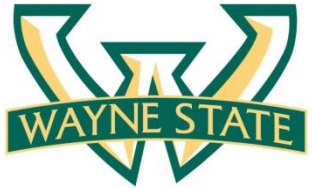
Guidelines for Designing Bridges in Michigan Suitable for Local Agencies

Christopher Eamon
Ihab Darwish
Ahmad Alsendi
MDOT RAP (PM: Keith Cooper)

Wayne State University



Alfred Benesch & Co.

MDOT

2018 Michigan Bridge Conference

March 20, 2018

Overview

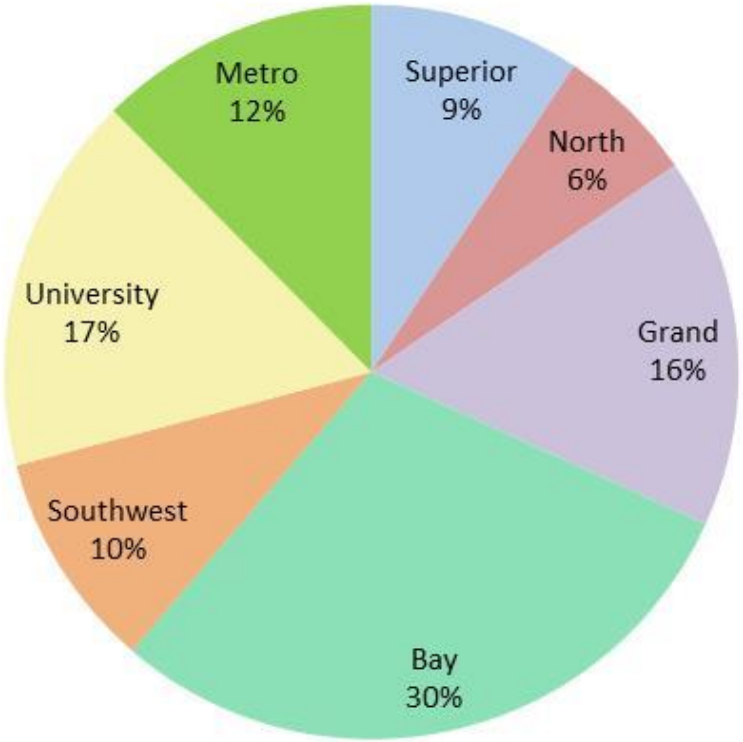
- Background
- Guideline Development
- Example: Steel Bridge Plans

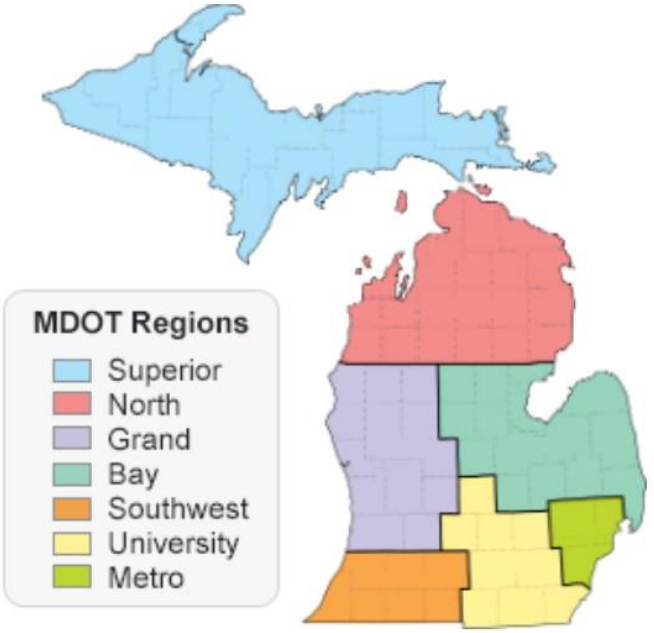
Background

Michigan Local Agency Bridges

- 6675 structures (vehicles, length ≥ 20’)
- 87% owned by County Highway Agencies
- 86% rural
- 97% span over water
- 30% girders; 34% box beam; 23% culvert

Location

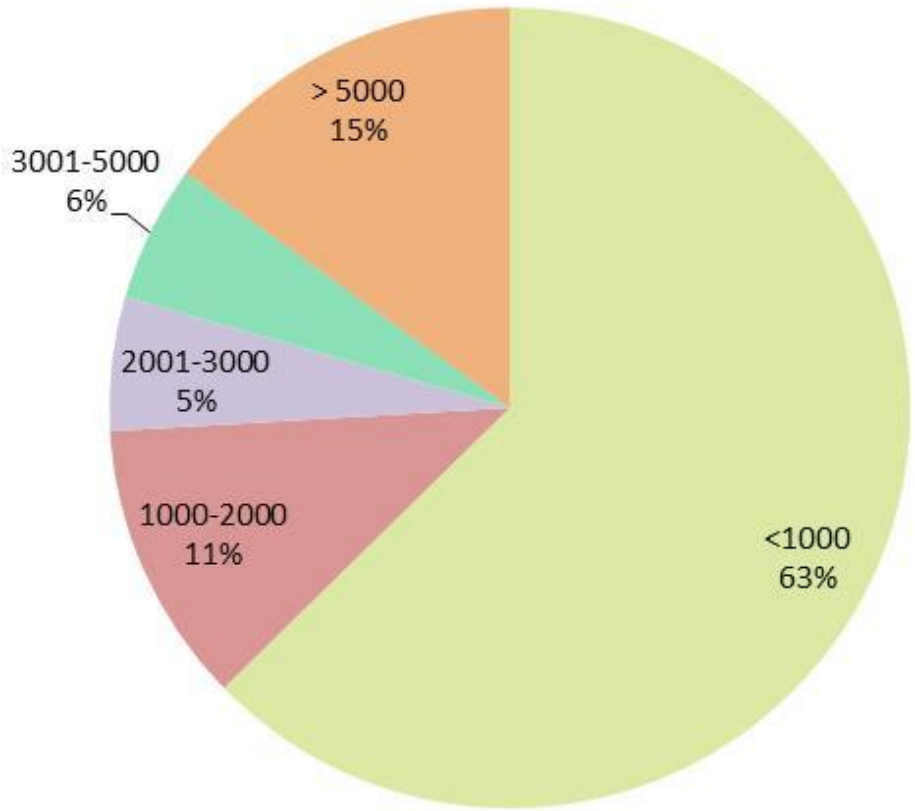




- Most (63%) in Bay, Grand, and University Regions

Region	%	No.
Superior	9.3	620
North	6.2	414
Grand	16.3	1085
Bay	29.5	1967
Southwest	9.6	644
University	16.7	1118
Metro	12.4	827

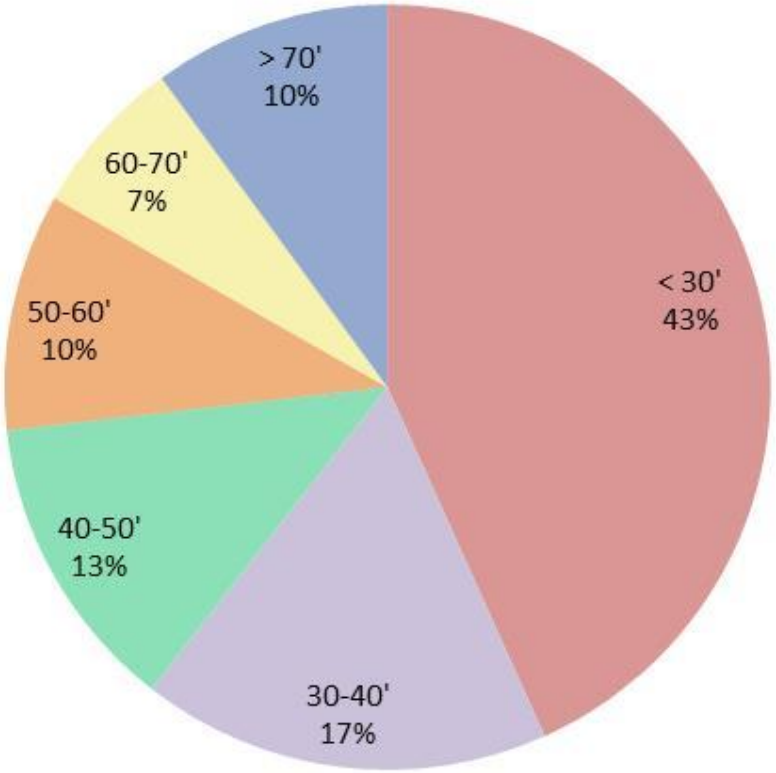
Traffic Volume



ADT	%	No.
< 1000	62.6	4218
1000-2000	11.4	769
2001-3000	5.4	363
3001-5000	5.5	369
5000-10000	7.0	474
10000-15000	3.5	239
15000-20000	2.1	144
>20000	2.3	157

- Most (63%) < 1000 ADT

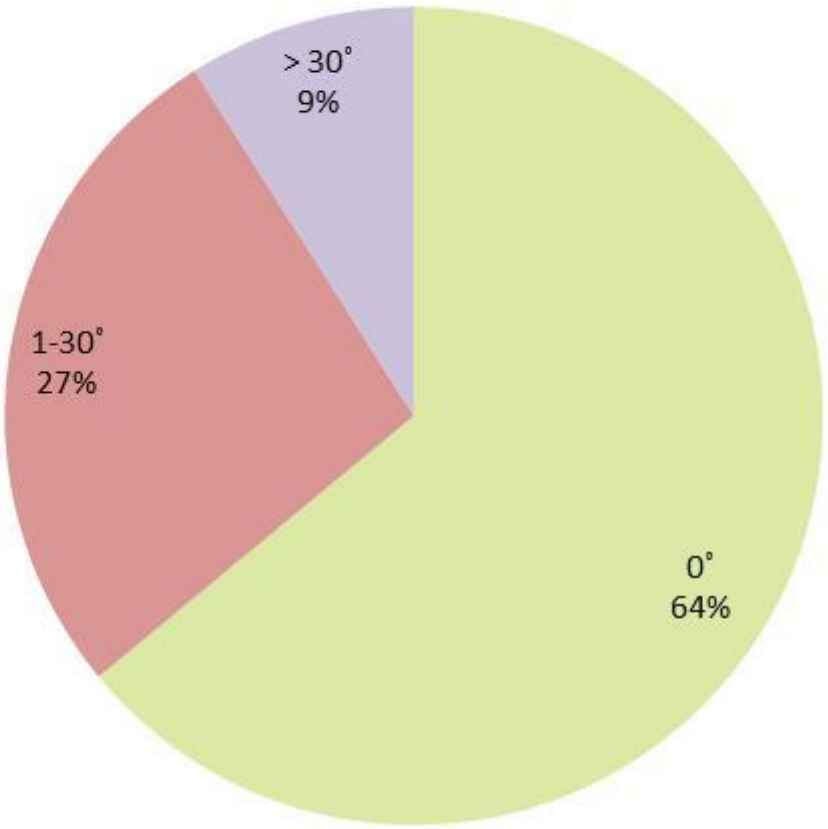
Span Lengths



Max span (ft)	%	No.
< 30	43.1	2878
30-40	17.2	1146
40-50	12.6	844
50-60	10.0	670
60-70	6.7	450
70-80	4.1	273
80-90	2.3	151
90-100	1.5	102
100-120	1.3	88
120-140	0.6	43
140-160	0.1	4
>160	0.3	17
No info.	0.1	10

- Most are short:
  - 43% < 30’
  - 73% < 50’
  - 98% < 100’

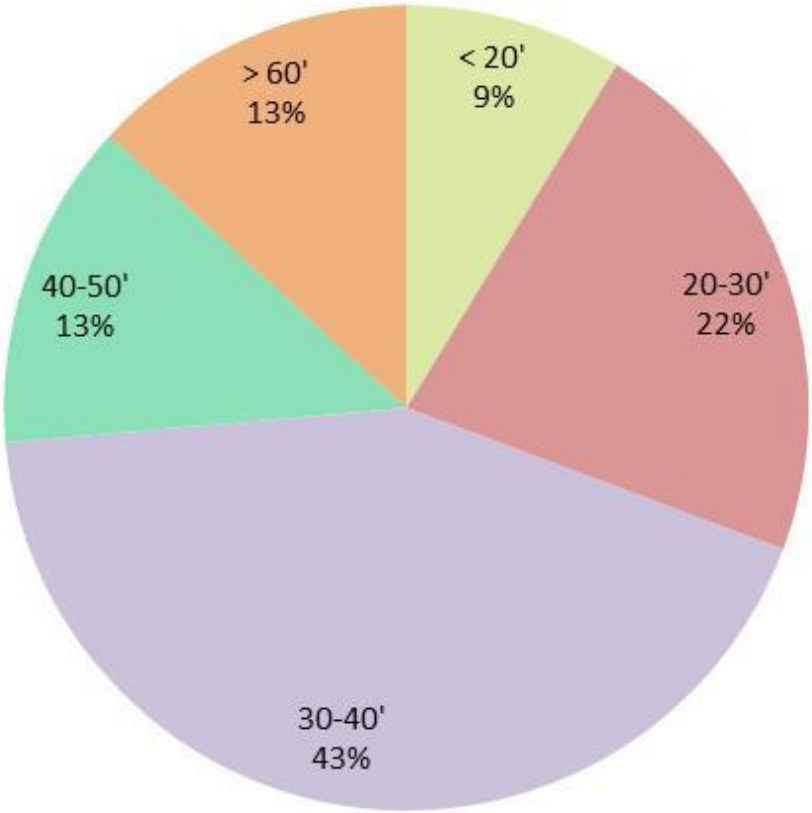
Skew



Skew (deg)	%	No.
0	61.9	4130
1-30	27.0	1803
31-60	7.9	525
60-99	0.6	40
No info.	2.7	179

- 91% < 30˚

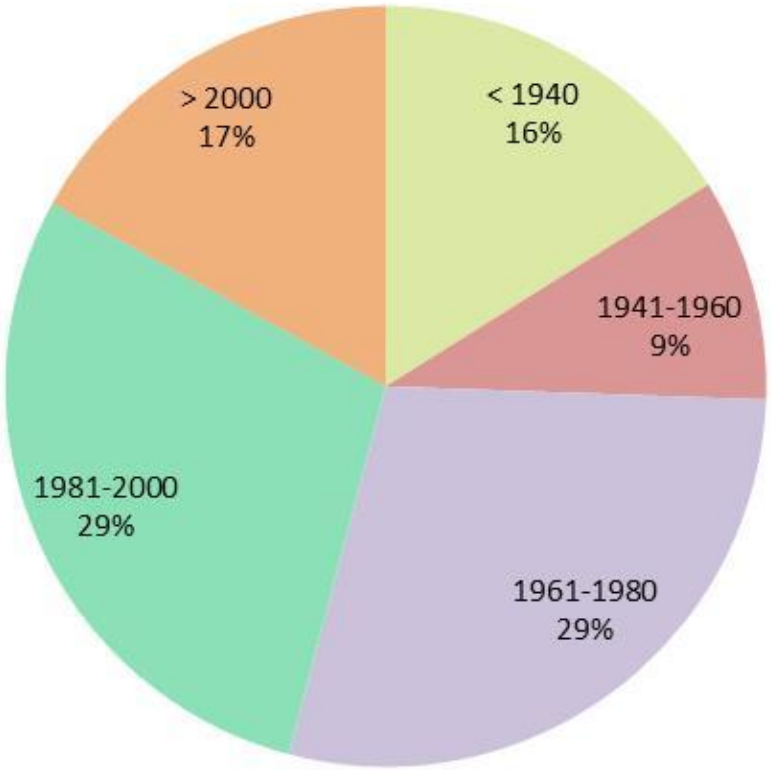
Deck Width



Width (ft)	%	No.
< 20	8.2	550
20-30	20.6	1375
30-40	40.2	2681
40-50	12.4	830
50-60	4.1	272
> 60	8.3	557
No info.	6.1	410

- Most (56%) from 30 - 50’

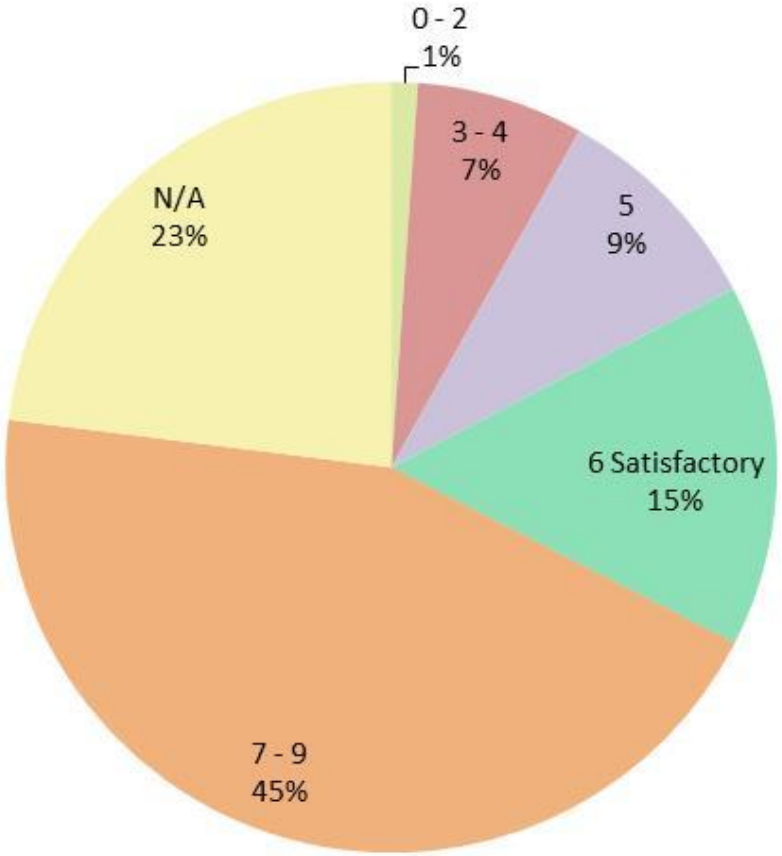
Year of Construction



Year	%	No.
< 1921	3.9	258
1921-1940	12.3	819
1941-1960	9.4	625
1961-1980	28.4	1898
1981-2000	28.7	1917
> 2000	16.9	1125
No info.	0.5	33

- Most (58%) built from 1960-2000
- ~ 25% 60+ years old

Condition of Superstructure



Condition	%	No.
0 Failed	0.1	9
1 Imminent Failure	0.1	10
2 Critical	0.9	63
3 Serious	2.6	185
4 Poor	4.4	312
5 Fair	9.2	647
6 Satisfactory	15.2	1063
7 Good	23.7	1663
8 Very Good	18.6	1306
9 Excellent	2.1	144
N N/A	22.5	1579

- Most (45%) rated good or better
- 17% less than satisfactory
- Over 16% posted < legal

Summary

MI Local Agency Bridges:

- Short Span (98% < 110’)
- Low skew (91% < 30˚)
- Moderate width (87% < 50’)
- Over water (97%)
- Concerning condition (25% age 60+; 17% unsatisfactory & posted)

Previous Bridge Plan Development Efforts

- TRB: *Innovative Bridge Designs for Rapid Renewal* (SHRP2; TRB 2014): plans for ABC; used by Iowa, Vermont, New York DOTs
- PCI: *Guidelines for Accelerated Bridge Construction Using Precast / Prestressed Concrete Components* (PCI 2006)
- PennDOT: Rapid Bridge Replacement Project replaced over 500 structures (2015)
- MoDOT: Safe & Sound Program: plans used to replace 550 bridges (2013)
- IowaDOT: Plans for prefabricated bridge components (Rossbach 2014).
- SDDOT, INDOT: Plans for fast construction (Rossbach 2014).
- UDOT, Idaho DOT, WSDOT: Plans for precast construction (TRB 2014).

