Tech will require one extra day prior to concrete placement for each casting in order to install instrumentation on the steel reinforcement.
- 6) Virginia Tech will also require one-half day per beam after form removal and prior to strand detensioning to install instrumentation on the concrete surfaces.
- 7) Because Virginia Tech will be testing one beam at a time, Contractors will need to provide storage for beams six months to one year prior to being shipped to Virginia Tech.
- 8) Virginia Tech will provide all shipping and disposal arrangements for the concrete beams.
- 9) Mix designs for all concrete used in this project will be provided by Virginia Tech.
- 10) Lightweight aggregate used in this project shall be Carolina Stalite rotary kiln expanded slate lightweight aggregate, or an approved equivalent.
- 11) Bids shall allow for an additional 4 ft³ of fresh concrete per beam used to make sample specimens for quality control testing at Virginia Tech.
- 12) All beams in this project shall be steam cured.
- 13) Any additional inquiries regarding these notes may be directed to Tommy Cousins (tcousins@vt.edu, 540-231-6753) or Carin Roberts-Wollmann (wollmann@vt.edu, 540-231-2052) of Virginia Tech.

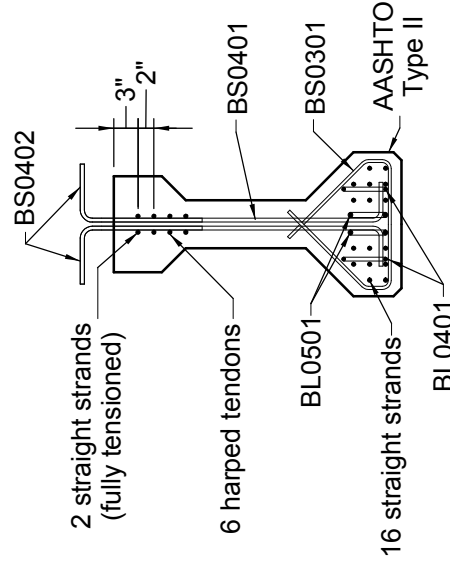
GIRDER PRODUCTION MATRIX						
BEAM ID	Section	Length (ft)	No. of Strands	Concrete Weight (pcf)	f'_c (ksi)	Casting Stage
1	Type II	41	24	120	8	1
2	Type II	41	24	120	8	
3	PCBT-45	59	34	145	8	2
4	PCBT-45	59	34	120	8	
5	PCBT-45	59	34	120	10	3
6	PCBT-45	59	34	120	10	

VIRGINIA TECH

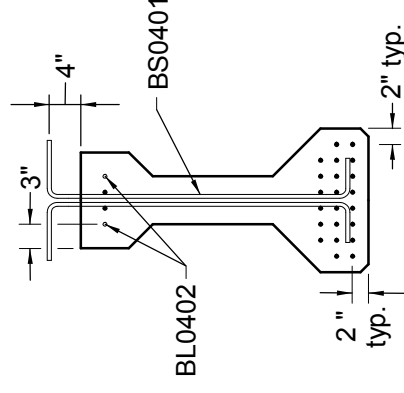
LIGHTWEIGHT CONCRETE
LARGE-SCALE TEST BEAMS



Part Elevation of Beam



End View



Midspan View

REINFORCING STEEL SCHEDULE																																																									
<p>BS0301</p>	<p>BS0402</p>																																																								
<p>BS0401</p>	<p>BL0401</p>																																																								
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<table border="1"> <thead> <tr> <th>Mark</th> <th>Size</th> <th>Pin Ø</th> <th>Length</th> <th>Wt./bar lbs.</th> <th>Quantity</th> <th>Weight lbs.</th> </tr> </thead> <tbody> <tr> <td>BS0301</td> <td>#3</td> <td>1.5"</td> <td>4' - 0 1/4"</td> <td>1.51</td> <td>26</td> <td>39.3</td> </tr> <tr> <td>BS0401</td> <td>#4</td> <td>2"</td> <td>3' - 11 1/2"</td> <td>2.64</td> <td>53</td> <td>139.9</td> </tr> <tr> <td>BS0402</td> <td>#4</td> <td>2"</td> <td>1' - 9 1/2"</td> <td>1.20</td> <td>50</td> <td>60.0</td> </tr> <tr> <td>BL0401</td> <td>#4</td> <td>4 3/4"</td> <td>11' - 2 1/2"</td> <td>7.49</td> <td>2</td> <td>15.0</td> </tr> <tr> <td>BL0402</td> <td>#4</td> <td>-</td> <td>13' - 6"</td> <td>5.08</td> <td>2</td> <td>10.1</td> </tr> <tr> <td>BL0501</td> <td>#5</td> <td>3 3/4"</td> <td>11' - 9 7/8"</td> <td>12.33</td> <td>2</td> <td>24.7</td> </tr> <tr> <td colspan="6" style="text-align: right;">Total Weight</td> <td>289.0</td> </tr> </tbody> </table>		Mark	Size	Pin Ø	Length	Wt./bar lbs.	Quantity	Weight lbs.	BS0301	#3	1.5"	4' - 0 1/4"	1.51	26	39.3	BS0401	#4	2"	3' - 11 1/2"	2.64	53	139.9	BS0402	#4	2"	1' - 9 1/2"	1.20	50	60.0	BL0401	#4	4 3/4"	11' - 2 1/2"	7.49	2	15.0	BL0402	#4	-	13' - 6"	5.08	2	10.1	BL0501	#5	3 3/4"	11' - 9 7/8"	12.33	2	24.7	Total Weight						289.0
Mark	Size	Pin Ø	Length	Wt./bar lbs.	Quantity	Weight lbs.																																																			
BS0301	#3	1.5"	4' - 0 1/4"	1.51	26	39.3																																																			
BS0401	#4	2"	3' - 11 1/2"	2.64	53	139.9																																																			
BS0402	#4	2"	1' - 9 1/2"	1.20	50	60.0																																																			
BL0401	#4	4 3/4"	11' - 2 1/2"	7.49	2	15.0																																																			
BL0402	#4	-	13' - 6"	5.08	2	10.1																																																			
BL0501	#5	3 3/4"	11' - 9 7/8"	12.33	2	24.7																																																			
Total Weight						289.0																																																			

Dimensions in bending diagram are out-to-out of the bars.

Reinforcing bars shown on the above schedule are for beams shown in this sheet only.

Reinforcing bars BS0401 and BS0402 shall be galvanized. All other reinforcing bars shall be epoxy coated.

At the contractor's option and at no additional cost, bar BS0403 may be fabricated as a two-piece bar with a minimum 1' - 8" overlap.

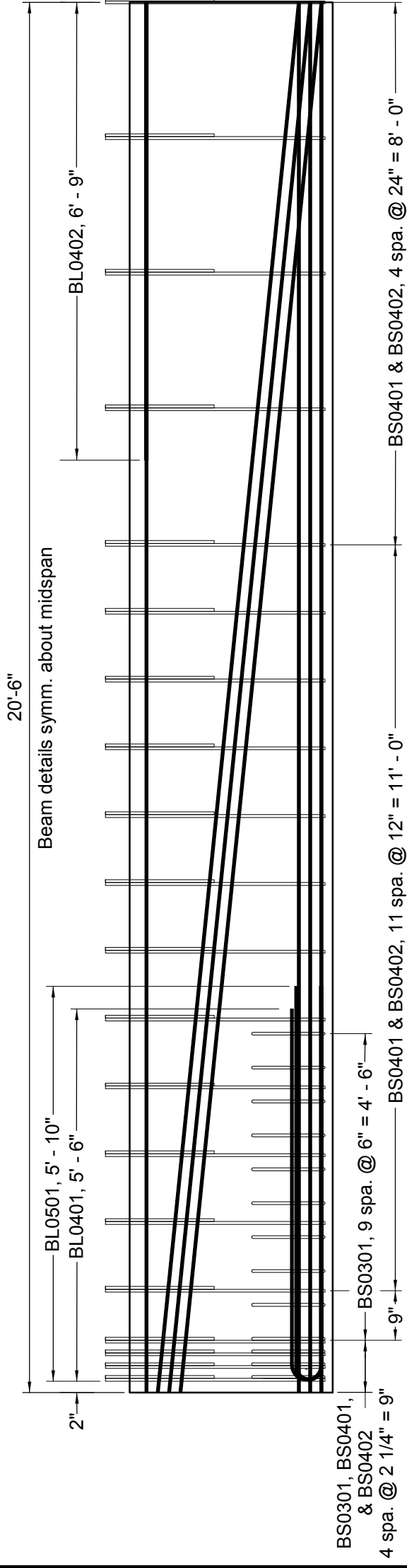
Notes:

- 1) Concrete strength at release = 6000psi
- 2) Concrete 28 day strength = 8000 psi
- 3) Concrete unit weight = 120 pcf
- 4) Concrete is a lightweight mix design
- 5) All strands are 0.5" diameter, Grade 270
- 6) All strands are stressed to 75% GUTS = 31 kips per strand
- 7) Beam is a standard AASHTO Type II shape
- 8) Surface of top flange shall be intentionally roughened to an amplitude of 1/4"

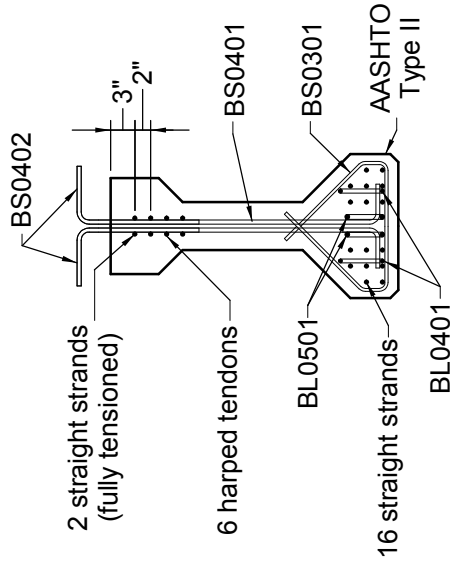
VIRGINIA TECH

LIGHTWEIGHT PRESTRESSED BEAM
AASHTO TYPE II
TYPICAL SHEAR REINFORCEMENT

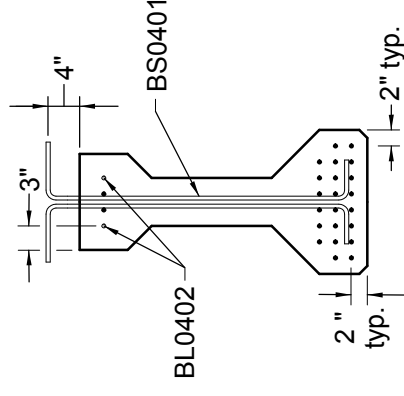
Midspan



Part Elevation of Beam



End View



Midspan View

REINFORCING STEEL SCHEDULE

Mark	Size	Pin ϕ	Length	Wt./bar lbs.	Quantity	Weight lbs
BS0301	#3	1.5"	4' - 0 1/4"	1.51	26	39.3
BS0401	#4	2"	3' - 11 1/2"	2.64	39	103.0
BS0402	#4	2"	1' - 9 1/2"	1.20	39	46.8
BL0401	#4	4 3/4"	11' - 2 1/2"	7.49	2	15.0
BL0402	#4	-	13' - 6"	5.08	2	10.1
BL0501	#5	3 3/4"	11' - 9 7/8"	12.33	2	24.7
Total Weight						238.9

Dimensions in bending diagram are out-to-out of the bars.

Reinforcing bars shown on the above schedule are for beams shown in this sheet only.

Reinforcing bars BS0401 and BS0402 shall be galvanized. All other reinforcing bars shall be epoxy coated.

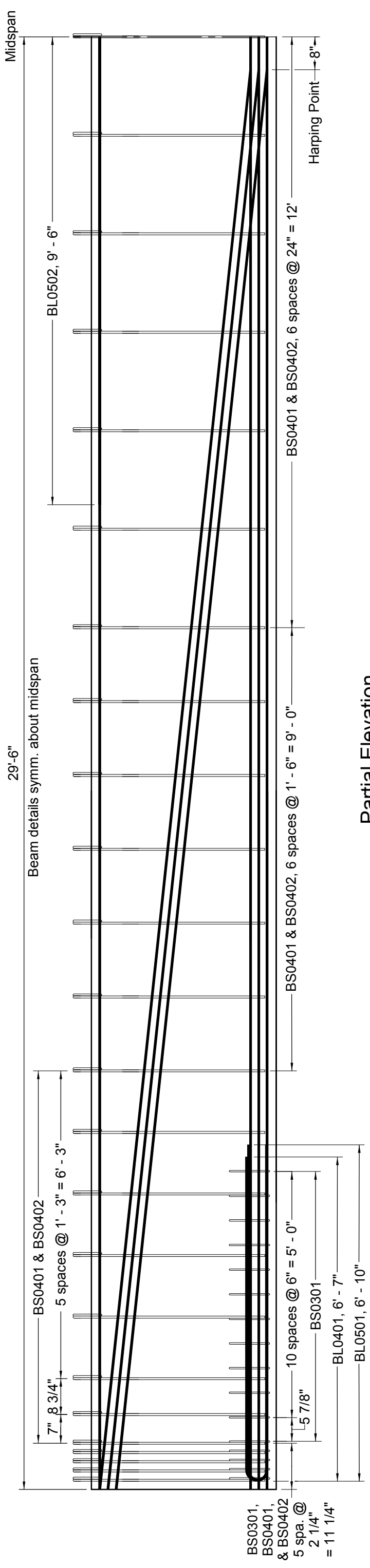
At the contractor's option and at no additional cost, bar BS0403 may be fabricated as a two-piece bar with a minimum 1' - 8" overlap.

