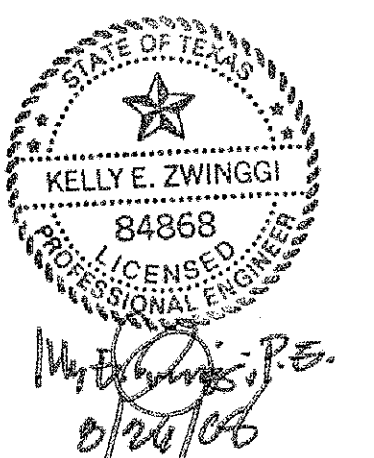
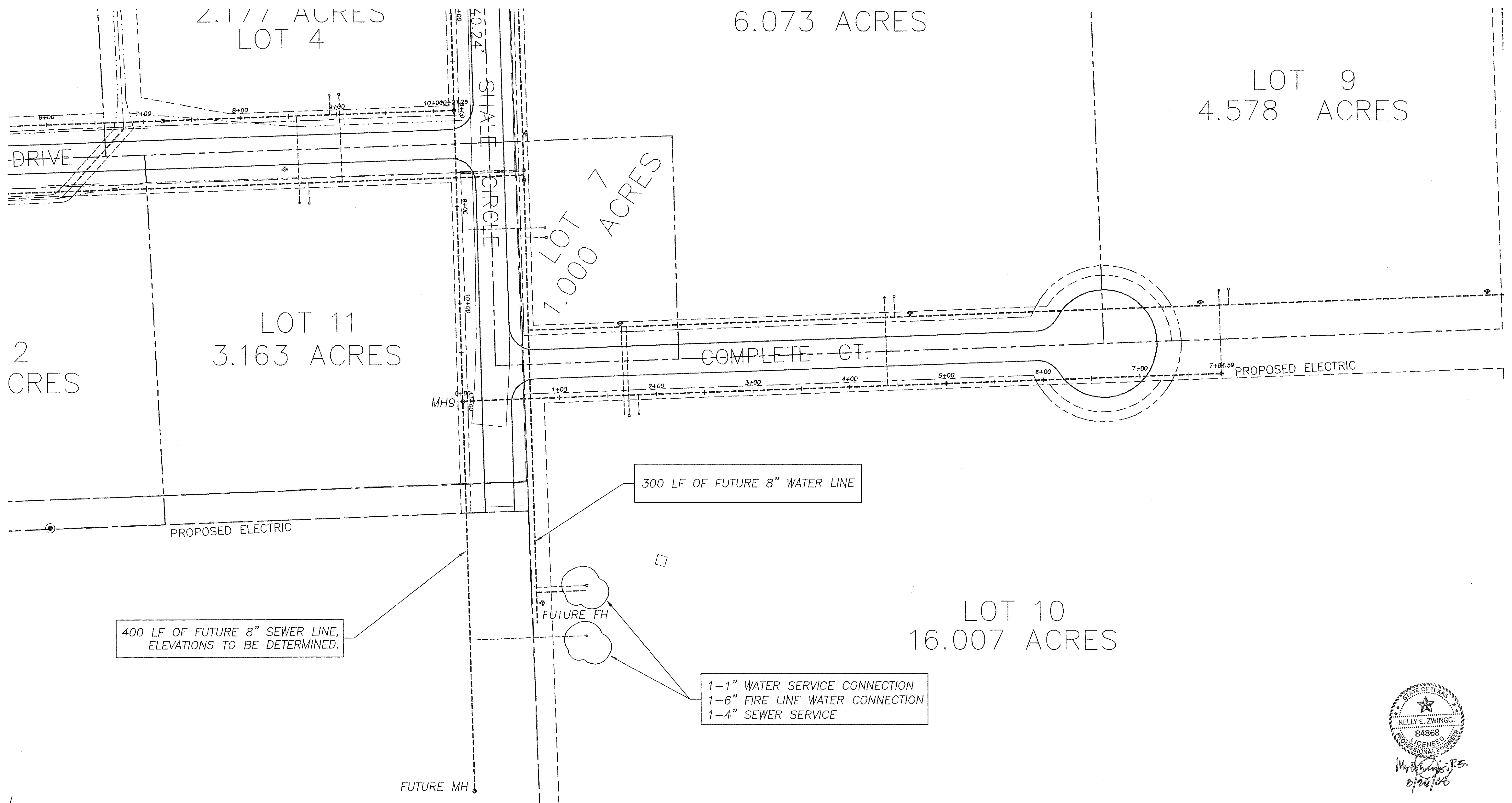




SHEET TITLE:

EXIBIT

PROJECT OWNER:

**BARNETT INDUSTRIAL PARK
CITY OF CLEBURNE
JOHNSON COUNTY, TEXAS**

ZWINGGI Engineering/
Planning, LLC

150 Parish Lane, #337
Roanoke, Texas 76262

940-390-0040
817-961-0299 Fax

JOB NO.: 07-194

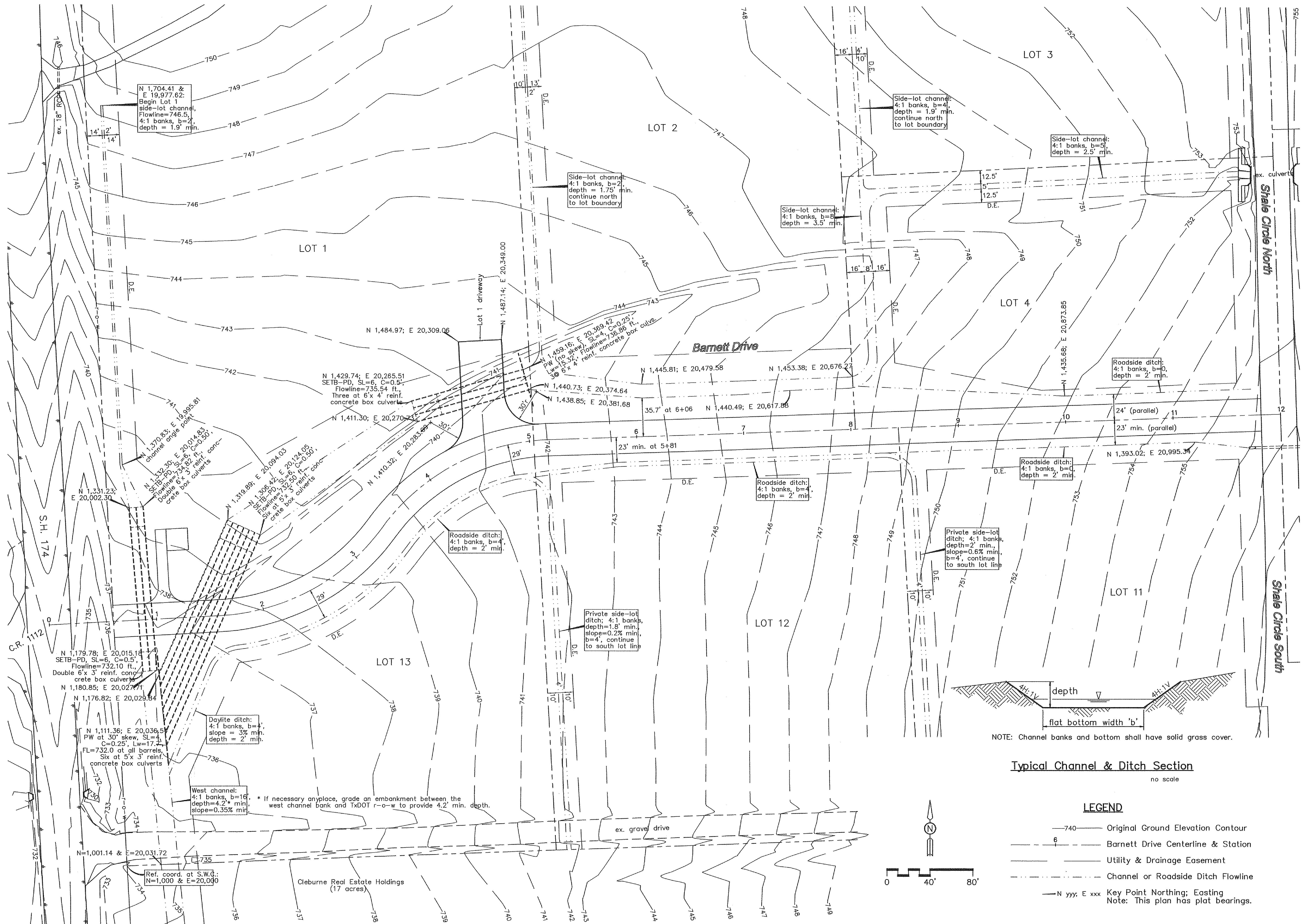
DRAWN BY: KZ

DATE: FEB 2008

SCALE:

SHEET 1 OF 1

Drawing name: Z:\00-Active Projects\07-194, Cleburne Industrial Park\Barnett\174chan.dwg Plotted on: Mar 10, 2008 - 2:07pm



Typical Channel & Ditch Section

no scale

LEGEND

- 740 — Original Ground Elevation Contour
 - 6 — Barnett Drive Centerline & Station
 - — Utility & Drainage Easement
 - — Channel or Roadside Ditch Flowline
 - N yyy; E xxx Key Point Northing; Easting
- Note: This plan has plat bearings.

PRELIMINARY - NOT FOR CONSTRUCTION

ZWINGGI Engineering/
Planning, LLC
940-390-0040
817-861-0288 Fax
150 Parish Lane, #337
Roanoke, Texas 76262

PROJECT NAME:
**BARNETT INDUSTRIAL PARK
CITY OF CLEBURNE
JOHNSON COUNTY, TEXAS**

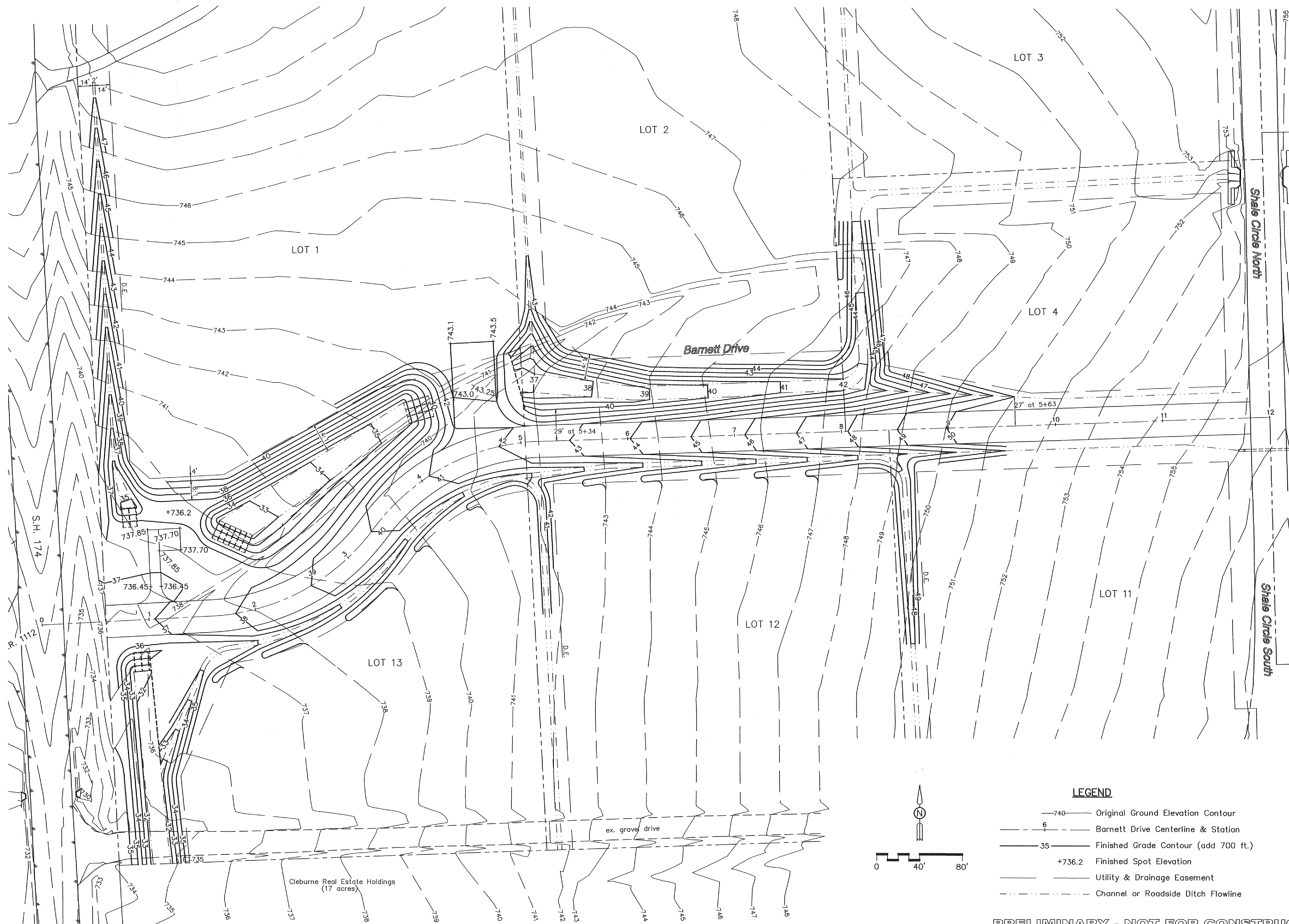
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POND & CHANNEL GRADING

SEAL



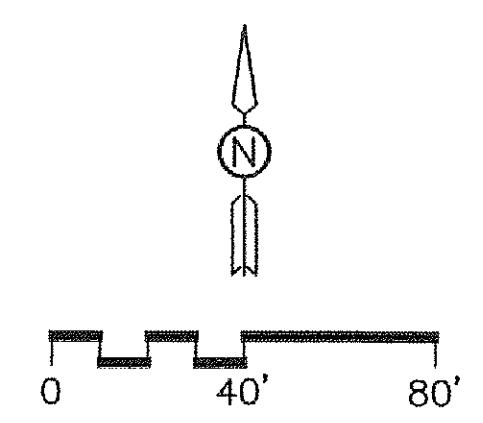
JOB NO.: 07-194
DRAWN BY: KZ
DATE: MARCH 2008
SCALE: 1"=40'
SHEET 7
OF 39

Drawing name: Z:\00-Active Projects\07-194 Cleburne Industrial Park\01\008\174chan.dwg Plotted on: Mar 10, 2008 - 2:08pm



LEGEND

- 740— Original Ground Elevation Contour
- 6— Barnett Drive Centerline & Station
- 35— Finished Grade Contour (add 700 ft.)
- +736.2 Finished Spot Elevation
- Utility & Drainage Easement
- - - - - Channel or Roadside Ditch Flowline



PRELIMINARY - NOT FOR CONSTRUCTION

SEAL

JOB NO.: 07-194
DRAWN BY: KZ
DATE: MARCH 2008
SCALE: 1"=40'
SHEET 8
OF 39

BARNETT DRIVE GRADING PLAN

PROJECT NAME:
**BARNETT INDUSTRIAL PARK
CITY OF CLEBURNE
JOHNSON COUNTY, TEXAS**

ZVINGGI Engineering/
Planning, LLC
150 Parish Lane, #337
Round Rock, Texas 76282
840-990-0040
817-961-0288 Fax

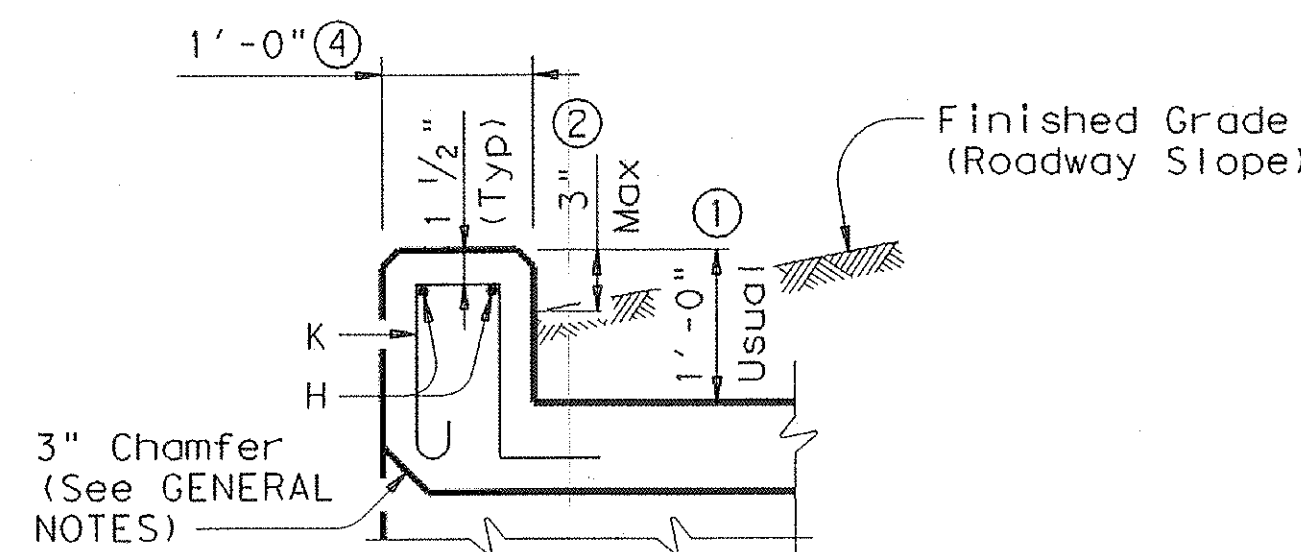
DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act". The quantity and quality of any work shall be the responsibility of the engineer or contractor. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