This project: Local agency bridges rather than ABC

Purpose of Guidelines

Desired outcomes for new bridges

“Low cost, low maintenance, easily constructible”

- Reduce problematic design and construction issues
- Improve quality control
- Increased durability
- Lower life cycle costs
- Efficiency by using recurrent specifications and layouts

Scope of Guidelines

- Provide design suggestions for local agency bridges
- Present recommended bridge geometries, girder selections, and details

  Format: bridge selection charts, construction notes, bridge plan templates

Audience

- Local agency representatives and their consultants

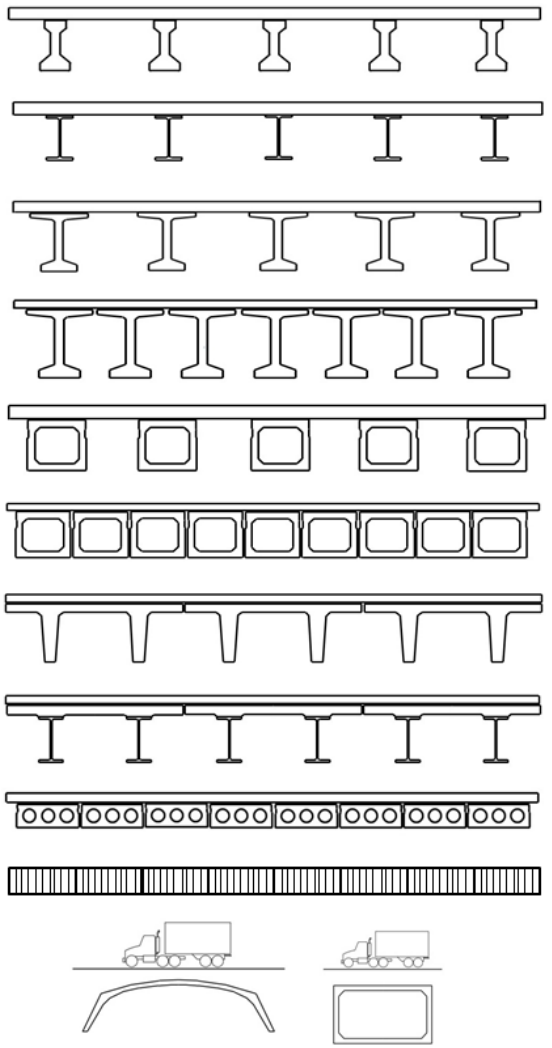
What the Guidelines are not

- Not a set of new MDOT standards
- Not required
- Not “off the shelf” plan sheets: templates
- Not complete designs
- Do not cover all cases
- Not meant to lower design costs

Guideline Development

Initial Concepts

1) AASHTO/PCI beams
2) Painted steel beams
3) Galvanized steel beams
4) Spread bulb tees
5) Side-by-side bulb tees
6) Spread box beams
7) Side-by-side box beams
8) Precast double tees
9) Prefabricated steel/concrete double tees
10) Slab
11) Timber slab
12) Culverts



Concept Review

- **Focus group meeting** (July 2016)

  Local agency representatives, engineering consultants, contractors, fabricators

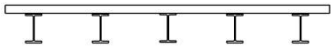
  Discussed performance, cost, constructability, durability/maintenance, other issues

- **On-line survey** (advertised in Crossroads Magazine)

- **Questionnaire** distributed to 2017 MBC

About 90 responses

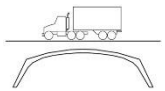
Concepts for Plan Development

Bridge Type		Some advantages
Galvanized Steel		lower weight, small depth for short spans
Spread Box		popular, readily available
Side-by-side Box		useful when small depth required
Bulb tee		efficient for longer spans

Other Competitive Structures

Timber 

Folded Plate 

Culvert 

currently available in prefabricated kits

Cost Analysis

- Initial and life cycle cost analysis (LCCA) of superstructure

LCCA

Agency Costs

- Material, personnel, and equipment costs for construction and maintenance
- Cost Events:

  Initial construction
  Routine and detailed inspections
  Deck patch, overlay, & replacement
  Beam end repair & replacement
  Superstructure demolition & replacement

- Operation, maintenance, and repair events based on MDOT practices

User costs

During construction & maintenance, the costs due to increased:

- Travel time
- Vehicle operation
- Crashes

Life cycle costs

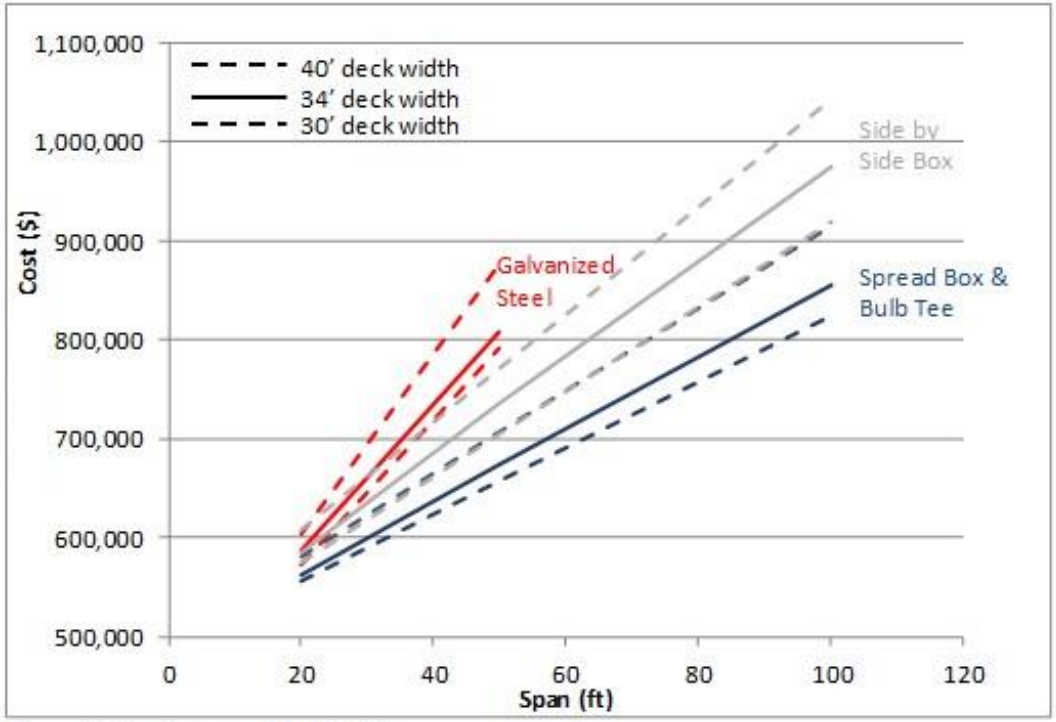
Cumulative yearly costs converted to present dollar value

Probabilistic LCCA

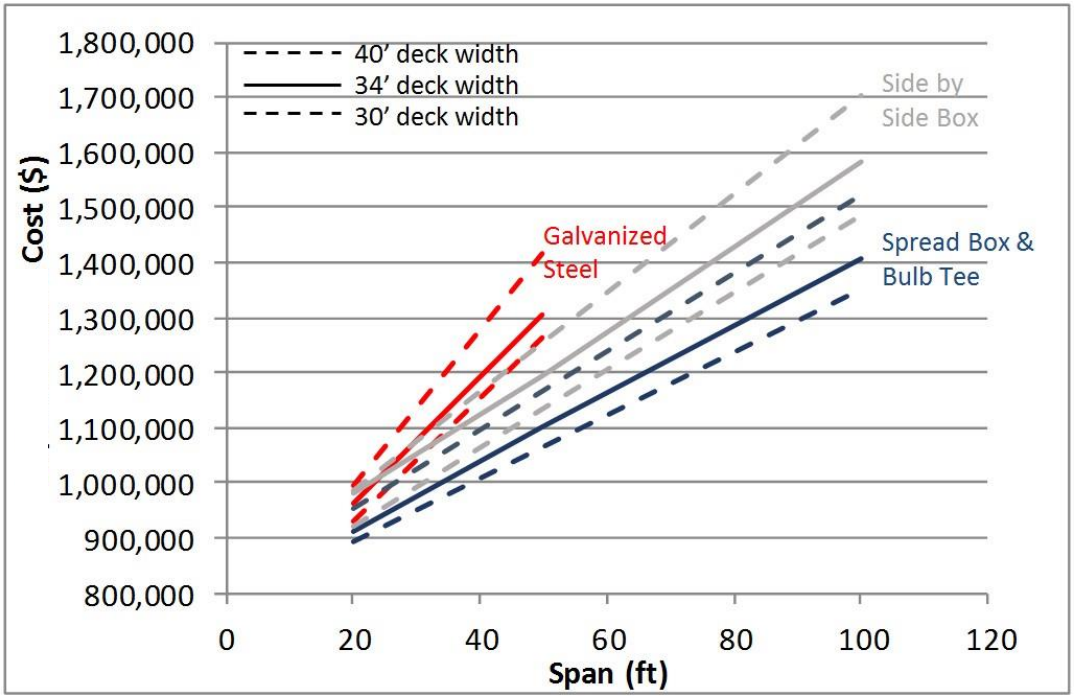
- LCCA considering cost uncertainties
- Costs expressed as random variables
- Analysis conducted with Monte Carlo Simulation

Example Results

Initial construction cost

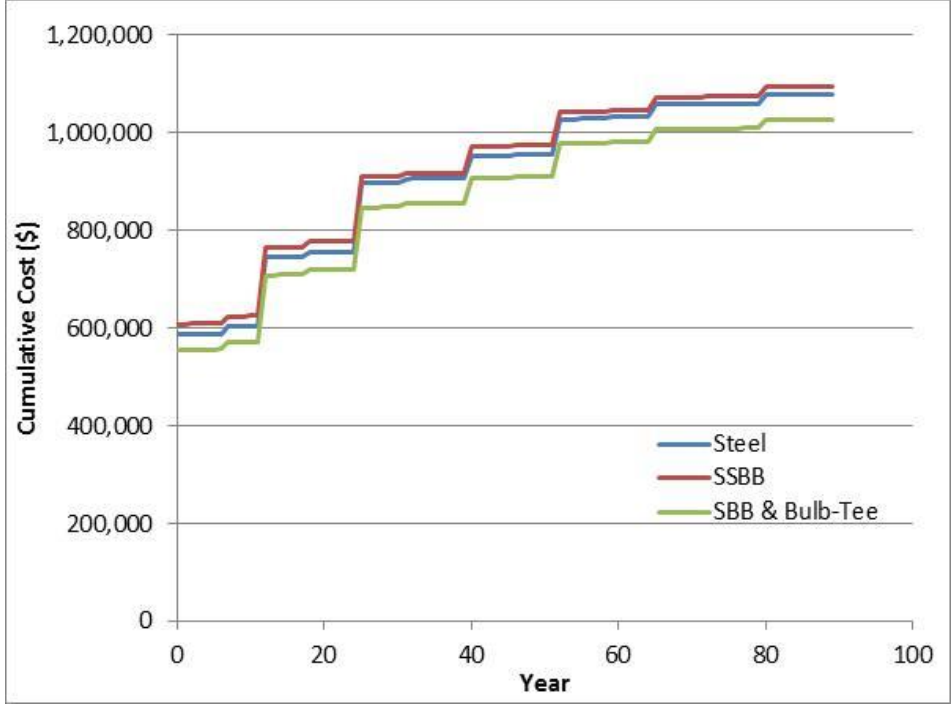


Life cycle cost

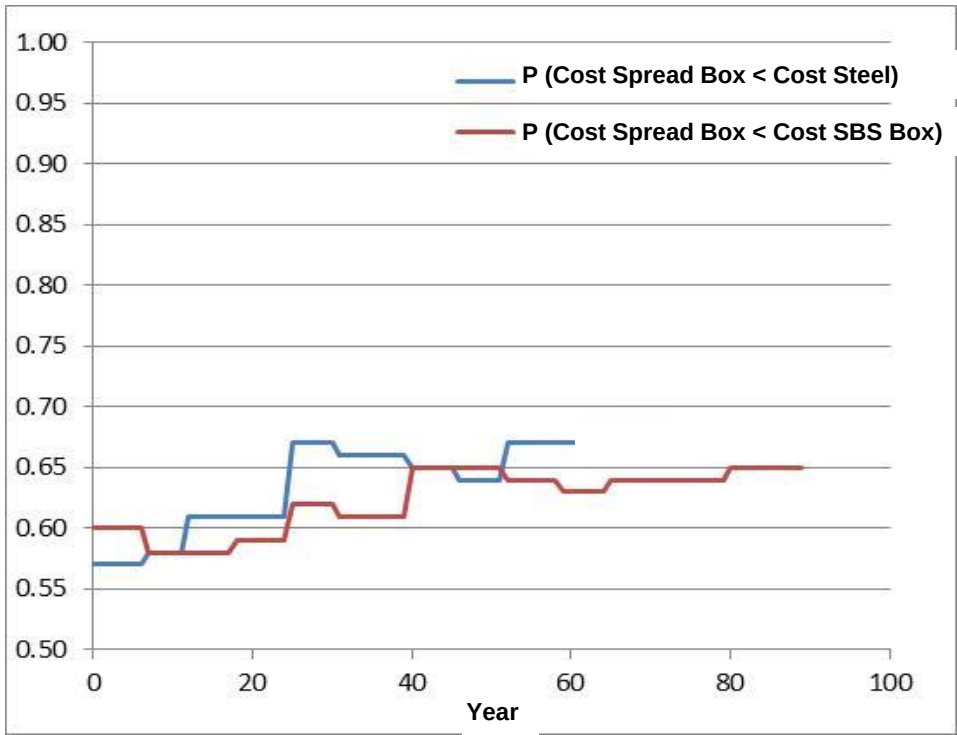


Example Results

Cumulative Cost, 20’ Span



Probabilistic Evaluation, 20’ Span



Summary of Recommended Designs

- Balance cost, beam depth, constructability

Deck Width	(2 Lane - Shoulder)	ADT
30’	11’ - 4’	≤ 1500 (+ ag. equipment)
34’	11’ - 6’	1500 - 2000
40’	12’ - 8’	> 2000

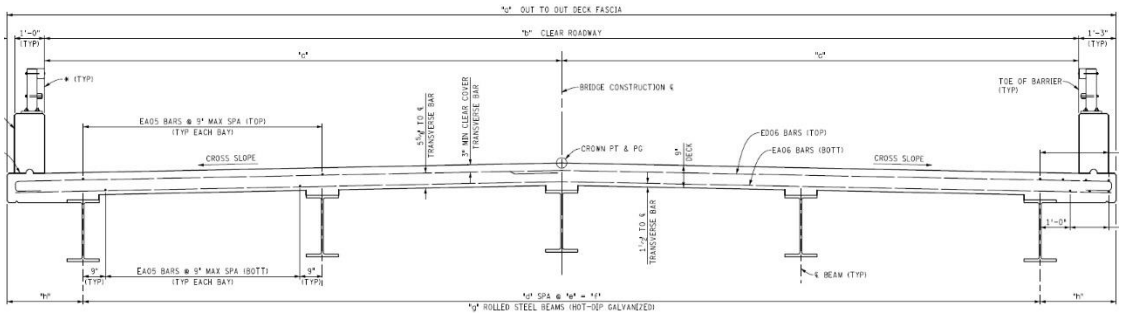
Bridge Type	Spans
Galvanized Steel	20-60’
Spread Box	20-70’
Side-by-side Box	20-70’
Bulb tee	70-110’

Skew
0 - 30°

Steel

Span (ft)	# beams x spacing (ft)	Overhang (ft)	Clear width (ft)	Total width (ft)
20 - 60	5 x 6.38	3.5	30	32.5
20 – 60	6 x 6.3	2.5	34	36.5
20 – 60	7 x 6.25	2.5	40	42.5

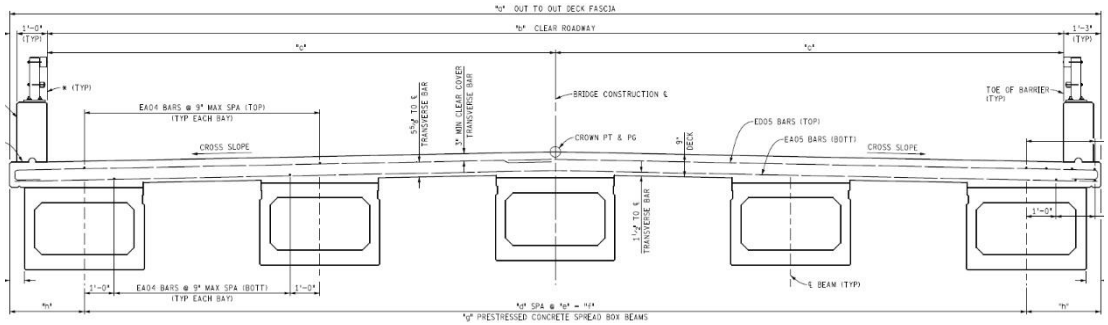
Span (ft)	Beam size
20 - 30	W14 x 120
40	W21 x 147
50	W30 x 173
60	W36 x 170



Spread Box

Span (ft)	# beams x spacing (ft)	Overhang (ft)	Clear width (ft)	Total width (ft)
20 - 50	4 x 9.17	2.5	30	32.5
60 - 110	5 x 6.87	2.5	30	32.5
20 - 110	5 x 7.87	2.5	34	36.5
20 - 50	5 x 9.37	2.5	40	42.5
60 - 110	6 x 7.5	2.5	40	42.5

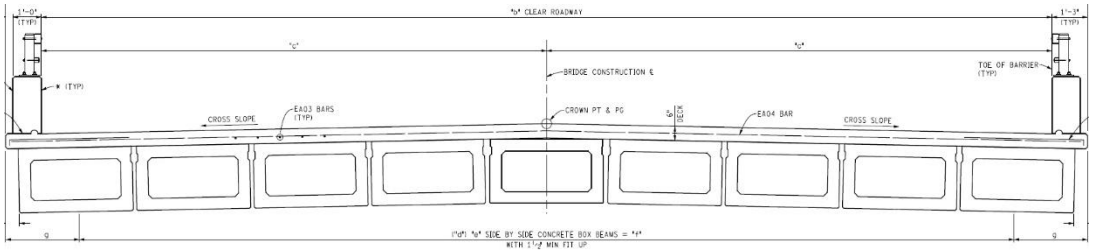
Span (ft)	Beam size
20 - 40	21 x 36
50 - 60	21 x 48
70	27 x 48
80	33 x 48
90 - 100	39 x 48
110	48 x 48



Side By Side Box

	# of beams for clear width		
Span (ft)	30’	34’	40’
20	10	12	13
30	10	12	13
40	10	12	13
50	10	12	13
60	8	9	10
70	8	9	10
80	8	9	10
90	8	9	10
100	8	9	10
110	8	9	10

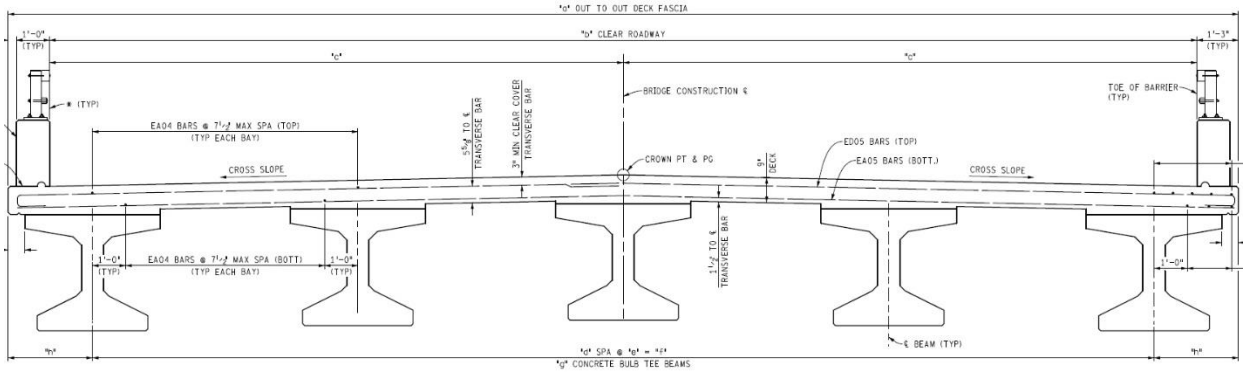
Span (ft)	Beam size
20 - 50	17 x 36
60 - 70	21 x 48
80 - 90	27 x 48
100	33 x 48
110	39 x 48



