COLORADO DEPT. OF HIGHWAYS
FORM C.D.H. 72
JANUARY 1960

TITLE SHEET

FEDERAL ROAD REGION NO	DIVISION	PROJ NO.	SHEET NO	TOTAL SHEETS
9	COLORADO	I 25-2(44)150	1	

COLORADO
DEPARTMENT OF HIGHWAYS

PLAN AND PROFILE OF PROPOSED

FEDERAL AID PROJECT NO. I 25-2(44) 150

STATE HIGHWAY NO. ± 25

EL PASO COUNTY

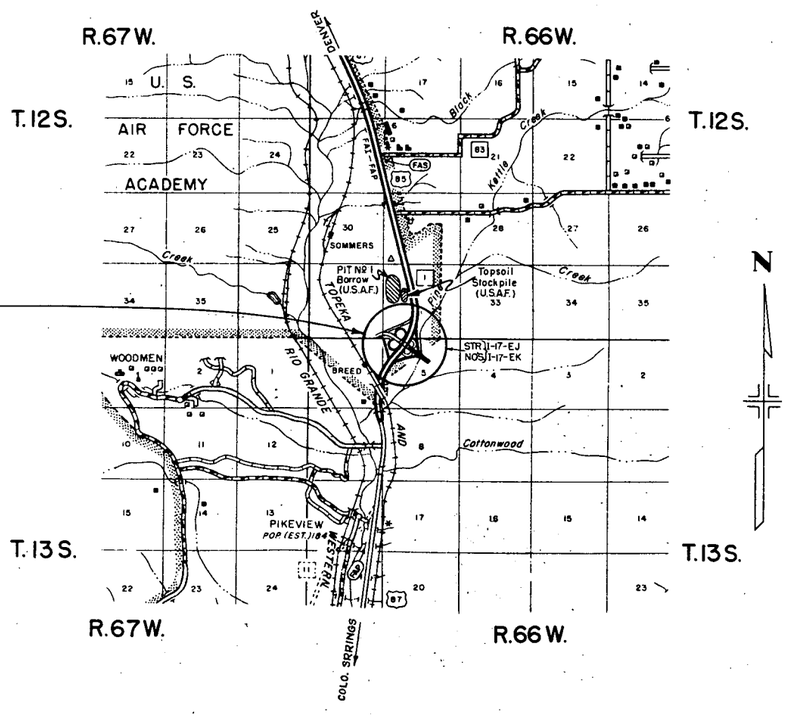
SCALES OF ORIGINAL DRAWINGS

ON PLAN 1 IN = 100 FT
ON PROFILE 1 IN = 100 FT. HORIZONTAL
1 IN = 10 FT VERTICAL

GRADE LINE ON PROFILE IS SHOWN AS GRADE OF FINISHED ROAD
GROSS LENGTH OF PROJECT } NO CENTERLINE LENGTH INVOLVED
NET LENGTH OF PROJECT }

CONVENTIONAL SIGNS

CENTER LINE (to PLAN SHEET / TITLE SHEET)
RIGHT OF WAY LINE (R.O.W. MARKER)
COUNTY LINE
TOWNSHIP OR RANGE LINE
LAND LINES (SECTION LINE / 1/4 SECTION LINE / 1/16 SECTION LINE)
RAILROAD (TITLE SHEET / PLAN SHEET)
BARBED WIRE FENCE
COMBINATION WIRE FENCE
SNOW FENCE
TELEPHONE & TELEGRAPH LINES
POWER LINE
DETOUR
PRESENT ROAD (Plan Sheets)
Protected By Freeway Law (Virgin Location)



INDEX OF SHEETS

SEE SPECIAL PROVISIONS FOR NOTICE TO BIDDERS

COLORADO DEPARTMENT OF HIGHWAYS

APPROVED
Neal Tillotson 3-7-60
CHIEF ENGINEER DATE

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

APPROVED

DIVISION ENGINEER

M.R.

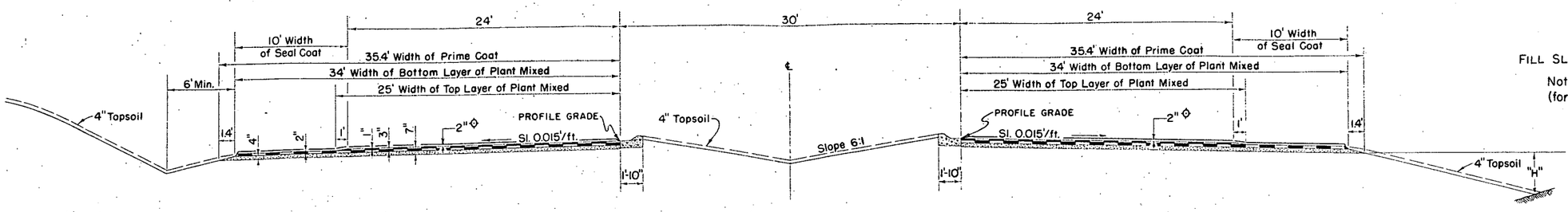
FORM C. D. H. 100
APRIL 1959

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I 25-2(44)150	2	

Rev. Sect. To Show Future Overlay, E.E.Q. 1-12-61

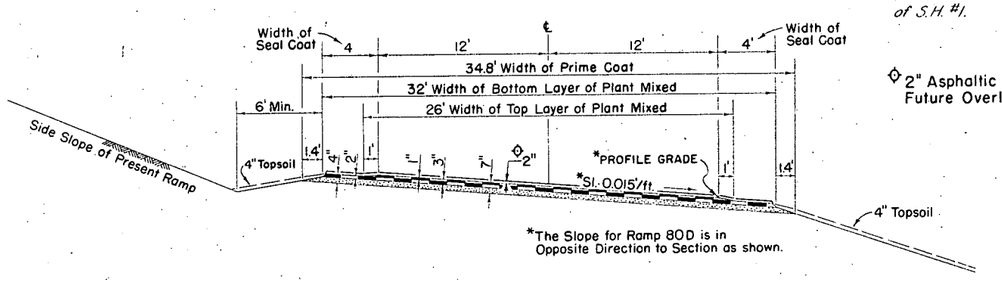
TYPICAL CROSS SECTIONS

TYPICAL SECTION "A", ROAD 80



FILL SLOPES – Sections "A", "B" & "C"
Not steeper than 4:1
(for placing Topsoil)

TYPICAL SECTION "B" RAMPS 80D & 80F



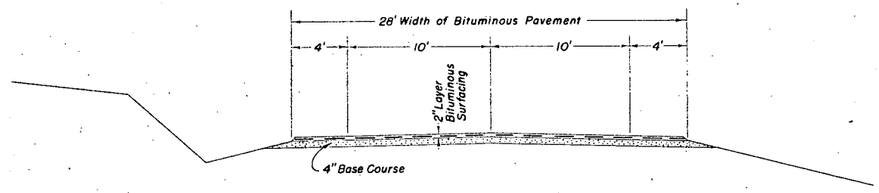
*The Slope for Ramp 80D is in Opposite Direction to Section as shown.

Note: Approximately 5200 Cu Yds of "Placing Topsoil" will be required for this project. Material will be available on the U.S.A.F. Academy Grounds, 1 mile from center of interchange, near Kettle Creek on N.W. side of S.H. #1.

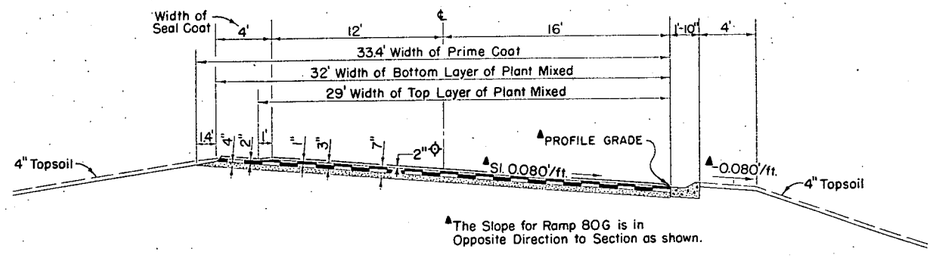
◇ 2" Asphaltic Concrete Pavement
Future Overlay

TYPICAL SECTION "D"

Assumed Typical Section for Construction of County Road to connect to Road 80.



TYPICAL SECTION "C" RAMPS 80G & 80H



▲The Slope for Ramp 80G is in Opposite Direction to Section as shown.

GENERAL NOTES

✓ This project is to be constructed in conformity with the Standard Specifications of the Colorado Department of Highways, adopted January 1, 1958.

. All quantities on preliminary plans are to be considered approximate only.

✓ All poles encroaching on construction are to be moved by the owners.

. All curves are to be superelevated and widened as provided by the Standard Superelevation sheet included with the plans.

For preliminary plan quantities of Asphaltic Road Materials and Stone Screenings, the following rates of application were used:

PRIME COAT	MC	@ 0.40 Gals. per Sq. Yd.
PAVING ASPHALT	(85-100 Pen)	@ 6.67 Lbs./Sq. Yd./inch
SEAL COAT	RC	@ 0.22 Gals. per Sq. Yd.
STONE SCREENINGS	Type I	@ 24 Lbs per Sq. Yd.

Rate of application and grade of Asphaltic Material shall be as determined by the Engineer at time of application.

✓ Application methods for liquid asphaltic road material which result in the discoloration of concrete pavement, curbs or gutters will not be permitted.

Approximate 7" compacted thickness of Gravel or Crushed Rock Surfacing shall be placed in separate courses at the following rates per square yard of roadway:

1" Top Layer Plant Mixed Asph. Surf.	111.2 Lbs.
2" Bottom Layer Plant Mixed Asph. Surf.	222.4 Lbs.
4" Base Course Surfacing	400 Lbs.

The bottom 2" layer of Bituminous Surfacing shall be completed for full width before top 1" layer is placed. Paving joints in top layer will overlap a minimum of 1 ft. over joint in bottom layer.

When ordered by the Engineer, a tack coat is to be applied between pavement courses to improve bond. Tack coat will be placed at the approximate rate of 0.07 to 0.10 gallon per square yard if required.

Form C. D. H. 126
APRIL 1959

SUMMARY OF APPROXIMATE QUANTITIES

ITEM NO.	ITEM	UNIT					TOTAL		
10	Clearing and Grubbing Entire Project	L. S.					•	✓	
11	Reset Concrete Flared End Sections	Each					3	✓	
12	Removing Fence	Lin. Ft.					100	✓	
13	Unclassified Excavation	Cu. Yd.					201,000	✓	
13	Unclassified Ditch Excavation	Cu. Yd.					50	✓	
14	Unclassified Structural Excavation - Miscellaneous	Cu. Yd.					230		
16	Structure Backfill (Class I)	Cu. Yd.					300	✓	
17	Compaction (Modified)	Cu. Yd.					225,000	✓	
17	Wetting	M Gal.					5,710	✓	
18	Station Yard Overhaul	Sta. Yd.					2,242,000	✓	
18	Yard Mile Overhaul	Yd. Mi.					184,800	✓	
19	Placing Top Soil	Cu. Yd.					5,200	✓	
26	Gravel or Crushed Rock Surfacing (Grading C)	Ton					6,300	✓	
29	Asphalt (85 - 100 Penetration) (Tack Coat)	Ton					10	✓	
30	Asphaltic Road Material MC (Prime)	Gal.					12,900	✓	
30	Asphaltic Road Material RC (Seal)	Gal.					1,400	✓	
31	Stone Screenings (Type I)	Ton					90	✓	
32	Plant Mixed Asphaltic Surfacing	Ton					4,780	✓	
32	Plant Mixed Asphaltic Shoulder Roll	Ton					40	✓	
46	Class "A" Concrete	Cu. Yd.					132	✓	
47	Reinforcing Steel	Lb.					11,000	✓	
52	18" Reinforced Concrete Culvert Pipe (Class II)	Lin. Ft.					70	✓	
52	24" Reinforced Concrete Culvert Pipe (Class II)	Lin. Ft.					374	✓	
52	24" Reinforced Concrete Culvert Pipe (Class III)	Lin. Ft.					146	✓	
52	24" Reinforced Concrete Culvert Pipe (Class IV)	Lin. Ft.					172	✓	
52	36" Reinforced Concrete Culvert Pipe (Class II)	Lin. Ft.					96	✓	
53	12" Corrugated Metal Culvert Pipe	Lin. Ft.					94	✓	
63	Grouted Rubble Slope and Ditch Paving	Cu. Yd.					10	✓	
84	Concrete Combination Curb and Gutter (Type I-M)	Lin. Ft.					4810	✓	
92	Timber Guard Posts	Each					86	✓	
93	Metal Embankment Protectors (Type 3)	Each					3	✓	
132	No 12 Inlet Grating and Frame	Each					2		
132	Inlet Grating and Frame (Median)	Each					1	✓	
152	18" Flared End Sections for Reinf. Conc. Culv. Pipe	Each					1	✓	
152	24" " " " " " " " "	Each					11	✓	
152	36" " " " " " " " "	Each					2	✓	
	FORCE ACCOUNT								
	Relocate Telephone Poles (Work by A.T.&T. Co. Forces)	L. S.					•	✓	
	Relocate Power Poles (Work by City of Colorado Springs Forces) (Non Federal Aid)	L. S.					•	✓	
	STATE FORCES								
	Signing and Striping Entire Project (Non Fed Aid)	L. S.					•	✓	

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I 25-2(44)150	3	

Form C. D. H. 126
APRIL 1959

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I 25-2(44)150	4	

SUMMARY OF EARTHWORK QUANTITIES

EXCAVATION		
FROM CROSS SECTIONS	1,781	
BORROW	180,248	
EST. FOR SUBSIDENCE	18,203	
LIST OF STRUCTURES AS EXCAVATION	90	
LIST OF STRUCTURES AS EMBANKMENT	10	
EST. FOR CUT SLOPE TREATMENT	100	
TOTALS	200,432	Cu. Yds.
EXCAVATION		
FROM CROSS SECTIONS	1,781	
BORROW	180,248	
TOTALS	182,029	Cu. Yds.
EMBANKMENT		
FROM CROSS SECTIONS	158,285	Cu. Yds.
EMBANKMENT X FACTOR	182,029	Cu. Yds.
STATION YARD OVERHAUL		
FROM MASS DIAGRAM	1,982,728	
EST. FOR SUBSIDENCE	198,273	
EST. FOR TOPSOIL	57,112	
EST. FOR STRUCTURE BACKFILL	3,190	
TOTALS	2,241,303	Sta. Yds.
YARD MILE OVERHAUL		
FROM MASS DIAGRAM	163,271	
EST. FOR SUBSIDENCE	16,327	
EST. FOR TOPSOIL	4,917	
EST. FOR STRUCTURE BACKFILL	277	
TOTALS	184,792	Yd. Mi.
COMPACTION		
EXCAVATION FROM EARTHWORK SUMMARY	200,432	
BASE OF CUTS AND FILLS	24,050	
TOTALS	224,482	Cu. Yds.

TIMBER GUARD POSTS

STATION	SIDE	SPACING	NO.
Ramp 80G			
0+50	Rt.	Exit	2
1+50 to 8+50	"	50'	15
9+16	Lt.	Culvert	1
9+50	Rt.	Entrance	5
Ramp 80H			
0+90	Lt.	Entrance	5
1+50 to 9+50	"	50'	17
8+75	Rt. & Lt.	Culvert	2
9+40	Rt.	"	1
10+06	Lt.	Exit	2
Ramp 80D			
1+38	Rt.	Exit	2
3+38 to 5+76	Rt. & Lt.	11° Curve	10
16+22	Rt.	Entrance	5
Ramp 80F			
1+78	Lt.	Entrance	5
3+26 to 5+78	"	11° Curve	5
11+60 to 15+18	"	" "	5
16+10	"	Exit	2
Road 80			
182+80	Rt. & Lt.	Culvert	2
Total			86

CURB & GUTTER TABULATION

STATION TO STATION	SIDE	LIN. FT.
Ramp 80 G 0+00 to 10+36.7	Lt.	1,037
Ramp 80 H 0+00 to 10+36.7	Rt.	1,037
Weaving Lane 308+55.6 to 313+97.6 (85-87)	Lt.	542
Road 80 171+05.7 to 182+00	Median	2,194
TOTAL		4,810

SHOULDER ROLL TABULATION

STATION TO STATION	SIDE	LIN. FT.
Ramp 80D 0+00 to 2+00 6+50 to 12+50	Lt. Lt	200 600
Ramp 80F 0+00 to 4+10	Rt.	410
Road 80 175+00 to 179+95 181+74.6 to 182+50 175+00 to 180+65 181+99 to 182+50	Lt. Lt. Rt. Rt.	495 76 565 51
TOTAL		2,397= 37 Tons

SURFACING PLAN

The source for Surfacing Material on this project is undesignated. Estimated quantities of Surfacing are shown below. Alteration of the plan as here outlined will be allowed only on written permission from the Department.

MATERIAL TO BE PLACED		TONS USED GRADING C			
		TOP COURSE PLANT MIXED	BOTTOM COURSE PLANT MIXED	BASE COURSE	
Ramp 80 G					
Exit (-1+40 to 2+00)		31	70	127	
2+00 to 8+00		108	240	438	
Entrance (8+00 to 10+86.7)		42	97	180	
Ramp 80 H					
Entrance (-1+40 to 2+50)		42	97	180	
2+50 to 8+00		99	220	402	
Exit (8+00 to 10+86.7)		37	86	157	
Weaving Lane (Road 85-87)		33	66	118	
Ramp 80 D					
Exit (0+00 to 3+00)		25	76	143	
3+00 to 14+50		173	460	851	
Entrance (14+50 to 17+92.4)		47	124	233	
Deceleration Lane		32	84	158	
Ramp 80 F					
Entrance (0+00 to 3+00)		31	87	164	
3+00 to 14+00		165	440	814	
Exit (14+00 to 16+79.7)		35	91	171	
Acceleration Lane		61	163	306	
Road 80					
Connection (172+27.2 to 173+84)		26	54	98	
173+84 to 178+98.6 Lt.		77	216	396	
173+84 to 180+17.5 Rt.		95	266	488	
178+98.6 to 181+99 Lt.		45	90	159	
180+17.5 to 181+99 Rt.		27	54	96	
Taper (181+99 to 185+30.0)		144	317	573	
TOTALS		4,773		6,252	

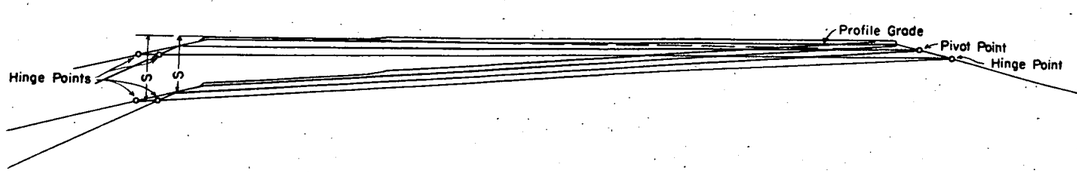
LIST OF STRUCTURE QUANTITIES

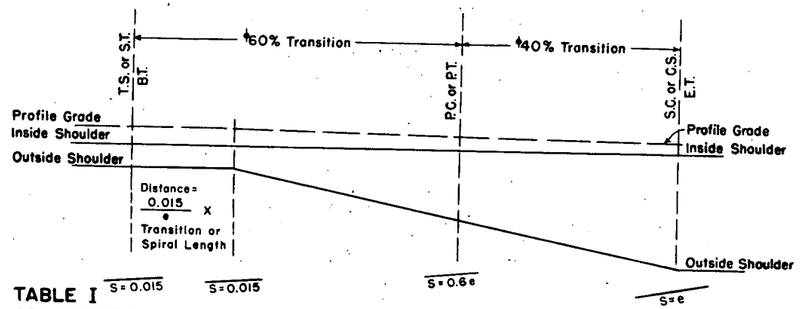
FEDERAL ROAD DIVISION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I 25-2(44)150	5	

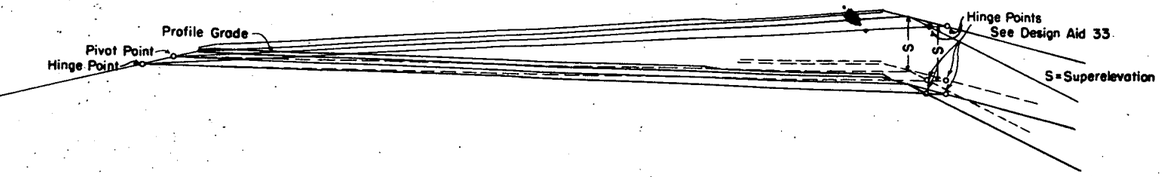
LOCATION	MISCELLANEOUS	REMOVE STRUCTURE	EXCAVATION			UNCLASSIFIED STRUCTURAL EXCAVATION MISCELLANEOUS	STRUCTURE BACKFILL		GRAVEL OR CRUSHED ROCK SURFACING		CONCRETE	REINFORCING STEEL	GROUTED RUBBLE SLOPE & DITCH PAVING	⊕ REINFORCED CONC. CULVERT PIPE			FLARED END SECTIONS FOR R.C.C.P.			METAL APRONS FOR C.M.P. CULVERTS	
			CUBIC YARDS			CUBIC YARDS	CUBIC YARDS				CUBIC YARDS			LINEAR FEET			EACH			NO.	
		NO. KIND	UNCL.	EMB.	UNCL. DITCH		CL. 1		TONS		CL. "A"	LBS.	GU. YDS	18" CI 2	24" CI 2	36" CI 2	18"	24"	36"		
RAMP 80 G																					
9+	1-Reset Flared End Section 1-No 12 Inlet Grating and Frame		3			22	12				.72	137		32							
RAMP 80 H																					
2+50						21	25							92				2			
8+75	1-Reset Flared End Section					6	19							54				1			
9+40	1-No. 12 Inlet Grating and Frame					8	6				.72	119		20							
RAMP 80 D																					
4+18						39	47								172			2			
12+30						26	52									96			2		
12+50	1-Metal Embankment Protector (Type 3) 38 Lin. Ft. of 12" C.M.P.					1					0.4										
14+70				5		11	20							62				2			
RAMP 80 F																					
3+50						34	41								146			2			
10+30						26	31							108				2			
326+00 (S.H. #1)	1-Reset Flared End Section					3	4							6							
ROAD 80																					
181+50	1-Inlet Grating and Frame (Median)			10		11	15				1.71	127	3	70				1			
182+40	2-Metal Embankment Protectors (Type 3) 22 Lin. Ft. of 12" C.M.P. & 34 Lin. Ft. of 12" C.M.P.					2					0.8										
182+80			87			16	18				12.80	10,517									
183+	100-Lin. Ft. Removing Fence																				
Project Totals			90	10	5	226	290				131.15	10,900	3	70	374	146	172	96	1	11	2

⊕ Class of pipe based on Ordinary Bedding

FEDERAL ROAD REG. NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	I 25-2 (44) 150	6	







*When Curve is Not Spiralled

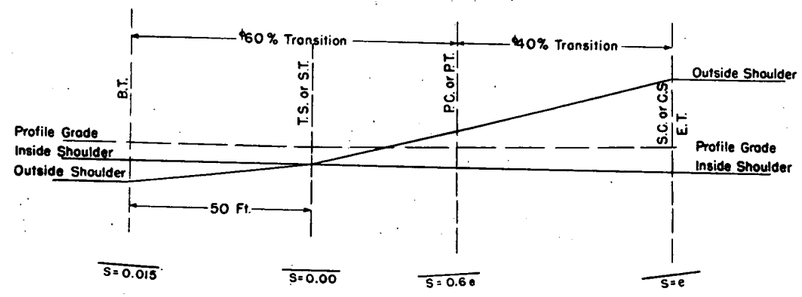


TABLE I
MAXIMUM SPEEDS & REQUIRED TRANSITION OR SPIRAL LENGTHS FOR FOUR LANE DIVIDED HIGHWAYS

Degree of Curve	Maximum Superelevation = 0.08			Maximum Superelevation = 0.12		
	Super. Rate Ft./Ft.	Maximum Design Speed M.P.H.	Minimum Transition or Spiral Length	Super. Rate Ft./Ft.	Maximum Design Speed M.P.H.	Minimum Transition or Spiral Length
0° 15'	0.015	>70	◦ 100'	0.015	>70	◦ 100'
0° 30'	0.015	>70	◦ 100'	0.015	>70	◦ 100'
0° 45'	0.021	>70	100'	0.021	>70	100'
1° 00'	0.028	>70	100'	0.029	>70	100'
1° 30'	0.042	>70	150'	0.043	>70	150'
2° 00'	0.056	>70	200'	0.057	>70	200'
2° 30'	0.069	>70	250'	0.071	>70	250'
3° 00'	0.077	>70	300'	0.086	>70	300'
3° 30'	0.080	70	350'	0.100	>70	350'
4° 00'	0.080	66	350'	0.114	70	400'
5° 00'	0.080	60	300'	0.120	65	400'
6° 00'	0.080	55	300'	0.120	60	350'
7° 00'	0.080	52	300'	0.120	56	350'
8° 00'	0.080	49	300'	0.120	53	350'
9° 00'	0.080	46	250'	0.120	50	300'
10° 00'	0.080	44	250'	0.120	48	300'
11° 00'	0.080	42	250'	0.120	46	300'
12° 00'	0.080	41	250'	0.120	44	300'
13° 00'	0.080	39	200'	0.120	42	300'
14° 00'	0.080	38	200'	0.120	41	250'
15° 00'	0.080	37	200'	0.120	39	250'
16° 00'	0.080	36	200'	0.120	38	250'
17° 00'	0.080	35	200'	0.120	37	250'
18° 00'	0.080	34	200'	0.120	36	250'
19° 00'	0.080	33	200'	0.120	35	250'
20° 00'	0.080	32	200'	0.120	34	250'
21° 00'	0.080	31	200'	0.120	34	250'
22° 00'	0.080	30	200'	0.120	33	250'
23° 00'	0.080	30	200'	0.120	32	250'
24° 00'	0.080	29	150'	0.120	32	200'
25° 00'	0.080	29	150'	0.120	31	200'
26° 00'	0.080	28	150'	0.120	30	200'
27° 00'	0.080	28	150'	0.120	30	200'

NOTE - Plains Areas use 0.12 Superelevation.
Mountainous Areas & areas where icing conditions frequently exist, use 0.08 Superelevation.

