

#### LEGEND

○ INDICATES WING NUMBER

#### DESIGN DATA

##### LIVE LOAD:

DESIGN LOADING: HL-93  
INVENTORY RATING FACTOR: RF=1.\_\_\_\_  
OPERATING RATING FACTOR: RF=1.\_\_\_\_  
WISCONSIN STANDARD PERMIT VEHICLE (WIS.-SPV): \_\_\_\_ (KIPS)

\*\* DESIGNED FOR FILL HEIGHT RANGE OF \_\_\_\_ TO \_\_\_\_ FEET

##### MATERIAL PROPERTIES:

CONCRETE MASONRY \_\_\_\_\_  $f'_c$  = 3,500 P.S.I.  
BAR STEEL REINFORCEMENT \_\_\_\_\_  $f_y$  = 60,000 P.S.I.

#### NOTES

SEE STANDARD 36.02 FOR NOTES.

#### DESIGNER NOTES

FOR SECTION C2 AND CONST. JOINT DETAILS SEE STANDARD 36.03

\*\* SEE SECTION 36.5 FOR DESIGN RANGE OF FILL HEIGHTS. HEIGHT TO BE TO THE NEAREST 0.5 FEET ON FILLS UNDER 4 FEET AND TO THE NEAREST FOOT ON FILLS OVER 4 FEET.

SEE STANDARD 36.02 FOR ADDITIONAL DESIGNER NOTES.

SEE CHAPTER 45 FOR LOAD RATING OF EXISTING CONCRETE BOX CULVERTS.

LOCATE THE NAME PLATE ON THE FIRST RIGHT WING TRAVELING IN THE HIGHWAY CARDINAL DIRECTIONS OF NORTH OR EAST.

#### BOX CULVERT LAYOUT

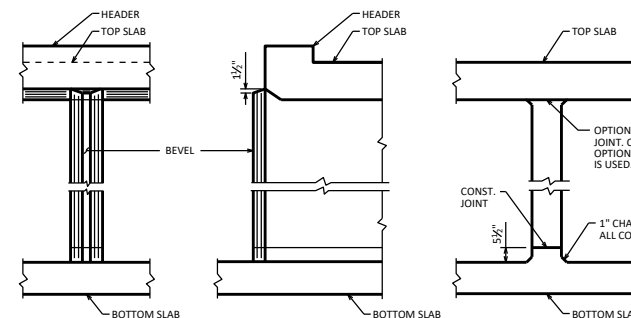
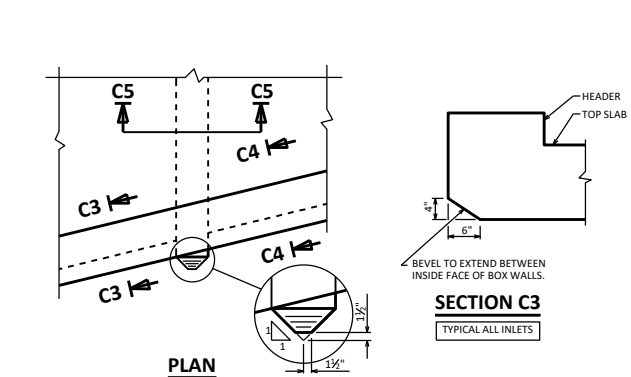


**BUREAU OF  
STRUCTURES**

APPROVED: *Laura Shadewald*

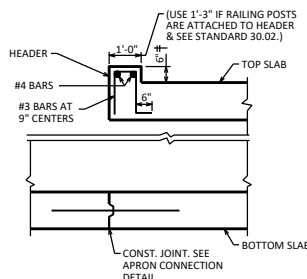
DATE:  
7-24





### INLET NOSE CENTER WALL DETAILS

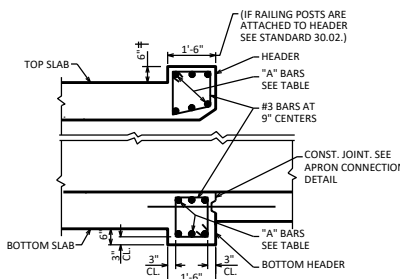
TYPICAL ALL INLETS



### SECTION C2

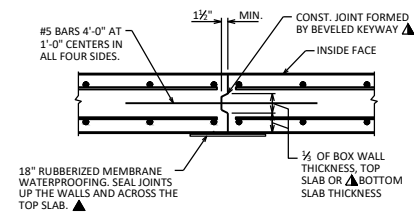
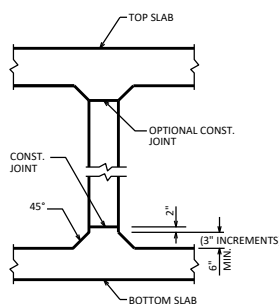
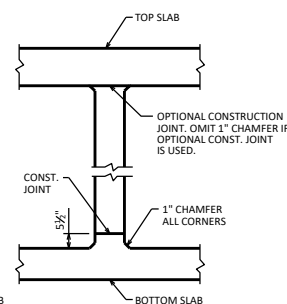
(OUTLET HEADERS SHOWN FOR SKEW OF 20° AND UNDER)

† IF RAILING POSTS ARE ATTACHED TO HEADER THIS DIMENSION MAY BE INCREASED IF NECESSARY TO KEEP RAILING PARALLEL TO ROADWAY. INCREASE WING HEIGHT IF NECESSARY.



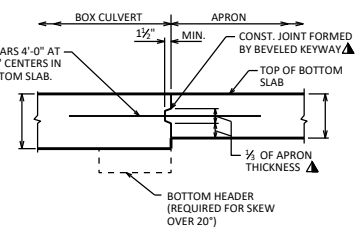
### SECTION C2

(INLET HEADERS SHOWN FOR SKEW OVER 20°)

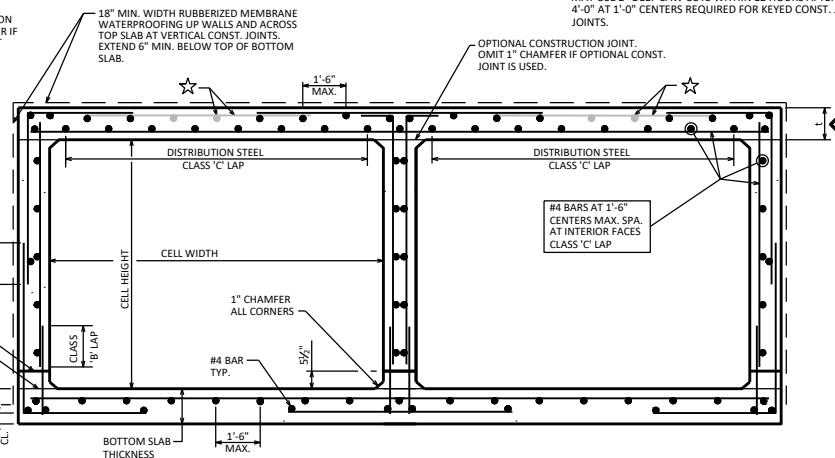
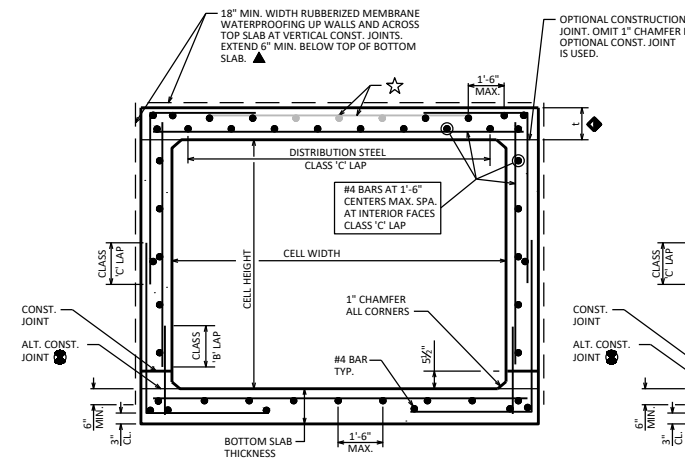


### VERTICAL CONSTRUCTION JOINT

▲ IN LIEU OF KEVED CONST. JOINTS IN THE BOTTOM SLAB, THE CONTRACTOR MAY USE 2" DEEP SAW CUTS WITHIN 12 HOURS AFTER POURING. #5 BARS 4'-0" AT 1'-0" CENTERS REQUIRED FOR KEVED CONST. JOINTS AND SAW CUT JOINTS.



### APRON CONNECTION DETAIL



### SECTION THRU BOX

TWIN CELL BOX

* HEADER LENGTH	"A" BARS
TO 11'-0"	6 - #7
OVER 11'-0" - 14'-0"	6 - #8
OVER 14'-0" - 17'-0"	6 - #9
OVER 17'-0" - 20'-0"	6 - #10

\* HEADER LENGTH EQUALS THE DISTANCE BETWEEN C/L OF WALLS IN ONE CELL MEASURED ALONG THE SKEW.

### DESIGNER NOTES

SEE BRIDGE MANUAL SECTION 36.2 FOR ADDITIONAL REQUIREMENTS FOR PEDESTRIAN UNDERPASSES AND CATTLE PASSES.

◆ DETAIL NOT ALLOWED WHEN HAUNCHES ARE REQ'D OR FOR PEDESTRIAN UNDERPASSES. OMIT 1" CHAMFER IF ALTERNATIVE CONSTRUCTION JOINT IS USED.

◆ t = 1'-0" MIN. FOR PEDESTRIAN UNDERPASSES.  
t = 1'-0" MIN. FOR SLABS WITH DEPTH OF FILLS < 2'-0"  
t = 6 1/2" MIN. OTHERWISE

### ★ TOP BARS FOR TOP SLAB:

- FOR t < 10' WITH DEPTH OF FILLS ≥ 2'-0". BARS NOT REQUIRED
- FOR t ≥ 10': #4 AT 1'-6" MAX. EACH DIRECTION
- FOR PEDESTRIAN UNDERPASSES: #4 AT 1'-6" MAX. EACH DIRECTION
- FOR SLABS WITH DEPTH OF FILLS < 2'-0": #4 AT 1'-0" MAX. EACH DIRECTION. USE CLASS 'C' LAPS

▲ FOR PEDESTRIAN UNDERPASSES, PROVIDE A CONTINUOUS SHEET MEMBRANE FOR THE ENTIRE LENGTH OF THE CULVERT IN LIEU OF 18" WIDE RUBBERIZED MEMBRANE WATERPROOFING STRIPS OVER THE JOINTS. USE BID ITEM "SHEET MEMBRANE WATERPROOFING FOR BURIED STRUCTURES" (S16.0610.S), UNLESS DIRECTED OTHERWISE. INCLUDE THE FOLLOWING NOTE:

SHEET MEMBRANE WATERPROOFING REQUIRED ON THE WALLS AND ACROSS TOP SLAB FOR ENTIRE CULVERT LENGTH. EXTEND 6" MIN. BELOW THE TOP OF BOTTOM SLAB.