Bulb Tees

Span (ft)	# beams x spacing (ft)	Overhang (ft)	Clear width (ft)	Total width (ft)
70 – 110	4 x 9.17	2.5	30	32.5
70 - 110	5 x 7.87	2.5	34	36.5
70 - 100	5 x 9.37	2.5	40	42.5
110	5 x 8.87	3.5	40	42.5

Span (ft)	Beam size
70 - 90	42 x 49
100 - 110	48 x 49



Design Guidelines

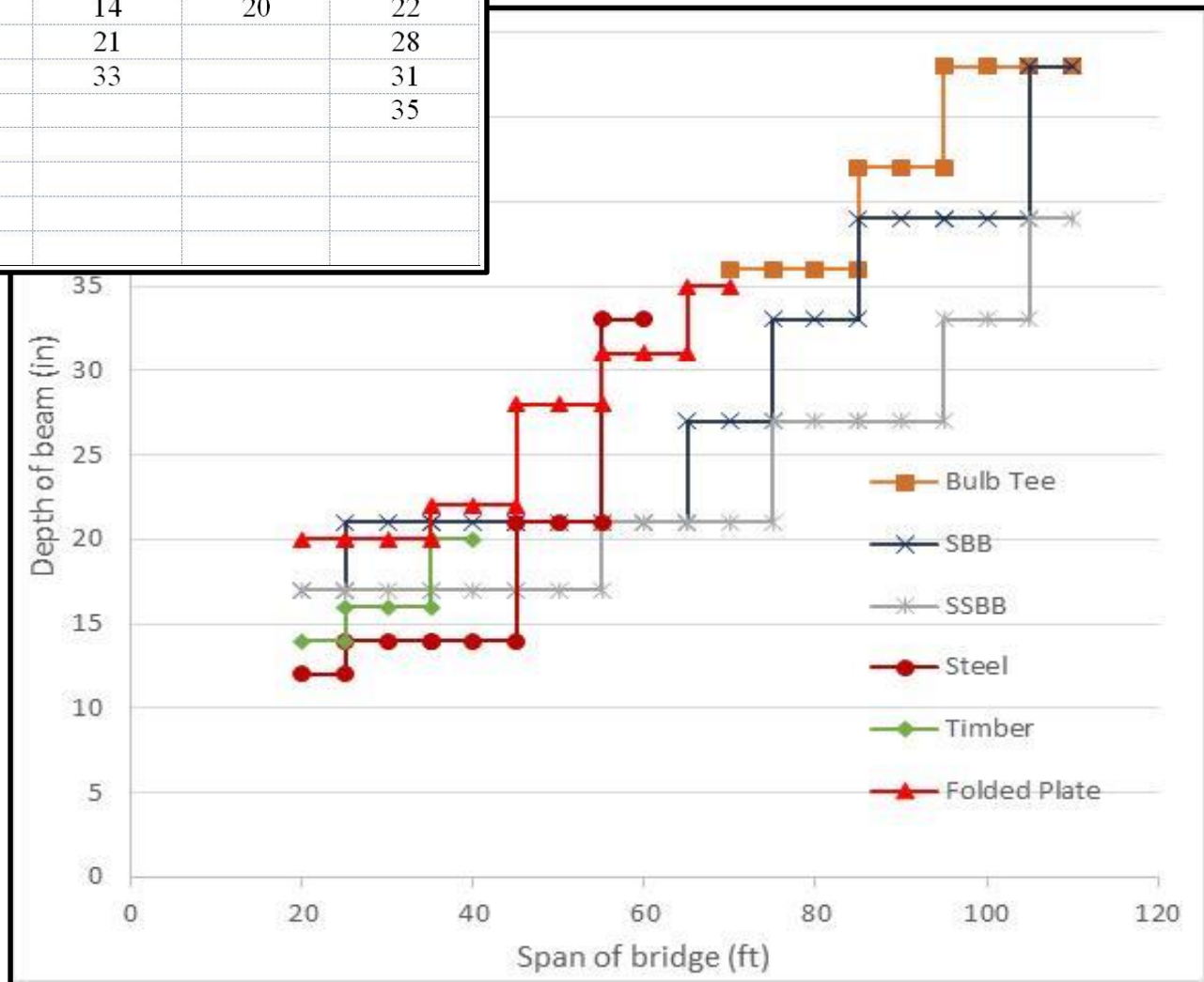
Summary Document

- Summary of design considerations
- Discussion of bridge types & pros/cons of selections
- Initial span/depth selection charts
- Initial and life cycle cost estimates
- Discussion of design assumptions/limitations on plan templates
- Example design

Guide span-depth selections

Table 1. Typical Beam Depth Requirements

	Beam Depth (in) by Bridge Type					
Span (ft)	Bulb Tee	SBB	SSBB	Steel	Timber	Fold Plate
20		17	17	12	14	20
30		21	17	14	16	20
40		21	17	14	20	22
50		21	17	21		28
60		21	21	33		31
70	36	27	21			35
80	36	33	27			
90	42	39	27			
100	48	39	33			
110	48	48	39			



Guide template use instructions

Summarizes:

- Sheet contents
- Variable-defined items
- Inputs required
- Selections required
- Explanatory notes

Example template instruction information

Sheet 1: Deck Plan

Contains: deck plan, haunch detail

Variable items: span length (L), out-to-out bridge width (a), angle of crossing, deck reinforcement, structural slab thickness (T), fascia depth (F), haunch detail

Select: haunch detail (for concrete or steel beams), angle of crossing case

Notes: The left side of the deck plan applies to angles of crossing from 70-90˚, while the right side applies to angles of crossing 60-70˚. Deck plan should be redrawn to appropriately match the required angle of crossing. See section sheets for out-to-out width dimension (a).

Plan Sheet Templates

- 28 sheets for steel, box beam, and bulb tee bridges
- Templates in Mircostation and Autocad formats
- Superstructure templates:

Deck plan	Shear reinforcement
Approach slab	Beam sections
Abutment back wall	Strand layout
End wall	Diaphragms
Barrier	Camber diagram
Bridge section	Bearing pads
Erection diagram	Expansion joints

- Selection tables for girder sizes, strands, stirrups, bearings, etc.

Plan Sheet Templates

Table 2. Sheet Numbers Per Bridge Type.

Sheet Number:	Bridge Type			
Sheet Name	Steel	Spread Box	SBS Box	Bulb Tee
Deck plan & haunch detail	1	1	1	1
Abutment back wall	2	2	n/a	2
Approach slab	3	3	3	3
Barrier & end walls	4	4	4	4
Bridge section	8	5	6	7
Erection diagram	21	9	13	18
Shear reinforcement	22	10	14	19
Beam sections & strands*	24	11, 12	15,16	19
Diaphragms	23	n/a	n/a	20
Bearings	27	25	25	26
Expansion joint	28	28	28	28

*For steel, a camber diagram is given in place of beam section & strand diagram.

Example: Steel Bridge Sheets

Sheets needed:

1: Deck plan

2: Abutment back wall

3: Approach slab

4: Barrier and end wall

8: Bridge section

21: Erection diagram

22: Shear studs

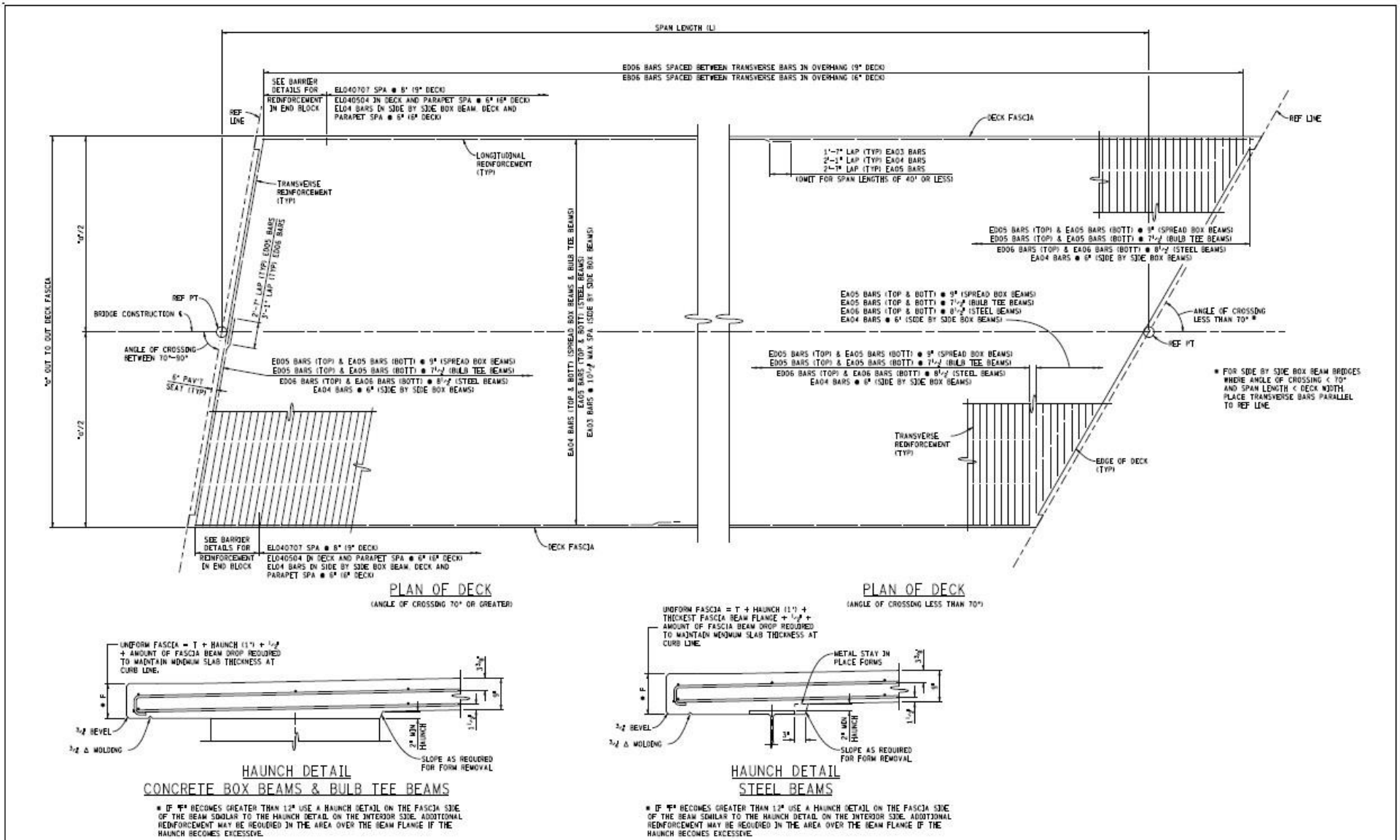
23: Diaphragms

24: Camber diagram

27: Bearing assembly

28: Expansion joints

Sheet 1: Deck Plan



PLAN OF DECK
(ANGLE OF CROSSING 70° OR GREATER)

PLAN OF DECK
(ANGLE OF CROSSING LESS THAN 70°)

HAUNCH DETAIL
CONCRETE BOX BEAMS & BULB TEE BEAMS

* IF "F" BECOMES GREATER THAN 12" USE A HAUNCH DETAIL ON THE FASCIA SIDE OF THE BEAM SIMILAR TO THE HAUNCH DETAIL ON THE INTERIOR SIDE. ADDITIONAL REINFORCEMENT MAY BE REQUIRED IN THE AREA OVER THE BEAM FLANGE IF THE HAUNCH BECOMES EXCESSIVE.

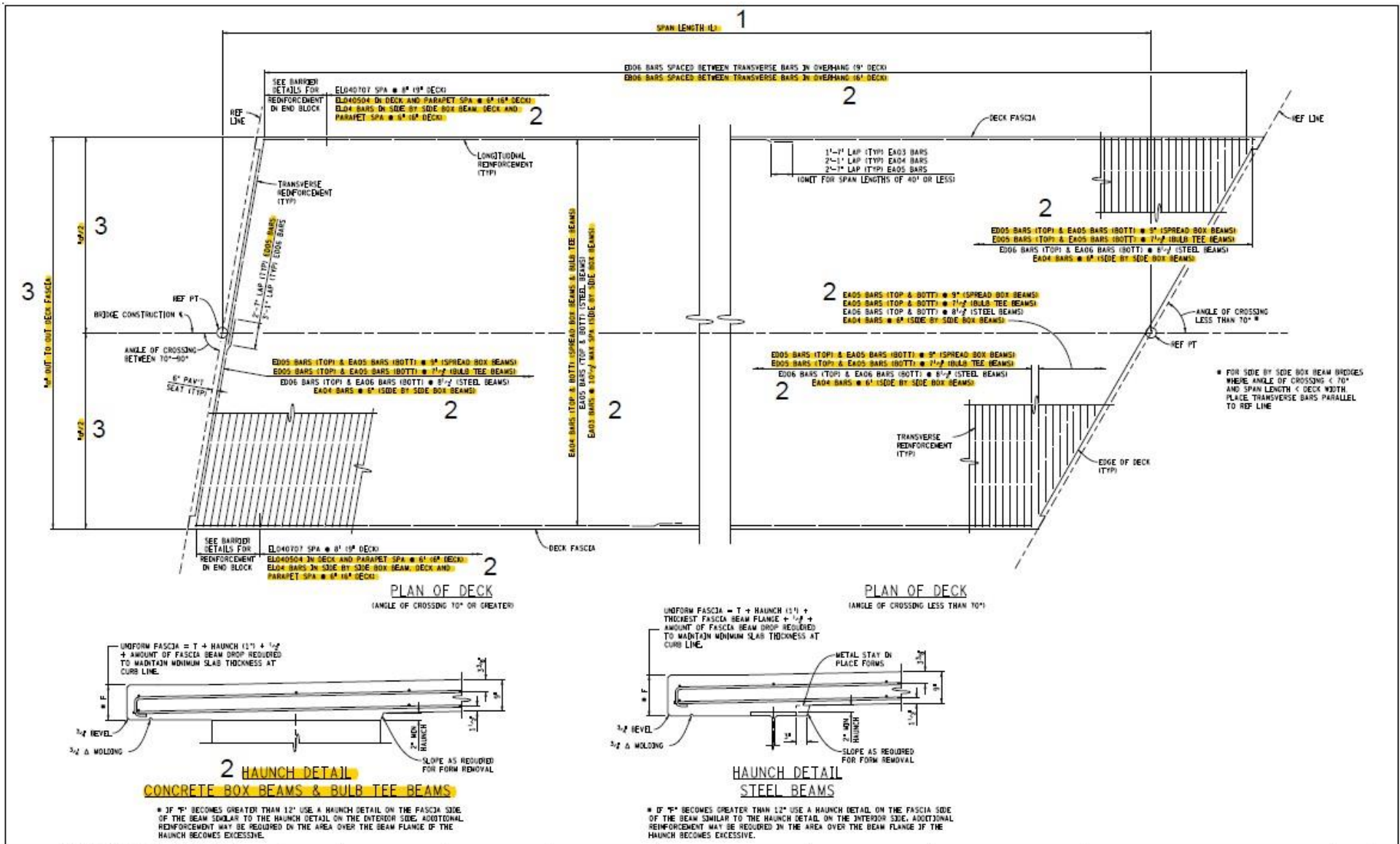
HAUNCH DETAIL
STEEL BEAMS

* IF "F" BECOMES GREATER THAN 12" USE A HAUNCH DETAIL ON THE FASCIA SIDE OF THE BEAM SIMILAR TO THE HAUNCH DETAIL ON THE INTERIOR SIDE. ADDITIONAL REINFORCEMENT MAY BE REQUIRED IN THE AREA OVER THE BEAM FLANGE IF THE HAUNCH BECOMES EXCESSIVE.

FINAL ROW PLAN REVISIONS				(SUBMITTAL DATE:)				NO SCALE		DATE:	CS:	SUPERSTRUCTURE DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			DESIGN UNIT:	JN:		DECK	SECT
									FILE: Deck_001.dgn	TSC:			001	

Sheet 1: Deck Plan

1) Insert: span
2) Delete: rebar notes, haunch detail
3) Insert width & choose skew case



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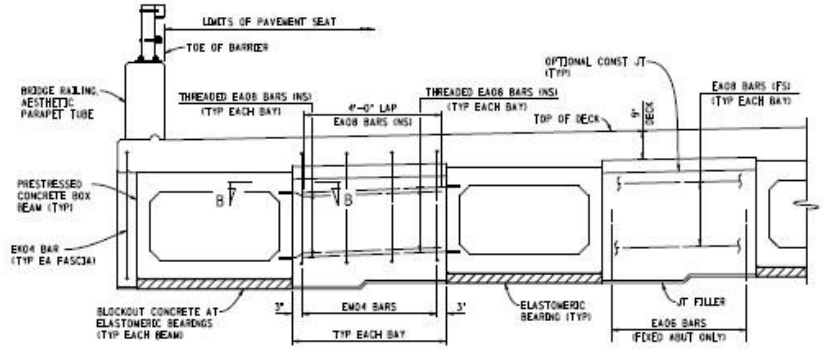
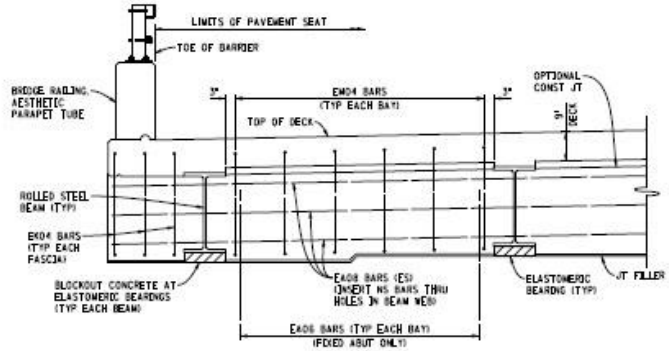
									FILE: Deck_001.dgn	TSC:			001	

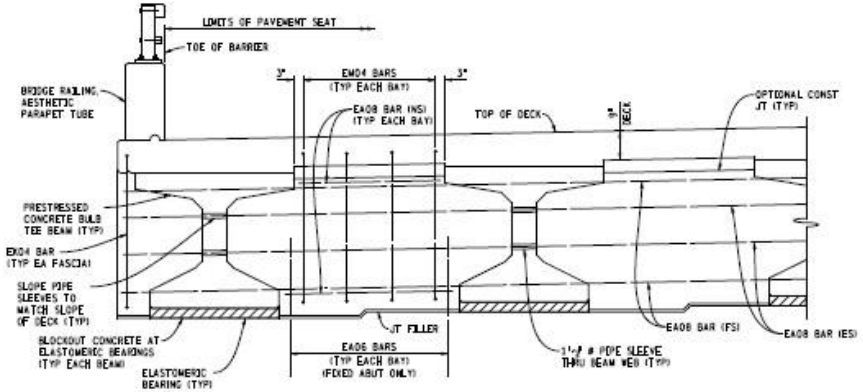
Sheet 2: Abutment back wall



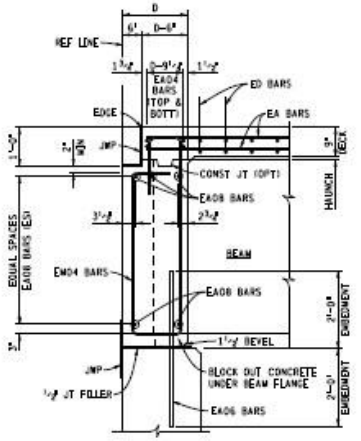
TYPICAL ABUTMENT BACKWALL – SPREAD BOX BEAM



TYPICAL ABUTMENT BACKWALL – ROLLED STEEL BEAM



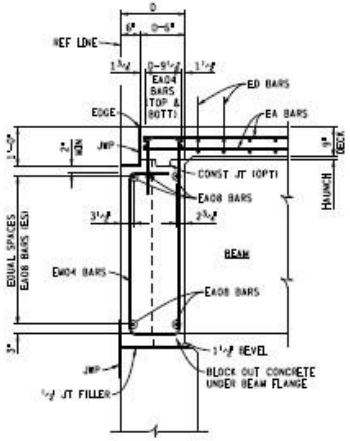
TYPICAL ABUTMENT BACKWALL – BULB TEE BEAM



TYPICAL BACKWALL SECTION (FIXED)

CAST LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT. (USE WITH MANDITORY JOINT)

IF A CONSTRUCTION JOINT IS USED, CAST THE LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT.