Notes:

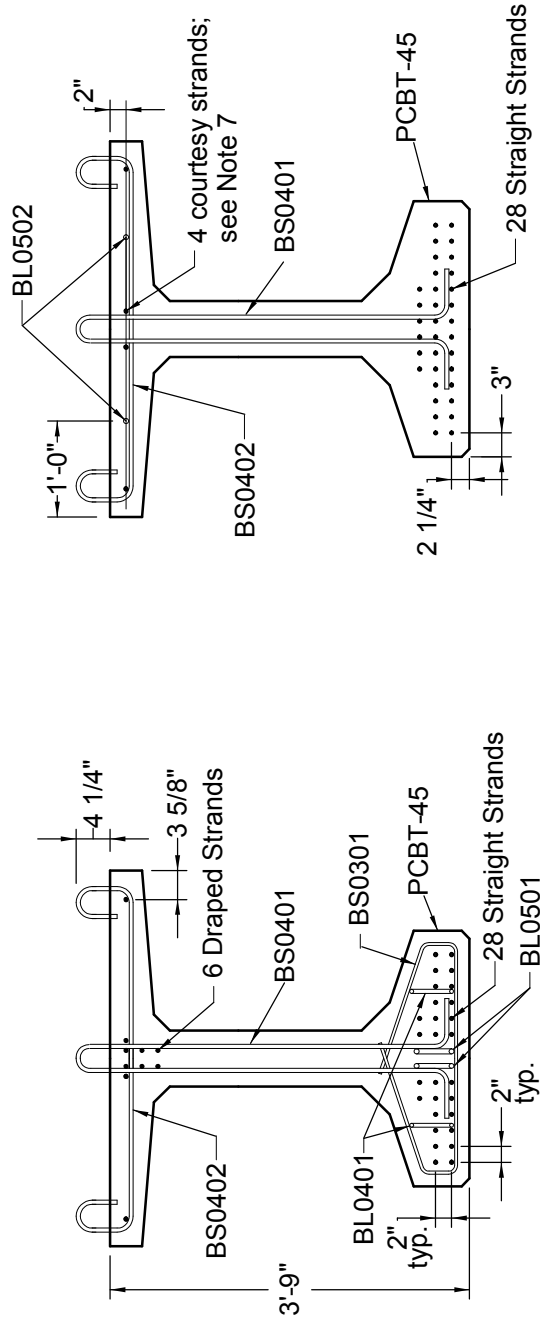
- 1) Concrete strength at release = 6000psi
- 2) Concrete 28 day strength = 8000 psi
- 3) Concrete unit weight = 120 pcf
- 4) Concrete is a lightweight mix design
- 5) All strands are 0.5" diameter, Grade 270
- 6) All strands are stressed to 75% GUTS = 31 kips per strand
- 7) Beam is a standard AASHTO Type II shape
- 8) Surface of top flange shall be intentionally roughened to an amplitude of 1/4"

VIRGINIA TECH

LIGHTWEIGHT PRESTRESSED BEAM
AASHTO TYPE II
MINIMUM SHEAR REINFORCEMENT



Partial Elevation



End View

Center Line View

REINFORCING STEEL SCHEDULE			
Mark	Size	Pin ϕ	Length
BS0301	#3	2"	5' - 11 1/2"
BS0401	#4	2 1/2"	8' - 8 1/2"
BS0402	#4	3"	5' - 8 1/4"
BL0401	#4	4 1/2"	13' - 4 3/8"
BL0501	#5	3 3/4"	13' - 9 7/8"
BL0502	#5	-	19' - 0"
BS0401			
Wt./bar lbs	Qty.	Weight lbs	
2.24	32	71.7	
5.82	47	273.4	
3.80	47	178.6	
8.93	4	35.7	
14.42	4	57.7	
19.8	2	39.6	
Total Weight			656.7
			BL0401
			BL0501

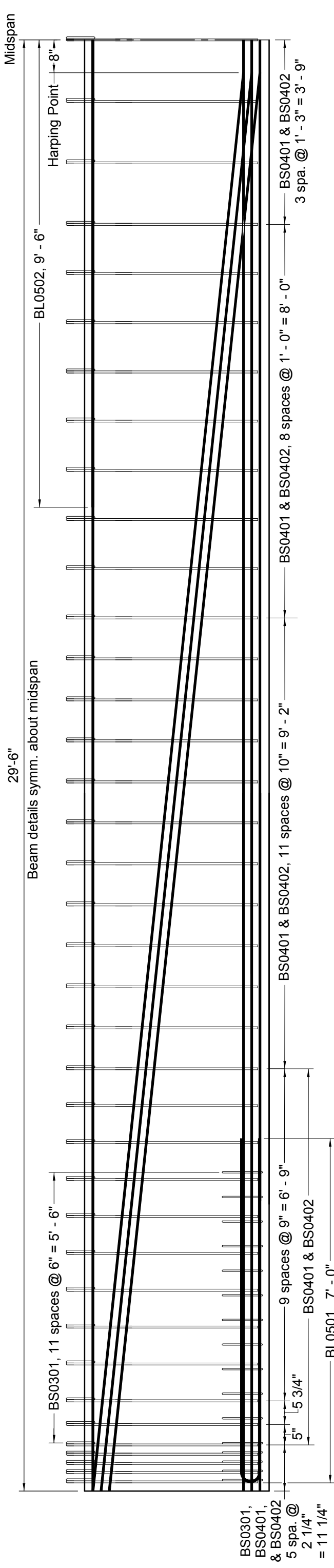
- Notes:**
- Concrete strength at release = 6000psi
 - Concrete 28 day strength = 8000 psi
 - Concrete unit weight = 145 pcf
 - Concrete is normal weight mix design
 - All strands are 0.5" diameter, Grade 270
 - Bottom and draped strands are stressed to 75% GUTS = 31 kips per strand
 - 4 - 1/2 ϕ strands stressed to 1000 lbs
 - Beam is standard PCBT-45 shape
 - Surface of top flange shall be intentionally roughened to an amplitude of 1/4"

Dimensions in bending diagram are out-to-out of the bars.

Reinforcing bars shown on the above schedule are for beams shown in this sheet only.

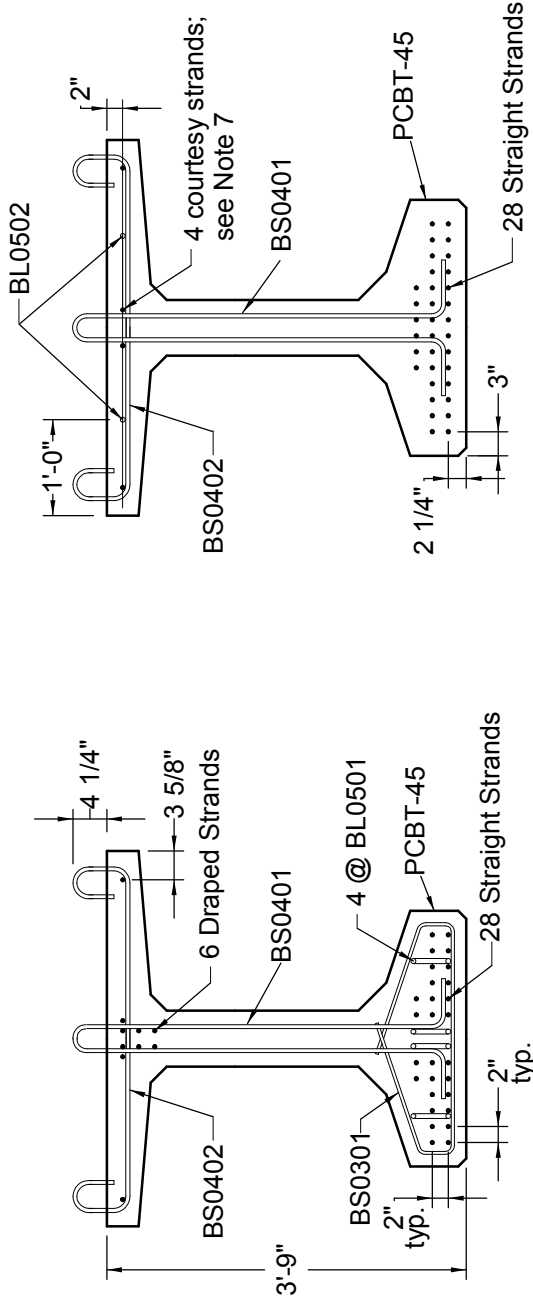
Reinforcing bars BS0401 and BS0402 shall be galvanized. All other reinforcing bars shall be epoxy coated.

29'-6"
Beam details symm. about midspan



BS0301,
BS0401,
& BS0402
5 spa. @
2 1/4"
= 11 1/4"

Partial Elevation



End View

Center Line View

REINFORCING STEEL SCHEDULE				BS0401		BL0501	
Mark	Size	Pin ϕ	Length	Wt./bar lbs	Qty.	Weight lbs	Total Weight
BS0301	#3	2"	5' - 11 1/2"	2.24	32	71.7	948.0
BS0401	#4	2 1/2"	8' - 8 1/2"	5.82	75	436.5	
BS0402	#4	3"	5' - 8 1/4"	3.80	75	284.9	
BL0501	#5	3 3/4"	13' - 9 7/8"	14.42	8	115.3	
BL0502	#5	-	19' - 0"	19.8	2	39.6	
						Total Weight	948.0

Dimensions in bending diagram are out-to-out of the bars.

Reinforcing bars shown on the above schedule are for beams shown in this sheet only.

Reinforcing bars BS0401 and BS0402 shall be galvanized. All other reinforcing bars shall be epoxy coated.

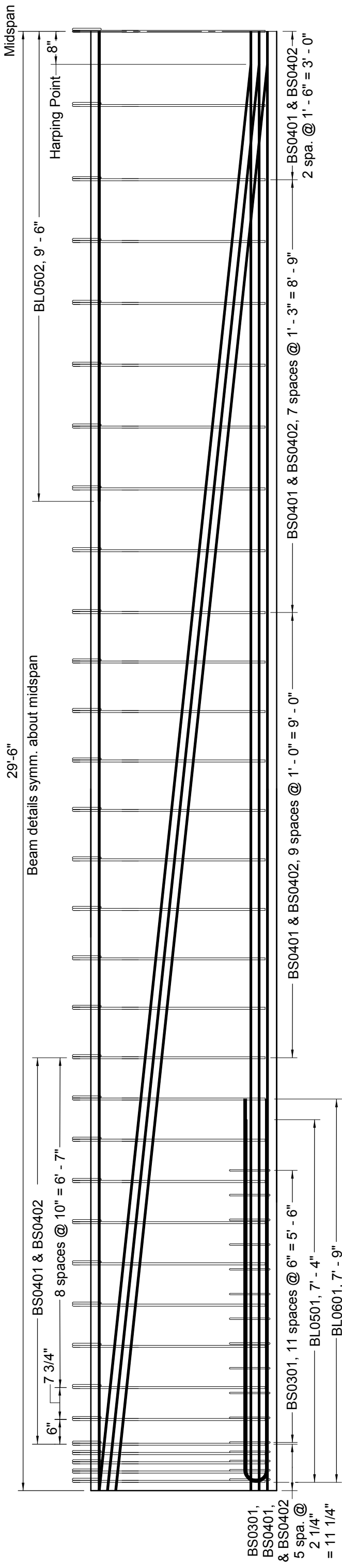
Notes:

- 1) Concrete strength at release = 6000psi
- 2) Concrete 28 day strength = 8000 psi
- 3) Concrete unit weight = 120 pcf
- 4) Concrete is lightweight mix design
- 5) All strands are 0.5" diameter, Grade 270
- 6) Bottom and draped strands are stressed to 75% GUTS = 31 kips per strand
- 7) 4 - 1/2 ϕ strands stressed to 1000 lbs
- 8) Beam is standard PCBT-45 shape
- 9) Surface of top flange shall be intentionally roughened to an amplitude of 1/4"

VIRGINIA TECH

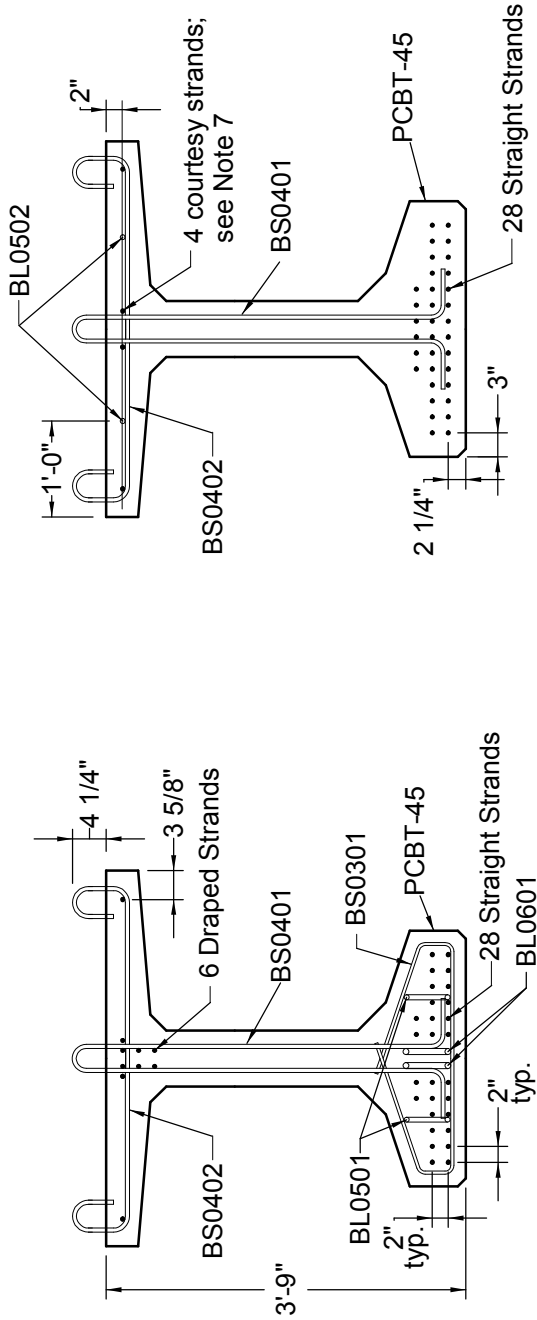
8-KSI LIGHTWEIGHT PRESTRESSED BEAM
VIRGINIA PCBT-45

Scale: 1/2"=1'-0" Rev. 2 Date: 04/05/09 Sheet No.: 5 of 7



BS0301,
BS0401,
& BS0402
5 spa. @
2 1/4"
= 11 1/4"

Partial Elevation



End View

Center Line View

REINFORCING STEEL SCHEDULE			
Mark	Size	Pin ϕ	Length
BS0301	#3	2"	5' - 11 1/2"
BS0401	#4	2 1/2"	8' - 8 1/2"
BS0402	#4	3"	5' - 8 1/4"
BL0501	#5	4 1/2"	14' - 10 1/4"
BL0502	#5	-	19' - 0"
BL0601	#6	4 1/2"	15' - 8 1/4"
Total Weight			870.5

Mark	Size	Pin ϕ	Length	Wt./bar lbs	Qty.	Weight lbs
BS0401	#4	2 1/2"	3'-10 1/2"	2.24	32	71.7
BS0401	#4	2 1/2"	7'-4"	5.82	65	378.3
BS0402	#4	3"	7'-9"	3.80	65	247.0
BL0501	#5	4 1/2"	5 3/4"	9.92	4	39.7
BL0502	#5	-	6 1/4"	19.8	2	39.6
BL0601	#6	4 1/2"	6 1/4"	13.05	4	94.2
Total Weight						870.5

Dimensions in bending diagram are out-to-out of the bars.

Reinforcing bars shown on the above schedule are for beams shown in this sheet only.

Reinforcing bars BS0401 and BS0402 shall be galvanized. All other reinforcing bars shall be epoxy coated.

