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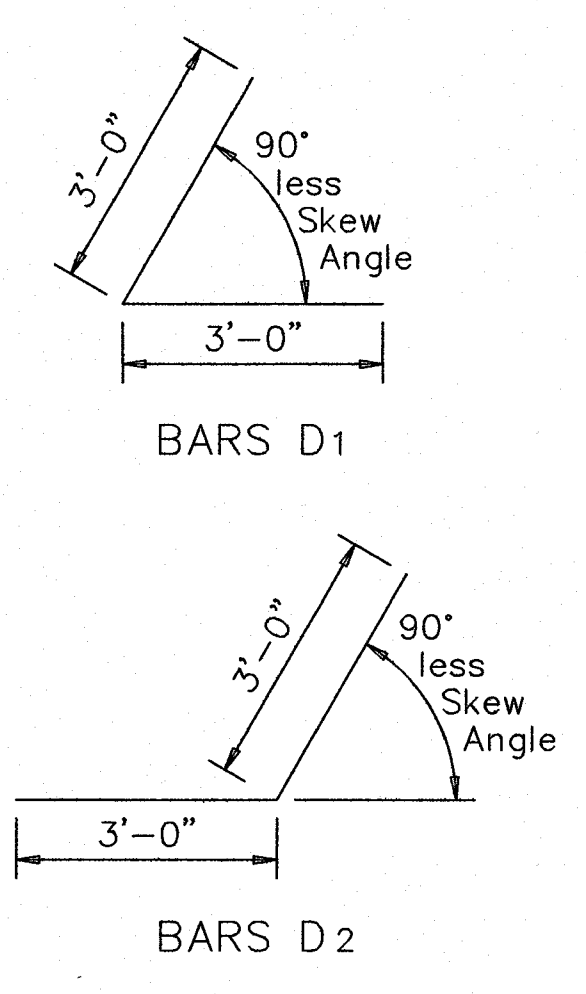
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TABLE OF DIMENSIONS & REINFORCING STEEL (Wings for One Structure End)												
Maximum Wingwall Height Hw	Dimensions				Variable Reinforcing				Estimated Quantities per ft. of wing (2~Wings)		Estimated Quantities per ft. of Toewall (1~Toewall)	
	W	X	Y	Z	Bars J1		Bars J2		Reinf (Lb/Ft)	Conc (CY/Ft)	Reinf (Lb/Ft)	Conc (CY/Ft)
	Size	Spa	Size	Spa	Size	Spa	Size	Spa				
2'-6"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	48.64	0.406	6.85	0.071
2'-9"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	49.31	0.424	6.85	0.071
3'-0"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	49.98	0.444	6.85	0.071
3'-3"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	53.32	0.462	6.85	0.071
3'-6"	2'-10"	10"	1'-0"	7"	#4	1'-0"	#4	1'-0"	53.98	0.480	6.85	0.071
4'-0"	3'-2"	1'-2"	1'-0"	7"	#4	1'-0"	#4	1'-0"	55.77	0.532	6.85	0.071
4'-6"	3'-2"	1'-2"	1'-0"	7"	#4	1'-0"	#4	1'-0"	59.77	0.568	6.85	0.071
5'-0"	3'-9"	1'-7"	1'-2"	7"	#4	1'-0"	#4	1'-0"	63.45	0.632	6.96	0.075
5'-6"	3'-9"	1'-7"	1'-2"	7"	#4	1'-0"	#4	1'-0"	67.46	0.668	6.96	0.075
6'-0"	4'-4"	2'-0"	1'-4"	7"	#5	1'-0"	#5	1'-0"	80.67	0.730	7.07	0.078
6'-6"	4'-4"	2'-0"	1'-4"	7"	#5	1'-0"	#5	1'-0"	85.05	0.768	7.07	0.078
7'-0"	5'-0"	2'-3"	1'-9"	8"	#5	1'-0"	#5	1'-0"	92.15	0.864	8.07	0.093
7'-6"	5'-0"	2'-3"	1'-9"	8"	#5	1'-0"	#5	1'-0"	96.54	0.902	8.07	0.093
8'-0"	5'-6"	2'-8"	1'-10"	8"	#5	6"	#5	6"	139.04	0.962	8.13	0.095
8'-6"	5'-6"	2'-8"	1'-10"	8"	#5	6"	#5	6"	144.47	1.000	8.13	0.095
9'-6"	6'-0"	2'-10"	2'-2"	9"	#5	6"	#5	6"	156.93	1.136	8.41	0.110
10'-6"	6'-5"	3'-0"	2'-5"	9"	#6	6"	#5	6"	196.27	1.234	8.57	0.117
11'-6"	7'-2"	3'-6"	2'-8"	11"	#6	6"	#6	6"	230.13	1.438	9.52	0.140
12'-6"	7'-8"	3'-9"	2'-11"	1'-0"	#7	6"	#6	6"	283.41	1.592	9.74	0.157
13'-6"	8'-2"	4'-0"	3'-2"	1'-2"	#8	6"	#6	6"	348.72	1.804	10.02	0.186
14'-6"	8'-10"	4'-5"	3'-5"	1'-4"	#9	6"	#6	6"	432.94	2.046	10.30	0.218
15'-6"	9'-6"	4'-10"	3'-8"	1'-6"	#9	6"	#7	6"	489.52	2.302	11.24	0.253
16'-0"	9'-11"	5'-0"	3'-11"	1'-7"	#9	6"	#7	6"	505.72	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	~	8"
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)

