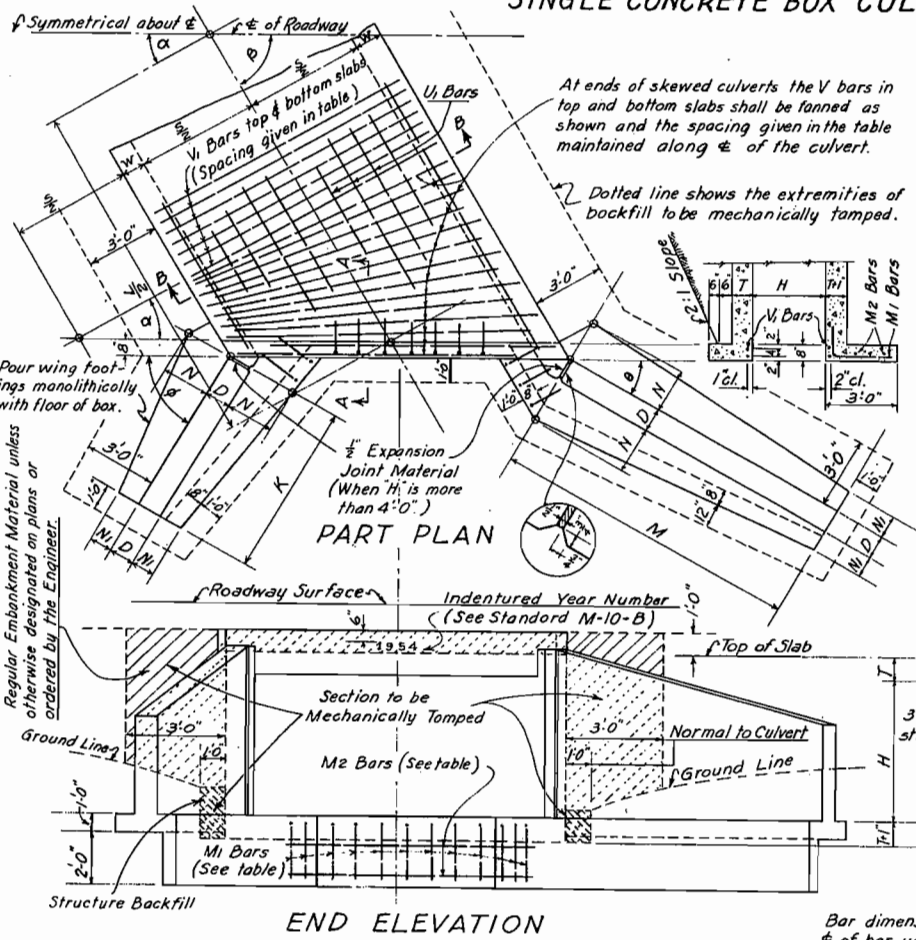


Dimensions & Quantities (see Standard M-50-AW for Wings)