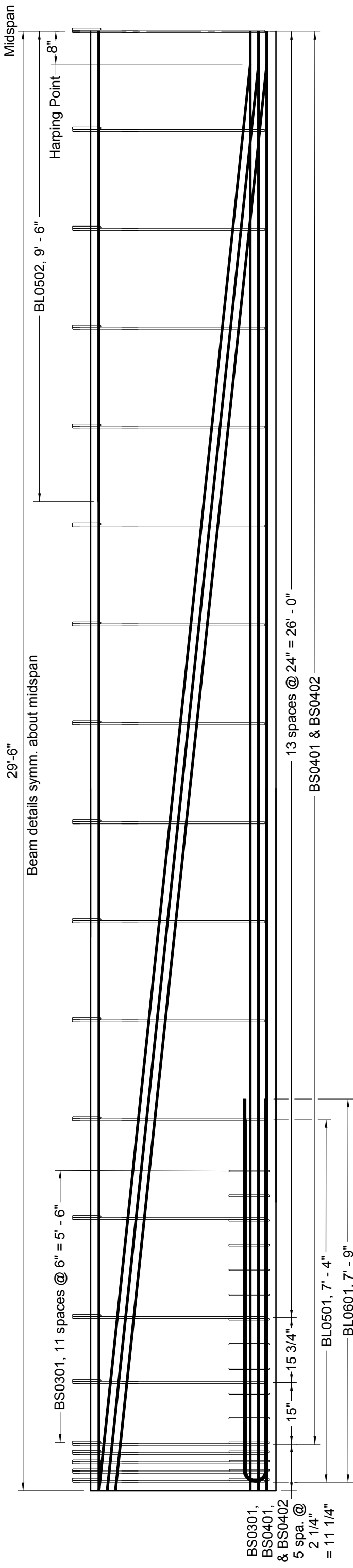
Notes:

- Concrete strength at release = 7500psi
- Concrete 28 day strength = 10000 psi
- Concrete unit weight = 120 pcf
- Concrete is lightweight mix design
- All strands are 0.5" diameter, Grade 270
- Bottom and draped strands are stressed to 75% GUTS = 31 kips per strand
- 4 - 1/2 ϕ strands stressed to 1000 lbs
- Beam is standard PCBT-45 shape
- Surface of top flange shall be intentionally roughened to an amplitude of 1/4"

VIRGINIA TECH

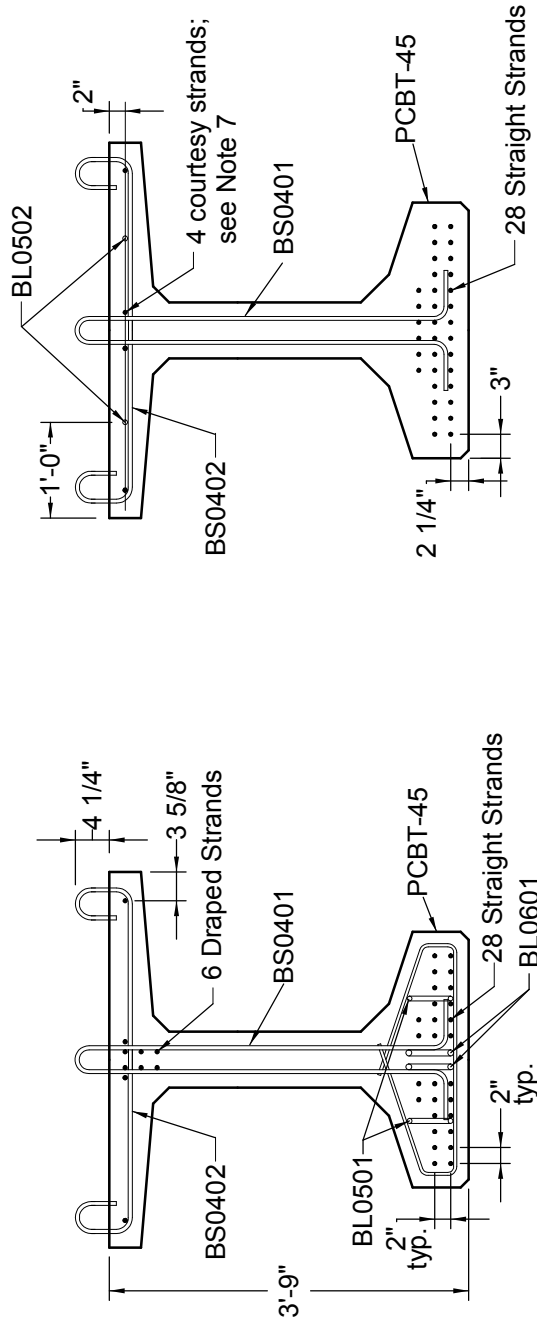
10-KSI LIGHTWEIGHT PRESTRESSED BEAM
VIRGINIA PCBT-45
TYPICAL SHEAR REINFORCEMENT

Scale: 1/2"=1'-0" Rev. 3 Date: 04/15/09 Sheet No.: 6 of 7



BS0301,
BS0401,
& BS0402
5 spa. @
2 1/4"
= 11 1/4"

Partial Elevation



End View

Center Line View

REINFORCING STEEL SCHEDULE			
Mark	Size	Pin ϕ	Length
BS0301	#3	2"	5' - 11 1/2"
BS0401	#4	2 1/2"	8' - 8 1/2"
BS0402	#4	3"	5' - 8 1/4"
BL0501	#5	4 1/2"	14' - 10 1/4"
BL0502	#5	-	19' - 0"
BL0601	#6	4 1/2"	15' - 8 1/4"
Total Weight			620.4

Mark	Wt./bar lbs	Qty.	Weight lbs
BS0401	2.24	32	71.7
BS0401	5.82	39	227.0
BS0402	3.80	39	148.2
BL0501	9.92	4	39.7
BL0502	19.8	2	39.6
BL0601	13.05	4	94.2
Total Weight			620.4

Notes:

- Concrete strength at release = 7500psi
- Concrete 28 day strength = 10000 psi
- Concrete unit weight = 120 pcf
- Concrete is lightweight mix design
- All strands are 0.5" diameter, Grade 270
- Bottom and draped strands are stressed to 75% GUTS = 31 kips per strand
- 4 - 1/2 ϕ strands stressed to 1000 lbs
- Beam is standard PCBT-45 shape
- Surface of top flange shall be intentionally roughened to an amplitude of 1/4"

Dimensions in bending diagram are out-to-out of the bars.

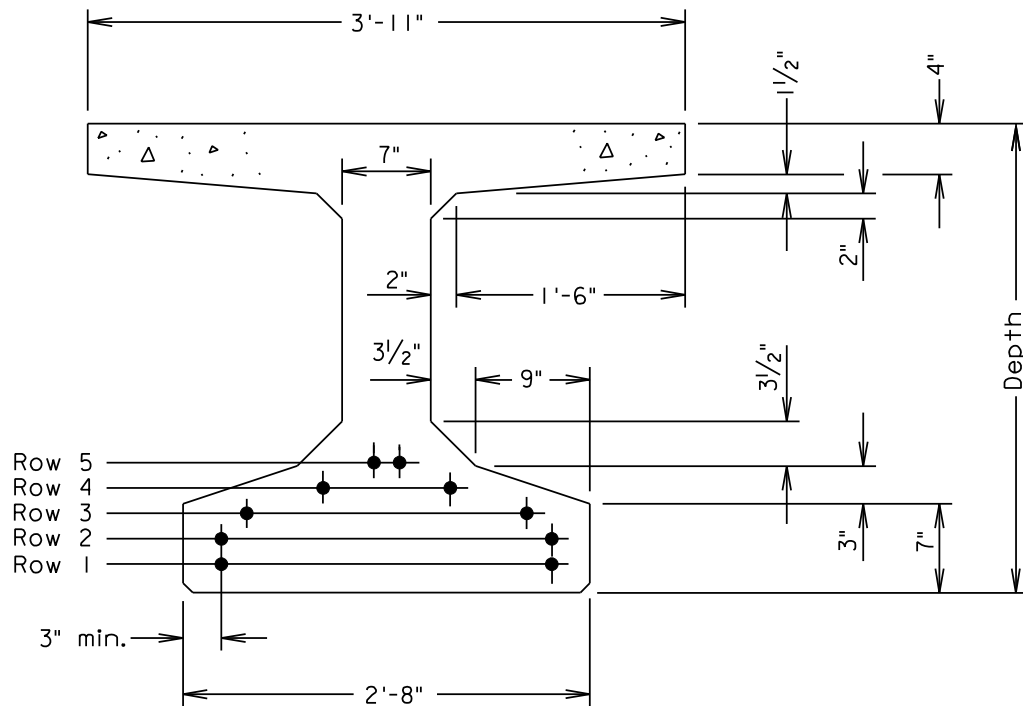
Reinforcing bars shown on the above schedule are for beams shown in this sheet only.

Reinforcing bars BS0401 and BS0402 shall be galvanized. All other reinforcing bars shall be epoxy coated.

VIRGINIA TECH

10-KSI LIGHTWEIGHT PRESTRESSED BEAM
VIRGINIA PCBT-45
MINIMUM SHEAR REINFORCEMENT

Scale: 1/2"=1'-0" Rev. 3 Date: 04/15/09 Sheet No.: 7 of 7



Maximum number of strands in row number 1: 14
 2: 14
 3: 12
 4: 6
 5 and higher: 2

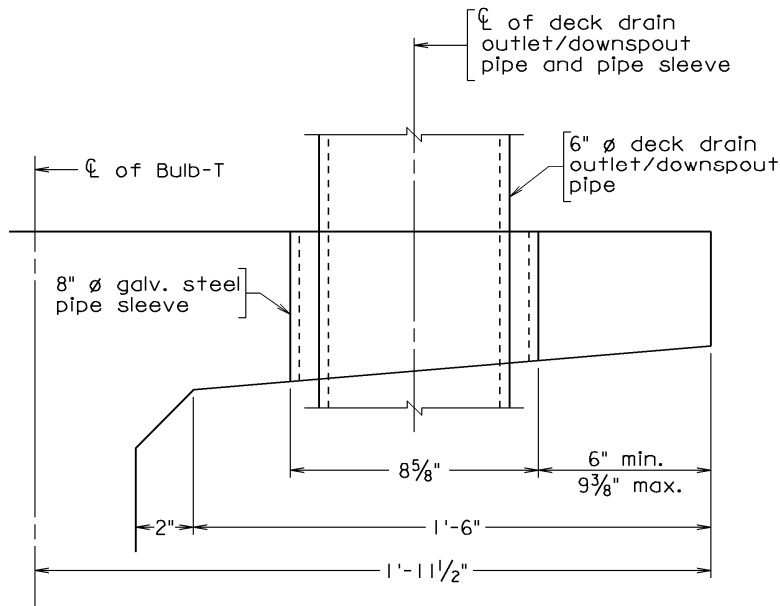
Beam Designation	Depth D (in)	Area A (in ²)	Volume to Surface Ratio V/S (in)	Centroid to Bottom y _b (in)	Moment of Inertia I (x 10 ³ in ⁴)	Section Modulus		Weight @ 150 pcf (lbs/lin. ft.)
						S _{top} (in ³)	S _{bottom} (in ³)	
PCBT-29	29	634.7	3.40	14.66	66.8	4658	4557	661
PCBT-37	37	690.7	3.41	18.43	126.0	6785	6837	720
PCBT-45	45	746.7	3.41	22.23	207.3	9104	9325	778
PCBT-53	53	802.7	3.42	26.06	312.4	11596	11988	836
PCBT-61	61	858.7	3.42	29.92	443.1	14257	14810	894
PCBT-69	69	914.7	3.43	33.79	601.3	17078	17795	953
PCBT-77	77	970.7	3.43	37.67	788.7	20053	20937	1011
PCBT-85	85	1026.7	3.44	41.57	1007.2	23191	24229	1070
PCBT-93	93	1082.7	3.44	45.48	1258.5	26484	27672	1128

**PRESTRESSED CONCRETE
 BULB-T'S - LRFD
 SECTION PROPERTIES**

VOL. V - PART 2
 DATE: 31Jul2009
 SHEET 3 of 15
 FILE NO. 12.03-3

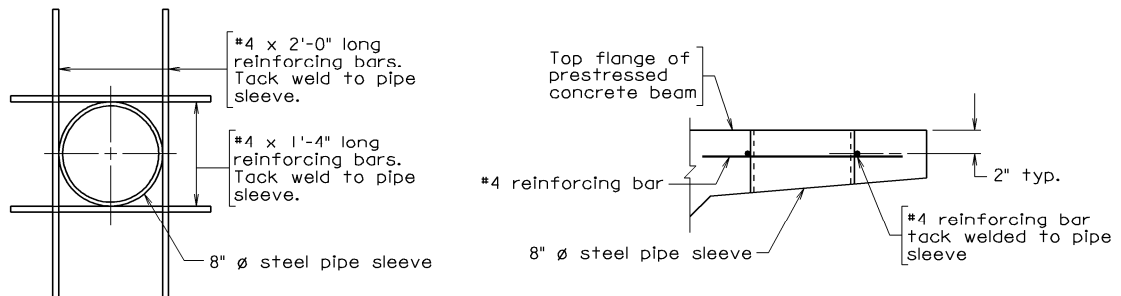
TOP FLANGE SLEEVE DETAILS FOR DECK DRAINS:

When top flanges of Bulb-T sections interfere with the installation of bridge deck drain outlet/downspout pipes, a galvanized steel pipe sleeve shall be provided and located within the limits shown below.

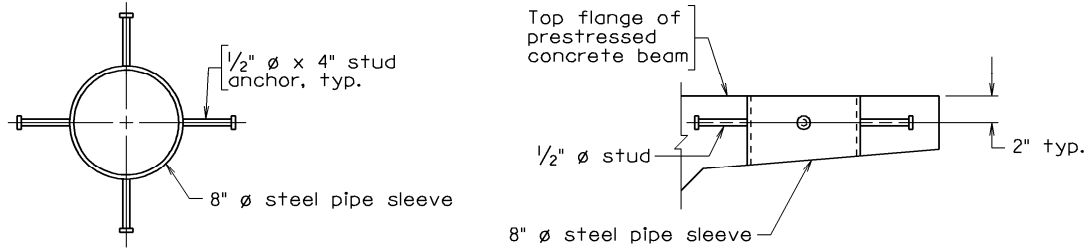


BULB-T TOP FLANGE SLEEVE DETAIL

When the location of deck drain outlet/downspout pipe will not provide the minimum distance from edge of top flange to pipe sleeve shown above, the designer shall either decrease the length of deck cantilever or locate the deck drain outlet/downspout pipe outside the top flange.



PIPE SLEEVE DETAILS



ALTERNATE PIPE SLEEVE DETAILS

Steel pipe sleeves shall be fabricated from 8" diameter seamless galvanized Schedule 40 steel pipe conforming to ASTM A53 except hydrostatic test will not be required.

Plans having concrete deck slabs with deck drains where top flange sleeves are required, details of the pipe sleeve shall be provided on the miscellaneous beam detail sheet. Cells containing the pipe sleeve details shown above are provided.

Cost for furnishing and installing steel pipe sleeves shall be included in the contract unit price for prestressed concrete members.

PRELIMINARY BULB-T DESIGN TABLES:

The Design Tables that follow are intended to assist the designer in selecting the most economical Bulb-T beam section and concrete strength for a particular beam spacing and span length. The tables are not intended to provide a **final beam design**.

These tables were developed in accordance with the AASHTO LRFD specifications using CONSPAN RATING Version 7.0.0 by LEAP Software, Inc.

Design parameters used for the development of these tables include the following:

1. Beams are designed as simple spans for a typical interior beam.
2. Strands used for the tables are seven-wire, Grade 270 low relaxation strands placed on a 2" grid (spacing) with drape points located at 0.4L and 0.6L.
3. Draping of strands is limited to 14 strands (7 rows of 2 strands).
4. Non-composite dead loads include an assumed 2" bolster, steel diaphragms treated as a uniformly distributed dead load of 10 plf and 20 psf construction tolerance.
5. Composite dead loads include F-shape parapet (VDOT Standard BPB-3) and 15 psf future wearing surface.
6. Live Load: HL-93.
7. Minimum concrete compressive strength at release equals 4000 psi. Concrete compressive strength at release when necessary is increased in 500 psi increments but in no case greater than $0.8 f'_c$.
8. The approximate estimate method is used in computing time dependent prestress losses. Elastic gains are not used in the computation of prestress losses.
9. Allowable tension at Service Limit State is limited to $0.19 \sqrt{f'_c}$.
10. Slab thicknesses and dead loads used are shown below the design tables.

The number of strands shown in the design tables indicates the number of strands required for a successful design run using the design parameters listed above. No adjustments are made to the strand pattern to achieve a more practical or economical layout.

To use the preliminary design tables, the designer must first select the appropriate table based on the beam spacing. From the appropriate table the designer can determine a preliminary beam section and concrete strength for use in the final design of the superstructure.