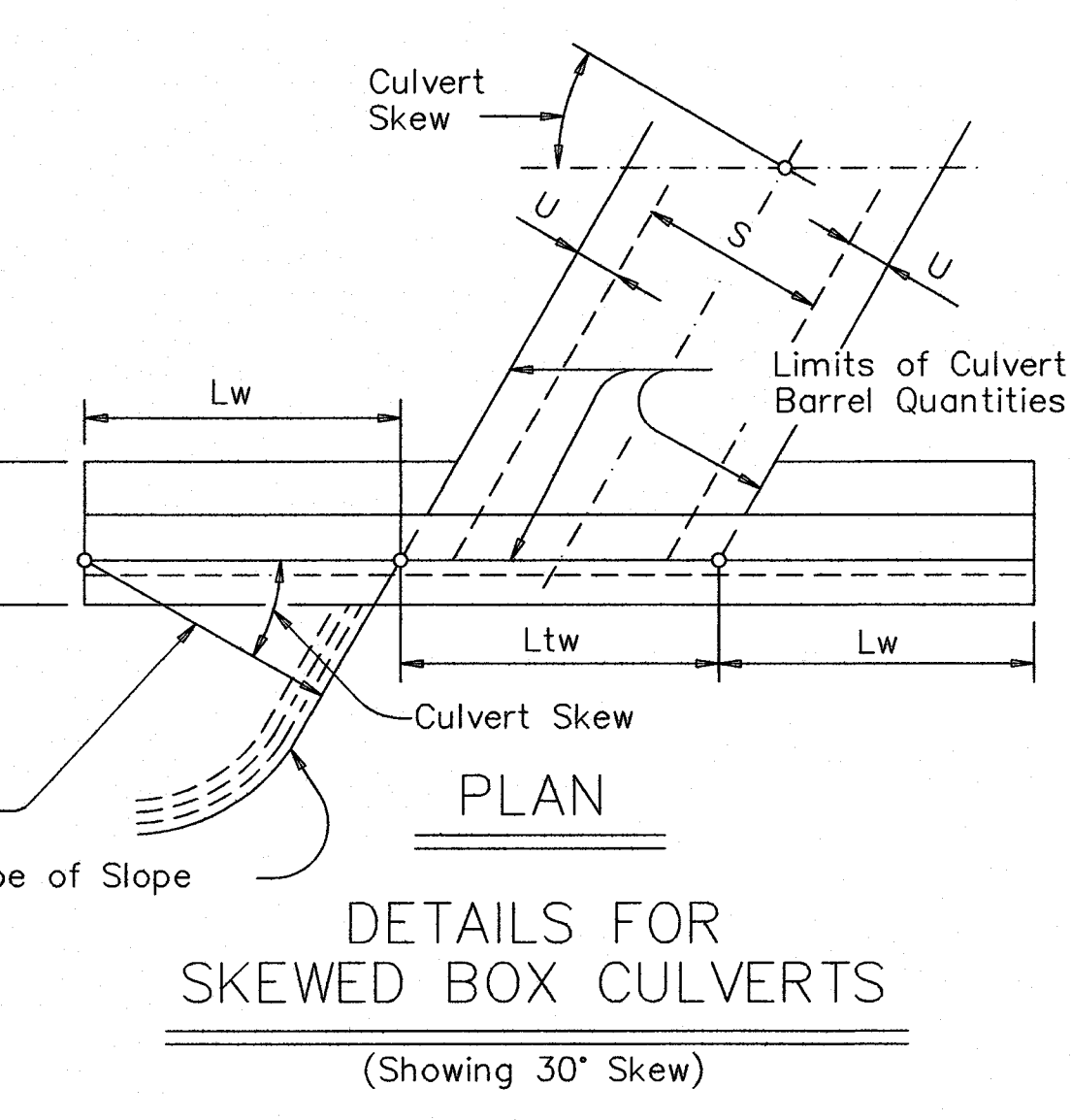
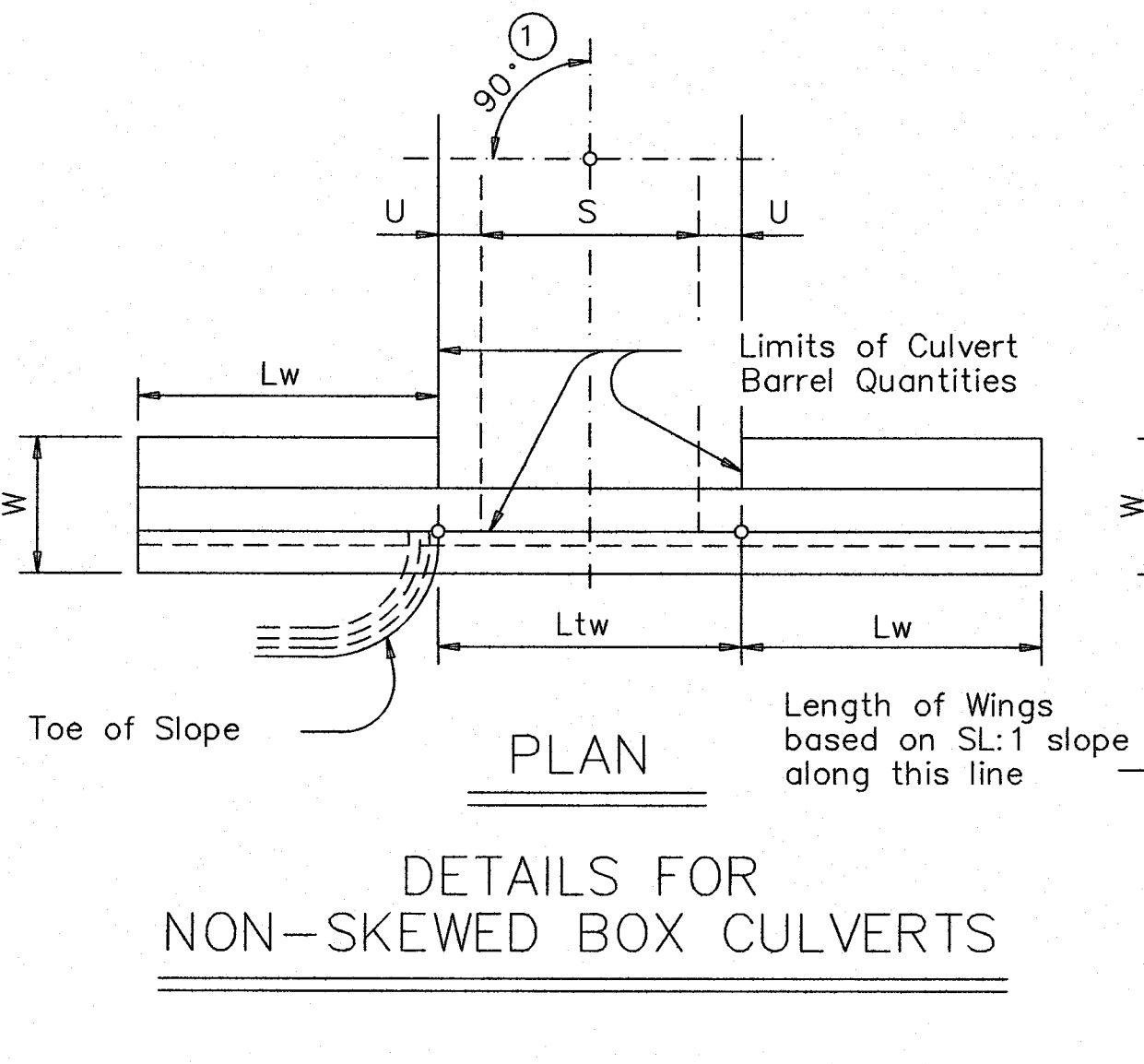