Height of Fill Allowed	Type	Span S	Height H	Slab T	Wall W	Bar Size & Spacing		No. Bars Required	Quantities for One Lin. Ft. of Box		Quantities for Two Headwalls	
						V ₁ Size Spc.	V ₂ Size Spc.		Concrete Cu. Yds.	Steel Lbs.	Concrete Cu. Yds.	Steel Lbs.
35'-0"	2A	2'-0"	2'-0"	6"	8"	3/4"	12"	8	0.232	17.5	1.30	81
30'-0"	3A	3'-0"	3'-0"	7"	8"	3/4"	12"	10	0.299	26.3	1.50	112
20'-0"	4A	4'-0"	4'-0"	7 1/2"	8"	3/4"	12"	12	0.362	31.8	1.50	150
16'-0"	5A	5'-0"	4'-0"	8"	8"	3/4"	12"	16	0.461	37.3	2.10	153
20'-0"	5B	5'-0"	4'-0"	8 1/2"	8"	3/4"	12"	18	0.530	42.7	2.40	157
14'-0"	6A	6'-0"	6'-0"	8 1/2"	8"	3/4"	12"	20	0.579	52.0	2.60	161
20'-0"	6B	6'-0"	5'-0"	10"	8"	3/4"	12"	16	0.500	45.5	2.20	153
12'-0"	7A	7'-0"	7'-0"	9"	9"	3/4"	12"	16	0.598	52.2	2.60	161
15'-0"	7B	7'-0"	10'-0"	9"	9"	3/4"	12"	20	0.605	54.7	2.60	161
20'-0"	7C	7'-0"	11'-0"	9"	9"	3/4"	12"	24	0.654	58.1	2.85	184
10'-0"	8A	8'-0"	9'-0"	10"	10"	3/4"	12"	26	0.704	61.4	3.00	188
16'-0"	8B	8'-0"	11'-0"	10"	10"	3/4"	12"	28	0.753	64.9	3.30	192
20'-0"	8C	8'-0"	12'-0"	10"	10"	3/4"	12"	30	0.817	72.4	3.70	223
7'-0"	9A	9'-0"	10'-0"	11"	11"	3/4"	12"	20	0.720	69.9	3.90	228
14'-0"	9B	9'-0"	12'-0"	11"	11"	3/4"	12"	24	0.820	75.9	4.30	239
20'-0"	9C	9'-0"	14'-0"	11"	11"	3/4"	12"	28	0.938	84.5	4.75	273
5'-0"	10A	10'-0"	10'-0"	12"	12"	3/4"	12"	32	0.887	79.2	3.70	220
10'-0"	10B	10'-0"	12'-0"	12"	12"	3/4"	12"	34	0.937	86.0	4.00	229
16'-0"	10C	10'-0"	14'-0"	12"	12"	3/4"	12"	36	0.984	90.0	4.25	242
5'-0"	11A	11'-0"	11'-0"	12"	12"	3/4"	12"	36	0.937	86.0	4.00	229
9'-0"	11B	11'-0"	12'-0"	12"	12"	3/4"	12"	38	0.984	90.0	4.25	242
13'-0"	11C	11'-0"	14'-0"	12"	12"	3/4"	12"	40	1.023	94.5	4.50	257
5'-0"	12A	12'-0"	12'-0"	12"	12"	3/4"	12"	40	1.084	101.0	4.75	269
4'-0"	13A	13'-0"	12'-0"	12"	12"	3/4"	12"	42	1.146	106.0	5.00	274
8'-0"	13B	13'-0"	14'-0"	12"	12"	3/4"	12"	44	1.208	111.0	5.25	288
4'-0"	14A	14'-0"	13'-0"	12"	12"	3/4"	12"	46	1.270	116.0	5.50	297
8'-0"	14B	14'-0"	15'-0"	12"	12"	3/4"	12"	48	1.332	121.0	5.75	309



Bar List for Culvert & Headwalls (See Standard M-50-AW for Wings)

Mark	Size	No. Req'd.	Type	Length
V ₁	See table	10 + 24L / Spa.	I	S + 2W - 6
W ₁	See table	6 + 24L / Spa.	I	H + 2T - 5
U ₁	1/2"	See table	I	L + 1'0"
M ₁	1/2"	See table	II	3'-6"
M ₂	1/2"	4	I	S + 2W - 6 / Cos α

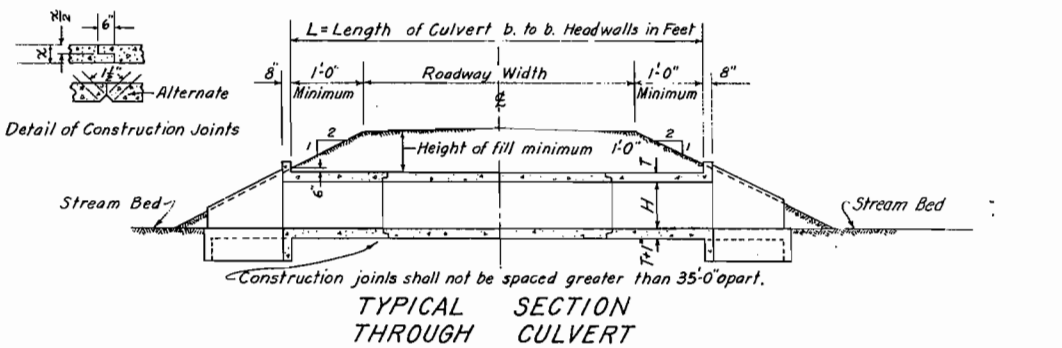
Possible Combinations (Span & Height)