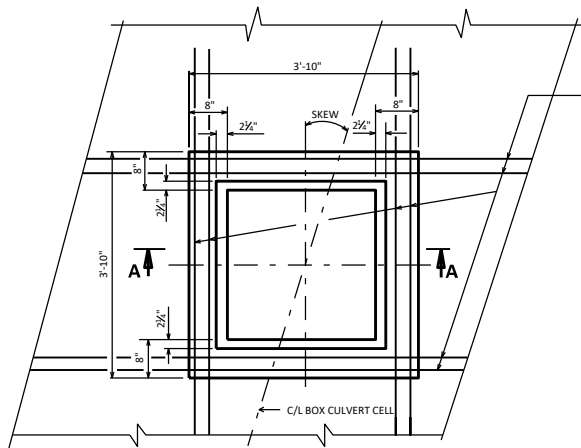
### BOX CULVERT DETAILS



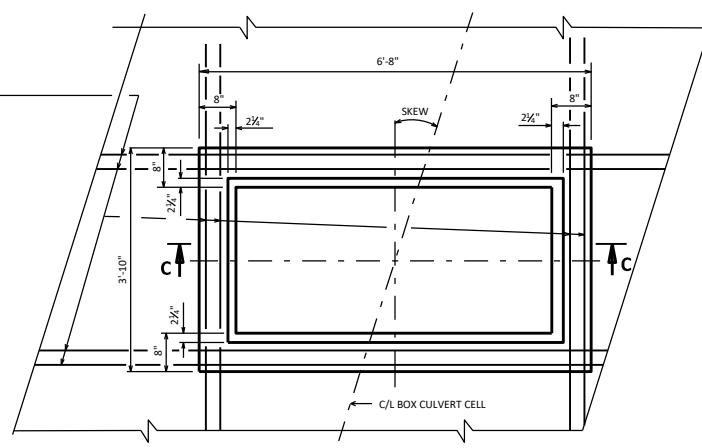
**BUREAU OF STRUCTURES**

APPROVED: *Laura Shadewald*

DATE:  
1-25



**INLET TYPE 8**



**INLET TYPE 9**

**MEDIAN INLET PLAN**  
(INLET COVER NOT SHOWN)

**NOTES**

FIELD CUT BAR STEEL REINFORCEMENT IN TOP SLAB TO CLEAR THE OPENING PROVIDED FOR MEDIAN INLET.

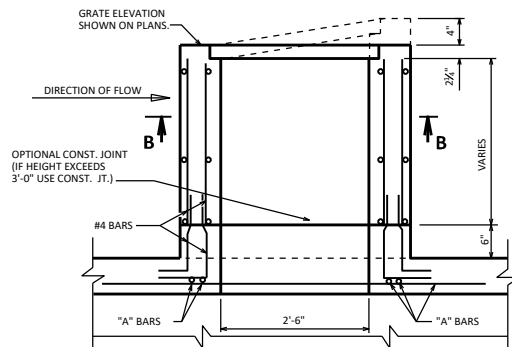
ADJUSTMENT OF THE COVER TO GRADE MAY BE ACCOMPLISHED BY THE USE OF MORTAR AND BRICK. MAXIMUM ADJUSTMENT SHALL BE 8".

**DESIGN NOTES**

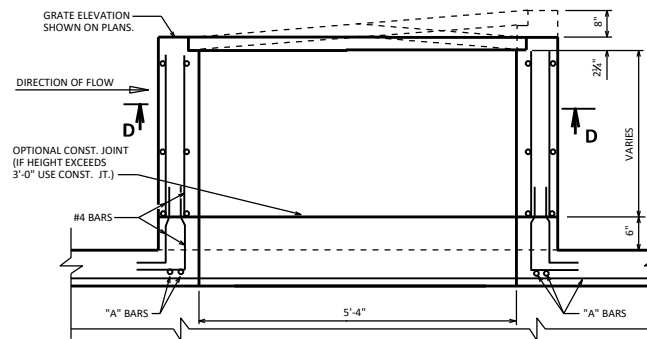
SIZE AND LENGTH OF "A" BARS TO BE DETERMINED BY THE DESIGNER.

STEEL SHOWN IS ADEQUATE TO DEPTHS UP TO 15'-6" FOR INLET TYPE 9 AND 44'-0" FOR INLET TYPE 8, ASSUMING A COEFFICIENT OF LATERAL EARTH PRESSURE OF 0.5 AND A UNIT WEIGHT OF SOIL OF 0.120 KCF.

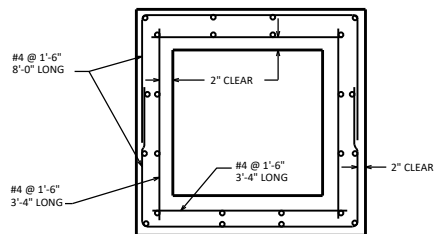
VERTICAL STEEL ADEQUATE FOR DEPTH UP TO 25'-0" ASSUMING WIND LOAD OF 50#/SQ. FT..



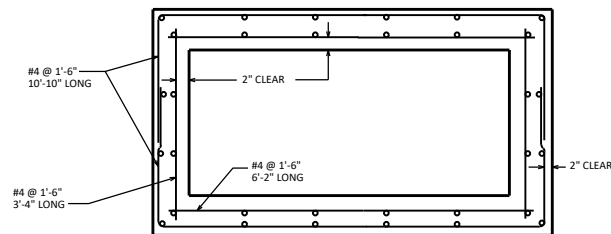
**SECTION A-A**



**SECTION C-C**



**SECTION B-B**



**SECTION D-D**

**BOX CULVERT MANHOLE  
FOR INLET TYPE 8 & 9**



**BUREAU OF  
STRUCTURES**

APPROVED: *Laura Shadewald*

DATE:  
7-16

## NOTES

DETAILS FOR MATERIALS, FABRICATION, CONSTRUCTION AND DESIGN OF PRECAST BOX CULVERTS NOT SHOWN OR STATED ON THIS DRAWING SHALL BE IN ACCORDANCE WITH THE CURRENT ASTM SPECIFICATION C1577; AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS; WISCONSIN DOT BRIDGE MANUAL; WISCONSIN DOT STANDARD SPECIFICATIONS & APPLICABLE SPECIAL PROVISIONS, EXCEPT THAT THE CONCRETE MIXTURE SHALL CONTAIN NOT LESS THAN 565 LBS. OF CEMENTITIOUS MATERIALS PER CUBIC YARD.

THE DESIGN OF PRECAST BOX CULVERTS WITH ALL FILL HEIGHTS SHALL BE AS STATED IN ASTM C1577.

THE JOINT ON ALL SIDES OF THE CULVERT SHALL BE SEALED WITH A PREFORMED BUTYL RUBBER SEALANT IN CONFORMANCE WITH ASTM C990 SECTION 6.2. A 2'-0" STRIP OF GEOTEXTILE TYPE OF SCHEDULE 4 SHALL BE PLACED OVER THE JOINTS ON THE TOP AND ON THE SIDES OF THE CULVERT. THE GEOTEXTILE SHALL CONFORM TO SECTION 645.2.2.4 OF THE STANDARD SPECIFICATION. (FABRIC NOT REQUIRED OVER INSIDE WALL JOINTS OF MULTICELL INSTALLATION.)

PRECAST CONCRETE SECTIONS SHALL BE PLACED ON A BEDDING OF "STRUCTURE BACKFILL TYPE B" OF 6" MINIMUM DEPTH AND AS APPROVED BY THE ENGINEER.

THE COVER OF CONCRETE OVER THE REINFORCEMENT SHALL BE 1 INCH OR 2 INCHES AS SHOWN WITH AN ALLOWABLE VARIATION OF  $\frac{1}{8}$ " TO  $+\frac{1}{8}$ ".

THE SPACING CTR. TO CTR. OF THE CIRCUMFERENTIAL WIRES SHALL NOT BE LESS THAN 2 INCHES NOR MORE THAN 4 INCHES. THE SPACING CTR. TO CTR. OF THE LONGIT. WIRES SHALL NOT BE MORE THAN 8 INCHES. PROVIDE 0.03 SQ. IN./FT. MINIMUM LONG. REINFORCEMENT AT EACH FACE IN SLABS AND WALLS.

NOT MORE THAN FOUR (4) HOLES MAY BE CAST, DRILLED OR OTHERWISE NEATLY MADE IN THE SHELL OF EACH PIECE OF BOX SECTION FOR HANDLING. THE HOLES SHALL BE TAPERED UNLESS DRILLED. HOLES SHALL BE FILLED WITH PORTLAND CEMENT MORTAR EXCEPT TAPERED HOLES MAY BE FILLED WITH CONCRETE. PLUGS SECURED WITH PORTLAND CEMENT MORTAR OR OTHER APPROVED ADHESIVE.

WHEN TWO OR MORE BARRELS ARE UTILIZED IN PARALLEL FOR MULTICELL INSTALLATIONS THE CLEAR SPACING BETWEEN BARRELS SHALL BE 6 INCHES AND THE SPACE BETWEEN ADJACENT BARRELS FROM TOP OF BEDDING TO TOP OF TOP SLAB SHALL BE FILLED WITH GRADE "B" CONCRETE.

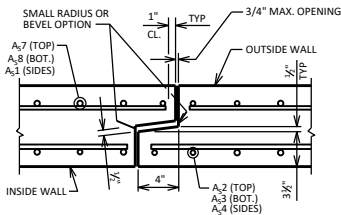
SHOP DRAWINGS SHALL PROVIDE "BOX CULVERT BARREL DATA" WITH REQUIRED AND ACTUAL REINFORCEMENT AREAS.

### MATERIAL PROPERTIES:

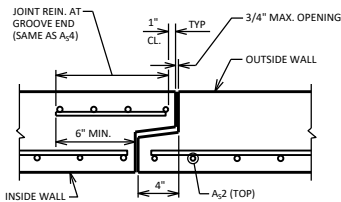
CONCRETE (PRECAST BOX)  $F_c = 5,000$  P.S.I.  
BAR STEEL REINFORCEMENT  $f_y = 60,000$  P.S.I.  
STEEL REINFORCEMENT (WIRE)  $f_y = 65,000$  P.S.I.

### DESIGNER NOTE:

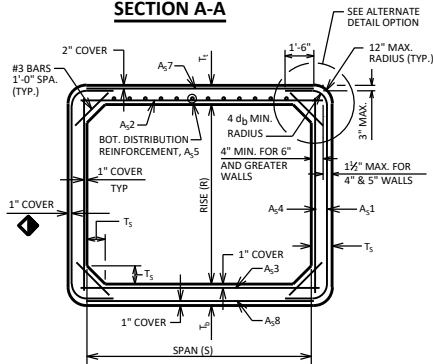
SEE STANDARD 36.02 FOR DESIGNER NOTES.