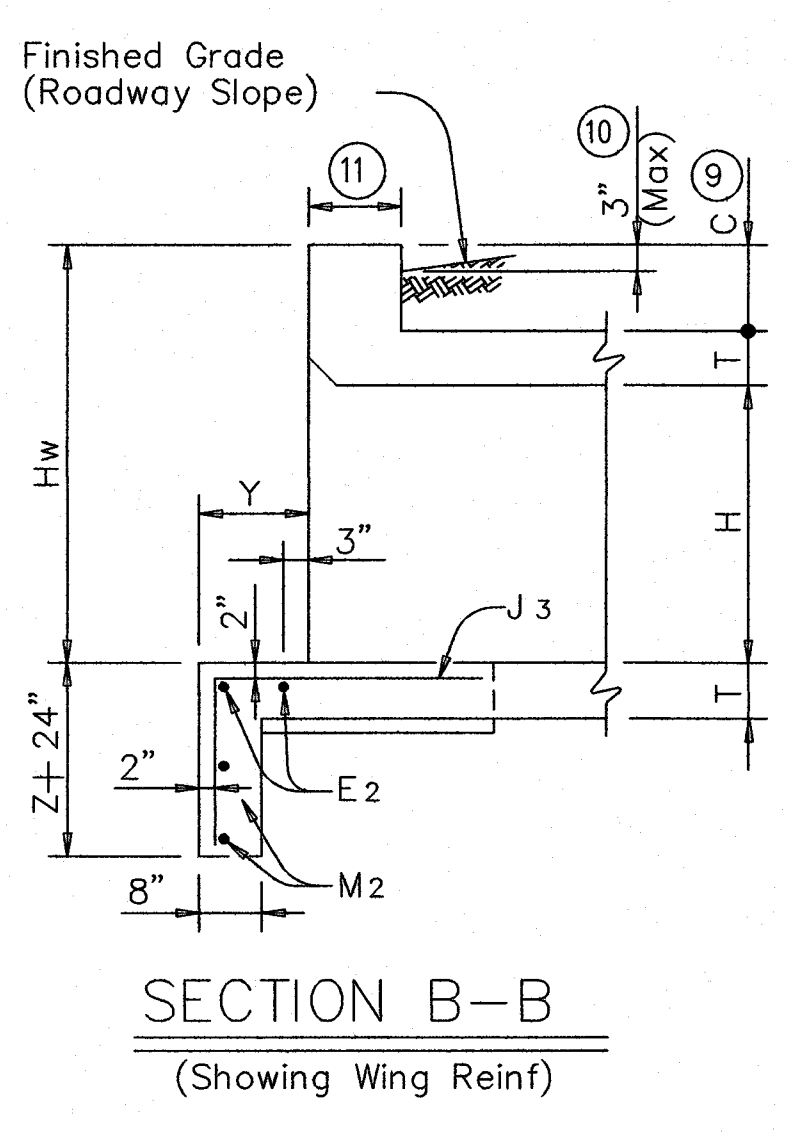
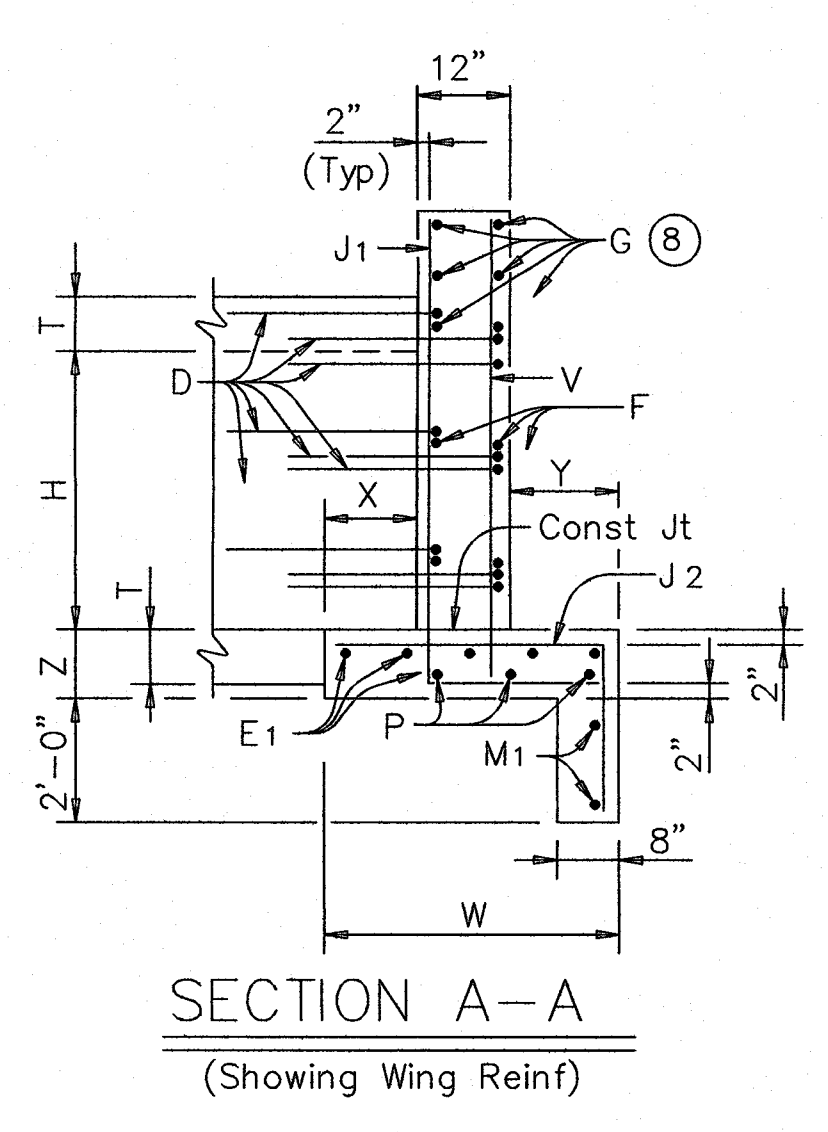
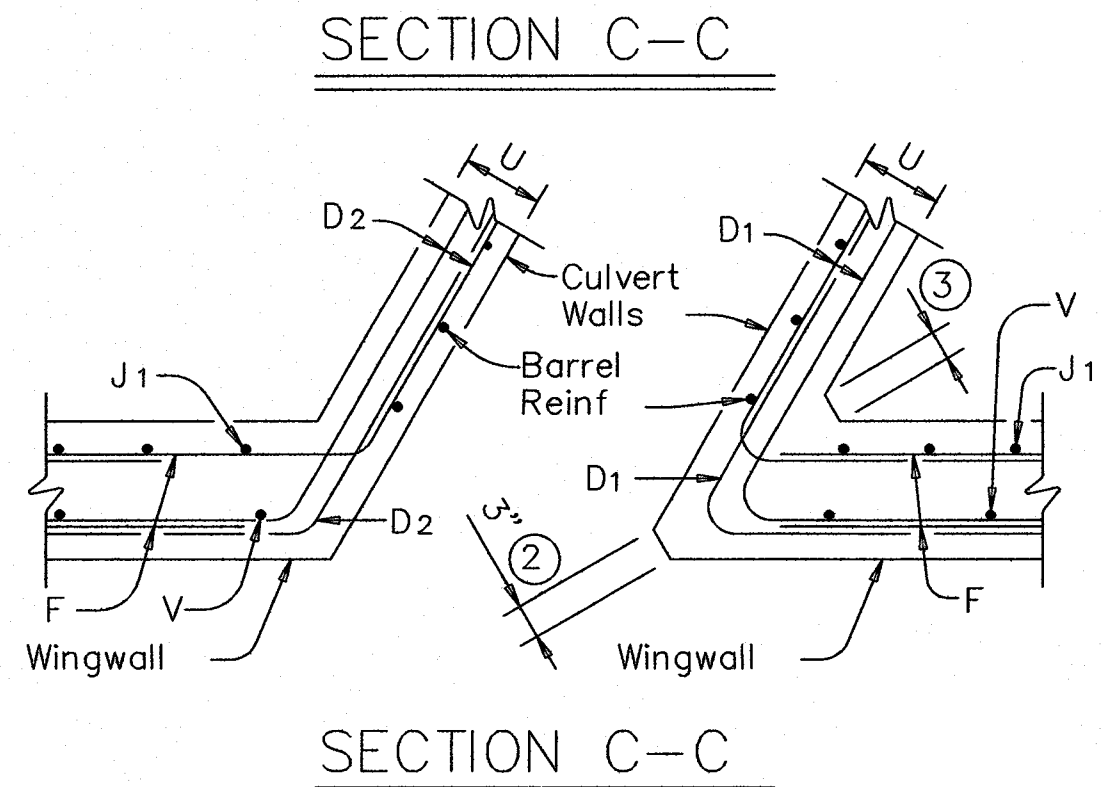