2' x 2'	5' x 5'	9' x 5'	10' x 7'	11' x 8'	11' x 10'
3' x 2'	7' x 4'	8' x 6'	9' x 8'	10' x 9'	14' x 8'
4' x 2'	6' x 5'	7' x 7'	12' x 6'	13' x 7'	13' x 9'
3' x 3'	8' x 4'	9' x 6'	11' x 7'	12' x 8'	12' x 10'
4' x 3'	7' x 5'	8' x 7'	13' x 6'	14' x 7'	14' x 9'
5' x 3'	6' x 6'	10' x 6'	10' x 8'	11' x 9'	13' x 10'
4' x 4'	8' x 5'	9' x 7'	9' x 9'	10' x 10'	14' x 10'
5' x 4'	6' x 7'	8' x 8'	12' x 7'	13' x 8'	
6' x 4'	7' x 6'	11' x 6'	14' x 6'	12' x 9'	

STANDARD M-50-A

Use in conjunction with Standard M-50-AW

FED. ROAD DIV. NO.	DISTRICT	SHEET NO.	TOTAL SHEETS
9	COLO.	002-2(40) 34	



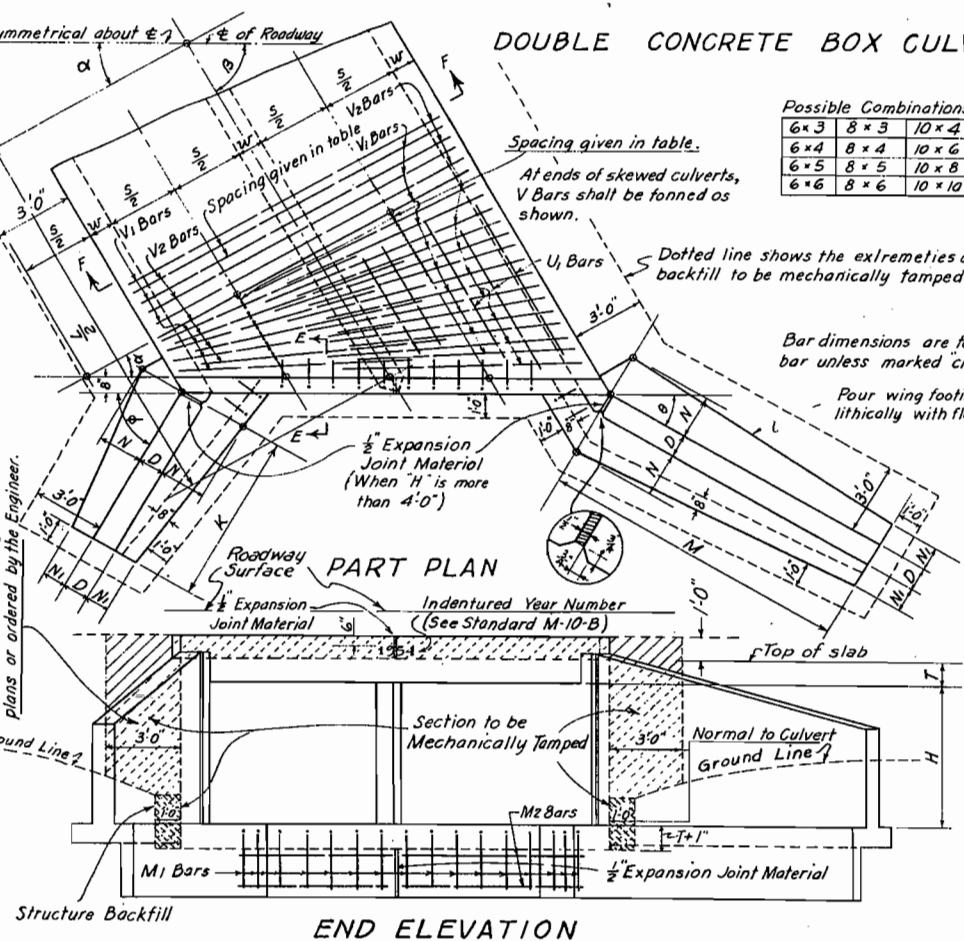
Bar List for Culvert & Headwalls (See Standard M-50-AW for Wings)

Mark	Size	Number Required	Type	L	Total Length
V ₁	See table	2(L+2)	I	S + 15W + 4"	L
V ₂	See table	Spacing	II	0.75S + 4"	2L + m
W ₁	1/2"	2(L+2)	I	H + 2T - 4"	L
U ₁	1/2"	See table	I	L + 12"	L
M ₁	1/2"	See table	III	3'-6"	L
M ₂	1/2"	8	I	S + 1.5W / Cos α	L

(Bar dimensions are out to out of bar.)
For General Notes, Loading and Design Data, see Standard M-50-AW.