TYPICAL BACKWALL SECTION (EXPANSION)

CAST LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT. (USE WITH MANDITORY JOINT)

IF A CONSTRUCTION JOINT IS USED, CAST THE LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT.

NOTES:

NS DENOTES NEAR SIDE.

FS DENOTES FAR SIDE.

ES DENOTES EACH SIDE.

JWP DENOTES JOINT WATERPROOFING.

FOR SECTION B-B, SEE DWG "SBB004".

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:			
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

NO SCALE

FILE: Deck_002.dgn

DATE:

DESIGN UNIT:

TSC:

CS:

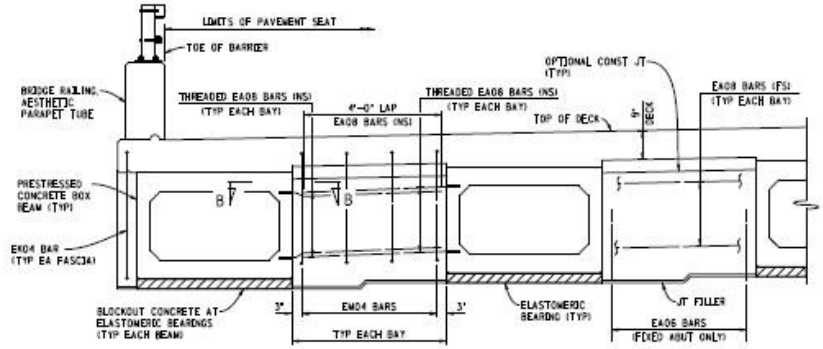
JN:

SUPERSTRUCTURE DETAILS

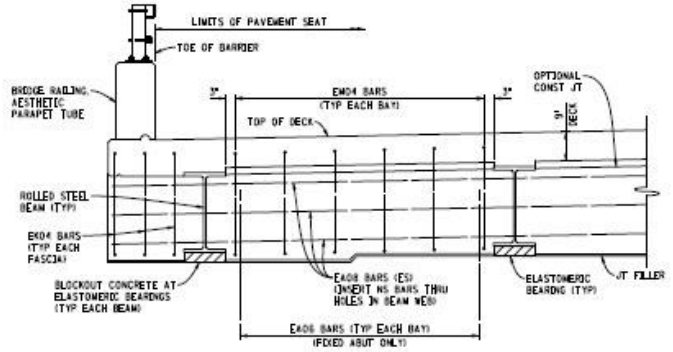
DRAWING	SHEET
DECK	SECT
002	

Sheet 2: Abutment back wall

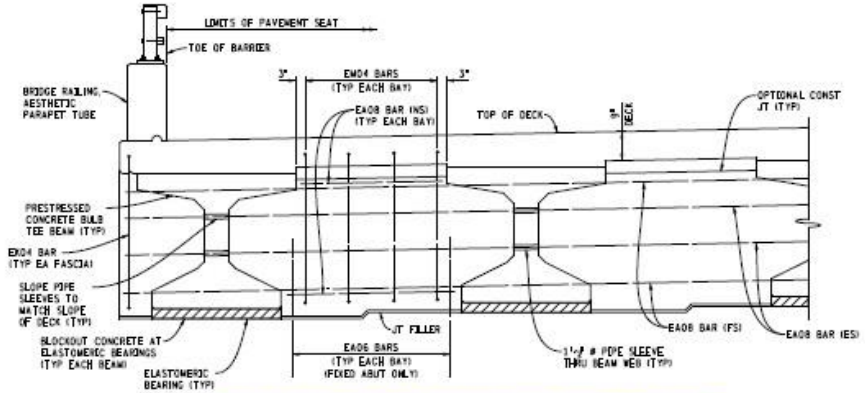
1) Insert: back wall width (D) [max(1'-8", f(bearing dim.))]
2) Delete: back wall details



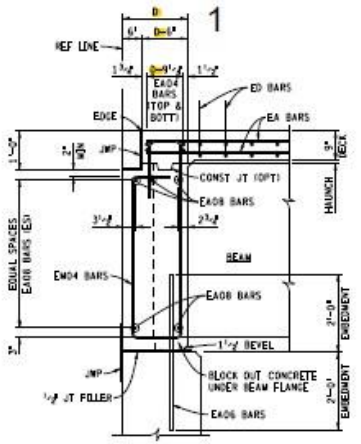
TYPICAL ABUTMENT BACKWALL – SPREAD BOX BEAM 2



TYPICAL ABUTMENT BACKWALL – ROLLED STEEL BEAM



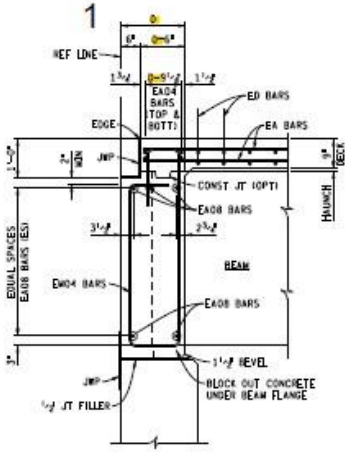
TYPICAL ABUTMENT BACKWALL – BULB TEE BEAM 2



TYPICAL BACKWALL SECTION (FIXED)

CAST LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT. (USE WITH MANDITORY JOINT)

IF A CONSTRUCTION JOINT IS USED, CAST THE LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT.



TYPICAL BACKWALL SECTION (EXPANSION)

CAST LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT. (USE WITH MANDITORY JOINT)

IF A CONSTRUCTION JOINT IS USED, CAST THE LOWER PORTION OF THE BACKWALL PRIOR TO PLACING DECK REINFORCEMENT.

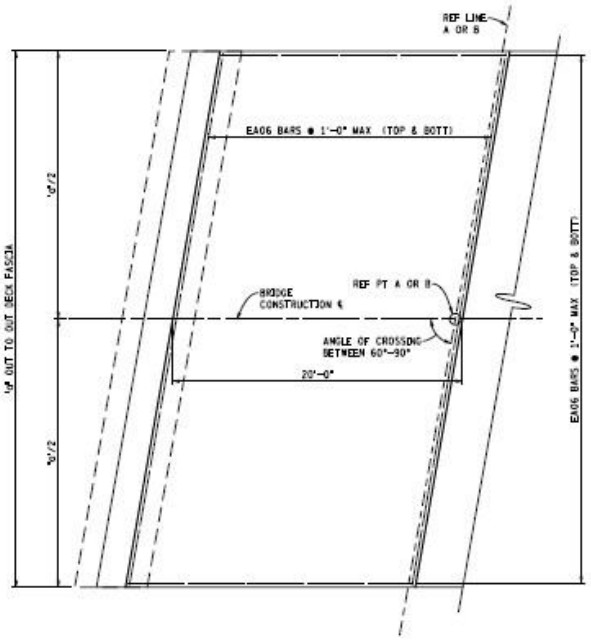
NOTES:

NS DENOTES NEAR SIDE.
FS DENOTES FAR SIDE.
ES DENOTES EACH SIDE.
JWP DENOTES JOINT WATERPROOFING.
FOR SECTION B-B, SEE DWG "SB8004".

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:)											
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION		NO SCALE	DATE:	CS:
										DESIGN UNIT:	JN:
									FILE: Deck_002.dgn	TSC:	

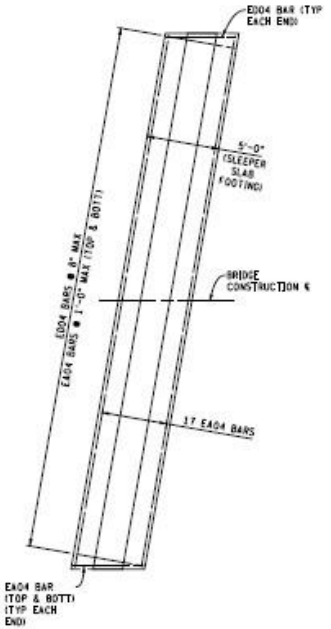
SUPERSTRUCTURE DETAILS	DRAWING	SHEET
	DECK	SECT
	002	

Sheet 3: Approach Slab



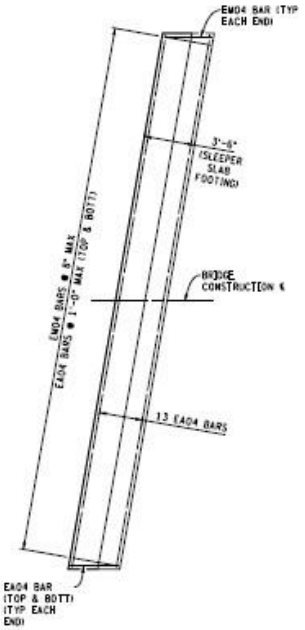
PLAN OF APPROACH SLAB (EXPANSION SIDE)

(ANGLE OF CROSSING 60° OR GREATER)
(SLEEPER SLAB FOR CONCRETE APPROACH SHOWN)



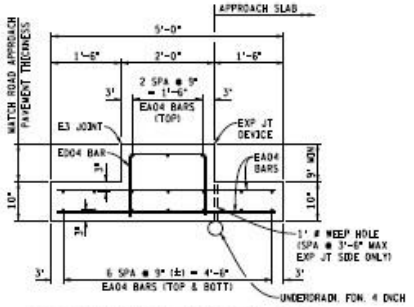
PLAN OF SLEEPER SLAB

(ANGLE OF CROSSING 60° OR GREATER)
(CONCRETE APPROACH)

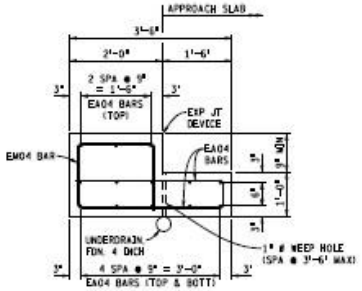


PLAN OF SLEEPER SLAB

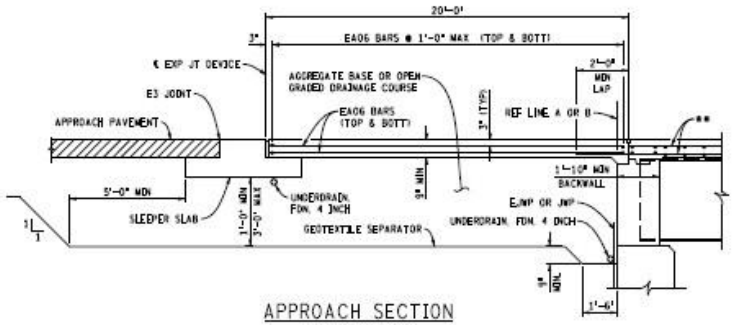
(ANGLE OF CROSSING 60° OR GREATER)
(HMA APPROACH)



SECTION THRU SLEEPER SLAB WITH CONCRETE APPROACH

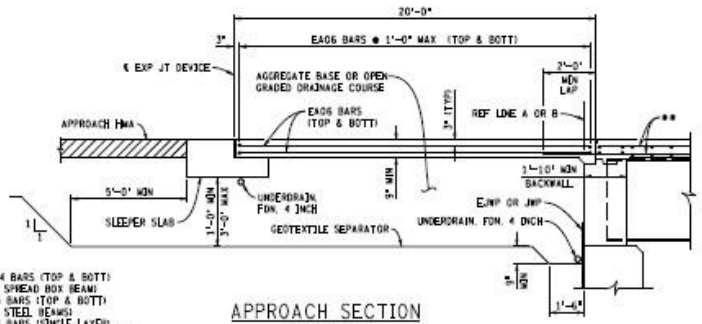


SECTION THRU SLEEPER SLAB WITH HMA APPROACH



APPROACH SECTION

(CONCRETE APPROACH)



APPROACH SECTION

(HMA APPROACH)

** EA04 BARS (TOP & BOTT)
(FOR SPREAD BOX BEAM)
EA05 BARS (TOP & BOTT)
(FOR STEEL BEAMS)
EA03 BARS (SINGLE LAYER)
(FOR SIDE BY SIDE BOX BEAMS)

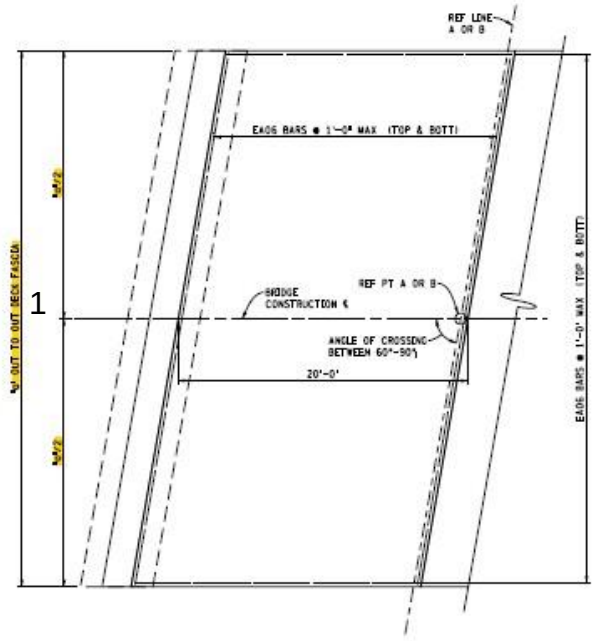
NOTES:

USE APPROACH SLAB DETAILS ON STANDARD PLAN R-45 SERIES WHEN LENGTH OF BRIDGE CONTRIBUTING TO EXPANSION AT AN ABUTMENT IS LESS THAN 50 FEET FOR CONCRETE BEAM BRIDGES, AND LESS THAN 25 FEET FOR ROLLED STEEL BRIDGES.

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:)								NO SCALE		DATE: 03/07/18	CS:	SUPERSTRUCTURE DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			DESIGN UNIT:	JN:		DECK	SECT
									FILE: Deck_003.dgn	TSC:			003	

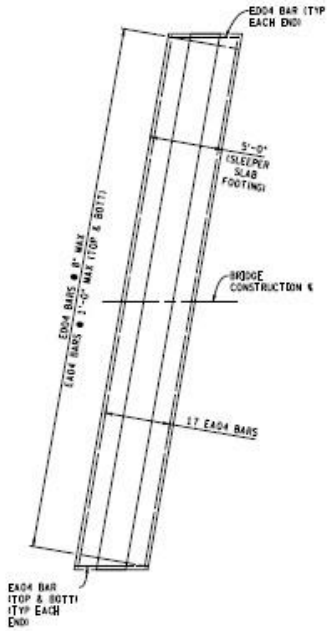
Sheet 3: Approach Slab

1) Insert: width
2) Select approach type (concrete, HMA, R-45)

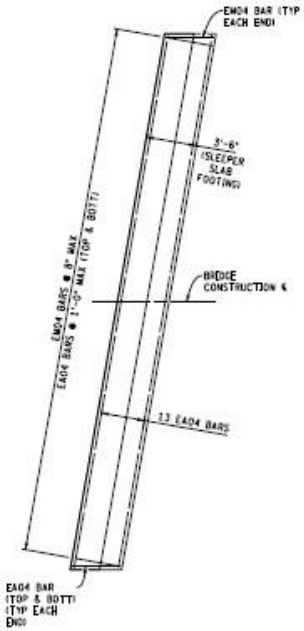


1

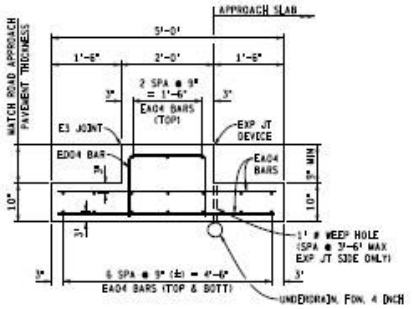
PLAN OF APPROACH SLAB (EXPANSION SIDE)
(ANGLE OF CROSSING 60° OR GREATER)
(SLEEPER SLAB FOR CONCRETE APPROACH SHOWN)



PLAN OF SLEEPER SLAB
(ANGLE OF CROSSING 60° OR GREATER)
(CONCRETE APPROACH)

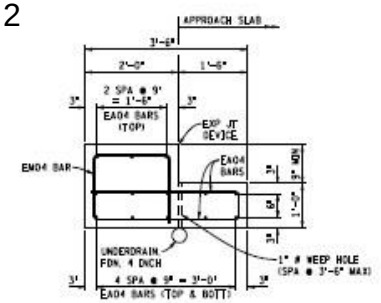


PLAN OF SLEEPER SLAB
(ANGLE OF CROSSING 60° OR GREATER)
(HMA APPROACH)

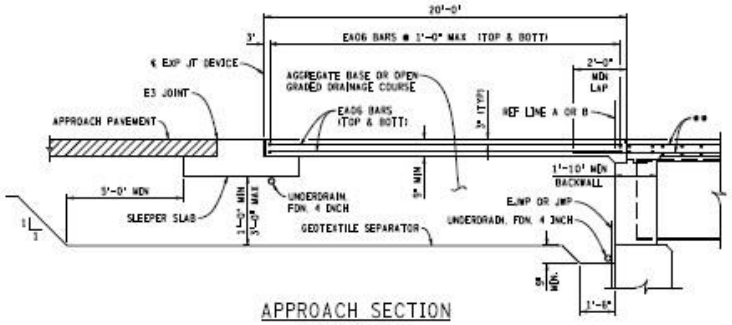


SECTION THRU SLEEPER SLAB
WITH CONCRETE APPROACH

2

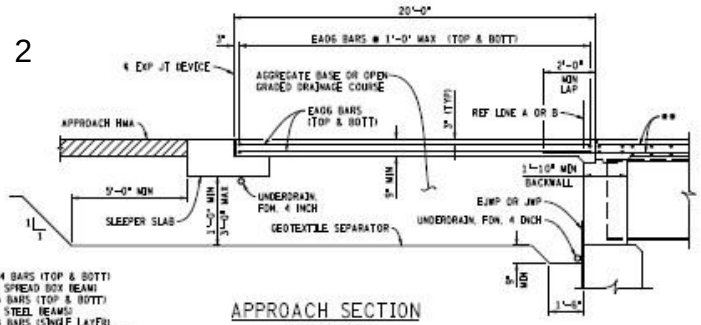


SECTION THRU SLEEPER SLAB
WITH HMA APPROACH



APPROACH SECTION
(CONCRETE APPROACH)

2



APPROACH SECTION
(HMA APPROACH)

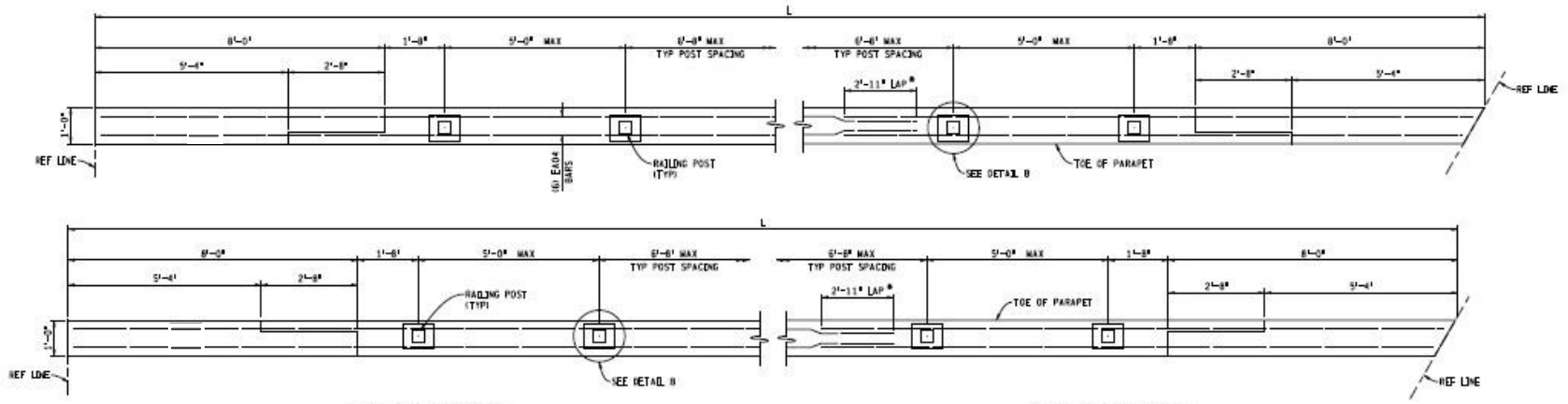
** EA04 BARS (TOP & BOTT)
(FOR SPREAD BOX BEAM)
EA05 BARS (TOP & BOTT)
(FOR STEEL BEAMS)
EA03 BARS (SINGLE LAYER)
(FOR SIDE BY SIDE BOX BEAMS)

NOTES:

USE APPROACH SLAB DETAILS ON STANDARD PLAN R-45 SERIES WHEN LENGTH OF BRIDGE CONTRIBUTING TO EXPANSION AT AN ABUTMENT IS LESS THAN 50 FEET FOR CONCRETE BEAM BRIDGES, AND LESS THAN 25 FEET FOR ROLLED STEEL BRIDGES.