BEAM SPACING = 6' - 0"

Span Length L (ft.)	Number of 1/2" diameter strands																																						
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93						
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi							
40	12	12	12	12	10	10	10	10	8	8	10	10	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6		
45	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	6	6	8	8	6	6	6	6	6		
50	18	18	18	18	14	14	14	14	12	12	12	12	10	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
55	20	20	20	20	16	16	16	14	14	14	14	14	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	8		
60	26	26	26	26	18	20	20	20	16	16	16	16	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	
65		30	30	30	22	22	22	22	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	12	12	10	12	12	12	12	
70			38	38	26	26	26	26	20	20	20	20	18	18	18	18	16	16	16	16	14	16	16	16	14	14	14	14	12	14	14	14	14	12	12	12	12	12	
75				42	26	32	30	30	24	24	24	24	20	20	20	20	18	18	18	18	16	16	16	16	16	16	16	14	14	14	14	14	14	14	14	14	14	14	
80					36	36	36	28	28	26	26	22	22	22	22	20	20	20	20	18	18	18	18	16	18	18	18	16	16	16	16	16	14	14	14	14	16	16	
85						40	40	32	32	32	32	26	26	26	26	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	18	16	16	16	16	16	16	
90							46	36	36	36	36	30	28	28	28	24	24	24	24	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	20	18	18	18	18
95									40	42	40	32	32	32	32	28	28	28	26	24	24	24	24	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	
100										46	46		38	36	36	32	32	30	30	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	
105													42	42	40	36	36	34	34	30	30	30	30	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	
110													46	46	46	40	38	38	38	34	34	34	32	30	30	28	28	26	26	26	26	24	24	24	24	24	24	24	
115														52	52		44	42	42	38	38	38	36	34	32	32	32	30	28	28	28	26	26	26	26	26	26		
120															58		48	48	46	42	40	40	40	36	36	36	36	32	32	32	32	30	28	28	28	28	28	28	
125																	54	54		46	44	44	40	40	40	40	36	36	36	34	32	32	32	32	32	32	30	30	
130																				50	48	46	44	44	44	40	40	38	38	36	36	36	34	34	34	34	34	34	
135																				54	54		48	48	48	44	44	42	42	40	38	38	38	38	38	38	38	38	
140																					60			52	52	48	46	46	46	42	42	42	42	42	42	42	42	42	
145																									56		52	50	50	48	46	44	44	44	44	44	44	44	44
150																									62			54	54	52	50	48	48	48	48	48	48	48	48
155																												60	58		54	52	52	52	52	52	52	52	52
160																													64									58	58
165																																						62	62
170																																							68
175																																							

Slab thickness: 7 1/2" (including 1/2" w.s.).

Dead loads: Non-composite = 0.23 kips/ft. (excluding weight of beam and slab)
Composite = 0.24 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 7 of 15
FILE NO. 12.03-7

BEAM SPACING = 6' - 6"

Span Length L (ft.)	Number of 1/2" diameter strands																																						
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93						
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi							
40	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6	6	8	6	6	6	6	6	6	6		
45	16	16	16	16	12	12	12	12	12	12	12	12	10	10	10	10	8	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6	6
50	18	18	18	18	14	14	14	14	12	12	12	14	12	12	12	12	10	10	10	10	10	10	10	10	8	8	10	10	8	8	8	8	8	8	8	8	8	8	
55	22	22	22	22	18	18	18	18	14	14	14	16	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
60		26	26	26	20	20	20	20	16	18	18	18	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	
65			32	32	24	24	22	22	20	20	20	20	16	18	18	18	16	16	16	16	14	14	14	14	12	14	14	14	12	12	12	12	12	12	12	12	12	12	
70			38	38	28	28	28	26	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14	14	14	14	12	12	12	12
75					32	32	32	26	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	14	16	16	16	16	14	14	14	14	14	14	
80						38	36	30	28	28	28	24	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16	16	16	16	
85						42	42	34	34	34	34	28	26	26	26	24	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	18	18	18	
90							50		38	38	38	32	30	30	30	26	26	26	26	24	24	24	24	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	
95										44	42	36	36	34	34	30	28	28	28	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	22	20	20	20	20
100										48	48		40	38	40	34	32	32	32	28	28	28	28	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	
105														44	44	38	36	36	36	32	32	32	30	28	28	28	28	26	26	26	26	24	24	24	24	24	24		
110														48	50		42	42	40	36	36	36	34	32	30	30	30	28	28	28	28	26	26	26	26	26	26		
115															54		46	46	44	40	38	38	38	34	34	34	34	30	30	30	30	28	28	28	28	28	28		
120																	50	50	46	44	42	42	38	38	38	38	34	34	34	32	30	30	30	30	30	30	30		
125																		56	54		48	46	46	42	42	40	40	38	38	36	36	34	34	34	34	32	32		
130																					52	52	48	46	46	44	42	42	40	40	38	36	36	36	36	36	36		
135																							56		50	50	50	46	44	44	44	42	40	40	40	40	40	40	
140																										54	54	48	48	48	46	44	44	44	44	44	44	44	44
145																											60	60	54	52	52	50	48	48	48	46	46	46	
150																												66		56	56								
155																													64	60							56	56	
160																																				60	58		
165																																							
170																																							
175																																							

Slab thickness: 7 1/2" (including 1/2" w.s.).

Dead loads: Non-composite = 0.24 kips/ft. (excluding weight of beam and slab).
Composite = 0.25 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 8 of 15
FILE NO. 12.03-8

BEAM SPACING = 7' - 0"

Span Length L (ft.)	Number of 1/2" diameter strands																																			
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93			
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi				
40	12	14	14	14	10	12	12	12	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6	6		
45	16	16	16	16	12	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
50	18	18	18	18	16	16	16	16	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	
55	24	24	24	22	18	18	18	18	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	
60		28	28	28	20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14	12	12	12	14	12	12	12	12	12	12	12	10	10	10	10	
65			34	34	24	24	24	24	20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	
70				40	30	28	28	28	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	14	16	16	16	14	14	14	14	14	14	14	
75					34	34	34	26	26	26	26	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16	14	14	14	14	
80						40	40	30	30	30	30	24	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	16	16	16	16	
85						46	46		36	34	34	28	28	28	28	24	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	
90									40	40	32	32	32	32	28	26	26	26	24	24	24	24	22	22	22	22	20	20	20	20	20	20	20	20	20	
95									44	44	38	38	36	36	32	30	30	30	30	26	26	26	26	24	24	24	24	22	22	22	22	20	20	22	22	
100											52		42	42	42	36	34	34	34	30	28	30	28	26	26	26	26	24	24	24	24	22	22	22	22	
105													46	46	40	38	38	38	34	34	34	32	30	30	28	28	26	26	26	26	24	24	24	24		
110												52	52		44	44	42	38	38	36	36	34	32	32	32	30	28	28	28	26	26	26	26			
115																48	48	42	42	40	40	36	36	36	36	32	32	32	32	30	28	28	28			
120																52	52		46	44	46	42	40	40	36	36	36	34	32	32	32	32	32			
125																		50	50	46	44	44	44	40	40	40	38	36	36	34	34	34	34			
130																		54	54		48	48	48	44	44	44	42	40	40	38	38	38				
135																			60		52	50	50	48	46	46	44	42	42	42	42	42	42			
140																					58		52	52	52	48	46	46	46	46	46	46	46			
145																													56	56	52	50	50	50		
150																														60		56	54	54		
155																														66			58	58		
160																																66	64			
165																																		70		
170																																				
175																																				

Slab thickness: 8" (including 1/2" w.s.).

Dead loads: Non-composite = 0.25 kips/ft. (excluding weight of beam and slab).
Composite = 0.26 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 9 of 15
FILE NO. 12.03-9

BEAM SPACING = 8' - 0"

Span Length L (ft.)	Number of 1/2" diameter strands																																								
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93								
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi									
40	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6			
45	16	16	16	16	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8		
50	20	20	20	20	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8		
55	26	26	26	26	18	20	20	20	16	16	16	16	14	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	12	12	12	12	12	10	10	10	10	10	10	
60			32	30	22	22	22	22	18	18	18	20	16	16	16	16	14	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
65			38	38	28	26	26	26	22	22	22	22	18	18	18	18	16	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14	14	14	12	12	12	12	12	
70					32	32	32	24	24	24	24	22	22	22	22	18	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16	16	16	14	16	16	16	14	14	14	14
75						38	38	30	30	28	28	24	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	
80						44	44		34	34	34	28	28	26	26	24	24	24	24	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	
85										38	38	32	32	32	30	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	20
90										44	44		36	36	36	30	30	30	30	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	22	22	22	22	22	22	
95												50		42	40	40	34	34	34	34	30	28	28	28	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	22	
100														46	46	40	40	38	38	34	32	32	32	28	28	28	28	26	26	26	26	24	24	24	24	24	24	24	24		
105														52	50		44	44	42	38	38	36	36	32	32	32	32	28	28	28	28	26	26	26	26	26	26	26	26		
110														58			48	48	42	42	40	40	36	36	36	36	32	32	32	32	30	28	28	28	28	28	28	28			
115																	52	52		46	46	46	42	40	40	40	36	36	36	36	32	32	32	32	32	32	32	30			
120																		60			52	50	46	46	46	40	40	40	40	36	36	36	36	34	34	34	34				
125																					56	56		50	48	48	44	44	44	44	40	40	38	38	38	38	38	38			
130																						62		54	54		48	48	48	44	44	42	42	42	42	42	42	42			
135																								60	58		54	52	52	48	48	48	48	48	48	48	48	48	48		
140																										64		58	56		52	52	52	52	52	52	52	52	52		
145																													62	62								56	56		
150																														68							60	60			
155																																						66			
160																																									
165																																									
170																																									
175																																									

Slab thickness: 8 1/2" (including 1/2" w.s.).

Dead loads: Non-composite = 0.27 kips/ft. (excluding weight of beam and slab).
Composite = 0.27 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 11 of 15
FILE NO. 12.03-11

BEAM SPACING = 10' - 0"

Span Length L (ft.)	Number of 1/2" diameter strands																																						
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93						
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi							
40	16	16	16	16	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
45	20	20	20	20	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	
50	26	24	24	24	18	18	18	20	16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	
55			30	30	22	22	22	22	18	18	20	20	16	16	16	16	16	16	16	16	14	14	14	14	12	12	12	14	12	12	12	12	12	12	12	12	12	12	
60			38	38	28	26	26	26	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14	14	14	12	12	12	12	
65					32	32	32	26	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16	16	16	14	14	14	14		
70						38	38	30	30	30	28	24	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	18	18	18	18	16	16	16	16
75							44		34	34	34	28	28	28	28	24	24	24	24	22	22	22	22	20	20	20	20	18	20	20	20	18	18	18	18	18	18	18	
80									40	40	34	32	32	32	28	26	26	28	24	24	24	24	22	22	22	22	20	20	22	22	20	20	22	22	20	20	20	20	
85									46	46		38	36	36	32	32	30	30	26	26	26	28	24	24	24	24	22	22	24	24	22	22	24	24	22	22	22	22	
90									52			42	42	36	36	36	36	30	30	30	30	26	28	28	28	26	26	26	26	24	24	24	24	24	24	24	24		
95												48	48		40	40	40	36	34	34	34	30	30	30	30	28	28	28	28	26	26	26	26	26	26	26	26		
100													54			46	44	40	40	40	38	34	34	34	34	30	30	30	30	28	28	28	28	28	28	28	28		
105																50	50		44	44	42	38	38	38	38	34	34	34	32	30	30	30	30	30	30	30			
110																	56		48	48	44	44	42	42	38	38	38	38	34	34	34	34	34	34	34	34	32		
115																			54	52		48	46	46	42	42	42	42	38	38	38	38	38	38	38	36	36		
120																					60			52	50	46	46	46	42	42	42	42	42	42	42	40	40		
125																								56	56		52	50	48	46	46	46	46	46	46	46	46	46	
130																									64		56	56		50	50	50	50	50	50	50	50	50	
135																												62	60		56	56	54	54	54	54	54	54	
140																													68		60	60	60	60	60	60	60	60	
145																																							
150																																							
155																																							
160																																							
165																																							
170																																							
175																																							

Slab thickness: 8 1/2" (including 1/2" w.s.).

Dead loads: Non-composite = 0.31 kips/ft. (excluding weight of beam and slab).
Composite = 0.30 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

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GENERAL INFORMATION:

The AASHTO/PCI precast prestressed concrete I-beam sections used by the Structure and Bridge Division in the past have become less efficient with the adoption of the precast prestressed concrete Bulb-T sections. These sections will not be used except for widening of existing structures.

For widening of existing structures with Types V and VI beams, the use of precast concrete Bulb-T's closely matching the depth of existing beams should be considered.

PRECAST CONCRETE I-BEAMS SECTIONS:

The precast concrete I-beam sections (PCB-series) used by the Structure and Bridge Division and listed in File No. 12.04-3 along with their section properties are taken from the AASHTO/PCI Standard I-Beam sections.

For Prestressed Concrete I-Beam Preliminary Design Tables, see File Nos. 12.04-6 thru -15.

CONCRETE:

Concrete used in the design of precast prestressed concrete I-beams shall be Class A5 having a minimum 28 day compressive strength of 5000 psi. Concrete having strengths up to and including 8000 psi may be used whenever it is economical or necessary to meet the design requirements of the project. Concrete strengths exceeding 8000 psi up to 10,000 psi may be used only after obtaining a design waiver.

The minimum compressive strength of concrete required at release to be specified in the General Notes shown on the title sheet of the plans shall be the computed design value rounded up to the nearest 100 psi but in no case shall it be less than 4000 psi.

REINFORCEMENT:

All prestressed and non-prestressed reinforcement used in the design and fabrication of prestressed concrete I-beams shall conform to the requirements contained in File Nos. 12.01-1 and -2, and as specified below.

Prestressed concrete I-beams shall normally be designed using $\frac{1}{2}$ " diameter strands. Strand diameters of 0.6" and $\frac{1}{2}$ " (special) may be used when necessary to meet design requirements.

For draping of strands and hold-down forces, see File Nos. 12.01-11 and -12.

Stirrup reinforcing steel extending from the top flange of precast concrete I-beams shall be galvanized. All other reinforcing bars shall be epoxy coated or corrosion resistant except for continuity reinforcing bars which shall be black steel.

COMPOSITE SECTION PROPERTIES:

In computing the composite section properties for precast concrete I-beams, the effects of bolster shall be neglected.

For composite prestressed construction where slabs or flanges are assumed to act integrally with the precast concrete I-beam, the effective flange width shall be computed in accordance with the requirements of Article 4.6.2.6 of the AASHTO LRFD specifications.

MEMBER WEIGHT AND LENGTH LIMITATIONS:

When considering a precast prestressed concrete I-beam section to use, the designer shall investigate the feasibility of having the member hauled to the project site and erected.

The weight of any precast prestressed concrete I-beam shall be limited to 72 kips and the length limited to 75 feet in order to allow hauling by truck to the project site. Weights in excess of 72 kips but less than or equal to 100 kips and lengths in excess of 75 feet but less than or equal to 135 feet may be used with the approval of the District Structure and Bridge Engineer. The use of members with weights in excess of 100 kips and lengths in excess of 135 feet will require a design waiver.

BEAM DIAPHRAGM DETAILS:

For beam diaphragm details, see File Nos. 12.10-1 thru -15.

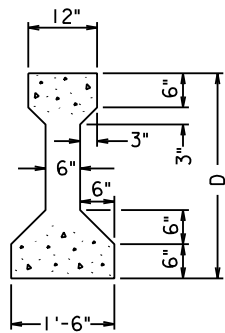
For beam continuity diaphragm details, see File Nos. 12.19-1 thru -9.

MISCELLANEOUS BEAM DETAILS:

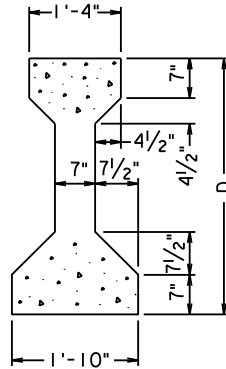
For camber and bolster computations, see File Nos. 12.02-1 thru -3.

For dead load deflection diagrams, see File No. 12.02-4.

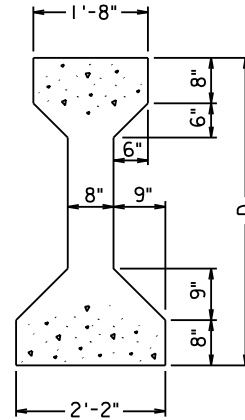
For top of slab elevations along centerline of beams, see File No. 12.02-5.



