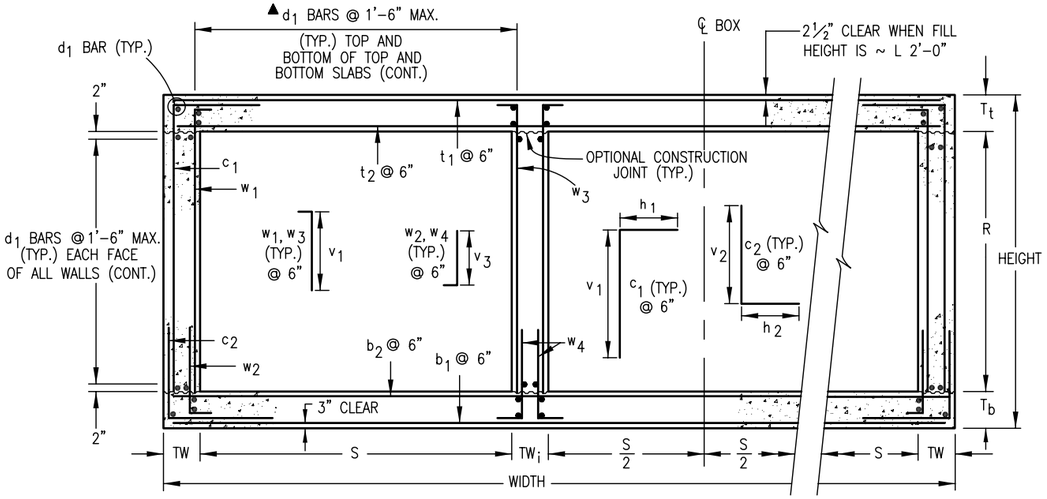
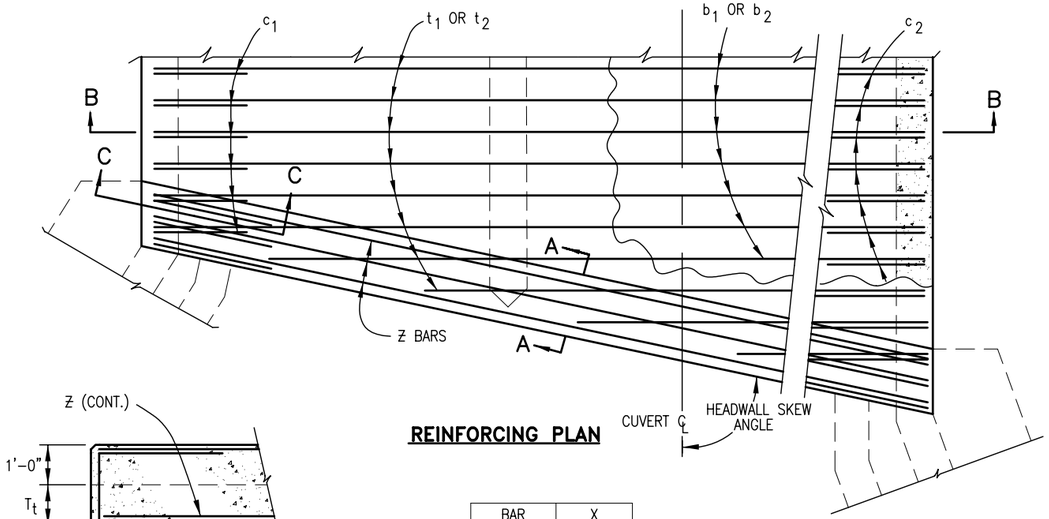
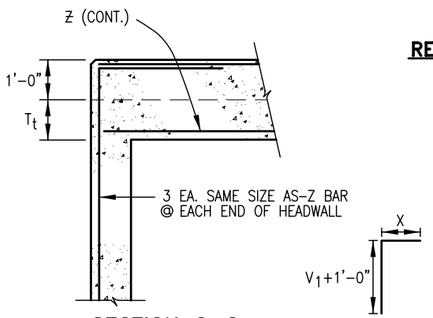