**JOINT DETAIL**

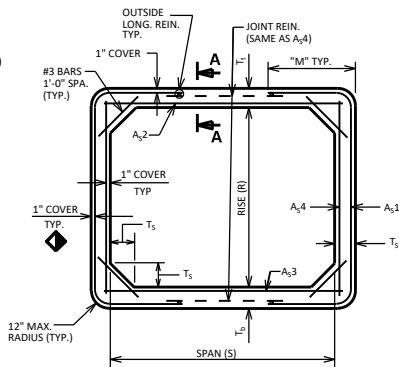


**SECTION A-A**



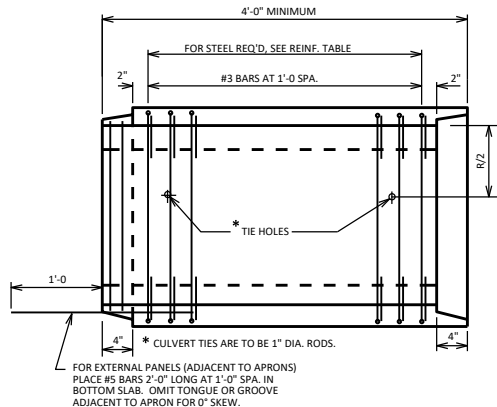
**SECTION THRU BARREL**

FILL HEIGHT LESS THAN 2 FEET  
(LONG. REIN. NOT SHOWN FOR CLARITY)

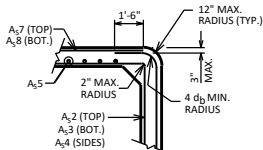


**SECTION THRU BARREL**

FILL HEIGHT 2'-0" OR GREATER  
(LONG. REIN. NOT SHOWN FOR CLARITY,  
UNLESS NOTED OTHERWISE.)



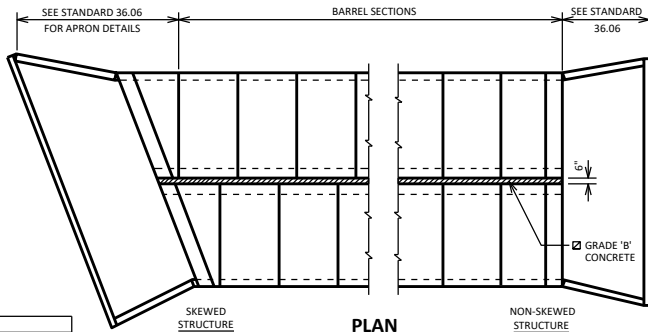
**LONGITUDINAL SECTION**



**ALTERNATE DETAIL OPTION**

### BOX CULVERT BARREL DATA

DIMENSIONS						REINFORCEMENT (IN <sup>2</sup> /FT)															
FILL HEIGHT (FT)	R (FT)	S (FT)	T <sub>1</sub> (IN)	T <sub>2</sub> (IN)	T <sub>3</sub> (IN)	A <sub>1</sub>		A <sub>2</sub>		A <sub>3</sub>		A <sub>4</sub>		A <sub>5</sub>		A <sub>7</sub>		A <sub>8</sub>			
						REQ'D	ACT.	M (IN)	REQ'D	ACT.	REQ'D	ACT.	REQ'D	ACT.	REQ'D	ACT.	REQ'D	ACT.	REQ'D	ACT.	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		



**PLAN  
MULTICELL INSTALLATION**

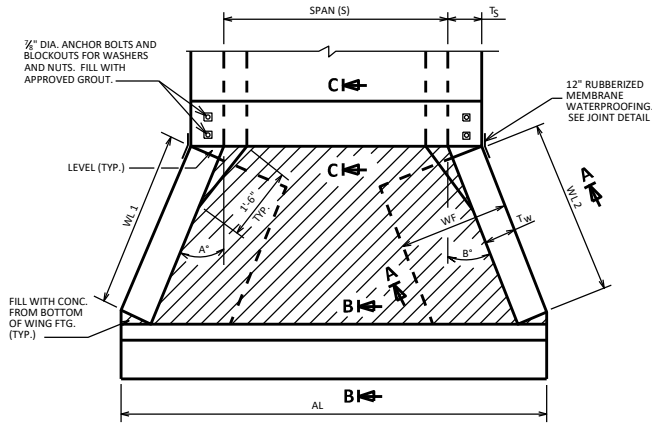
## PRECAST CONCRETE BOX CULVERT BARREL DETAILS



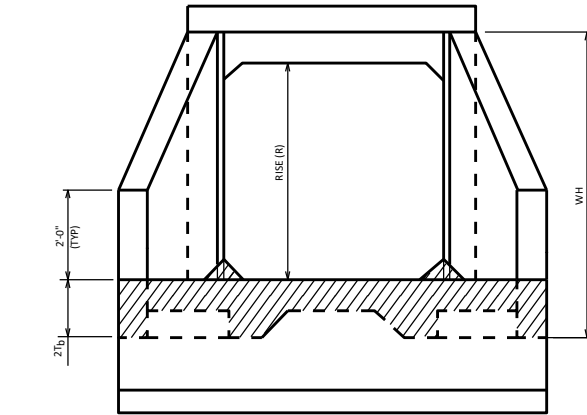
**BUREAU OF  
STRUCTURES**

APPROVED: *Laura Shadewald*

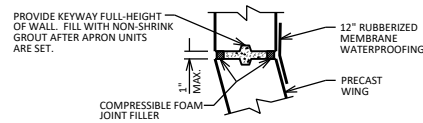
DATE:  
7-25



**APRON PLAN**  
(NON-SKEWED STRUCTURE)



**END VIEW**

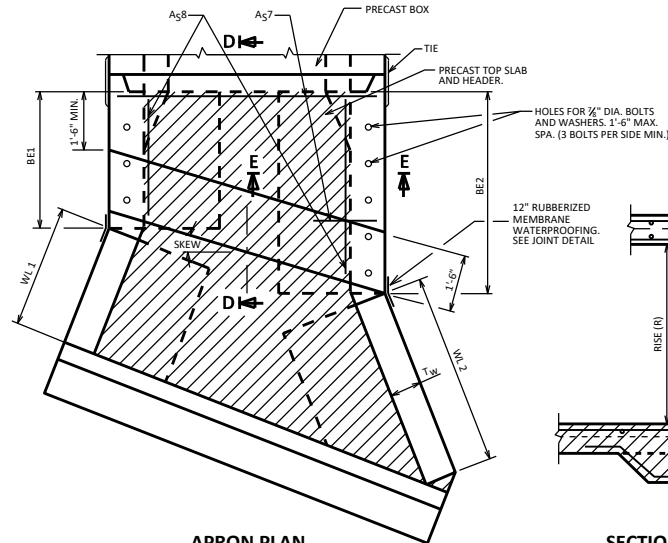


**JOINT DETAIL**

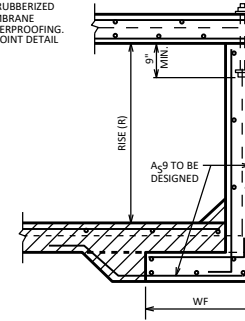
JOINT DETAIL EXAMPLE SHOWN. PRECAST SUPPLIER TO SUBMIT JOINT DETAIL FOR ACCEPTANCE.

**BOX CULVERT APRON DATA**

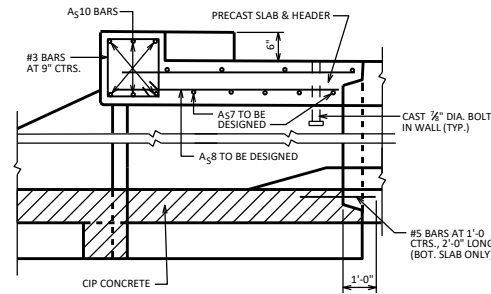
	R (Ft)	S (Ft)	T OR T <sub>5</sub> (IN)	SKEW	ANGLE A	ANGLE B	WL 1	WL 2	AL	AH	WH	BE 1	BE 2
INLET													
OUTLET													



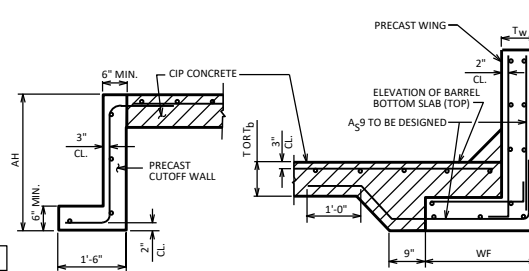
**APRON PLAN**  
(SKEWED STRUCTURE)



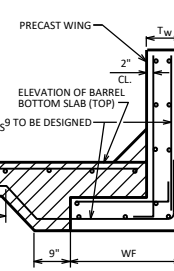
**SECTION E-E**



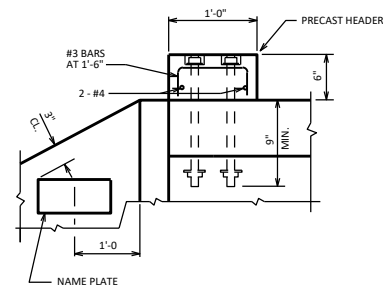
**SECTION D-D**



**SECTION B-B**



**SECTION A-A**



**SECTION C-C**

**NOTES**

CONCRETE COVER ON ALL REINFORCEMENT IN THE PRECAST ELEMENTS SHALL BE 2" UNLESS SHOWN OR NOTED OTHERWISE.

ALTERNATE DETAILS OF EQUAL STRENGTH AND HYDRAULIC CAPACITY TO THE DETAILS SHOWN ON THIS SHEET MAY BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

VERTICAL CONSTRUCTION JOINTS THRU THE WALLS AND FOOTING WILL BE ALLOWED ONLY WITH THE APPROVAL OF THE ENGINEER. DETAILS MUST BE SHOWN ON THE SHOP DRAWINGS FOR APPROVAL.

THE AREA OF REINFORCING STEEL NOT IDENTIFIED IN SECTIONS SHALL BE DESIGNED AND SHALL EXCEED TO THE FOLLOWING TEMPERATURE AND SHRINKAGE REQUIREMENTS:

THICKNESS	T&S REINF.
≤ 12"	#4 @ 18"
> 12" - 18"	#4 @ 12"

THE 7/8" DIA. ANCHOR BOLTS SHALL BE GALVANIZED AND CONFORM TO THE REQUIREMENTS OF ASTM A575.

**MATERIAL PROPERTIES:**

CONCRETE (CAST-IN-PLACE)	f <sub>c</sub> = 3,500 P.S.I.
CONCRETE (PRECAST WING)	f <sub>c</sub> = 4,000 P.S.I.
BAR STEEL REINFORCEMENT	f <sub>y</sub> = 60,000 P.S.I.
STEEL REINFORCEMENT (WIRE)	f <sub>y</sub> = 65,000 P.S.I.

RISE (R)	T <sub>w</sub> (MIN.)	WF (MIN.)
4'-0"	8"	2'-6"
6'-0"	8"	3'-6"
8'-0"	8"	4'-0"
10'-0"	10"	4'-9"

SPAN (S)	A510 BARS (MIN.)		
	SKEW		
	0°-15°	16°-30°	31°-45°
6'-0"	(6) - #6	(6) - #6	(6) - #6
7'-0"	(6) - #6	(6) - #6	(6) - #7
8'-0"	(6) - #6	(6) - #7	(6) - #8
10'-0"	(6) - #7	(6) - #8	(6) - #8

**DESIGNER NOTE:**

SEE STANDARD 36.02 FOR DESIGNER NOTES.