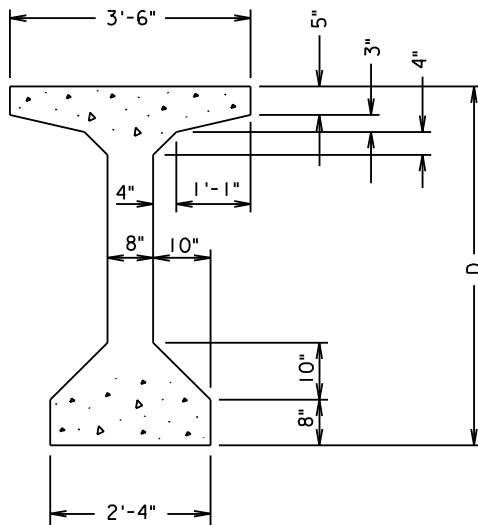
PCB-2



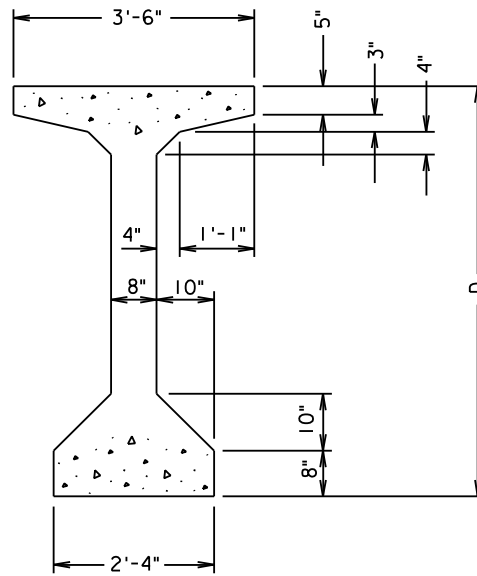
PCB-3



PCB-4



PCB-5

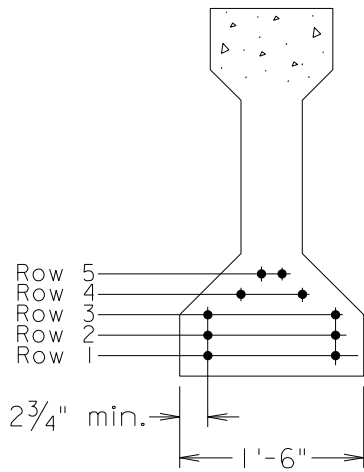


PCB-6

Beam Type	Depth D (in)	Area A (in ²)	Volume To Surface Ratio V/S (in)	Centroid to Bottom y _b (in)	Moment of Inertia I (x 10 ³ in ⁴)	Section Modulus		Weight @ 150 pcf (lbs/lin. ft.)
						S _{top} (in ³)	S _{bott} (in ³)	
PCB-2	36	369	3.37	15.83	50.98	2528	3220	384
PCB-3	45	560	4.06	20.27	125.39	6186	5070	583
PCB-4	54	789	4.74	24.73	260.73	8908	10543	822
PCB-5	63	1013	4.44	31.96	521.18	16791	16307	1055
PCB-6	72	1085	4.41	36.38	733.32	20587	20157	1130

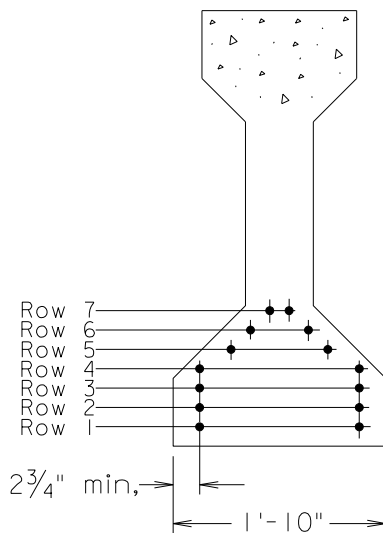
**PRESTRESSED CONCRETE
I-BEAMS - LRFD
SECTION PROPERTIES**

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PCB - 2

Maximum number of strands in row 1: 6
 2: 6
 3: 6
 4: 4
 5 and higher: 2

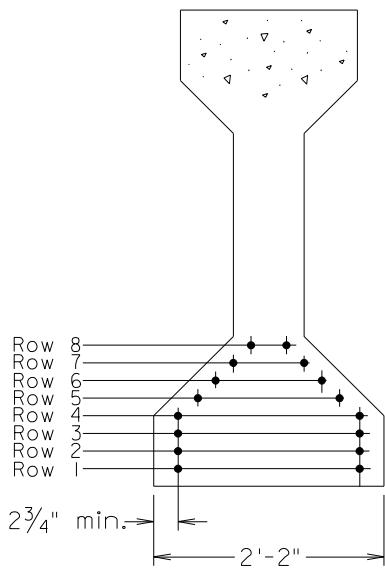


PCB - 3

Maximum number of strands in row 1: 8
 2: 8
 3: 8
 4: 8
 5: 6
 6: 4
 7 and higher: 2

**PRESTRESSED CONCRETE
 I-BEAMS - LRFD
 SECTION PROPERTIES**

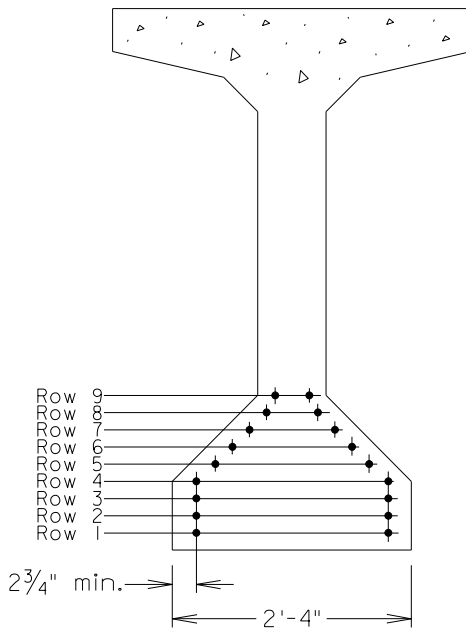
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Maximum number of strands in row 1: 11*
 2: 11*
 3: 11*
 4: 11*
 5: 9*
 6: 7*
 7: 5*
 8 and higher: 3*

PCB - 4

Maximum number of strands indicated above by asterisk (*) shall be decreased by one strand when draping two strands per row.



Maximum number of strands in row 1: 12*
 2: 12*
 3: 12*
 4: 12*
 5: 10*
 6: 8*
 7: 6*
 8: 4*
 9 and higher: 3

PCB - 5 and PCB - 6

Maximum number of strands indicated above by asterisk (*) shall be decreased by one strand when draping three strands per row.

**PRESTRESSED CONCRETE
 I-BEAMS - LRFD
 SECTION PROPERTIES**

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PRELIMINARY I-BEAM DESIGN TABLES:

The Design Tables that follow are intended to assist the designer in selecting the most economical I-beam section and concrete strength for a particular beam spacing and span length. The tables are not intended to provide a **final beam design**.

These tables were developed in accordance with the AASHTO LRFD specifications using CONSPAN RATING Version 7.0.0 by LEAP Software, Inc.

Design parameters used for the development of these tables include the following:

1. Beams are designed as simple spans for a typical interior beam.
2. Strands used for the tables are seven-wire, Grade 270 low relaxation strands placed on a 2" grid (spacing) with drape points located at 0.4L and 0.6L.
3. Draping of strands is limited to 14 strands (7 rows of 2 strands).
4. Non-composite dead loads include an assumed 2" bolster, steel diaphragms treated as a uniformly distributed dead load of 10 plf and 20 psf construction tolerance.
5. Composite dead loads include F-shape parapet (VDOT Standard BPB-3) and 15 psf future wearing surface.
6. Live Load: HL-93.
7. Minimum concrete compressive strength at release equals 4000 psi. Concrete compressive strength at release when necessary is increased in 500 psi increments but in no case greater than $0.8 f'_c$.
8. The approximate estimate method is used in computing time dependent prestress losses. Elastic gains are not used in the computation of prestress losses.
9. Allowable tension at Service Limit State is limited to $0.19 \sqrt{f'_c}$.
10. Slab thicknesses and dead loads used are shown below the design tables.

The number of strands shown in the design tables indicates the number of strands required for a successful design run using the design parameters listed above. No adjustments are made to the strand pattern to achieve a more practical or economical layout.

To use the preliminary design tables, the designer must first select the appropriate table based on the beam spacing. From the appropriate table the designer can determine a preliminary beam section and concrete strength for use in the final design of the superstructure.

BEAM SPACING = 6'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi
40	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6
45	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8
50	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10
55		16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	12	10	10	10
60			20	20	16	16	16	16	14	14	14	14	14	14	14	14	14	12	12	12
65				24	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14
70					22	22	22	22	18	18	18	18	16	16	16	16	16	16	16	16
75						26	24	24	20	20	20	20	18	18	18	18	16	16	16	16
80							30	28	24	24	24	22	20	20	20	20	18	18	18	18
85								34	34	28	28	26	26	22	22	22	22	20	20	20
90									38	32	32	32	32	24	24	24	26	22	22	22
95										36	36	36	36	28	28	28	28	24	24	24
100											42	40	40	32	32	32	32	28	26	26
105												46	46	36	36	36	36	30	30	30
110													50	50	40	40	40	34	34	34
115														56		44	44	38	38	38
120																50	50	42	42	42
125																	54	54	48	46
130																		60	58	50
135																			64	54
140																				60
145																				64
150																				70
155																				
160																				

Slab thickness: $7\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.23 kips/ft. (excluding weight of beam and slab).
Composite = 0.24 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

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BEAM SPACING = 6'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi
40	10	10	10	10	8	8	8	10	8	8	8	8	8	8	8	8	8	8	8	8
45	12	12	12	12	10	10	10	10	10	10	10	10	8	10	10	10	8	8	8	8
50	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10
55		18	18	18	14	14	14	14	12	14	14	14	12	12	12	12	10	12	12	12
60			22	22	16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12
65					20	20	18	18	16	16	16	16	16	16	16	16	14	14	14	14
70					24	24	22	22	18	18	18	18	18	18	18	18	16	16	16	16
75						26	26	26	22	22	22	22	20	20	20	20	18	18	18	18
80							32	30	26	24	24	24	22	22	22	22	20	20	20	20
85							36	36	30	28	28	28	24	24	24	24	22	22	22	22
90									34	34	32	32	26	26	26	26	24	24	24	24
95										38	38	38	30	30	30	28	26	26	26	26
100										44	44	42	34	34	34	32	28	28	28	28
105											50	48	38	38	38	36	32	32	32	30
110												56	44	42	42	42	36	36	36	34
115												60		48	48	48	40	40	40	38
120															52	52	44	44	44	44
125															56	56	50	50	50	48
130																62		54	54	54
135																			58	58
140																			62	62
145																				68
150																				
155																				
160																				

Slab thickness: $7\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.24 kips/ft. (excluding weight of beam and slab).
Composite = 0.25 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

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BEAM SPACING = 7'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi
40	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	
45	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	
50		16	16	16	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	
55			18	18	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	
60				24	16	16	16	16	16	16	16	16	14	14	14	14	12	12	12	
65					20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	
70					24	24	24	24	20	20	20	20	18	18	18	18	16	16	16	
75							28	28	22	22	22	22	20	20	20	20	18	18	18	
80							34	34	26	26	26	26	22	22	22	22	20	20	20	
85								38	30	30	30	30	24	24	24	24	22	22	22	
90									36	36	36	34	28	28	26	26	24	24	24	
95										40	40	40	32	32	30	30	26	26	26	
100											46	46	36	36	34	34	30	30	28	
105											50	50	40	40	40	40	34	34	32	
110												58	46	46	46	44	38	38	36	
115														50	50	50	42	42	42	
120															56	54	48	48	46	
125															60	60		52	50	
130																64		56	54	
135																		60	60	
140																			64	
145																				
150																				
155																				
160																				

Slab thickness: 8" (including 1/2" w.s.).

Dead loads: Non-composite = 0.25 kips/ft. (excluding weight of beam and slab).
Composite = 0.26 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

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DATE: 31Jul2009
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BEAM SPACING = 7'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																								
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6								
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi					
40	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8						
45	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8					
50		16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10					
55			20	20	16	16	16	16	14	14	14	14	12	12	12	14	12	12	12	12					
60				24	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14					
65					22	22	22	22	18	18	18	18	16	16	16	16	16	16	16	16					
70						26	26	26	20	20	20	20	18	18	18	18	16	16	18	18					
75							30	30	24	24	24	22	20	20	20	20	18	18	18	18					
80								34	34	28	28	28	26	22	22	24	24	20	20	20	20				
85									40	32	32	32	32	26	26	26	26	22	22	22	24				
90											36	36	36	28	28	28	28	24	26	26	26				
95												42	42	42	34	32	32	32	28	28	28	28			
100													48	48	38	38	36	36	32	32	30	30			
105														54	54	42	42	42	42	36	34	34	34		
110																60		46	46	46	40	40	38	38	
115																		52	52	52	44	44	44	44	
120																			56	56	50	50	50	48	
125																				62	62		54	54	54
130																							58	58	
135																							62	62	
140																								68	
145																									
150																									
155																									
160																									

Slab thickness: 8" (including 1/2" w.s.).

Dead loads: Non-composite = 0.26 kips/ft. (excluding weight of beam and slab).
Composite = 0.26 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
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FILE NO. 12.04-10

BEAM SPACING = 8'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8
45	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10
50			16	16	14	14	14	14	12	12	12	12	12	12	12	12	12	10	10	10
55			22	20	16	16	16	16	14	14	14	14	14	14	14	14	14	12	12	12
60					18	18	18	18	16	16	16	16	16	16	16	16	16	14	14	14
65						22	22	22	18	18	18	18	18	18	18	18	18	16	16	16
70							26	26	22	20	20	22	20	20	20	20	20	18	18	18
75							32	32	26	24	24	24	22	22	22	22	22	20	20	20
80								36	30	30	28	28	24	24	24	24	24	22	22	22
85									34	34	34	34	26	26	26	26	26	24	24	24
90										40	38	38	30	30	30	30	30	26	26	26
95											44	44	34	34	34	34	34	30	28	28
100											50	50	40	40	38	38	34	32	32	32
105												56	46	46	44	44	38	36	36	36
110														50	50	50	42	42	42	40
115															54	54	48	46	46	46
120															60	60		52	52	52
125																66			56	56
130																			60	60
135																				66
140																				
145																				
150																				
155																				
160																				

Slab thickness: 8¹/₂" (including 1¹/₂" w.s.).

Dead loads: Non-composite = 0.27 kips/ft. (excluding weight of beam and slab).
Composite = 0.27 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

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DATE: 31Jul2009
SHEET 11 of 15
FILE NO. 12.04-11

BEAM SPACING = 8'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8
45	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10
50			18	18	14	14	14	14	12	12	14	14	12	12	12	12	10	10	10	12
55			22	22	16	16	16	16	14	14	16	16	14	14	14	14	12	12	12	12
60					20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14
65						24	24	24	20	20	20	20	18	18	18	18	16	16	16	16
70							28	28	22	22	22	22	20	20	20	20	18	18	18	18
75							34	32	26	26	26	26	22	22	22	22	20	20	20	20
80								40	32	30	30	30	24	24	24	24	22	22	22	22
85										36	34	34	28	28	28	28	24	24	24	24
90										40	40	40	32	32	32	30	26	26	26	26
95											46	46	36	36	36	36	30	30	30	30
100											52	52	42	42	40	40	34	34	34	34
105														46	46	46	40	38	38	38
110														52	52	52	44	44	42	42
115															56	56	50	50	48	48
120																62		54	54	54
125																			58	58
130																			64	64
135																				
140																				
145																				
150																				
155																				
160																				

Slab thickness: $8\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.28 kips/ft. (excluding weight of beam and slab).
Composite = 0.28 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 12 of 15
FILE NO. 12.04-12

BEAM SPACING = 9'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	8	8	10	10	8	8	8	8
45	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10
50		18	18	16	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12
55				22	16	16	16	18	16	16	16	16	14	14	14	14	12	12	12	14
60					22	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14
65						24	24	22	20	20	20	20	18	18	18	18	16	16	16	16
70						28	28	28	22	22	22	22	20	20	20	20	18	18	18	18
75							34	32	28	26	26	24	22	22	22	22	20	20	20	20
80								38	32	30	30	28	26	26	26	26	22	22	22	22
85										36	34	34	28	28	28	28	24	26	26	26
90										42	40	38	34	32	30	30	28	28	28	28
95											46	44	38	36	36	34	32	30	30	30
100												50	44	42	40	38	36	34	34	32
105													58		46	46	44	40	38	36
110															54	50	50	46	44	40
115																58	56		48	46
120																	62		54	52
125																			58	58
130																			66	64
135																				
140																				
145																				
150																				
155																				
160																				

Slab thickness: 8¹/₂" (including 1¹/₂" w.s.).