SECTION B–B



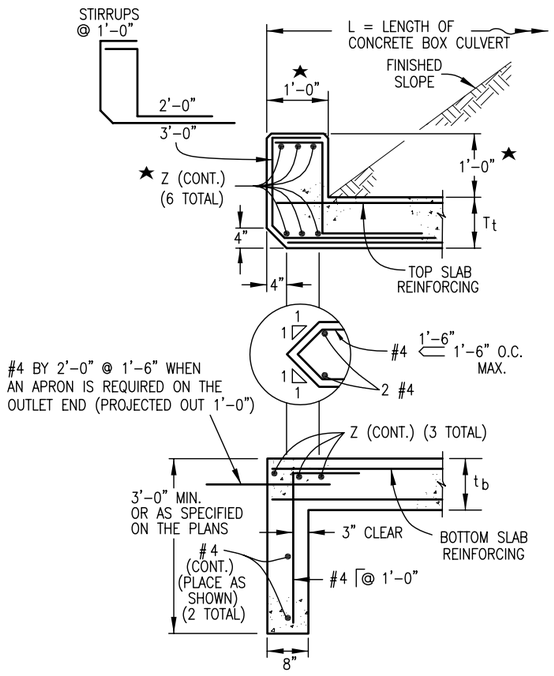
REINFORCING PLAN



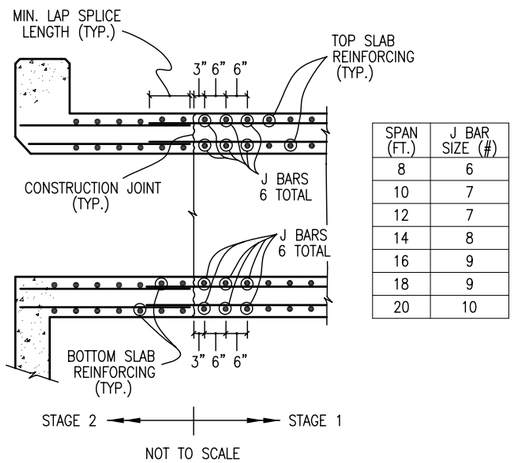
SECTION C–C

BAR SIZE (#)	X (FT.-IN.)
4	1-9
5	2-2
6	2-7
7	3-1
8	4-0
9	5-1
10	6-5
11	7-11

HEADWALL CORNER REINFORCING DETAIL



SECTION A–A



SPAN (FT.)	J BAR SIZE (#)
8	6
10	7
12	7
14	8
16	9
18	9
20	10

CONSTRUCTION JOINT DETAIL FOR STAGED CONSTRUCTION

NOTE: THIS DETAIL IS FOR CONSTRUCTION JOINTS PERPENDICULAR TO THE ℄ OF THE BOX ONLY.

GENERAL NOTES

1. ALL CONCRETE SHALL BE CLASS D (BOX CULVERT).
2. ALL CONSTRUCTION JOINTS SHALL BE THOROUGHLY CLEANED BEFORE FRESH CONCRETE IS PLACED.
3. CONSTRUCTION JOINTS NOT SHOWN ON THE PLANS MAY BE CONSTRUCTED ONLY IF APPROVED BY THE ENGINEER.
4. THE CONTRACTOR SHALL MAINTAIN THE STABILITY OF THE STRUCTURE DURING CONSTRUCTION.
5. STRUCTURE EXCAVATION AND BACKFILL SHALL BE IN ACCORDANCE WITH STANDARD PLAN M-206-1.
6. FOR ANY CULVERT SPAN 20 FT. OR GREATER, A FOUNDATION INVESTIGATION AND REPORT ARE REQUIRED.
7. BACKFILL SHALL NOT BEGIN UNTIL TOP SLAB HAS REACHED DESIGN STRENGTH, f'_c.
8. SPLICE QUANTITIES FOR LONGITUDINAL AND TRANSVERSE BARS ARE NOT INCLUDED.
9. REINFORCING STEEL SHALL BE GRADE 60.
10. THE MINIMUM LAP SPLICE LENGTH FOR EPOXY COATED REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-3"	1'-6"	1'-10"	2'-2"	3'-8"	4'-8"	5'-11"	7'-3"