PROVIDE "BOX CULVERT APRON DATA" TABLE ON CONTRACT PLANS WHEN A PRECAST ONLY DESIGN IS PROVIDED.

**PRECAST WINGS, HEADERS, AND CUTOFF WALLS FOR PRECAST CONCRETE BOX CULVERT**



APPROVED: *Laura Shadewald*

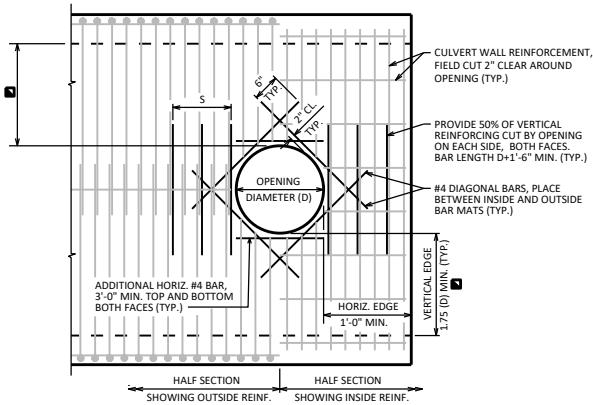
DATE:  
7-25

NOTES

ALL BAR STEEL REINFORCEMENT SHALL BE CUT 2" CLEAR AROUND OPENING.

DESIGNER NOTES

DETAILS SHOWN ARE FOR CAST-IN-PLACE CULVERTS. PRECAST CULVERT  
DETAILS TO BE SIMILAR.



ELEVATION

WHEN  $D \leq 1'-6"$   $S = 1'-6"$   
WHEN  $D > 1'-6"$   $S = 1'-6"$  MIN, D MAX

PIPE OPENING IN  
CULVERT WALL

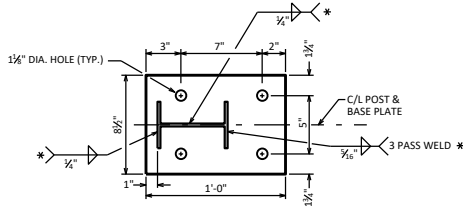


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STRUCTURES

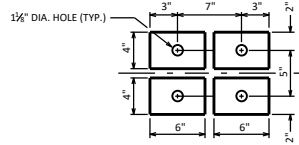
APPROVED: *Laura Shadewald*

DATE:  
1-13

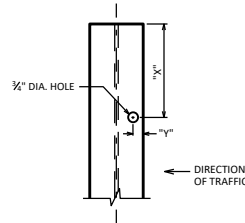
\* WELDING IS TO BE COMPLETED USING THE GAS-METAL ARC WELDING (GMAW) PROCESS WITH ER70S-3 WELDING WIRE AND ARGON-OXYGEN OR CO<sub>2</sub> COVER GAS.



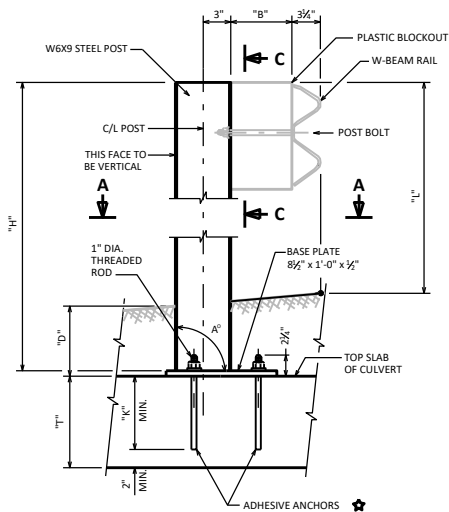
SECTION A-A  
POST & BASE PLATE



SECTION B-B  
(4)-BOTTOM PLATES



SECTION C-C  
HOLE IN POST FLANGE ON  
APPROACHING TRAFFIC SIDE

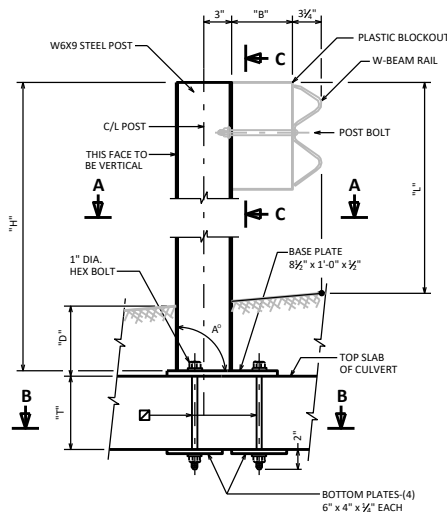


ELEVATION

### GUARDRAIL POST ANCHORS TYPE 1

USE FOR THICKNESS "T" OF 11-INCHES OR MORE WITH A MINIMUM EMBEDMENT "K" OF 9-INCHES FOR A CONCRETE STRENGTH ( $f_c$ ) OF 3,500 PSI

USE FOR THICKNESS "T" OF 10-INCHES OR MORE WITH A MINIMUM EMBEDMENT "K" OF 8-INCHES FOR A CONCRETE STRENGTH ( $f_c$ ) OF 4,000 PSI



ELEVATION

### GUARDRAIL POST ANCHORS TYPE 2

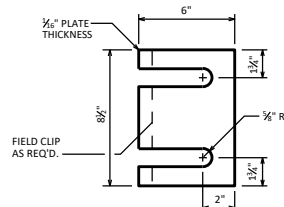
USE FOR THICKNESS "T" OF 8-INCHES OR MORE AND MINIMUM CONCRETE STRENGTH ( $f_c$ ) OF 3,500 PSI

### GUARDRAIL POST ANCHORAGE SYSTEM

CRITERIA:

USE FOR POSTS WITH "D" EMBEDMENT LESS THAN OR EQUAL TO 4'-0" AND GREATER THAN OR EQUAL TO 9".  
NOT REQ'D FOR POSTS WITH "D" EMBEDMENT MORE THAN 4'-0".  
NOT ALLOWED FOR POSTS WITH "D" EMBEDMENT LESS THAN 9".

	"L"	"B"	"X"	"Y"	SOURCE
CLASS "A" GUARDRAIL	2'-4 1/2"	8"	7"	3/16"	SDD 14 B 15
MGS GUARDRAIL	2'-7 1/2"	12"	7 1/4"	3/4"	SDD 14 B 42



STEEL SHIM DETAIL

4 PER POST

### NOTES

DETAILS SHOWN FOR POSTS, PLATES, ANCHORAGE SYSTEM AND INSTALLATION, BLOCKS, AND GUARDRAIL ARE NOT PART OF THE STRUCTURE CONTRACT, BUT ARE BID PER THE ROADWAY DESIGN PLANS.

POST BASE PLATES (AND BOTTOM PLATES IF USED) SHALL BE FLAT WITH ALL SURFACES SMOOTH AND FREE FROM WARP AND ALL EDGES SMOOTH, STRAIGHT AND VERTICAL. ALL PLATE CUTS SHALL BE MACHINE OR MACHINE FLAME CUTS.

CUT BOTTOM OF POST SO THAT POST WILL BE VERTICAL WHEN POST ASSEMBLY IS PLACED ON TOP OF THE CULVERT. ALONG THE ROADWAY THE POST WILL BE NORMAL TO GRADE LINE. HEX BOLTS AND THREADED RODS ARE TO BE PLACED PERPENDICULAR TO THE BASE PLATE (AND BOTTOM PLATE IF USED).

POST, BASE PLATE (AND BOTTOM PLATE IF USED), AND SHIMS SHALL BE GALVANIZED AFTER FABRICATION.

PRIOR TO GALVANIZING, ALL STEEL POSTS AND PLATES SHALL BE GIVEN A NO. 6 COMMERCIAL BLAST CLEANING BY SSPC SPECS.

ALL MATERIAL USED IN POSTS AND PLATES SHALL BE MADE FROM MATERIAL CONFORMING TO ASTM DESIGNATION A709 GRADE 50 OR S05.

HEX BOLTS, THREADED RODS, HEX NUTS AND WASHERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM F1554 GRADE 36, AND SHALL BE GALVANIZED. RODS ARE TO BE FULLY THREADED AND BOLTS TO BE THREADED 3". CHAMFER TOP OF BOLTS AND RODS BEFORE THREADING.

★ ADHESIVE ANCHORS (1-INCH DIA. THREADED ROD). EMBED IN CONCRETE AS DETAILED. CHARACTERISTIC BOND STRENGTH SHALL MEET OR EXCEED 1305 PSI FOR UNCRACKED CONCRETE. SEE STANDARD SPECIFICATION 502.3.14 AND APPLY TO THREADED RODS.

☑ THRU-BOLTS (1-INCH DIA. HEX BOLT). DRILL THRU TOP SLAB WHEN THE CONCRETE HAS ACHIEVED ITS DESIGN STRENGTH ( $f_c$ ).

STEEL SHIMS MAY BE USED BETWEEN PLATES AND SLAB WHERE REQUIRED FOR ALIGNMENT.

### DESIGNER NOTES

CHECK CRITERIA TO SEE IF POST ANCHORAGE SYSTEM IS REQUIRED BASED ON FILL HEIGHT "D" AT POSTS. IF REQUIRED, THEN SELECT WHICH TYPE OF ANCHORAGE (TYPE 1 OR TYPE 2) SHOULD BE USED.

"MGS" GUARDRAIL SHOULD BE USED FOR ALL NEW SYSTEMS. CONTACT THE ROADWAY DESIGN SECTION TO VERIFY THAT CONDITIONS AT THE SITE OF THE STRUCTURE WOULD NOT REQUIRE A CLASS "A" GUARDRAIL SYSTEM TO BE USED.

POST SPACING IS 3'-1 1/2" PER FDM SDD 14 B 51. SEE FDM SDD 14 B 51 FOR MINIMUM CLEARANCES FROM EDGES, JOINTS OR OBSTRUCTIONS TO ANCHORAGE SYSTEM. FOR TYPE 2 ANCHORAGE, MAKE SURE BOTTOM PLATE IS NOT PLACED AT THE SLOPED HAUNCH BETWEEN THE WALL AND TOP SLAB. SHIFT LOCATION OF POSTS (LONGITUDINALLY ALONG C/L OF POSTS) IF REQUIRED TO MEET SPACING AND CLEARANCE REQUIREMENTS. CHECK WITH ROADWAY DESIGN SECTION TO VERIFY SPACING IS ACCEPTABLE.

SHOW DETAILS AND PERTINENT NOTES FOUND ON THIS STANDARD ON THE STRUCTURE PLANS FOR THE CHOSEN ANCHOR TYPE.