LEVELS DISPLAYED

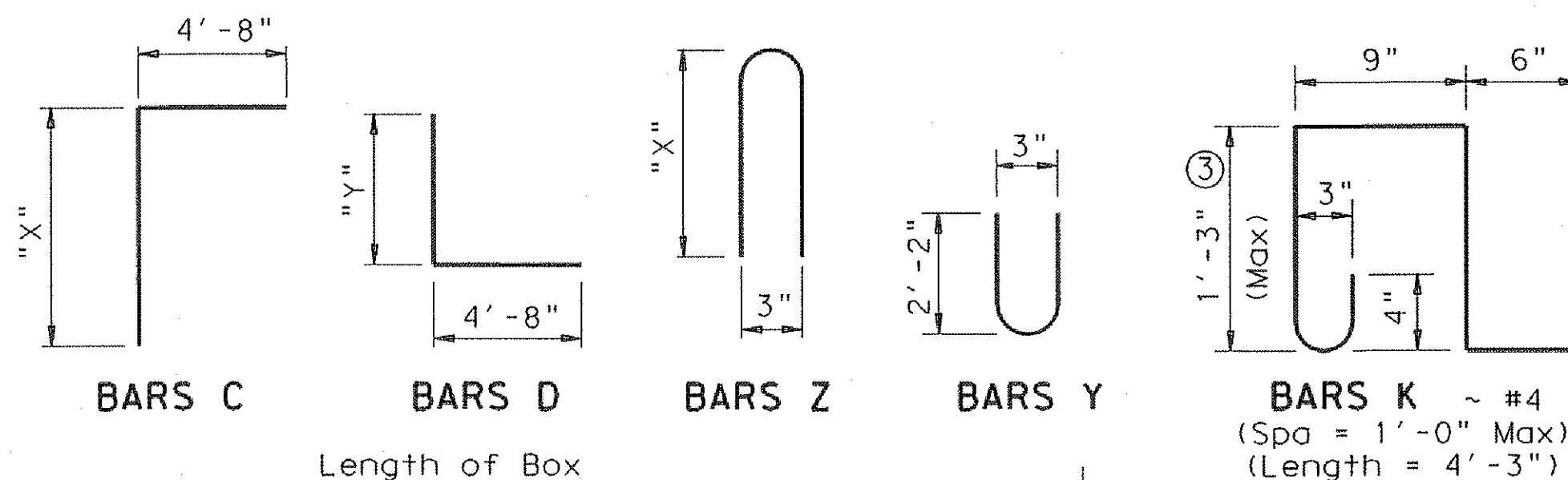
ACC:

NUMBER OF SPANS	SECTION DIMENSIONS				BILLS OF REINFORCING STEEL (For Box Length = 40 feet)																												QUANTITIES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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2	5'-0"	2'-0"	7"	7"	194	#4	5"	11'-6"	1,490	162	#4	6"	7'-1"	767	6'-10"	739	162	#5	6"	5'-8"	957	14	8"	39'-9"	372	38	39'-9"	1,009	56	2'-0"	75	41	4'-6"	123	5'-0"	137	11'-6"	31	26	74	0.637	141.7	0.9	105	26.4	5,774																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
3	5'-0"	2'-0"	7"	7"	194	#4	5"	17'-1"	2,214	162	#4	6"	7'-1"	767	6'-10"	739	162	#5	6"	11'-3"	1,901	21	8"	39'-9"	558	54	39'-9"	1,434	56	2'-0"	75	82	4'-6"	246	5'-0"	274	17'-1"	46	36	102	0.922	205.2	1.3	148	38.2	8,356																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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H	Bar Dimensions	
	"X"	"Y"
2'-0"	2'-5"	2'-2"
3'-0"	3'-5"	2'-2"
4'-0"	4'-5"	2'-2"
5'-0"	5'-5"	2'-2"

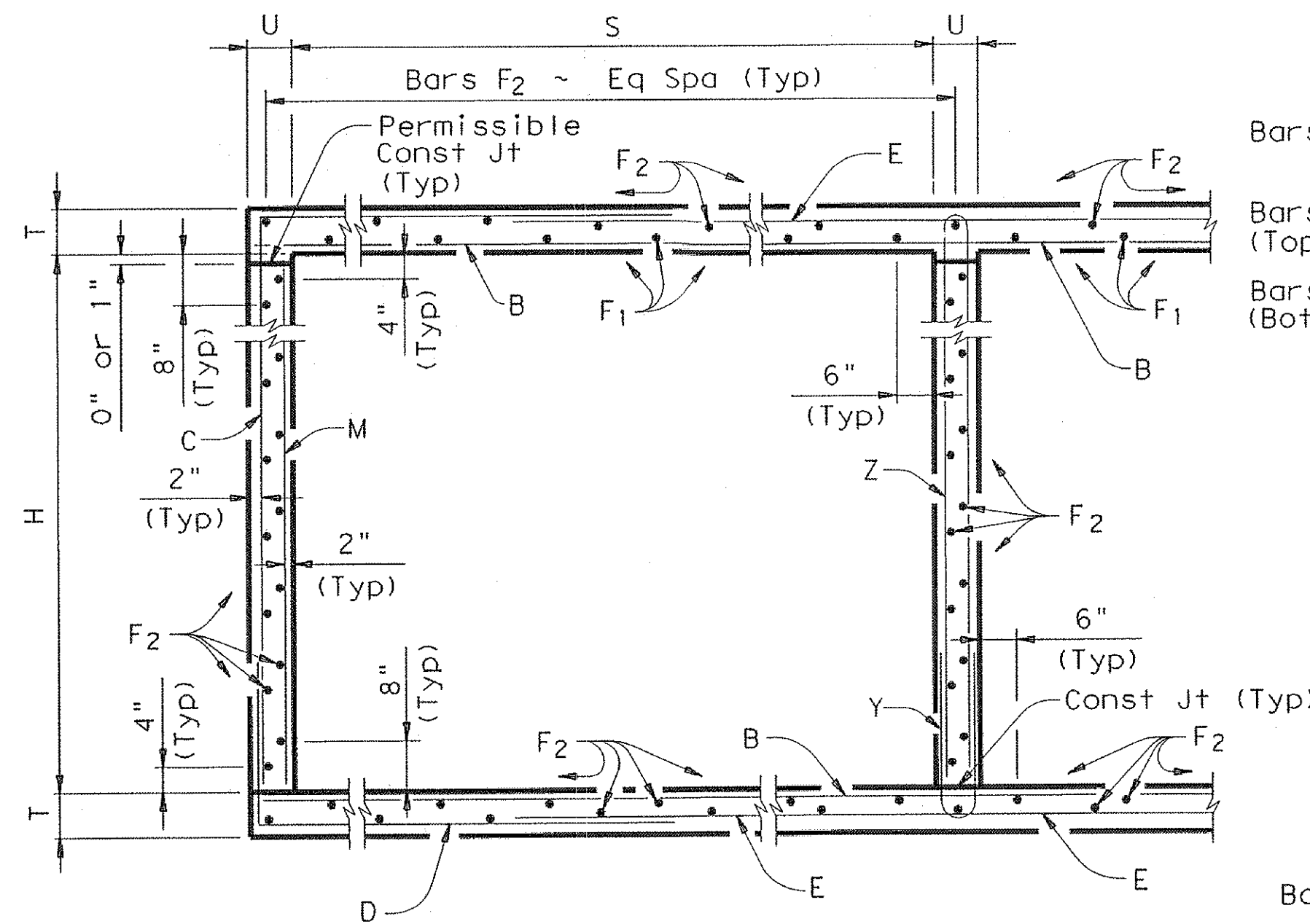


SECTION THRU CURB

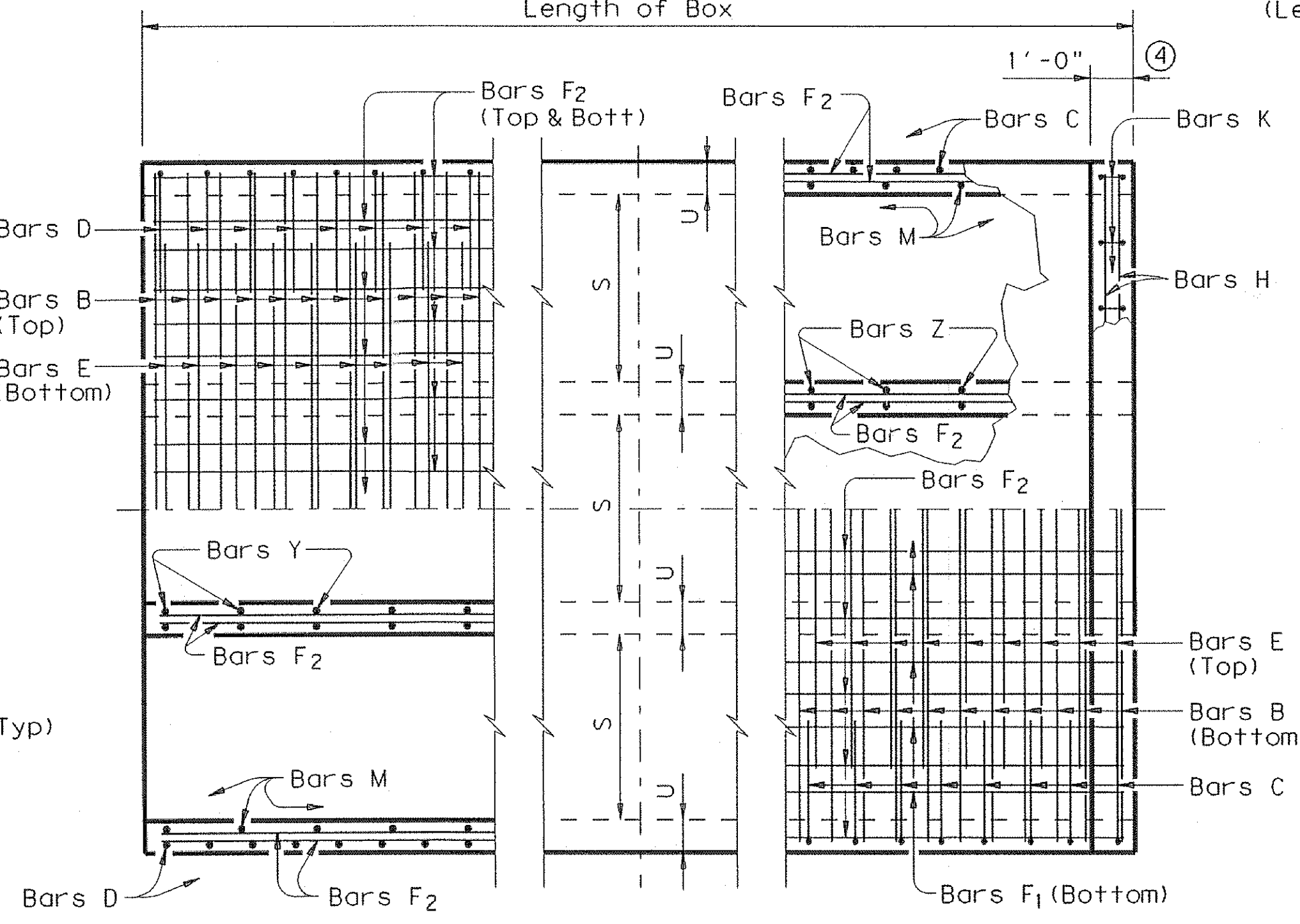


GENERAL NOTES:

Designed according to current AASHTO Standard and Interim Specifications. Designed to the maximum fill height shown. All reinforcing steel shall be Grade 60. All concrete shall be Class "C" with these exceptions: use Class "S" for top slabs of culverts with overlay, with 1-to-2 course surface treatment, or with the top slab as the final riding surface. Class "C" concrete shall have a minimum compressive strength of 3,600 psi. Class "S" concrete shall have a minimum compressive strength of 4,000 psi. The use of permanent forms is not allowed. The bottom edge of the top slab shall be chamfered 3" at the entrance. Reinforcing bars shall be adjusted to provide a minimum of 1 1/4" clear cover. Construction joints shown at the flow line may be raised a maximum of 6" at the Contractor's option. If this option is used, Bars M may be cut off or raised, Bars C and D may be reversed, and Bars Y and Z may be reversed. See standard MC-MD for skewed ends, angle sections and lengthening details.



TYPICAL SECTION



BOTTOM SLAB

PART PLANS

TOP SLAB

- 0" min to 5'-0" max. Estimated curb heights are shown elsewhere in the plans. For structures without railing and curbs taller than 1'-0", refer to ECD standard. For structures with T6 bridge rail, refer to T6-CM standard. For structures with bridge rail, other than T6, refer to RAC standard.
- For vehicle safety, the following requirements must be met:
 - For structures without bridge rail, curbs shall project no more than 3" above finished grade.
 - For structures with bridge rail, curbs shall be flush with finished grade.Curb heights shall be reduced, if necessary, to meet the above requirements. No changes will be made in quantities and no additional compensation will be allowed for this work.
- For curbs less than 1'-0" high, tilt bars K or reduce bar height as necessary to maintain cover. For curbs less than 3" high, bars K may be omitted.
- 1'-0" typical. 2'-0" when RAC standard is referred to elsewhere in the plans.

HS20 LOADING

Texas Department of Transportation
Bridge Division

MULTIPLE BOX CULVERTS
CAST-IN-PLACE
5'-0" SPAN
0' TO 20' FILL

MC-5-20

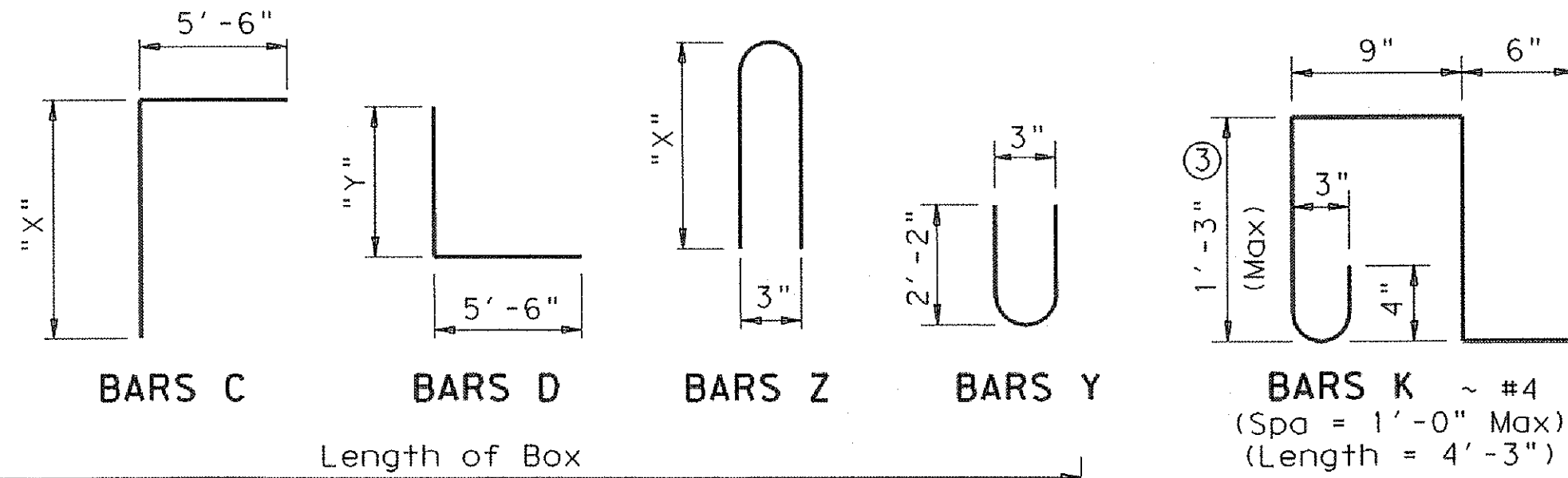
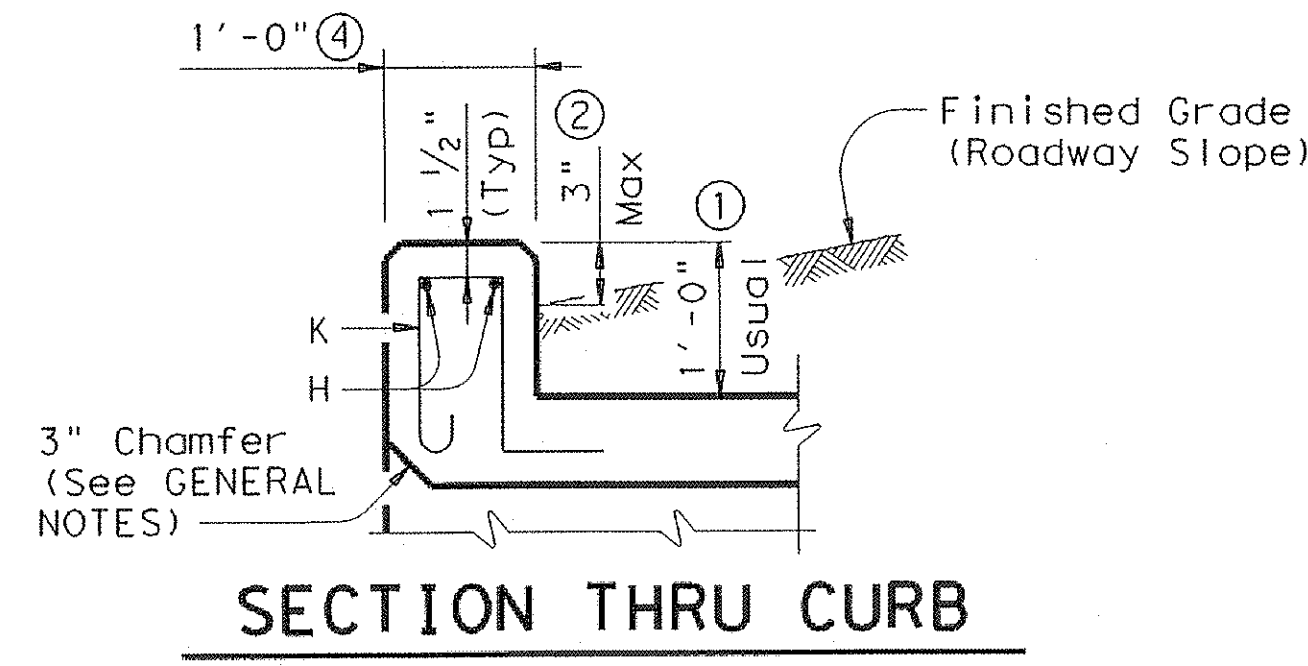
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© TxDOT May 2005	DISTRICT	FEDERAL AID PROJECT	SHEET	
REVISIONS	COUNTY	CONTROL	SECT	JOB
				HIGHWAY

DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for the use of this standard in any other format or for incorrect results or damages resulting from its use.