TABLE II
MINIMUM SUPERELEVATION RATES & TRANSITION LENGTHS TO BE USED WHEN MAXIMUM SPEED IS FIXED, AS IN URBAN ROADWAYS

Degree of Curve	25 M.P.H.		30 M.P.H.		35 M.P.H.		40 M.P.H.		45 M.P.H.		50 M.P.H.		55 M.P.H.		60 M.P.H.	
	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral	Minimum Super. Rate Ft./Ft.	Minimum Transition or Spiral
0° 15'	Normal Slope		Normal Slope		Normal Slope		Normal Slope		Normal Slope		Normal Slope		Normal Slope		N. S.	
0° 30'	"		"		"		"		"		0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'
0° 45'	"		"		"		"		"		0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'
1° 00'	"		"		"		"		"		0.015	◦ 100'	0.015	◦ 100'	0.015	100'
1° 30'	"		0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.016	100'
2° 00'	"		0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.017	100'	0.022	100'	0.022	100'
2° 30'	"		0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.017	100'	0.022	100'	0.027	150'	0.027	150'
3° 00'	0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.016	100'	0.021	100'	0.026	100	0.032	150'	0.032	150'
3° 30'	0.015	◦ 100'	0.015	◦ 100'	0.015	◦ 100'	0.019	100'	0.024	100'	0.031	150'	0.038	200'	0.038	200'
4° 00'	0.015	◦ 100'	0.015	◦ 100'	0.016	◦ 100'	0.021	100'	0.028	100'	0.035	150'	0.043	200'	0.043	200'
5° 00'	0.015	◦ 100'	0.015	◦ 100'	0.020	100'	0.027	100'	0.034	150'	0.044	200'	0.054	250'	0.053	250'
6° 00'	0.015	◦ 100'	0.017	◦ 100'	0.024	100'	0.032	150'	0.041	150'	0.052	250'	0.076	300'	0.079	300'
7° 00'	0.015	◦ 100'	0.020	100'	0.028	100'	0.037	150'	0.048	200'	0.064	250'	0.111	350'	0.120	350'
8° 00'	0.016	◦ 100'	0.023	100'	0.032	100'	0.043	150'	0.055	200'	0.093	300'	0.120	350'		
9° 00'	0.017	◦ 100'	0.026	100'	0.036	150'	0.048	200'	0.067	250'	0.120	300'				
10° 00'	0.019	◦ 100'	0.029	100'	0.040	150'	0.053	200'	0.091	250'						
11° 00'	0.021	◦ 100'	0.031	100'	0.044	150'	0.059	200'	0.114	300'						
12° 00'	0.023	100'	0.034	100'	0.048	150'	0.073	250'	0.120	300'						
13° 00'	0.025	100'	0.037	100'	0.052	200'	0.092	250'								
14° 00'	0.027	100'	0.040	150'	0.056	200'	0.111	250'								
15° 00'	0.029	100'	0.043	150'	0.060	200'	0.120	250'								
16° 00'	0.031	100'	0.046	150'	0.073	200'										
17° 00'	0.033	100'	0.049	150'	0.087	200'										
18° 00'	0.035	100'	0.051	150'	0.102	200'										
19° 00'	0.037	100'	0.054	150'	0.116	250'										
20° 00'	0.039	100'	0.057	150'	0.120	250'										
21° 00'	0.041	100'	0.060	150'												
22° 00'	0.043	100'	0.070	200'												
23° 00'	0.045	100'	0.081	200'												
24° 00'	0.047	100'	0.091	200'												
25° 00'	0.048	100'	0.102	200'												
26° 00'	0.050	100'	0.112	200'												
27° 00'	0.052	100'	0.120	200'												
30° 00'	0.058	150'														
33° 00'	0.075	150'														
36° 00'	0.097	150'														
40° 00'	0.120	150'														

NOTES ◦ Includes 50 Ft. of Runout when Spiraled.
Transition or Spiral Lengths are shown in the tables for 4 Lane Divided Highways.
For 6 Lane Divided Highways use 1.2 times the lengths shown, rounded to the nearest 50 feet.

FORMULAE FOR TABLES

$$D = \frac{85{,}950\,(e+f)}{V^2}$$

$$L_s = \frac{1.6 \times D \times V^3}{5730}$$

D = Degree of Curve
e = Superelevation Rate — Ft. per Ft. of Width
f = Side Friction Factor (varies from 0.12 at 70 M.P.H. to 0.16 at 30 M.P.H.)
L_s = Spiral Length — Feet
Note for Table II — A straight line transition was used for e from 0.015 to 0.06.

COLORADO DEPARTMENT OF HIGHWAYS

METHODS FOR SUPERELEVATION OF CURVES DIVIDED HIGHWAYS

Designed by R.W.L.
Made by S.B.L.
Approved by C. E. Tuthill

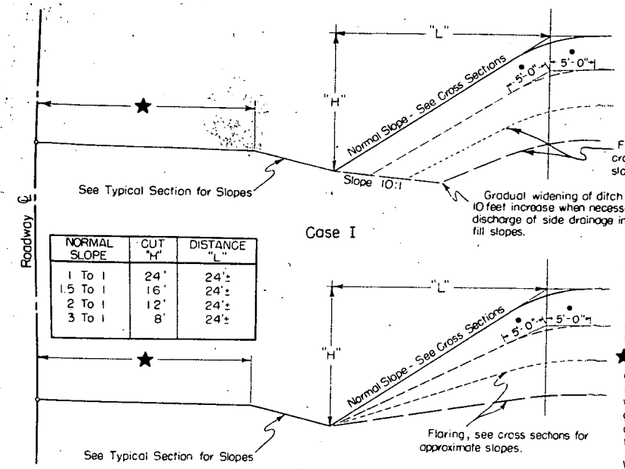
STANDARD SIDE APPROACH ROADS, FLARING, CUT SLOPE TREATMENT & WIDENING AT BRIDGES AND AT CREST OF GRADES

REVISIONS

STANDARD M-2-EN

FED. ROAD REG. NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	I25-2(44)150	7	

GENERAL DETAILS FOR FLARING OF EARTH CUTS, CUT SLOPE TREATMENT & WIDENING AT BRIDGES



NORMAL SLOPE	CUT "H"	DISTANCE "L"
1 To 1	24'	24'±
1.5 To 1	16'	24'±
2 To 1	12'	24'±
3 To 1	8'	24'±

FLARING OF EARTH CUTS : The backslopes at ends of all earth cuts shall be flattened & where necessary the ditch shall be widened gradually to discharge side ditch drainage away from the base of adjacent fill slopes in order to avoid erosion & to improve appearance. The transition of flattened backslopes & widened ditch shall be constructed in such a manner that a uniform appearance of slope & ditch results. Backslopes shall be flared to the approximate "L" distance shown on Slope Table included with this detail. Rock cuts shall not be flared.

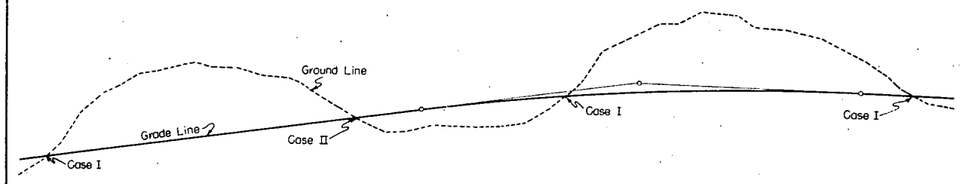
Flaring with widened ditch, see cross sections for approximate slopes.

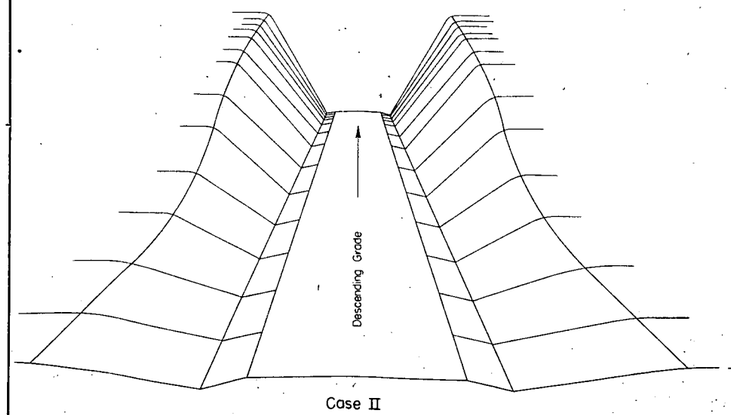
•CUT SLOPE TREATMENT IN EARTH CUTS: The intersection of cut slopes with the existing ground shall be rounded in earth cuts, beginning 5ft. outside the slope stake and extending 5 ft down the cut slope. Where the cut slope is less than 5ft. reduce each of the above widths of slope treatment to the actual slope distance. Quantities shall be included in "Unclassified Excavation".

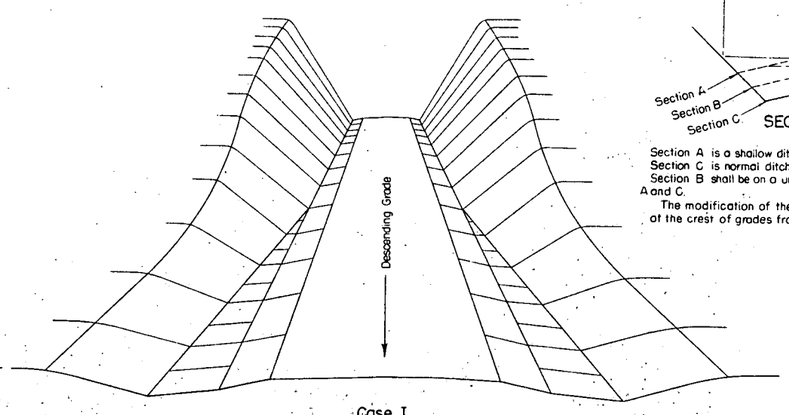
★WIDENING AT BRIDGE APPROACHES: Roadway embankment at bridge approaches shall be so constructed that base of surfacing at shoulder point is a Min. of 2 ft. beyond the outside edge of bridge deck. Where widening of the section is necessary to achieve this result it shall take place gradually over a distance of 300 ft. This is done to accomodate guard fence and/or guard posts at bridge approaches. (See additional requirements for Guard Fences below.)

WIDENING TO ACCOMODATE GUARD FENCES: At all locations on the project (except as provided above for bridge approaches) where guard fence is to be constructed the shoulders shall be widened 2 ft. to provide additional lateral support for guard fence posts.

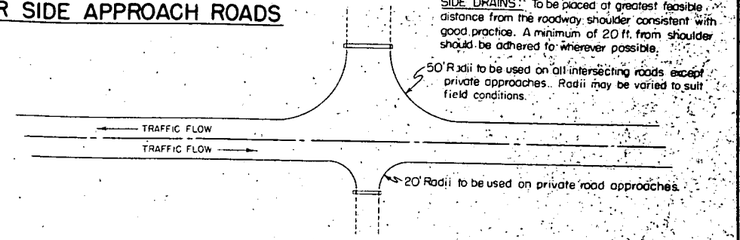
PLAN OF FLARING IN EARTH CUTS





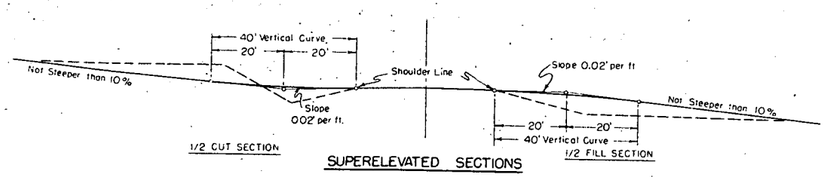


TYPICAL PLANS FOR SIDE APPROACH ROADS

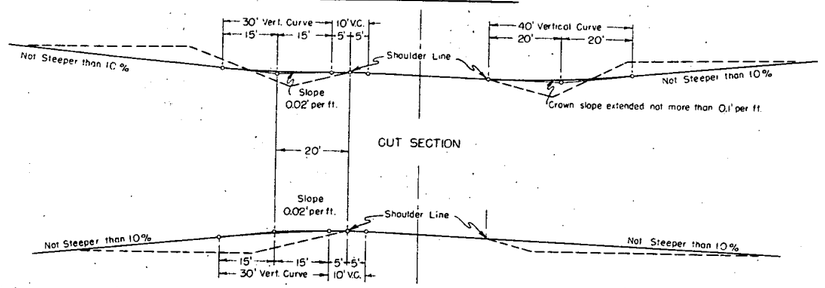


SIDE DRAINS: To be placed at greatest feasible distance from the roadway shoulder consistent with good practice. A minimum of 20 ft. from shoulder should be adhered to wherever possible.

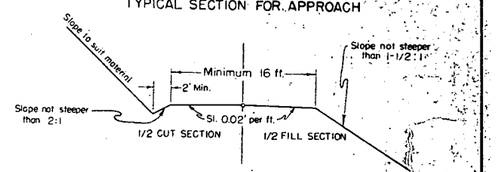
STANDARD CROWNED SECTION



SUPERELEVATED SECTIONS



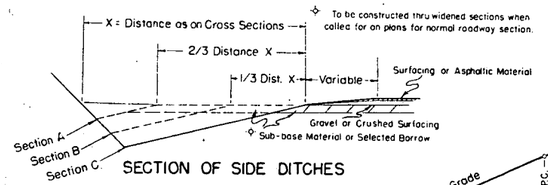
TYPICAL SECTION FOR APPROACH



NOTE:
ROAD APPROACHES: To conform to the above details unless otherwise indicated on plans by Special Details. The width of the crowned section shall be not less than the width of the crowned section of the existing approach road and in no case shall the new construction be less than sixteen (16) feet in width.

DETAILS FOR DITCH & WIDENED SHOULDERS AT CREST OF GRADES

(TO BE USED ONLY WHERE SIGHT DISTANCE AT CREST OF GRADE IS 600 FT. OR LESS)



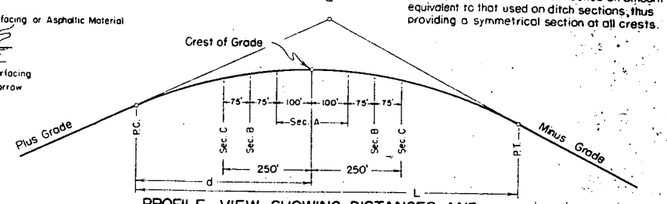
SECTION OF SIDE DITCHES

Section A is a shallow ditch section.
Section C is normal ditch section.
Section B shall be on a uniform transition between Sections A and C.
The modification of the ditch indicated shall be used only at the crest of grades from which drainage breaks both ways.

Formula for finding the Crest of Grade

$$d = \frac{\text{Plus Grade}}{\text{Algebraic Diff.}} \times L$$

NOTE
Where section is in embankment at crest of grades, the shoulder shall be widened an amount equivalent to that used on ditch sections, thus providing a symmetrical section at all crests.



PROFILE VIEW SHOWING DISTANCES AND RELATIVE POSITIONS OF DITCH-TREATMENT SECTIONS

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications of the Colorado Department of Highways applicable to the Project.

All side approach roads to the Project shall be Gravel Surfaced with a four (4) inch thickness of "Gravel or Crushed Rock Surfacing" extending approximately to the Right of Way Line. Estimated tonnage & type of material required for this operation are shown in the Surfacing Plan.

The maximum grades shown are to be the limiting grades for all road approaches. Modifications of grades will be permitted where adherence to the grades as shown would cause damage to property or create other unsatisfactory conditions. Grades less than the maximum shown are to be used wherever feasible

COLORADO DEPARTMENT OF HIGHWAYS

STANDARD SIDE APPROACH ROADS, FLARING, CUT SLOPE TREATMENT, AND WIDENING AT BRIDGES AND AT CREST OF GRADES

Designed by A.Z.	Approved by A. Julian
Made by SJM & ABH	
Checked by C.R.S	Date: November 1, 1953

	Initial	Date
...gned By		
...ked By		
...n By		
...ked By		
...ed By		

REVISIONS

STANDARD M-10-D

REV. 9-9-59 ADD NOTE ON MEASUREMENT (D.G.S.)

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	225-2 (44) 150 8		

1 2 3 4 5 6 7 8 9 0 .

A B C D E F G H I J K L

M N O P Q R S T U V W

a f g l J 14 K 1 9 5 0

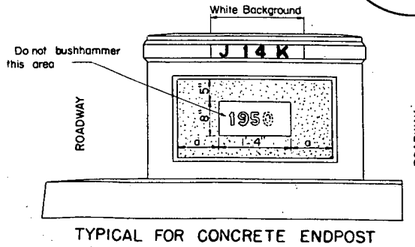
abcdefghijklmnopqrstuvwxyz

Scale in inches 0 1 2 3

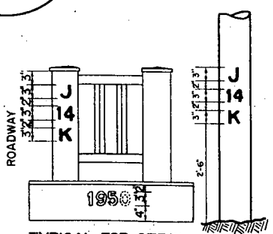
SAMPLE BRIDGE NUMBER

SAMPLE YEAR NUMBER

SECTION

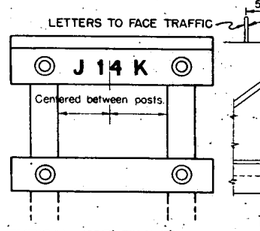


TYPICAL FOR CONCRETE ENDPOST

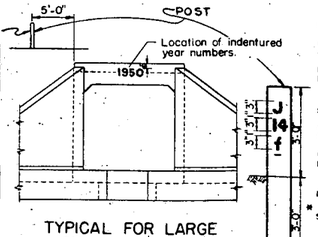


TYPICAL FOR STEEL HANDRAIL END POST

TYPICAL FOR SIGN POSTS



TYPICAL FOR TIMBER WING HANDRAIL



TYPICAL FOR LARGE BOX CULVERTS & STRUCTURES WITHOUT END POSTS

GENERAL NOTES

ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.

THE SIZE SHAPE AND SPACING OF THE LETTERS AND FIGURES SHALL BE IN ACCORDANCE WITH THE FULL SIZE SHOWN ON THIS SHEET. ADDITIONAL COPIES OF THIS FULL SIZE SHEET CAN BE OBTAINED FROM THE DEPARTMENT WITHOUT CHARGE.

THE YEAR NUMBERS ARE RECESSED IN CONCRETE ¾" MINIMUM AS SHOWN INTO THE PANEL OF THE ENDPOST ON THE RIGHT HAND SIDE OF EACH BRIDGE END AND INTO THE FACE OF THE DOWNSTREAM HEADWALL OF CULVERTS AS SHOWN ON PLAN DETAILS. NUMBERS TO BE MADE OF WOOD, METAL OR OTHER SUITABLE MATERIAL AND ATTACHED TO THE FORMS BEFORE CONCRETE IS POURED. THE YEAR NUMBER OF EACH STRUCTURE SHALL CORRESPOND WITH THE YEAR IN WHICH THE CONCRETE IS POURED.

THE STRUCTURE NUMBER SHALL BE STENCILED ON THE RIGHT HAND SIDE OF EACH BRIDGE END AS SHOWN ON THIS STANDARD AND AS SPECIFIED. WHERE THE STRUCTURE HAS NO END POSTS THE NUMBER SHALL BE PLACED ON A POST ON THE RIGHT HAND SIDE OF THE ROAD AS SHOWN. FOR SIGNS THE NUMBER SHALL BE PLACED ON SIGN POSTS ON THE RIGHT HAND SIDE OF THE ROADWAY.

THE CORRECT NUMBER FOR EACH BRIDGE OR SIGN IS SHOWN ON THE PLANS.

THE NUMBERS FOR MAJOR STRUCTURES OF OVER 20 FEET CLEAR SPAN SHALL BE UPPER CASE LETTERS. THE NUMBERS FOR MINOR STRUCTURES OF 12 TO 20 FEET CLEAR SPAN SHALL BE LOWER CASE LETTERS. SIGN BRIDGES SHALL BE CONSIDERED AS MAJOR STRUCTURES.*

A PROPER WHITE BACKGROUND, RECTANGULAR IN SHAPE AND EXTENDING THREE INCHES BEYOND THE LIMITS OF THE NUMBER SHALL BE PAINTED WITH TWO COATS OF ACCEPTABLE WHITE PAINT UNLESS AN APPROVED WHITE CONCRETE PAINT IS USED. BEFORE PAINTING THE SURFACE MUST BE THOROLY DRIED, CLEANED AND PROPERLY SIZED. ON TIMBER HANDRAILS THE WHITE PAINT USED ON THE BRIDGE WILL BE SATISFACTORY.