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE)								NO SCALE	DATE: 03/07/18	CS:	SUPERSTRUCTURE DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION		DESIGN UNIT:	JN:		DECK	SECT
								FILE: Deck_003.dgn	TSC:			003	

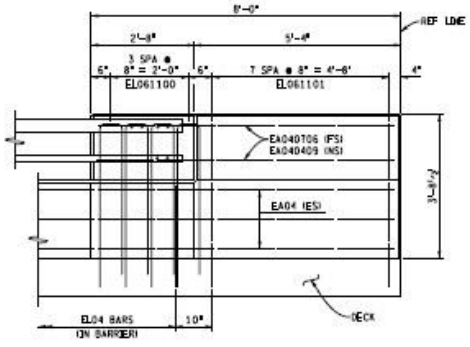
Sheet 4: Barrier and end wall



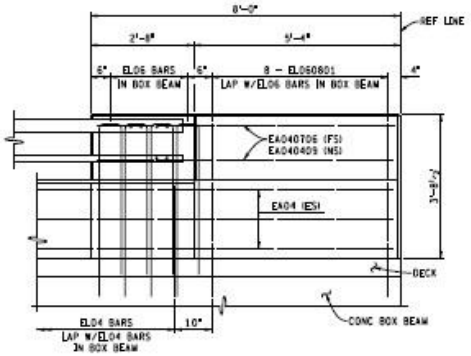
PLAN OF BARRIER
(ANGLE OF CROSSING 90°)
(AESTHETIC PARAPET TUBE)

PLAN OF BARRIER
(ANGLE OF CROSSING LESS THAN 90°)
(AESTHETIC PARAPET TUBE)

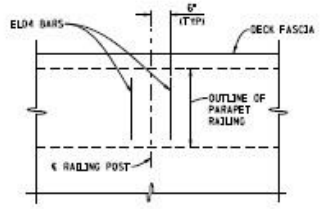
* OMIT LAP FOR SPANS 40'-0" OR UNDER



END WALL ELEVATION
(SPREAD BOX BEAM, BULB T BEAM, ROLLED STEEL BEAM)

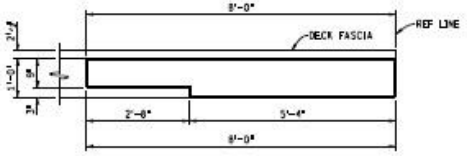


END WALL ELEVATION
(SIDE BY SIDE BOX BEAM)



DETAIL B

PLACE 2 ADDITIONAL EL04 BARS AT EACH RAILING POST AS SHOWN. ADJUST SPACING OF ADJACENT REINFORCEMENT IF NECESSARY.



END WALL PLAN

NOTES:

ES DENOTES EACH SIDE.

FS DENOTES FAR SIDE.

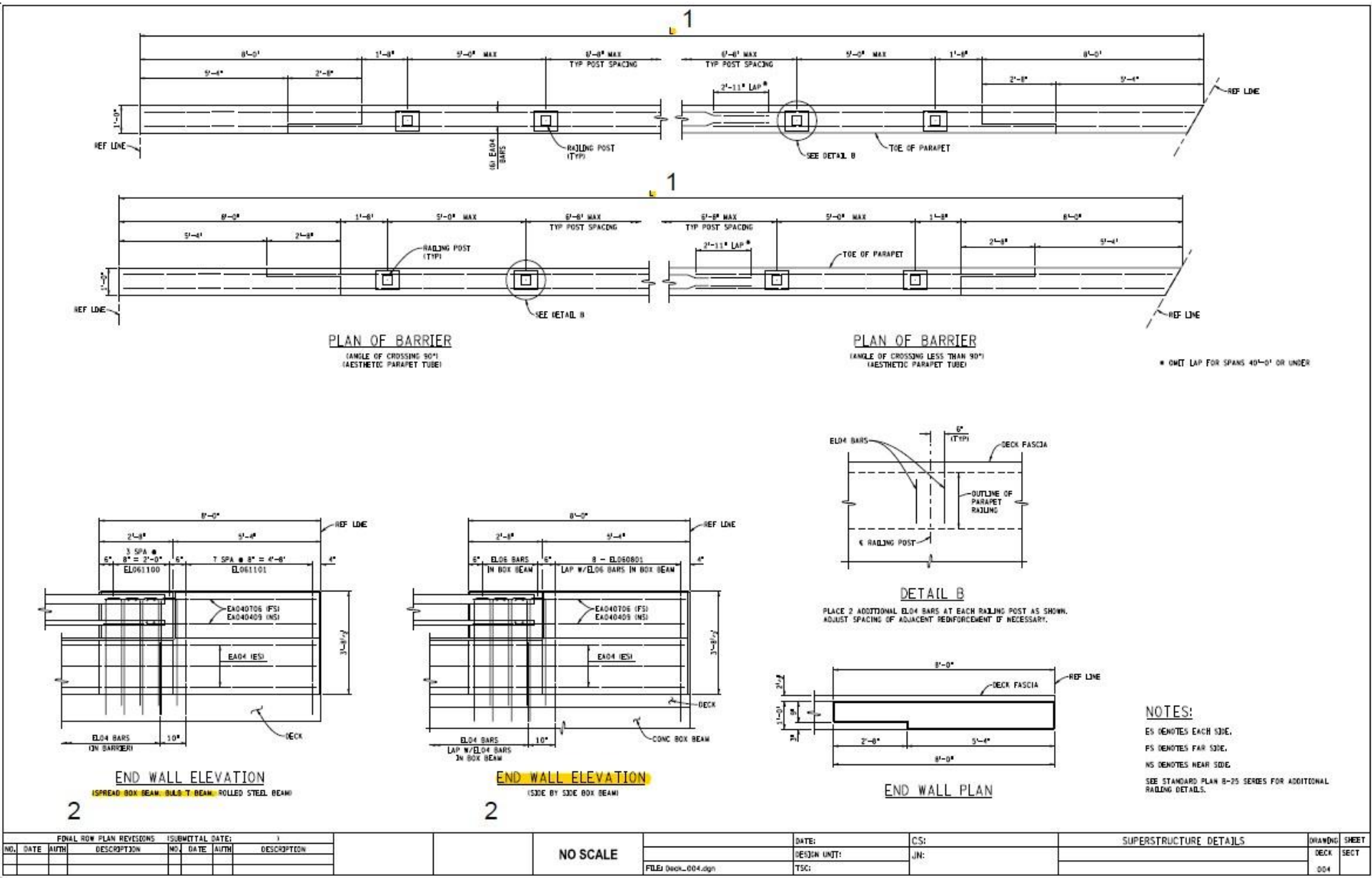
NS DENOTES NEAR SIDE.

SEE STANDARD PLAN B-25 SERIES FOR ADDITIONAL RAILING DETAILS.

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:				NO SCALE	DATE:	CS:	SUPERSTRUCTURE DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION		DESIGN UNIT:	JN:		DECK	SECT
									FILE: (deck_004.dgn	TSC:		004	

Sheet 4: Barrier and end wall

1) Insert: span
2) Delete: note and end wall elevation



FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:			
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

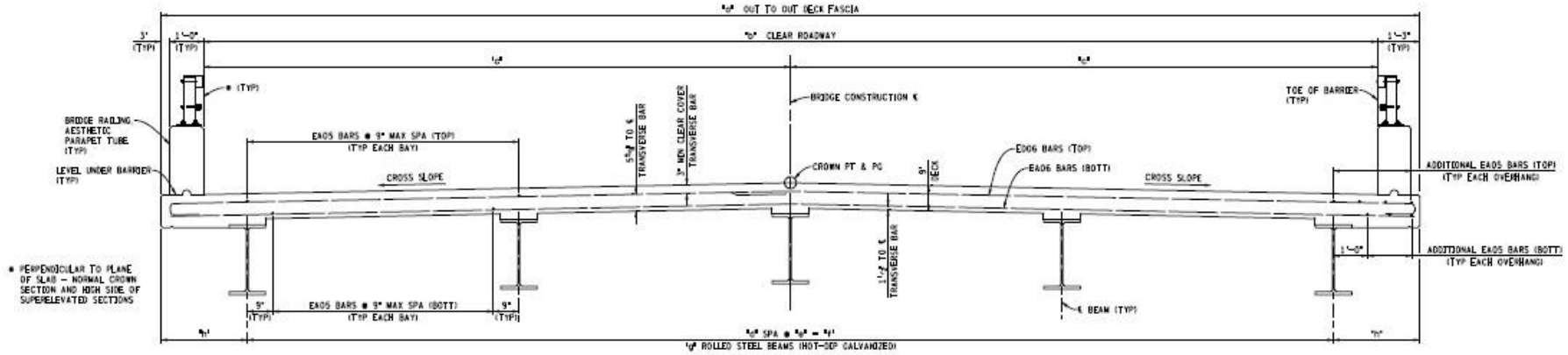
NO SCALE

DATE:
DESIGN UNIT:
TSC:
FILE: Deck_004.dgn
CS:
JN:

SUPERSTRUCTURE DETAILS

DRAWING: DECK 004
SHEET: SECT

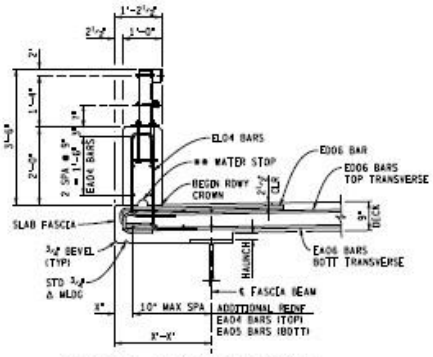
Sheet 8: Bridge section



DECK SECTION

(AESTHETIC PARAPET TUBE RAILING SHOWN)

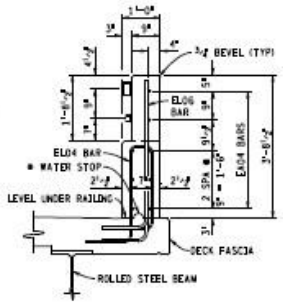
DIMENSION TABLE								
SPAN LENGTH (FT)	DIMENSION							
	OUT-TO-OUT "A"	CLR RDWY "B"	"C"	BEAM SPACING "D"	"E"	"F"	BEAM SIZE "G"	"H"
20	32'-6"	30'-0"	15'-0"	4	8'-4 1/2"	25'-6"	W14 x 120	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W14 x 120	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W14 x 120	2'-6"
30	32'-6"	30'-0"	15'-0"	4	8'-4 1/2"	25'-6"	W14 x 120	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W14 x 120	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W14 x 120	2'-6"
40	32'-6"	30'-0"	15'-0"	4	8'-4 1/2"	25'-6"	W21 x 147	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W21 x 147	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W21 x 147	2'-6"
50	32'-6"	30'-0"	15'-0"	4	8'-4 1/2"	25'-6"	W30 x 173	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W30 x 173	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W30 x 173	2'-6"
60	32'-6"	30'-0"	15'-0"	4	8'-4 1/2"	25'-6"	W36 x 170	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W36 x 170	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W36 x 170	2'-6"



TYPICAL RAILING SECTION

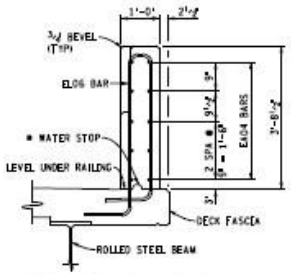
(AESTHETIC PARAPET TUBE RAILING SHOWN)

** 2" HIGH x 4" LONG (±). FORMING NOT REQUIRED



SECTION AT END WALL

(TUBE CONNECTION AREA)



SECTION AT END WALL

(FULL CONCRETE AREA)

** 2" HIGH x 4" LONG (±). FORMING NOT REQUIRED

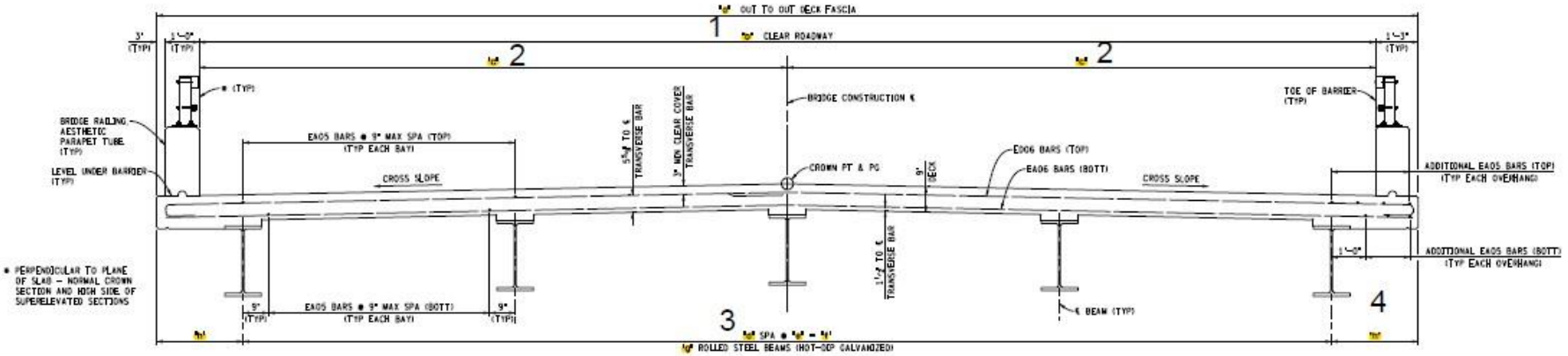
NOTES:

FOR SUPERELEVATED SECTIONS REFER TO MDOT DESIGN GUIDES FOR DETERMINING THE CROSS SLOPE.

FINAL ROW PLAN REVISIONS				(SUBMITTAL DATE:)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION		NO SCALE	DATE:	CS:	SUPERSTRUCTURE DETAILS	DRAWING	SHEET
										DESIGN UNIT:	JN:	ROLLED STEEL BEAM	DECK	SECT
										FILE: Deck_RSB_002.dgn	TSC:		008	

Sheet 8: Bridge section

1, 2) Insert: bridge width parameters (a, b, c)
3) Insert: beam spacing parameters (d, e, f)
4) Insert: overhang (h)
5) Select on table: bridge span and width

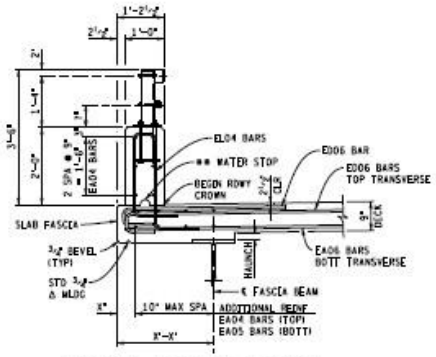


DECK SECTION
(AESTHETIC PARAPET TUBE RAILING SHOWN)

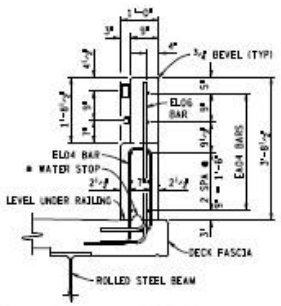
5

DIMENSION TABLE

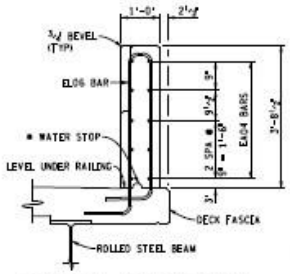
SPAN LENGTH (FT)	DIMENSION							
	OUT-TO-OUT "a"	CLR RDWY "b"	"c"	BEAM SPACING "d"	"e"	"f"	BEAM SIZE	"h"
20	32'-6"	30'-0"	19'-0"	4	8'-4 1/2"	25'-6"	W14 x 120	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W14 x 120	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W14 x 120	2'-6"
30	32'-6"	30'-0"	19'-0"	4	8'-4 1/2"	25'-6"	W14 x 120	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W14 x 120	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W14 x 120	2'-6"
40	32'-6"	30'-0"	19'-0"	4	8'-4 1/2"	25'-6"	W21 x 147	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W21 x 147	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W21 x 147	2'-6"
50	32'-6"	30'-0"	19'-0"	4	8'-4 1/2"	25'-6"	W30 x 173	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W30 x 173	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W30 x 173	2'-6"
60	32'-6"	30'-0"	19'-0"	4	8'-4 1/2"	25'-6"	W36 x 170	3'-6"
	36'-6"	34'-0"	17'-0"	5	8'-3"	31'-3"	W36 x 170	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	8'-3"	37'-6"	W36 x 170	2'-6"



TYPICAL RAILING SECTION
(AESTHETIC PARAPET TUBE RAILING SHOWN)
** 2" HIGH x 4" LONG (±). FORMING NOT REQUIRED



SECTION AT END WALL
(TUBE CONNECTION AREA)



SECTION AT END WALL
(FULL CONCRETE AREA)

* 2" HIGH x 4" LONG (±). FORMING NOT REQUIRED

NOTES:

FOR SUPERELEVATED SECTIONS REFER TO MDOT DESIGN GUIDES FOR DETERMINING THE CROSS SLOPE.