LEVELS DISPLAYED
ACC:

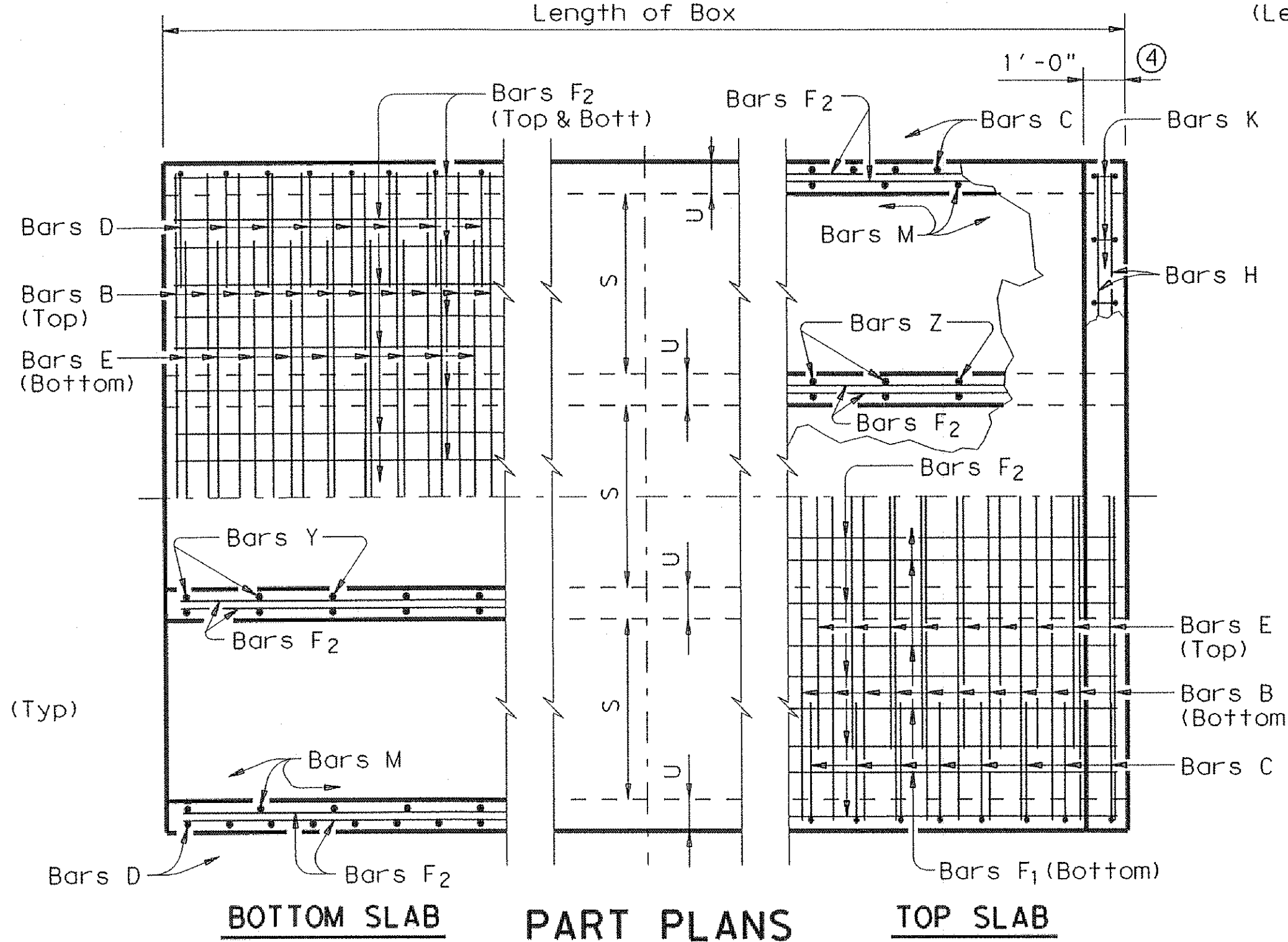
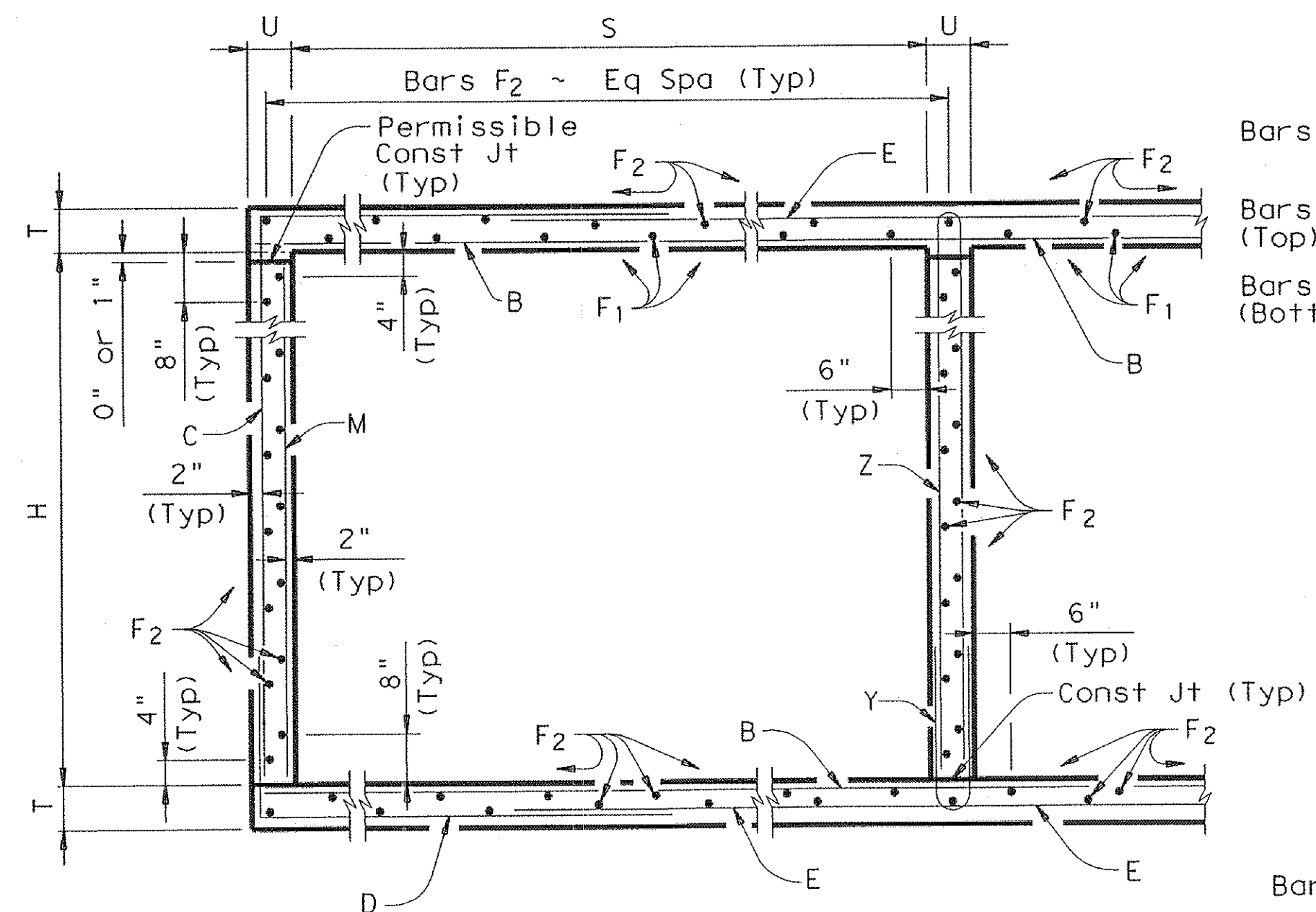
NUMBER OF SPANS	SECTION DIMENSIONS				BILLS OF REINFORCING STEEL (For Box Length = 40 feet)																								QUANTITIES																	
					Bars B				Bars C & D				Bars E				Bars F ₁ ~#4				Bars F ₂ ~#4 at 1'-6" Max			Bars M~#4 at 1'-6" Max			Bars Y & Z~#4 at 1'-0" Max				Bars H 4~#4		Bars K		Per foot of Barrel		Curb		Total							
	S	H	T	U	No.	Size	Spa	Length	Wt	No.	Size	Spa	Bar C		Bar D		No.	Size	Spa	Length	Wt	No.	Spa	Length	Wt	No.	Length	Wt	No.	Length	Wt	No.	Bar Y Length	Bar Y Wt	Bar Z Length	Bar Z Wt	Length	Weight	No.	Weight	Conc (CY)	Reinf (Lb)	Conc (CY)	Reinf (Lb)	Conc (CY)	Reinf (Lb)
2	6'-0"	3'-0"	7"	7"	162	#5	6"	13'- 6"	2,281	162	#4	6"	8'-11"	965	7'- 8"	830	194	#5	5"	6'- 0"	1,214	16	9"	39'-9"	425	50	39'-9"	1,328	56	3'- 0"	112	41	4'- 6"	123	7'- 0"	192	13'- 6"	36	30	85	0.789	186.8	1.0	121	32.6	7,591
3	6'-0"	3'-0"	7"	7"	162	#5	6"	20'- 1"	3,393	162	#4	6"	8'-11"	965	7'- 8"	830	194	#5	5"	12'- 7"	2,546	24	9"	39'-9"	637	71	39'-9"	1,885	56	3'- 0"	112	82	4'- 6"	246	7'- 0"	383	20'- 1"	54	42	119	1.138	274.9	1.5	173	47.0	11,170
4	6'-0"	3'-0"	7"	7"	162	#5	6"	26'- 8"	4,506	162	#4	6"	8'-11"	965	7'- 8"	830	194	#5	5"	19'- 2"	3,878	32	9"	39'-9"	850	92	39'-9"	2,443	56	3'- 0"	112	123	4'- 6"	370	7'- 0"	575	26'- 8"	71	56	159	1.487	363.2	2.0	230	61.5	14,759
5	6'-0"	3'-0"	7"	7"	162	#5	6"	33'- 3"	5,618	162	#4	6"	8'-11"	965	7'- 8"	830	194	#5	5"	25'- 9"	5,210	40	9"	39'-9"	1,062	113	39'-9"	3,000	56	3'- 0"	112	164	4'- 6"	493	7'- 0"	767	33'- 3"	89	70	199	1.836	451.4	2.5	288	75.9	18,345
6	6'-0"	3'-0"	7"	7"	162	#5	6"	39'-10"	6,730	162	#4	6"	8'-11"	965	7'- 8"	830	194	#5	5"	32'- 4"	6,542	48	9"	39'-9"	1,275	134	39'-9"	3,558	56	3'- 0"	112	205	4'- 6"	616	7'- 0"	959	39'-10"	106	82	233	2.186	539.7	3.0	339	90.4	21,926
2	6'-0"	4'-0"	7"	7"	162	#5	6"	13'- 6"	2,281	162	#4	6"	9'-11"	1,073	7'- 8"	830	194	#5	5"	6'- 0"	1,214	16	9"	39'-9"	425	50	39'-9"	1,328	56	4'- 0"	150	41	4'- 6"	123	9'- 0"	246	13'- 6"	36	30	85	0.853	191.8	1.0	121	35.1	7,791
3	6'-0"	4'-0"	7"	7"	162	#5	6"	20'- 1"	3,393	162	#4	6"	9'-11"	1,073	7'- 8"	830	194	#5	5"	12'- 7"	2,546	24	9"	39'-9"	637	71	39'-9"	1,885	56	4'- 0"	150	82	4'- 6"	246	9'- 0"	493	20'- 1"	54	42	119	1.224	281.3	1.5	173	50.5	11,426
4	6'-0"	4'-0"	7"	7"	162	#5	6"	26'- 8"	4,506	162	#4	6"	9'-11"	1,073	7'- 8"	830	194	#5	5"	19'- 2"	3,878	32	9"	39'-9"	850	92	39'-9"	2,443	56	4'- 0"	150	123	4'- 6"	370	9'- 0"	739	26'- 8"	71	56	159	1.595	371.0	2.0	230	65.8	15,069
5	6'-0"	4'-0"	7"	7"	162	#5	6"	33'- 3"	5,618	162	#4	6"	9'-11"	1,073	7'- 8"	830	194	#5	5"	25'- 9"	5,210	40	9"	39'-9"	1,062	113	39'-9"	3,000	56	4'- 0"	150	164	4'- 6"	493	9'- 0"	986	33'- 3"	89	70	199	1.966	460.6	2.5	288	81.1	18,710
6	6'-0"	4'-0"	7"	7"	162	#5	6"	39'-10"	6,730	162	#4	6"	9'-11"	1,073	7'- 8"	830	194	#5	5"	32'- 4"	6,542	48	9"	39'-9"	1,275	134	39'-9"	3,558	56	4'- 0"	150	205	4'- 6"	616	9'- 0"	1,232	39'-10"	106	82	233	2.337	550.2	3.0	339	96.5	22,345
2	6'-0"	5'-0"	7"	7"	162	#5	6"	13'- 6"	2,281	162	#4	6"	10'-11"	1,181	7'- 8"	830	194	#5	5"	6'- 0"	1,214	16	9"	39'-9"	425	56	39'-9"	1,487	56	5'- 0"	187	41	4'- 6"	123	11'- 0"	301	13'- 6"	36	30	85	0.918	200.7	1.0	121	37.7	8,150
3	6'-0"	5'-0"	7"	7"	162	#5	6"	20'- 1"	3,393	162	#4	6"	10'-11"	1,181	7'- 8"	830	194	#5	5"	12'- 7"	2,546	24	9"	39'-9"	637	79	39'-9"	2,098	56	5'- 0"	187	82	4'- 6"	246	11'- 0"	603	20'- 1"	54	42	119	1.311	293.0	1.5	173	53.9	11,894
4	6'-0"	5'-0"	7"	7"	162	#5	6"	26'- 8"	4,506	162	#4	6"	10'-11"	1,181	7'- 8"	830	194	#5	5"	19'- 2"	3,878	32	9"	39'-9"	850	102	39'-9"	2,708	56	5'- 0"	187	123	4'- 6"	370	11'- 0"	904	26'- 8"	71	56	159	1.703	385.4	2.0	230	70.1	15,644
5	6'-0"	5'-0"	7"	7"	162	#5	6"	33'- 3"	5,618	162	#4	6"	10'-11"	1,181	7'- 8"	830	194	#5	5"	25'- 9"	5,210	40	9"	39'-9"	1,062	125	39'-9"	3,319	56	5'- 0"	187	164	4'- 6"	493	11'- 0"	1,205	33'- 3"	89	70	199	2.096	477.6	2.5	288	86.3	19,393
6	6'-0"	5'-0"	7"	7"	162	#5	6"	39'-10"	6,730	162	#4	6"	10'-11"	1,181	7'- 8"	830	194	#5	5"	32'- 4"	6,542	48	9"	39'-9"	1,275	148	39'-9"	3,930	56	5'- 0"	187	205	4'- 6"	616	11'- 0"	1,506	39'-10"	106	82	233	2.488	569.9	3.0	339	102.5	23,136
2	6'-0"	6'-0"	7"	7"	162	#5	6"	13'- 6"	2,281	194	#4	5"	11'-11"	1,544	7'- 8"	994	194	#5	5"	6'- 0"	1,214	16	9"	39'-9"	425	62	39'-9"	1,646	56	6'- 0"	224	41	4'- 6"	123	13'- 0"	356	13'- 6"	36	30	85	0.983	220.2	1.0	121	40.3	8,928
3	6'-0"	6'-0"	7"	7"	162	#5	6"	20'- 1"	3,393	194	#4	5"	11'-11"	1,544	7'- 8"	994	194	#5	5"	12'- 7"	2,546	24	9"	39'-9"	637	87	39'-9"	2,310	56	6'- 0"	224	82	4'- 6"	246	13'- 0"	712	20'- 1"	54	42	119	1.397	315.2	1.5	173	57.4	12,779
4	6'-0"	6'-0"	7"	7"	162	#5	6"	26'- 8"	4,506	194	#4	5"	11'-11"	1,544	7'- 8"	994	194	#5	5"	19'- 2"	3,878	32	9"	39'-9"	850	112	39'-9"	2,974	56	6'- 0"	224	123	4'- 6"	370	13'- 0"	1,068	26'- 8"	71	56	159	1.811	410.2	2.0	230	74.4	16,638
5	6'-0"	6'-0"	7"	7"	162	#5	6"	33'- 3"	5,618	194	#4	5"	11'-11"	1,544	7'- 8"	994	194	#5	5"	25'- 9"	5,210	40	9"	39'-9"	1,062	137	39'-9"	3,638	56	6'- 0"	224	164	4'- 6"	493	13'- 0"	1,424	33'- 3"	89	70	199	2.225	505.2	2.5	288	91.5	20,495
6	6'-0"	6'-0"	7"	7"	162	#5	6"	39'-10"	6,730	194	#4	5"	11'-11"	1,544	7'- 8"	994	194	#5	5"	32'- 4"	6,542	48	9"	39'-9"	1,275	162	39'-9"	4,302	56	6'- 0"	224	205	4'- 6"	616	13'- 0"	1,780	39'-10"	106	82	233	2.639	600.2	3.0	339	108.6	24,346

H	Bar Dimensions	
	"X"	"Y"
3'-0"	3'-5"	2'-2"
4'-0"	4'-5"	2'-2"
5'-0"	5'-5"	2'-2"
6'-0"	6'-5"	2'-2"



GENERAL NOTES:

- Designed according to current AASHTO Standard and Interim Specifications. Designed to the maximum fill height shown. All reinforcing steel shall be Grade 60. All concrete shall be Class "C" with these exceptions: use Class "S" for top slabs of culverts with overlay, with 1-to-2 course surface treatment, or with the top slab as the final riding surface. Class "C" concrete shall have a minimum compressive strength of 3,600 psi. Class "S" concrete shall have a minimum compressive strength of 4,000 psi. The use of permanent forms is not allowed. The bottom edge of the top slab shall be chamfered 3" at the entrance. Reinforcing bars shall be adjusted to provide a minimum of 1 1/4" clear cover. Construction joints shown at the flow line may be raised a maximum of 6" at the Contractor's option. If this option is used, Bars M may be cut off or raised, Bars C and D may be reversed, and Bars Y and Z may be reversed. See standard MC-MD for skewed ends, angle sections and lengthening details.



- ① 0" min to 5'-0" max. Estimated curb heights are shown elsewhere in the plans. For structures without railing and curbs taller than 1'-0", refer to ECD standard. For structures with T6 bridge rail, refer to T6-CM standard. For structures with bridge rail, other than T6, refer to RAC standard.
- ② For vehicle safety, the following requirements must be met:
- For structures without bridge rail, curbs shall project no more than 3" above finished grade.
- For structures with bridge rail, curbs shall be flush with finished grade. Curb heights shall be reduced, if necessary, to meet the above requirements. No changes will be made in quantities and no additional compensation will be allowed for this work.
- ③ For curbs less than 1'-0" high, tilt bars K or reduce bar height as necessary to maintain cover. For curbs less than 3" high, bars K may be omitted.
- ④ 1'-0" typical. 2'-0" when RAC standard is referred to elsewhere in the plans.