AFTER THE WHITE BACKGROUND HAS DRIED SUFFICIENTLY, THE CORRECT STRUCTURE NUMBER SHALL BE CAREFULLY STENCILED ON IT, WITH TWO COATS OF "SECOND FIELD COATS-DARK" OR "EXTERIOR BLACK PAINT (MAINT)" AS SPECIFIED UNDER ITEM 30 "PAINTS AND PAINTING". THE BRACES OF THE STENCILED LETTERS AND FIGURES SHALL BE CAREFULLY FILLED IN BY HAND TO MAKE SOLID FIGURES.

SUFFICIENT TIME BETWEEN SUCCESSIVE COATS SHALL BE ALLOWED TO PERMIT THORO DRYING.

THE COST OF PAINTING OF STRUCTURE NUMBERS AND FURNISHING AND PLACING POSTS FOR STRUCTURE NUMBERS SHALL BE CONSIDERED SUBSIDIARY WORK AND SHALL BE INCLUDED IN THE ORIGINAL CONTRACT ITEMS AND WILL NOT PAID FOR AS A SEPERATE ITEM.

* THE LENGTH OF SPAN OF STRUCTURE SHALL BE MEASURED ALONG CENTER LINE OF ROADWAY. IN CASE OF DOUBLE OR MULTIPLE BOX CULVERTS THE CENTER WALL OR WALLS SHALL BE DISREGARDED AND CLEAR SPAN MEASURED FROM INSIDE OF END WALLS.

STRUCTURE NO.

COLORADO DEPARTMENT OF HIGHWAYS

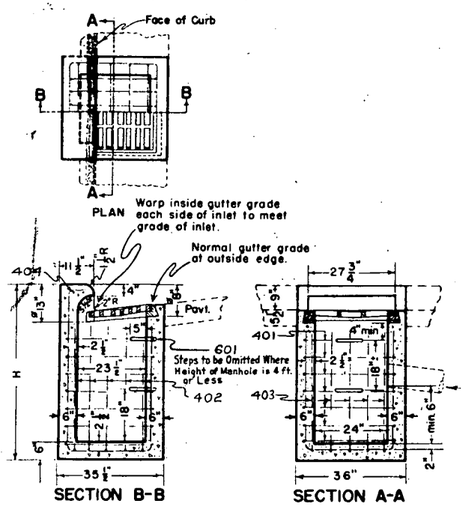
STANDARD LETTERS AND FIGURES FOR YEAR NUMBERS AND STRUCTURE NUMBERS

Designed by	Approved by L.H. Woodall
Made by	Bridge Engineer
Checked by	Date: Feb. 17, 1958

STANDARD M-12-E-13

FED. ROAD REGION NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	I 25-2 (9) 150	9	

NO. 12 CONCRETE INLET



* These dimensions for 6" curb. Dimensions to be modified as required for other heights of curb.

BAR LIST FOR H = 3' 0"

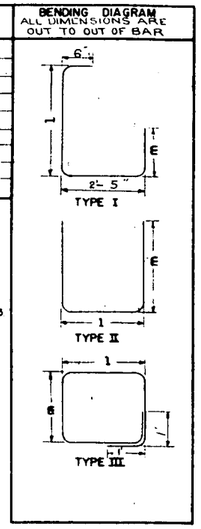
MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS l	DIMENSIONS m
601	3/4"ø	*Note	2' 6"	II	1'- 0"	0'-10"
401	1/2"ø	3	11'-10"	III	2'- 6"	2'- 6
402	1/2"ø	5	5'- 6"	II	2'-5	*1'- 7"
403	1/2"ø	5	7'- 1"	I	*2'- 7"	*1'- 8"
404	1/2"ø	2	2' 7"	STR.	—	—

* Omit 601 when H is 4'-0" or less.

* These dimensions to be increased in increments of 6" for H above 3'-0"
Add 1- 401 for each 6" additional height above 3'0".
601 required as follows;
H= 4'6" to 5'6" - 1 bar; H= 9'0" to 10'0"- 4 bars
H= 6'0" to 7'0"- 2 bars;
H= 7'6" to 8'6"- 3 bars;
Cut or bend bars around pipes as required.

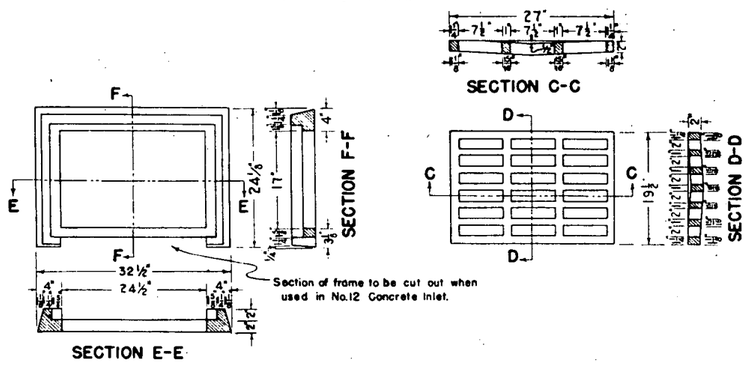
See Plans for size and locations of outlets.

BENDING DIAGRAM ALL DIMENSIONS ARE OUT TO OUT OF BAR

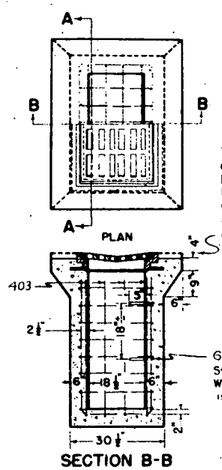


NO. 12 INLET GRATING & FRAME

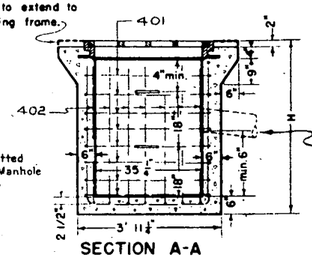
Approx. Weight 340 lbs.



NO. 13 CONCRETE INLET



0.06 Cu.Yds. of concrete is included in quantities in table. To be deducted when all processed material is to extend to edge of grating frame.



BAR LIST FOR H = 3'0"

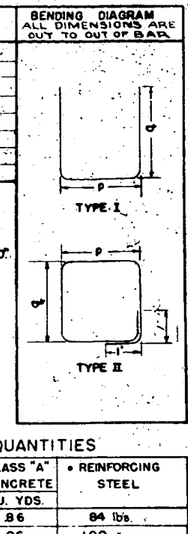
MARK	SIZE	NO. REQD.	LENGTH	TYPE	DIMENSIONS p	DIMENSIONS q
601	3/4"ø	*Note	2' 6"	I	1'- 0"	0'- 10"
401	1/2"ø	4	12'-10"	II	3'- 5"	2'- 1"
402	1/2"ø	7	6'- 1"	I	2'- 0"	*2'- 1"
403	1/2"ø	4	7'- 5"	I	3'- 4"	*2'- 1"

* Omit 601 when H is 4'-0" or less.

* These dimensions to be increased in increments of 6" for H above 3' 0"
Add 1- 401 for each 6" additional height above 3'0".
601 required as follows;
H= 4'6" to 5'6" 1 bar; 9'0" to 10'0"- 4 bars.
H= 6'0" to 7'0" 2 bars;
H= 7'6" to 8'6" 3 bars;
Cut or bend bars around pipes as required.

See Plans for size and locations of outlets.

BENDING DIAGRAM ALL DIMENSIONS ARE OUT TO OUT OF BAR



QUANTITIES

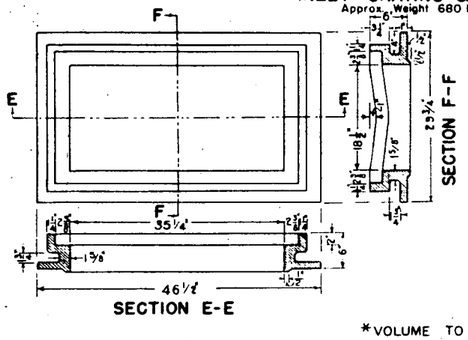
H	CLASS "A" CONCRETE *CU. YDS.	* REINFORCING STEEL
3' 0"	.86	84 lbs.
3' 6"	.96	100 "
4' 0"	1.06	116 "
4' 6"	1.16	136 "
5' 0"	1.26	156 "
5' 6"	1.36	172 "
6' 0"	1.46	192 "
6' 6"	1.57	208 "
7' 0"	1.67	225 "
7' 6"	1.77	245 "
8' 0"	1.87	261 "
8' 6"	1.97	277 "
9' 0"	2.07	297 "
9' 6"	2.17	313 "
10' 0"	2.28	329 "

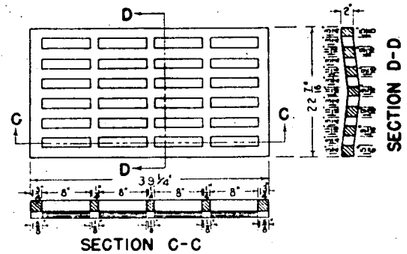
*Volume for inlet - volume occupied by pipes to be deducted for pay quantity of concrete.

* Includes 1% allowance for overrun.

NO. 13 INLET GRATING & FRAME

Approx. Weight 680 lbs.





QUANTITIES

H	CLASS "A" CONCRETE *CU. YDS.	* REINFORCING STEEL
3' 0"	0.54	70 lbs.
3' 6"	0.63	85 "
4' 0"	0.72	100 "
4' 6"	0.81	119 "
5' 0"	0.90	137 "
5' 6"	0.99	152 "
6' 0"	1.08	166 "
6' 6"	1.17	185 "
7' 0"	1.27	200 "
7' 6"	1.36	215 "
8' 0"	1.45	233 "
8' 6"	1.54	248 "
9' 0"	1.63	263 "
9' 6"	1.73	282 "
10' 0"	1.82	297 "

*Volume for inlet - volume occupied by pipes to be deducted for pay quantity of concrete.

* Includes 1% allowance for overrun.

*VOLUME TO BE DEDUCTED FOR EACH OPENING

	C.M.P.	R.C.P.
18"	0.03	0.05
24"	0.06	0.09
30"	0.09	0.14
36"	0.13	—

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications of the Colorado Department of Highways applicable to the project
All reinforced concrete shall be class "A," AND AIR ENTRAINED AS SPECIFIED.
All concrete walls shall be formed on both sides.
All exposed concrete corners shall be beveled to a 1" face.
All reinforcing bars shall be deformed, of intermediate grade, and shall be tagged with BAR designation and station number.
All castings shall be painted with two coats of asphalt or coal tar and oil.

ALL DIMENSIONS NOT SHOWN AS CLEAR ARE TO ℄ OF BAR.
ALL REINFORCING STEEL BARS SHALL CONFORM TO A.S.T.M. SPECIFICATION A-305-50T OR LATEST REVISION THEREOF.

COLORADO DEPARTMENT OF HIGHWAYS
STANDARD NO.12 AND NO.13 CONCRETE INLETS

Designed by A.P.G Mode by A.P.G Check Design A.Z Check Detail C.R.S.	Approved by C. D. Bailey Bridge Engineer Date JUL 10 1951

STANDARD M-13-C

FED. ROAD REGION NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	I 25-2(94)150	10	

REVISIONS

7-17-59	GENERAL - TYPE NO. 1	H.E.P.
10-27-59	NOTE ON TYPE NO. 1	E.E.O.
11-13-59	REV. TYPE NO. 3	E.E.O.

GENERAL NOTES

All work shall be done according to the Standard Specifications of the Colorado Department of Highways applicable to the Project.

All concrete for inlets and drains shall be Class "A".

All exposed corners shall be beveled to a 2" face.

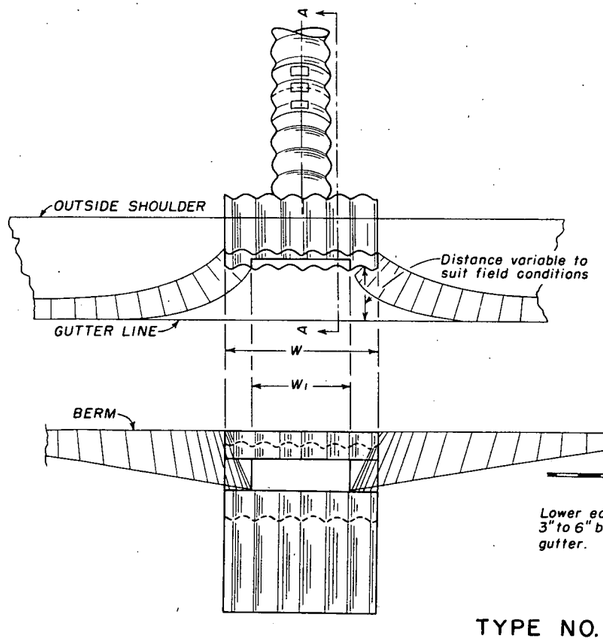
All construction joints shall be thoroughly cleaned before fresh concrete is poured.

All walls shall have forms on both sides.

Minimum grade of pipe shall be 1%.

For size and location of protectors, see List of Structures.

Footings in rock shall be poured out to the rock and not formed.

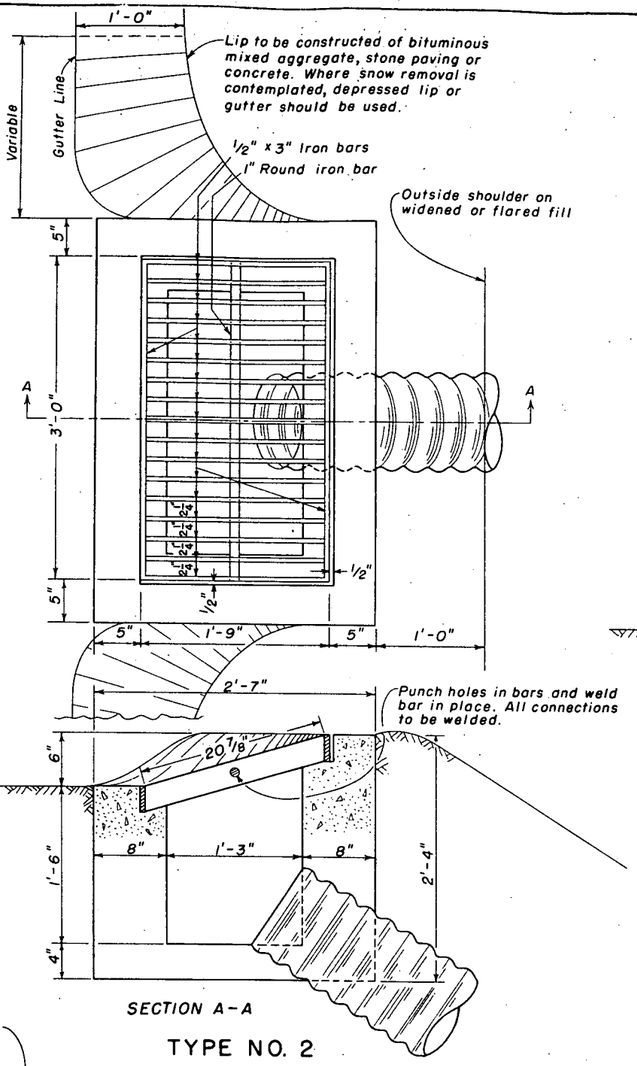


TYPE NO. 1

TABULATION OF DIMENSIONS

D	O	W	W1	▲ D1	H	H1
12"	6"	25 1/2"	16 1/2"	8"	3"	16"
18"	9"	49 1/2"	37 1/2"	10"	3"	18"
24"	12"	49 1/2"	37 1/2"	12"	4"	20"

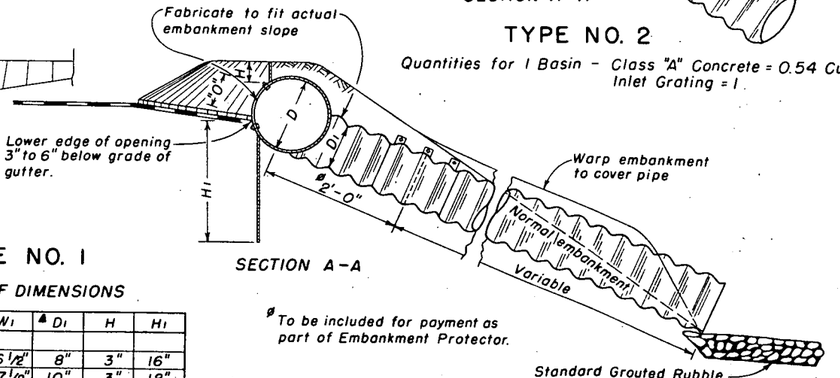
▲ Size to be designated by diameter of outlet.



SECTION A-A

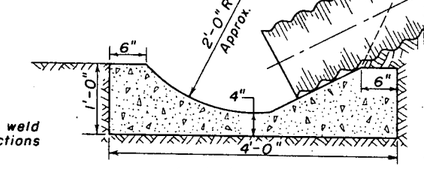
TYPE NO. 2

Quantities for 1 Basin - Class "A" Concrete = 0.54 Cu. Yds.
Inlet Grating = 1

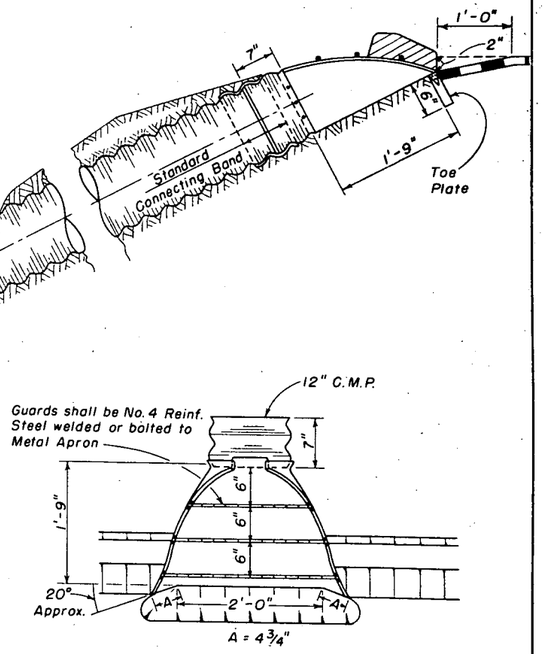


SECTION A-A

ø To be included for payment as part of Embankment Protector.



4' x 4' x 1' Concrete Apron
Where required on plans
Class "A" Concrete = 0.40 Cu. Yd.



If Protector is located in a sag vertical, depress gutter at inlet to allow for flow from both directions.

TYPE NO. 3

COLORADO
DEPARTMENT OF HIGHWAYS

STANDARD EMBANKMENT PROTECTORS

Designed by		Approved by	
Made by	T.E.F.		C. Dubson
Checked by	E.E.O.	Date:	November 1959

STANDARD M-13-C

STANDARD TIMBER GUARD POSTS

STANDARD M-19-E

FED. ROAD REGION NO.	DIVISION	SHEET NO.	TOTAL SHEETS
9	COLO.	525-2(04) 150 11	

REVISIONS

10-9-58	Added Spacing Table	J.C.R.

SPECIFICATIONS

(Work By Contractor)

POSTS- *Lodgepole Pine, Southern Yellow Pine or West Coast Douglas Fir, not less than six (6) inches in diameter. All posts shall be pressure treated with Pentachlorophenol as provided under paragraph 42.2.20 of the specifications, after being peeled and shaved in accordance with specifications.*

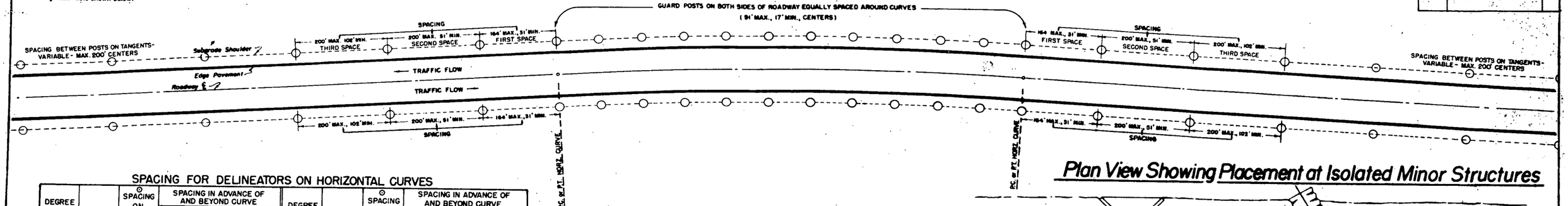
PAINTING- *Posts shall be painted with aluminum paint and a black band placed around each post as per details on this sheet. Number of coats and type of paint applied shall be in accordance with specifications.*

(Work By State Forces)

REFLECTIVE SHEETING- *In accordance with the details hereon, State Forces will furnish and place the required 2"x 6" smooth surfaced reflective delineators fabricated from 3s - H14 aluminum alloy, minimum thickness 0.025", reflectorized with reflective sheeting strips or other approved reflective materials. Strips shall be suitable for placement around a curved surface.*

Typical Installation on Curves & Tangents

INSTALLATION of guard posts on curves shall be in accordance with details shown below. Spacing shall be in conformity with table shown below.