SHOW LOCATION OF POSTS AND SPACING ALONG C/L OF POST IN PLAN VIEW OF STRUCTURE PLANS. LABEL EACH POST (P1, P2, ETC.). SHOW A TABLE PROVIDING THE ESTIMATED LENGTH "H" OF EACH POST, AND THE ANGLE "A" BETWEEN BASE PLATE AND POST.

IN THE TOP SLAB PROVIDE A MINIMUM OF #4 BARS AT 1'-0" SPACING IN EACH DIRECTION FOR TOP AND BOTTOM MAT WHEN TYPE 1 OR TYPE 2 ANCHORAGE DETAILS ARE USED.

THIS "MGS" GUARDRAIL SYSTEM AND ANCHORAGE SYSTEM MEET MASH 2016 EVALUATION CRITERIA FOR TEST LEVEL 3 (TL-3).

### GUARDRAIL POST ANCHORAGE SYSTEM



BUREAU OF  
STRUCTURES

APPROVED: *Laura Shadewald*

DATE:  
1-23



DESIGNER NOTES FOR PRECAST CONCRETE STRUCTURE

BID ITEM SHALL BE "THREE-SIDED PRECAST CONCRETE STRUCTURE".

PRECAST BRIDGES WILL BE LIMITED TO SPANS NOT TO EXCEED 42'-0".

SECURE WISDOT BOS AND GEOTECHNICAL (SOILS) ENGINEER'S APPROVAL BEFORE INCORPORATING PRECAST BRIDGES IN ANY PROJECT.

CHECK FOUNDATION PRESSURE, SCOUR AND SETTLEMENT TO ENSURE THAT NO FOUNDATION FAILURE OCCURS. PREFERABLY, PROVIDE FOOTING ON NON-YIELDING FOUNDATION MATERIAL. HOWEVER, ALLOWABLE DIFFERENTIAL SETTLEMENT FOR FOOTING ON SOIL SUPPORTING THE STRUCTURE = 0.002 FT. PER FT. (MAX.) OF THE SPAN. DESIGN STRUCTURE COMPONENTS TO RESIST FORCES CAUSED BY THIS DIFFERENTIAL SETTLEMENT. ADEQUATELY REINFORCE THE ENTIRE FOOTING AS REQUIRED BY THE DESIGN.

WHEN BEAM GUARD POSTS ARE TO BE EMBEDDED IN FILL ABOVE THE PRECAST ARCH UNIT, PROVIDE A DEPTH OF FILL, MEASURED FROM TOP OF ARCH CROWN TO TOP OF ROADWAY, AT LEAST EQUAL TO THE MINIMUM EMBEDMENT DEPTH SHOWN ON SDD 14B42 PLUS 6".

FOR SHORTER SPAN CULVERTS, WHERE BEAM GUARD CROSSES THE LENGTH OF THE STRUCTURE, CONSIDERATION SHALL BE GIVEN TO THE DETAILS SHOWN ON SDD 14B43 PROVIDED ALL REQUIREMENTS ON THIS STANDARD CAN BE MET.

WHEN A CONCRETE BARRIER (SINGLE SLOPE) CROSSES THE LENGTH OF THE STRUCTURE, THE FILL DEPTH MUST BE ADEQUATE TO ACCOMMODATE THE REQUIRED FOOTING DEPTH. SEE SDD 14B32 AND SDD 14B34 FOR CONCRETE BARRIER DETAILS.

PROVIDE A SUITABLE DRAINAGE PIPE ALONG THE CULVERT AND WINGWALLS TO RELEASE HYDROSTATIC PRESSURE. WHERE SIGNIFICANT SEEPAGE OR RELATIVELY RAPID ACCUMULATION OF WATER IS ANTICIPATED BEHIND THE WALL, INCORPORATE PIPE UNDERDRAIN WRAPPED AS SPECIFIED, INTO THE BACKFILL STRUCTURE, BEHIND THE WALL TO IMPROVE DRAINAGE CONDITIONS. DIRECT SEEPAGE FROM DRAINAGE PIPE TO WEEP HOLES ALONG THE EXTERIOR FACE OF THE WALL OR TO THE STORM WATER CONVEYANCES.

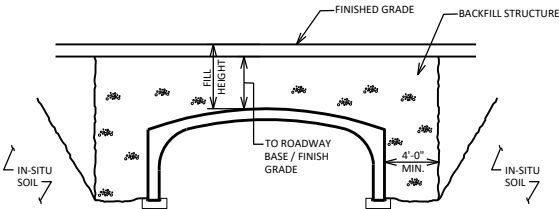
PLACE FOOTINGS BELOW SCOUR AND FROST DEPTHS. PLACE BOTTOM OF FOOTING AT A MINIMUM DEPTH EQUAL TO PREVAILING FROST DEPTH OR SCOUR DEPTH BUT NOT LESS THAN 4'-0" BELOW GROUND ELEVATION UNLESS CONSTRUCTED ON ROCK FOUNDATION OR OTHERWISE INDICATED.

PROVIDE DUCTILE JOINT SYSTEM BETWEEN VERTICAL LEG OF THE PRECAST SEGMENT AND FOOTER AS INDICATED ON THE STANDARD DETAIL DRAWINGS.

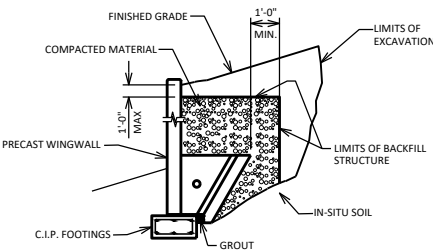
BENDING OF REINFORCEMENT FOR PRECAST BRIDGE UNITS - THE OUTSIDE AND INSIDE CIRCUMFERENTIAL REINFORCING STEEL FOR THE CORNERS OF THE BRIDGE SHALL BE BENT TO SUCH AN ANGLE THAT IS APPROXIMATELY EQUAL TO THE CONFIGURATION OF THE BRIDGE'S OUTSIDE CORNER.

LRFD DESIGN LOADS

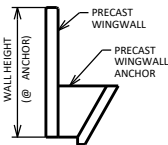
LIVE LOAD: HL-93  
HORIZONTAL EARTH PRESSURE: UNIT WEIGHT = 125 PCF  
VERTICAL EARTH PRESSURE: UNIT WEIGHT = 120 PCF



BACKFILL REQUIREMENTS



WALL BACKFILL REQUIREMENTS



APPROXIMATE/GUIDELINE NUMBER OF ANCHORS PER WALL	
LENGTH OF WALL	NO. ANCHORS
L = 14'-0"	2
L = 20'-0"	3
L = 24'-0"	4
24'-0" < L	MULTIPLE-PIECE WINGWALL *

\*NOTE: ADJACENT SEGMENTS SHALL BE ATTACHED TO EACH OTHER TO KEEP FRONT FACES IN ALIGNMENT. PLACE A FILLER AT THESE JOINTS WITH A MEMBRANE ALONG THE JOINT AT THE BACK FACE.

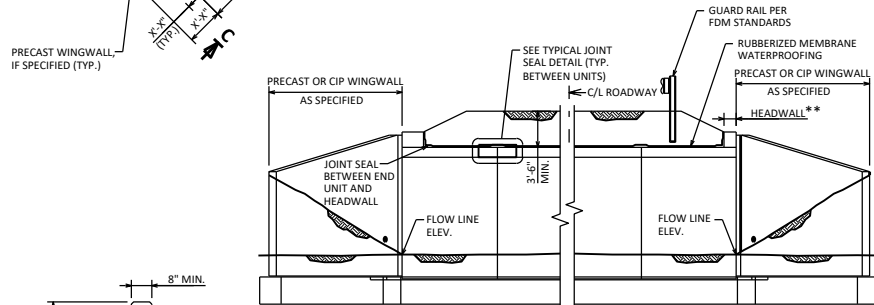
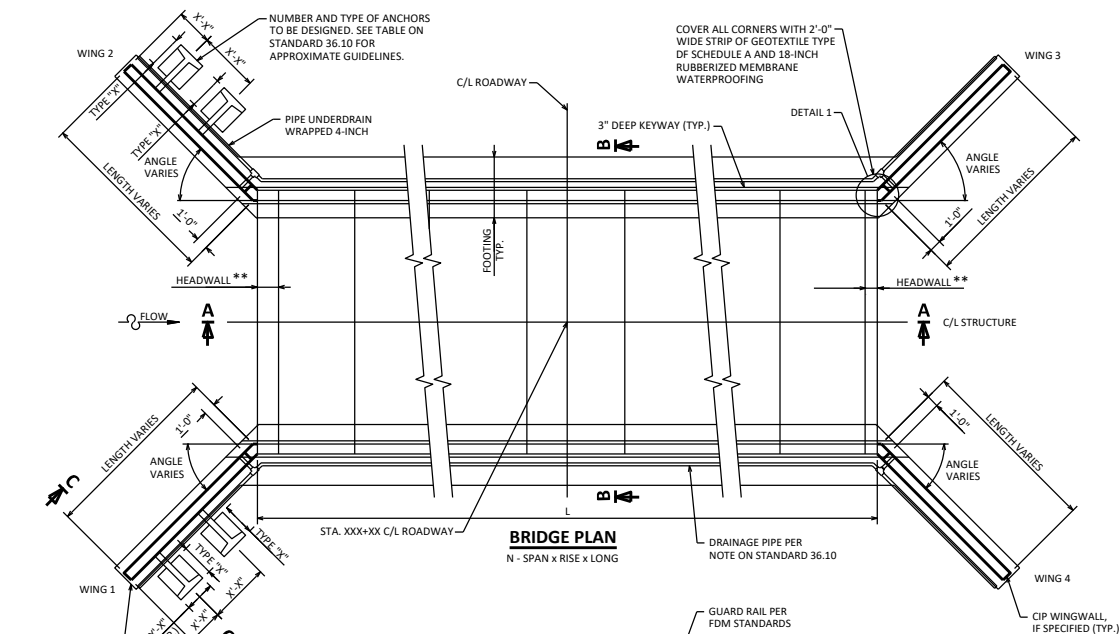
PRECAST THREE-SIDED BOX  
CULVERT DESIGN NOTES



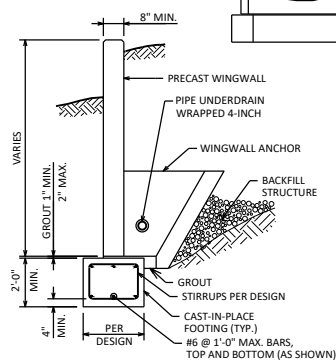
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STRUCTURES

APPROVED: *Laura Shadewald*

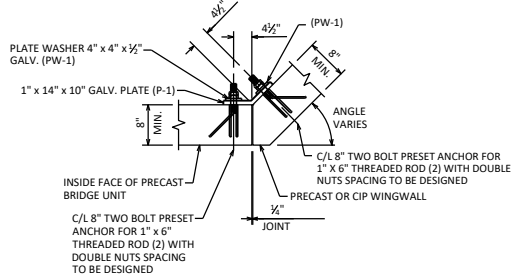
DATE:  
7-21



**SECTION A**

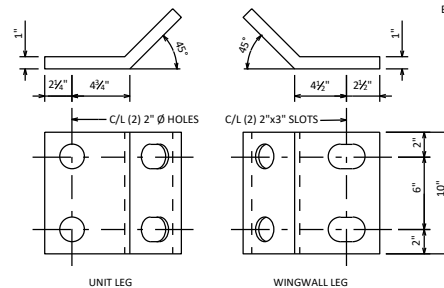


**SECTION C**



**DETAIL 1**

NOTE: CONNECTION PLATES (P-1) MUST BE POSITIONED WITH SMALL DIAMETER HOLES TOWARD PRECAST BRIDGE UNIT



**PLATE P-1**

PLATE, 1" x 14" x 10"  
NOTE: PLATE LENGTH AND THICKNESS SHALL BE INCREASED AS REQUIRED BY DESIGN.