HS20 LOADING

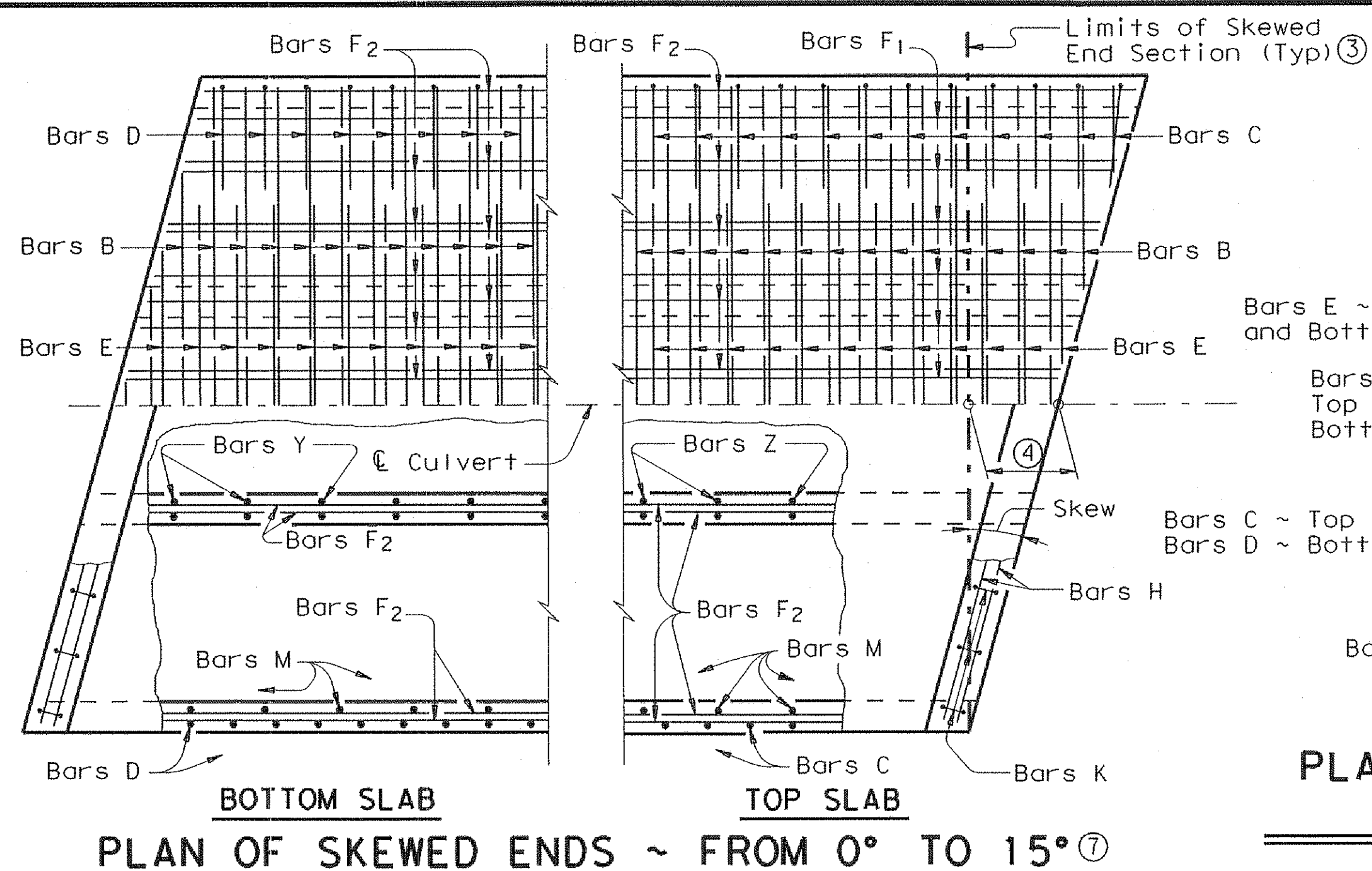
MULTIPLE BOX CULVERTS
CAST-IN-PLACE
6'-0" SPAN
0' TO 16' FILL
MC-6-16

FILE: mc616ste.dgn	DW: GAF	CK: LMW	DW: BWH/TxDOT	CK: GAF
© TxDOT May 2005	DISTRICT	FEDERAL AID PROJECT	SHEET	
REVISIONS	COUNTY	CONTROL	SECT	JOB
				HIGHWAY

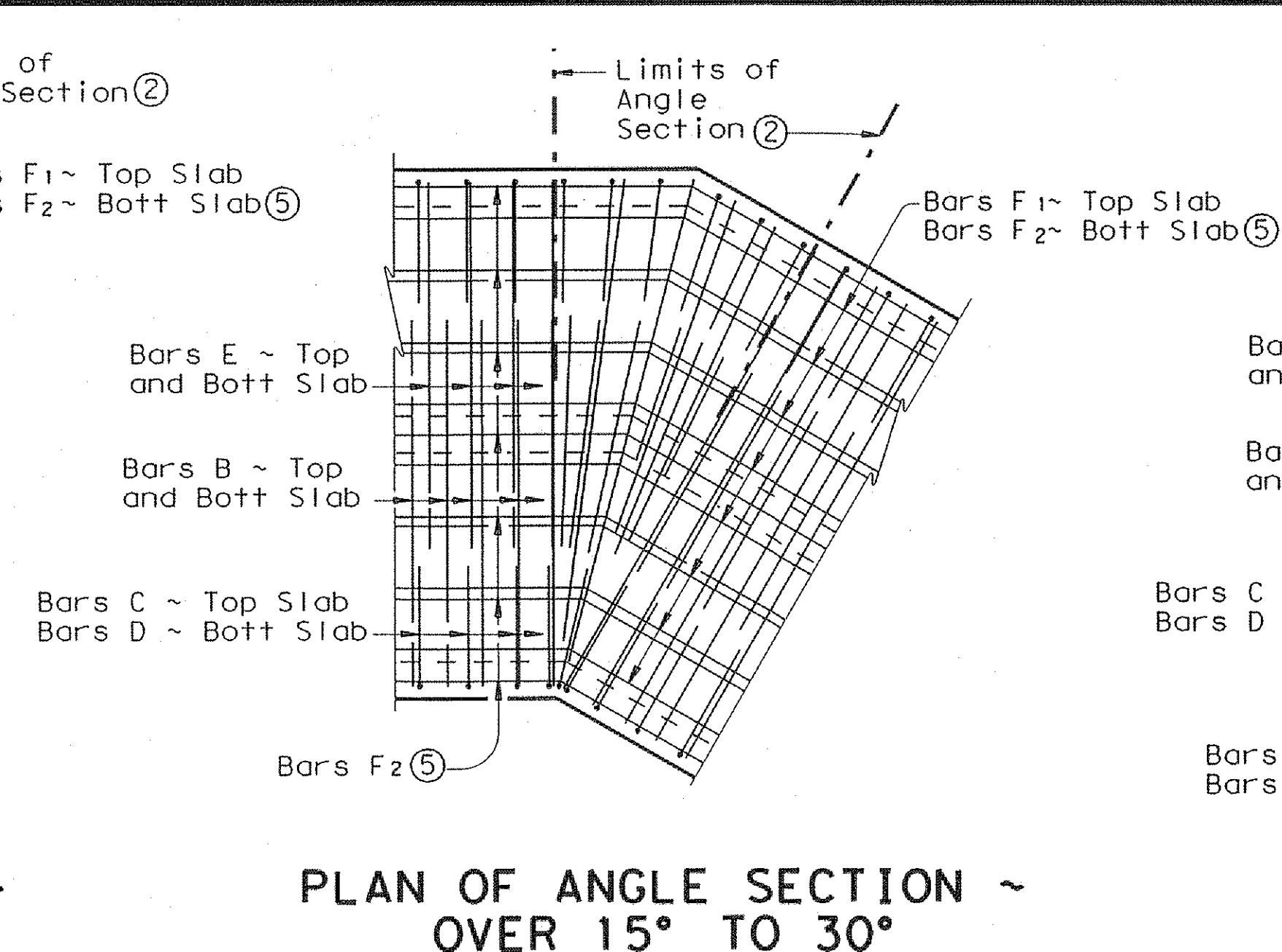
DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act". No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

COMMENTS:

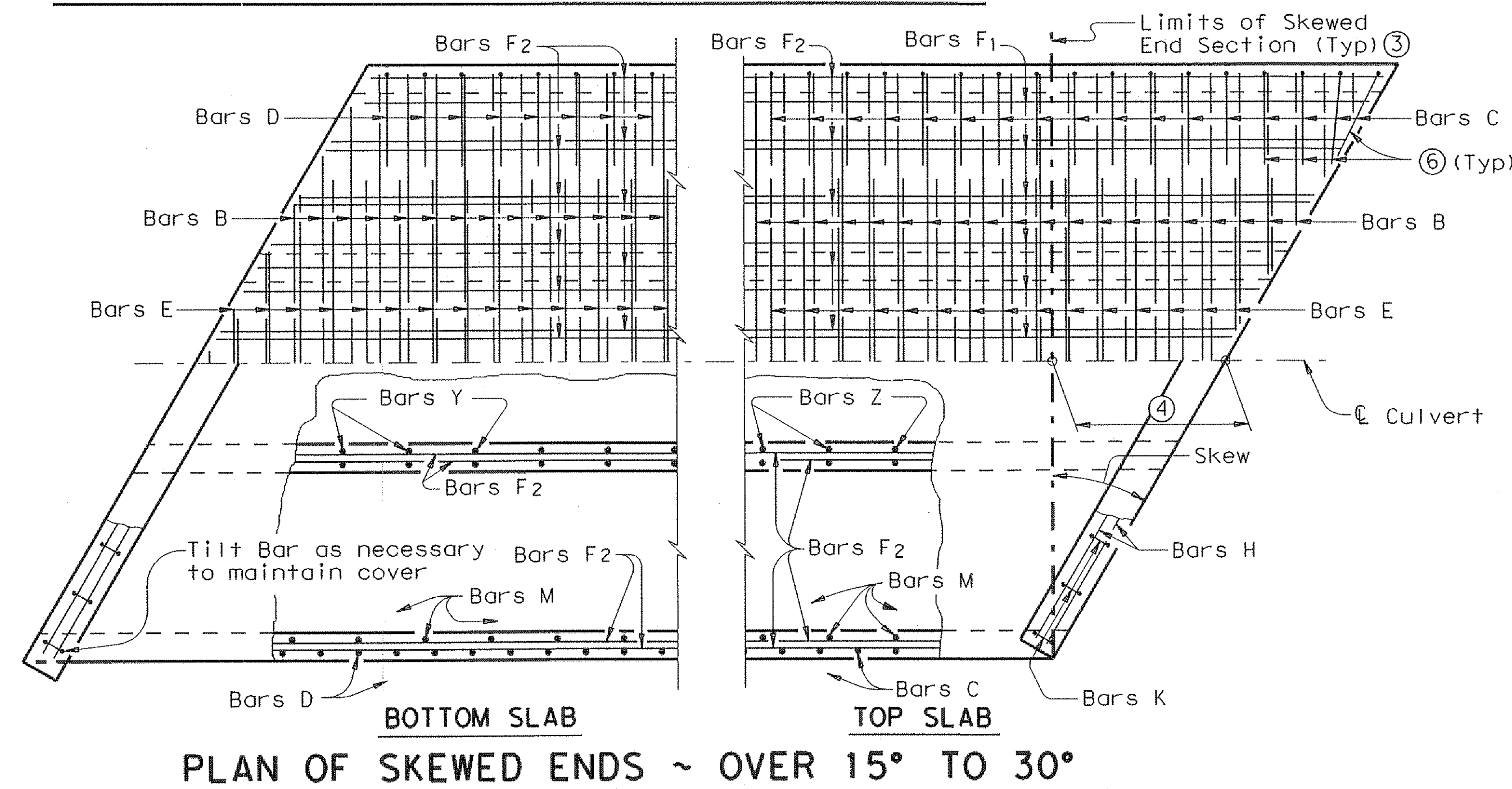
ACTIVE FILE LEVELS DISPLAYED



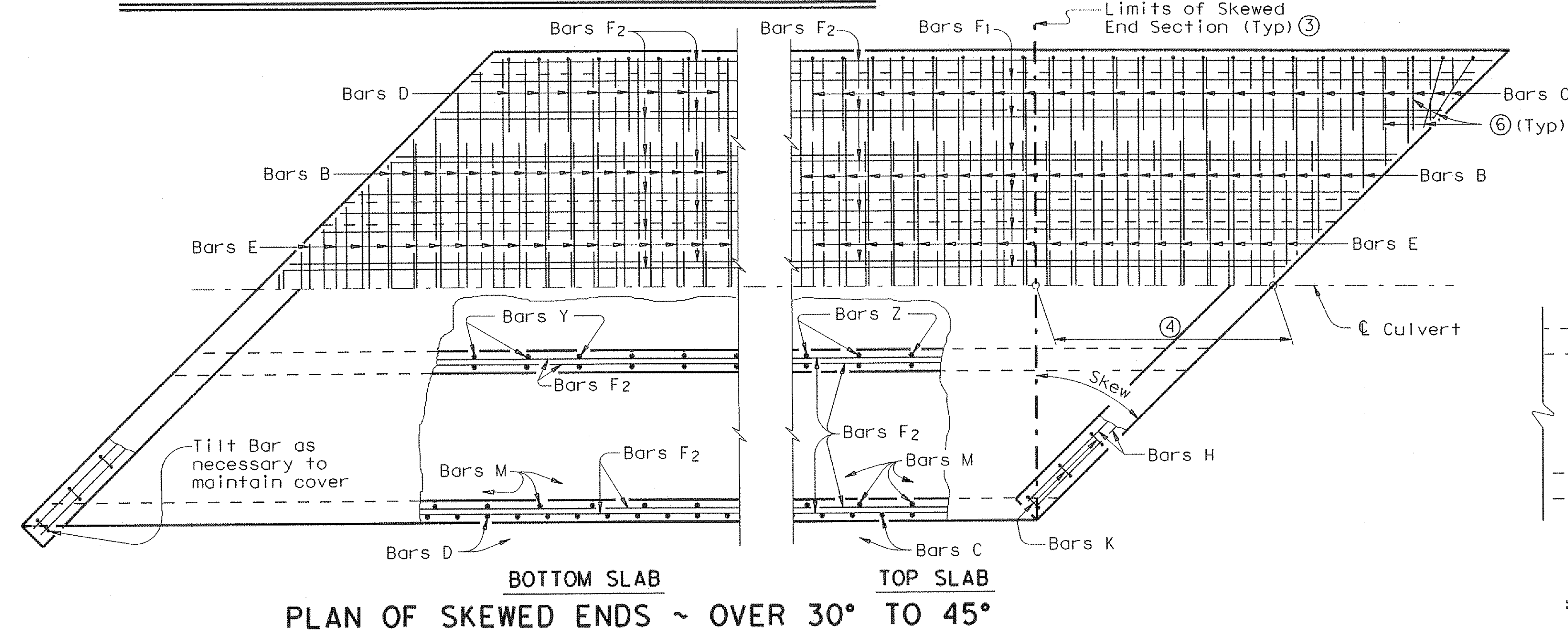
PLAN OF ANGLE SECTION ~ FROM 0° TO 15°



PLAN OF ANGLE SECTION ~ OVER 30° TO 45°



PLAN OF SKEWED ENDS ~ OVER 15° TO 30°



PLAN OF SKEWED ENDS ~ OVER 30° TO 45°

GENERAL NOTES:

Designed according to current AASHTO Standard and Interim Specifications.

All reinforcing steel shall be Grade 60.

All concrete shall be Class "C" with these exceptions: use Class "S" for top slabs of culverts with overlay, with 1-to-2 course surface treatment, or with the top slab as the final riding surface.

Class "C" concrete shall have a minimum compressive strength of 3,600 psi. Class "S" concrete shall have a minimum compressive strength of 4,000 psi.

Refer to Multiple Box Culverts Cast-in-Place standard for details of straight sections of culvert. For skewed sections and angle sections refer to Multiple Box Culverts Cast-in-Place standard for slab and wall dimensions, bar sizes, maximum bar spacing, and any other details not shown. For Skewed ends with curbs, adjust length of Bars H, number of Bars K, curb concrete volume and reinforcing steel weight by dividing the values shown on the culvert standards by the cosine of the skew angle.

The use of permanent forms is not allowed.

Laps for Bars H, when required, shall be 1'-9" for uncoated bars and 2'-7" for epoxy coated.

- For box culverts with less than 2'-0" of fill, the top slab shall be broken back to provide a minimum 1'-10" lap of the existing longitudinal bars with the longitudinal bars in the extension. If the depth of fill is 2'-0" or greater, the top slab shall be broken back to provide a 1'-0" minimum embedment of existing longitudinal reinforcing into the extension. Alternatively, if the fill height is greater than 2'-0", the existing curb may be left in place and 2'-0" long #6 bars shall be drilled and grouted 1'-0" into the existing top slab at 1'-6" center to center spacing. Wings and apron shall be broken back as necessary to install the extension. Exposed wingwall and apron reinforcing may be removed or cleaned and included in the extension. When lengthening existing box culverts with dimensions different than current standard dimensions, horizontal and vertical transitions shall be formed as directed by the Engineer. Bottom slabs shall match to maintain an uninterrupted flow line. Existing and new reinforcing shall be field bent into transition maintaining specified cover requirements. For top slabs of culverts with overlay, with 1-to-2 course surface treatment, or with the top slab as the final riding surface, the "H" dimension may be adjusted to provide a smooth riding surface.

- When the spacing between Bars B or Bars E becomes less than half of the normal spacing, bars shall be cut to avoid fouling

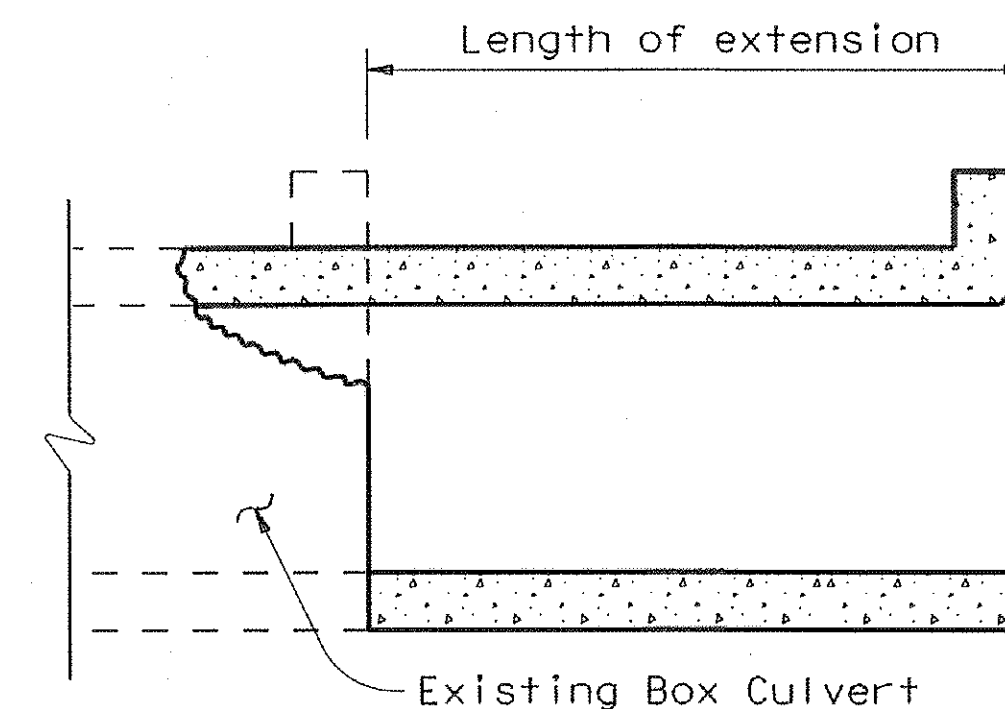
- The length of Bars B and E will vary in the skewed end sections

- [One half of overall width] x [Tan of the skew angle]

- Bars F1 and F2 shall be continuous through the angle section. They shall be bent to remain parallel to the walls of the Box Culvert.