THE MINIMUM LAP SPLICE LENGTH FOR BLACK REINFORCING BARS SHALL BE:

BAR SIZE:	#4	#5	#6	#7	#8	#9	#10	#11
SPLICE LENGTH:	1'-0"	1'-4"	1'-7"	1'-10"	2'-5"	3'-1"	3'-11"	4'-10"

11. ALL DIMENSIONS ARE PERPENDICULAR TO THE CENTERLINE OF THE BOX.
12. WINGWALLS SHALL BE TIED TO CONCRETE BOX CULVERT IN ACCORDANCE WITH STANDARD PLAN M-601-20.
13. ALL TRANSVERSE REINFORCING SHALL BE NORMAL TO THE CENTERLINE OF THE BOX.
14. FILL HEIGHT IS THE DISTANCE MEASURED FROM TOP OF TOP SLAB TO TOP OF PAVEMENT.
15. ALL EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED ¾ IN.

▲ WHEN THE FILL HEIGHT IS LESS THAN OR EQUAL TO 2 FT., THE SPACING OF THE d_1 BARS IN THE BOTTOM OF THE TOP SLAB SHALL BE 6 IN. OR LESS. USE THE FOLLOWING EQUATION TO CALCULATE THE ADDITIONAL REINFORCING QUANTITY. WHERE S IS IN FEET:

ADDED REINFORCING, LBS./LIN FT. = $3 \times \left(\frac{S}{0.5} - \frac{S}{1.5}\right) \times 0.668 = 2.672\ S$

DESIGN DATA: 16TH EDITION OF THE AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES

SERVICE LOAD DESIGN METHOD

UNIT STRESSES: f_s = 24,000 psi., f_y = 60,000 psi., f_c = 1,800 psi., f'_c = 4,500 psi., n = 8

LOADING DATA:

LIVE LOAD = AASHTO, HS 20-44 AND ALTERNATE MILITARY LOADING

DEAD LOAD CASE 1: VERTICAL EARTH LOAD = 120 LBS./CU. FT. HORIZONTAL EARTH LOAD = 30 LBS./CU.FT.

DEAD LOAD CASE 2: VERTICAL EARTH LOAD = 120 LBS./CU. FT. HORIZONTAL EARTH LOAD = 60 LBS./CU. FT.

FUTURE HMA OVERLAY = 48 LBS./SQ. FT. BASED ON 4 IN. THICKNESS

LIVE LOAD SURCHARGE ON EXTERIOR WALLS = 2 FT. OF EARTH

★ IF HEADWALL MOUNT GUARDRAIL IS USED (SEE STANDARD PLAN M-606-1, SHEET 16):

- ALL REINFORCING STEEL SHALL BE ACCORDING TO THIS BOX CULVERT PLAN.
- ANY ADDITIONAL STIRRUP LENGTH WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
- HEADWALL DIMENSION AND CONCRETE QUANTITY SHALL BE ACCORDING TO STANDARD PLAN M-606-1, SHEET 16.
- POST ANCHORS SHALL BE PROVIDED ACCORDING TO STANDARD PLAN M-606-1, SHEET 16.
- POST ANCHORS AND CONCRETE FOR HEADWALL MOUNT OF GUARDRAIL WILL NOT BE MEASURED AND PAID FOR SEPARATELY BUT SHALL BE INCLUDED IN THE WORK.
- POST ANCHORS WHEN REQUIRED AND ENCASED IN HEADWALL CONCRETE, SHALL CONFORM TO ASTM A 36 OR AASHTO M 169 STEEL.