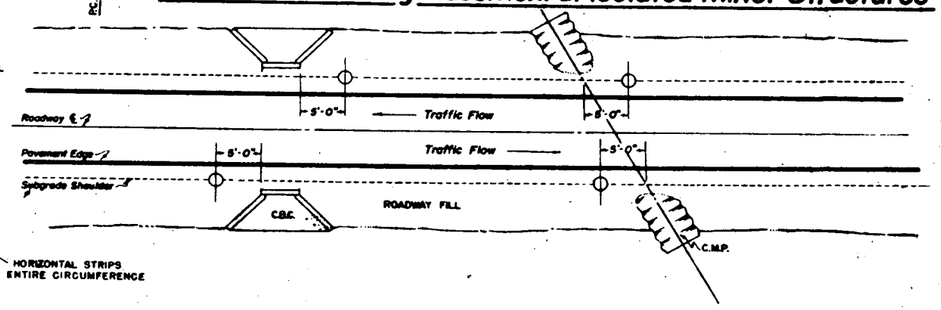
SPACING FOR DELINEATORS ON HORIZONTAL CURVES

DEGREE OF CURVE	RADIUS	⊙ SPACING ON CURVE	SPACING IN ADVANCE OF AND BEYOND CURVE			DEGREE OF CURVE	RADIUS	⊙ SPACING ON CURVE	SPACING IN ADVANCE OF AND BEYOND CURVE		
			FIRST SPACE	SECOND SPACE	THIRD SPACE				FIRST SPACE	SECOND SPACE	THIRD SPACE
		FEET	FEET	FEET	FEET			FEET	FEET	FEET	FEET
0°30'	11460.0'	129	200	200	200	8°00'	716.3'	33	59	99	198
1°00'	5730.0'	91	164	200	200	8°30'	674.1'	32	58	96	192
1°30'	3820.0'	74	133	200	200	9°00'	636.7'	31	56	93	186
2°00'	2865.0'	64	115	192	200	9°30'	603.2'	30	54	90	180
2°30'	2292.0'	58	104	174	200	10°00'	573.0'	29	52	87	174
3°00'	1910.0'	53	95	159	200	10°30'	545.7'	28	50	84	168
3°30'	1637.1'	49	88	147	200	11°00'	520.9'	28	50	84	168
4°00'	1432.5'	46	83	138	200	11°30'	498.3'	27	49	81	162
4°30'	1273.3'	43	77	129	200	12°00'	477.5'	27	49	81	162
5°00'	1146.0'	41	75	123	200	15°00'	382.0'	24	43	72	144
5°30'	1041.8'	39	70	117	200	18°00'	318.3'	22	40	66	132
6°00'	955.0'	37	67	111	200	21°00'	272.9'	20	36	60	120
6°30'	881.5'	36	65	108	200	25°00'	229.2'	19	34	57	114
7°00'	818.6'	35	63	105	200	30°00'	191.0'	17	31	51	102
7°30'	764.0'	34	61	102	200						

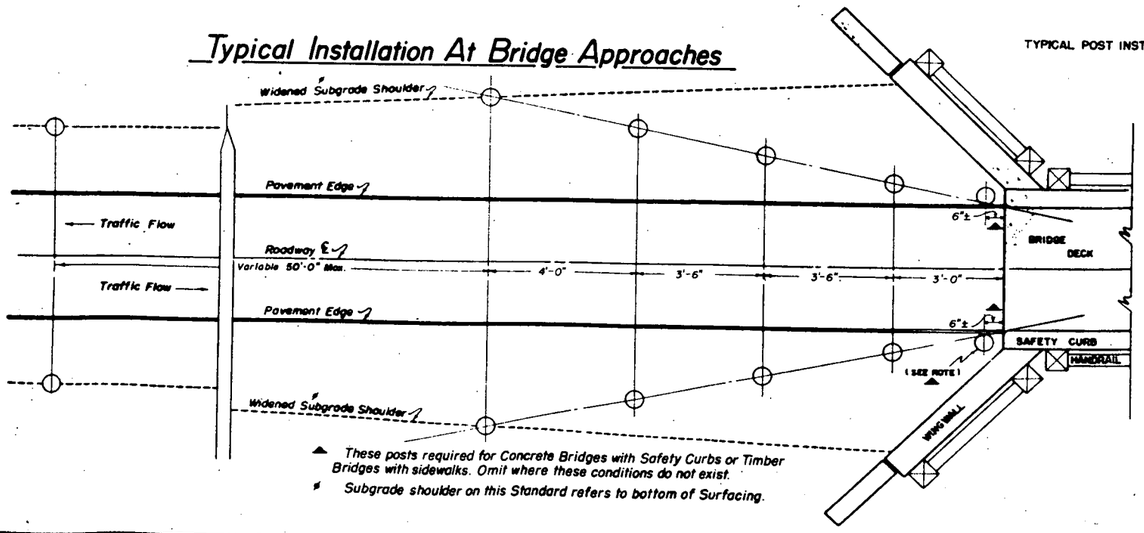
⊙ $S = 1.2\sqrt{R+18}$ 1-ST. SPACE = 1.8S 2-ND. SPACE = 3S 3-RD. SPACE = 6S

NO SPACES TO EXCEED 200 FT.

Plan View Showing Placement at Isolated Minor Structures

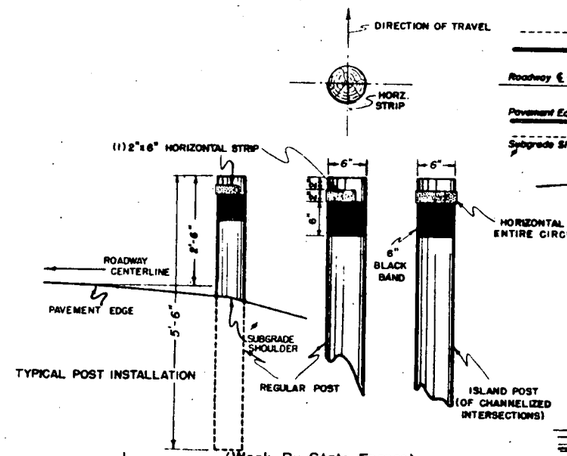


Typical Installation At Bridge Approaches



▲ *These posts required for Concrete Bridges with Safety Curbs or Timber Bridges with sidewalks. Omit where these conditions do not exist.*

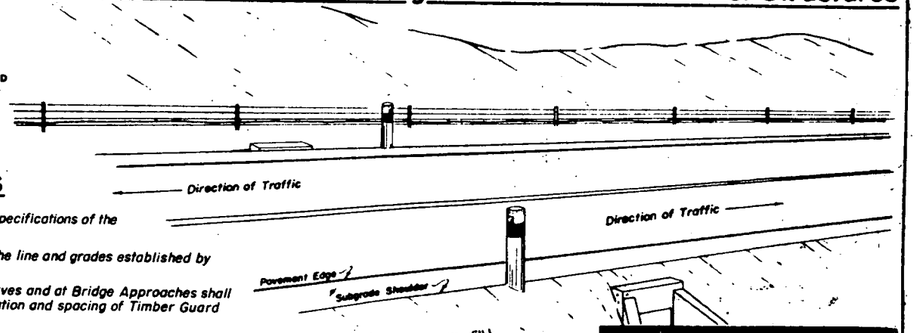
℄ *Subgrade shoulder on this Standard refers to bottom of Surfacing.*



(Work By State Forces)

INSTALLATION DETAILS OF REFLECTORIZED STRIPS

Pictorial View Showing Location at Isolated Minor Structures



GENERAL NOTES

(Work By Contractor)

All work shall be done in accordance with the Standard Specifications of the Colorado Department of Highways applicable to the project.

All posts shall be set and tamped in, plumb and firm, to the line and grades established by the Engineer.

INSTALLATION of Timber Guard Posts on Tangents, Curves and at Bridge Approaches shall be in conformity with details on this sheet. The number, location and spacing of Timber Guard Posts is shown on plans.

(Work By State Forces)

Reflective delineators shall be furnished and installed by State Forces after the Contractor has finished his operations.

Installation of reflective delineators shall be in accordance with the following: Wrap Around Reflective Sheeting Strips shall be installed horizontally one (1) sheet on all posts. Island posts shall have Wrap Around Reflective Sheeting Strips placed horizontally to cover entire circumference of Post.

On Divided Highways and Islands, Reflective Sheeting Strips shall be placed in a manner to obtain maximum visibility for the primary direction of travel. In all instances tests shall be made to insure the maximum effectiveness of reflective delineators.

All Traffic Islands shall be marked with Island Posts as indicated hereon.

COLORADO DEPARTMENT OF HIGHWAYS

STANDARD TIMBER GUARD POSTS

Designed by	Approved by C. Julian
Made by	Engineer, Survey & Plans
Checked by	Date: March 25, 1953

COLO. DEPT. OF HIGHWAYS
FORM C.D.H. 127
MAR. 1953

STANDARD ROADWAY CONSTRUCTION TRAFFIC SIGNS

STANDARD M-29-C
(SHEET 1 OF 2 SHEETS)

FED. ROAD REG. NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	[redacted]	150 12	

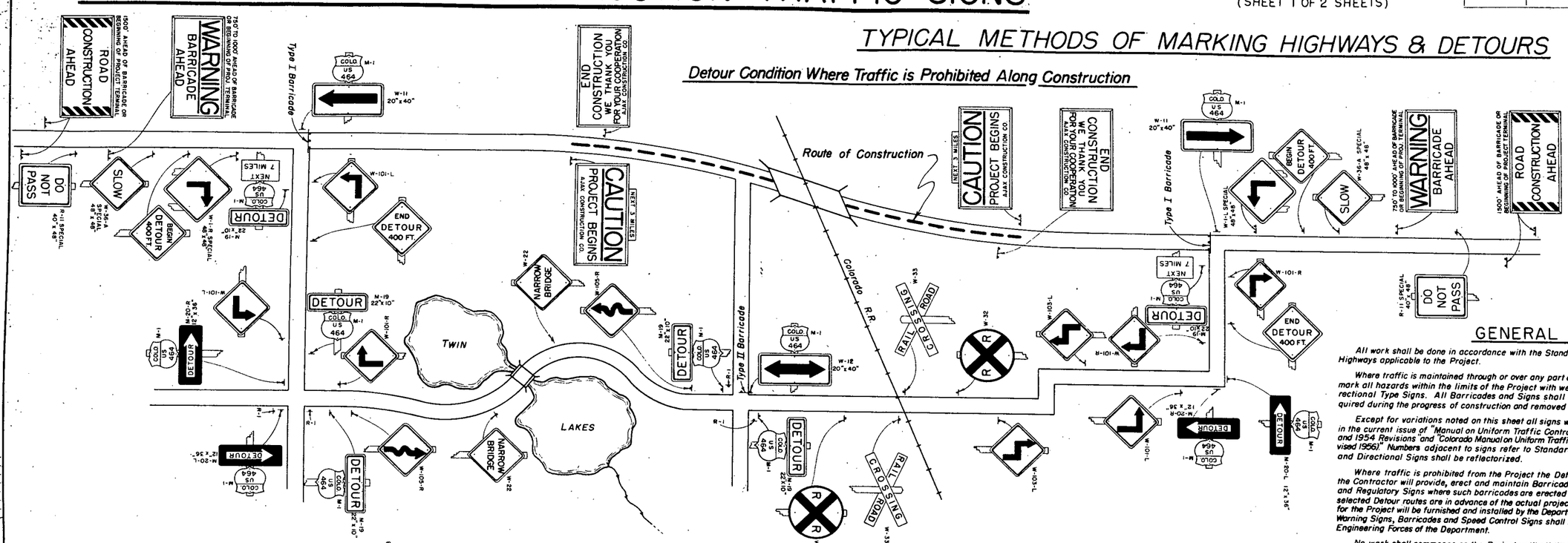
REVISIONS

10-23-58	General	J.C.R.

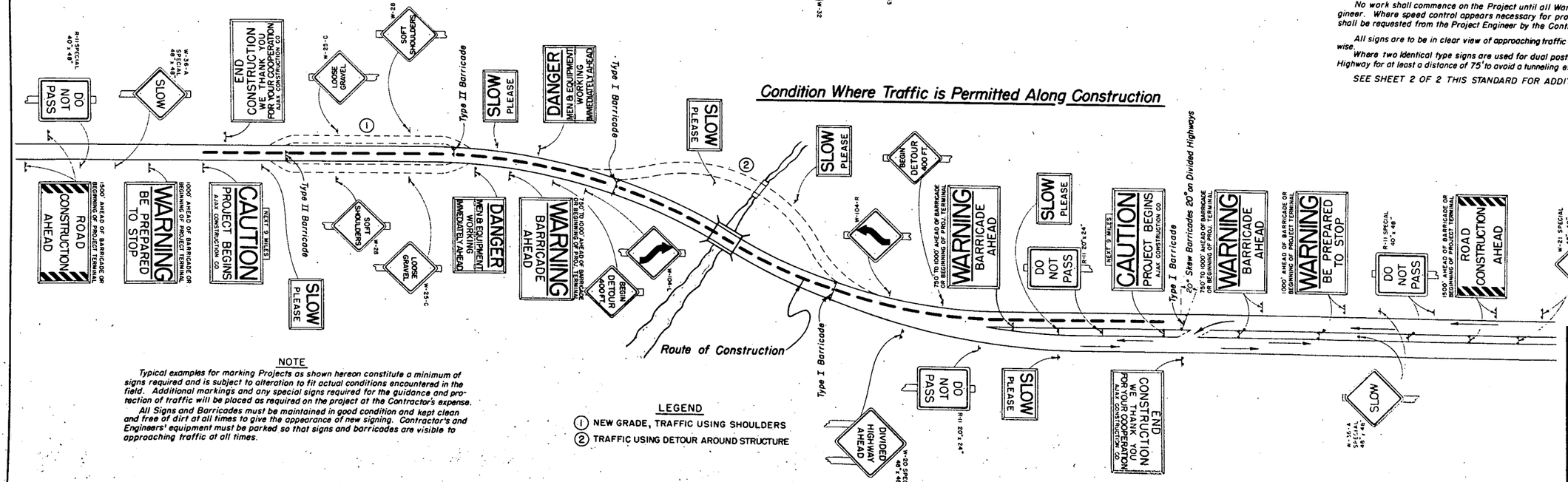
	Initial	Date
Designed By		
Checked By		
Drawn By		
Checked By		
Traced By		
Quantities By		

TYPICAL METHODS OF MARKING HIGHWAYS & DETOURS

Detour Condition Where Traffic is Prohibited Along Construction



Condition Where Traffic is Permitted Along Construction



NOTE

Typical examples for marking Projects as shown hereon constitute a minimum of signs required and is subject to alteration to fit actual conditions encountered in the field. Additional markings and any special signs required for the guidance and protection of traffic will be placed as required on the project at the Contractor's expense.

All Signs and Barricades must be maintained in good condition and kept clean and free of dirt at all times to give the appearance of new signing. Contractor's and Engineers' equipment must be parked so that signs and barricades are visible to approaching traffic at all times.

LEGEND

(1) NEW GRADE, TRAFFIC USING SHOULDERS
(2) TRAFFIC USING DETOUR AROUND STRUCTURE

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications of the Colorado Department of Highways applicable to the Project.

Where traffic is maintained through or over any part of the Project, the Contractor will be required to mark all hazards within the limits of the Project with well maintained Barricades, Warning Signs and Directional Type Signs. All Barricades and Signs shall be moved, added to, changed or removed as required during the progress of construction and removed entirely when project is completed.

Except for variations noted on this sheet all signs will be in conformity with the specification outlined in the current issue of "Manual on Uniform Traffic Control Devices for Streets & Highways, PRA August 1948 and 1954 Revisions" and "Colorado Manual on Uniform Traffic Control Devices for Streets & Highways CDOH 1952 (Revised 1956)." Numbers adjacent to signs refer to Standards in the manual. Standard Warning, Regulatory and Directional Signs shall be reflectorized.

Where traffic is prohibited from the Project the Detour will be marked by the Department except that the Contractor will provide, erect and maintain Barricades complete with approved Directional Arrows and Regulatory Signs where such barricades are erected and maintained at the ends of the Project or where selected Detour routes are in advance of the actual project terminal. U.S. or State Route Markers required for the Project will be furnished and installed by the Department. The location and positioning of Advance Warning Signs, Barricades and Speed Control Signs shall be as recommended by the appropriate District Engineering Forces of the Department.

No work shall commence on the Project until all Warning Signs are in place and approved by the Engineer. Where speed control appears necessary for protection of the travelling public, such speed control shall be requested from the Project Engineer by the Contractor.

All signs are to be in clear view of approaching traffic and are not to be obstructed by equipment, weeds or otherwise.

Where two identical type signs are used for dual posting they are to be staggered on the two sides of the Highway for at least a distance of 75' to avoid a tunneling effect.

SEE SHEET 2 OF 2 THIS STANDARD FOR ADDITIONAL NOTES AND DETAILS.

COLORADO
DEPARTMENT OF HIGHWAYS

Standard Roadway Construction Traffic Signs

Designed by J.C.R.	Approved by A. Julian
Made by J.C.R.	Engineer, Surveys & Plans
Checked by	Date: July 22, 1955

JANUARY, 1952

STANDARD ROADWAY CONSTRUCTION TRAFFIC SIGNS

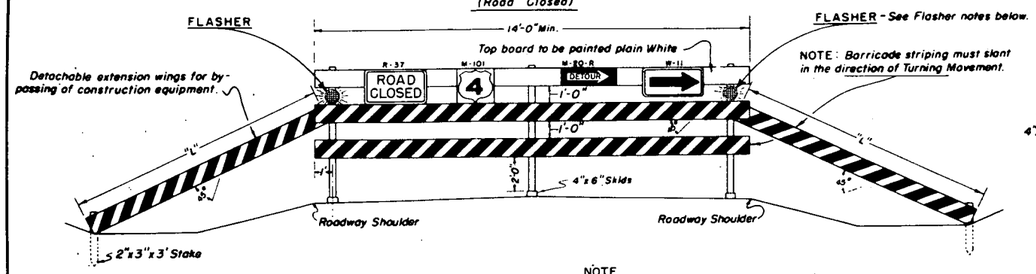
STANDARD M-29-C
(SHEET 2 OF 2 SHEETS)

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	F 25-2(44)15	13	

Rev. 10-23-58 by J.C.R.

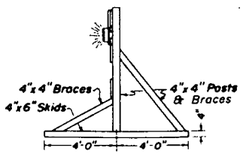
DETAILS OF BARRICADES

Type I
(Road Closed)



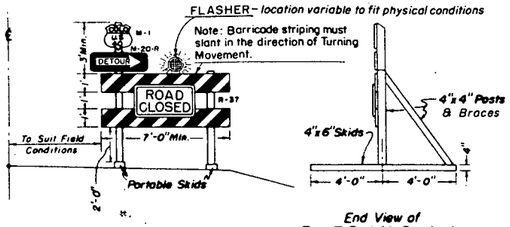
"L" Variable, length to be adequate to provide closing of borrow pit and shoulder.

NOTE
The various types & combinations of approved Signs and Beacons for Barricades required for each project will be governed by field conditions and subject to approval by the Engineer.



End View of
Type I Portable Barricade
(Optional)

Type II
(Beg. of Detour; By-Pass Areas within Proj; Extreme Hazards; etc.)



End View of
Type II Portable Barricade
(Optional)

NOTE: Alternate materials or other reflective elements on Construction Traffic Signs and Barricades will be permitted only after approval of such material by the Department.

SPECIFICATIONS

PAINT - *All paint and methods of painting shall be in conformity with the Standard Specifications of the Colorado Department of Highways for painting of Timber Structures.*

STRIPING - *Planking and Wings shall be painted with Maintenance Flat Black on both sides before adding any one of the following acceptable Reflective Strips:*
(a) Wide Angle White, 7" strip, spaced 9" apart.
(b) Flat Top Silver, 3" strip, spaced 7" apart.
▲(c) Direct Process of Glass Beads on Paint, 3" strip, spaced 7" apart.
Stripes shall be applied on both front and back of barricades for opposite direction use. Diversion of traffic will be accomplished as follows:
1- Stripes for barricades diverting traffic to the left shall start on the right hand side of the lower plank and progress up to the left. Traffic diversion to the right will be just the opposite.
2- Stripes on barricades diverting traffic in both directions shall begin at the center of the lower plank and progress up in both directions.

TIMBER - *All timber used shall conform to the Standard Specifications for Miscellaneous Untreated Timber.*

Planking	1"x12" or	2"x12" S4S
Posts (Barricades)		6"x6" S4S
Posts (Signs)		4"x4" S4S

The Reflectorized Stripes on planking & wings on all barricades shall be reflectorized with White or Silver Reflective Material of a type acceptable to the Department.

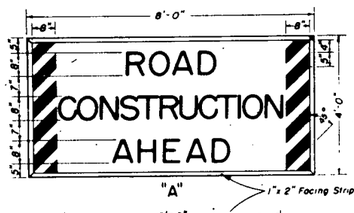
Barricades may be either portable as shown or fixed with posts set into the ground.

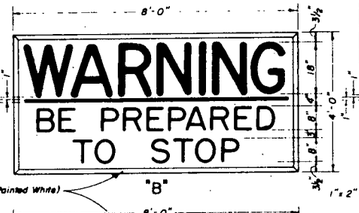
All skids, braces and posts to be painted white and nailed together with No. 20d nails.

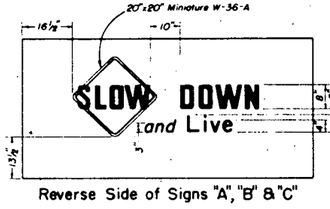
Bases to be weighted where necessary to provide stability.

▲ When this method is used as described above or when white binder and beads are applied to planking and wings, alternate black stripes using Maintenance Flat Black paint shall be applied over the reflective material in the prescribed pattern. All measurements for striping are to be made along the horizontal axis of the board.

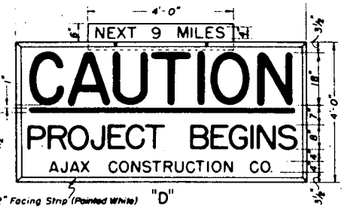
DETAILS OF CONSTRUCTION SIGNS



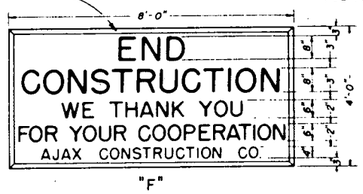


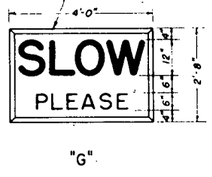


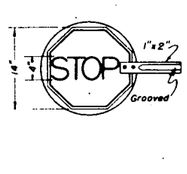
Reverse Side of Signs "A", "B" & "C"

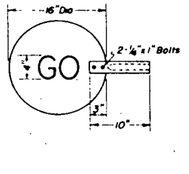


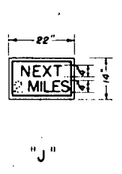
1"x 2" Facing Strip (Painted White) "D"











DETAILS OF SIGN AND BEACON FABRICATION AND USAGE

Construction Signs "A" through and including "G" shall be made of ¾" Plywood or other material after approval by the Department, and as per details above. Signs shall be reflectorized with reflective sheeting or other reflective materials of types approved by the Department.

CONSTRUCTION SIGN "A" - *Wide Angle White background with painted Black lettering. Barricade stripes of 4" Wide Angle White placed over Black painted vertical stripe spaced as shown above. This sign is the First advance warning sign and shall be placed 1500 feet ahead of barricade or beginning of project terminal and on both sides of the travelled way in all cases.*

CONSTRUCTION SIGN "B" - *Apply top 23" strip of Flat Top Silver, reversed screened or sprayed with Transparent Red Paint allowing the words "WARNING" and 1-inch Underline to remain as Flat Top Silver. Balance of lettering painted Black on a 22" strip of Wide Angle White. This sign is the Second advance warning sign and shall be placed 1000 feet ahead of barricade or beginning of project terminal and on both sides of the travelled way on divided highways and singly on two-lane highways.*

CONSTRUCTION SIGN "C" - *Apply top 23" strip of Flat Top Silver, reversed screened or sprayed with Transparent Red Paint allowing the words "WARNING" and 1-inch Underline to remain as Flat Top Silver. Balance of lettering painted Black on a 22" strip of Wide Angle White. This sign is the Third advance warning sign in cases where barricades are used and shall be placed 750 to 1000 feet ahead of barricade or beginning of project terminal and on both sides of the travelled way on divided highways and singly on two-lane highways.*

REVERSE SIDES OF SIGNS "A", "B" and "C" - *The word "SLOW" shall be painted Black and superimposed over a Yellow miniature W-36-A background panel. Balance of lettering shall be painted Black on a White background.*

CONSTRUCTION SIGN "D" - *Apply top 24½" strip of Flat Top Silver, reversed screened or sprayed with Transparent Red Paint allowing the words "CAUTION" and 1½-inch Underline to remain as Flat Top Silver. Balance of lettering painted Black on a 20½" strip of Wide Angle White. This sign will be provided with a detachable 1" material board mounted on back of sign with 2-½"x 2" bolts. This board shall be painted White with Black lettering. (Indicate to the nearest Mile). This sign shall be placed to mark the Beginning of the Project. To be placed singly and may be placed opposite barricade if desirable.*

CONSTRUCTION SIGN "E" - *Apply top 17½" strip of Flat Top Silver, reversed screened or sprayed with Transparent Red Paint allowing the words "DANGER" and 1-inch Underline to remain as Flat Top Silver. Balance of lettering painted Black on a 27½" strip of Wide Angle White. The sign is of the hinged and fold type to facilitate the closing down of sign when the need is not prevalent. This sign shall be placed 500 feet ahead of the situation on hand.*

CONSTRUCTION SIGN "F" - *The words "END CONSTRUCTION" and "CONTRACTORS NAME" shall be painted Black on strips 22" and 6½" respectively of Wide Angle White. For balance of lettering, apply 16½" strip of Flat Top Silver, reversed screened or sprayed with Transparent Red Paint allowing "WE THANK YOU FOR YOUR COOPERATION" remaining in Flat Top Silver. This sign shall be placed to mark the Ending of the Project. To be placed singly and may be placed opposite barricade if desirable.*

CONSTRUCTION SIGN "G" - *The words "SLOW" and "PLEASE" shall be painted Black on a background of Wide Angle Yellow. This sign shall be used frequently within the limits of the Project.*

All of the preceding signs shall be fastened to 2-4"x4" posts set 4 feet in the ground with a minimum of 3-1"x4" nailing strips on the back. Bottom of sign to be not less than 36" above the ground.