## GENERAL NOTES:

MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH WISCONSIN DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS, AND THE CONTRACT SPECIAL PROVISIONS.

DESIGN SPECIFICATION: DESIGN STRUCTURE BY CURRENT EDITION AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND AS SUPPLEMENTED BY WISDOT BRIDGE MANUAL.

USE GRADE A CONCRETE IN FOOTING AND WINGWALLS.  $f'_c = 4$  KSI (MIN.)

PROVIDE CONCRETE COVER ON REINFORCING BARS AS NOTED HEREIN.

CHAMFER EXPOSED CONCRETE EDGES  $1/4" \times 1/4"$  EXCEPT AS NOTED.

PROVIDE DEFORMED REINFORCEMENT STEEL MEETING THE REQUIREMENTS OF ASTM DESIGNATION 615, OR 617, GRADE 60 AS SET FORTH IN THE STANDARD SPECIFICATIONS.

IF A CAST-IN-PLACE OPTION IS SHOWN AND SPECIFICATIONS ALLOW FOR A PRECAST SUBSTITUTION, PRECAST STRUCTURE SYSTEM (INCLUDING WINGWALLS AND HEADWALLS) AND FOOTERS WILL BE DESIGNED BY CONTRACTORS.

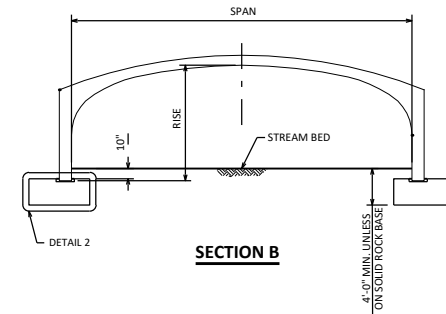
AT ANY TIME DURING PLACEMENT OF THE BACKFILL, DO NOT PERMIT A DIFFERENCE IN FILL ELEVATION ON THE SIDES OF THE CULVERT BARREL IN EXCESS OF 2'-0". DURING COMPACTION OF THE BACKFILL, DO NOT ALLOW THE WHEELS OF ROLLERS TO COME CLOSER THAN 1'-0" TO THE FACE OF THE STRUCTURE.

## DESIGNER NOTES:

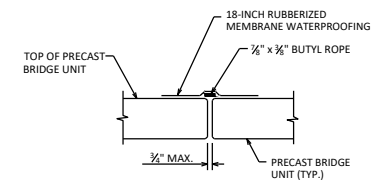
ALL BAR SPLICES TO BE "CLASS C" TENSION LAP SPLICES.

PRECAST CONCRETE CULVERT UNITS  
PLUS (N-1) JOINTS @  $1/2"$  TO  $1/2"$  PER JOINT = L

\*\* SEE STANDARD 36.13 AND STANDARD 36.14 FOR HEADWALL DETAILS AND FEASIBILITY GUIDELINES



**SECTION B**



**TYPICAL JOINT SEAL DETAIL**

## PRECAST THREE-SIDED BOX CULVERT LAYOUT DESIGNS

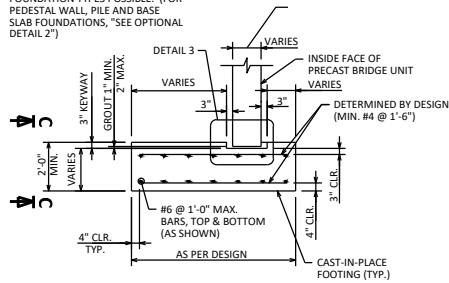


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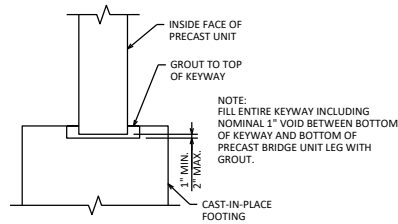
APPROVED: *Laura Shadewald*

DATE:  
7-18

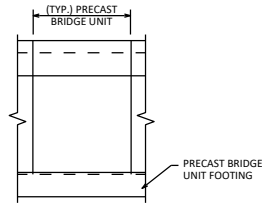
SPREAD FOOTING SHOWN, OTHER FOUNDATION TYPES POSSIBLE. (FOR PEDESTAL WALL, PILE AND BASE SLAB FOUNDATIONS, "SEE OPTIONAL DETAIL 2")



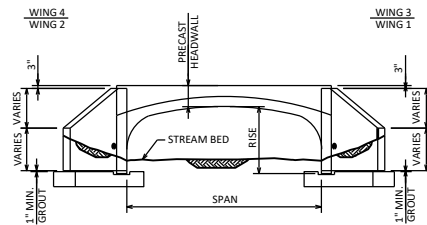
**DETAIL 2**



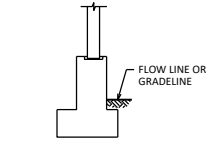
**DETAIL 3**



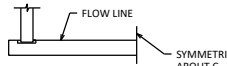
**SECTION C**



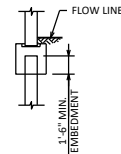
**TYPICAL END ELEVATION**



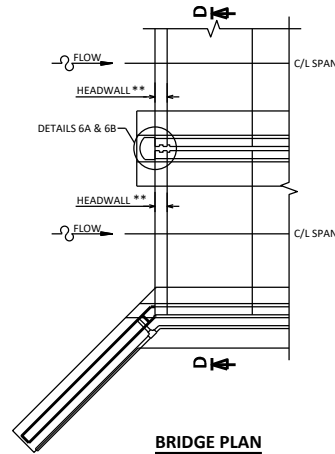
**OPTIONAL DETAIL 2**  
IF PEDESTAL IS REQUIRED



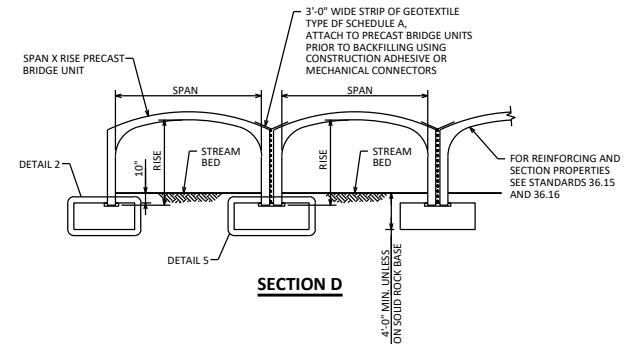
**OPTIONAL DETAIL 2**  
IF BASE SLAB IS REQUIRED



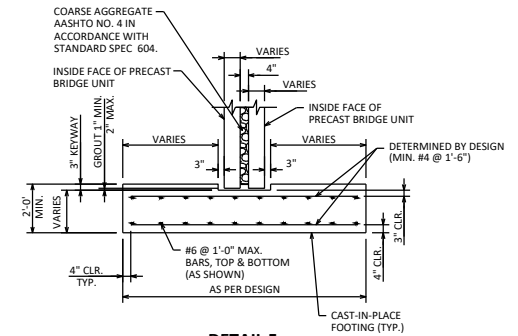
**OPTIONAL DETAIL 2**  
IF PILES ARE REQUIRED



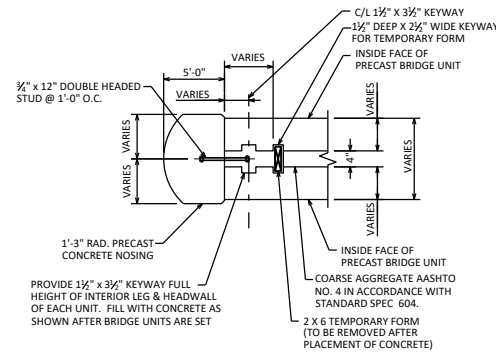
**BRIDGE PLAN**



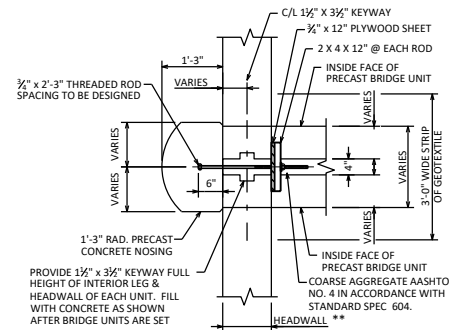
**SECTION D**



**DETAIL 5**



**DETAIL 6A**



**DETAIL 6B**

**NOTES:**

\*\*SEE STANDARDS 36.13 AND 36.14 FOR HEADWALL DETAILS AND FEASIBILITY GUIDELINES

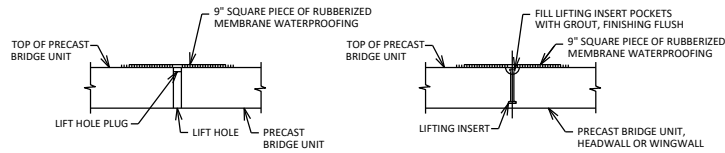
**PRECAST THREE-SIDED BOX CULVERT DETAILS**



**BUREAU OF STRUCTURES**

APPROVED: *Laura Shadewald*

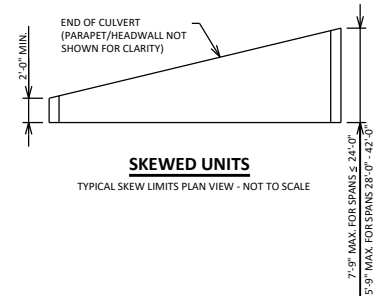
DATE:  
7-24



#### LIFTING HOLES

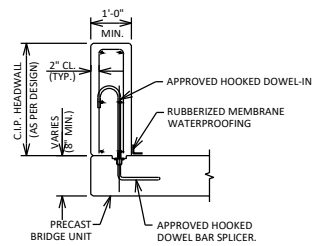
#### LIFTING INSERTS

#### TYPICAL LIFT POINT SEALING DETAIL



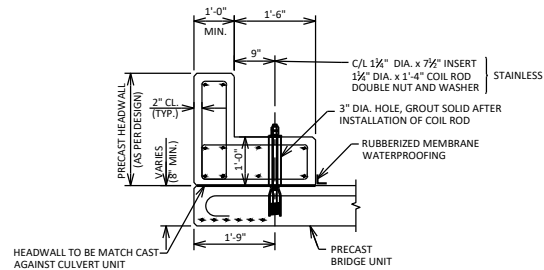
#### SKEWED UNITS

TYPICAL SKEW LIMITS PLAN VIEW - NOT TO SCALE



#### CAST-IN-PLACE HEADWALL DETAIL

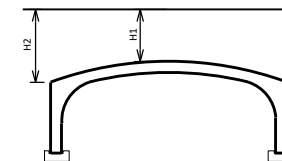
NOT TO SCALE



#### PRECAST HEADWALL DETAIL WITH COLLAR

NOT TO SCALE

	H1	H2
UNIT SPAN	MAX. HEIGHT @ CROWN TO T/HEADWALL (NO LIVE LOAD SURCHARGE)	MAX. APPROXIMATE HEIGHT @ EDGE OF SPAN
14'-0"	8'-0"	9'-6 1/2"
20'-0" - 28'-0"	7'-0"	10'-0"
36'-0"	6'-0"	10'-6"
42'-0"	4'-0"	10'-0"