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Project Development Branch SRJ/LTA

TRIPLE CONCRETE BOX CULVERT

Issued By: Project Development Branch on July 04, 2006

STANDARD PLAN NO.
M-601-3
Sheet No. 1 of 2

TRIPLE CONCRETE BOX CULVERT DIMENSIONS & QUANTITIES (EXCLUDING HEADWALLS & TOEWALLS)

BOX SIZE				FILL HEIGHT ALLOWED	SLAB & WALL THICKNESS (INCHES)			BAR SIZES								d_1▲	DIMENSIONS					QUANTITIES	
S	R	HT.	WIDTH					t_1*	t_2	b_1	b_2	w_1* & w_2	w_3* & w_4	c_1*	c_2		h_1	h_2	v_1	v_2	v_3	CONCRETE	REBAR STL
FT.	FT.	FT.–IN.	FT.–IN.	FT.–FT.	T_t	T_b	TW & TW_i	#	#	#	#	#	#	#	#	NO.	FT.–IN.	FT.–IN.	FT.–IN.	FT.–IN.	FT.–IN.	CU.YDS./LIN.FT.	LBS./LIN.FT.
8	6	7–6.5	27–4	0 TO 8	8.5	10	10	6	6	6	4	4	4	5	6	128	2–9	3–4	6–6	2–9	2–5	2.301	526
		7–9.5	27–4	>8 TO 12	10	11.5	10	6	5	6	5	4	4	4	5		2–7	2–9	6–8	2–5	2–5	2.555	490
		8–1.5	27–4	>12 TO 16	12	13.5	10	6	5	6	5	4	4	4	5		2–7	2–9	6–9	2–8	2–8	2.892	495
		8–5.5	27–4	>16 TO 20	14	15.5	10	6	5	6	5	4	4	4	4		2–7	2–7	7–0	2–9	2–9	3.229	486
		8–9.5	27–4	>20 TO 26	16	17.5	10	6	6	6	5	4	4	4	5		3–1	2–7	7–2	3–4	2–11	3.567	529
		9–1	27–4	>26 TO 30	18	19	10	6	6	6	5	4	4	5	5		3–6	2–9	7–4	3–6	3–1	3.862	545
	8	9–6.5	27–4	0 TO 8	8.5	10	10	6	6	6	4	4	4	5	6	144	2–9	3–4	8–6	2–9	2–4	2.548	521
		9–9.5	27–4	>8 TO 12	10	11.5	10	6	5	6	5	4	4	4	5		2–7	2–9	8–8	2–10	2–5	2.801	524
		10–1.5	27–4	>12 TO 16	12	13.5	10	6	5	5	5	4	4	4	5		2–7	2–9	8–10	2–7	2–7	3.139	502
		10–5	27–4	>16 TO 22	14.5	16	10	6	5	6	5	4	4	4	4		2–7	2–7	9–0	2–11	2–11	3.561	523
		11–0.5	27–10	>22 TO 30	17.5	19	11.5	6	5	6	5	4	4	5	5		3–10	2–11	9–3	3–6	3–1	4.271	567
10	6	7–9.5	33–4	0 TO 8	10	11.5	10	7	6	7	5	4	4	5	5	140	2–9	2–9	6–8	2–10	2–6	2.953	678
		8–2.5	33–4	>8 TO 12	12.5	14	10	6	6	6	5	4	4	4	4		2–7	2–7	6–10	2–8	2–8	3.467	608
		8–6.5	33–4	>12 TO 16	14.5	16	10	7	6	6	6	4	4	4	4		2–7	2–7	7–0	2–11	2–11	3.879	656
		9–1.5	33–4	>16 TO 22	18	19.5	10	7	6	6	6	4	4	5	5		3–6	2–9	7–4	3–6	3–1	4.599	692
	8	9–7.5	33–4	0 TO 6	9	10.5	10	7	6	7	5	4	4	5	5	156	2–9	2–9	8–7	2–9	2–4	2.994	711
		9–9.5	33–4	>6 TO 8	10	11.5	10	7	6	7	5	4	4	5	5		2–9	2–9	8–8	2–11	2–5	3.200	728
		10–2.5	33–4	>8 TO 12	12.5	14	10	6	6	6	5	4	4	4	5		2–7	2–9	8–10	2–8	2–8	3.714	625
		10–6.5	33–4	>12 TO 16	14.5	16	10	6	6	6	6	4	4	4	4		2–7	2–7	9–0	2–9	2–9	4.126	651
		11–1.5	33–4	>16 TO 22	18	19.5	10	6	6	6	6	4	4	5	5		3–6	2–9	9–4	3–6	3–1	4.846	691