Dimensions & Quantities (see Standard M-50-AW for Wings)

Height of Fill Allowed	Type	Span S	Height H	Slab T	Wall W	Bar Size & Spacing		No. Bars Required	Quantities for One Lin. Ft. of Box		Quantities for Two Headwalls	
						V ₁ Size Spc.	V ₂ Size Spc.		Concrete Cu. Yds.	Steel Lbs.	Concrete Cu. Yds.	Steel Lbs.
10'-0"	6-6-A	6'-0"	4'-0"	8 1/2"	8"	1/2"	12"	32	1.000	112.3	3.85	327
15'-0"	6-6-B	6'-0"	4'-0"	9 1/2"	8"	1/2"	12"	32	1.148	123.1	4.85	343
20'-0"	6-6-C	6'-0"	4'-0"	10 1/2"	8"	1/2"	12"	32	1.282	128.5	5.05	351
10'-0"	8-8-A	8'-0"	6'-0"	10"	10"	3/4"	12"	40	1.161	125.7	4.90	347
15'-0"	8-8-B	8'-0"	6'-0"	11"	10"	3/4"	12"	40	1.309	141.4	5.10	353
20'-0"	8-8-C	8'-0"	6'-0"	12 1/2"	10"	3/4"	12"	40	1.477	174.4	5.80	506
5'-0"	10-10-A	10'-0"	10'-0"	10"	12"	3/4"	12"	48	1.569	179.8	6.05	514
10'-0"	10-10-B	10'-0"	12'-0"	12"	12"	3/4"	12"	48	1.727	197.4	6.40	524
15'-0"	10-10-C	10'-0"	14'-0"	14"	12"	3/4"	12"	48	1.869	207.9	6.65	533
5'-0"	12-12-A	12'-0"	12'-0"	12"	12"	3/4"	12"	56	1.763	202.0	6.00	513
10'-0"	12-12-B	12'-0"	14'-0"	14"	12"	3/4"	12"	56	1.935	228.3	7.00	714
15'-0"	12-12-C	12'-0"	16'-0"	16"	12"	3/4"	12"	56	2.177	278.2	7.95	733
5'-0"	14-14-A	14'-0"	14'-0"	15"	12"	3/4"	12"	64	2.380	255.2	8.70	752
10'-0"	14-14-B	14'-0"	16'-0"	16"	12"	3/4"	12"	64	2.602	275.5	9.55	771
15'-0"	14-14-C	14'-0"	18'-0"	18"	12"	3/4"	12"	64	2.824	309.2	10.30	803
5'-0"	16-16-A	16'-0"	16'-0"	16"	12"	3/4"	12"	72	3.055	329.2	10.30	803
10'-0"	16-16-B	16'-0"	18'-0"	18"	12"	3/4"	12"	72	3.277	354.1	11.15	902
15'-0"	16-16-C	16'-0"	20'-0"	20"	12"	3/4"	12"	72	3.466	365.1	11.85	920
5'-0"	18-18-A	18'-0"	18'-0"	18"	12"	3/4"	12"	80	3.638	384.7	10.55	889
10'-0"	18-18-B	18'-0"	20'-0"	20"	12"	3/4"	12"	80	3.860	415.7	11.40	908
15'-0"	18-18-C	18'-0"	22'-0"	22"	12"	3/4"	12"	80	4.077	439.2	12.50	1023
5'-0"	20-20-A	20'-0"	20'-0"	20"	12"	3/4"	12"	88	4.246	452.2	11.75	1007
10'-0"	20-20-B	20'-0"	22'-0"	22"	12"	3/4"	12"	88	4.469	485.5	12.65	1026



Possible Combinations (Span & Height)

6' x 3'	8' x 3'	10' x 4'	12' x 6'	14' x 6'
6' x 4'	8' x 4'	10' x 6'	12' x 8'	14' x 8'
6' x 5'	8' x 5'	10' x 8'	12' x 10'	14' x 10'
6' x 6'	8' x 6'	10' x 10'		

Bar List for Culvert and Two Headwalls (See Standard M-50-AW for Wings)

Mark	Size	Number Required	Type	L	Total Length
V ₁	See table	2(L+2)	I	S + 15W + 4"	L
V ₂	See table	Spacing	II	0.75S + 4"	2L + m
W ₁	1/2"	2(L+2)	I	H + 2T - 4"	L
U ₁	1/2"	See table	I	L + 12"	L
M ₁	1/2"	See table	III	3'-6"	L
M ₂	1/2"	8	I	S + 1.5W / Cos α	L

(Bar dimensions are out to out of bar.)
For General Notes, Loading and Design Data, see Standard M-50-AW.