FLAGMAN WARNING SIGN "H" - *This sign shall be made of Plastic or other lightweight material, painted Red background with White lettering on the "STOP" side and painted Green background with White lettering on the "GO" side. Handle to be grooved on one side to indicate reading of sign to flagman. This sign will be used whenever flagmen are necessary. Sign to be reflectorized if used to stop traffic at night.*

DETOUR WARNING SIGN "I" - *To be of ⅜" (Min.) plywood or No. 16 (Min.) gauge metal with Black painted letters on a Wide Angle Yellow Background.*

CONSTRUCTION SIGN "J" - *⅜"x 9" metal slides to be placed between "NEXT ___ MILES" spaced so as to accommodate appropriate size numerals. Required numerals to be furnished by the Department and to be installed by the Contractor. Numerals calculated to the nearest Mile.*

All material shall be sound and durable. Barricades, signs, symbols and lettering conforming to styles noted hereon will be of good workmanship and well maintained. Uneven lettering will not be accepted.

FLARES AND TORCHES *shall be either of the oil burning or electrical type approved by the Department and shall be placed 3 feet to 5 feet ahead of the object to be illuminated. Particular care shall be taken to protect all signs and barricades from smoke and smudge arising from the use thereof.*

FLASHERS *used on Type I or II Barricade shall be of the Battery or Electrical Type and shall have no less than 12.566 sq. inches of light area (4" dia. lens). The illuminating element in a flashing amber beacon or signal shall be flashed continuously at a rate between 50 or 60 flashes per minute which will be clearly distinguishable to traffic. The duration in which Flashers will be left in operation will be governed by field conditions and subject to approval by the Engineer.*

Alternate methods of processing signs or the substitution of symbols or other reflecting elements for painted symbols will be permitted only after approval of such methods or materials by the Department.

The Department shall furnish and install the following as required OUTSIDE THE LIMITS *of the Project:*

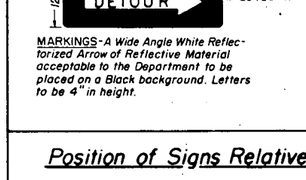
1.	"ROAD CONSTRUCTION AHEAD"	Minimum 4
2.	"CAUTION BE PREPARED TO STOP"	Minimum 2
3.	"WARNING BARRICADE AHEAD"	As Required
4. ■	Standard Warning & Directional Signs	As Required

The Contractor shall furnish and install the following as required WITHIN THE LIMITS *of the Project:*

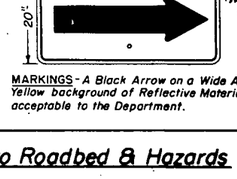
1.	All Barricades	As Required
2.	"CAUTION PROJECT BEGINS"	Minimum 2
3.	"DANGER MEN & EQUIPMENT WORKING IMMEDIATELY AHEAD"	As Required
4.	"END CONSTRUCTION WE THANK YOU FOR YOUR COOPERATION"	Minimum 2
5.	"SLOW PLEASE"	As Required
6.	Standard Warning & Directional Signs	As Required
7.	Approved Directional Arrows & Regulatory Signs for Barricades	As Required
8.	Torches and Flares as follows: Type I Barricade	Minimum 3
	Type II Barricade	Minimum 1
9.	Flashers - Type I Barricade	2 Required
	Type II Barricade	As Required

■ *Including Type I Barricade located immediately inside of Project terminal points.*

Details of Reflectorized Arrows

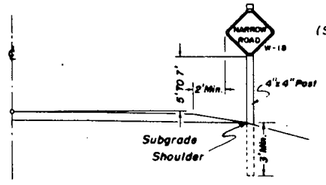


MARKINGS - *A Wide Angle White Reflectorized Arrow of Reflective Material acceptable to the Department to be placed on a Black background. Letters to be 4" in height.*



MARKINGS - *A Black Arrow on a Wide Angle Yellow background of Reflective Material acceptable to the Department.*

Position of Signs Relative to Roadbed & Hazards



NOTE:
Warning Signs to be made of 3/8" (Min.) plywood or No. 16 Gauge (Min.) metal and shall be reflectorized.
Location to be governed by field conditions. Exact location to be staked by the Engineer. In all cases warning signs are to be placed well in advance of hazard, the distance depending on topography, and existing approach speeds.

COLORADO DEPARTMENT OF HIGHWAYS

Standard Roadway Construction Traffic Signs

Designed by J.C.R.	Approved by J. Hutchins
Made by J.C.R.	Engineer, Surveys & Plans
Checked by	Date: July 22, 1955

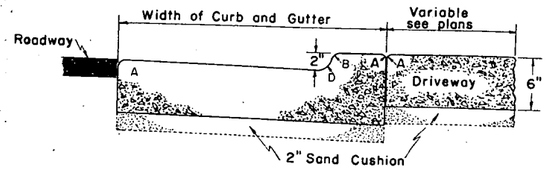
STANDARD CURBS AND GUTTERS

STANDARD M-45-A

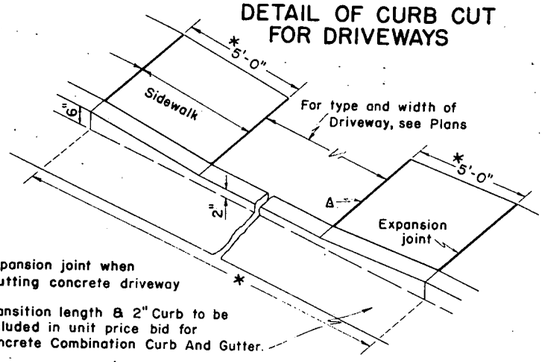
FED. ROAD REG. NO	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	I 25-2(47)150	14	

REVISIONS		
12-9-58	Curb Dimension	C.L.S.
3-26-59	Curb Dimension	J.C.R.

CONCRETE PAVEMENT (DRIVEWAYS)



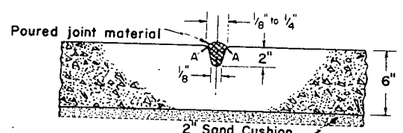
DETAIL OF CURB CUT FOR DRIVEWAYS



Δ Expansion joint when abutting concrete driveway

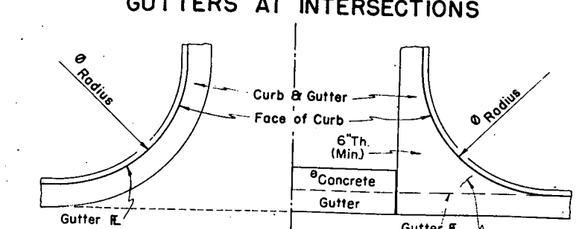
* Transition length & 2" Curb to be included in unit price bid for Concrete Combination Curb And Gutter.

TRANSVERSE WEAKENED PLANE JOINT FOR CONCRETE PAVEMENT (DRIVEWAYS)



This joint required where length of slab exceeds 20 feet.

CONSTRUCTION OF CONCRETE GUTTERS AT INTERSECTIONS



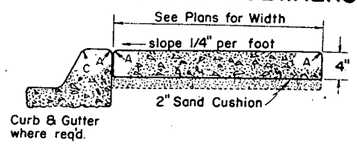
Ø Length of Radius as shown elsewhere on Plans.

Area to be included in unit price bid for Concrete Combination Curb And Gutter.

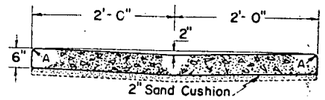
This section to be built when ØConcrete Gutter is not required.

This section to be built when ØConcrete Gutter is required.

CONCRETE SIDEWALKS

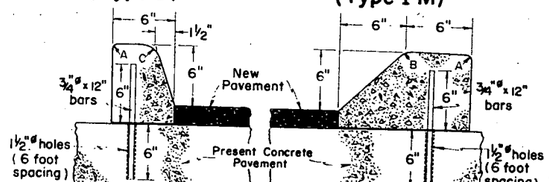


CONCRETE GUTTER



CONCRETE CURB (6" Barrier-Doweled) (Type I)

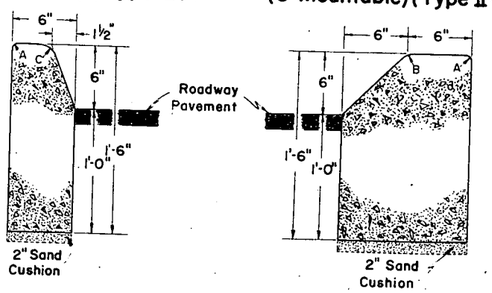
CONCRETE CURB (6" Mountable-Doweled) (Type I-M)



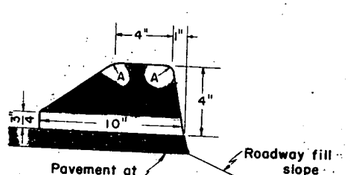
¾"ø x 12" reinforcing bars at 6 foot spacing. Cost of installation to be included in unit price bid for Curb. Bars to be grouted in 1½"ø holes in present concrete. Grout to consist of 2 parts clean sand and 1 part cement.

CONCRETE CURB (6" Barrier) (Type II)

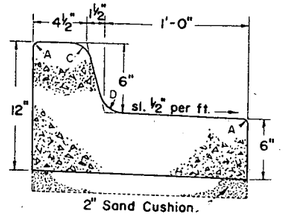
CONCRETE CURB (6" Mountable) (Type II-M)



ASPHALTIC SHOULDER ROLL

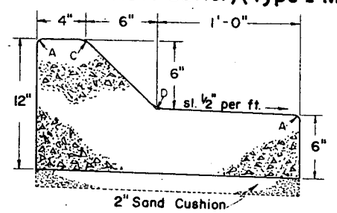


CONCRETE COMBINATION CURB AND GUTTER (6" Barrier-1' Gutter) (Type I)

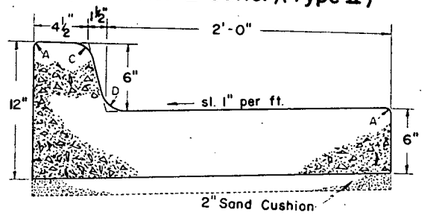


LEGEND FOR RADII	
A	= 1/8"
B	= 1"
C	= 1½"
D	= 1½" to 2"

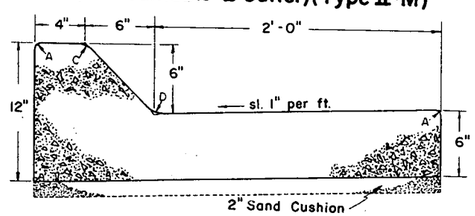
CONCRETE COMBINATION CURB AND GUTTER (6" Mountable-1' Gutter) (Type I-M)



CONCRETE COMBINATION CURB AND GUTTER (6" Barrier-2' Gutter) (Type II)



CONCRETE COMBINATION CURB AND GUTTER (6" Mountable-2' Gutter) (Type II-M)



GENERAL NOTES

All work shall done in accordance with the Specifications of the Colorado Department of Highways.

All Concrete used in the construction of concrete items on this sheet shall be Class "A" Concrete.

On Curves 3 degrees and sharper, Curbs and/or Gutters are to be placed on the Arc of the Curve unless otherwise noted on plans. A maximum chord length of 10 feet may be used when the degree of curve is less than 3 degrees.

Sand Cushion to be used only when called for on Plans.

At locations where in-place concrete pavement has been overlayed with asphalt, the asphalt shall be removed before placement of Doweled-type Curb.

COLORADO
DEPARTMENT OF HIGHWAYS

STANDARD

CURBS AND GUTTERS

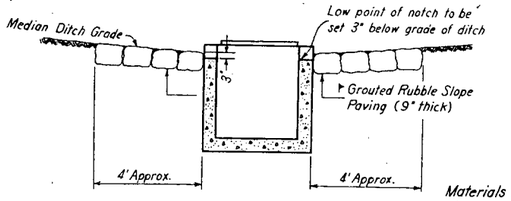
Designed by	Approved by
Made by	

REVISIONS

STANDARD M-46-B

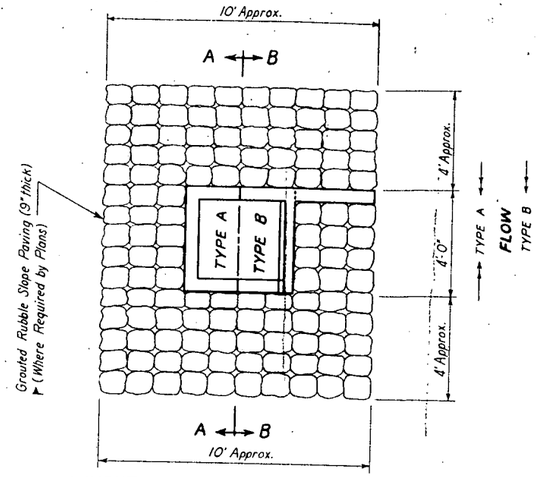
FED. ROAD REGION NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	L 25-2 (9)	150 15	

TYPE A
FOR USE AT BOTTOM OF VERTICAL CURVE

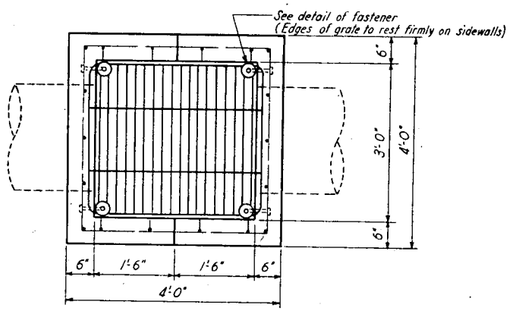


SECT. "A-A"

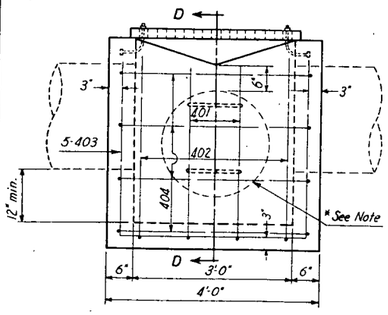
Materials used in the construction of Inlet gratings shall meet with the requirements of Item 48, Structural Steel, in the Standard Specifications.



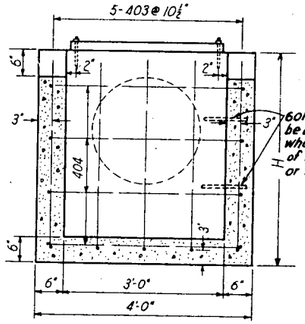
LAYOUT OF INLET IN MEDIAN DITCH



PLAN

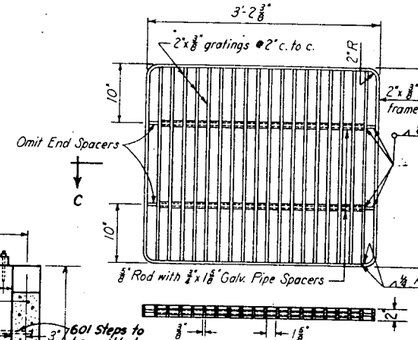


FRONT ELEV.

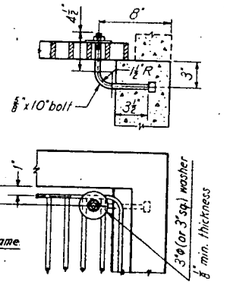


SECT. "D-D"

* Note for Longitudinal Pipe: 6" minimum between bottom of Inlet Opening and top of Longitudinal Pipe.



SECT. "C-C"



DETAIL OF FASTENER
4 REQ'D FOR EACH INLET

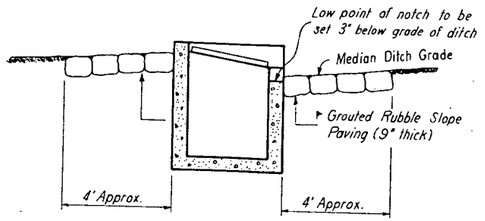
* DETAIL OF GRATING

MATERIAL LIST FOR GRATING AND FASTENERS.

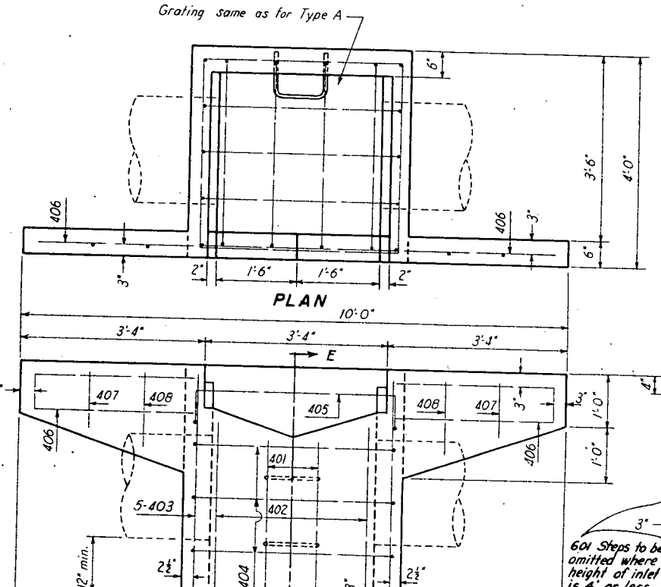
Strap Iron Frame	1 pc.	2"x⅜"x11'-9 5/16"	@ 2.55 lb. per ft.	= 30.0 lb.
Strap Iron Gratings	18 pcs.	2"x⅜"x 2'-9⅛"	@ 2.55 lb. per ft.	= 127.2 lb.
Galv. Iron Pipe Spacers	34 pcs.	¾"x 1⅜"	@ 1.13 lb. per ft.	= 5.2 lb.
Tie Rods	2 pcs.	⅝"x 3'-1⅝"	@ 1.04 lb. per ft.	= 6.5 lb.
Bolts	4 pcs.	⅝"x10"	@ 1.03 lb. ea.	= 4.1 lb.
Washers	4 pcs.		@ 0.23 lb ea.	= 0.9 lb.

* Note: Acceptable equivalent Gratings maybe substituted after approval by the Engineer.

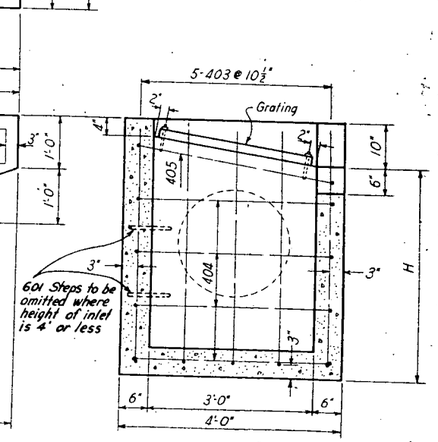
TYPE B
FLOW FROM ONE DIRECTION



SECT. "B-B"



FRONT ELEV.



SECT. "E-E"

QUANTITIES FOR ONE INLET

H	CLASS "A" CONCRETE ▲ CU. YDS.		REINFORCING STEEL ⊙ LBS.	
	TYPE A	TYPE B	TYPE A	TYPE B
3'-6"	1.05	1.36	98	127
4'-0"	1.18	1.49	104	133
4'-6"	1.31	1.62	115	143
5'-0"	1.44	1.75	135	163
5'-6"	1.56	1.88	141	169
6'-0"	1.69	2.01	158	185
6'-6"	1.82	2.13	168	195
7'-0"	1.95	2.26	184	212
7'-6"	2.08	2.39	190	218
8'-0"	2.21	2.52	211	238
8'-6"	2.34	2.65	217	244
9'-0"	2.47	2.78	233	261
9'-6"	2.60	2.91	243	270
10'-0"	2.73	3.04	259	287
10'-6"	2.86	3.17	265	293
11'-0"	2.99	3.30	286	313
11'-6"	3.12	3.43	292	320
12'-0"	3.25	3.56	308	336

⊙ Includes 1½% for overrun

▲ Volume occupied by pipes to be deducted for pay quantity of concrete

SIZE	C.M.P.	CONCRETE PIPE
18"	0.03 Cu.Yd./pipe	0.05 Cu.Yd./pipe
24"	0.06 " "	0.09 " "
30"	0.09 " "	0.14 " "
36"	0.13 " "	0.20 " "

BAR LIST FOR H = 4'-0"

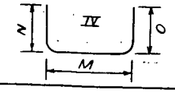
PC. JVG

MARK	NO. REQD	KIND	TYPE A DIMENSIONS M	N	O	LENGTH	TYPE B DIMENSIONS M	N	O	LENGTH
401	2	I	3'-5"	3'-3" ◆	3'-3" ◆	9'-10"	3'-5"	3'-3" ◆	4'-5" ◆	11'-0"
402	2	I	3'-5"	3'-6" ◆	3'-6" ◆	10'-4"	3'-5"	3'-6" ◆	4'-5" ◆	11'-3"
403	5	I	3'-6"	3'-7" ◆	3'-7" ◆	10'-7"	3'-7"	4'-5" ◆	4'-5" ◆	12'-4"
404	4 ◆	II	3'-7"	3'-7"		15'-4"	3'-8"	3'-6"		15'-4"
405	1	I					3'-8"	3'-7"	3'-7"	10'-9"
406	2	I					0'-8"	2'-10"	2'-10"	6'-3"
407	2	Str.								1'-1"
408	2	Str.								1'-5"
601	1	IV	1'-0"	0'-10"	0'-10"	2'-6"	1'-0"	0'-10"	0'-10"	2'-6"

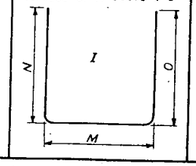
All reinforcing bars to be ½" ◆.

▲ BENDING DIAGRAMS (SAME FOR TYPES A & B)
All dimensions out to out of bars

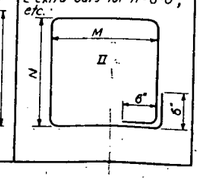
Steps 601 required as follows:
H = 4'-6" - 1 step
H = 5'-0" 5'-6" & 6'-0" - 2 steps
H = 6'-6" 7'-0" & 7'-6" - 3 steps
H = 8'-0" 8'-6" & 9'-0" - 4 steps
H = 9'-6" 10'-0" & 10'-6" - 5 steps
H = 11'-0" 11'-6" & 12'-0" - 6 steps



◆ Note for 401, 402 & 403 bars. Increase dimensions N & O 6" for each additional 6" increase of H above 4'-0"



◆ Note for 404 bar. Dimensions to remain constant. Add 1 extra bar for H = 5'-0", & 2 extra bars for H = 6'-0", etc.