#### LRFD COLLAR/HEADWALL DESIGN NOTES:

- HEADWALL DETAILS SHOWN HERE HAVE ONLY BEEN DESIGNED FOR THE FOLLOWING 2 LOAD CASES:
  - 1) EARTH PRESSURE ONLY
  - 2) EARTH PRESSURE + LIVE LOAD SURCHARGE
 THESE DETAILS ARE NOT TO BE USED WHERE A VEHICLE LOAD CAN BE TRANSMITTED THROUGH A BARRIER TO THE HEADWALL.
- 1'-0" HEADWALL THICKNESS
- 1'-0" COLLAR THICKNESS
- SOIL BEHIND HEADWALL IS AT SAME ELEVATION AS TOP OF HEADWALL
- ADDITIONAL HW HEIGHT MAY BE ACHIEVED WITH ADDITIONAL STEEL REINFORCEMENT OR THICKENED COLLAR
- FOR DETACHED HEADWALL DESIGNS ONLY

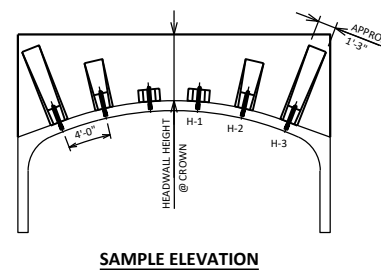
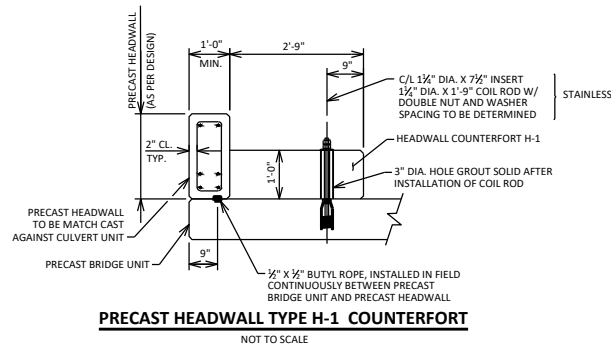
#### PRECAST THREE-SIDED BOX CULVERT HEADWALL DETAILS



**BUREAU OF STRUCTURES**

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DATE:  
1-11

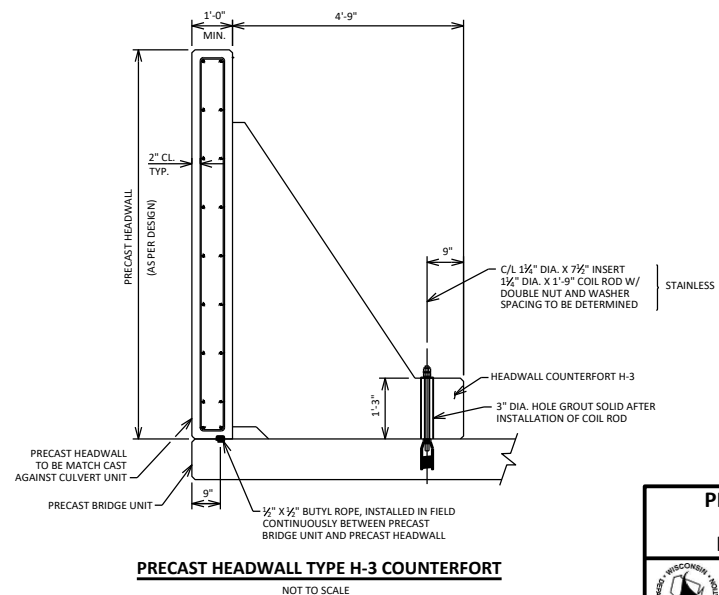
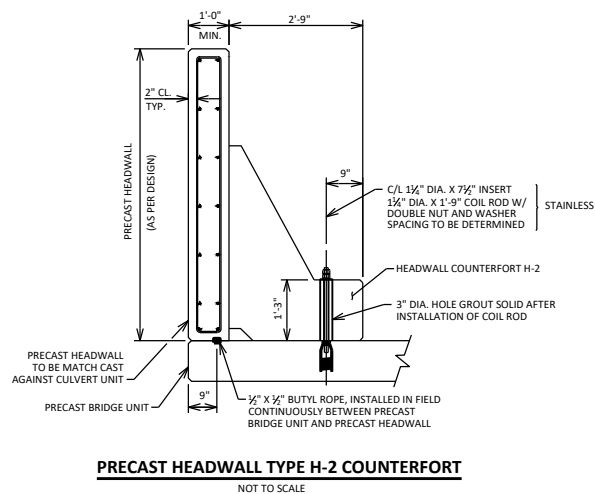


NOTE:  
THE ACTUAL NUMBER AND TYPE OF  
PRECAST HEADWALL COUNTERFORTS  
IS TO BE DESIGNED. HOWEVER, USE  
THE FOLLOWING CHART AS A  
GENERAL GUIDE TO FEASIBILITY OF  
COUNTERFORT USE.

	COUNTERFORT	MAX HEADWALL HEIGHT @ COUNTERFORT LOCATION	
		NO SURCHARGE	W/ 2'-0" SURCHARGE
14'-0" SPAN	H-1	7'-0"	5'-0"
	H-2	7'-0"	5'-0"
	H-3	8'-0"	6'-0"
20'-0" - 42'-0" SPANS	H-1	8'-0"	6'-0"
	H-2	10'-0"	7'-0"
	H-3	10'-0"	8'-0"

#### LRFD HEADWALL COUNTERFORTS

- HEADWALL DETAILS SHOWN HERE HAVE ONLY BEEN DESIGNED FOR THE FOLLOWING 2 LOAD CASES:
  - 1) EARTH PRESSURE ONLY
  - 2) EARTH PRESSURE + LIVE LOAD SURCHARGE
 THESE DETAILS ARE NOT TO BE USED WHERE A VEHICLE LOAD CAN BE TRANSMITTED THROUGH A BARRIER TO THE HEADWALL.
- ASSUMED 4'-0" SPACING OF COUNTERFORTS
- 1'-0" HEADWALL THICKNESS MIN.
- SOIL BEHIND HEADWALL IS AT SAME ELEVATION AS TOP OF HEADWALL
- ADDITIONAL HEADWALL HEIGHT MAY BE ACHIEVED WITH CLOSER COUNTERFORT SPACING
- FOR DETACHED HEADWALL DESIGNS ONLY



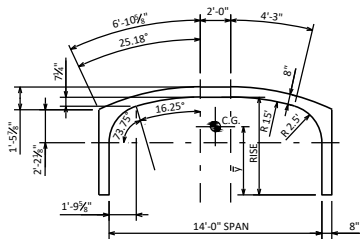
#### PRECAST THREE-SIDED BOX CULVERT HEADWALL DETAILS



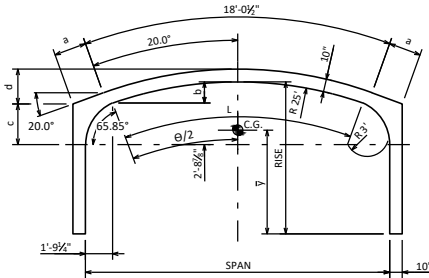
**BUREAU OF  
STRUCTURES**

APPROVED: *Laura Shadewald*

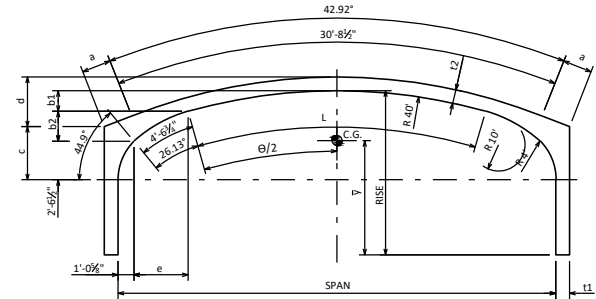
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**14'-0" SPAN**



**20'-0" TO 24'-0" SPANS**



**28'-0" TO 42'-0" SPANS**

CENTER OF GRAVITY $\bar{Y}$ FT						
RISE FT	SPAN - FT					
	14	20	24	28	36	42
4	3.2					
5	3.9	3.8				
6	4.6	4.6	4.6			
7	5.2	5.3	5.3	5.3		
8	5.8	6.0	6.0	6.0	5.8	
9	6.5	6.6	6.6	6.7	6.5	
10	7.1	7.3	7.3	7.4	7.2	6.9
11				8.0	7.9	7.7
12					8.6	8.4
13					9.3	9.1

AREA OF CONCRETE SECTION SQ. FT						
RISE FT	SPAN - FT					
	14	20	24	28	36	42
4	15.2					
5	16.5	24.8				
6	17.8	26.5	29.1			
7	19.2	28.2	30.8	39.9		
8	20.5	29.9	32.5	41.9	54.1	
9	21.8	31.5	34.2	43.9	56.4	
10	23.0	33.2	35.8	45.9	58.7	64.7
11				47.9	61.1	67.0
12					63.4	69.4
13					65.7	71.7

GEOMETRIC PROPERTIES (FT.) (NOT SHOWN ON DRAWING)					
	SPAN - FT				
	20	24	28	36	42
$\theta$	38.43°	48.29°	25.30°	37.93°	47.86°
L	16.77	21.07	17.66	26.48	33.41
a	2.13	4.25	0.00	4.48	4.48
b	1.39	2.19			
b1			0.97	2.17	3.50
b2			1.96	2.40	2.75
c	2.68	2.75	3.76	3.91	4.31
d	2.29	3.01	2.84	4.48	5.66
e			4.07	3.83	3.63
t1			1.00	1.17	1.17
t2			0.83	1.00	1.00

(REFER TO STANDARDS 36.16 FOR REINFORCING DETAILS)