- When necessary to avoid fouling in acute corners, the slab extension leg of Bars C and Bars D may be shortened to a minimum of 1'-6" for skews of 30° and 45°.

- For skews of 15° or less, the contractor has the option of placing Bars B, C, D and E parallel to the skewed end while maintaining spacing along centerline box. Lengths of Bars B and E shown on the standards shall be increased to accommodate the skew.



LENGTHENING DETAIL

HS20 LOADING

Texas Department of Transportation
Bridge Division

MULTIPLE BOX CULVERTS CAST-IN-PLACE MISCELLANEOUS DETAILS

MC-MD

FILE: mc-mdste.dgn	DN: GAF	CK: LMW	DN: BWH/TxDOT	CK: GAF
© TxDOT May 2005	DISTRICT	FEDERAL AID PROJECT	SHEET	
REVISIONS		COUNTY	CONTROL	SECT
				JOB
				HIGHWAY

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ACC: LEVELS DISPLAYED

TABLE OF DIMENSIONS & REINFORCING STEEL
(Wings for One Structure End)

Maximum Wingwall Height Hw	Dimensions				Variable Reinforcing				Estimated Quantities per ft of wing (2-Wings)		Estimated Quantities per ft of Toewall (1-Toewall)	
	W	X	Y	Z	Bars J1	Bars J2	Reinf (Lb/Ft)	Conc (CY/Ft)	Reinf (Lb/Ft)	Conc (CY/Ft)	Reinf (Lb/Ft)	Conc (CY/Ft)
2'-6"	2'-10"	10"	1'-0"	7"	#4	1'-0"	43.13	0.406	6.85	0.071		
2'-9"	2'-10"	10"	1'-0"	7"	#4	1'-0"	43.80	0.424	6.85	0.071		
3'-0"	2'-10"	10"	1'-0"	7"	#4	1'-0"	44.47	0.444	6.85	0.071		
3'-3"	2'-10"	10"	1'-0"	7"	#4	1'-0"	47.81	0.462	6.85	0.071		
3'-6"	2'-10"	10"	1'-0"	7"	#4	1'-0"	48.48	0.480	6.85	0.071		
4'-0"	3'-2"	1'-2"	1'-0"	7"	#4	1'-0"	50.26	0.532	6.85	0.071		
4'-6"	3'-2"	1'-2"	1'-0"	7"	#4	1'-0"	54.27	0.568	6.85	0.071		
5'-0"	3'-9"	1'-7"	1'-2"	7"	#4	1'-0"	57.94	0.632	6.96	0.075		
5'-6"	3'-9"	1'-7"	1'-2"	7"	#4	1'-0"	61.95	0.668	6.96	0.075		
6'-0"	4'-4"	2'-0"	1'-4"	7"	#5	1'-0"	75.16	0.730	7.07	0.078		
6'-6"	4'-4"	2'-0"	1'-4"	7"	#5	1'-0"	79.54	0.768	7.07	0.078		
7'-0"	5'-0"	2'-3"	1'-9"	8"	#5	1'-0"	86.65	0.864	8.07	0.093		
7'-6"	5'-0"	2'-3"	1'-9"	8"	#5	1'-0"	91.03	0.902	8.07	0.093		
8'-0"	5'-6"	2'-8"	1'-10"	8"	#5	6"	133.54	0.962	8.13	0.095		
8'-6"	5'-6"	2'-8"	1'-10"	8"	#5	6"	138.96	1.000	8.13	0.095		
9'-0"	6'-0"	2'-10"	2'-2"	9"	#5	6"	151.43	1.136	8.41	0.110		
10'-6"	6'-5"	3'-0"	2'-5"	9"	#6	6"	190.76	1.234	8.57	0.117		
11'-6"	7'-2"	3'-6"	2'-8"	11"	#6	6"	224.62	1.438	9.52	0.140		
12'-6"	7'-8"	3'-9"	2'-11"	1'-0"	#7	6"	277.90	1.592	9.74	0.157		
13'-6"	8'-2"	4'-0"	3'-2"	1'-2"	#8	6"	343.21	1.804	10.02	0.186		
14'-6"	8'-10"	4'-5"	3'-5"	1'-4"	#9	6"	427.43	2.046	10.30	0.218		
15'-6"	9'-6"	4'-10"	3'-8"	1'-6"	#9	6"	484.01	2.302	11.24	0.253		
16'-0"	9'-11"	5'-0"	3'-11"	1'-7"	#9	6"	500.21	2.448	11.47	0.279		

TABLE OF WINGWALL REINFORCING (2-Wings)

Bar	Size	No.	Spa
D1	#6	~	1'-0"
D2	#6	~	1'-0"
E1	#4	~	1'-0"
F	#4	~	1'-0"
G	#6	~	1'-0"
M1	#4	4	~
P	#4	~	1'-0"
V	#4	~	1'-0"

TABLE OF TOEWALL REINFORCING

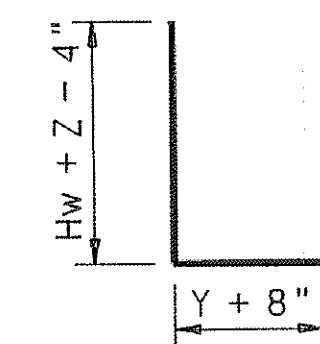
Bar	Size	No.	Spa
J3	#4	~	1'-0"
M2	#4	2	~
E2	#4	~	1'-0"

WING DIMENSION CALCULATIONS:

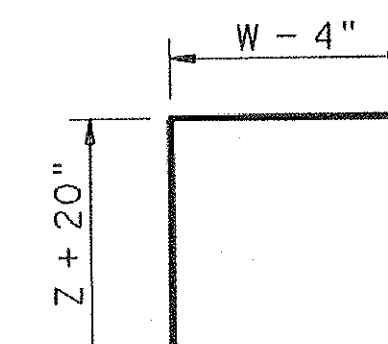
Formulas: (All values are in Feet)
 $Hw = H + T + C$
 $Lw = (Hw) (SL) \div \text{Cosine } (V)$
For Cast-in-place culverts:
 $Ltw = [(N) (S) + (N + 1) (U)] \div (\text{Cosine } V)$
For Precast culverts:
 $Ltw = [(N) (2 U + S) + (N - 1) (0.5')] \div (\text{Cosine } V)$
Total Wingwall Area (Two Wings ~ S.F.)
 $= (2) (Hw) (Lw)$

Hw = Height of Wingwall
Lw = Length of Wingwall
Ltw = Culvert Toewall Length
N = Number of Culvert Spans
SL:1 = Channel Slope ratio. (Horizontal: 1 Vertical, Usual value is 2:1)
V = Culvert Skew

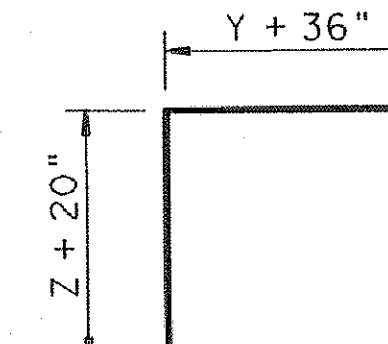
See applicable box culvert standard for S, H, T and U values.