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:			
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

NO SCALE

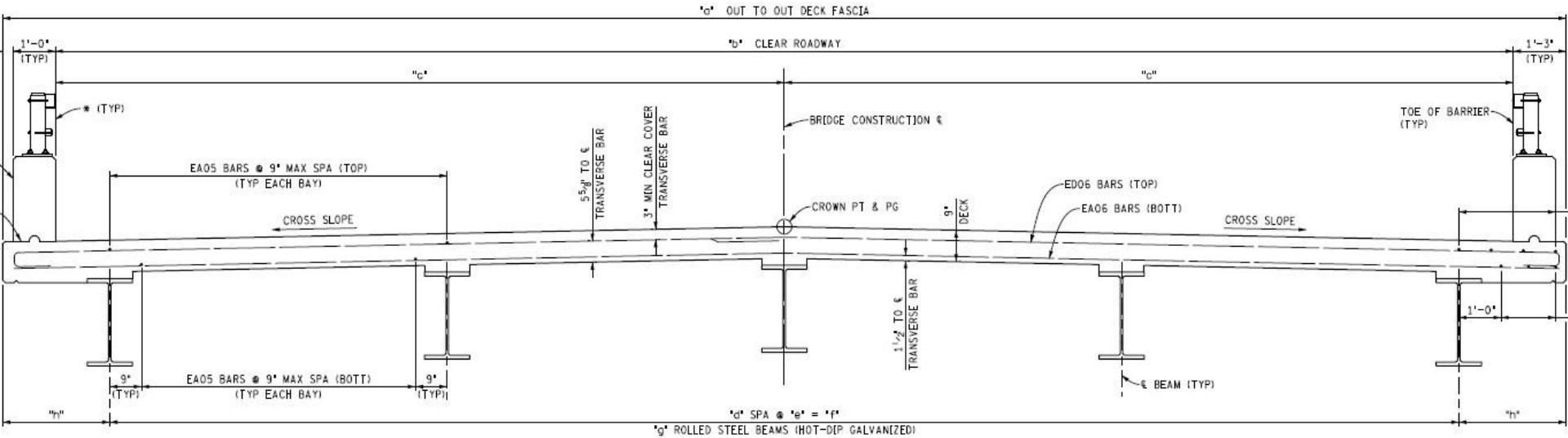
DATE:
DESIGN UNIT:
FILE: Deck_RSB_002.dgn
CS:
JN:
TSC:

SUPERSTRUCTURE DETAILS
ROLLED STEEL BEAM

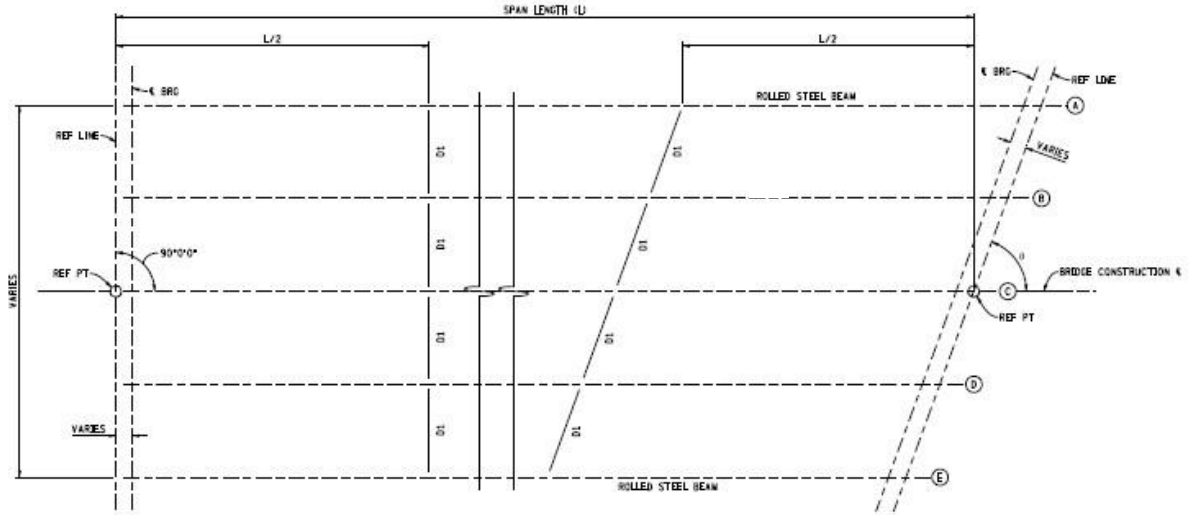
DRAWING: DECK 008
SHEET: SECT

Sheet 8: Beam size & spacing selection table

DIMENSION TABLE								
SPAN LENGTH (FT)	DIMENSION							
	OUT-TO-OUT "a"	CLR RDWY "b"	"c"	BEAM SPACING			BEAM SIZE "g"	"h"
				"d"	"e"	"f"		
20	32'-6"	30'-0"	15'-0"	4	6'-4 1/2"	25'-6"	W14 x 120	3'-6"
	36'-6"	34'-0"	17'-0"	5	6'-3"	31'-3"	W14 x 120	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	6'-3"	37'-6"	W14 x 120	2'-6"
30	32'-6"	30'-0"	15'-0"	4	6'-4 1/2"	25'-6"	W14 x 120	3'-6"
	36'-6"	34'-0"	17'-0"	5	6'-3"	31'-3"	W14 x 120	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	6'-3"	37'-6"	W14 x 120	2'-6"
40	32'-6"	30'-0"	15'-0"	4	6'-4 1/2"	25'-6"	W21 x 147	3'-6"
	36'-6"	34'-0"	17'-0"	5	6'-3"	31'-3"	W21 x 147	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	6'-3"	37'-6"	W21 x 147	2'-6"
50	32'-6"	30'-0"	15'-0"	4	6'-4 1/2"	25'-6"	W30 x 173	3'-6"
	36'-6"	34'-0"	17'-0"	5	6'-3"	31'-3"	W30 x 173	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	6'-3"	37'-6"	W30 x 173	2'-6"
60	32'-6"	30'-0"	15'-0"	4	6'-4 1/2"	25'-6"	W36 x 170	3'-6"
	36'-6"	34'-0"	17'-0"	5	6'-3"	31'-3"	W36 x 170	2'-7 1/2"
	42'-6"	40'-0"	20'-0"	6	6'-3"	37'-6"	W36 x 170	2'-6"



Sheet 21: Erection diagram



ERECTION DIAGRAM

SERVICE BEAM REACTIONS (KIPS)			
DECK WIDTH 30 FT			
(L) SPAN (ft)	DC	DW	LL+I
20	22	24.5	251
30	16.5	18	238
40	22	24.5	251
50	27	31	268
60	32.5	37	283.5
DECK WIDTH 34 FT			
(L) SPAN (ft)	DC	DW	LL+I
20	XX	XX	XX
30	XX	XX	XX
40	XX	XX	XX
50	XX	XX	XX
60	XX	XX	XX
DECK WIDTH 40 FT			
(L) SPAN (ft)	DC	DW	LL+I
20	XX	XX	XX
30	XX	XX	XX
40	XX	XX	XX
50	XX	XX	XX
60	XX	XX	XX

℄ DIAPHRAGMS

DW DENOTES SERVICE BEAM REACTION DUE TO FUTURE WEARING SURFACE

LL+I DENOTES SERVICE LIVE LOAD PLUS IMPACT REACTION PER LANE

NOTES:

THE DESIGN OF THESE STRUCTURES IS BASED ON 1.2 TIMES THE CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF SPAN LENGTH.

SHEAR DEVELOPERS SHALL BE ¾" DIAMETER STUDS.

ALL STRUCTURAL STEEL SHALL BE COATED ACCORDING TO SUBSECTION 716 OF THE STANDARD SPECIFICATIONS AND SHALL BE HOT-DIPPED GALVANIZED.

STRUCTURAL STEEL SHALL CONFORM TO AASHTO M270, GRADE 50 OR AASHTO M270, GRADE 50W. AASHTO M270, GRADE 36. STEEL MAY BE USED IN LIEU OF THESE STEELS FOR THE DIAPHRAGMS (EXCEPT CONNECTION PLATES).

ALL HOLES SHALL BE $^{13}/_{16}$" FOR ¾" HIGH-STRENGTH BOLTS.

FIELD CONNECTIONS SHALL BE BOLTED WITH ¾" HIGH-STRENGTH BOLTS (EXCEPT AS NOTED).

THE QUANTITY STRUCTURAL STEEL INCLUDES:
STEEL _____ LBS
BRONZE _____ LBS
TOTAL _____ LBS

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

NO SCALE

DATE: 03/07/18
DESIGN UNIT:
FILE: steel_001.dgn
TSC:
CS:
JN:

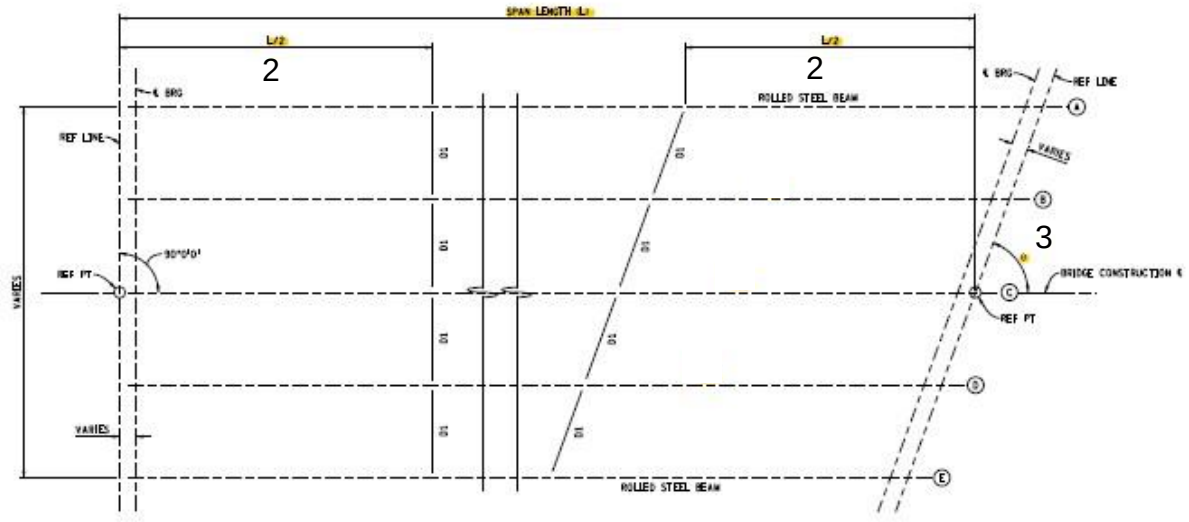
STRUCTURAL STEEL DETAILS
ROLLED STEEL BEAM

DRAWING	SHEET
STEEL	SECT
001	

Sheet 21: Erection diagram

1, 2) Insert: bridge length (L; L/2)
3) Insert: angle of crossing (θ)
4) Read reactions per bridge type
5) Enter material quantities

1



ERECTION DIAGRAM

4

SERVICE BEAM REACTIONS (KIPS)			
DECK WIDTH 30 FT			
(L) SPAN (ft)	DC	DW	LL+I
20	22	24.5	251
30	16.5	18	238
40	22	24.5	251
50	27	31	268
60	32.5	37	283.5
DECK WIDTH 34 FT			
(L) SPAN (ft)	DC	DW	LL+I
20	XX	XX	XX
30	XX	XX	XX
40	XX	XX	XX
50	XX	XX	XX
60	XX	XX	XX
DECK WIDTH 40 FT			
(L) SPAN (ft)	DC	DW	LL+I
20	XX	XX	XX
30	XX	XX	XX
40	XX	XX	XX
50	XX	XX	XX
60	XX	XX	XX

DC DENOTES SERVICE DEAD LOADS DUE TO BEAM SELF WEIGHT, DECK WEIGHT, & DIAPHRAGMS

DW DENOTES SERVICE BEAM REACTION DUE TO FUTURE WEARING SURFACE

LL+I DENOTES SERVICE LIVE LOAD PLUS IMPACT REACTION PER LANE

NOTES:

THE DESIGN OF THESE STRUCTURES IS BASED ON 1.2 TIMES THE CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF SPAN LENGTH.

SHEAR DEVELOPERS SHALL BE ¾" DIAMETER STUDS.

ALL STRUCTURAL STEEL SHALL BE COATED ACCORDING TO SUBSECTION 716 OF THE STANDARD SPECIFICATIONS AND SHALL BE HOT-DIPPED GALVANIZED.

STRUCTURAL STEEL SHALL CONFORM TO AASHTO M270, GRADE 50, OR AASHTO M270, GRADE 50W, AASHTO M270, GRADE 36, STEEL MAY BE USED IN LIEU OF THESE STEELS FOR THE DIAPHRAGMS (EXCEPT CONNECTION PLATES).

ALL HOLES SHALL BE 15/16" FOR ¾" HIGH-STRENGTH BOLTS.

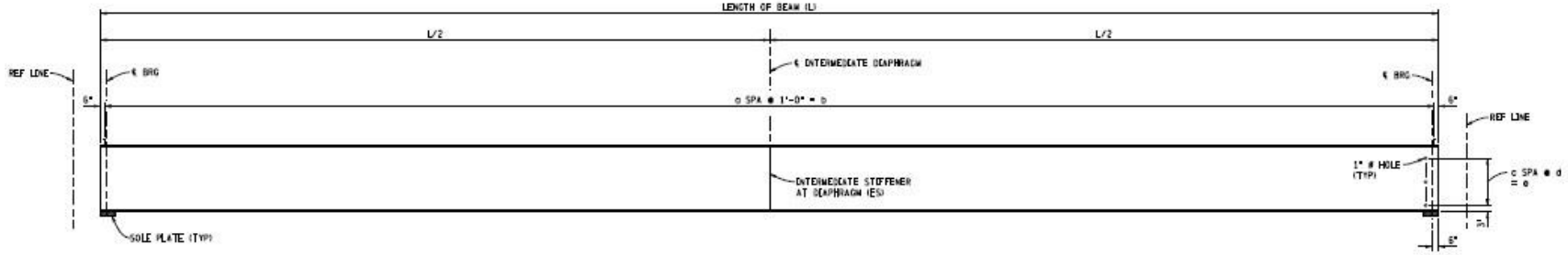
FIELD CONNECTIONS SHALL BE BOLTED WITH ¾" HIGH-STRENGTH BOLTS (EXCEPT AS NOTED).

THE QUANTITY STRUCTURAL STEEL INCLUDES:
STEEL _____ LBS
BRONZE _____ LBS
TOTAL _____ LBS

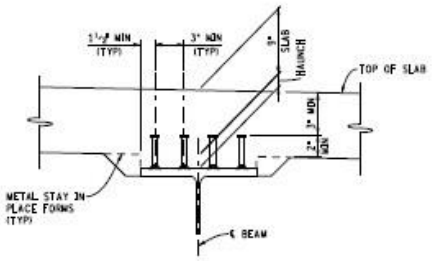
5

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:)													
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			NO SCALE		DATE: 03/07/18	CS:	STRUCTURAL STEEL DETAILS	DRAWING	SHEET
												DESIGN UNIT:	JN:	ROLLED STEEL BEAM	STEEL	NO.
											FILE: steel_001.dgn	TSC:			001	

Sheet 22: Shear studs



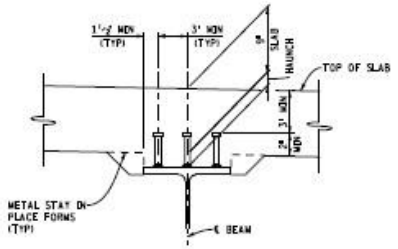
BEAM ELEVATION



SECTION

SHEAR STUD DEVELOPER DETAILS

W14 x 109 & W14 x 145 BEAMS



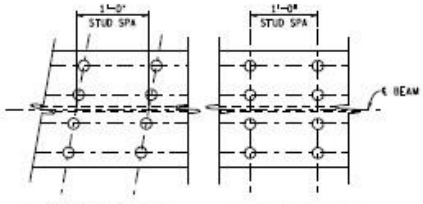
SECTION

SHEAR STUD DEVELOPER DETAILS

W30 x 173 & W33 x 152 BEAMS

BEAM DIMENSION TABLE

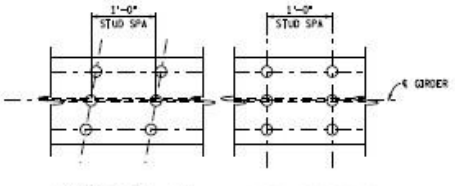
SPAN LENGTH	GIRDER TYPE	a	b	c	d	e
20'	W14 x 120	20	20'	1	6"	6"
30'	W14 x 120	30	30'	1	6"	6"
40'	W21 x 147	40	40'	1	6"	6"
50'	W30 x 173	50	50'	2	8"	16"
60'	W36 x 170	60	60'	2	12"	24"



PLAN

W14 x 109 & W14 x 145 BEAMS

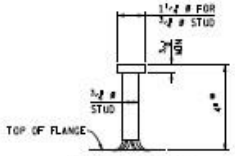
ROWS OF STUDS SHALL BE SET PARALLEL TO TRANSVERSE REINFORCEMENT.



PLAN

W30 x 173 & W33 x 152 BEAMS

ROWS OF STUDS SHALL BE SET PARALLEL TO TRANSVERSE REINFORCEMENT.



DETAIL OF STUD

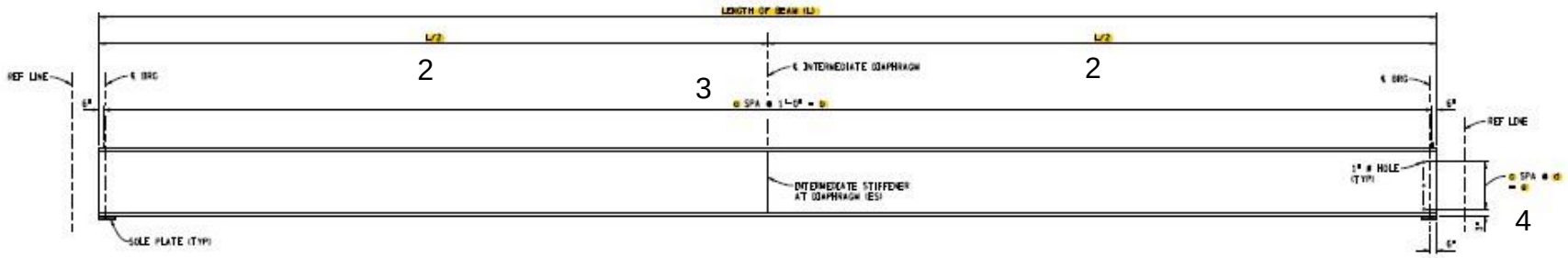
* INCREASE LENGTH OF STUD AS NEEDED TO MAINTAIN 2" MINIMUM PENETRATION OF STUD INTO DECK SLAB. (1" INCREMENTS)

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE: ( )				NO SCALE		DATE: 03/07/18	CS:	STRUCTURAL STEEL DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			DESIGN UNIT:	JN:	ROLLED STEEL BEAM	STEEL	SECT
									FILE: sheet_002.dgn	TSC:			002	

Sheet 22: Shear studs

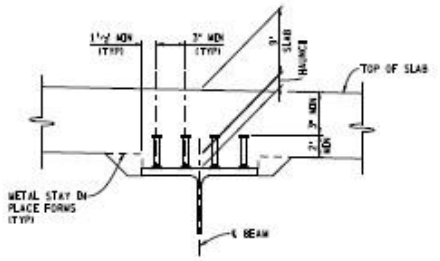
1, 2) Insert: bridge length (L = b)
3) Insert: # of studs (a) & length (b)
4) Insert: #of holes (c); spacing (d); tot. dist. (e)
5) Read dimensions per bridge span

1



2 2 3 4

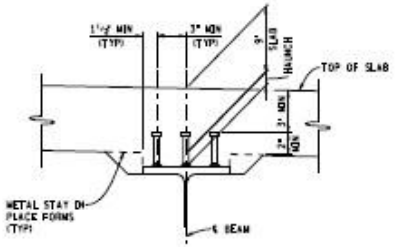
BEAM ELEVATION



SECTION

SHEAR STUD DEVELOPER DETAILS

W14 x 109 & W14 x 145 BEAMS



SECTION

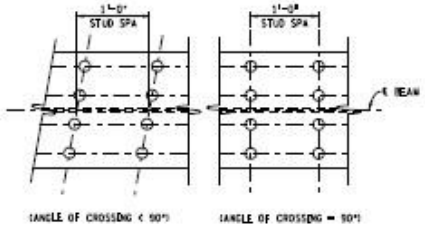
SHEAR STUD DEVELOPER DETAILS

W30 x 173 & W33 x 152 BEAMS

5

BEAM DIMENSION TABLE

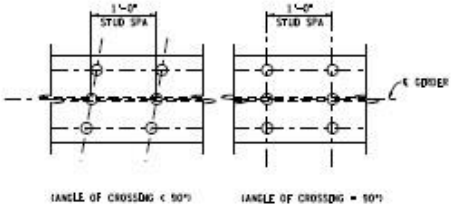
SPAN LENGTH	GIRDER TYPE	a	b	c	d	e
20'	W14 x 120	20	20'	1	6"	6"
30'	W14 x 120	30	30'	1	6"	6"
40'	W21 x 147	40	40'	1	6"	6"
50'	W30 x 173	50	50'	2	8"	16"
60'	W36 x 170	60	60'	2	12"	24"



PLAN

W14 x 109 & W14 x 145 BEAMS

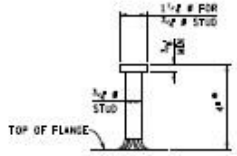
ROWS OF STUDS SHALL BE SET PARALLEL TO TRANSVERSE REINFORCEMENT.