COLORADO DEPARTMENT OF HIGHWAYS
STANDARD SINGLE AND DOUBLE CONCRETE BOX CULVERTS
(FOR SIZES SEE TABLE OF POSSIBLE COMBINATIONS)

Designed by: W.W.D. Approved by: J.L. Kowalk
Made by: W.W.D. Bridge Engineer
Checked by: T.J.M. Date: Aug. 30, 1954

Quantities for one culvert shall be (quantity for one lin. ft. of box times L) plus (quantity for two headwalls) plus (quantities for four wings).
Note: This design not to be used when height of fill exceeds the allowed amount tabulated.

Quantities for one culvert shall be (quantity for one lin. ft. of box times L) plus (quantity for two headwalls) plus (quantities for four wings).

STANDARD M-50-AW

Use in conjunction with Standard M-50-A and M-55-A

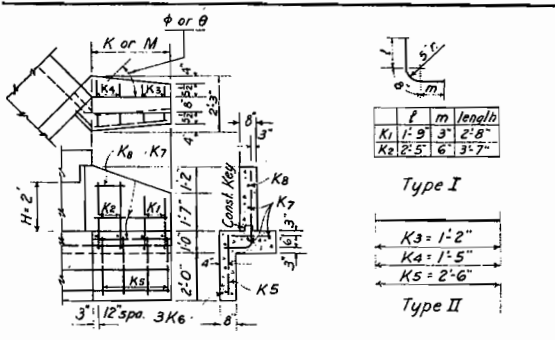
FED. ROAD DIV. NO.	DISTRICT	NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	002-2(40)	35	

Rev. 5-2-56, Deleted Finish Note, J.C.R.

TABLE SHOWING VALUES OF K AND M WHEN β AND H ARE GIVEN

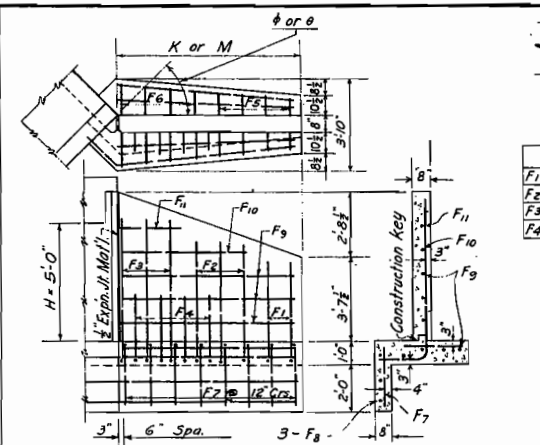
β	α	φ	θ	H=2'-0"		H=3'-0"		H=4'-0"		H=5'-0"		H=6'-0"		H=7'-0"		H=8'-0"		H=9'-0"		H=10'-0"	
				K	M	K	M	K	M	K	M	K	M	K	M	K	M	K	M	K	M
45°	45°	67°30'	22°30'	2.4	6.2	3.7	8.7	4.0	11.7	5.1	14.2	6.1	16.5	7.9	18.8	8.8	20.1	9.8	23.2	10.7	25.5
60°	30°	60°	30°	2.9	4.9	3.1	6.7	3.5	8.1	4.0	10.7	4.5	12.7	5.3	14.5	6.3	16.0	7.3	17.9	8.3	19.6
75°	15°	52°30'	37°30'	3.0	3.1	4.2	5.5	5.7	7.3	6.1	8.1	7.3	9.2	8.1	10.4	9.0	11.9	10.4	13.2	11.4	13.9
90°	0°	45°	45°	3.4	3.4	4.8	4.8	6.3	6.3	7.8	7.8	8.1	10.4	8.1	10.4	9.0	11.9	9.0	13.2	11.4	13.9
105°	15°	37°30'	52°30'	3.1	3.0	5.5	4.2	7.3	5.7	8.1	6.1	10.4	7.3	11.9	9.0	13.2	10.4	14.7	12.3	16.0	12.3
120°	30°	30°	60°	4.9	2.9	6.7	3.1	8.1	3.5	10.7	4.0	12.7	7.3	14.5	8.3	16.0	9.3	17.9	10.7	19.6	11.4
135°	45°	22°30'	67°30'	6.2	2.4	8.7	3.7	11.7	4.0	14.2	5.1	16.5	8.3	18.8	9.8	20.1	11.4	23.2	13.9	25.5	13.9