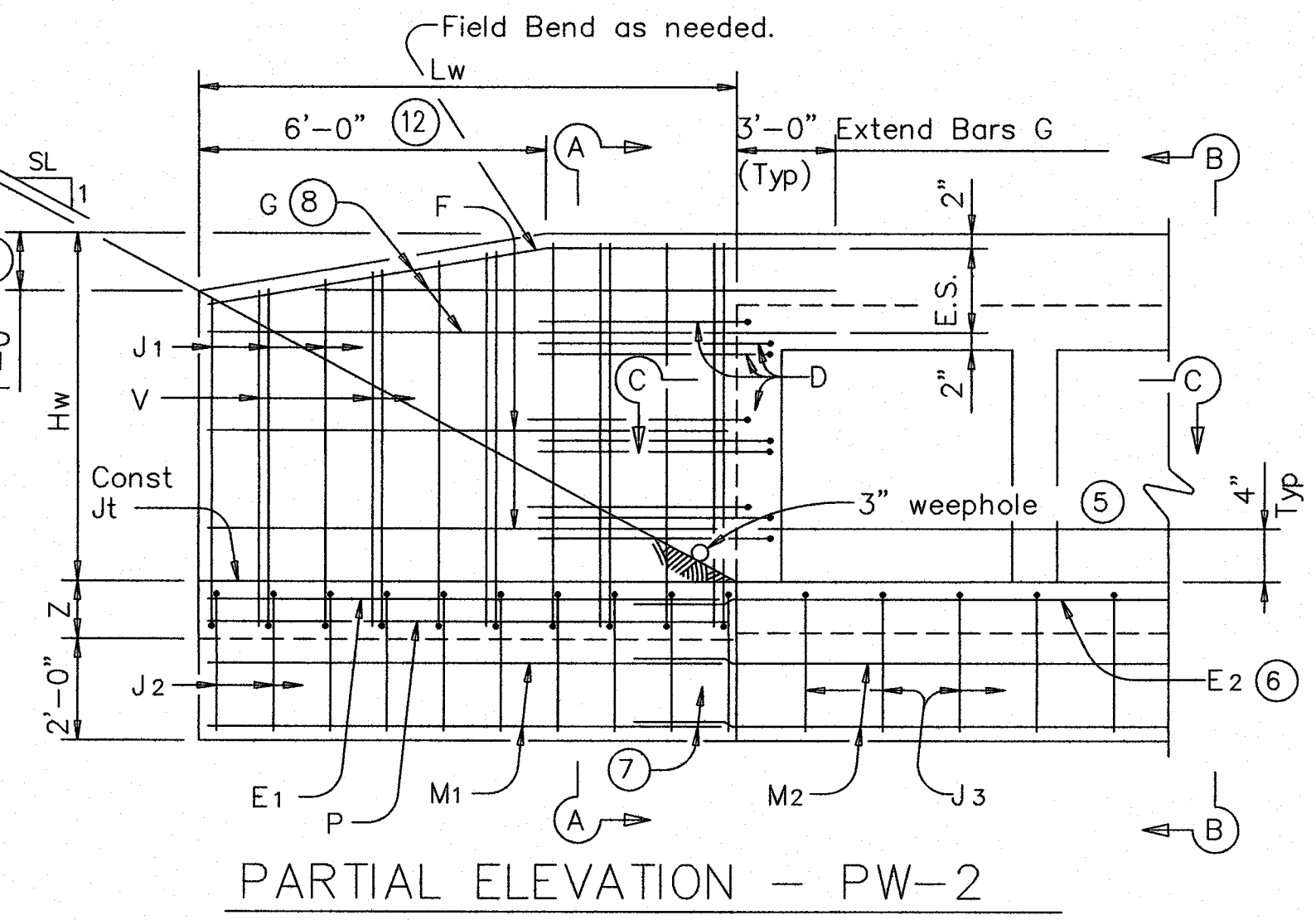
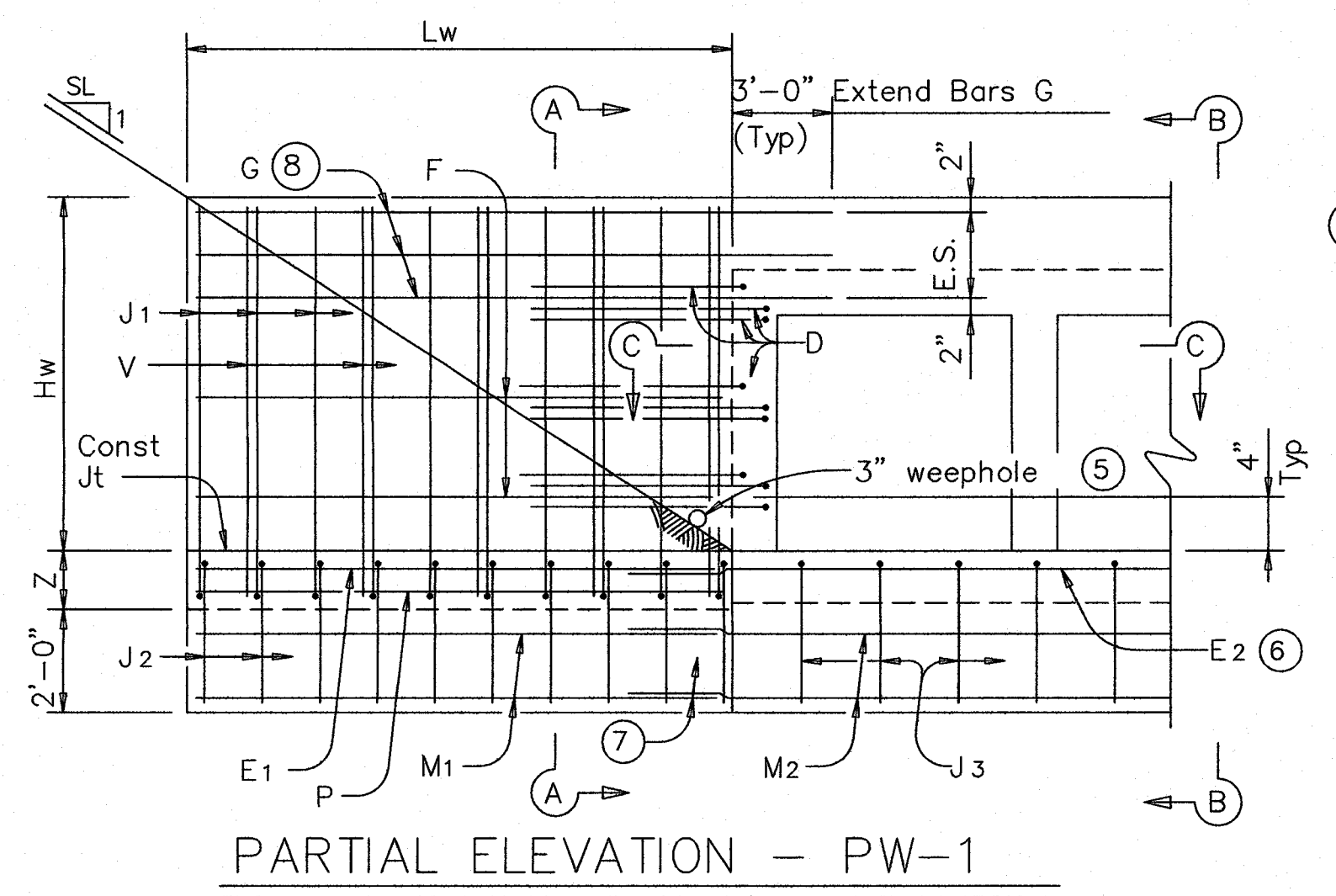