	10	11–9.5	33–4	0 TO 8	10	11.5	10	6	6	6	5	4	4	5	5	164	2–9	3–4	10–8	2–10	2–5	3.447	673
		12–2	33–4	>8 TO 12	12	14	10	6	5	6	5	4	4	5	5		2–9	2–9	10–10	3–1	2–8	3.909	665
		12–4.5	33–4	>12 TO 14	13.5	15	10	6	5	6	5	4	4	5	5		2–9	2–9	10–11	3–2	2–9	4.167	648
		12–6.5	33–6	>14 TO 16	14.5	16	10.5	6	6	6	5	4	4	5	5		2–10	2–10	11–0	3–3	2–10	4.450	677
		13–1	34–0	>16 TO 22	17.5	19.5	12	6	6	6	6	5	4	5	5		3–8	2–11	11–3	3–6	3–6	5.304	754
12	6	7–8.5	39–4	0 TO 4	9.5	11	10	7	6	7	5	4	5	5	6	152	2–9	3–4	6–7	2–10	2–10	3.229	816
		8–0.5	39–4	>4 TO 8	11.5	13	10	7	6	7	6	4	4	5	5		2–9	2–9	6–9	3–0	2–6	3.715	802
		8–3.5	39–4	>8 TO 10	13	14.5	10	7	6	7	6	4	4	5	5		2–9	2–9	6–11	3–1	2–8	4.079	807
		8–5.5	39–4	>10 TO 12	14.5	16	10	7	6	7	6	4	4	4	4		2–7	2–7	7–0	2–9	2–9	4.443	783
		9–0.5	39–4	>12 TO 16	17.5	19	10	7	7	7	6	4	4	5	5		3–6	2–9	7–3	3–6	3–1	5.172	862
		9–2.5	39–4	>16 TO 18	18.5	20	10	7	7	7	7	4	4	5	5		3–6	2–9	7–4	3–7	3–2	5.415	906
	8	9–9.5	39–4	0 TO 4	10	11.5	10	7	6	7	5	4	5	6	7	168	3–4	3–8	8–8	3–3	2–11	3.598	903
		10–0.5	39–4	>4 TO 8	11.5	13	10	7	6	7	6	4	4	5	5		2–9	2–9	8–9	3–0	2–8	3.962	840
		10–6.5	39–4	>8 TO 12	14.5	16	10	7	6	7	6	4	4	5	4		2–9	2–7	9–0	2–10	2–10	4.690	834
		11–2.5	39–4	>12 TO 18	18.5	20	10	7	7	7	6	4	4	5	5		3–6	2–9	9–4	3–7	3–2	5.662	899
	10	11–8.5	39–4	0 TO 4	10	11.5	10	7	6	7	5	4	5	6	7	176	3–4	3–8	10–6	3–4	2–10	3.845	945
		12–1	39–4	>4 TO 8	11.5	13.5	10	7	6	7	6	4	4	5	5		2–9	2–9	10–9	3–0	2–7	4.270	869
		12–6.5	39–4	>8 TO 12	14.5	16	10	7	6	7	6	4	4	5	5		2–9	2–9	11–0	3–3	2–10	4.937	877
		13–3	39–8	>12 TO 18	18.5	20.5	11	7	6	7	6	5	4	5	5		3–7	2–10	11–4	3–8	3–8	6.133	922
14	6	7–11	45–4	0 TO 4	11	12	10	7	7	8	6	4	5	6	7	176	3–4	3–8	6–8	3–4	2–11	3.959	1103
		8–4	45–4	>4 TO 8	13.5	14.5	10	8	7	8	6	4	4	5	5		2–9	2–9	6–11	3–1	2–8	4.658	1070
		8–11	45–4	>8 TO 12	17	18	10	8	7	8	7	4	4	5	5		3–6	2–9	7–3	3–7	3–0	5.638	1130
	8	9–11	45–4	0 TO 4	11	12	10	7	7	8	6	4	5	6	7	192	3–4	3–8	8–9	3–4	2–11	4.206	1148
		10–4.5	45–4	>4 TO 8	13.5	15	10	8	7	8	6	4	4	5	5		2–9	2–9	8–11	3–2	2–9	4.975	1106
		10–11.5	45–4	>8 TO 12	17	18.5	10	8	7	8	7	4	4	5	5		3–6	3–9	9–3	3–5	3–0	5.955	1169
	10	11–11	45–4	0 TO 4	11	12	10	7	7	8	6	4	5	6	7	200	3–4	3–8	10–9	3–4	2–11	4.453	1087
		12–4.5	45–4	>4 TO 8	13.5	15	10	8	7	8	6	4	4	6	5		3–4	2–9	10–11	3–2	2–9	5.222	1164