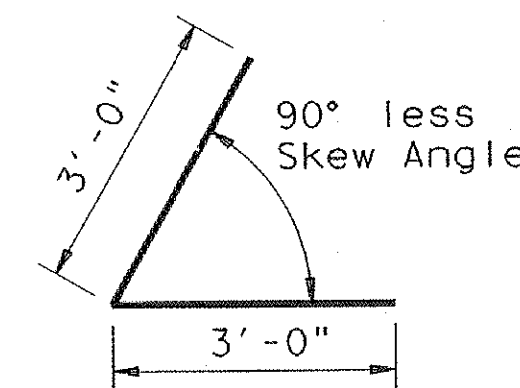
BARS J1



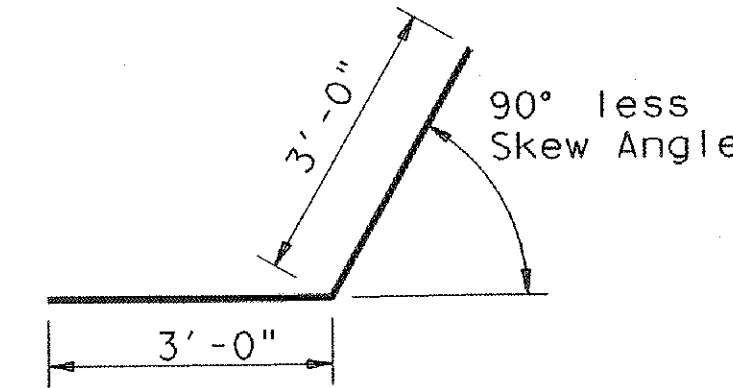
BARS J2



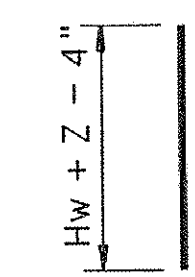
BARS J3



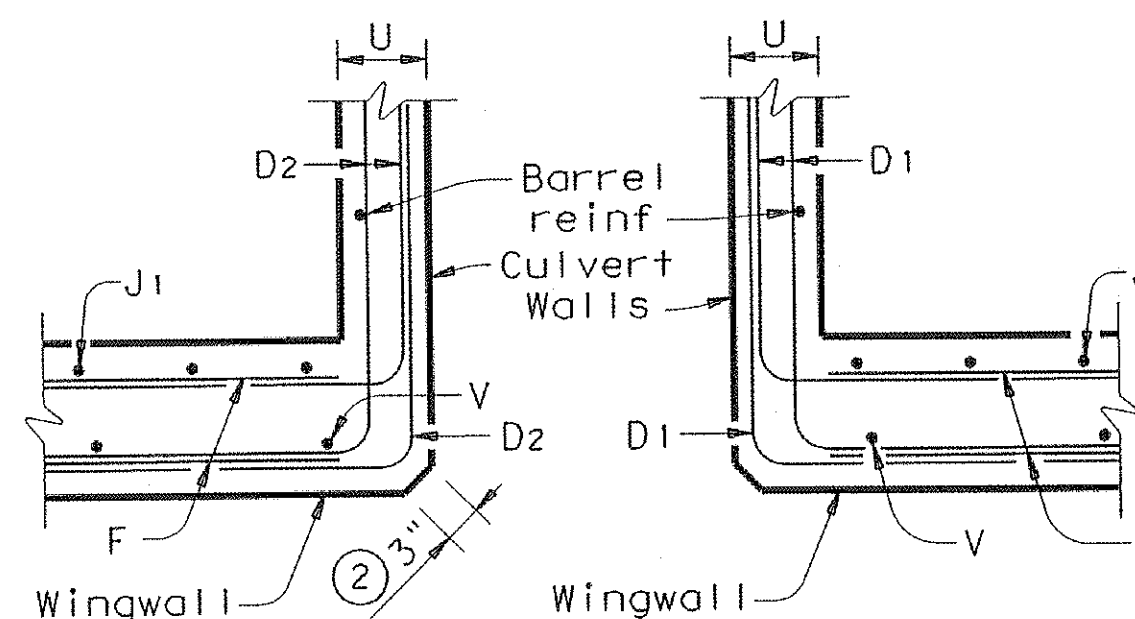
BARS D1



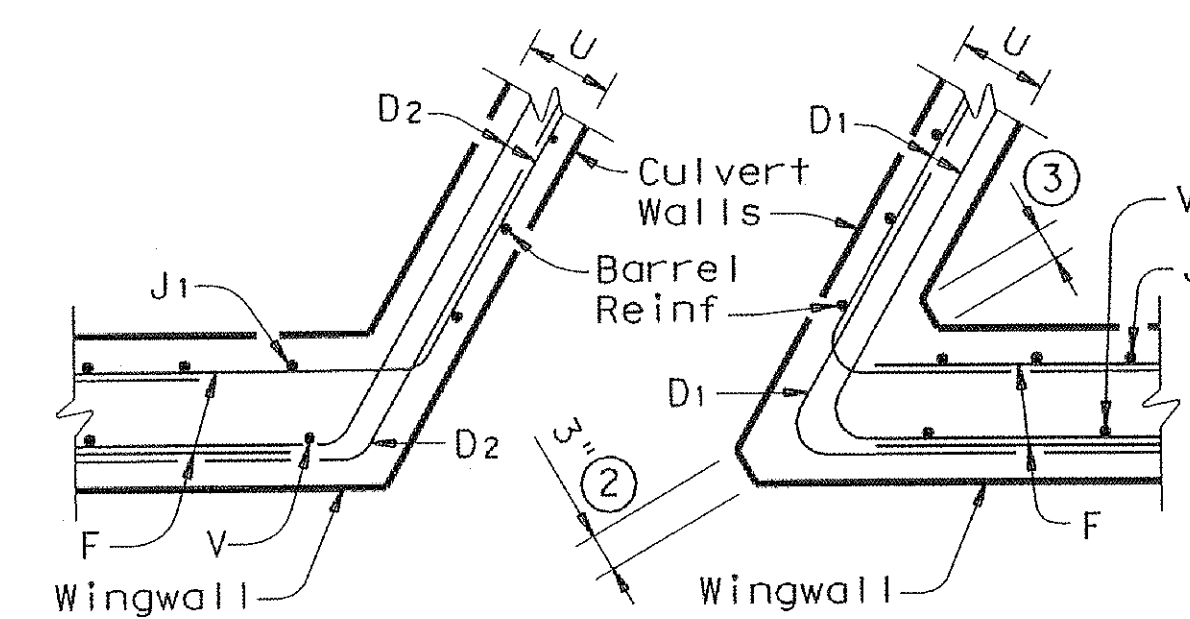
BARS D2



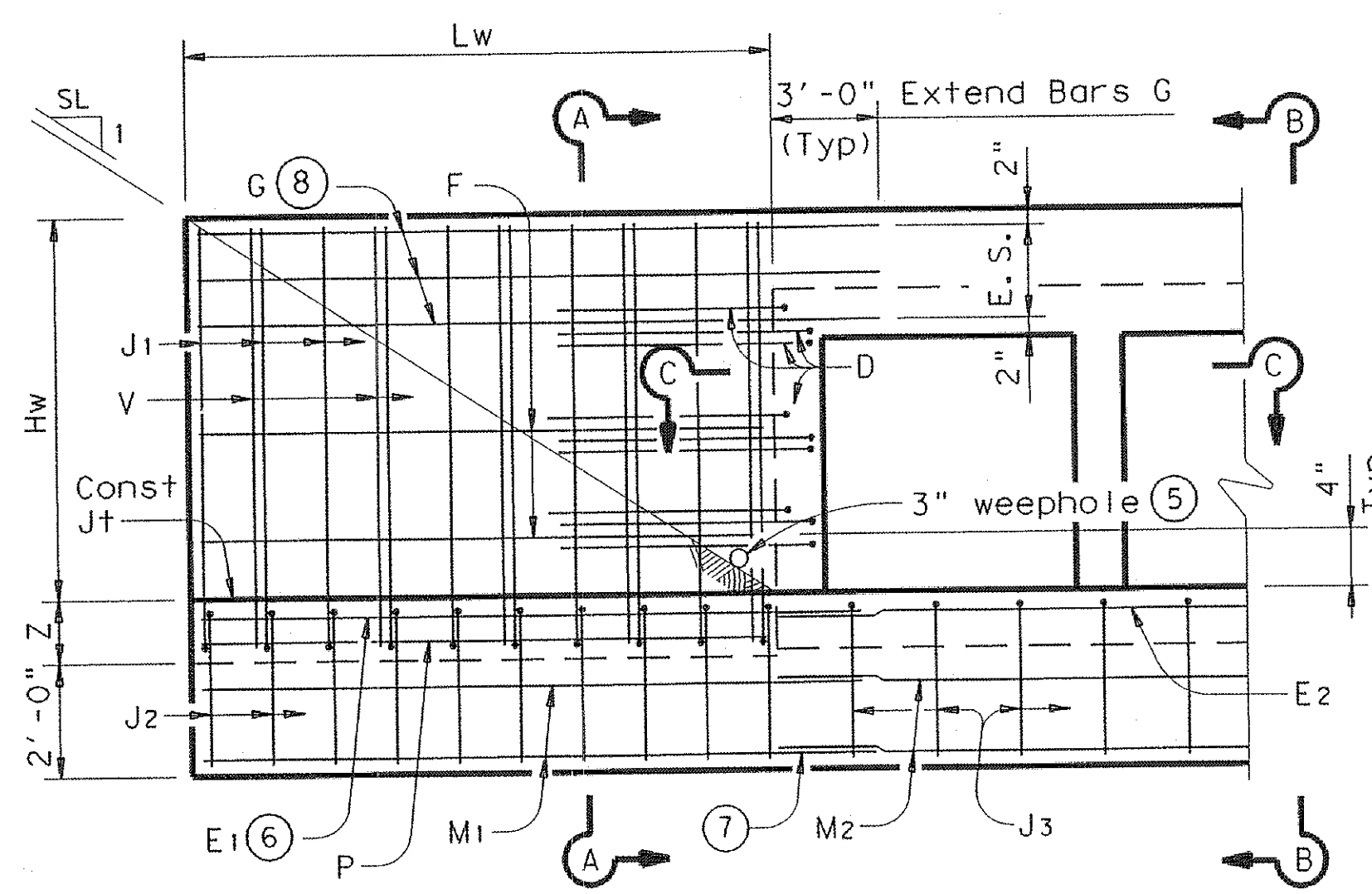
BARS V



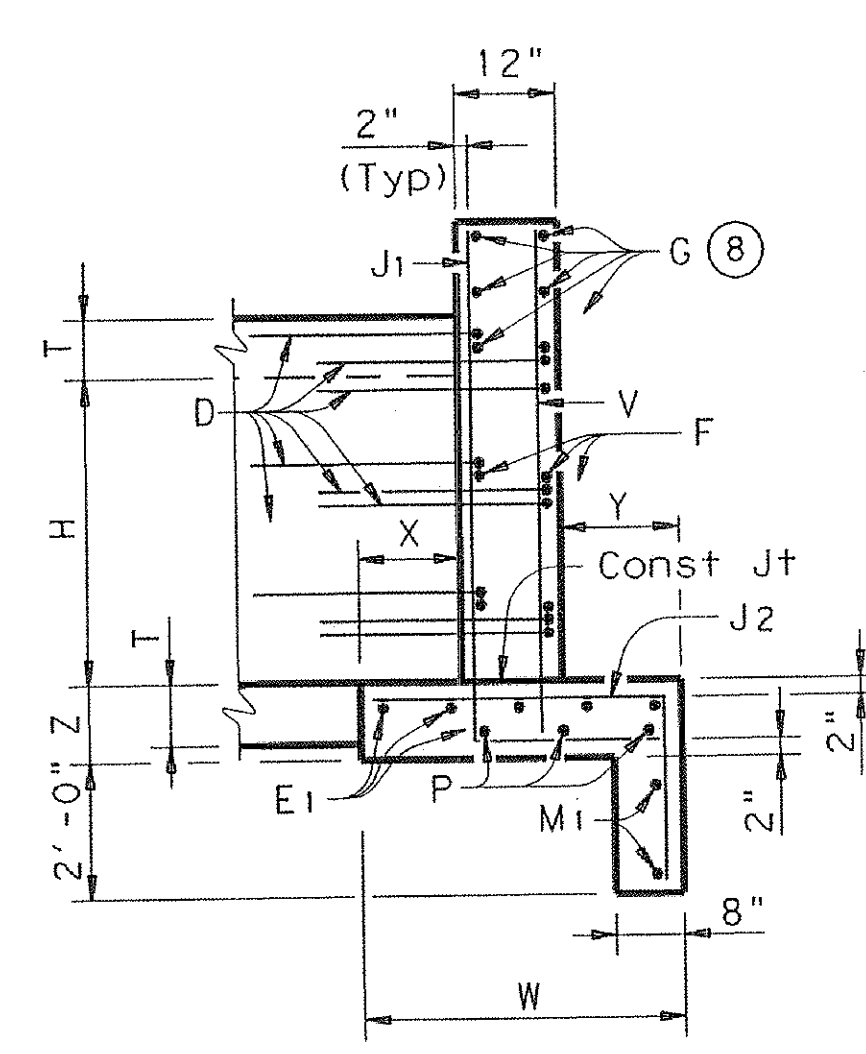
SECTION C-C



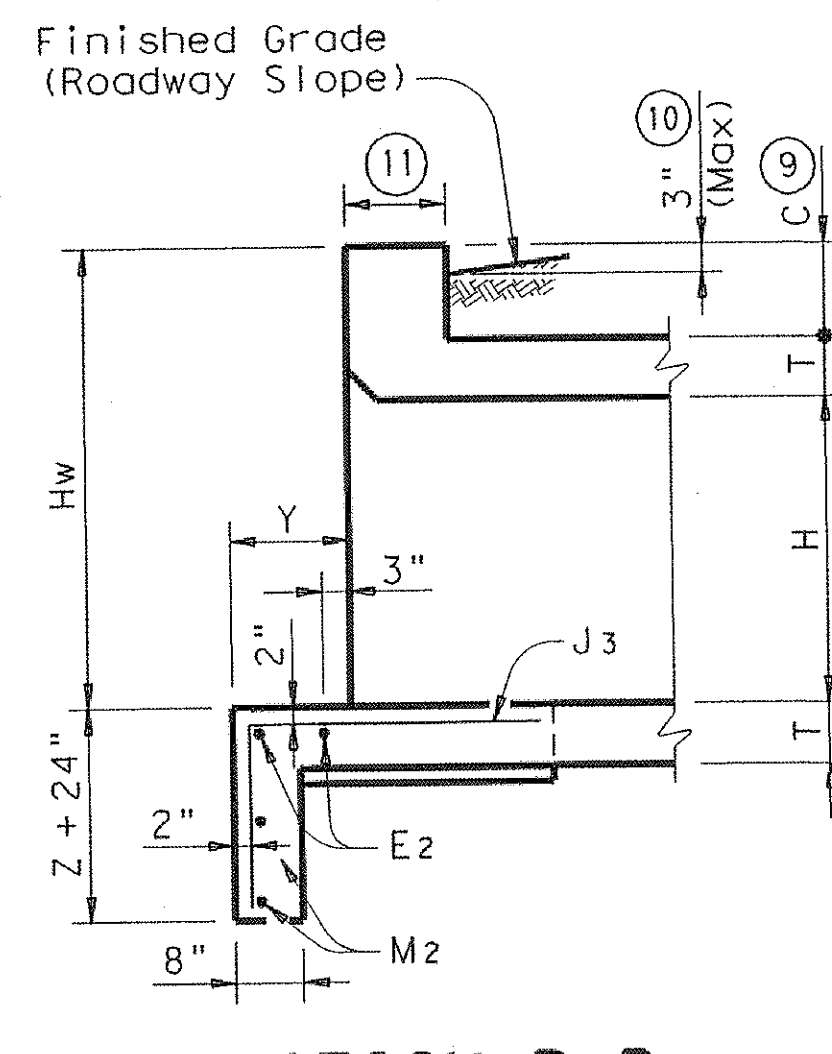
SECTION C-C



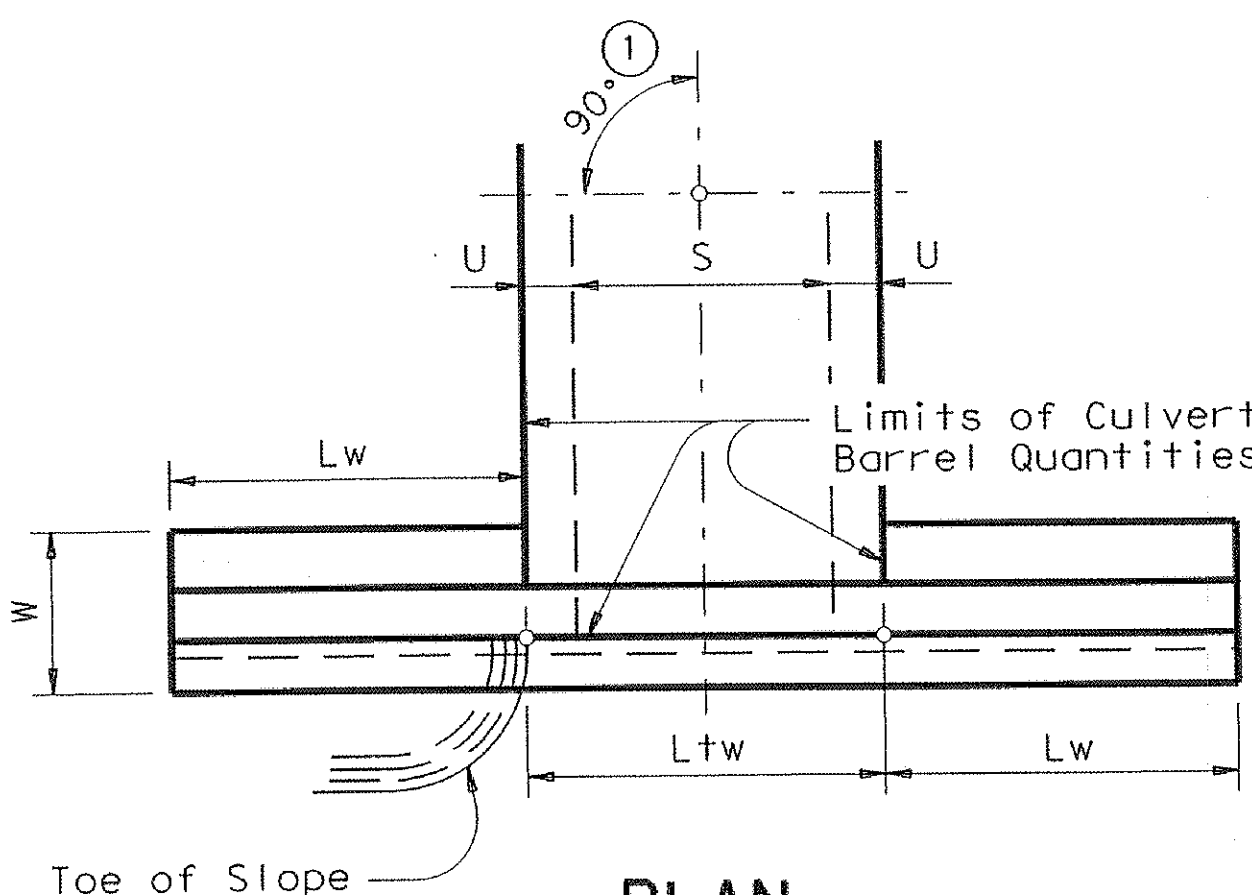
PARTIAL ELEVATION



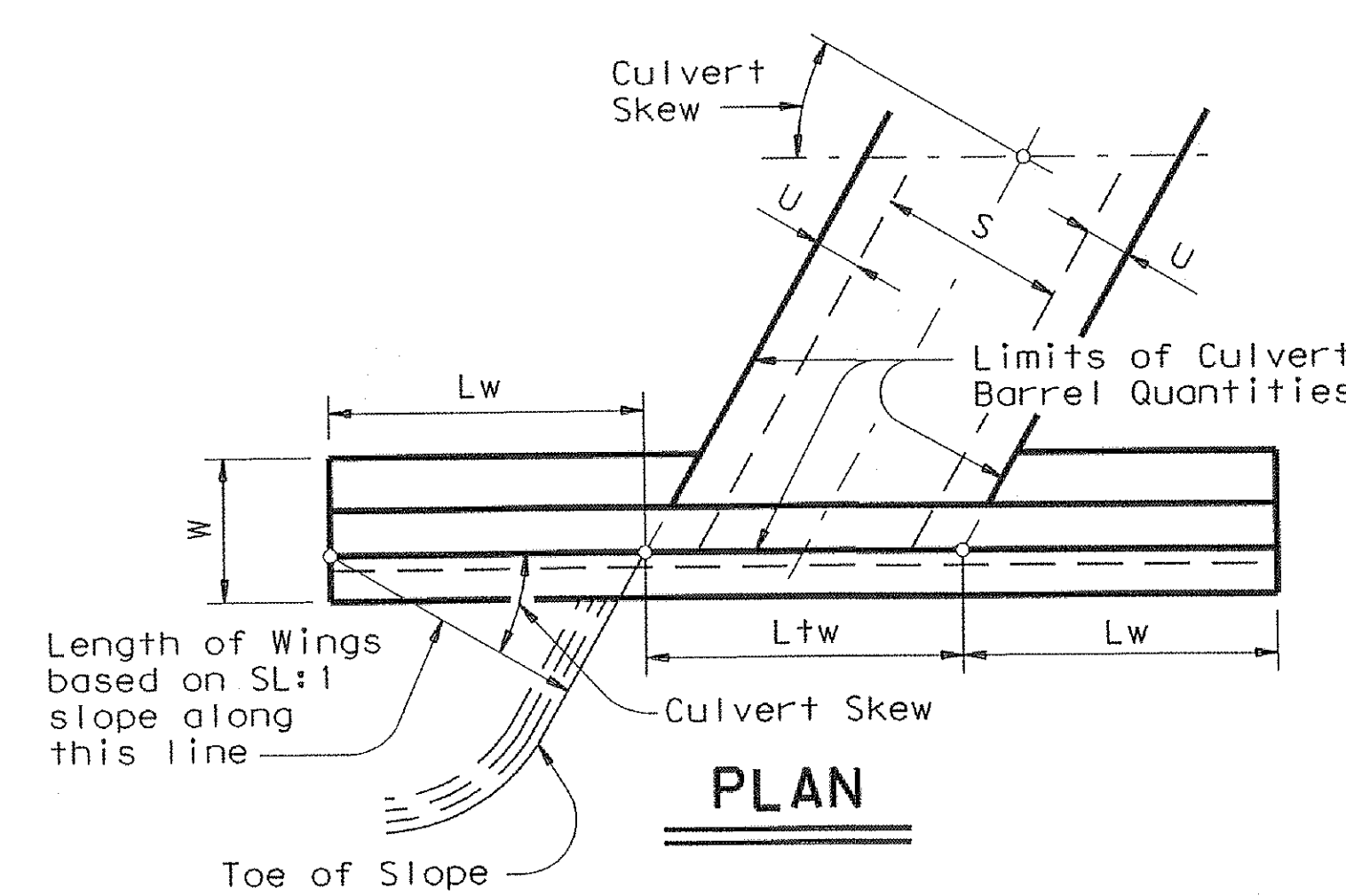
SECTION A-A
(Showing Wing Reinf)



SECTION B-B
(Showing Toewall Reinf)



DETAILS FOR NON-SKEWED BOX CULVERTS



DETAILS FOR SKEWED BOX CULVERTS
(Showing 30° Skew)

- Skew Angle = 0°
- At discharge end, chamfer may be 3/4".
- For 15° Skew ~ 1"
For 30° Skew ~ 2"
For 45° Skew ~ 3"
- Quantities shown are for two wings. To determine total quantities for two wings, multiply the tabulated values by Lw.
- Provide weepholes for Hw = 5'-0" and greater. Fill around weepholes with coarse gravel.
- Extend Bars E1 1'-6" minimum into the bottom slab of the culvert.
- Lap Bars M1 1'-6" minimum with Bars M2.
- Bars G shall be equally spaced at 8" maximum, placed as shown. There shall be at least 4 Bars G per wing.
- 0" min to 5'-0" max. For T6 or C6 Rail, see T6-CM standard for additional details. For all other rail types, refer to the RAC standard. For curbs without rail and greater than 1'-0" high, see ECD standard for additional details. Estimated curb heights are shown elsewhere in the plans.
- For vehicle safety, the following requirements must be met:
 - For structures without bridge rail, curbs shall project no more than 3" above finished grade.
 - For structures with bridge rail, curbs shall be flush with finished grade.Curb heights shall be reduced, if necessary, to meet the above requirements. No changes will be made in quantities and no additional compensation will be allowed for this work.
- 1'-0" typical. 2'-0" typical when RAC standard is referenced elsewhere in the plans.

GENERAL NOTES:

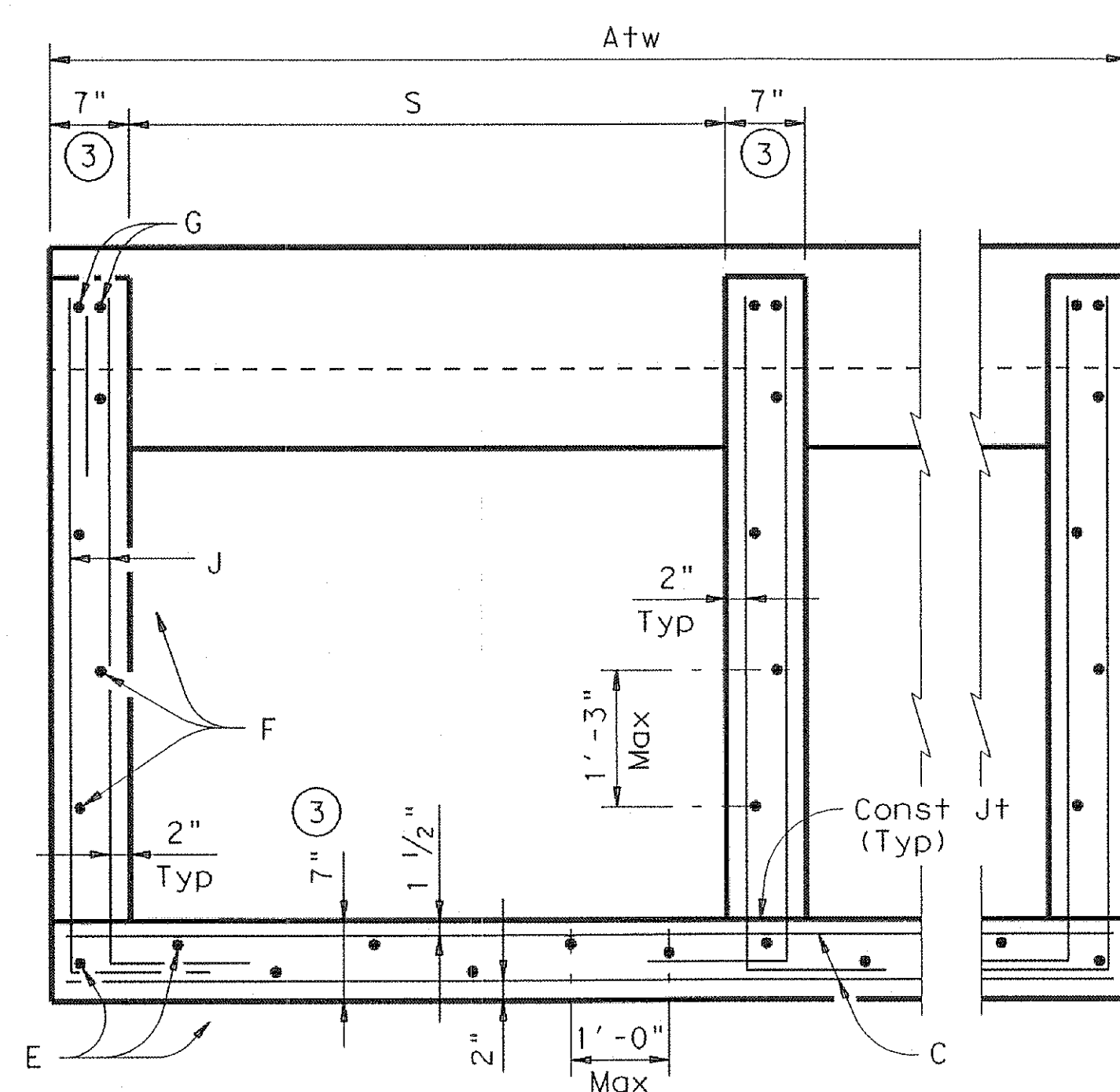
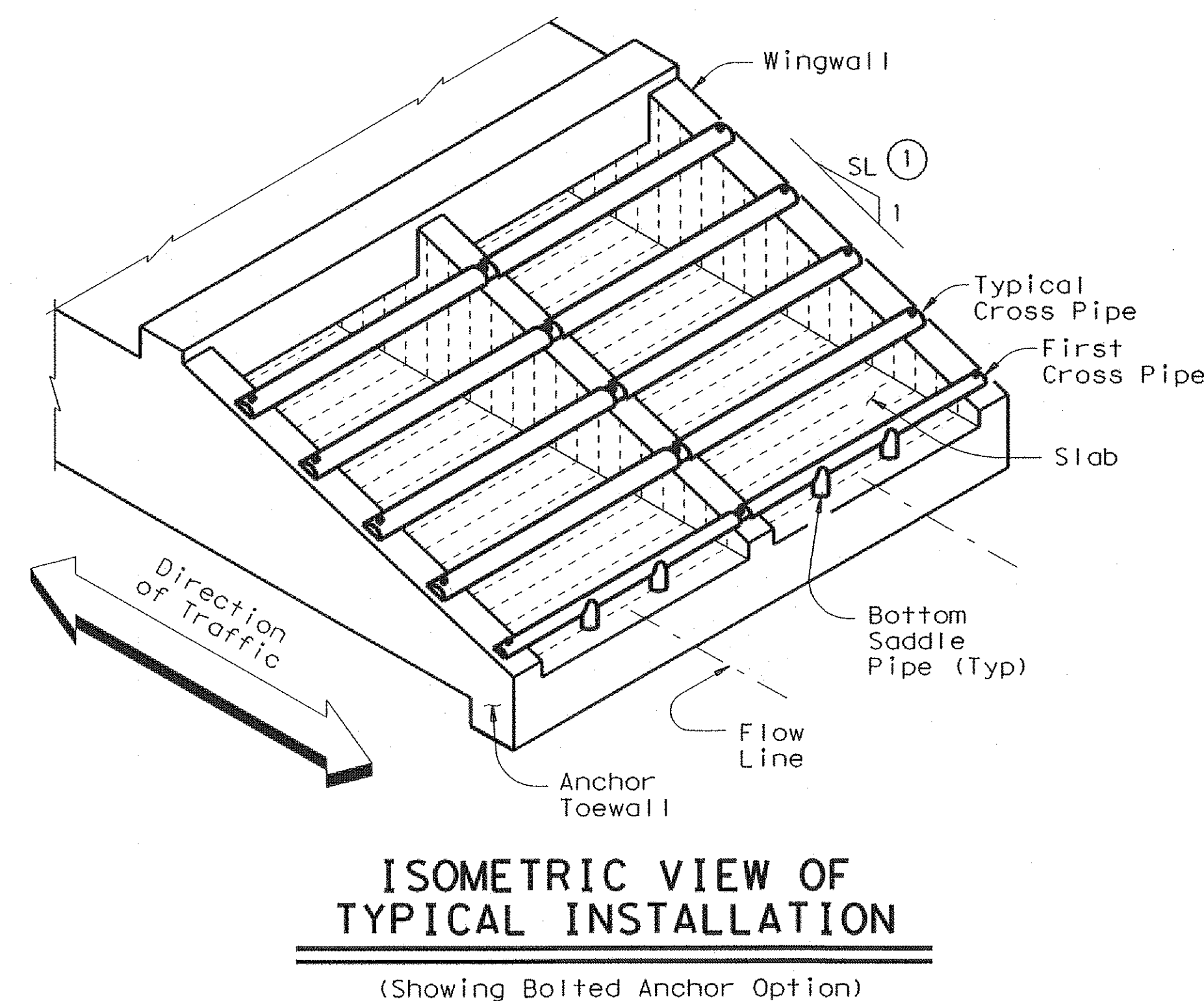
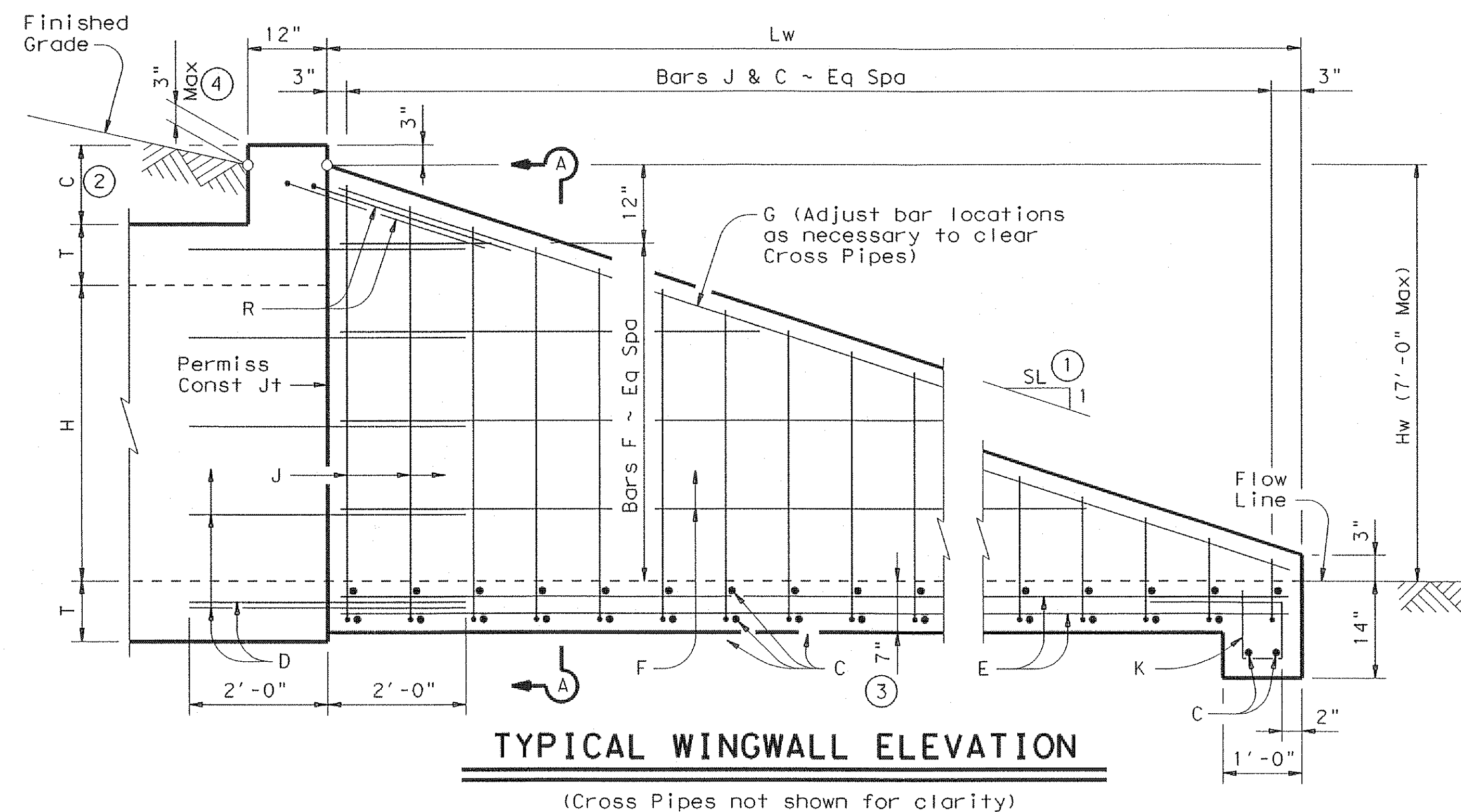
Designed according to current AASHTO Standard and Interim Specifications.
All reinforcing steel shall be Grade 60.
All concrete shall be Class "C" and shall have a minimum compressive strength of 3600 psi.
All reinforcing bars shall be adjusted to provide a minimum of 1 1/4" clear cover.
When structure is founded on solid rock, depth of toewalls for culverts and wingwalls may be reduced or eliminated as directed by the Engineer.
See BCS sheet for additional dimensions and information.
The quantities for concrete and reinforcing steel resulting from the formulas given on this sheet are for Contractor's information only.

Texas Department of Transportation
Bridge Division

CONCRETE WINGWALLS
WITH PARALLEL WINGS FOR
SKEWED AND NON-SKEWED
BOX CULVERTS

PW

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REVISIONS:				
08-07: Size & No. of Bars D, Size & Lgh of Bars G.	COUNTY	CONTROL	SECT	JOB

[illegible]

SECTION A-A

(Showing typical Wingwall and Wing Slab reinforcing)
(Pipe Runners not shown for clarity)

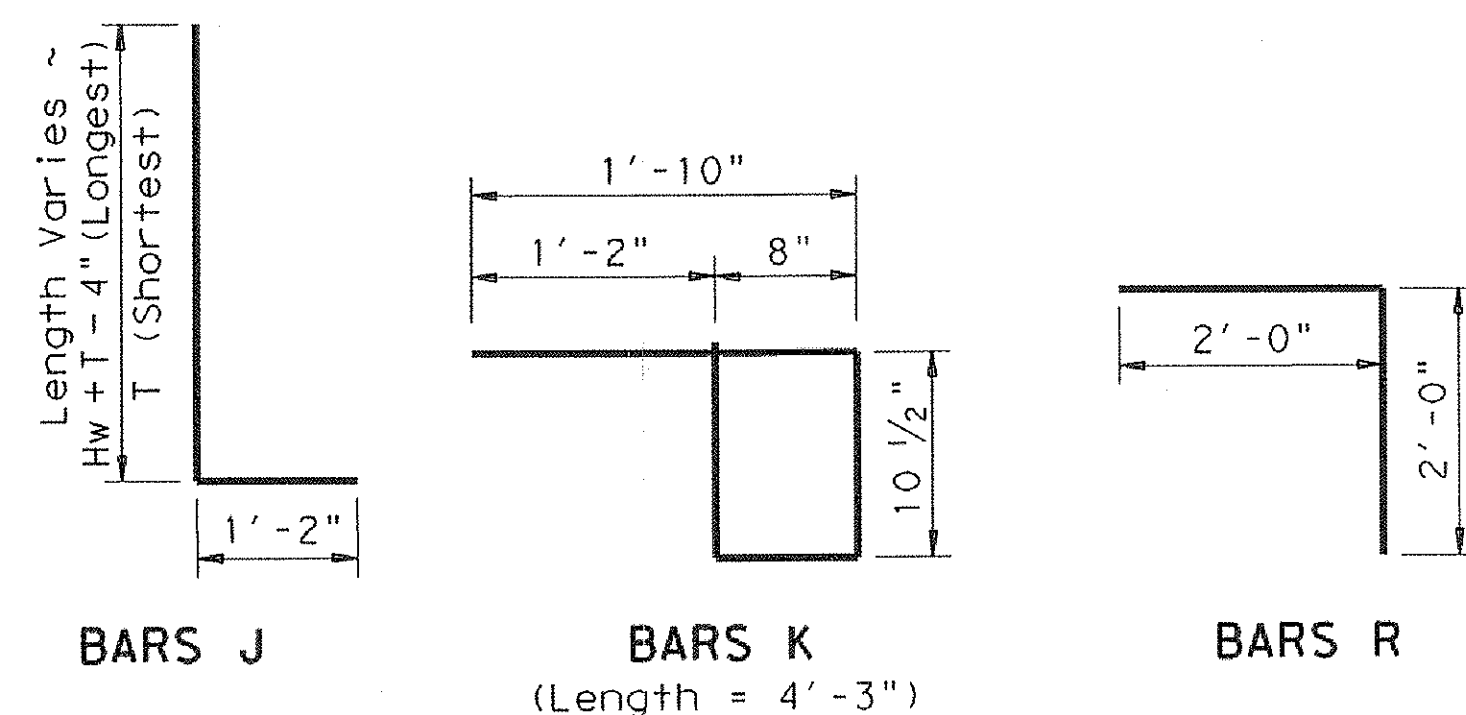
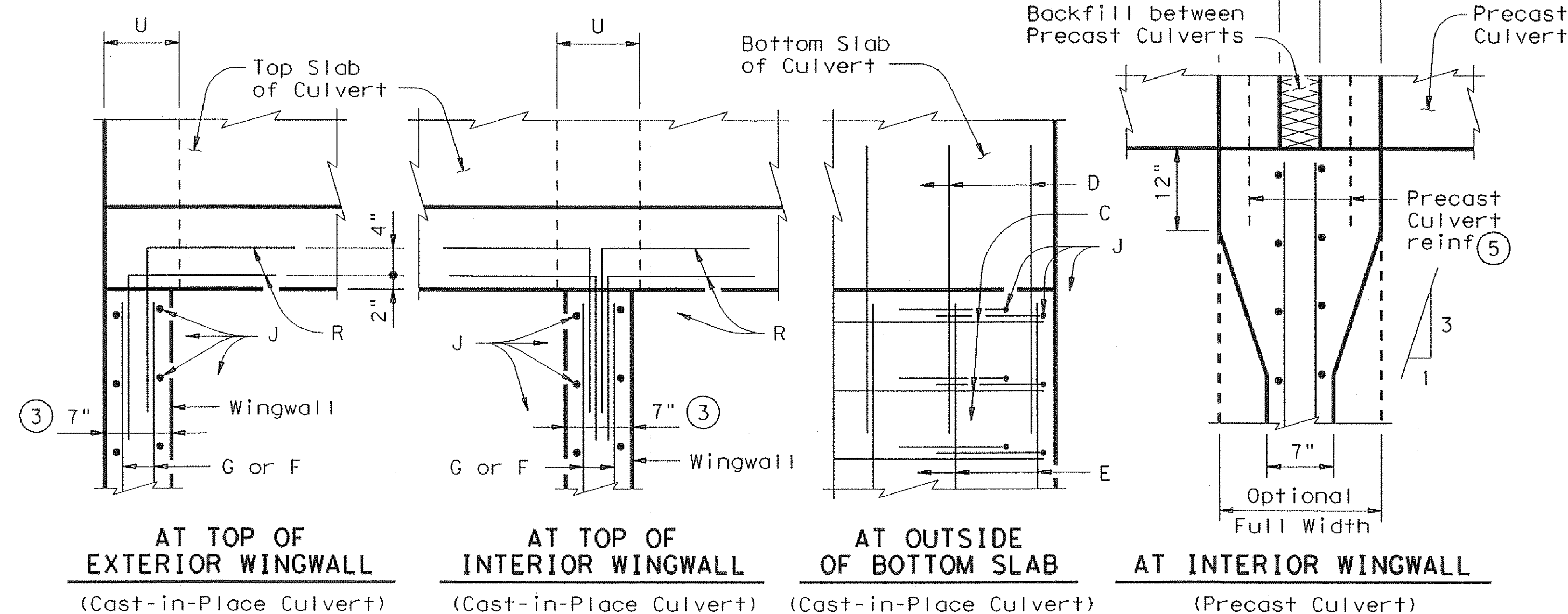


TABLE OF REINFORCING BAR SIZES & SPACING		
Bar	Size	Spacing
C	#4	10" Max
D	#4	match F & E
E	#4	1' - 0" Max
F	#4	1' - 3" Max
G	#6	Shown
J	#4	10" Max
K	#4	1' - 0" Max
R	#4	Shown



PLAN VIEWS OF CORNER DETAILS

- ① Slope may be 6:1 or flatter.
- ② 0" min to 5'-0" max. Estimated curb heights are shown elsewhere in the plans. For structures without railing and curbs taller than 1'-0", refer to ECD standard.
- ③ Wingwall and slab thicknesses may be the same as the adjacent culvert wall and slab thicknesses (7" Minimum). If thicknesses greater than the minimum (7") are used, no changes will be made in quantities and no additional compensation will be allowed.
- ④ For vehicle safety, curbs shall project no more than 3" above finished grade. Curb heights shall be reduced, if necessary, to meet these requirements. No changes will be made in quantities and no additional compensation will be allowed for this work.
- ⑤ For Culverts with $C = 0"$, the precast culvert reinforcing may extend 1'-0" minimum into Wingwall. Wingwall Bars D and R may be omitted. Otherwise, refer to the "Wingwall Connection Detail" on the SCP-MD standard.

Formulas: (All values are in Feet)

$H_w = H + T + C - 0.250'$

$L_w = (H_w - 0.250') (SL)$

For Cast-in-place culverts:

$A_{tw} = (N) (S) + (N+1) (U)$

For Precast culverts:

$A_{tw} = (N) (2U + S) + (N-1) (0.500')$

Total Wingwall Area (S.F.)

$= (0.5) (H_w + 0.250') (L_w) (N+1)$

Total Concrete Volume (C.Y.)

$= [(Wingwall Area) (0.583') +$
 $(L_w) (A_{tw}) (0.583') +$
 $(A_{tw}) (1.000') (1.167' - 0.583')] \div (27)$

Total Reinforcing (Lbs)

$= (1.55) (L_w) (A_{tw}) +$
 $(4.43) (A_{tw}) +$
 $(K) (H_w) (N+1) (\sqrt{L_w})$

C = Height of Curb above top of Top Slab
Hw = Height of Wingwall
K = Constant Value for use in formulas
Slope SL:1 ~ 10.41
6:1 ~ 10.41
Atw = Anchor Toewall Length
Lw = Length of Wingwall
N = Number of Culvert Barrels
S = Clear Span of each Barrel
SL:1 = Side Slope Ratio (Horizontal : 1 Vertical)
See applicable box culvert standard for H, S,
T, and U values.

GENERAL NOTES:

Designed according to current AASHTO Standard
and Interim Specifications.

The Safety End Treatments shown herein are intended for use in those installations where out of control vehicles are likely to traverse the openings approximately perpendicular to the Cross Pipes.

Cross Pipes are designed for a traversing load of 10,000 pounds at yield as recommended by Research Report 280-2F, "Safety Treatment of Roadside Parallel-Drainage Structures", Texas Transportation Institute, March 1981.

All concrete shall be Class "C" and shall have a minimum compressive strength of 3600 psi.

All reinforcing steel shall be Grade 60. All reinforcing shall be adjusted as necessary to provide a minimum clear cover of 1 1/4".

The quantities for concrete, reinforcing steel, and Cross Pipes resulting from the formulas given herein are for Contractor's information only.

Cross Pipes, Sleeve Pipes, and Saddle Pipes shall conform to the requirements of ASTM A53 (Type E or S, Grade B), ASTM A500 (Grade B), or API 5LX52.

Bolts and nuts shall conform to ASTM A307.

All steel components, except the concrete reinforcing, shall be galvanized after fabrication. Galvanizing damaged during transport or construction shall be repaired in accordance with the specifications.

See BCS standard sheet for additional dimensions and information.

Alternate design drawings bearing the seal of a professional engineer will be acceptable for precast construction of the Safety End Treatments.