β EQUALS THE ANGLE BETWEEN β OF CULVERT AND α OF ROADWAY. α EQUALS THE ANGLE BETWEEN α OF CULVERT AND A NORMAL TO α OF ROADWAY.
 φ AND θ ARE ANGLES BETWEEN THE WINGWALL AND A LINE PARALLEL WITH THE CENTER LINE OF ROADWAY.
 EXAMPLE FOR USING THE ABOVE TABLE. SUPPOSE A STREAM MAKES AN ANGLE OF β = 65° WITH THE CENTER LINE OF ROADWAY. THEN, FROM THE TABLE, SELECT THE NEAREST ANGLE β = 60°. THEN α, φ AND θ EQUAL 30°, 60° AND 30° RESPECTIVELY. IF THE DESIRED HEIGHT "H" OF CULVERT IS 8'-0", THEN "K" AND "M" WILL BE 9'3" AND 16'-0". LOCATE THE WING DETAIL WHEN H = 8'-0" ON THIS SHEET.



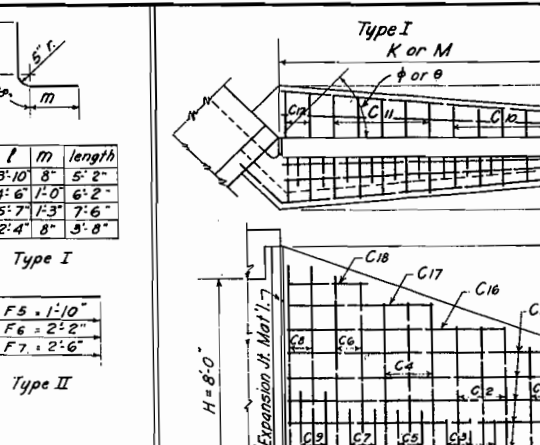
BAR LIST & QUANTITIES FOR ONE WING WHEN H=2'-0"

When φ or θ equals	Number of Bars Required								Length of Bars								Quantities for One Wing				
	K1	K2	K3	K4	K5	3-K6	3-K7	1-K8	F1	F2	F3	F4	F5	F6	F7	3-F8	7-F9	1-F10	1-F11	Concrete	Steel
22°30'	4	3	4	3	8	8-3"	5-10"	2-2"	1-07	1.07	0.82	0.47									
30°	3	2	3	2	6	6-2"	4-5"	1-2"	0.82	0.47											
37°30'	2	2	2	2	6	5-0"	3-7"	1-2"	0.68	0.40											
45°	2	2	2	2	5	4-4"	3-0"	1-2"	0.57	0.36											
52°30'	2	2	2	2	4	4-0"	2-8"	1-2"	0.52	0.33											
60°	2	1	2	1	4	3-6"	2-5"	1-0"	0.48	0.28											
67°30'	2	1	2	1	4	3-0"	2-0"	1-0"	0.40	0.26											



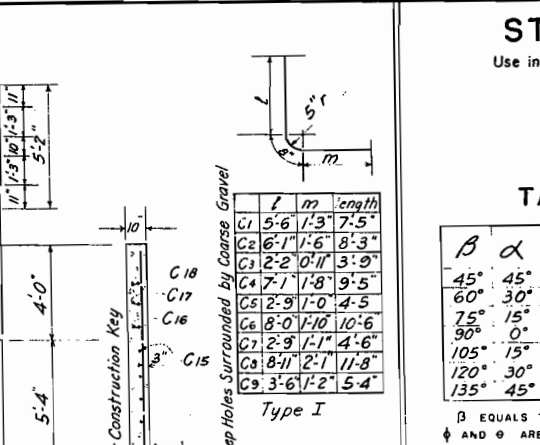
BAR LIST & QUANTITIES FOR ONE WING WHEN H=5'-0"

When φ or θ equals	Number of Bars Required											Length of Bars											Quantities for One Wing	
	F1	F2	F3	F4	F5	F6	F7	3-F8	7-F9	1-F10	1-F11	E1	E2	E3	E4	E5	E6	E7	3-E8	7-E9	1-E10	1-E11	Concrete	Steel
22°30'	5	5	5	6	7	8	17	17-3"	13-10"	9-2"	4-2"	4.06	2.37											
30°	3	4	4	5	6	13	13-3"	10-6"	7-2"	3-2"	3.10	1.80												
37°30'	3	3	3	4	4	5	11	11-0"	8-7"	5-2"	2-2"	2.55	1.47											
45°	2	3	3	4	4	4	9	9-6"	7-4"	5-2"	2-2"	2.20	1.30											
52°30'	2	2	3	3	3	4	8	8-6"	6-6"	4-2"	2-2"	1.96	1.13											
60°	2	2	3	3	3	4	8	7-9"	5-11"	4-2"	2-2"	1.79	1.09											
67°30'	2	2	2	3	3	3	7	7-3"	5-7"	3-2"	1-2"	1.69	0.97											