▲ Note: Cut or bend bars to fit around pipes as required

GENERAL NOTES

All work shall be done according to the Standard Specifications of the Colorado Department of Highways applicable to the project.
All concrete shall be Class "A" and air entrained as specified.
All walls shall have forms on both sides. Bevel all exposed corners to a 1" face.
All reinforcing bars shall be deformed, of intermediate grade, and shall be tagged with the station number and bar designation.
All reinforcing steel bars shall conform to ASTM specification A305-50T or latest revision thereof.
All edge distances not marked clear are to the ℄ of the bar.
Inlet grating to be painted as per specifications for structural steel. One Shop Coat of Zinc Chromate primer and two field coats of Aluminum.

	Initial	Date
...ed By		
...ed By		
...By	PC	2-15-52
...ed By		
...By	PC	2-26-52
...By	JVG	2-29-52

COLORADO DEPARTMENT OF HIGHWAYS

TYPES A & B CONCRETE INLETS FOR MEDIAN DITCH

18", 24", 30" and 36" CULVERTS

Designed by W. McL. Approved by C. J. Bartley
Made by PC. Bridge Engineer

STANDARD M-50-B

Use in conjunction with Standard M-50-BW

FED. ROAD REG. NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	125-2(44) 150	16	

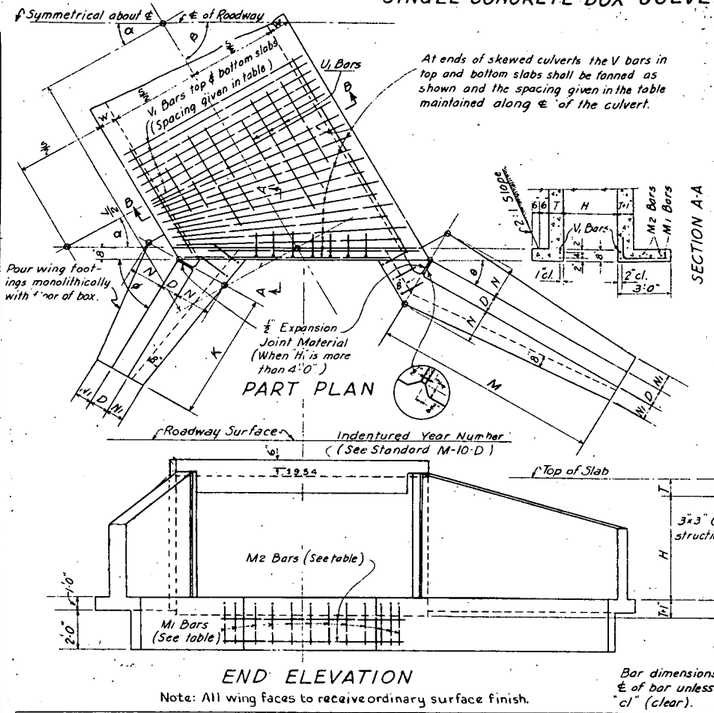
SINGLE CONCRETE BOX CULVERT

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

Height of Fill Allowed	Type	Span S	Height H	Slab T	Wall W	Bar size & spacing V1 Size	Spa.	W1 Size	Spa.	No. bars required U1	M1	Quantities For One Lin. Ft. of Box Concrete Cu Yds.	Steel Lbs.	Quantities for Two Headwalls Concrete Cu Yds	Steel Lbs.
35'-0"	2A	2'-0"	2'-0"	6"	8"	3/4"	12"	1/2"	12"	8	8	0.232	17.5	1.30	81
30'-0"	3A	3'-0"	2'-0"	7"	8"	7/8"	12"	1/2"	12"	10	10	0.299	26.3	1.50	113
			3'-0"							12	Cos α	0.329	29.0	1.65	123
20'-0"	4A	4'-0"	2'-0"	7 1/2"	8"	7/8"	12"	1/2"	12"	12	10	0.362	31.8	1.75	150
			3'-0"							14	Cos α	0.412	34.6	1.90	154
			4'-0"							16		0.461	37.3	2.10	158
16'-0"	5A	5'-0"	2'-0"	8"	8"	3/4"	8"	1/2"	8"	16	12	0.481	45.3	2.20	153
			4'-0"							18	Cos α	0.530	48.7	2.40	157
			5'-0"							20		0.579	52.0	2.60	161
20'-0"	5B	5'-0"	3'-0"	8 1/2"	8"	3/4"	8"	1/2"	8"	16	12	0.500	45.5	2.20	153
			4'-0"							18	Cos α	0.549	48.8	2.40	157
			5'-0"							20		0.598	52.1	2.60	161
			4'-0"							20		0.605	54.7	2.65	180
14'-0"	6A	6'-0"	5'-0"	8 1/2"	8"	3/4"	8"	1/2"	8"	22	14	0.654	58.1	2.85	184
			6'-0"							24	Cos α	0.704	61.4	3.00	188
			7'-0"							26		0.753	64.9	3.30	192
20'-0"	6B	6'-0"	4'-0"	10"	8"	7/8"	8"	5/8"	8"	20	14	0.671	72.4	2.70	223
			5'-0"							22	Cos α	0.720	76.9	2.90	228
			6'-0"							24		0.771	81.4	3.10	234
			7'-0"							26		0.820	85.9	3.35	239
			4'-0"							22		0.720	68.2	3.05	208
12'-0"	7A	7'-0"	5'-0"	9"	9"	3/4"	7"	1/2"	7"	24	16	0.776	71.9	3.25	212
			6'-0"							26	Cos α	0.832	75.5	3.40	216
			7'-0"							28		0.887	79.2	3.70	220
			4'-0"							22		0.772	81.0	3.05	257
15'-0"	7B	7'-0"	5'-0"	10"	9"	7/8"	8"	5/8"	8"	24	16	0.827	85.5	3.25	262
			6'-0"							26	Cos α	0.883	90.0	3.45	268
			7'-0"							28		0.938	94.5	3.75	273
			4'-0"							22		0.826	91.1	3.10	257
20'-0"	7C	7'-0"	5'-0"	11"	9"	7/8"	7"	5/8"	7"	24	16	0.881	96.0	3.30	263
			6'-0"							26	Cos α	0.937	101.0	3.50	268
			7'-0"							28		0.993	106.0	3.75	274
			4'-0"							24		0.844	75.8	3.40	235
			5'-0"							26	18	0.905	79.5	3.60	239
10'-0"	8A	8'-0"	6'-0"	9 1/2"	10"	3/4"	7"	1/2"	7"	28	Cos α	0.966	83.2	3.80	245
			7'-0"							30		1.027	86.8	4.10	247
			8'-0"							32		1.089	90.5	4.40	251
			4'-0"							24		0.963	100.2	3.50	292
			5'-0"							26	18	1.025	105.9	3.70	297
16'-0"	8B	8'-0"	6'-0"	11 1/2"	10"	7/8"	7"	5/8"	7"	28	Cos α	1.086	110.8	3.90	303
			7'-0"							30		1.148	115.8	4.20	308
			8'-0"							32		1.210	120.8	4.45	314
			4'-0"							24		1.023	115.8	3.55	292
			5'-0"							26	18	1.084	121.4	3.75	298
20'-0"	8C	8'-0"	6'-0"	12 1/2"	10"	7/8"	6"	5/8"	6"	28	Cos α	1.146	126.2	3.95	304
			7'-0"							30		1.208	132.5	4.25	309
			8'-0"							32		1.270	138.1	4.50	315
			5'-0"							28		1.040	102.7	4.00	326
			6'-0"							30	20	1.108	107.1	4.20	331
7'-0"	9A	9'-0"	7'-0"	10"	11"	7/8"	8"	5/8"	8"	32	Cos α	1.176	111.6	4.50	337
			8'-0"							34		1.244	116.1	4.80	342
			9'-0"							36		1.311	120.7	5.15	348
			5'-0"							28		1.174	131.9	4.10	327
			6'-0"							30	20	1.242	137.5	4.30	333
14'-0"	9B	9'-0"	7'-0"	12"	11"	7/8"	6"	5/8"	6"	32	Cos α	1.310	143.1	4.60	338
			8'-0"							34		1.378	148.6	4.90	344
			9'-0"							36		1.445	154.2	5.25	349
			5'-0"							28		1.309	150.4	4.20	407
			6'-0"							30	20	1.377	156.9	4.40	408
20'-0"	9C	9'-0"	7'-0"	14"	11"	1"	7"	3/4"	7"	32	Cos α	1.444	163.4	4.70	416
			8'-0"							34		1.513	170.0	5.00	423
			9'-0"							36		1.581	176.6	5.35	430
			6'-0"							32		1.260	107.7	4.60	355
			7'-0"							34	22	1.334	111.0	4.90	358
5'-0"	10A	10'-0"	8'-0"	10 1/2"	12"	7/8"	8"	1/2"	8"	36	Cos α	1.408	114.4	5.20	363
			9'-0"							38		1.483	117.8	5.60	367
			10'-0"							40		1.558	121.1	5.95	371
			6'-0"							32		1.369	130.4	4.70	367
			7'-0"							34	22	1.443	135.4	5.00	372
			8'-0"							36	Cos α	1.517	140.4	5.30	378
			9'-0"							38		1.591	145.3	5.65	383
			10'-0"							40		1.665	150.3	6.05	388
			6'-0"							32		1.518	150.7	4.80	449
			7'-0"							34	22	1.593	156.6	5.10	456
10'-0"	10B	10'-0"	8'-0"	12"	12"	7/8"	7"	5/8"	7"	36	Cos α	1.666	162.5	5.40	464
			9'-0"							38		1.741	168.4	5.80	471
			10'-0"							40		1.815	174.3	6.15	478
			6'-0"							34		1.367	178.6	4.95	383
			7'-0"							36	24	1.441	182.7	5.25	387
5'-0"	11A	11'-0"	8'-0"	11"	12"	7/8"	7"	1/2"	7"	38	Cos α	1.515	186.9	5.55	391
			9'-0"							40		1.589	191.0	5.90	395
			10'-0"							42		1.664	195.1	6.25	399
			6'-0"							34		1.490	204.3	5.00	467
			7'-0"							36	24	1.564	212.8	5.30	472
9'-0"	11B	11'-0"	8'-0"	12 1/2"	12"	1"	8"	5/8"	8"	38	Cos α	1.638	217.3	5.65	478
			9'-0"							40		1.712	221.8	6.00	483
			10'-0"							42		1.787	226.4	6.35	489
			7'-0"							36		1.682	165.1	5.40	401
			8'-0"							38	24	1.756	170.7	5.70	407
13'-0"	11C	11'-0"	9'-0"	14"	12"	7/8"	6"	5/8"	6"	40	Cos α	1.830	176.2	6.10	413
			10'-0"							42		1.904	181.8	6.45	418
			6'-0"							36		1.525	173.4	5.25	411
			7'-0"							38	26	1.599	141.0	5.60	415
			8'-0"							40	Cos α	1.673	144.7	5.90	419
5'-0"	12A	12'-0"	9'-0"	12"	12"	7/8"	7"	1/2"	7"	42		1.747	148.4	6.25	423
			10'-0"							44		1.821	152.0	6.60	427
			6'-0"							34		1.697	177.7	5.40	502
			7'-0"							36	26	1.772	182.7	5.70	508
			8'-0"							38	Cos α	1.846	187.7	6.00	513
10'-0"	12B	12'-0"	9'-0"	14"	12"	1"	7"	5/8"	7"	40		1.920	192.6	6.40	519
			10'-0"							42		1.994	197.6	6.70	524
			6'-0"							38		1.645	146.0	5.60	442
			7'-0"							40	28	1.720	149.1	5.90	446
4'-0"	13A	13'-0"	8'-0"	12 1/2"	12"	7/8"	7"	1/2"	7"	42	Cos α	1.794	153.3	6.20	450
			9'-0"							44		1.868	157.0	6.55	454
			10'-0"							46		1.942	160.7	6.95	458
			6'-0"							38		1.787	188.4	5.70	538
			7'-0"							40	28	1.861	193.5	6.00	543
8'-0"	13B	13'-0"	8'-0"	14"	12"	1"	7"	5/8"	7"	42	Cos α	1.935	198.3	6.30	549
			9'-0"							44		2.009	203.3	6.65	555
			10'-0"							46		2.083	208.2	7.05	560
			6'-0"							40		1.827	177.2	5.95	571
			7'-0"							42	30	1.901	181.7	6.25	577
4'-0"	14A	14'-0"	8'-0"	13 1/2"	12"	1"	8"	5/8"	8"	44	Cos α	1.975	186.2	6.55	582
			9'-0"							46		2.049	190.7	6.95	588
			10'-0"							48		2.123	195.2	7.30	593
			6'-0"							40		1.975	199.5	6.05	572
			7'-0"							42	30	2.049	204.5	6.40	578
8'-0"	14B	14'-0"	8'-0"	15"	12"	1"	7"	5/8"	7"	44	Cos α	2.123	209.4	6.70	583
			9'-0"							46		2.198	214.4	7.05	589
			10'-0"							48		2.270	219.4	7.40	595

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

Note: This design not to be used when height of fill exceeds the allowed amount tabulated.



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

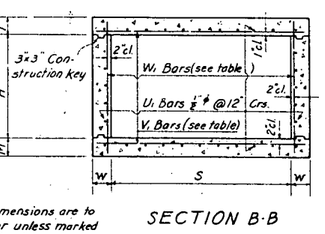
Mark	Size	No. Req'd.	Type	Length
V1	See table	10+ 24L/Spa.	I	S+2W-6
W1	See table	6+ 24L/Spa.	I	H+2T-5
U1	1/2" #	See table	I	L+1'-0"
M1	1/2" #	See table	II	3'-6"
M2	1/2" #	4	I	S+2W-6 / Cos α

Straight — Type I; 2'-6", 1'-0" — Type II

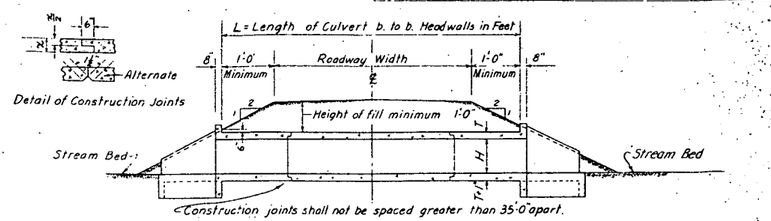
(Bar dimensions are out to out of bar)

Possible Combinations (Span & Height)

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



Bar dimensions are to ℄ of bar unless marked "cl" (clear).



TYPICAL SECTION THROUGH CULVERT

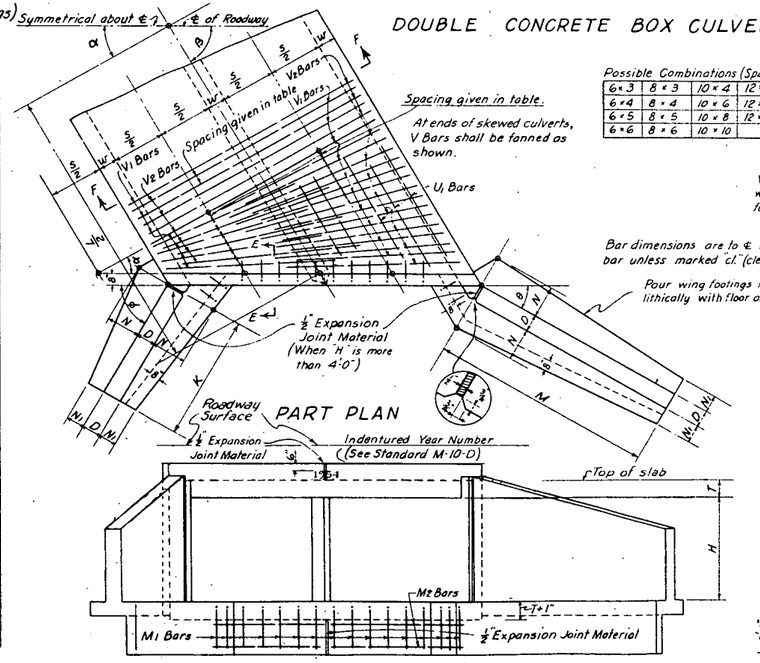
Note: K, M, N, N1 and D are dimensioned on Standard M-50-BW for the various heights of culverts.

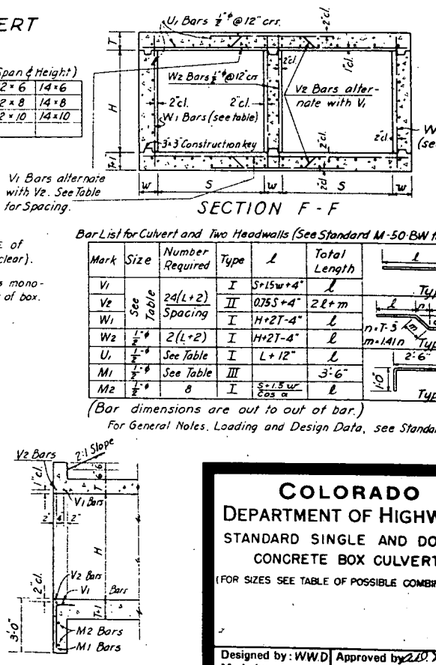
DOUBLE CONCRETE BOX CULVERT

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

Height of fill allowed	Type	Span S	Height H	Slab T	Wall W	Bar Size & Spacing V1 Size	Spa.	V2 Size	Spa.	W1 Size	Spa.	No. Bars Required U1	M1	Quantities for One Lin. Ft. of Box Concrete Cu Yds	Steel Lbs	Quantities for Two Headwalls Concrete Cu Yds	Steel Lbs.
10'-0"	6-6-A	6'-0"	3'-0"	8 1/2"	8"	1/2" #	5 1/2" Spa.	5/8" #	5 1/2" Spa.	1/2" #	12"	48	32	1.000	1123	3.85	327
			4'-0"								12"	57		1.073	1177	4.60	335
			5'-0"								12"	56	Cos α	1.148	1231	4.85	343
			6'-0"								12"	60		1.222	1285	5.25	351
15'-0"	6-6-B	6'-0"	3'-0"	9 1/2"	8"	1/2" #	5" Spa.	5/8" #	5" Spa.	1/2" #	12"	48	32	1.087	1203	4.45	329
			4'-0"								12"	52		1.161	1257	4.65	337
			5'-0"								12"	56	Cos α	1.235	1311	4.90	346
			6'-0"								8"	60		1.309	1414	5.10	353
20'-0"	6-6-C	6'-0"	3'-0"	10 1/2"	8"	1/2" #	4 1/2" Spa.	5/8" #	4 1/2" Spa.	1/2" #	12"	48	32	1.173	1300	4.50	331
			4'-0"								12"	52		1.247	1358	4.75	339
			5'-0"								10"	56	Cos α	1.321	1425	4.95	347
			6'-0"								7"	60		1.395	1524	5.15	355
10'-0"	8-8-A	8'-0"	3'-0"	10"	10"	5/8" #	6" Spa.	3/4" #	6" Spa.	1/2" #	12"	60	40	1.477	1744	5.80	506
			4'-0"								12"	64		1.569	1798	6.05	514
			5'-0"								12"	68	Cos α	1.662	1852	6.30	522
			6'-0"								12"	72		1.755	1906	6.55	531
15'-0"	8-8-B	8'-0"	3'-0"	11"	10"	5/8" #	5 1/2" Spa.	3/4" #	5 1/2" Spa.	1/2" #	12"	60	40	1.592	1886	5.90	508
			4'-0"								12"	64		1.684	1920	6.15	516
			5'-0"								12"	68	Cos α	1.777	1974	6.40	524
			6'-0"								8"	72		1.869	2079	6.65	533
20'-0"	8-8-C	8'-0"	3'-0"	12 1/2"	10"	5/8" #	5" Spa.	3/4" #	5" Spa.	1/2" #	12"	60	40	1.763	2020	6.00	513
			4'-0"								12"	64		1.856	2074	6.30	521
			5'-0"								10"	68	Cos α	1.948	2146	6.55	529
			6'-0"								7"	72		2.041	2257	6.75	537
5'-0"	10-10-A	10'-0"	4'-0"	10"	12"	5/8" #	7" Spa.	3/4" #	7" Spa.	5/8" #	15"	78	48	1.955	2283	7.40	712
			6'-0"								15"	86		2.157	2398	7.95	733
			8'-0"								12"	94	Cos α	2.380	2552	8.70	752
			10'-0"								9"	102		2.602	2755	9.55	771
10'-0"	10-10-B	10'-0"	4'-0"	12"	12"	5/8" #	7" Spa.	3/4" #	7" Spa.	5/8" #	15"	78	48	2.220	2310	7.65	721
			6'-0"								15"	86		2.443	2425	8.20	740
			8'-0"								12"	94	Cos α	2.664	2580	8.90	759
			10'-0"								8"	102		2.886	2826	9.75	778
15'-0"	10-10-C	10'-0"	4'-0"	14"	12"	5/8" #	6" Spa.	7/8" #	6" Spa.	5/8" #	15"	78	48	2.503	2608	7.85	727
			6'-0"								12"	86		2.725	2756	8.40	746
			8'-0"								9"	94	Cos α	2.947	2905	9.15	765
			10'-0"								6"	102		3.170	3055	10.00	784
5'-0"	12-12-A	12'-0"	4'-0"	12"	12"	5/8" #	7" Spa.	7/8" #	7" Spa.	5/8" #	15"	98	56	2.751	2787	9.35	857
			6'-0"								12"	106	Cos α	2.973	2945	10.05	876
			8'-0"								9"	114		3.195	3150	10.90	895
			10'-0"								6"	122		3.418	3355	11.75	914
10'-0"	12-12-B	12'-0"	4'-0"	14"	12"	5/8" #	6" Spa.	7/8" #	6" Spa.	5/8" #	15"	98	56	3.083	3435	9.60	864
			6'-0"								12"	106	Cos α	3.305	3298	10.30	883
			8'-0"								8"	114		3.528	3541	11.15	902
			10'-0"								6"	122		3.751	3784	12.00	921
15'-0"	12-12-C	12'-0"	4'-0"	16"	12"	5/8" #	5" Spa.	7/8" #	5" Spa.	5/8" #	12"	98	56	3.416	3651	9.85	870
			6'-0"								9"	106	Cos α	3.638	3847	10.55	889
			8'-0"								6"	114		3.860	4157	11.40	908
			10'-0"								4"	122		4.083	4467	12.25	927
5'-0"	14-14-A	14'-0"	4'-0"	15"	12"	5/8" #	6" Spa.	7/8" #	6" Spa.	5/8" #	15"	110	64	3.733	3562	10.95	984
			6'-0"								12"	118	Cos α	3.855	3720	11.60	1003
			8'-0"								9"	126		4.077	3929	12.60	1023
			10'-0"								6"	134		4.299	4137	13.45	1042
10'-0"	14-14-B	14'-0"	4'-0"	16"	12"	5/8" #	5" Spa.	7/8" #	5" Spa.	5/8" #	15"	110	64	3.824	4094	11.05	988
			6'-0"								12"	118	Cos α	4.046	4252	11.75	1007
			8'-0"								8"	126		4.269	4450	12.65	1026
			10'-0"								6"	134		4.491	4648	13.55	1045

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





Possible Combinations (Span & Height)

6×3	8×3	10×4	12×6	14×6
6×4	8×4	10×6	12×8	14×8
6×5	8×5	10×8	12×10	14×10
6×6	8×6	10×10		

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

Mark	Size	Number Required	Type	ℓ	Total Length
Vi	See Table	24(L+2) Spacing	I	S+15w+4"	ℓ
Ve			II	0.785 S+4"	2ℓ+m
Wi			I	H+2T-4"	ℓ
Wz	½" #	2(L+2)	I	H+2T-4"	ℓ
Ui	½" #	See Table	I	L+12"	ℓ
M1	½" #	See Table	III		3'-6"
Mz	½" #	8	I	S+1.5w / Cos α	ℓ

Type I; Type II (n+T-5, m-1.41n); Type III (2'-6", 10")

(Bar dimensions are out to out of bar.)