Dead loads: Non-composite = 0.29 kips/ft. (excluding weight of beam and slab).
Composite = 0.28 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 13 of 15
FILE NO. 12.04-13

BEAM SPACING = 9'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8
45		14	14	14	12	12	12	14	12	12	12	12	10	10	10	10	10	10	10	10
50			18	18	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12
55				24	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14
60					22	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16
65						26	24	24	20	20	20	20	18	18	18	18	18	18	18	18
70							30	28	24	24	24	24	22	22	22	22	20	20	20	20
75								34	28	28	26	26	24	24	24	24	22	22	22	22
80								40	34	32	30	30	26	26	26	26	24	24	24	24
85										38	36	34	30	28	28	28	26	26	26	26
90											42	40	34	34	32	32	28	28	28	28
95												48	46	40	38	36	32	32	32	32
100													54		44	42	40	38	36	34
105															48	46	46	42	40	38
110																54	52	48	46	44
115																60	58		52	50
120																	66		58	54
125																			62	60
130																				66
135																				
140																				
145																				
150																				
155																				
160																				

Slab thickness: $8\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.30 kips/ft. (excluding weight of beam and slab).
Composite = 0.29 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 14 of 15
FILE NO. 12.04-14

BEAM SPACING = 10'- 0"

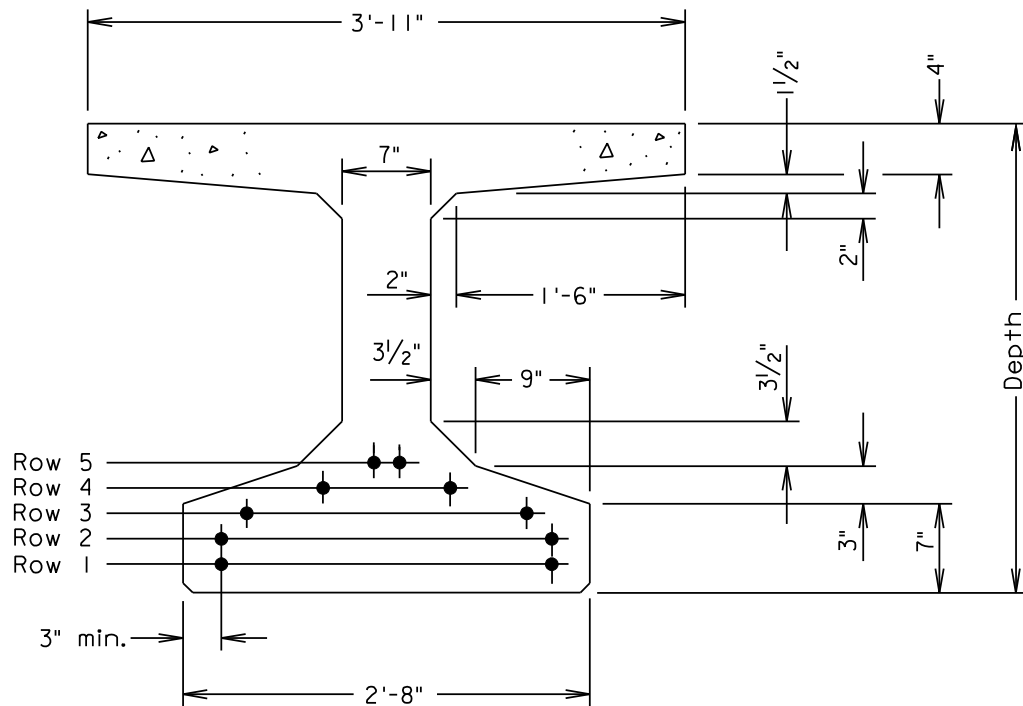
Span Length L (ft)	Number of 1/2" diameter strands																				
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6				
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	
40	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	
45					14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	
50					16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12	
55					18	18	18	18	16	16	16	16	16	16	16	16	14	14	14	14	
60					22	22	20	20	18	18	18	18	18	18	18	18	16	16	16	16	
65						26	26	24	22	22	22	22	20	20	20	20	18	18	18	18	
70							30	30	24	24	24	24	22	22	22	22	20	20	20	20	
75								36	30	28	28	26	24	24	24	24	22	22	22	22	
80										34	32	32	26	26	26	28	24	24	24	24	
85										40	38	36	32	30	30	30	26	26	26	26	
90											44	42	36	34	34	32	30	30	30	30	
95												50	48	42	40	38	36	34	32	32	
100													56		44	44	42	38	38	36	36
105															50	50	48	44	42	40	40
110																56	54		48	46	44
115																	60		54	52	50
120																		68		58	56
125																				64	62
130																					68
135																					
140																					
145																					
150																					
155																					
160																					

Slab thickness: 8¹/₂" (including 1¹/₂" w.s.).

Dead loads: Non-composite = 0.31 kips/ft. (excluding weight of beam and slab).
Composite = 0.30 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 15 of 15
FILE NO. 12.04-15



Maximum number of strands in row number 1: 14
 2: 14
 3: 12
 4: 6
 5 and higher: 2

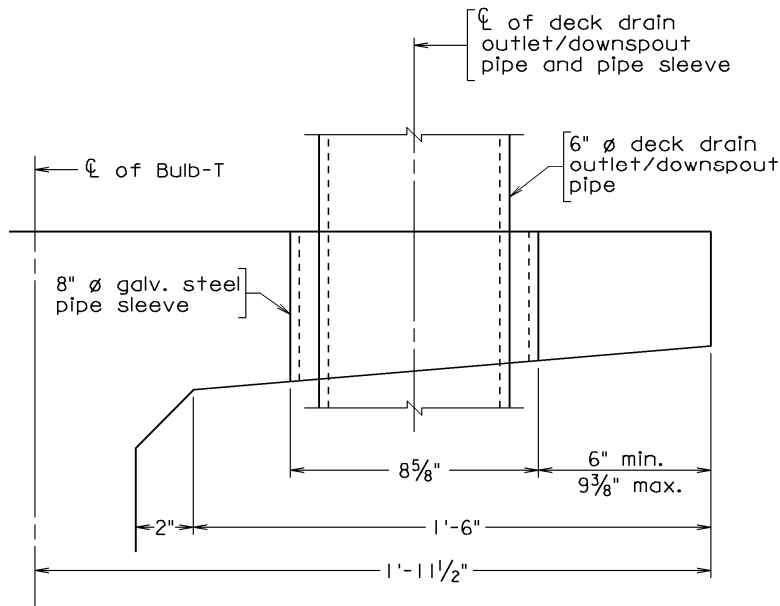
Beam Designation	Depth D (in)	Area A (in ²)	Volume to Surface Ratio V/S (in)	Centroid to Bottom y _b (in)	Moment of Inertia I (x 10 ³ in ⁴)	Section Modulus		Weight @ 150 pcf (lbs/lin. ft.)
						S _{top} (in ³)	S _{bottom} (in ³)	
PCBT-29	29	634.7	3.40	14.66	66.8	4658	4557	661
PCBT-37	37	690.7	3.41	18.43	126.0	6785	6837	720
PCBT-45	45	746.7	3.41	22.23	207.3	9104	9325	778
PCBT-53	53	802.7	3.42	26.06	312.4	11596	11988	836
PCBT-61	61	858.7	3.42	29.92	443.1	14257	14810	894
PCBT-69	69	914.7	3.43	33.79	601.3	17078	17795	953
PCBT-77	77	970.7	3.43	37.67	788.7	20053	20937	1011
PCBT-85	85	1026.7	3.44	41.57	1007.2	23191	24229	1070
PCBT-93	93	1082.7	3.44	45.48	1258.5	26484	27672	1128

**PRESTRESSED CONCRETE
 BULB-T'S - LRFD
 SECTION PROPERTIES**

VOL. V - PART 2
 DATE: 31Jul2009
 SHEET 3 of 15
 FILE NO. 12.03-3

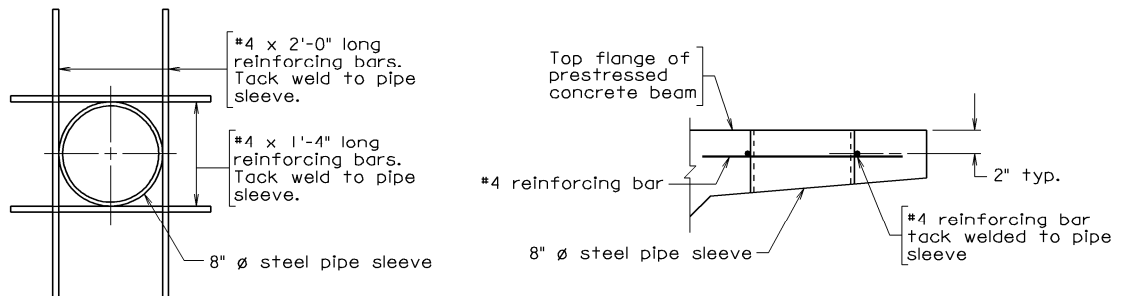
TOP FLANGE SLEEVE DETAILS FOR DECK DRAINS:

When top flanges of Bulb-T sections interfere with the installation of bridge deck drain outlet/downspout pipes, a galvanized steel pipe sleeve shall be provided and located within the limits shown below.

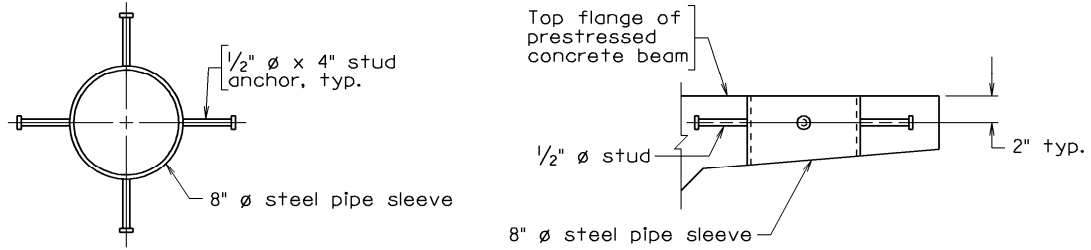


BULB-T TOP FLANGE SLEEVE DETAIL

When the location of deck drain outlet/downspout pipe will not provide the minimum distance from edge of top flange to pipe sleeve shown above, the designer shall either decrease the length of deck cantilever or locate the deck drain outlet/downspout pipe outside the top flange.



PIPE SLEEVE DETAILS



ALTERNATE PIPE SLEEVE DETAILS

Steel pipe sleeves shall be fabricated from 8" diameter seamless galvanized Schedule 40 steel pipe conforming to ASTM A53 except hydrostatic test will not be required.

Plans having concrete deck slabs with deck drains where top flange sleeves are required, details of the pipe sleeve shall be provided on the miscellaneous beam detail sheet. Cells containing the pipe sleeve details shown above are provided.

Cost for furnishing and installing steel pipe sleeves shall be included in the contract unit price for prestressed concrete members.

PRELIMINARY BULB-T DESIGN TABLES:

The Design Tables that follow are intended to assist the designer in selecting the most economical Bulb-T beam section and concrete strength for a particular beam spacing and span length. The tables are not intended to provide a **final beam design**.

These tables were developed in accordance with the AASHTO LRFD specifications using CONSPAN RATING Version 7.0.0 by LEAP Software, Inc.

Design parameters used for the development of these tables include the following:

1. Beams are designed as simple spans for a typical interior beam.
2. Strands used for the tables are seven-wire, Grade 270 low relaxation strands placed on a 2" grid (spacing) with drape points located at 0.4L and 0.6L.
3. Draping of strands is limited to 14 strands (7 rows of 2 strands).
4. Non-composite dead loads include an assumed 2" bolster, steel diaphragms treated as a uniformly distributed dead load of 10 plf and 20 psf construction tolerance.
5. Composite dead loads include F-shape parapet (VDOT Standard BPB-3) and 15 psf future wearing surface.
6. Live Load: HL-93.
7. Minimum concrete compressive strength at release equals 4000 psi. Concrete compressive strength at release when necessary is increased in 500 psi increments but in no case greater than $0.8 f'_c$.
8. The approximate estimate method is used in computing time dependent prestress losses. Elastic gains are not used in the computation of prestress losses.
9. Allowable tension at Service Limit State is limited to $0.19 \sqrt{f'_c}$.
10. Slab thicknesses and dead loads used are shown below the design tables.

The number of strands shown in the design tables indicates the number of strands required for a successful design run using the design parameters listed above. No adjustments are made to the strand pattern to achieve a more practical or economical layout.

To use the preliminary design tables, the designer must first select the appropriate table based on the beam spacing. From the appropriate table the designer can determine a preliminary beam section and concrete strength for use in the final design of the superstructure.

BEAM SPACING = 6' - 0"

Span Length L (ft.)	Number of 1/2" diameter strands																																					
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93					
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi						
40	12	12	12	12	10	10	10	10	8	8	10	10	8	8	8	8	8	8	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6		
45	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6	8	8	6	6	6	6	
50	18	18	18	18	14	14	14	14	12	12	12	12	10	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	
55	20	20	20	20	16	16	16	14	14	14	14	14	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8		
60	26	26	26	26	18	20	20	20	16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	
65		30	30	30	22	22	22	22	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	12	10	12	12	12		
70			38	38	26	26	26	26	20	20	20	20	18	18	18	18	16	16	16	16	14	16	16	16	14	14	14	14	12	14	14	14	14	12	12	12	12	
75				42	26	32	30	30	24	24	24	24	20	20	20	20	18	18	18	18	16	16	16	16	16	16	16	14	14	14	14	14	14	14	14	14	14	
80					36	36	36	28	28	26	26	22	22	22	22	20	20	20	20	18	18	18	18	16	18	18	18	16	16	16	16	16	14	14	14	14	16	
85						40	40	32	32	32	32	26	26	26	26	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	16	16	16	16	16	16	
90							46	36	36	36	36	30	28	28	28	24	24	24	24	22	22	22	22	20	20	20	20	20	20	20	20	20	20	20	18	18	18	18
95									40	42	40	32	32	32	32	28	28	28	26	24	24	24	24	22	22	22	22	20	20	20	20	20	20	20	20	20	20	
100										46	46		38	36	36	32	32	30	30	26	26	26	26	24	24	24	24	22	22	22	22	22	22	22	22	22	22	
105													42	42	40	36	36	34	34	30	30	30	30	26	26	26	26	24	24	24	24	22	22	22	22	22	22	
110													46	46	46	40	38	38	38	34	34	34	32	30	30	28	28	26	26	26	26	24	24	24	24	24	24	
115														52	52		44	42	42	38	38	38	36	34	32	32	32	30	28	28	28	26	26	26	26	26		
120															58		48	48	46	42	40	40	40	36	36	36	36	32	32	32	32	30	28	28	28	28		
125																	54	54		46	44	44	40	40	40	40	36	36	36	34	32	32	32	32	30	30	30	
130																				50	48	46	44	44	44	40	40	38	38	36	36	34	34	34	34	34	34	
135																				54	54		48	48	48	44	44	42	42	40	38	38	38	38	38	38	38	
140																					60			52	52	48	46	46	46	42	42	42	42	42	42	42	42	
145																									56		52	50	50	48	46	44	44	44	44	44	44	44
150																									62			54	54	52	50	48	48	48	48	48	48	
155																												60	58		54	52	52	52	52	52	52	52
160																													64								58	58
165																																					62	62
170																																						68
175																																						

Slab thickness: 7¹/₂" (including 1¹/₂" w.s.).