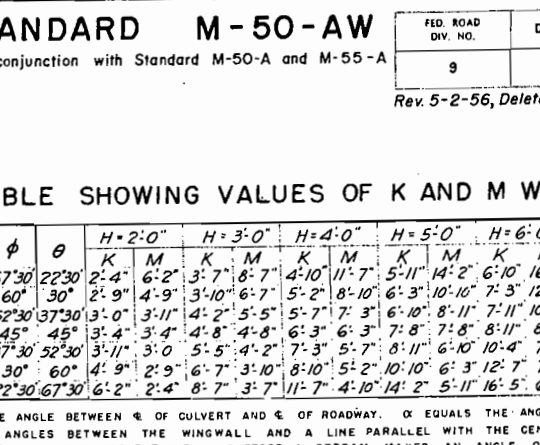
BAR LIST & QUANTITIES FOR ONE WING WHEN H=8'-0"

When φ or θ equals	Number of Bars Required												Length of Bars												Quantities for One Wing	
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	3-C14	10-C15	1-C16	1-C17	1-C18	Concrete	Steel						
22°30'	4	4	5	4	4	4	4	4	9	9	9	3	25	24-8"	20-6"	12-2"	7-2"	9.00	5.26							
30°	3	3	4	4	3	3	3	3	7	6	3	19	19-0"	15-8"	12-2"	9-2"	5-2"	6.91	4.02							
37°30'	2	3	3	3	3	3	3	2	6	5	2	16	16-0"	12-10"	10-2"	7-2"	4-2"	5.69	3.30							
45°	2	3	3	3	2	2	2	2	5	5	2	14	13-8"	11-0"	9-2"	6-2"	3-2"	4.89	2.87							
52°30'	2	2	3	2	2	2	2	2	4	4	2	13	12-2"	9-9"	7-2"	5-2"	3-2"	4.35	2.57							
60°	1	2	3	2	2	2	2	2	4	4	2	12	11-0"	8-11"	7-2"	5-2"	3-2"	3.99	2.42							
67°30'	1	2	2	2	2	2	2	2	4	3	2	10	10-3"	8-4"	6-9"	4-6"	2-4"	3.74	2.28							



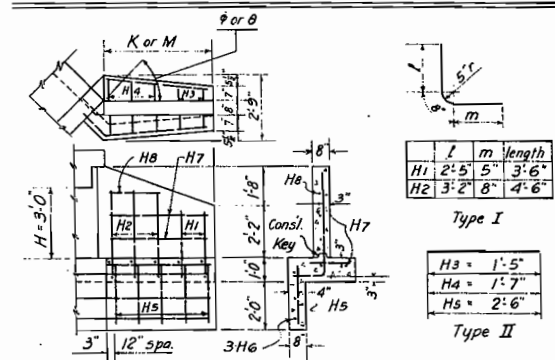
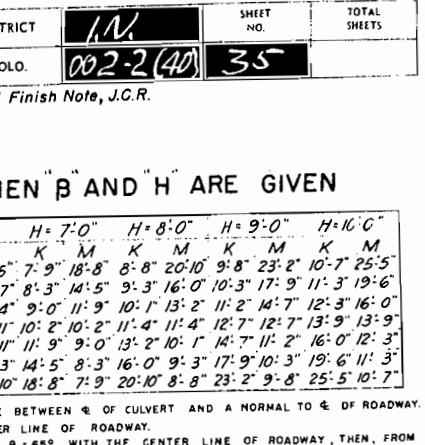
BAR LIST & QUANTITIES FOR ONE WING WHEN H=9'-0"