		12–11.5	45–4	>8 TO 12	17	18.5	10	8	7	8	7	4	4	6	5		4–3	2–9	11–3	3–5	3–0	6.202	1226
16	6	8–1.5	51–4	0 TO 4	12	13.5	10	8	7	8	6	4	5	6	7	188	3–4	3–4	6–10	3–5	3–0	4.781	1274
		8–5	51–4	>4 TO 6	14	15	10	8	7	9	7	4	4	6	6		3–4	3–4	7–0	3–7	2–9	5.335	1354
		8–8.5	51–4	>6 TO 8	15.5	17	10	8	7	8	7	4	4	5	5		3–6	2–9	7–1	3–4	2–11	5.890	1248
		9–0	51–4	>8 TO 10	17.5	18.5	10	8	8	9	7	4	4	5	5		3–6	2–9	7–3	3–6	3–0	6.444	1401
	8	10–1	51–4	0 TO 4	11.5	13.5	10	8	7	8	6	5	5	6	6	204	3–4	3–4	8–9	3–6	3–1	4.949	1324
		10–5	51–4	>4 TO 6	14	15	10	8	7	9	7	4	4	6	6		3–4	3–4	9–0	3–7	2–9	5.582	1393
		10–8.5	51–4	>6 TO 8	15.5	17	10	8	7	8	7	4	4	5	5		3–6	2–9	9–1	3–4	2–11	6.137	1283
		11–0	51–4	>8 TO 10	17	19	10	8	7	8	7	4	4	5	5		3–6	2–9	9–3	3–6	3–1	6.691	1287
	10	12–1	51–4	0 TO 4	12	13	10	8	7	8	6	4	5	7	7	212	3–8	3–8	10–10	4–11	3–0	5.195	1407
		12–5	51–4	>4 TO 6	14	15	10	8	7	8	7	4	4	6	6		3–4	3–4	11–0	3–7	2–9	5.829	1377
		12–8.5	51–4	>6 TO 8	15.5	17	10	8	7	8	7	4	4	6	6		4–3	3–4	11–1	3–9	2–10	6.444	1359
		13–0.5	51–4	>8 TO 10	17	19.5	10	8	7	8	7	4	4	6	5		4–3	2–9	11–3	3–6	3–1	7.017	1348
18	6	8–4	57–4	0 TO 4	13.5	14.5	10	9	8	9	7	4	5	7	7	200	3–8	3–8	6–11	3–7	3–2	5.695	1717
		8–8.5	57–4	>4 TO 6	15.5	17	10	9	8	9	7	4	4	6	6		4–3	3–4	7–1	3–9	2–11	6.492	1648
		9–1.5	57–4	>6 TO 8	18	19.5	10	9	8	9	7	4	4	5	5		3–6	2–9	7–4	3–6	3–1	7.377	1612
	8	10–4	57–4	0 TO 4	13.5	14.5	10	9	8	9	7	4	5	7	7	216	3–8	3–8	8–11	3–6	3–1	5.942	1684
		10–8	57–4	>4 TO 6	15.5	16.5	10	9	8	9	7	4	4	6	6		4–3	3–4	9–1	3–8	2–10	6.650	1685
		11–1	57–4	>6 TO 8	18	19	10	9	8	9	7	4	4	6	5		4–3	2–9	9–4	3–6	3–1	7.535	1665
	10	12–4.5	57–4	0 TO 4	13.5	15	10	9	8	9	7	4	5	7	7	224	3–8	3–8	10–11	4–1	3–2	6.278	1818
		12–8	57–4	>4 TO 6	15.5	16.5	10	9	8	9	7	4	4	6	6		4–3	3–4	11–1	3–8	2–10	6.897	1719
		13–1.5	57–4	>6 TO 8	18	19.5	10	9	8	9	7	4	4	6	6		4–3	3–4	11–4	3–11	3–1	7.870	1726
20	6	8–6.5	63–4	0 TO 4	14.5	16	10	9	8	9	7	4	5	8	7	224	4–1	3–8	7–0	4–2	3–3	6.703	1913
		8–10.5	63–6	>4 TO 6	16.5	18	10.5	9	8	10	8	4	4	7	6		4–9	3–4	7–2	3–11	3–0	7.539	2031
	8	10–6.5	63–4	0 TO 4	14.5	16	10	9	8	9	7	4	5	7	7	240	3–8	3–8	9–0	4–2	3–3	6.950	1931
		10–11	63–4	>4 TO 6	17	18	10	9	8	10	8	4	4	6	6		4–3	3–4	9–3	3–10	3–0	7.829	2037
	10	12–6.5	63–4	0 TO 4	14.5	16	10	9	8	9	7	4	5	8	7	248	4–1	3–8	11–0	4–2	3–3	7.197	2016
		12–11	63–4	>4 TO 6	17	18	10	9	8	10	8	4	4	7	7		4–9	3–8	11–3	4–5	3–0	8.076	2131