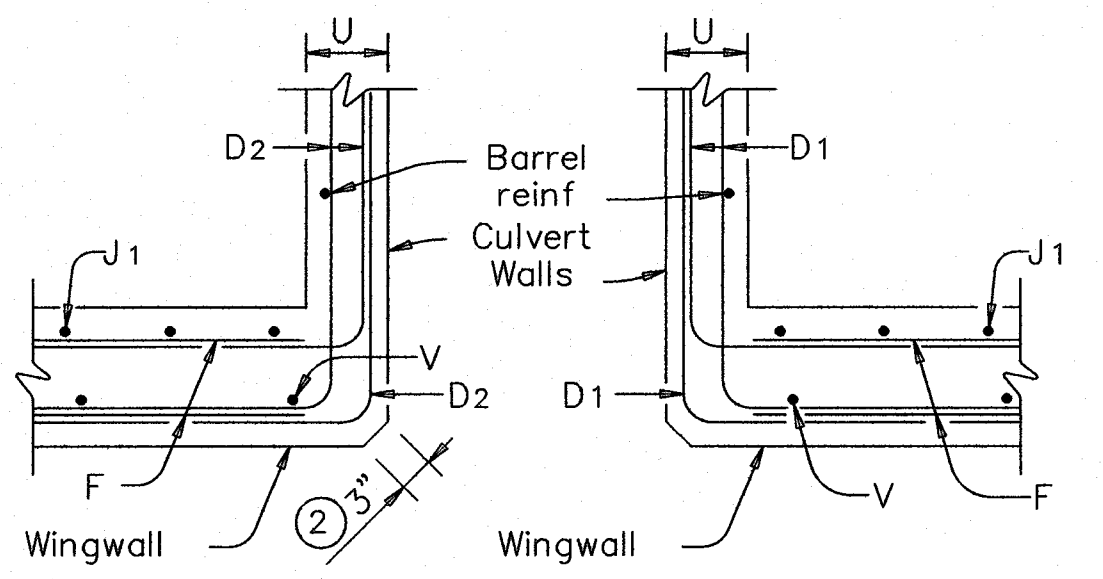
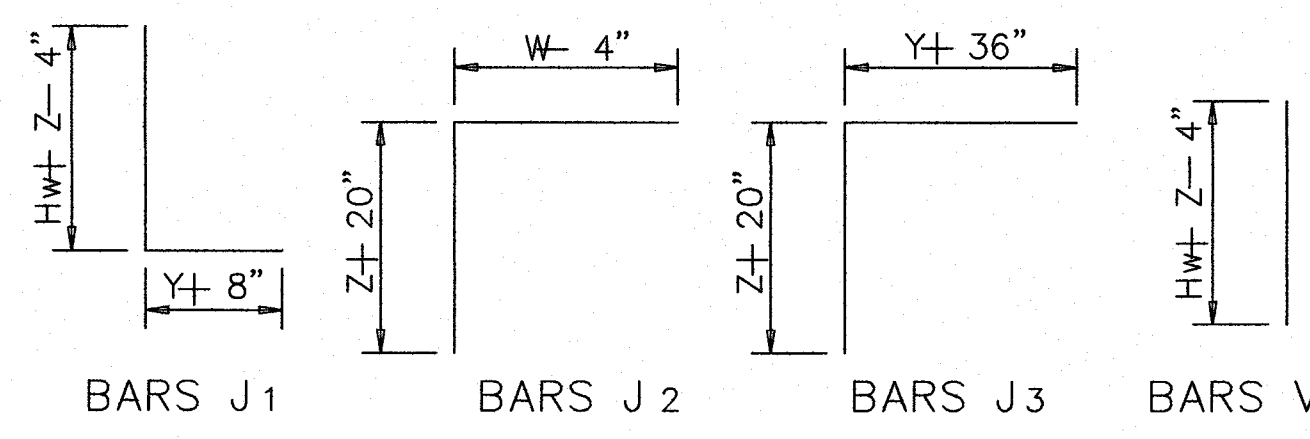
$Hw = H + T + C$   
 $Lw = (Hw)(SL) \div \text{Cosine } \theta$  for Ty PW-1  
 $= (Hw - 1')(SL) \div \text{Cosine } \theta$  for Ty PW-2 and  $Hw \geq 4'$   
 $= (Hw - 0.5')(SL) \div \text{Cosine } \theta$  for Ty PW-2 and  $Hw < 4'$