When φ or θ equals	Number of Bars Required													Length of Bars													Quantities for One Wing	
	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	3-B14	11-B15	1-B16	1-B17	1-B18	Concrete	Steel								
22°30'	5	6	6	6	7	6	5	5	5	6	7	25	27-7"	22-10"	17-2"	11-2"	4-2"	11.56	6.66									
30°	4	4	4	5	6	4	3	3	4	5	6	20	21-2"	17-5"	13-2"	8-2"	3-2"	8.86	5.10									
37°30'	3	3	4	4	5	4	3	3	3	4	5	17	17-4"	14-3"	11-2"	7-2"	2-2"	7.27	4.27									
45°	3	3	3	3	4	3	3	3	3	4	5	15	15-0"	12-3"	9-2"	6-2"	2-2"	6.28	3.70									
52°30'	3	3	3	3	3	3	3	2	2	3	4	14	13-4"	10-10"	7-2"	5-2"	2-2"	5.57	3.22									
60°	3	3	2	2	3	3	2	2	2	3	3	12	12-3"	9-11"	6-2"	4-2"	1-2"	5.11	2.94									
67°30'	3	2	2	2	3	3	2	2	2	3	3	12	11-6"	9-4"	6-2"	4-2"	1-2"	4.82	2.79									



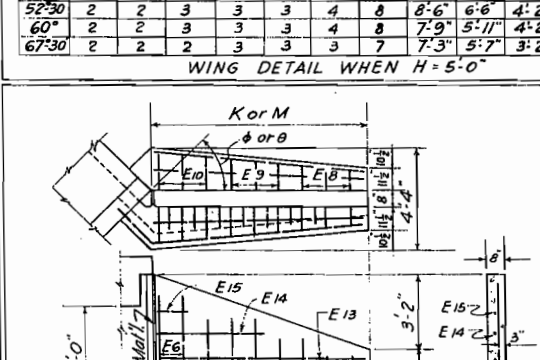
BAR LIST & QUANTITIES FOR ONE WING WHEN H=10'-0"

When φ or θ equals	Number of Bars Required														Length of Bars														Quantities for One Wing	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	3-A14	11-A15	1-A16	1-A17	2-A18	Concrete	Steel										
22°30'	6	6	5	5	8	7	6	6	6	6	7	5	6	30	30-0"	25-1"	19-2"	14-2"	6-2"	14.35	8.30									
30°	5	4	4	4	5	6	6	6	6	4	4	4	23	23-0"	19-2"	12-2"	10-2"	5-2"	11.01	6.36										
37°30'	3	4	4	4	4	5	4	4	4	4	4	4	19	19-0"	15-8"	12-2"	10-2"	4-2"	9.03	5.23										
45°	3	3	3	3	4	4	4	4	3	3	3	3	16	16-3"	13-5"	10-2"	7-2"	3-2"	7.76	4.40										
52°30'	3	3	3	3	3	3	3	3	3	3	3	3	14	14-9"	11-11"	8-2"	6-2"	3-2"	6.92	3.94										
60°	2	2	2	2	3	3	3	3	3	3	3	3	13	13-6"	10-11"	8-2"	5-2"	2-2"	6.35	3.63										
67°30'	2	2	2	2	3	3	3	3	3	3	3	2	12	12-10"	10-3"	8-2"	5-2"	2-2"	5.97	3.48										



BAR LIST & QUANTITIES FOR ONE WING WHEN H=3'-0"

When φ or θ equals	Number of Bars Required								Length of Bars								Quantities for One Wing				
	H1	H2	H3	H4	H5	3-H6	4-H7	1-H8	E1	E2	E3	E4	E5	E6	E7	3-E8	7-E9	1-E10	1-E11	Concrete	Steel
22°30'	4	4	4	5	11	10-10"	8-3"	4-2"	1.78	0.99											
30°	3	4	4	4	8	8-4"	6-3"	3-2"	1.36	0.76											
37°30'	3	3	3	3	7	6-8"	5-1"	2-2"	1.12	0.63											
45°	2	3	3	3	6	5-10"	4-4"	2-2"	0.97	0.54											
52°30'	2	2	2	2	5	4-4"	3-10"	2-2"	0.86	0.52											
60°	2	2	2	2	5	4-10"	3-6"	1-2"	0.79	0.44											
67°30'	2	2	2	2	5	4-8"	3-3"	1-2"	0.74	0.43											



BAR LIST & QUANTITIES FOR ONE WING WHEN H=5'-0"

When φ or θ equals	Number of Bars Required											Length of Bars											Quantities for One Wing	
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	3-E12	8-E13	1-E14	1-E15	Concrete	Steel							
22°30'	4	4	4	5	4	4	4	5	6	20	19-9"	16-7"	8-7"	3-2"	5.21	3.17								