Dead loads: Non-composite = 0.23 kips/ft. (excluding weight of beam and slab)
Composite = 0.24 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 7 of 15
FILE NO. 12.03-7

BEAM SPACING = 9' - 0"

Span Length L (ft.)	Number of 1/2" diameter strands																																					
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93					
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi						
40	14	14	14	14	12	12	12	12	10	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6	6		
45	18	18	18	18	14	14	14	16	12	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	
50	22	22	22	22	18	18	18	18	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	
55		28	28	28	20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14	12	14	14	14	12	12	12	12	12	12	12	12	12	12	10	10	10	10
60			36	34	24	24	24	24	20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	
65				42	30	30	30	22	24	24	24	20	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16	16	16	14	14	14	14	14	14	14	14	
70						34	34	28	28	26	26	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	18	16	16	16	16	16	16	16	16	16	
75						40	40	32	32	32	32	26	26	26	26	22	22	22	22	20	20	20	20	20	20	20	20	20	18	18	18	18	16	16	16	16		
80							48			36	36	30	30	30	30	26	26	26	26	22	22	24	24	22	22	22	22	20	20	20	20	18	18	18	18	18		
85										42	42		34	34	34	28	28	28	28	26	26	26	26	24	24	24	24	22	22	22	22	20	20	20	20	20		
90										48	48		40	40	40	34	32	32	32	28	28	28	28	26	26	26	26	24	24	24	24	22	22	22	22	22		
95														44	44	38	38	38	38	32	32	32	30	28	28	28	28	26	26	26	26	24	24	24	24	24		
100														50	50		42	42	42	36	36	36	36	32	32	30	30	28	28	28	28	26	26	26	26	26		
105															56			46	46	42	42	40	40	36	36	34	34	32	30	30	30	28	28	28	28	28		
110																		52	52		46	44	44	40	40	40	38	36	34	34	34	34	32	32	30	30		
115																			58			50	48	44	44	44	40	38	38	38	36	34	34	34	34			
120																						56	54	48	48	48	44	44	42	42	40	38	38	38	38			
125																							60		52	52	48	48	48	44	42	42	42	42	42	42		
130																									58	58	52	52	52	48	48	46	46	46	46	46	46	
135																										64		56	56		52	50	50	50	50	50	50	
140																												62	62		56	56	56	56	56	56	56	
145																													68		62	60	60	60	60	60	60	
150																																					66	
155																																						
160																																						
165																																						
170																																						
175																																						

Slab thickness: 8 1/2" (including 1/2" w.s.).

Dead loads: Non-composite = 0.29 kips/ft. (excluding weight of beam and slab).
Composite = 0.28 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

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DATE: 31Jul2009
SHEET 13 of 15
FILE NO. 12.03-13

BEAM SPACING = 10' - 0"

Span Length L (ft.)	Number of 1/2" diameter strands																																						
	PCBT-29				PCBT-37				PCBT-45				PCBT-53				PCBT-61				PCBT-69				PCBT-77				PCBT-85				PCBT-93						
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi							
40	16	16	16	16	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
45	20	20	20	20	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8	
50	26	24	24	24	18	18	18	20	16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	10	
55			30	30	22	22	22	22	18	18	20	20	16	16	16	16	16	16	16	16	14	14	14	14	12	12	12	14	12	12	12	12	12	12	12	12	12	12	
60			38	38	28	26	26	26	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14	14	14	12	12	12	12	
65						32	32	32	26	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16	16	16	14	14	14	14	
70							38	38	30	30	30	28	24	24	24	24	22	22	22	22	20	20	20	20	18	18	18	18	18	18	18	18	18	18	18	16	16	16	16
75								44		34	34	34	28	28	28	28	24	24	24	24	22	22	22	22	20	20	20	20	18	20	20	20	18	18	18	18	18	18	
80										40	40	34	32	32	32	28	26	26	28	24	24	24	24	22	22	22	22	20	20	22	22	20	20	22	22	20	20	20	20
85										46	46		38	36	36	32	32	30	30	26	26	26	28	24	24	24	24	22	22	24	24	22	22	22	22	22	22	22	22
90											52			42	42	36	36	36	36	30	30	30	30	26	28	28	28	26	26	26	26	24	24	24	24	24	24	24	
95														48	48		40	40	40	36	34	34	34	30	30	30	30	28	28	28	28	26	26	26	26	26	26		
100															54			46	44	40	40	40	38	34	34	34	34	30	30	30	30	28	28	28	28	28	28		
105																		50	50		44	44	42	38	38	38	38	34	34	34	32	30	30	30	30	30	30		
110																			56			48	48	44	44	42	42	38	38	38	38	34	34	34	34	34	34	32	
115																							54	52		48	46	46	42	42	42	42	38	38	38	36	36	36	
120																								60			52	50	46	46	46	42	42	42	40	40	40	40	
125																										56	56		52	50	50	48	46	46	46	46	46	46	
130																											64		56	56		50	50	50	50	50	50	50	
135																													62	60		56	56	54	54	54	54	54	
140																														68		60	60	60	60	60	60	60	
145																																66	66	66	66	66	66		
150																																							
155																																							
160																																							
165																																							
170																																							
175																																							

Slab thickness: 8¹/₂" (including .¹/₂" w.s.).

Dead loads: Non-composite = 0.31 kips/ft. (excluding weight of beam and slab).
Composite = 0.30 kips/ft.

**PRESTRESSED CONCRETE
BULB-T'S - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 15 of 15
FILE NO. 12.03-15

GENERAL INFORMATION:

The AASHTO/PCI precast prestressed concrete I-beam sections used by the Structure and Bridge Division in the past have become less efficient with the adoption of the precast prestressed concrete Bulb-T sections. These sections will not be used except for widening of existing structures.

For widening of existing structures with Types V and VI beams, the use of precast concrete Bulb-T's closely matching the depth of existing beams should be considered.

PRECAST CONCRETE I-BEAMS SECTIONS:

The precast concrete I-beam sections (PCB-series) used by the Structure and Bridge Division and listed in File No. 12.04-3 along with their section properties are taken from the AASHTO/PCI Standard I-Beam sections.

For Prestressed Concrete I-Beam Preliminary Design Tables, see File Nos. 12.04-6 thru -15.

CONCRETE:

Concrete used in the design of precast prestressed concrete I-beams shall be Class A5 having a minimum 28 day compressive strength of 5000 psi. Concrete having strengths up to and including 8000 psi may be used whenever it is economical or necessary to meet the design requirements of the project. Concrete strengths exceeding 8000 psi up to 10,000 psi may be used only after obtaining a design waiver.

The minimum compressive strength of concrete required at release to be specified in the General Notes shown on the title sheet of the plans shall be the computed design value rounded up to the nearest 100 psi but in no case shall it be less than 4000 psi.

REINFORCEMENT:

All prestressed and non-prestressed reinforcement used in the design and fabrication of prestressed concrete I-beams shall conform to the requirements contained in File Nos. 12.01-1 and -2, and as specified below.

Prestressed concrete I-beams shall normally be designed using $\frac{1}{2}$ " diameter strands. Strand diameters of 0.6" and $\frac{1}{2}$ " (special) may be used when necessary to meet design requirements.

For draping of strands and hold-down forces, see File Nos. 12.01-11 and -12.

Stirrup reinforcing steel extending from the top flange of precast concrete I-beams shall be galvanized. All other reinforcing bars shall be epoxy coated or corrosion resistant except for continuity reinforcing bars which shall be black steel.

COMPOSITE SECTION PROPERTIES:

In computing the composite section properties for precast concrete I-beams, the effects of bolster shall be neglected.

For composite prestressed construction where slabs or flanges are assumed to act integrally with the precast concrete I-beam, the effective flange width shall be computed in accordance with the requirements of Article 4.6.2.6 of the AASHTO LRFD specifications.

MEMBER WEIGHT AND LENGTH LIMITATIONS:

When considering a precast prestressed concrete I-beam section to use, the designer shall investigate the feasibility of having the member hauled to the project site and erected.

The weight of any precast prestressed concrete I-beam shall be limited to 72 kips and the length limited to 75 feet in order to allow hauling by truck to the project site. Weights in excess of 72 kips but less than or equal to 100 kips and lengths in excess of 75 feet but less than or equal to 135 feet may be used with the approval of the District Structure and Bridge Engineer. The use of members with weights in excess of 100 kips and lengths in excess of 135 feet will require a design waiver.

BEAM DIAPHRAGM DETAILS:

For beam diaphragm details, see File Nos. 12.10-1 thru -15.

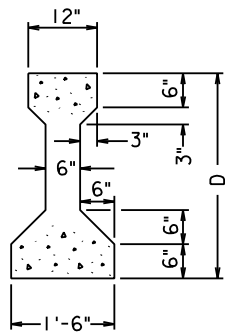
For beam continuity diaphragm details, see File Nos. 12.19-1 thru -9.

MISCELLANEOUS BEAM DETAILS:

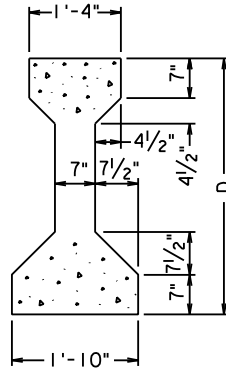
For camber and bolster computations, see File Nos. 12.02-1 thru -3.

For dead load deflection diagrams, see File No. 12.02-4.

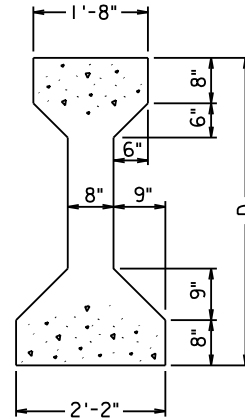
For top of slab elevations along centerline of beams, see File No. 12.02-5.



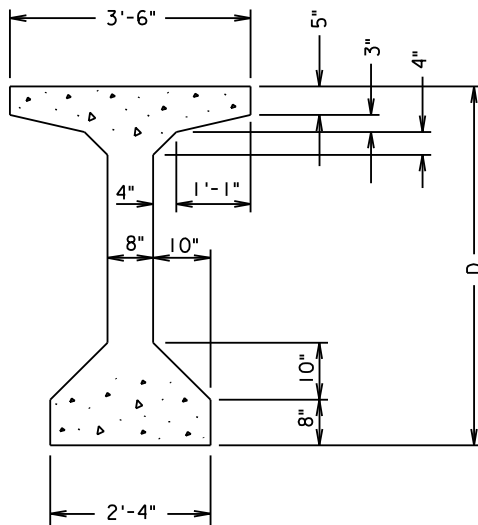
PCB-2



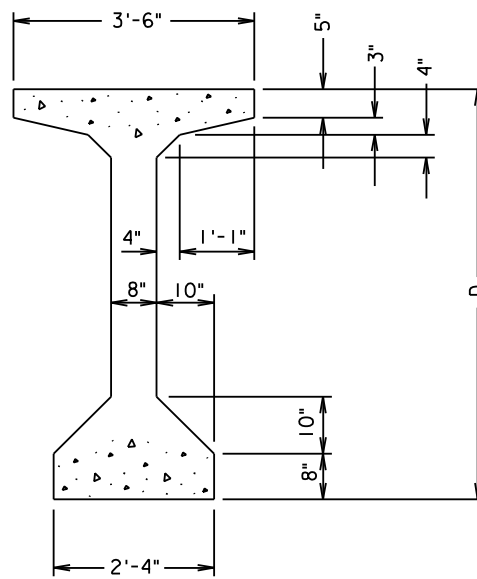
PCB-3



PCB-4



PCB-5

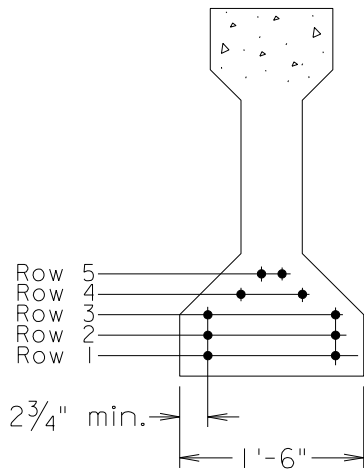


PCB-6

Beam Type	Depth D (in)	Area A (in ²)	Volume To Surface Ratio V/S (in)	Centroid to Bottom y _b (in)	Moment of Inertia I (x 10 ³ in ⁴)	Section Modulus		Weight @ 150 pcf (lbs/lin. ft.)
						S _{top} (in ³)	S _{bott} (in ³)	
PCB-2	36	369	3.37	15.83	50.98	2528	3220	384
PCB-3	45	560	4.06	20.27	125.39	6186	5070	583
PCB-4	54	789	4.74	24.73	260.73	8908	10543	822
PCB-5	63	1013	4.44	31.96	521.18	16791	16307	1055
PCB-6	72	1085	4.41	36.38	733.32	20587	20157	1130

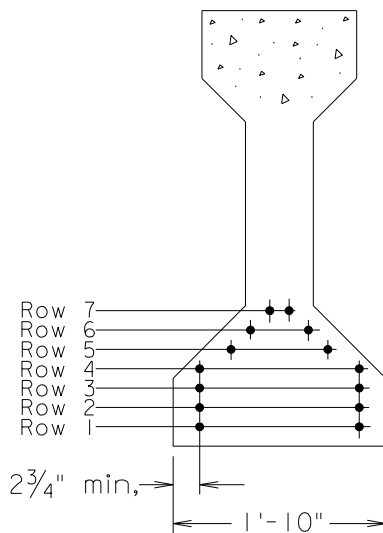
**PRESTRESSED CONCRETE
I-BEAMS - LRFD
SECTION PROPERTIES**

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FILE NO. 12.04-3



PCB - 2

Maximum number of strands in row 1: 6
 2: 6
 3: 6
 4: 4
 5 and higher: 2

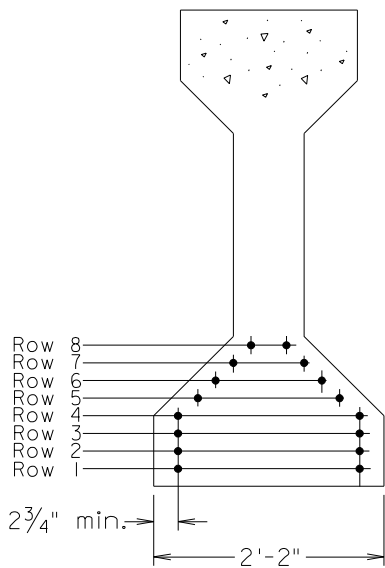


PCB - 3

Maximum number of strands in row 1: 8
 2: 8
 3: 8
 4: 8
 5: 6
 6: 4
 7 and higher: 2

**PRESTRESSED CONCRETE
 I-BEAMS - LRFD
 SECTION PROPERTIES**

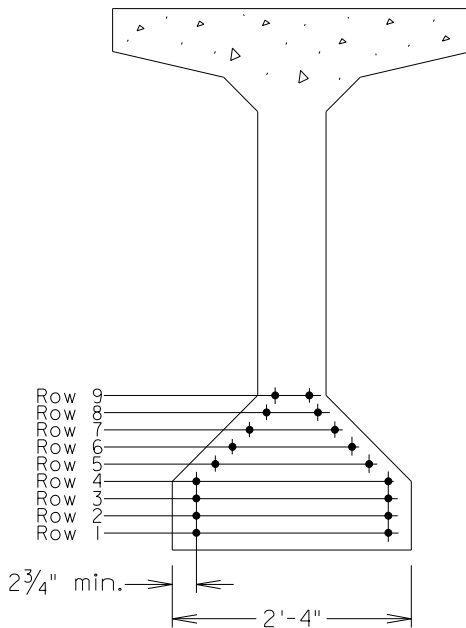
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Maximum number of strands in row 1: 11*
 2: 11*
 3: 11*
 4: 11*
 5: 9*
 6: 7*
 7: 5*
 8 and higher: 3*

PCB - 4

Maximum number of strands indicated above by asterisk (*) shall be decreased by one strand when draping two strands per row.