SHEET 1 OF 2

 **Texas Department of Transportation**
Bridge Division

SAFETY END TREATMENT
FOR BOX CULVERTS
(MAXIMUM Hw = 7' - 0")
TYPE I ~ PARALLEL DRAINAGE

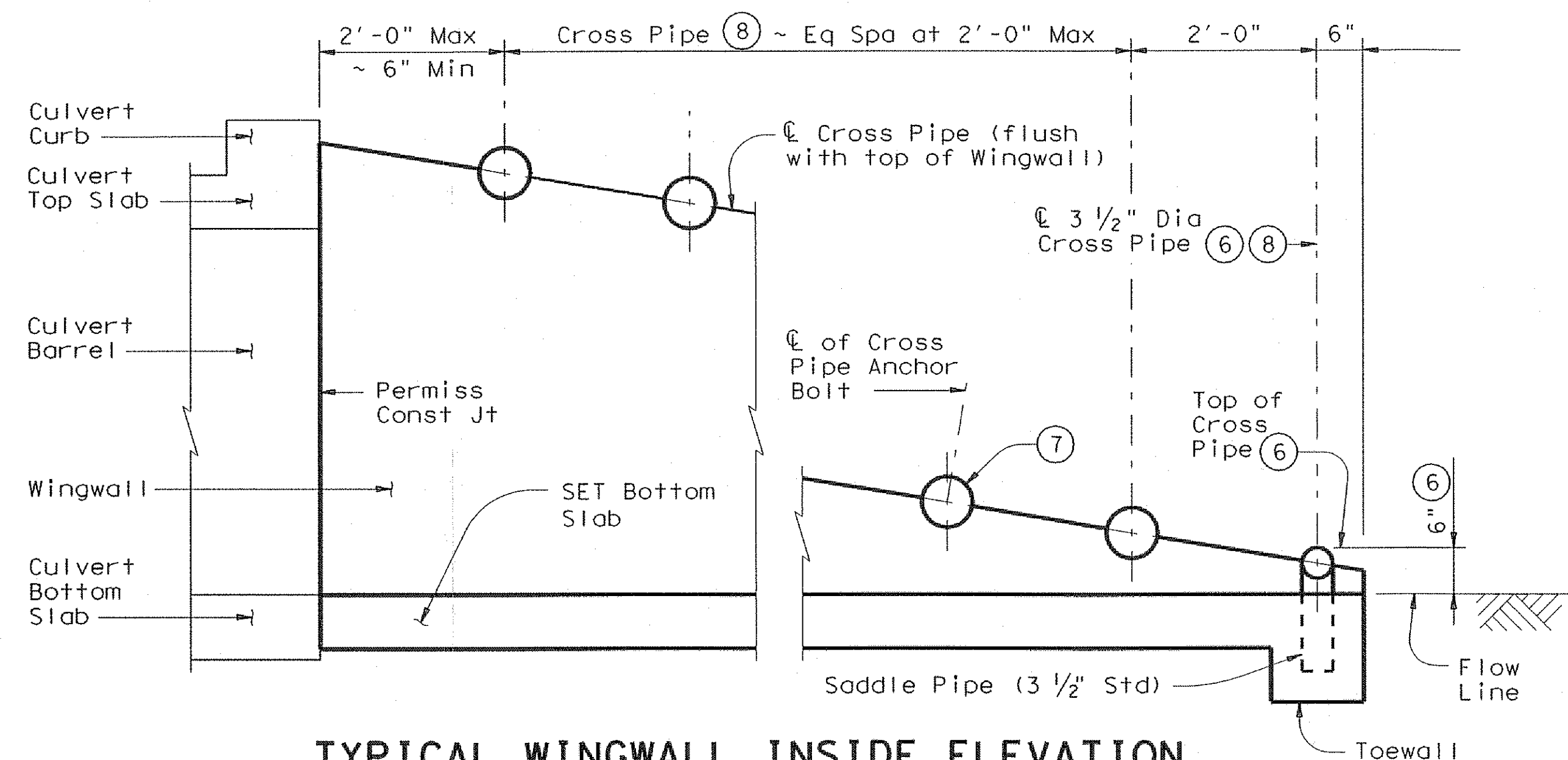
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				HIGHWAY

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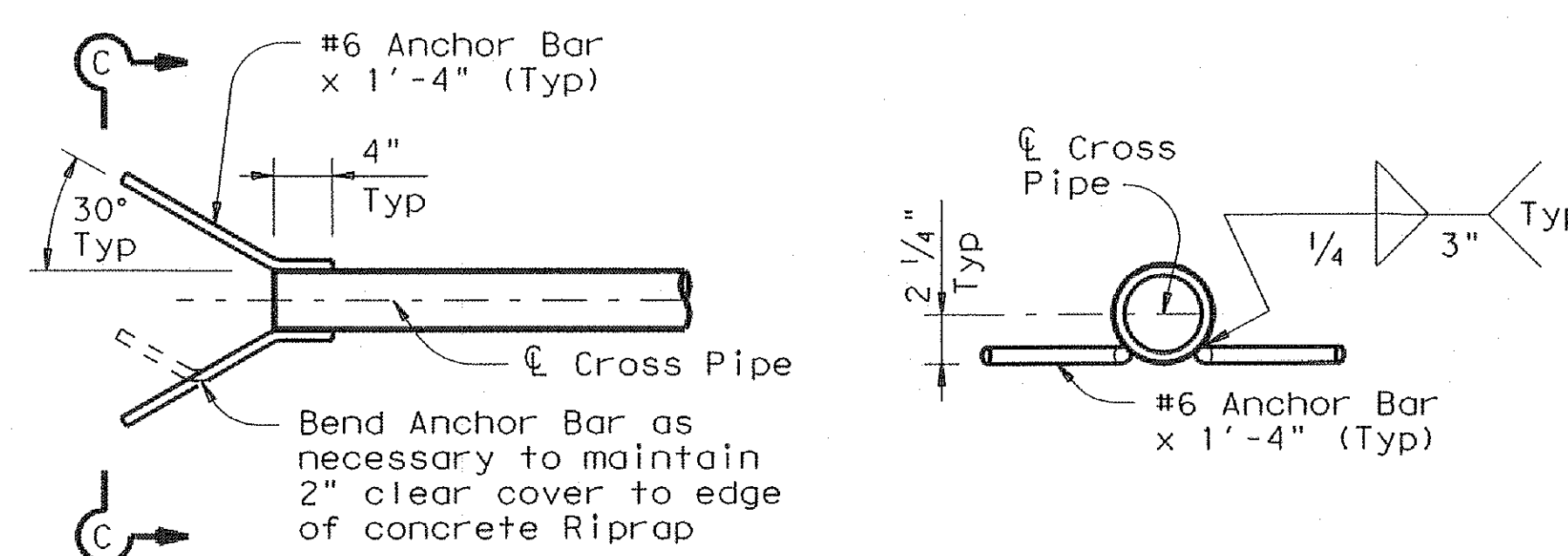
LEVELS DISPLAYED

ACC:



TYPICAL WINGWALL INSIDE ELEVATION

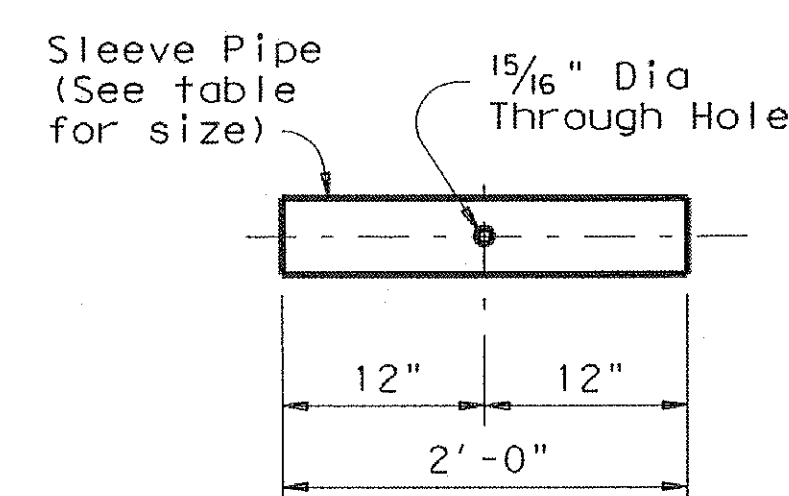
(Showing installation of Cross Pipes)



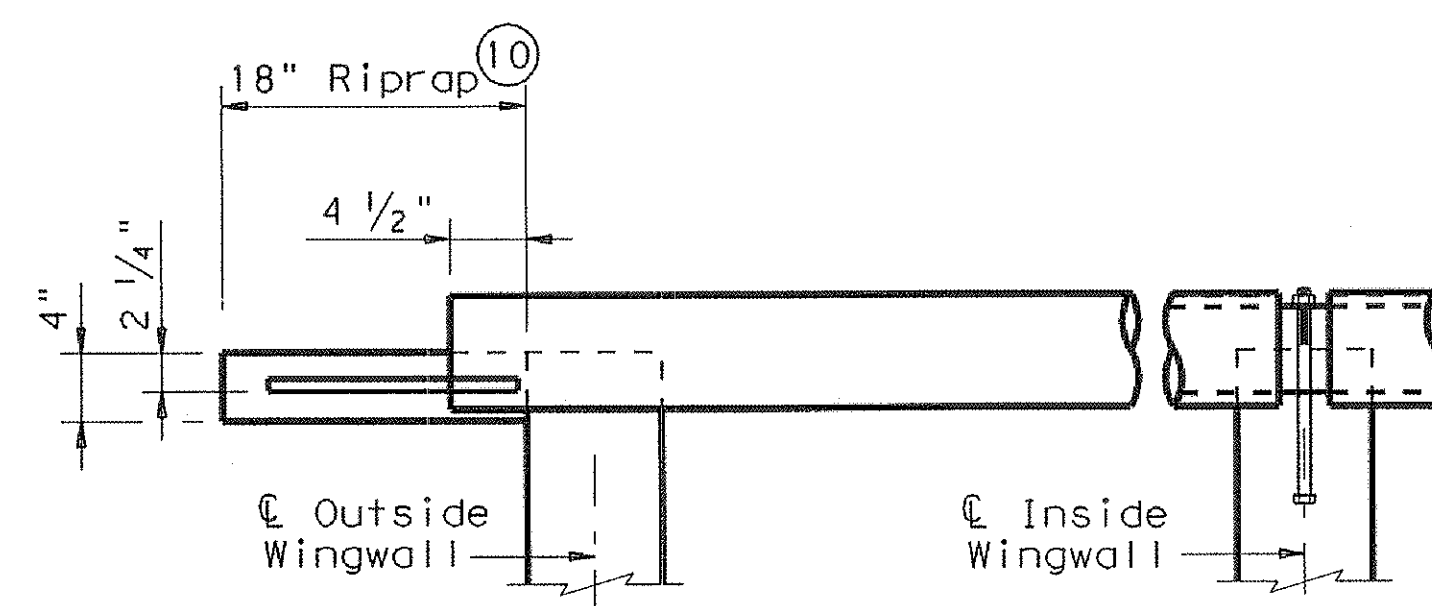
PART PLAN

SECTION C-C

OPTIONAL ANCHOR BAR DETAILS

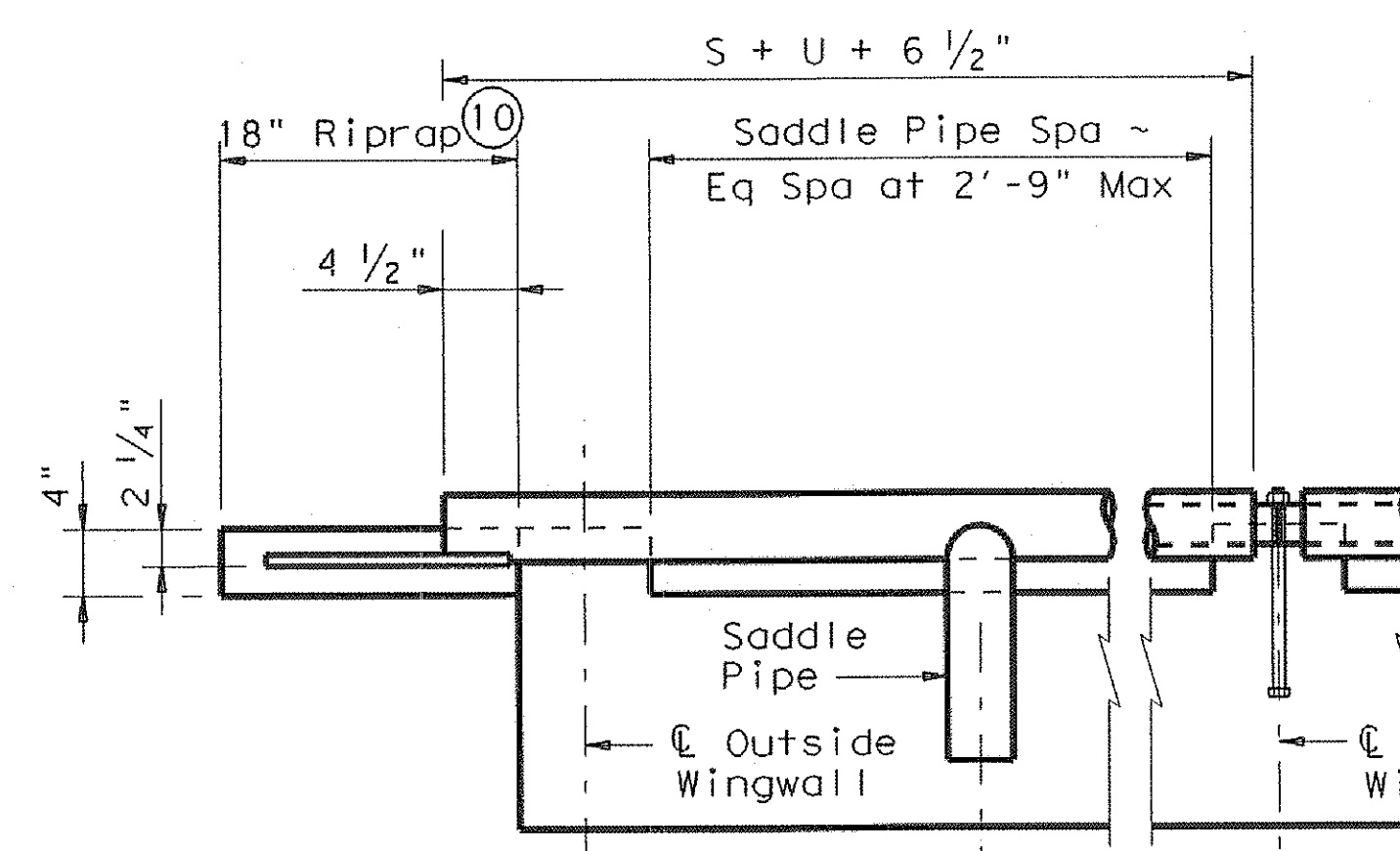


SLEEVE PIPE DETAILS (9)

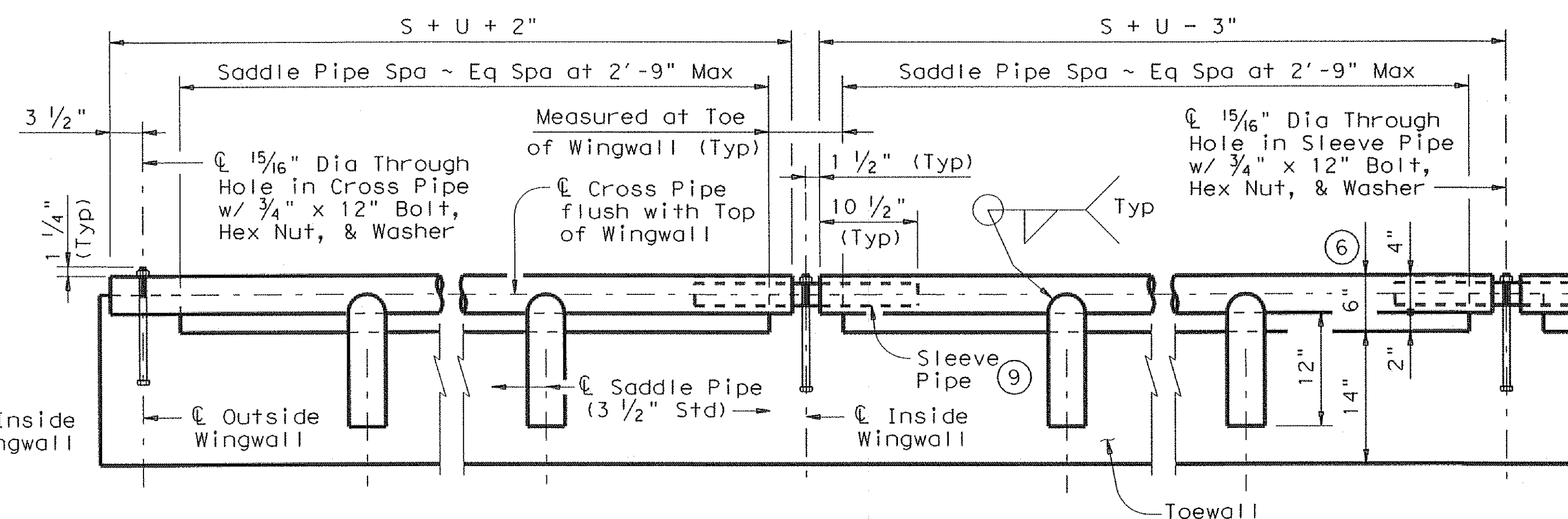


SECTION THROUGH INSTALLATION OF TYPICAL FULL CROSS PIPE

(Anchor details and dimensions are similar to those shown below in SECTION THROUGH INSTALLATION OF 3 1/2" FIRST CROSS PIPE detail.)



OUTSIDE CULVERT BARREL WITH
OPTIONAL ANCHOR BARS & RIPRAP



SECTION THROUGH INSTALLATION OF 3 1/2" FIRST CROSS PIPE

OUTSIDE CULVERT BARREL
WITH BOLTED ANCHOR

INSIDE CULVERT BARREL

CROSS PIPE INSTALLATION DETAILS

REQUIRED PIPE SIZES (8)			STANDARD PIPE SIZES		
Culvert Span Sizes	Cross Pipe Size	Sleeve Pipe Size (9)	Pipe Size	Pipe O.D.	Pipe I.D.
First Pipe	3 1/2" STD	2 1/2" STD	2 1/2" STD	2.875"	2.469"
30" to 42"	4" STD	3" STD	3" STD	3.500"	3.068"
48" to 72"	5" STD	4" STD	3 1/2" STD	4.000"	3.548"
78" to 120"	6" STD	5" STD	4" STD	4.500"	4.026"
			5" STD	5.563"	5.047"
			6" STD	6.625"	6.065"

- The proper installation of the first Cross Pipe is critical for vehicle safety. The top of the first Cross Pipe must be placed at no more than 6" above the flow line.
- The third Cross Pipe from the bottom of the Culvert shall always be installed using a bolted connection. Care shall be taken to ensure that concrete does not flow into this Cross Pipe so as to permit disassembly of the bolted connection to allow cleanout access.
- Cross Pipes and Sleeve Pipes (if required) shall be as shown in the REQUIRED PIPE SIZES table. Saddle Pipes for the 3 1/2" first Cross Pipe shall also be 3 1/2".
- At Contractor's option, the Cross Pipe may be continuous across the Inside Wingwalls. If such option is selected, the Sleeve Pipe shall be omitted and a 1 5/16" diameter through hole made in the Cross Pipe to accept the anchor bolt at the centerline of each Interior Wingwall.
- Riprap will be required when using the optional Anchor Bar details and shall be included in the Price Bid for Safety End Treatment. Such Riprap shall be concrete Riprap in accordance with Item 432, "Riprap".

SHEET 2 OF 2

Texas Department of Transportation
Bridge Division
SAFETY END TREATMENT
FOR BOX CULVERTS
(MAXIMUM Hw = 7'-0")
TYPE I ~ PARALLEL DRAINAGE

SETB-PD

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