PLAN

W30 x 173 & W33 x 152 BEAMS

ROWS OF STUDS SHALL BE SET PARALLEL TO TRANSVERSE REINFORCEMENT.



DETAIL OF STUD

* INCREASE LENGTH OF STUD AS NEEDED TO MAINTAIN 2" MINIMUM PENETRATION OF STUD INTO DECK SLAB. (1" INCREMENTS)

FINAL ROW PLAN REVISIONS				SUBMITTAL DATES			
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

NO SCALE

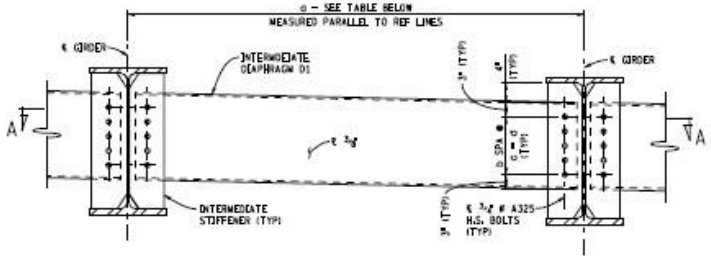
DATE: 03/07/18
DESIGN UNIT:
TSC:
FILE: steel_002.dgn

CS:
JN:

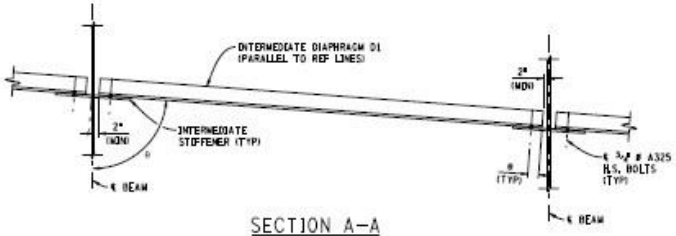
STRUCTURAL STEEL DETAILS
ROLLED STEEL BEAM

DRAWING: STEEL 002
SHEET: SECT

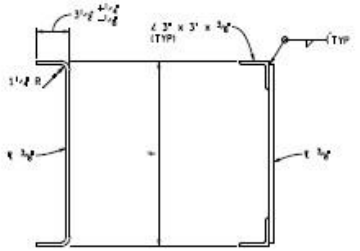
Sheet 23: Diaphragms



INTERMEDIATE DIAPHRAGM D1 ELEVATION



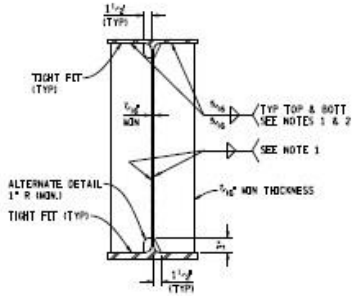
SECTION A–A



ALTERNATE

TYPICAL INTERMEDIATE DIAPHRAGM

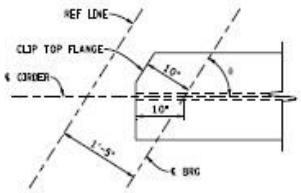
DIAPHRAGM DIMENSION TABLE						
GIRDER TYPE	a	b	c	d	e	f
W14 x 120	8'	1	2½"	2½"	2"	10"
W21 x 147	8'	1	2½"	2½"	2"	10"
W30 x 173	8'	3	2½"	3½"	2"	12"
W36 x 170	8'	6	2½"	15"	2"	22"



INTERMEDIATE TRANSVERSE STIFFENER DETAIL @ CROSSFRAME

BOLT HOLES NOT SHOWN FOR CLARITY

NOTE 1: STOP WELD ½" SHORT OF CORNER CLIPS
NOTE 2: WRAP WELD AROUND OUTSIDE EDGE



TOP FLANGE CLIP DETAIL

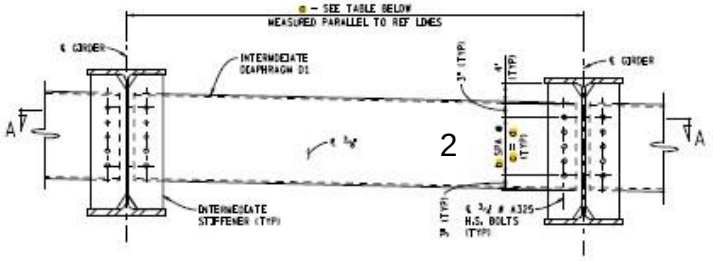
* BASED ON ABUTMENT AND BEARING GEOMETRY

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:				NO SCALE	DATE: 03/07/18	CS:	STRUCTURAL STEEL DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION		DESIGN UNIT:	JN:	ROLLED STEEL BEAM	STEEL	SECT
									FILE: sheet_003.dgn	TSC:		003	

Sheet 23: Diaphragms

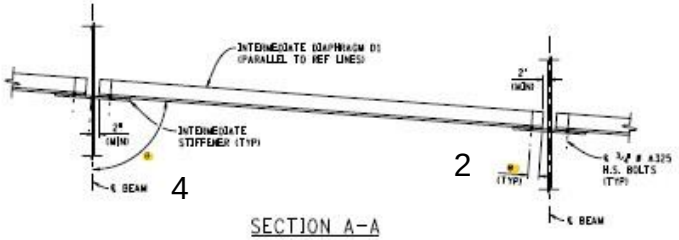
1) Insert: beam spacing (a)
2) Insert: #of holes (b); spacing (c, e); tot. dist. (d)
3) Insert: diaphragm depth (f)
4) Insert: angle of crossing (θ)
5) Read diaphragm dim. per beam type

1



INTERMEDIATE DIAPHRAGM D1 ELEVATION

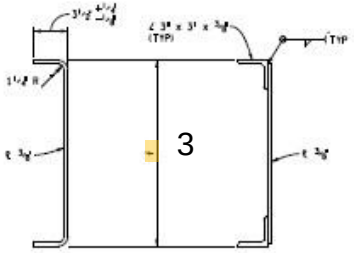
2



4

SECTION A-A

3

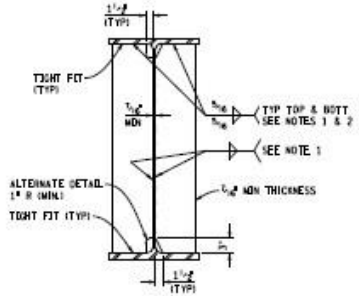


TYPICAL INTERMEDIATE DIAPHRAGM

5

DIAPHRAGM DIMENSION TABLE

GIRDER TYPE	a	b	c	d	e	f
W14 x 120	8'	1	2½"	2½"	2"	10"
W21 x 147	8'	1	2½"	2½"	2"	10"
W30 x 173	8½	3	2½"	2½"	2"	12"
W36 x 170	8'	6	2½"	15"	2"	22"

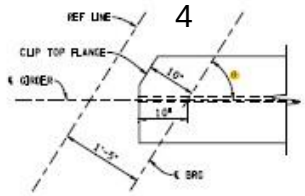


INTERMEDIATE TRANSVERSE STIFFENER DETAIL @ CROSSFRAME

BOLT HOLES NOT SHOWN FOR CLARITY

NOTE 1: STOP WELD ½" SHORT OF CORNER CLIPS
NOTE 2: WRAP WELD AROUND OUTSIDE EDGE

4



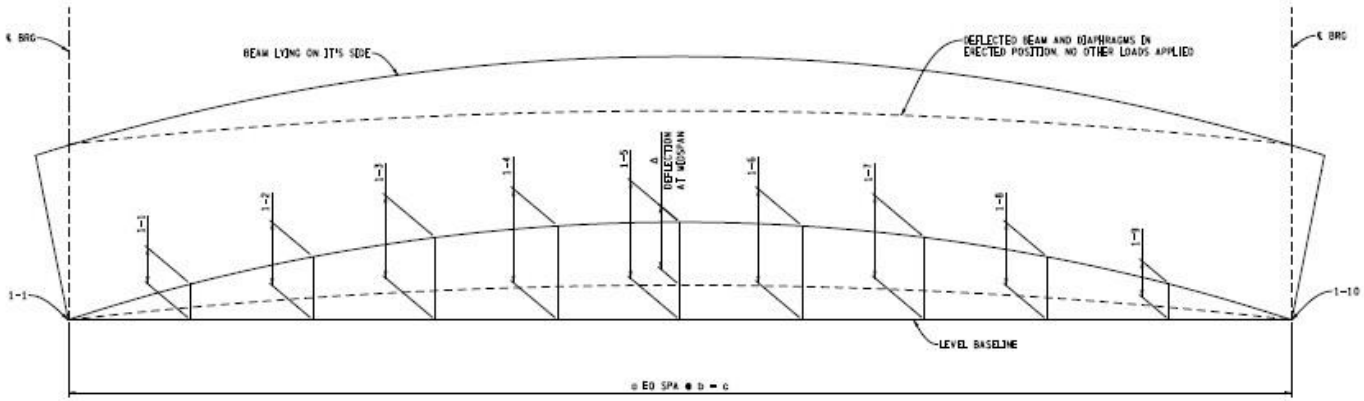
TOP FLANGE CLIP DETAIL

* BASED ON ABUTMENT AND BEARING GEOMETRY

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:)														
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			NO SCALE		DATE: 03/07/18	CS:	STRUCTURAL STEEL DETAILS
												DESIGN UNIT:	JN:	ROLLED STEEL BEAM
											FILE: sheetL003.dgn	TSC:		

DRAWING	SHEET
STEEL	SECT
003	

Sheet 24: Camber diagram



CAMBER DIAGRAM

ORDINATE DIMENSION TABLE				
SPAN LENGTH	GIRDER TYPE	a	b	c
30'	W14 x 120	X	X	X
40'	W21 x 147	X	X	X
50'	W30 x 173	X	X	X
60'	W36 x 170	X	X	X

THEORETICAL CAMBER TABLE												
BEAM	SPAN LENGTH	CAMBER ORDINATES										
		1-0	1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10
W14 x 120	30'	X	X	X	X	X	X	X	X	X	X	X
W21 x 147	40'	X	X	X	X	X	X	X	X	X	X	X
W30 x 173	50'	X	X	X	X	X	X	X	X	X	X	X
W36 x 170	60'	X	X	X	X	X	X	X	X	X	X	X

NOTES:

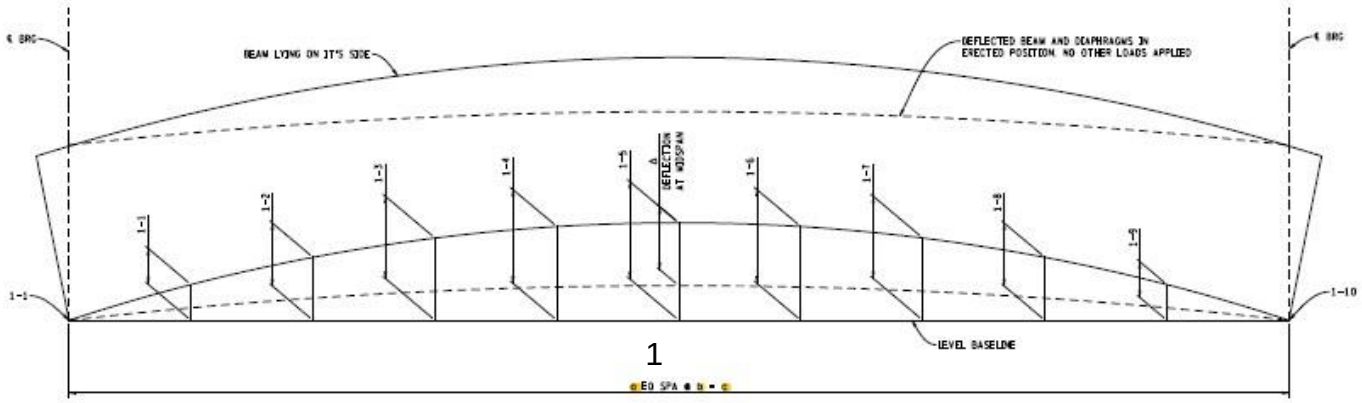
THE BEAMS SHALL HAVE A PARABOLIC CAMBER WITH ORDINATES AS SHOWN ON THE CAMBER DIAGRAM. HEATING IS TO BE USED, IF NECESSARY, TO PROVIDE THE CAMBER WITHIN A TOLERANCE OF +1/4" AT THE CENTER. THE CAMBER SHOWN IS TO BE MEASURED WITH THE BEAM LYING ON ITS SIDE.

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:						
NO.	DATE	AUTH	DESCRIPTION		NO.	DATE	AUTH	DESCRIPTION		

NO SCALE	DATE: 03/07/18	CS:	STRUCTURAL STEEL DETAILS	DRAWING	SHEET
	DESIGN UNIT:	JN:	ROLLED STEEL BEAM	STEEL	SECT
FILE: s-steel_004.dgn	TSC:			004	

Sheet 24: Camber diagram

1) Insert: number of ordinates (a), spacing (b), length (c)
2) Read ordinate location per span
3) Read camber values per span



1

CAMBER DIAGRAM

2

ORDINATE DIMENSION TABLE

SPAN LENGTH	GIRDER TYPE	a	b	c
30'	W14 x 120	X	X	X
40'	W21 x 147	X	X	X
50'	W30 x 173	X	X	X
60'	W36 x 170	X	X	X

3

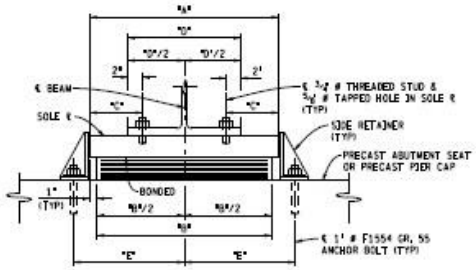
THEORETICAL CAMBER TABLE

BEAM	SPAN LENGTH	CAMBER ORDINATES										
		1-0	1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10
W14 x 120	30'	X	X	X	X	X	X	X	X	X	X	X
W21 x 147	40'	X	X	X	X	X	X	X	X	X	X	X
W30 x 173	50'	X	X	X	X	X	X	X	X	X	X	X
W36 x 170	60'	X	X	X	X	X	X	X	X	X	X	X

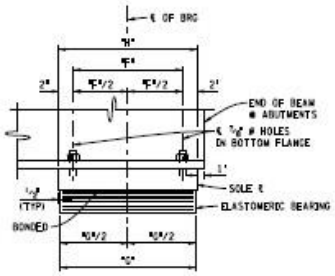
NOTES:

THE BEAMS SHALL HAVE A PARABOLIC CAMBER WITH ORDINATES AS SHOWN ON THE CAMBER DIAGRAM. HEATING IS TO BE USED, IF NECESSARY, TO PROVIDE THE CAMBER WITHIN A TOLERANCE OF +'-/ AT THE CENTER. THE CAMBER SHOWN IS TO BE MEASURED WITH THE BEAM LYING ON ITS SIDE.

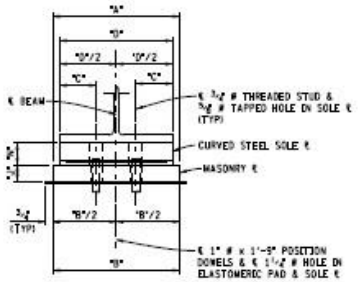
Sheet 27: Bearing assembly



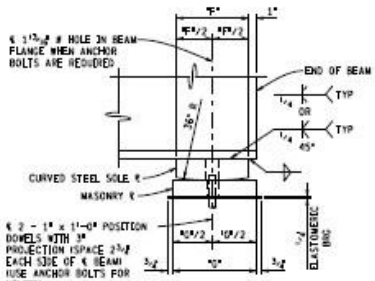
ELASTOMERIC EXPANSION BEARING
END VIEW



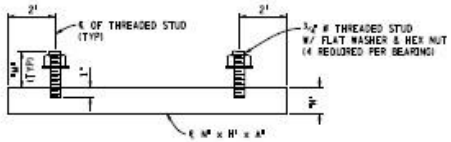
ELASTOMERIC EXPANSION BEARING
SIDE VIEW



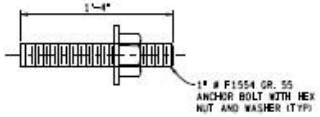
CURVED STEEL PLATE FIXED BEARING
END VIEW



CURVED STEEL PLATE FIXED BEARING
SIDE VIEW



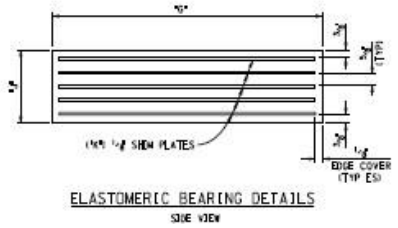
SOLE PLATE DETAILS
SIDE VIEW



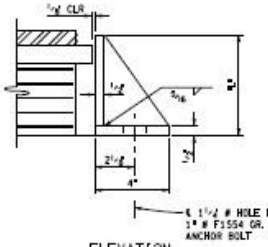
ANCHOR BOLT DETAIL

BEARING ASSEMBLY DIMENSIONS

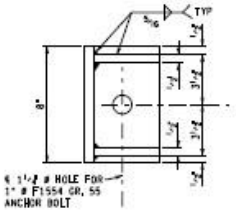
BEAM SIZE	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"L"	"M"	"N"
W14 x 120	X	X	X	X	X	X	X	X	X	X	X	X	X
W21 x 147	X	X	X	X	X	X	X	X	X	X	X	X	X
W30 x 173	X	X	X	X	X	X	X	X	X	X	X	X	X
W36 x 170	X	X	X	X	X	X	X	X	X	X	X	X	X



ELASTOMERIC BEARING DETAILS
SIDE VIEW

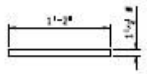


ELEVATION



PLAN

SIDE RETAINER



POSITION DOWEL DETAIL

NOTES:

ES DENOTES EACH SIDE.

FOR SINGLE SPAN STRUCTURES 40'-0" OR LESS IN LENGTH, ALLOWANCE FOR EXPANSION IS NOT REQUIRED IN THE DESIGN OF THE ELASTOMERIC BEARING PADS.

FOR SINGLE SPAN STRUCTURES WITH SPAN LENGTHS OVER 40'-0", ALLOWANCE FOR EXPANSION IS REQUIRED IN THE DESIGN OF THE ELASTOMERIC BEARING PADS.

USE NON-DEFORMED STEEL RODS IN ACCORDANCE WITH AASHTO M 270 GRADE 36 AND HOT-DIP GALVANIZED IN ACCORDANCE WITH AASHTO M 111, AS POSITION DOWELS FOR PRECAST BEAMS.

STEEL FOR SOLE PLATES AND OTHER BEARING COMPONENTS SHALL MEET THE REQUIREMENTS OF AASHTO M 270 GRADE 36.

FOR SIMPLE SPAN STRUCTURES, ONE ABUTMENT SHALL BE EXPANSION BEARINGS AND THE OTHER ABUTMENT SHALL BE FIXED BEARINGS.

ANCHOR BOLT LENGTHS SHOWN ARE MINIMUM. BOLTS LONGER THAN THAT SHOWN MAY BE FURNISHED AT NO ADDITIONAL COST. ANCHOR BOLTS AND POSITION DOWELS SHALL BE GALVANIZED ACCORDING TO MDOT STANDARD SPECIFICATION 707.03.C.16.