COVER ft	ARCH UNIT PRIMARY REINFORCING (MINIMUM)																	
	14'-0" SPAN 4'-0" TO 10'-0" RISE			20'-0" SPAN 5'-0" TO 10'-0" RISE			24'-0" SPAN 6'-0" TO 10'-0" RISE			28'-0" SPAN 7'-0" TO 11'-0" RISE			36'-0" SPAN 8'-0" TO 13'-0" RISE			42'-0" SPAN 10'-0" TO 13'-0" RISE		
	A1 SQ. IN/FT	A3 SQ. IN/FT	F <sub>c</sub> REQ'D. PSI	A1 SQ. IN/FT	A3 SQ. IN/FT	F <sub>c</sub> REQ'D. PSI	A1 SQ. IN/FT	A3 SQ. IN/FT	F <sub>c</sub> REQ'D. PSI	A1 SQ. IN/FT	A3 SQ. IN/FT	F <sub>c</sub> REQ'D. PSI	A1 SQ. IN/FT	A3 SQ. IN/FT	F <sub>c</sub> REQ'D. PSI	A1 SQ. IN/FT	A3 SQ. IN/FT	F <sub>c</sub> REQ'D. PSI
3	0.66	0.48	5000	0.90	0.78	5000	0.72	0.84	5000	0.96	1.08	5000	1.50	1.68	6000	1.44	1.44	6000
6	0.66	0.48	5000	0.72	0.78	5000	0.72	1.08	5000	0.96	1.32	5000	1.50	1.92	6000	1.44	1.44	6000 ①
9	0.66	0.48	5000	0.72	0.90	5000	0.72	1.44	5000	0.96	1.68	5000 ①	1.50	2.40	6000	1.44	1.92	6000 ①
12	0.66	0.60	5000	0.72	1.08	5000	0.72	1.80	6000 ①	0.96	1.80	6000 ①	1.50	3.00	6000 ①	1.44	2.16	6000 ①

① SHEAR REINFORCEMENT REQUIRED

② SHEAR REINFORCEMENT REQUIRED FOR 6'-0" & 7'-0" RISE

③ SHEAR REINFORCEMENT REQUIRED FOR 8'-0" & 9'-0" RISE

④ SHEAR REINFORCEMENT REQUIRED FOR 10'-0" & 11'-0" RISE

⑤ MINIMUM PRECAST UNIT WIDTH = 3'-11 1/4"

NOTE:

THESE STEEL AREAS ARE SHOWN FOR COVER OF 12'-0" OR LESS.

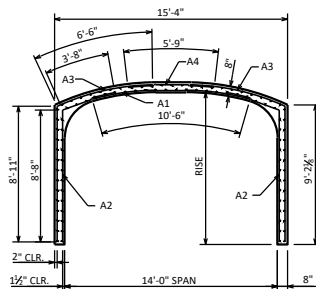
## PRECAST THREE-SIDED BOX CULVERT CROSS SECTIONS



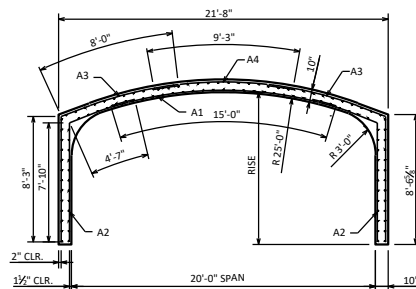
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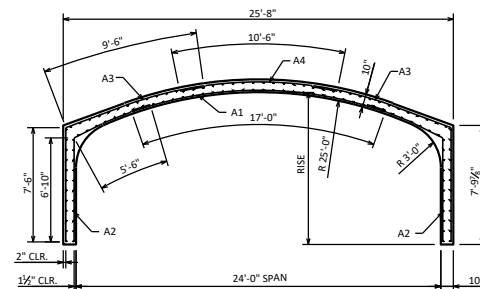
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1-11



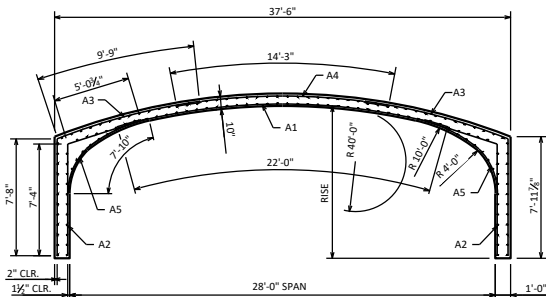
**14'-0" SPAN**  
RISE = 10'-0" \*\*SEE NOTE



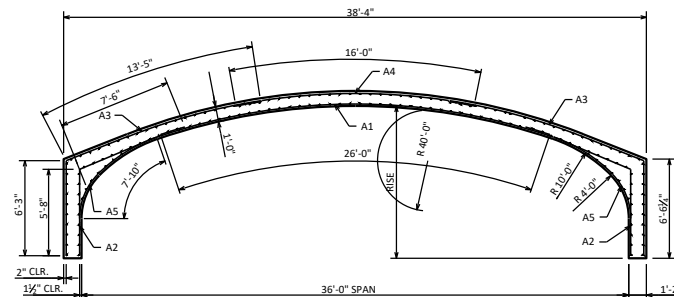
**20'-0" SPAN**  
RISE = 10'-0" \*\*SEE NOTE



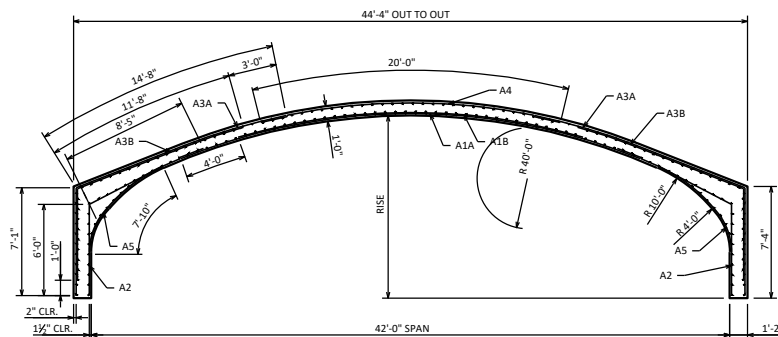
**24'-0" SPAN**  
RISE = 10'-0" \*\*SEE NOTE



**28'-0" SPAN**  
RISE = 10'-0"



**36'-0" SPAN**  
RISE = 10'-0"



**42'-0" SPAN**  
RISE = 12'-0"

#### NOTES:

\*\* SEE ARCH UNIT PRIMARY REINFORCING CHART ON STANDARD 36.15 FOR MORE INFORMATION.

ALL REINFORCING DIMENSIONS SHOWN ARE FOR 10'-0" RISE. A2 AND A3 STEEL LENGTHS SHALL BE REVISED ACCORDINGLY FOR RISES OTHER THAN 10'-0".

THESE STEEL AREAS, STEEL LENGTHS AND ARCH THICKNESS ARE SHOWN FOR COVER OF 12'-0" OR LESS.

THREE-SIDED PRECAST CONCRETE STRUCTURES SHALL BE DESIGNED FOR COVER GREATER THAN 12'-0", AND CAN BE DESIGNED FOR UP TO THE LIMITS OF COVER SHOWN IN THE TABLE BELOW.

THE COVER OF CONCRETE OVER THE OUTSIDE CIRCUMFERENTIAL REINFORCEMENT SHALL BE 2 INCHES MINIMUM.

THE COVER OF CONCRETE OVER THE INSIDE CIRCUMFERENTIAL REINFORCEMENT SHALL BE 1 1/2 INCHES MINIMUM.

THE CLEAR DISTANCE OF THE END CIRCUMFERENTIAL WIRES SHALL NOT BE LESS THAN 1" NOR MORE THAN 2" FROM THE ENDS OF EACH SECTION.

AN ALTERNATE EQUIVALENT OF WELDED WIRE FABRIC (WWF) ASTM A497 MAY BE SUBSTITUTED FOR THE REINFORCEMENT SHOWN, UPON APPROVAL OF THE STRUCTURES DEVELOPMENT SECTION.

MINIMUM COVER FOR WILDED WIRE FABRIC: 1-INCH

#### DESIGN DATA:

$f'_c$  = 5,000 PSI MINIMUM FOR CONCRETE  
 $f_y$  = 60,000 PSI FOR STEEL REINFORCING BARS  
 $f_y$  = 65,000 PSI FOR WELDED WIRE FABRIC (IN FLAT SHEET)

SPAN FT	APPROX. MAX. COVER
14'	50'
20' - 24'	30'
28' - 36'	20'
42'	15'

ARCH UNIT LONGITUDINAL REINFORCEMENT (MINIMUM)							
14'-0" SPAN			20'-0" SPAN			24'-0" SPAN	
CIRCUMF. AREA REQ'D SQ. IN/FT	LONGITUDINAL AREA REQ'D SQ. IN/FT	LENGTH FT	CIRCUMF. AREA REQ'D SQ. IN/FT	LONGITUDINAL AREA REQ'D SQ. IN/FT	LENGTH FT	CIRCUMF. AREA REQ'D SQ. IN/FT	LONGITUDINAL AREA REQ'D SQ. IN/FT
A1 = **	0.13	10'-6"	A1 = **	0.13	15'-0"	A1 = **	0.13
A2 = 0.24	0.13	12'-3"	A2 = 0.24	0.13	12'-5"	A2 = 0.24	0.13
A3 = **	0.13	15'-4"	A3 = **	0.13	16'-3"	A3 = **	0.13
A4 = 0.24	0.13	5'-9"	A4 = 0.24	0.13	9'-3"	A4 = 0.24	0.13

28'-0" SPAN			36'-0" SPAN			42'-0" SPAN		
CIRCUMF. AREA REQ'D SQ. IN/FT	LONGITUDINAL AREA REQ'D SQ. IN/FT	LENGTH FT	CIRCUMF. AREA REQ'D SQ. IN/FT	LONGITUDINAL AREA REQ'D SQ. IN/FT	LENGTH FT	CIRCUMF. AREA REQ'D SQ. IN/FT	LONGITUDINAL AREA REQ'D SQ. IN/FT	LENGTH FT
A1A = **	0.13	22'-0"	A1A = **	0.13	26'-0"	A1A = **	0.13	31'-0"
A1B = **	NOT REQ'D	16'-0"	A1B = **	NOT REQ'D	18'-0"	A1B = **	NOT REQ'D	23'-0"
A2 = 0.36	0.13	12'-6"	A2 = 0.36	0.13	13'-2"	A2 = 0.48	0.13	14'-4"
A3A = **	0.13	17'-6"	A3A = **	0.13	19'-8"	A3A = **	0.13	21'-9"
A3B = **	NOT REQ'D	13'-6"	A3B = **	NOT REQ'D	15'-8"	A3B = **	NOT REQ'D	17'-9"
A4 = 0.36	0.13	14'-3"	A4 = 0.36	0.13	16'-0"	A4 = 0.48	0.13	20'-0"
A5 = 0.24	0.13	7'-10"	A5 = 0.24	0.13	7'-10"	A5 = 0.24	0.13	7'-10"

#### PRECAST THREE-SIDED BOX CULVERT REINFORCEMENT



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APPROVED: *Laura Shadewald*

DATE:  
7-14