HEADWALL AND TOEWALL QUANTITIES

HEADWALL SKEW ANGLE	90° TO 75°			74° TO 60°			59° TO 45°		
SPAN – S	Ƶ	STIRRUPS	REBAR QUANT.	Ƶ	STIRRUPS	REBAR QUANT.	Ƶ	STIRRUPS	REBAR QUANT.
FT.	#	#	LBS./LIN.FT.	#	#	LBS./LIN.FT.	#	#	LBS./LIN.FT.
8	4	4	22.3	4	4	22.1	5	4	25.9
10	5	4	26.5	5	4	26.3	7	4	38.1
12	5	4	25.7	6	4	30.8	8	5	47.4
14	6	4	30.0	7	4	35.8	10	5	65.0
16	6	4	29.5	8	5	46.2	✯	✯	✯
18	7	4	34.9	9	5	53.7	✯	✯	✯
20	7	4	34.3	11	6	74.4	✯	✯	✯
CONCRETE QUANTITY = 0.085 CU.YDS./LIN.FT.									

NOTES

1. QUANTITIES ARE PER LINEAR FOOT (OF HEADWALL) FOR ONE HEADWALL AND TOEWALL AND INCLUDE ALL HEADWALL AND TOEWALL REINFORCING STEEL. QUANTITY INCLUDED WAS CALCULATED PER 1 FT. STRIP. SKEW ANGLE MAY VARY. QUANTITIES SHALL BE PAID FOR AS SHOWN ON THE PLANS.
2. ✯ A SKEWED HEADWALL IS NOT RECOMMENDED FOR THESE SPANS. A SPECIAL DESIGN IS REQUIRED.
3. FOR HEADWALL AND TOEWALL DETAILS SEE SHEET 1.
4. WHEN THE FILL HEIGHT IS LESS THAN OR EQUAL TO 2 FT.–0 IN., ALL REINFORCING BARS IN THE HEADWALL, ALL REINFORCING BARS DESIGNATED BY AN ASTERISK (*), AND THE d_1 IN THE BARS IN THE TOP MAT OF THE TOP SLAB SHALL BE EPOXY COATED.
5. REINFORCING QUANTITIES INCLUDE BOTH EPOXY–COATED AND UNCOATED BARS.
6. WHEN AN R (RISE) OF LESS THAN 6 FT. IS REQUIRED, USE THE BAR SIZES AND THE SLAB AND WALL THICKNESSES FOR THE 6 FT. RISE (IF AVAILABLE ON THE TABLE).
7. ▲ THE SIZE OF d_1 BARS IS #4. THE NUMBER OF BARS REQUIRED IS LISTED.

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TRIPLE CONCRETE BOX CULVERT

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STANDARD PLAN NO.
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