For Cast-in-place culverts:  
 $Ltw = [(N)(S) + (N + 1)(U)] \div \text{Cosine } \theta$

For Precast culverts:  
 $Ltw = [(N)(2U + S) + (N - 1)(0.5') ] \div \text{Cosine } \theta$   
 Total Wingwall Area (Two Wings ~ SF)  
 $= (2)(Hw)(Lw)$  for Ty PW-1  
 $= (2)(Hw)(Lw) - 6 \text{ SF}$  for Ty PW-2 and  $Hw \geq 4'$   
 $= (2)(Hw)(Lw) - 1.5 \text{ SF}$  for Ty PW-2 and  $Hw < 4'$

$Hw$  = 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)  
 $\theta$  = Culvert Skew

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



- 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 Type PW-1 wings. Adjust concrete volume for Type PW-2 wings. To determine estimated quantities for two wings, multiply the tabulated values by Lw. Quantities shown do not include weight of Bars D.
- Provide weepholes for Hw = 5'-0" and greater. Fill around weepholes with coarse gravel.
- Extend Bars E2 1'-6" minimum into the wingwall footing.
- Lap Bars M1 1'-6" minimum with Bars M2.
- Bars G equally spaced at 8" maximum, place as shown. Provide at least two pair Bars G per wing.
- 0" min to 5'-0" max. Estimated curb heights are shown elsewhere in the plans. For structures with pedestrian rail, bicycle rail or curbs taller than 1'-0", refer to ECD standard. For structures with T6 bridge rail, refer to T6-CM standard. For structures with traffic rail, other than T6, refer to RAC standard.
- For vehicle safety, the following requirements must be met:
  - For structures without bridge rail, curbs cannot project more than 3" above finished grade.
  - For structures with bridge rail, build curbs flush with finished grade.
 Reduce curb heights, 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.
- 3'-0" for Hw < 4'.
- 6" for Hw < 4'.

**GENERAL NOTES:**

Designed in accordance with AASHTO LRFD Bridge Design Specifications.

Provide Class "C" Concrete ( $f'c = 3,600$  psi Min) and Grade 60 reinforcing steel.

Provide 1 1/4" Min clear cover to reinforcing steel.

Depth of toewalls for wingwalls and culverts may be reduced or eliminated when founded on solid rock, when directed by the Engineer.

See BCS sheet for wingwall type and additional dimensions and information.

The quantities for concrete and reinforcing steel resulting from the formulas given on this sheet are for the Contractor's information only.

**DESIGNER NOTES:**

Type PW-1 can be used for all applications and must be used if railing is to be mounted to the wingwall.

Type PW-2 can only be used for applications without a railing mounted to the wingwall.

<b>CONCRETE WINGWALLS WITH PARALLEL WINGS FOR BOX CULVERTS TYPES PW-1 AND PW-2</b>			
PW			
FILE: pwstde01.dgn	DN: GAF	CK: CAT	DW: TxDOT
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REVISIONS			
11-10 Reinforcing Quantities	DIST	COUNTY	SHEET NO.
01-12 PW-1 & PW-2			