ANCHOR BOLTS SHALL CONFORM TO SECTION 908.15.

ANCHOR BOLTS SHALL BE INSTALLED AFTER BEAMS ARE ERECTED IN PLACE.

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:			
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

NO SCALE

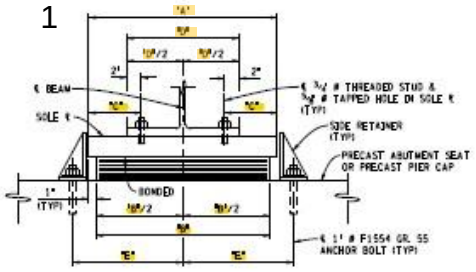
DATE: 03/07/18
DESIGN UNIT:
FILE: sheet_005.dgn
TSC:
CS:
JN:

ROLLED STEEL BEAM BEARING DETAILS

DRAWING: BRG
SHEET: 003
SECT

Sheet 27: Bearing assembly

1) Insert: bearing dimensions (A-N)
2) Read dimensions from table per girder type



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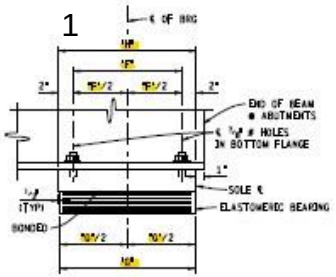
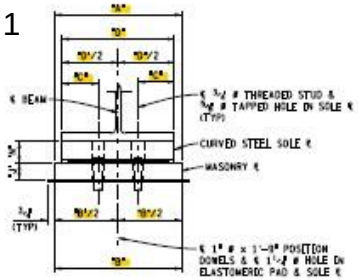
ELASTOMERIC EXPANSION BEARING
END VIEW



1

ELASTOMERIC EXPANSION BEARING
SIDE VIEW



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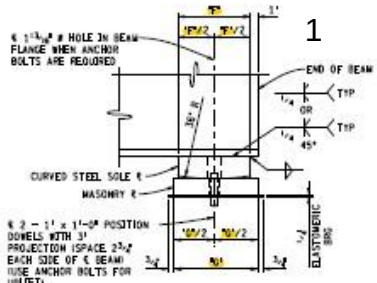
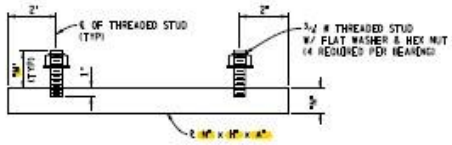
CURVED STEEL PLATE FIXED BEARING
END VIEW



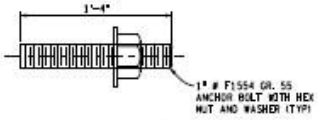
1

CURVED STEEL PLATE FIXED BEARING
SIDE VIEW



SOLE PLATE DETAILS
SIDE VIEW

1



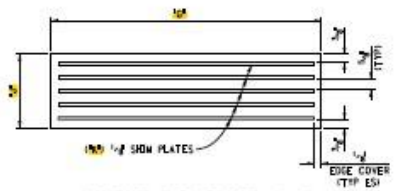
ANCHOR BOLT DETAIL

2

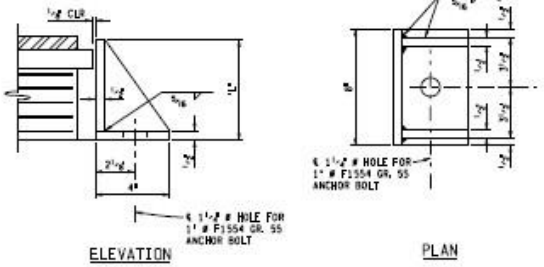
BEARING ASSEMBLY DIMENSIONS

BEAM SIZE	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"J"	"K"	"L"	"M"	"N"
W14 x 120	X	X	X	X	X	X	X	X	X	X	X	X	X
W21 x 147	X	X	X	X	X	X	X	X	X	X	X	X	X
W30 x 173	X	X	X	X	X	X	X	X	X	X	X	X	X
W36 x 170	X	X	X	X	X	X	X	X	X	X	X	X	X

1



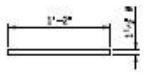
ELASTOMERIC BEARING DETAILS
SIDE VIEW



ELEVATION

PLAN

SIDE RETAINER



POSITION DOWEL DETAIL

NOTES:

ES DENOTES EACH SIDE.

FOR SINGLE SPAN STRUCTURES 40'-0" OR LESS IN LENGTH, ALLOWANCE FOR EXPANSION IS NOT REQUIRED IN THE DESIGN OF THE ELASTOMERIC BEARING PADS.

FOR SINGLE SPAN STRUCTURES WITH SPAN LENGTHS OVER 40'-0", ALLOWANCE FOR EXPANSION IS REQUIRED IN THE DESIGN OF THE ELASTOMERIC BEARING PADS.

USE NON-DEFORMED STEEL RODS IN ACCORDANCE WITH AASHTO M 270 GRADE 36 AND HOT-DIP GALVANIZED IN ACCORDANCE WITH AASHTO M 111. AS POSITION DOWELS FOR PRECAST BEAMS.

STEEL FOR SOLE PLATES AND OTHER BEARING COMPONENTS SHALL MEET THE REQUIREMENTS OF AASHTO M 270 GRADE 36.

FOR SIMPLE SPAN STRUCTURES, ONE ABUTMENT SHALL BE EXPANSION BEARINGS AND THE OTHER ABUTMENT SHALL BE FIXED BEARINGS.

ANCHOR BOLT LENGTHS SHOWN ARE MINIMUM. BOLTS LONGER THAN THAT SHOWN MAY BE FURNISHED AT NO ADDITIONAL COST. ANCHOR BOLTS AND POSITION DOWELS SHALL BE GALVANIZED ACCORDING TO MDOT STANDARD SPECIFICATION 707.03.C.16.

ANCHOR BOLTS SHALL CONFORM TO SECTION 908.15.

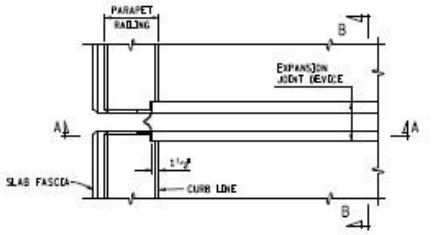
ANCHOR BOLTS SHALL BE INSTALLED AFTER BEAMS ARE ERECTED IN PLACE.

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION				

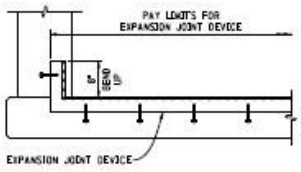
NO SCALE

	DATE: 03/07/18	CS:	ROLLED STEEL BEAM BEARING DETAILS	DRAWING	SHEET
	DESIGN UNIT:	JN:		BRG	SECT
FILE: sheetL005.dgn	TSC:			003	

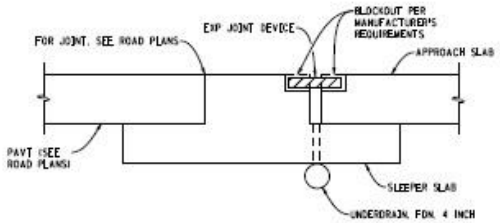
Sheet 28: Expansion joints



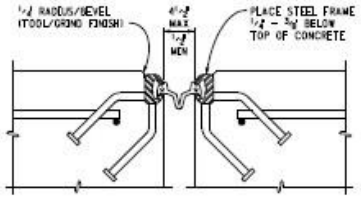
PLAN AT FLUSH MOUNT PARAPET RAILING



SECTION A-A



SECTION B-B



SECTION THROUGH EXPANSION JOINT

WABO STRIP SEAL TYPE M			
TOTAL TRAVEL *	PLATE WIDTH	Y	Z
< 1"	10"	3 1/2"	5 3/4"
1" - 2"	11"	3 1/2"	6 3/4"
2" - 3"	12"	3 1/2"	7 3/4"
> 3"	13"	3 1/2"	8 3/4"

ALL OTHER DEVICES			
TOTAL TRAVEL *	PLATE WIDTH	Y	Z
< 1 1/2"	8"	2 1/2"	5"
1 1/2" - 3 1/2"	10"	2 1/2"	7"
> 3 1/2"	12"	2 1/2"	9"

* SEE TABLE FOR MINIMUM TOTAL TRAVEL ALONG CENTERLINE OF BRIDGE

NOTES:

JOINT TYPES

THE EXPANSION JOINT DEVICE SHALL BE OF A TYPE THAT INCLUDES A CONTINUOUS NEOPRENE (OR EQUIVALENT) SEAL ACROSS THE DECK. UNLESS OTHERWISE NOTED ON THE PLANS, THE CONTRACTOR HAS THE OPTION OF USING ANY OF THE DEVICES LISTED BELOW:

DEVICE	MANUFACTURER
WABO STRIP SEAL - TYPE M	WATSON-BOWMAN & ACME, INC.
WABO STRIP SEAL - TYPE A	WATSON-BOWMAN & ACME, INC.
STEELFLEX-SSA2	D.S. BROWN
STEELFLEX-SSCM	D.S. BROWN
ONFLEX 40 SS	STRUCTURAL RUBBER PRODUCTS CO.
ONFLEX 40 SSA	STRUCTURAL RUBBER PRODUCTS CO.

THE MODEL OF THE JOINT TYPE SELECTED SHALL BE SUITABLE TO ACCOMMODATE THE TOTAL MOVEMENT NOTED ON THE PLANS.

COMPLETE WORKING DRAWINGS OF ALL DETAILS OF FABRICATION OF THE EXPANSION JOINT DEVICE SHALL BE SUBMITTED FOR REVIEW IN ACCORDANCE WITH STANDARD SPECIFICATION 104.02. THIS REQUIREMENT IS WAIVED FOR EXPANSION JOINT DEVICES FOR WHICH A SET OF STANDARD INSTALLATION DETAILS HAS BEEN APPROVED. STANDARD INSTALLATION DETAILS CAN BE OBTAINED FROM THE DESIGN DIVISION.

FABRICATION AND INSTALLATION

REMOVE SHIPPING BOLTS PRIOR TO PLACEMENT OF CONCRETE.

THE EXPANSION JOINT SHALL BE SHOP FABRICATED TO CONFORM TO THE CONTOUR OF THE ENDING DECK, BARRIERS, ETC. IT SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS SUBJECT TO NOTES HEREON AND THE APPROVAL OF THE ENGINEER.

TIE DECK REINFORCING STEEL TO STEEL FRAME ANCHORS TO MAXIMUM EXTENT PRACTICABLE WITHOUT DAMAGING GALVANIZED OR EPOXY COATINGS.

THE TOP OF THE EXPANSION JOINT DEVICE SHALL BE SET 1/2" - 3/4" BELOW THE CONCRETE SLAB (PAVEMENT).

THE STEEL ANCHORAGE FOR STRIP SEAL GLANDS SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH SUBSECTION 707.03C.17 OF THE STANDARD SPECIFICATIONS.

THE AREA OF THE STEEL ANCHORAGE AND SEALING GLAND WHICH WILL BE IN CONTACT WITH A SEALANT, OR LUBRICANT-ADHESIVE SHALL BE CLEANED WITH TOLUENE OR OTHER APPROVED SOLVENT.

IN THE EVENT THAT SPLICING IS REQUIRED OF THE SEALING GLAND, IT SHALL BE SPLICED BY AN APPROVED METHOD (SUCH AS COLD VULCANIZATION) BY A TRAINED REPRESENTATIVE OF THE MANUFACTURER.

DETAILS AT CURBS OR BARRIERS

THE DETAILS ON THIS SHEET SHOW AN APPROVED MEANS OF TERMINATING THE EXPANSION JOINT DEVICE AT CURBS OR BARRIERS. VARIATIONS OR ALTERNATIVE SCHEMES WILL BE CONSIDERED AND MAY BE USED IF APPROVED BY THE ENGINEER.

MATERIALS

THE COST OF ALL MATERIALS AND LABOR REQUIRED FOR PROPER INSTALLATION OF THE EXPANSION JOINT AND THE TERMINAL ASSEMBLIES AT THE CURBS, SIDEWALKS, OR BARRIERS IS INCLUDED IN THE PAYMENT FOR THE EXPANSION JOINT DEVICE.

STRUCTURE NUMBER	ANGLE OF CROSSING TO NEAREST 10°	LOCATION OF JOINT	MIN. TOT. TRAVEL ALONG CENTERLINE OF BRIDGE	REQUIRED LENGTH OF EXPANSION JOINT DEVICE
XXX	90°	SLEEPER SLAB AT ABUT A	XX	XXX

NOTES:

FOR SINGLE SPAN STRUCTURES 40FT OR LESS IN SPAN LENGTH EXPANSION JOINTS ARE NOT REQUIRED.

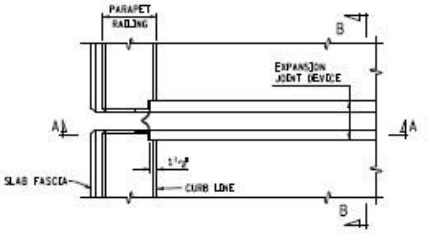
FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:							
NO.	DATE	AUTH	DESCRIPTION		NO.	DATE	AUTH	DESCRIPTION			

NO SCALE

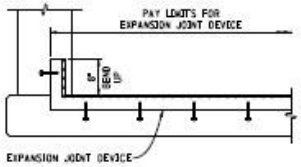
	DATE: 03/07/18	CS:	EXPANSION JOINT DETAILS	DRAWING	SHEET
	DESIGN UNIT:	JN:		EXPJT	SECT
FILE: expjt_001.dgn	TSC:			001	

Sheet 28: Expansion joints

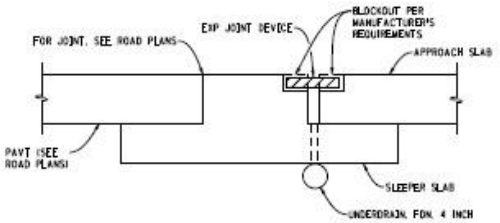
1) Select joint dimensions
2) Enter bridge information



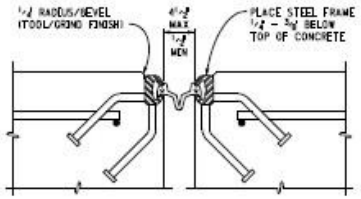
PLAN AT FLUSH MOUNT PARAPET RAILING



SECTION A-A



SECTION B-B



SECTION THROUGH EXPANSION JOINT

1

WABO STRIP SEAL TYPE M			
TOTAL TRAVEL *	PLATE WIDTH	Y	Z
< 1"	10"	3 1/2"	5 3/4"
1" - 2"	11"	3 1/2"	6 3/4"
2" - 3"	12"	3 1/2"	7 3/4"
> 3"	13"	3 1/2"	8 3/4"

ALL OTHER DEVICES			
TOTAL TRAVEL *	PLATE WIDTH	Y	Z
< 1 1/2"	8"	2 1/2"	5"
1 1/2" - 3 1/2"	10"	2 1/2"	7"
> 3 1/2"	12"	2 1/2"	9"

* SEE TABLE FOR MINIMUM TOTAL TRAVEL ALONG CENTERLINE OF BRIDGE

NOTES:

JOINT TYPES

THE EXPANSION JOINT DEVICE SHALL BE OF A TYPE THAT INCLUDES A CONTINUOUS NEOPRENE (OR EQUIVALENT) SEAL ACROSS THE DECK. UNLESS OTHERWISE NOTED ON THE PLANS, THE CONTRACTOR HAS THE OPTION OF USING ANY OF THE DEVICES LISTED BELOW:

DEVICE	MANUFACTURER
WABO STRIP SEAL - TYPE M	WATSON-BOWMAN & ACME, INC.
WABO STRIP SEAL - TYPE A	WATSON-BOWMAN & ACME, INC.
STEELFLEX-SSA2	D.S. BROWN
STEELFLEX-SSCM	D.S. BROWN
ONFLEX 40 SS	STRUCTURAL RUBBER PRODUCTS CO.
ONFLEX 40 SSA	STRUCTURAL RUBBER PRODUCTS CO.

THE MODEL OF THE JOINT TYPE SELECTED SHALL BE SUITABLE TO ACCOMMODATE THE TOTAL MOVEMENT NOTED ON THE PLANS.

COMPLETE WORKING DRAWINGS OF ALL DETAILS OF FABRICATION OF THE EXPANSION JOINT DEVICE SHALL BE SUBMITTED FOR REVIEW IN ACCORDANCE WITH STANDARD SPECIFICATION 104.02. THIS REQUIREMENT IS WAIVED FOR EXPANSION JOINT DEVICES FOR WHICH A SET OF STANDARD INSTALLATION DETAILS HAS BEEN APPROVED. STANDARD INSTALLATION DETAILS CAN BE OBTAINED FROM THE DESIGN DIVISION.

FABRICATION AND INSTALLATION

REMOVE SHIPPING BOLTS PRIOR TO PLACEMENT OF CONCRETE.

THE EXPANSION JOINT SHALL BE SHOP FABRICATED TO CONFORM TO THE CONTOUR OF THE ENDING DECK, BARRIERS, ETC. IT SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS SUBJECT TO NOTES HEREON AND THE APPROVAL OF THE ENGINEER.

TIE DECK REINFORCING STEEL TO STEEL FRAME ANCHORS TO MAXIMUM EXTENT PRACTICABLE WITHOUT DAMAGING GALVANIZED OR EPOXY COATINGS.

THE TOP OF THE EXPANSION JOINT DEVICE SHALL BE SET 1/2" - 3/4" BELOW THE CONCRETE SLAB (PAVEMENT).

THE STEEL ANCHORAGE FOR STRIP SEAL GLANDS SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH SUBSECTION 707.03C.17 OF THE STANDARD SPECIFICATIONS.

THE AREA OF THE STEEL ANCHORAGE AND SEALING GLAND WHICH WILL BE IN CONTACT WITH A SEALANT, OR LUBRICANT-ADHESIVE SHALL BE CLEANED WITH TOLUENE OR OTHER APPROVED SOLVENT.

IN THE EVENT THAT SPLICING IS REQUIRED OF THE SEALING GLAND, IT SHALL BE SPLICED BY AN APPROVED METHOD (SUCH AS COLD VULCANIZATION) BY A TRAINED REPRESENTATIVE OF THE MANUFACTURER.

DETAILS AT CURBS OR BARRIERS

THE DETAILS ON THIS SHEET SHOW AN APPROVED MEANS OF TERMINATING THE EXPANSION JOINT DEVICE AT CURBS OR BARRIERS. VARIATIONS OR ALTERNATIVE SCHEMES WILL BE CONSIDERED AND MAY BE USED IF APPROVED BY THE ENGINEER.

MATERIALS

THE COST OF ALL MATERIALS AND LABOR REQUIRED FOR PROPER INSTALLATION OF THE EXPANSION JOINT AND THE TERMINAL ASSEMBLIES AT THE CURBS, SIDEWALKS, OR BARRIERS IS INCLUDED IN THE PAYMENT FOR THE EXPANSION JOINT DEVICE.

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STRUCTURE NUMBER	ANGLE OF CROSSING TO NEAREST 10°	LOCATION OF JOINT	MIN. TOT. TRAVEL ALONG CENTERLINE OF BRIDGE	REQUIRED LENGTH OF EXPANSION JOINT DEVICE
XXX	90°	SLEEPER SLAB AT ABUT A	XX	XXX

NOTES:

FOR SINGLE SPAN STRUCTURES 40FT OR LESS IN SPAN LENGTH EXPANSION JOINTS ARE NOT REQUIRED.

FINAL ROW PLAN REVISIONS				SUBMITTAL DATE:				NO SCALE		DATE: 03/07/18	CS:	EXPANSION JOINT DETAILS	DRAWING	SHEET
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION			DESIGN UNIT:	JN:		EXPJT	SECT
									FILE: expjt_001.dgn	TSC:			001	

Wayne State University

Alfred Benesch & Co.

MDOT