For General Notes, Loading and Design Data, see Standard M-50-BW.

COLORADO DEPARTMENT OF HIGHWAYS

STANDARD SINGLE AND DOUBLE CONCRETE BOX CULVERTS

(FOR SIZES SEE TABLE OF POSSIBLE COMBINATIONS)

Designed by: W.W.D. Made by: W.W.D. Checked by: T.J.M.

Approved by: [signature] Bridge Engineer

Date: Aug. 30, 1954

	Initial	Date
ed By	W.W.D	5-1-54
ed By	W.W.D	5-7-54
ed By	T.J.M	5-5-54
ed By	T.J.M	5/6/54
ed By	M.G.D	7-23-54

E TRACING
LOADING DATA
NERAL NOTES

STANDARD M-50-BW

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

FED. ROAD REG. NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	I 25-2(44)	50 17	

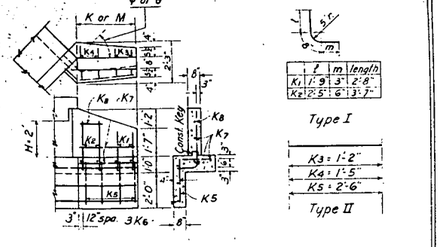
TABLE SHOWING VALUES OF K AND M WHEN "β" AND "H" ARE GIVEN

β	α	φ	θ	H=2'-0" K	H=2'-0" M	H=3'-0" K	H=3'-0" M	H=4'-0" K	H=4'-0" M	H=5'-0" K	H=5'-0" M	H=6'-0" K	H=6'-0" M	H=7'-0" K	H=7'-0" M	H=8'-0" K	H=8'-0" M	H=9'-0" K	H=9'-0" M	H=10'-0" K	H=10'-0" M
45°	45°	67°30'	22°30'	2'-4"	6'-2"	3'-7"	8'-7"	4'-10"	11'-7"	5'-11"	14'-2"	6'-10"	16'-5"	7'-9"	18'-8"	8'-8"	20'-10"	9'-8"	23'-2"	10'-7"	25'-5"
60°	30°	60°	30°	2'-9"	6'-9"	3'-10"	9'-3"	5'-1"	12'-4"	6'-3"	15'-10"	7'-5"	18'-7"	8'-3"	21'-5"	9'-3"	24'-6"	10'-3"	27'-9"	11'-3"	30'-11"
75°	15°	52°30'	37°30'	3'-0"	7'-11"	4'-2"	11'-0"	5'-5"	14'-2"	6'-10"	17'-5"	8'-2"	20'-8"	9'-0"	23'-11"	9'-10"	27'-1"	10'-7"	30'-4"	11'-5"	33'-7"
90°	0°	45°	45°	3'-4"	8'-4"	4'-0"	12'-1"	5'-7"	15'-10"	7'-1"	19'-7"	8'-5"	23'-4"	9'-10"	27'-1"	11'-2"	30'-10"	12'-2"	34'-7"	13'-1"	38'-4"
105°	15°	37°30'	52°30'	3'-11"	9'-0"	4'-7"	13'-1"	5'-4"	17'-3"	8'-1"	21'-5"	9'-8"	25'-7"	11'-0"	29'-9"	12'-3"	33'-11"	13'-5"	38'-1"	14'-7"	42'-3"
120°	30°	30°	60°	4'-9"	9'-9"	5'-6"	14'-0"	6'-4"	18'-3"	7'-3"	22'-6"	8'-1"	26'-9"	9'-0"	31'-0"	9'-10"	35'-3"	10'-8"	39'-6"	11'-6"	43'-9"
135°	45°	22°30'	67°30'	6'-2"	10'-6"	7'-1"	15'-5"	8'-0"	20'-4"	8'-10"	25'-3"	9'-8"	30'-2"	10'-6"	35'-1"	11'-4"	40'-0"	12'-2"	44'-11"	13'-0"	49'-10"

β EQUALS THE ANGLE BETWEEN ℄ OF CULVERT AND ℄ OF ROADWAY. α EQUALS THE ANGLE BETWEEN ℄ OF CULVERT AND A NORMAL TO ℄ 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.

WING DETAIL WHEN H = 2'-0"



	l	m	length
K1	1'-9"	3"	2'-8"
K2	2'-5"	6"	3'-7"

Type I

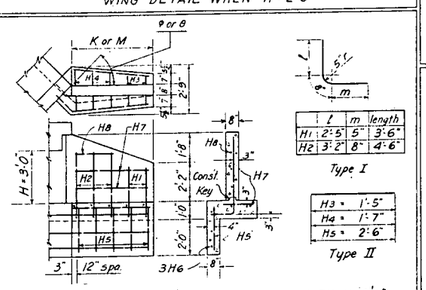
K3 = 1'-2"
K4 = 1'-5"
K5 = 2'-6"

Type II

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

When φ or θ equals	Number of bars required K1 Type I	K2 Type I	K3 Type II	K4 Type II	K5 Type II	Length of Bars 3-K6 Type II	3-K7 Type II	1-K8 Type II	Quantities for One Wing Concrete Cu Yds	Steel Lbs.
22°30	4	3	4	3	8	8'-3"	5'-10"	2'-2"	1.07	64
30°	3	2	3	2	6	6'-2"	4'-5"	1'-2"	0.82	47
37°30	2	2	2	2	5	5'-0"	3'-7"	1'-2"	0.68	40
45°	2	2	2	2	5	4'-4"	3'-0"	1'-2"	0.57	36
52°30	2	2	2	2	4	4'-0"	2'-8"	1'-2"	0.52	33
60°	2	1	2	1	4	3'-6"	2'-5"	1'-0"	0.48	28
67°30	2	1	2	1	4	3'-0"	2'-0"	1'-0"	0.40	26

WING DETAIL WHEN H = 3'-0"



	l	m	length
H1	2'-5"	5"	3'-6"
H2	3'-2"	8"	4'-6"

Type I

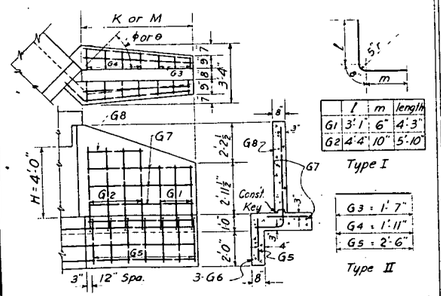
H3 = 1'-5"
H4 = 1'-7"
H5 = 2'-6"

Type II

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

When φ or θ equals	Number of Bars Required H1 Type I	H2 Type I	H3 Type II	H4 Type II	H5 Type II	Length of Bars 3-H6 Type II	4-H7 Type II	1-H8 Type II	Quantities for One Wing Concrete Cu Yds.	Steel Lbs.
22°30	4	5	4	5	11	10'-10"	8'-3"	4'-2"	1.78	99
30°	3	4	3	4	8	8'-4"	6'-3"	3'-2"	1.36	76
37°30	3	3	3	3	7	6'-8"	5'-1"	2'-2"	1.12	63
45°	2	3	2	3	6	5'-10"	4'-4"	2'-2"	0.97	54
52°30	2	3	2	3	6	5'-4"	3'-10"	2'-2"	0.86	52
60°	2	2	2	2	5	4'-10"	3'-6"	1'-2"	0.79	44
67°30	2	2	2	2	5	4'-8"	3'-3"	1'-2"	0.74	43

WING DETAIL WHEN H = 4'-0"



	l	m	length
G1	3'-1"	6"	4'-3"
G2	4'-4"	10"	5'-10"

Type I

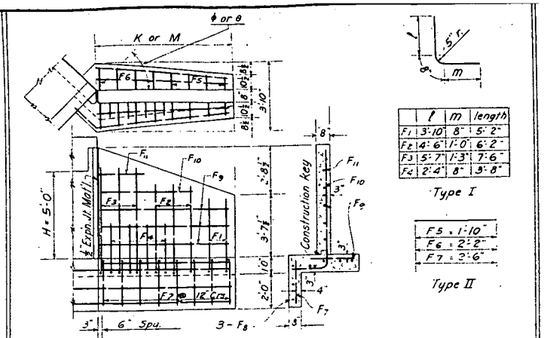
G3 = 1'-7"
G4 = 1'-11"
G5 = 2'-6"

Type II

BAR LIST & QUANTITIES FOR ONE WING WHEN H = 4'-0"

When φ or θ equals	Number of Bars Required G1 Type I	G2 Type I	G3 Type II	G4 Type II	G5 Type II	Length of Bars 3-G6 Type II	7-G7 Type II	1-G8 Type II	Quantities for One Wing Concrete Cu Yds.	Steel Lbs.
22°30	6	6	6	6	14	14'-3"	11'-3"	5'-2"	2.89	164
30°	4	5	4	5	11	10'-9"	8'-6"	4'-2"	2.21	125
37°30	3	4	3	4	9	8'-9"	6'-11"	3'-2"	1.81	101
45°	3	4	3	4	8	7'-8"	5'-11"	3'-2"	1.56	92
52°30	3	3	3	3	7	6'-9"	5'-3"	2'-2"	1.40	79
60°	3	3	3	3	7	6'-4"	4'-10"	2'-2"	1.29	77
67°30	2	3	2	3	6	6'-0"	4'-6"	2'-2"	1.21	69

WING DETAIL WHEN H = 5'-0"



	l	m	length
F1	3'-10"	8"	5'-2"
F2	4'-6"	1'-0"	6'-2"
F3	5'-7"	1'-3"	7'-6"
F4	2'-4"	8"	3'-8"

Type I

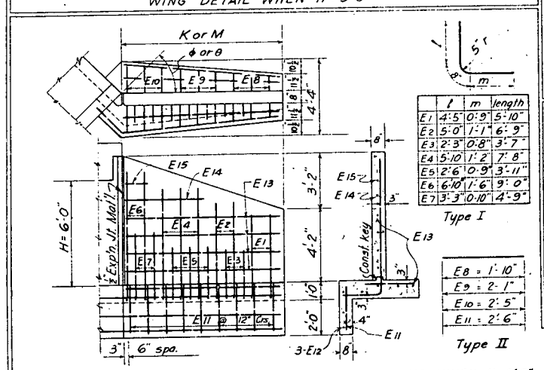
F5 = 1'-10"
F6 = 2'-2"
F7 = 2'-6"

Type II

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

When φ or θ equals	Number of bars required F1 Type I	F2 Type I	F3 Type I	F4 Type I	F5 Type II	F6 Type II	F7 Type II	Length of Bars 3-F8 Type II	7-F9 Type II	1-F10 Type II	1-F11 Type II	Quantities One Wing Concrete Cu Yds	Steel Lbs
22°30	5	5	5	6	7	8	17	17'-3"	13'-10"	9'-2"	4'-2"	4.06	237
30°	3	4	4	5	5	6	13	13'-3"	10'-6"	7'-2"	3'-2"	3.10	180
37°30	3	3	3	4	4	5	11	11'-0"	8'-7"	5'-2"	2'-2"	2.55	147
45°	2	3	3	4	4	4	9	9'-6"	7'-4"	5'-2"	2'-2"	2.20	130
52°30	2	2	3	3	3	4	8	8'-6"	6'-6"	4'-2"	2'-2"	1.96	113
60°	2	2	3	3	3	4	8	7'-9"	5'-11"	4'-2"	2'-2"	1.79	109
67°30	2	2	2	3	3	3	7	7'-3"	5'-7"	3'-2"	1'-2"	1.69	97

WING DETAIL WHEN H = 6'-0"



	l	m	length
E1	4'-5"	0'-9"	5'-10"
E2	5'-0"	1'-1"	6'-9"
E3	2'-8"	0'-8"	3'-7"
E4	5'-10"	1'-2"	7'-8"
E5	2'-6"	0'-9"	3'-11"
E6	6'-10"	1'-6"	9'-0"
E7	3'-3"	0'-10"	4'-9"

Type I

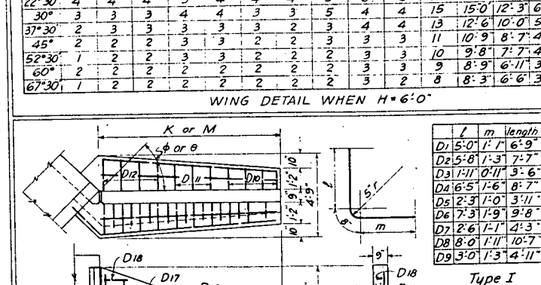
E8 = 1'-10"
E9 = 2'-1"
E10 = 2'-5"
E11 = 2'-6"

Type II

BAR LIST & QUANTITIES FOR ONE WING WHEN H = 6'-0"

When φ or θ equals	Number of Bars Required E1 Type I	E2 Type I	E3 Type I	E4 Type I	E5 Type I	E6 Type I	E7 Type I	E8 Type I	E9 Type II	E10 Type II	E11 Type II	Length of Bars 3-E12 Type II	8-E13 Type II	1-E14 Type II	1-E15 Type II	Quantities for One Wing Concrete Cu Yds.	Steel Lbs
22°30	4	4	4	5	4	4	4	5	6	6	20	19'-9"	16'-1"	8'-2"	3'-2"	5.21	317
30°	3	3	3	4	4	3	3	5	4	4	13	12'-6"	10'-0"	5'-2"	2'-2"	3.28	203
37°30	2	2	3	3	3	3	2	3	3	3	11	10'-9"	8'-7"	4'-2"	1'-2"	2.83	171
45°	2	2	2	3	3	2	2	3	3	3	10	9'-8"	7'-7"	4'-2"	1'-2"	2.51	156
52°30	1	2	2	2	3	3	2	2	3	3	9	8'-9"	6'-11"	3'-2"	1'-2"	2.30	145
60°	2	2	2	2	2	2	2	2	3	3	8	8'-3"	6'-6"	3'-2"	1'-2"	2.17	134
67°30	1	2	2	2	2	2	2	2	3	2	8	8'-3"	6'-6"	3'-2"	1'-2"	2.17	134

WING DETAIL WHEN H = 7'-0"



	l	m	length
D1	5'-0"	1'-1"	6'-9"
D2	5'-8"	1'-3"	7'-7"
D3	1'-11"	0'-11"	3'-6"
D4	6'-5"	1'-6"	8'-7"
D5	2'-3"	1'-0"	3'-11"
D6	7'-3"	1'-9"	9'-8"
D7	2'-6"	1'-1"	4'-3"
D8	8'-0"	1'-11"	10'-7"
D9	3'-0"	1'-3"	4'-11"

Type I

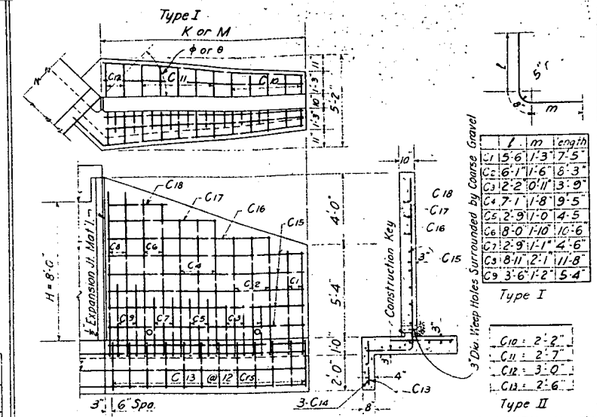
D10 = 2'-0"
D11 = 2'-3"
D12 = 2'-7"
D13 = 2'-6"

Type II

BAR LIST & QUANTITIES FOR ONE WING WHEN H = 7'-0"

When φ or θ equals	Number of Bars Required D1 Type I	D2 Type I	D3 Type I	D4 Type I	D5 Type I	D6 Type I	D7 Type II	D8 Type II	D9 Type II	D10 Type II	D11 Type II	D12 Type II	D13 Type II	Length of Bars 3-D14 Type II	10-D15 Type II	1-D16 Type II	1-D17 Type II	1-D18 Type II	Quantities for One Wing Concrete Cu Yds.	Steel Lbs.
22°30	4		4	5	4	4	4	3	3	3	6	6	7	22'-3"	18'-4"	10'-2"	6'-2"	2'-2"	7.01	436
30°	3		3	4	4	3	3	3	2	2	5	5	5	17'-6"	14'-1"	8'-2"	4'-2"	1'-2"	5.42	339
37°30	3		2	3	3	2	2	2	2	2	4	4	4	14'-0"	11'-5"	6'-2"	3'-2"	1'-2"	4.41	267
45°	2		2	2	2	2	2	2	2	2	4	3	4	12'-3"	9'-10"	5'-2"	3'-2"	1'-2"	3.82	238
52°30	2		1	2	2	2	2	2	2	2	3	3	3	10'-9"	8'-8"	5'-2"	3'-2"	1'-2"	3.38	212
60°	2		1	2	2	2	2	2	1	1	3	3	3	10'-0"	7'-11"	4'-2"	2'-2"	1'-2"	3.10	191
67°30	2		1	2	2	2	2	2	1	1	2	3	3	9'-6"	7'-5"	4'-2"	2'-2"	1'-2"	2.91	184

WING DETAIL WHEN H = 8'-0"



	l	m	length
C1	1'-5"	0'-6"	1'-11"
C2	1'-6"	0'-7"	2'-1"
C3	2'-2"	0'-11"	3'-0"
C4	7'-1"	1'-8"	9'-5"
C5	2'-9"	1'-0"	4'-5"
C6	8'-0"	1'-10"	10'-6"
C7	2'-9"	1'-1"	4'-6"
C8	8'-11"	2'-1"	11'-8"
C9	3'-6"	1'-2"	5'-4"

Type I

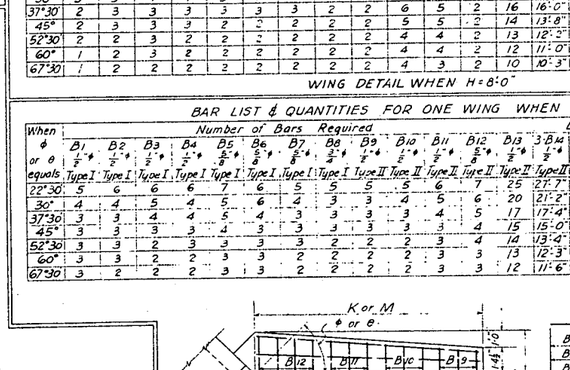
C10 = 2'-2"
C11 = 2'-7"
C12 = 3'-0"
C13 = 2'-6"

Type II

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

When φ or θ equals	Number of bars required C1 Type I	C2 Type I	C3 Type I	C4 Type I	C5 Type I	C6 Type I	C7 Type I	C8 Type I	C9 Type II	C10 Type II	C11 Type II	C12 Type II	C13 Type II	Length of Bars 3-C14 Type II	10-C15 Type II	1-C16 Type II	1-C17 Type II	1-C18 Type II	Quantities for One Wing Concrete Cu Yds.	Steel Lbs.
22°30	4	4	5	5	4	4	4	4	9	9	3	6	3	24'-8"	20'-6"	16'-2"	12'-2"	7'-2"	9.00	526
30°	3	3	4	4	3	3	3	3	7	6	3	6	3	19'-0"	15'-8"	12'-2"	9'-2"	5'-2"	6.91	402
37°30	2	3	3	3	3	3	2	2	6	5	2	5	2	16'-0"	12'-10"	10'-2"	7'-2"	4'-2"	5.69	330
45°	2	3	3	3	2	2	2	2	5	5	2	4	2	13'-8"	11'-0"	9'-2"	6'-2"	3'-2"	4.89	287
52°30	2	2	3	2	2	2	2	2	4	4	2	4	2	12'-5"	9'-9"	7'-2"	5'-2"	3'-2"	4.35	257
60°	1	2	3	2	2	2	2	2	4	4	2	3	2	11'-0"	8'-11"	7'-2"	5'-2"	3'-2"	3.99	242
67°30	1	2	2	2	2	2	2	2	4	3	2	3	2	10'-3"	8'-4"	6'-9"	4'-6"	2'-4"	3.74	228

WING DETAIL WHEN H = 9'-0"



	l	m	length
B1	6'-1"	1'-5"	8'-2"
B2	4'-0"	0'-11"	5'-3"
B3	7'-2"	1'-8"	9'-6"
B4	2'-9"	0'-11"	4'-6"
B5	8'-3"	2'-0"	10'-11"
B6	3'-2"	1'-3"	5'-1"
B7	9'-8"	2'-4"	12'-8"
B8	4'-2"	1'-5"	6'-3"

Type I

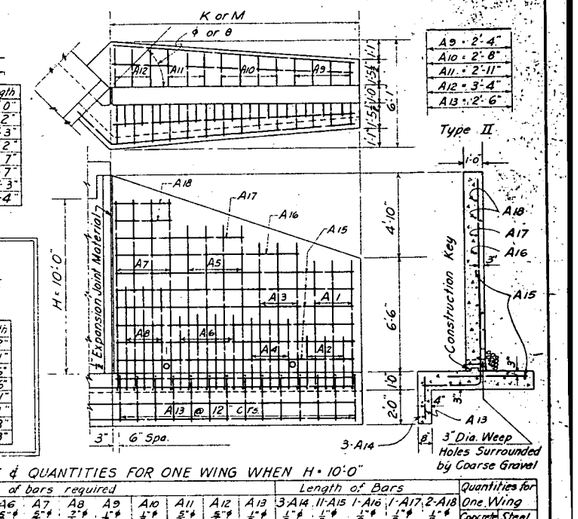
B9 = 2'-2"
B10 = 2'-5"
B11 = 2'-8"
B12 = 3'-2"
B13 = 2'-6"

Type II

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

When φ or θ equals	Number of bars required B1 Type I	B2 Type I	B3 Type I	B4 Type I	B5 Type I	B6 Type I	B7 Type II	B8 Type II	B9 Type II	B10 Type II	B11 Type II	B12 Type II	B13 Type II	Length of Bars 3-B14 Type II	11-B15 Type II	1-B16 Type II	1-B17 Type II	1-B18 Type II	Quantities for One Wing Concrete Cu Yds.	Steel Lbs.
22°30	5	6	6	6	7	6	5	5	5	5	6	6	7	27'-7"	22'-10"	17'-2"	11'-2"	4'-2"	11.56	666
30°	4	4	5	4	5	4	3	3	3	4	5	5	6	21'-2"	17'-5"	13'-2"	8'-2"	3'-2"	8.86	510
37°30	3	4	4	4	5	4	3	3	3	3	4	4	5	17'-4"	14'-3"	11'-2"	7'-2"	2'-2"	7.27	427
45°	3	3	3	3	4	3	3	3	3	3	3	4	4	15'-0"	12'-3"	9'-2"	6'-2"	2'-2"	6.28	370
52°30	3	3	2	3	3	3	2	2	2	2	3	3	4	13'-4"	10'-10"	7'-2"	5'-2"	2'-2"	5.57	322
60°	3	3	2	2	3	3	2	2	2	2	3	3	3	12'-3"	9'-11"	6'-2"	4'-2"	1'-2"	5.11	294
67°30	3	2	2	2	3	3	2	2	2	2	3	3	3	11'-6"	9'-4"	6'-2"	4'-2"	1'-2"	4.82	279

WING DETAIL WHEN H = 10'-0"



	l	m	length
A1	6'-9"	1'-7"	9'-0"
A2	2'-5"	1'-1"	3'-2"
A3	7'-9"	1'-10"	10'-3"
A4	3'-3"	1'-2"	5'-2"
A5	8'-10"	2'-1"	11'-7"
A6	3'-8"	1'-3"	5'-7"
A7	10'-3"	2'-4"	13'-3"
A8	5'-1"	1'-4"	7'-4"

Type I

A9 = 2'-4"
A10 = 2'-8"
A11 = 2'-11"
A12 = 3'-4"
A13 = 2'-6"

Type II

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

When φ or θ equals	Number of bars required A1 Type I	A2 Type I	A3 Type I	A4 Type I	A5 Type I	A6 Type I	A7 Type II	A8 Type II	A9 Type II	A10 Type II	A11 Type II	A12 Type II	A13 Type II	Length of Bars 3-A14 Type II	11-A15 Type II	1-A16 Type II	1-A17 Type II	2-A18 Type II	Quantities for One Wing Concrete Cu Yds.	Steel Lbs.
22°30	6	6	5	5	8	8	7	5	6	8	7	5	6	30'-0"	25'-1"	19'-2"	14'-2"	9'-2"	14.35	830
30°	5	4	4	4	5	6	5	6	5	6	6	4	4	23'-0"	19'-2"	15'-2"	10'-2"	5'-2"	11.01	636
37°30	3	4	4	3	4	5	5	4	4	4	4	4	4	19'-1"	15'-8"	12'-2"	8'-2"	4'-2"	9.03	523
45°	3	3	3	3	4	4	4	4	3	4	4	3	3	16'-3"	13'-5"	10'-2"	7'-2"	3'-2"	7.76	440
52°30	3	3	2	3	3	3	4	3	3	3	3	3	3	14'-1"	11'-11"	8'-2"	6'-2"	3'-2"	6.92	394
60°	2	2	3	3	3	3	3	3	3	3	3	3	3	13'-6"	10'-11"	8'-2"	5'-2"	2'-2"	6.35	363
67°30	2	2	2	3	3	3	3	3	3	3	3	3	2	12'-10"	10'-3"	8'-2"	5'-2"	2'-2"	5.97	348

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS OF THE COLORADO DEPARTMENT OF HIGHWAYS APPLICABLE TO THE PROJECT.