Maximum number of strands in row 1: 12*
 2: 12*
 3: 12*
 4: 12*
 5: 10*
 6: 8*
 7: 6*
 8: 4*
 9 and higher: 3

PCB - 5 and PCB - 6

Maximum number of strands indicated above by asterisk (*) shall be decreased by one strand when draping three strands per row.

**PRESTRESSED CONCRETE
 I-BEAMS - LRFD
 SECTION PROPERTIES**

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 DATE: 31Jul2009
 SHEET 5 of 15
 FILE NO. 12.04-5

PRELIMINARY I-BEAM DESIGN TABLES:

The Design Tables that follow are intended to assist the designer in selecting the most economical I-beam section and concrete strength for a particular beam spacing and span length. The tables are not intended to provide a **final beam design**.

These tables were developed in accordance with the AASHTO LRFD specifications using CONSPAN RATING Version 7.0.0 by LEAP Software, Inc.

Design parameters used for the development of these tables include the following:

1. Beams are designed as simple spans for a typical interior beam.
2. Strands used for the tables are seven-wire, Grade 270 low relaxation strands placed on a 2" grid (spacing) with drape points located at 0.4L and 0.6L.
3. Draping of strands is limited to 14 strands (7 rows of 2 strands).
4. Non-composite dead loads include an assumed 2" bolster, steel diaphragms treated as a uniformly distributed dead load of 10 plf and 20 psf construction tolerance.
5. Composite dead loads include F-shape parapet (VDOT Standard BPB-3) and 15 psf future wearing surface.
6. Live Load: HL-93.
7. Minimum concrete compressive strength at release equals 4000 psi. Concrete compressive strength at release when necessary is increased in 500 psi increments but in no case greater than $0.8 f'_c$.
8. The approximate estimate method is used in computing time dependent prestress losses. Elastic gains are not used in the computation of prestress losses.
9. Allowable tension at Service Limit State is limited to $0.19 \sqrt{f'_c}$.
10. Slab thicknesses and dead loads used are shown below the design tables.

The number of strands shown in the design tables indicates the number of strands required for a successful design run using the design parameters listed above. No adjustments are made to the strand pattern to achieve a more practical or economical layout.

To use the preliminary design tables, the designer must first select the appropriate table based on the beam spacing. From the appropriate table the designer can determine a preliminary beam section and concrete strength for use in the final design of the superstructure.

PRESTRESSED CONCRETE I-BEAMS - LRFD PRELIMINARY DESIGN TABLES

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FILE NO. 12.04-6

BEAM SPACING = 6'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi
40	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6	6
45	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8
50	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10
55		16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	12	10	10	10
60			20	20	16	16	16	16	14	14	14	14	14	14	14	14	14	12	12	12
65				24	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14
70					22	22	22	22	18	18	18	18	16	16	16	16	16	16	16	16
75						26	24	24	20	20	20	20	18	18	18	18	16	16	16	16
80							30	28	24	24	24	22	20	20	20	20	18	18	18	18
85								34	34	28	28	26	26	22	22	22	22	20	20	20
90									38	32	32	32	32	24	24	24	26	22	22	22
95										36	36	36	36	28	28	28	28	24	24	24
100											42	40	40	32	32	32	32	28	26	26
105												46	46	36	36	36	36	30	30	30
110													50	50	40	40	40	34	34	34
115														56		44	44	38	38	38
120																50	50	42	42	42
125																	54	54	48	46
130																		60	58	50
135																			64	54
140																				60
145																				64
150																				70
155																				
160																				

Slab thickness: $7\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.23 kips/ft. (excluding weight of beam and slab).
Composite = 0.24 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

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DATE: 31Jul2009
SHEET 7 of 15
FILE NO. 12.04-7

BEAM SPACING = 6'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi
40	10	10	10	10	8	8	8	10	8	8	8	8	8	8	8	8	8	8	8	
45	12	12	12	12	10	10	10	10	10	10	10	10	8	10	10	10	8	8	8	8
50	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10
55		18	18	18	14	14	14	14	12	14	14	14	12	12	12	12	10	12	12	12
60			22	22	16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12
65					20	20	18	18	16	16	16	16	16	16	16	16	14	14	14	14
70					24	24	22	22	18	18	18	18	18	18	18	18	16	16	16	16
75						26	26	26	22	22	22	22	20	20	20	20	18	18	18	18
80							32	30	26	24	24	24	22	22	22	22	20	20	20	20
85							36	36	30	28	28	28	24	24	24	24	22	22	22	22
90									34	34	32	32	26	26	26	26	24	24	24	24
95										38	38	38	30	30	30	28	26	26	26	26
100										44	44	42	34	34	34	32	28	28	28	28
105											50	48	38	38	38	36	32	32	32	30
110												56	44	42	42	42	36	36	36	34
115												60		48	48	48	40	40	40	38
120															52	52	44	44	44	44
125															56	56	50	50	50	48
130																62		54	54	54
135																			58	58
140																			62	62
145																				68
150																				
155																				
160																				

Slab thickness: $7\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.24 kips/ft. (excluding weight of beam and slab).
Composite = 0.25 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

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DATE: 31Jul2009
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FILE NO. 12.04-8

BEAM SPACING = 7'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi	$f'_c = 5000$ psi	6000 psi	7000 psi	8000 psi
40	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	
45	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
50		16	16	16	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	
55			18	18	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	
60				24	16	16	16	16	16	16	16	16	14	14	14	14	12	12	12	
65					20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	
70					24	24	24	24	20	20	20	20	18	18	18	18	16	16	16	
75							28	28	22	22	22	22	20	20	20	20	18	18	18	
80							34	34	26	26	26	26	22	22	22	22	20	20	20	
85								38	30	30	30	30	24	24	24	24	22	22	22	
90									36	36	36	34	28	28	26	26	24	24	24	
95										40	40	40	32	32	30	30	26	26	26	
100											46	46	36	36	34	34	30	30	28	
105											50	50	40	40	40	40	34	34	32	
110												58	46	46	46	44	38	38	36	
115														50	50	50	42	42	42	
120															56	54	48	48	46	
125															60	60		52	50	
130																64			54	
135																		60	60	
140																			64	
145																				
150																				
155																				
160																				

Slab thickness: 8" (including 1/2" w.s.).

Dead loads: Non-composite = 0.25 kips/ft. (excluding weight of beam and slab).
Composite = 0.26 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 9 of 15
FILE NO. 12.04-9

BEAM SPACING = 7'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																									
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6									
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi						
40	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8	8	8	8	8						
45	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10	8	8	8	8					
50		16	16	16	14	14	14	14	12	12	12	12	12	12	12	12	12	10	10	10	10					
55			20	20	16	16	16	16	14	14	14	14	12	12	12	14	12	12	12	12	12					
60				24	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14	14					
65					22	22	22	22	18	18	18	18	16	16	16	16	16	16	16	16	16					
70						26	26	26	20	20	20	20	18	18	18	18	16	16	18	18	18					
75							30	30	24	24	24	22	20	20	20	20	18	18	18	18	18					
80								34	34	28	28	28	26	22	22	24	24	20	20	20	20					
85									40	32	32	32	32	26	26	26	26	22	22	22	24					
90											36	36	36	28	28	28	28	24	26	26	26					
95												42	42	42	34	32	32	32	28	28	28	28				
100													48	48	38	38	36	36	32	32	30	30				
105														54	54	42	42	42	42	36	34	34	34			
110																60		46	46	46	40	40	38	38		
115																		52	52	52	44	44	44	44		
120																			56	56	50	50	50	48		
125																				62	62		54	54	54	
130																							58	58		
135																								62	62	
140																									68	
145																										
150																										
155																										
160																										

Slab thickness: 8" (including 1/2" w.s.).

Dead loads: Non-composite = 0.26 kips/ft. (excluding weight of beam and slab).
Composite = 0.26 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 10 of 15
FILE NO. 12.04-10

BEAM SPACING = 8'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8
45	14	14	14	14	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10
50			16	16	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10
55			22	20	16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12
60					18	18	18	18	16	16	16	16	16	16	16	16	14	14	14	14
65						22	22	22	18	18	18	18	18	18	18	18	16	16	16	16
70							26	26	22	20	20	22	20	20	20	20	18	18	18	18
75							32	32	26	24	24	24	22	22	22	22	20	20	20	20
80								36	30	30	28	28	24	24	24	24	22	22	22	22
85									34	34	34	34	26	26	26	26	24	24	24	24
90										40	38	38	30	30	30	30	26	26	26	26
95											44	44	34	34	34	34	30	28	28	28
100											50	50	40	40	38	38	34	32	32	32
105												56	46	46	44	44	38	36	36	36
110														50	50	50	42	42	42	40
115															54	54	48	46	46	46
120															60	60		52	52	52
125																66			56	56
130																			60	60
135																				66
140																				
145																				
150																				
155																				
160																				

Slab thickness: 8¹/₂" (including 1¹/₂" w.s.).

Dead loads: Non-composite = 0.27 kips/ft. (excluding weight of beam and slab).
Composite = 0.27 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 11 of 15
FILE NO. 12.04-11

BEAM SPACING = 8'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	8	8	8	8
45	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10
50			18	18	14	14	14	14	12	12	14	14	12	12	12	12	10	10	10	12
55			22	22	16	16	16	16	14	14	16	16	14	14	14	14	12	12	12	12
60					20	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14
65						24	24	24	20	20	20	20	18	18	18	18	16	16	16	16
70							28	28	22	22	22	22	20	20	20	20	18	18	18	18
75							34	32	26	26	26	26	22	22	22	22	20	20	20	20
80								40	32	30	30	30	24	24	24	24	22	22	22	22
85										36	34	34	28	28	28	28	24	24	24	24
90										40	40	40	32	32	32	30	26	26	26	26
95											46	46	36	36	36	36	30	30	30	30
100											52	52	42	42	40	40	34	34	34	34
105														46	46	46	40	38	38	38
110														52	52	52	44	44	42	42
115															56	56	50	50	48	48
120																62		54	54	54
125																			58	58
130																			64	64
135																				
140																				
145																				
150																				
155																				
160																				

Slab thickness: $8\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.28 kips/ft. (excluding weight of beam and slab).
Composite = 0.28 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 12 of 15
FILE NO. 12.04-12

BEAM SPACING = 9'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	8	8	10	10	8	8	8	8
45	14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10
50		18	18	16	14	14	14	14	14	14	14	14	12	12	12	12	12	12	12	12
55				22	16	16	16	18	16	16	16	16	14	14	14	14	12	12	12	14
60					22	20	20	20	18	18	18	18	16	16	16	16	14	14	14	14
65						24	24	22	20	20	20	20	18	18	18	18	16	16	16	16
70						28	28	28	22	22	22	22	20	20	20	20	18	18	18	18
75							34	32	28	26	26	24	22	22	22	22	20	20	20	20
80								38	32	30	30	28	26	26	26	26	22	22	22	22
85										36	34	34	28	28	28	28	24	26	26	26
90										42	40	38	34	32	30	30	28	28	28	28
95											46	44	38	36	36	34	32	30	30	30
100												50	44	42	40	38	36	34	34	32
105													58		46	46	44	40	38	36
110															54	50	50	46	44	40
115																58	56		48	46
120																	62		54	52
125																			58	58
130																			66	64
135																				
140																				
145																				
150																				
155																				
160																				

Slab thickness: $8\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.29 kips/ft. (excluding weight of beam and slab).
Composite = 0.28 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 13 of 15
FILE NO. 12.04-13

BEAM SPACING = 9'- 6"

Span Length L (ft)	Number of 1/2" diameter strands																			
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6			
	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi	f'c = 5000 psi	6000 psi	7000 psi	8000 psi
40	12	12	12	12	10	10	10	10	10	10	10	10	10	10	10	10	8	8	8	8
45		14	14	14	12	12	12	14	12	12	12	12	10	10	10	10	10	10	10	10
50			18	18	16	16	16	16	14	14	14	14	12	12	12	12	12	12	12	12
55				24	18	18	18	18	16	16	16	16	14	14	14	14	14	14	14	14
60					22	20	20	20	18	18	18	18	16	16	16	16	16	16	16	16
65						26	24	24	20	20	20	20	18	18	18	18	18	18	18	18
70							30	28	24	24	24	24	22	22	22	22	20	20	20	20
75								34	28	28	26	26	24	24	24	24	22	22	22	22
80								40	34	32	30	30	26	26	26	26	24	24	24	24
85										38	36	34	30	28	28	28	26	26	26	26
90											42	40	34	34	32	32	28	28	28	28
95												48	46	40	38	36	32	32	32	32
100													54		44	42	40	38	36	34
105															48	46	46	42	40	38
110																54	52	48	46	44
115																60	58		52	50
120																	66		58	54
125																			62	60
130																				66
135																				
140																				
145																				
150																				
155																				
160																				

Slab thickness: $8\frac{1}{2}$ " (including $\frac{1}{2}$ " w.s.).

Dead loads: Non-composite = 0.30 kips/ft. (excluding weight of beam and slab).
Composite = 0.29 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 14 of 15
FILE NO. 12.04-14

BEAM SPACING = 10'- 0"

Span Length L (ft)	Number of 1/2" diameter strands																				
	PCB-2				PCB-3				PCB-4				PCB-5				PCB-6				
	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	f' _c = 5000 psi	6000 psi	7000 psi	8000 psi	
40	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	8	8	8	8	
45					14	14	14	14	12	12	12	12	12	12	12	12	10	10	10	10	
50					16	16	16	16	14	14	14	14	14	14	14	14	12	12	12	12	
55					18	18	18	18	16	16	16	16	16	16	16	16	14	14	14	14	
60					22	22	20	20	18	18	18	18	18	18	18	18	16	16	16	16	
65						26	26	24	22	22	22	22	20	20	20	20	18	18	18	18	
70							30	30	24	24	24	24	22	22	22	22	20	20	20	20	
75								36	30	28	28	26	24	24	24	24	22	22	22	22	
80										34	32	32	26	26	26	28	24	24	24	24	
85										40	38	36	32	30	30	30	26	26	26	26	
90											44	42	36	34	34	32	30	30	30	30	
95												50	48	42	40	38	36	34	32	32	
100													56		44	44	42	38	38	36	36
105															50	50	48	44	42	40	40
110																56	54		48	46	44
115																	60		54	52	50
120																		68		58	56
125																				64	62
130																					68
135																					
140																					
145																					
150																					
155																					
160																					

Slab thickness: 8¹/₂" (including 1¹/₂" w.s.).

Dead loads: Non-composite = 0.31 kips/ft. (excluding weight of beam and slab).
Composite = 0.30 kips/ft.

**PRESTRESSED CONCRETE
I-BEAMS - LRFD
PRELIMINARY DESIGN TABLES**

VOL. V - PART 2
DATE: 31Jul2009
SHEET 15 of 15
FILE NO. 12.04-15