ALL CONCRETE SHALL BE CLASS "A" AND AIR ENTRAINED AS SPECIFIED.

ALL WING SURFACES TO RECEIVE ORDINARY SURFACE FINISH.

WING FOOTINGS AND FLOOR OF BOX SHALL BE POURED MONOLITHICALLY.

FORMS FOR CONCRETE SURFACES EXPOSED IN THE FINISHED WORK SHALL BE CONSTRUCTED OF SHIPLAP OR TONGUE AND GROOVE LUMBER S 1 S, UNLESS FACED WITH PANEL BOARD.

FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED.

SOUNDINGS AND DEPTH OF FOOTING SHOWN ARE IN ACCORDANCE WITH THE BEST AVAILABLE DATA AND WHEN DIFFERENT CONDITIONS ARE ENCOUNTERED THE BRIDGE ENGINEER WILL INSPECT AND DETERMINE IF REDESIGN IS NECESSARY.

ALL REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A 305-50T OR THE LATEST REVISION THEREOF AND SHALL BE INTERMEDIATE GRADE STEEL OF A DEFORMED TYPE. EACH BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. PRIMARY BARS SHALL NOT BE SPLICED AND SECONDARY BARS WHEN SPLICED SHALL LAP 12 DIAMETERS OF THE BAR. DIMENSIONS FOR REINFORCING STEEL NOT SHOWN AS CLEAR SHALL BE TO THE CENTER LINE OF THE BAR. OUT TO OUT DIMENSIONS SHALL BE USED ON BAR BENDING DETAILS.

SUPPORTING SOILS FOR ALL CULVERTS MUST BE COMPOSED OF FIRM AND UNIFORM MATERIAL THROUGHOUT.

HORIZONTAL CONSTRUCTION KEYS ARE NOT REQUIRED WHEN FOOTINGS AND WALL ARE POURED MONOLITHICALLY.

ALL CONSTRUCTION KEYS SHOWN BETWEEN FOOTINGS AND WALLS ARE 3" X 3".

WHEN EXCAVATING FOR FOOTINGS THE FINAL ONE FOOT IN DEPTH SHALL BE DONE BY HAND LABOR METHODS.

FOR STD. METHODS OF STRUCTURE BACKFILL SEE STD. M-60-8.

STEEL WEIGHTS INCLUDE 1% ± FOR OVERRUN.

EXPANSION JOINT MATERIAL IS TO BE INCLUDED IN THE PRICE OF CLASS "A" CONCRETE AND SHALL CONFORM TO AASHO SPECIFICATION M-153-52 TYPE III.

FOR CULVERTS REQUIRED AND GOVERNING DIMENSIONS SEE "LIST OF STRUCTURES".

LOADING DATA INTERSTATE ALTERNATE
LIVE LOAD : A.A.S.H.O. (H20-S16-44)
DEAD LOAD: CONCRETE 150 POUNDS PER CUBIC FOOT.
EARTH 84 POUNDS PER CUBIC FOOT.

DESIGNING DATA
A.A.S.H.O. 1953 UNIT STRESSES, EXCEPT AS NOTED.

Reinforcing Steel	fs	20000 lbs. per sq. in.
Structural Steel	fs	18000 lbs. per sq. in.
	fc	1000 lbs. per sq. in.
	n	10

COLORADO DEPARTMENT OF HIGHWAYS

WINGWALLS FOR VARIOUS TYPES OF CONCRETE BOX CULVERTS

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

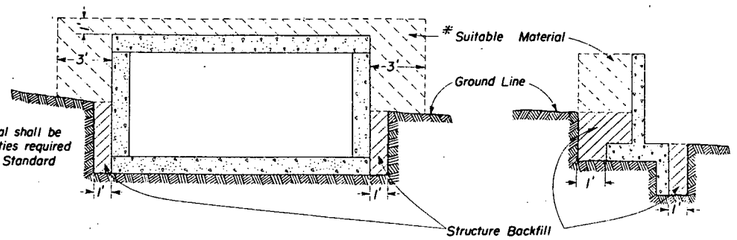
STANDARD M-60-B

FED. ROAD REGION NO	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	F 25-2(44) 150	18	

REVISIONS

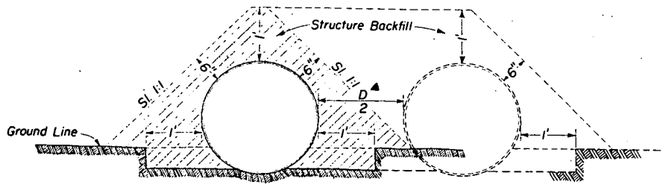
2-9-59	Dbl. Cond. & Cond. in Tr.	H.E.P.

CONCRETE BOX CULVERTS & WINGWALLS



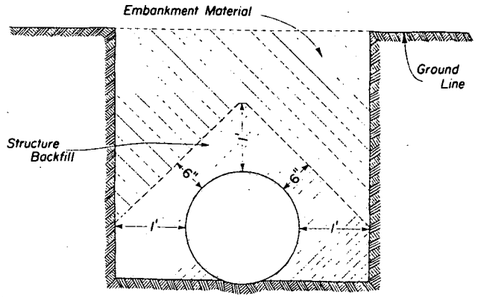
* Suitable Material shall be compacted to densities required for Item 16 of the Standard Specifications.

CIRCULAR CONDUIT



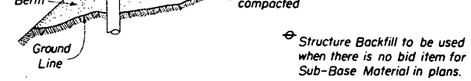
When two or more conduits are layed side by side, the distance between conduits shall be 1/2 the conduit diameter but not less than 2'-0".

SIPHONS OR CONDUIT IN TRENCH

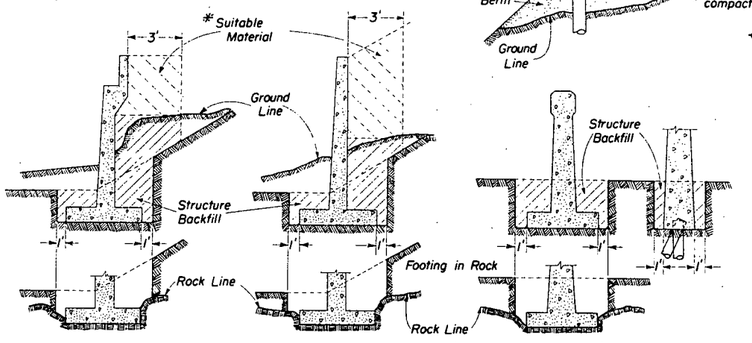


PIERS, ABUTMENTS, RETAINING WALLS ETC.

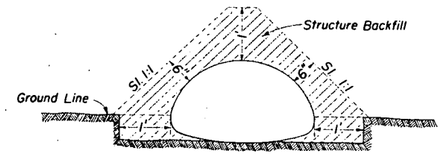
All material that is to be compacted shall be placed in horizontal layers not more than 6" inches in depth and compacted before the next layer is placed. For Arches, Rigid Frames and Box Culverts the fill shall be brought up uniformly on both sides of the center of structure to avoid stresses in the structure caused by unsymmetrical loading.



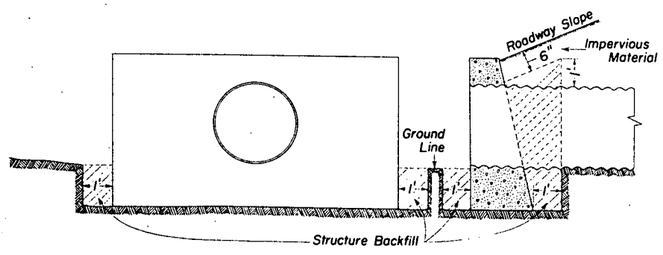
Structure Backfill to be used when there is no bid item for Sub-Base Material in plans.

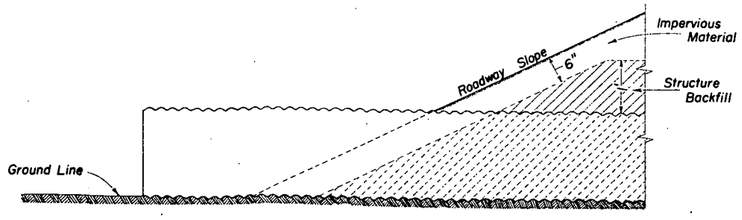


ELLIPTICAL OR ARCH CONDUIT

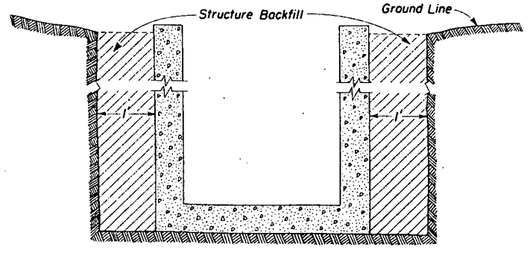


HEADWALLS AND END OF CULVERTS





DROP INLETS, DIVISION BOXES, INTERCEPTING HEADWALLS ETC.



GENERAL NOTES

All work shall be done according to the Standard Specifications of the Colorado Department of Highways applicable to the Project.

If, in the opinion of the Engineer, the material beneath the Structure is of such character as to cause unequal settlement along the length of the Structure, the material shall be removed to such a depth ordered, and backfilled with gravel or other suitable material and compacted in accordance with Item 16 of the Standard Specifications.

Suitable Material shall be any "Unclassified Excavation" material developed on the project except large rock, boulders or other materials considered by the Engineer to be undesirable for backfill around culverts, boxes etc.

COLORADO
DEPARTMENT OF HIGHWAYS

STANDARD METHODS OF BACKFILL AROUND STRUCTURES

Designed by H.E.P.	Approved by C. D. Knowlton
Made by D.M.E.	Bridge Engineer
Checked by L.E.O.	Date: May 2, 1958

REVISIONS

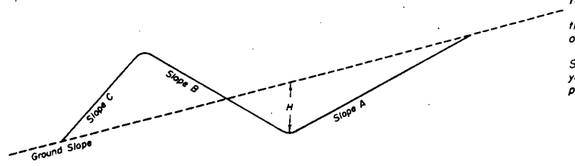
STANDARD TYPES of DITCHES and CONSTRUCTION METHODS

STANDARD M-107-D

FED. ROAD REG. NO.	DIVISION		SHEET NO.	TOTAL SHEETS
9	COLO.	225-2(44)	150 19	

DETAILS for CONTOUR INTERCEPTING DITCHES

Typical Section for Contour Intercepting Ditches



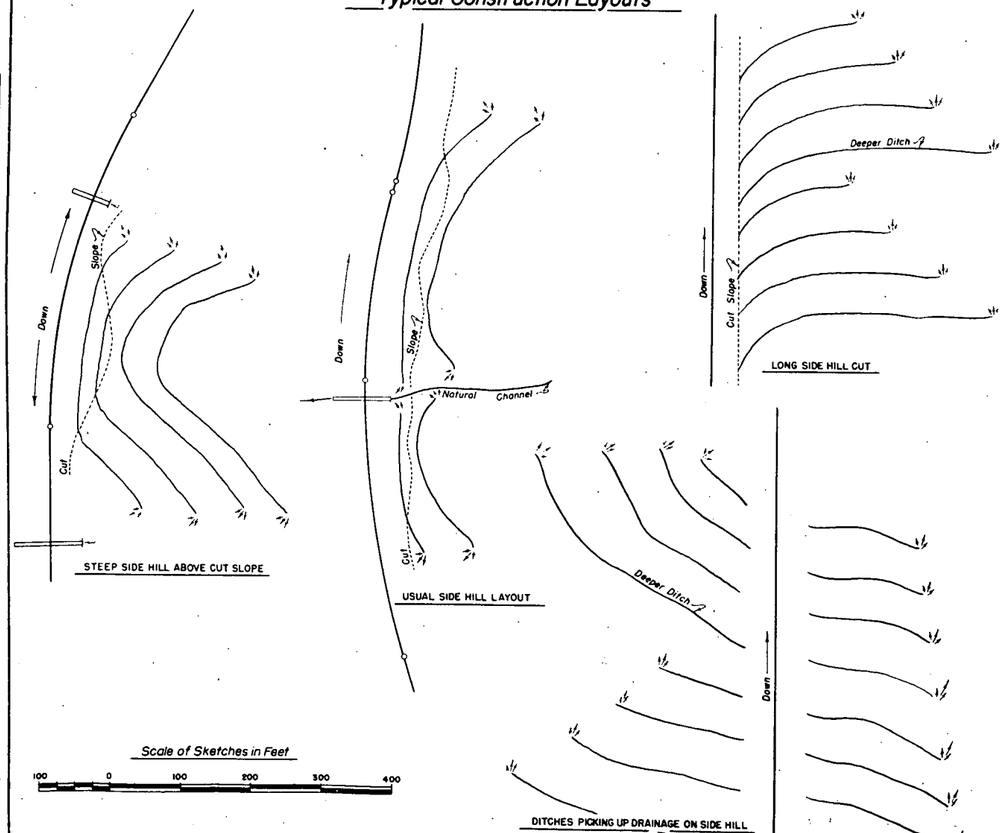
PURPOSE & USE OF THE TABLE

The primary purpose of the information for Contour and Intercepting Ditches shown on this sheet is to serve as a guide in construction and to readily arrive at yardages of excavation involved.

Foremost consideration in constructing these ditches is given first to the natural ground line slope confronted in construction, thence to the other values shown on the Typical Section.

By properly arriving at the combination of values shown on the Typical Section and in the Table for a specified condition, the number of cubic yards of excavation per 100 lin. ft. of ditch may be read under the appropriate column for this item.

Typical Construction Layouts



Scale of Sketches in Feet

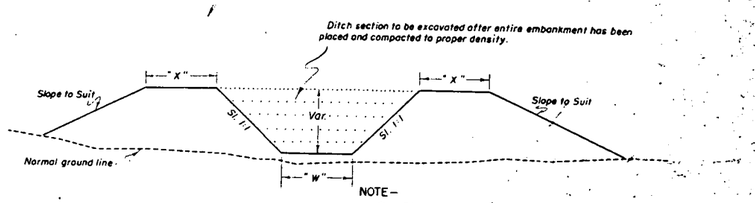
100 0 100 200 300 400

Table of Slopes and Yardages

SLOPES Ground	A	B	C	H	Cubic Yards per 100 lin. ft. of Ditch
5:1 Or Flatter	2:1	4:1	2:1	15"	16
				18"	23
				21"	32
		3:1		15"	15
				18"	22
				21"	30
		2:1		15"	14
				18"	20
				21"	27
		1-1/2:1		15"	13
				18"	19
				21"	25
	1-1/2:1	4:1	1-1/2:1	15"	12
				18"	18
				21"	25
		3:1		15"	12
				18"	17
				21"	23
		2:1		15"	10
				18"	15
				21"	20
		1-1/2:1		15"	10
				18"	14
				21"	19
4:1	2:1	4:1	2:1	15"	17
				18"	25
				21"	34
		3:1		15"	17
				18"	24
				21"	32
		2:1		15"	15
				18"	22
				21"	30
		1-1/2:1		15"	15
				18"	21
				21"	29
	1-1/2:1	4:1	1-1/2:1	15"	13
				18"	18
				21"	25
		3:1		15"	12
				18"	17
				21"	23
		2:1		15"	11
				18"	16
				21"	21
		1-1/2:1		15"	10
				18"	14
				21"	20
3:1	2:1	3:1	2:1	15"	22
				18"	31
				21"	43
		2:1		15"	21
				18"	30
				21"	41
		1-1/2:1		15"	20
				18"	29
				21"	40
	1-1/2:1	3:1	1-1/2:1	15"	13
				18"	19
				21"	26
		2:1		15"	12
				18"	17
				21"	24
		1-1/2:1		15"	12
				18"	17
				21"	23
2:1	1-1/2:1	2:1	1-1/2:1	15"	20
				18"	29
				21"	40
		1-1/2:1		15"	20
				18"	28
				21"	39
	1:1	2:1	1:1	15"	9
				18"	13
				21"	17
		1-1/2:1		15"	8
				18"	12
				21"	16
1-1/2:1	1:1	1-1/2:1	1:1	15"	11
				18"	16
				21"	21

▲ *Slopes are approximate and may be varied to suit conditions encountered during construction.*

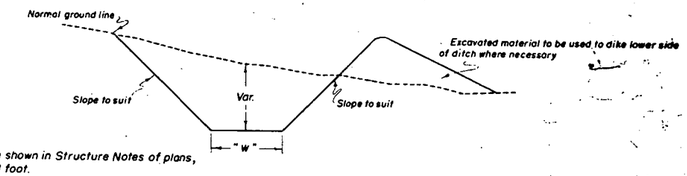
TYPICAL SECTIONS for DRAINAGE, IRRIGATION DITCHES and CHANNEL CHANGES



NOTE –
See Structure Notes in plans for dimension "W". Dimension "X" = W/2 with minimum of 2 feet.

For Embankment Sections

(Generally for use in Irrigation Ditches & Channel Changes)



NOTE –
Unless otherwise shown in Structure Notes of plans, dimension "W" = 1 foot.

For Cut Sections

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications of the Colorado State Highway Department applicable to the Project.

All ditches are to be constructed to lines and grades as staked by the Engineer using the ditch section shown on plans or as ordered by the Engineer.

CONTOUR INTERCEPTING DITCHES: *Ditches are to be laid out along the ground contour on a grade of not over 1% (Type of soil shall govern the grade).*

Ends of ditches are to be lined up so that concentration of flow from a higher contour ditch into one of lower contour is, as far as possible avoided. The use of a deeper ditch is recommended where this condition is encountered.

The following horizontal spacing of ditches is recommended:

4% to 6%	Approximately 70' Centers
8% to 10%	Approximately 60' Centers
20% to 4:1 Slope	Approximately 55' Centers
30% to 1-1/2:1 Slope	Approximately 50' Centers

Where ditch checks are required the intervening ditch between one set of ditch checks shall not exceed a grade of 1.0%. Details of checks will be shown on plans when required.

Initial	Date
Approved By	
Checked By	
Drawn By	
Checked By	
Sent By	
Checked By	

COLORADO
DEPARTMENT OF HIGHWAYS

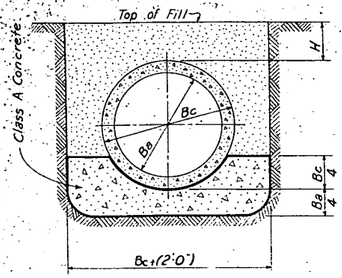
Standard Types of Ditches and Construction Methods

Designed by C.G.M.	Approved by Merrill
Made by C.G.M.	Engineer, Surveys & Plans
Checked by	Date: Aug. 19, 1950

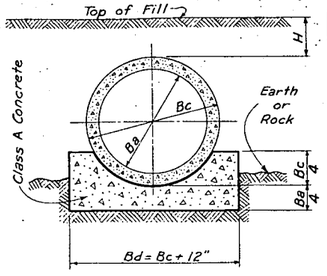
STANDARD M-112-F

FED. ROAD REGION NO.	DIVISION	PROJECT NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	F-25-2(43)	So 20	

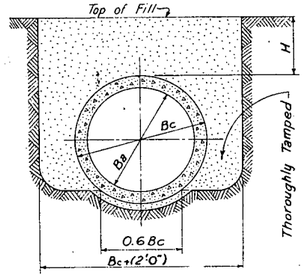
Rev. / Ref. of Conc. Pipe to Class - 7-9-58 E.E.O.



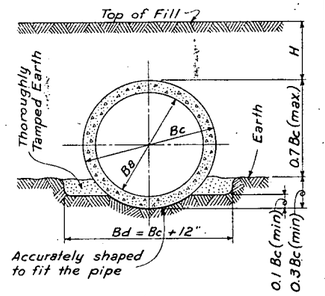
CONCRETE CRADLE BEDDING IN TRENCHES



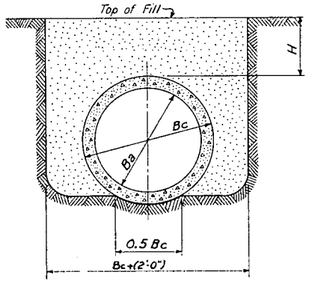
CONCRETE CRADLE BEDDING IN FILLS



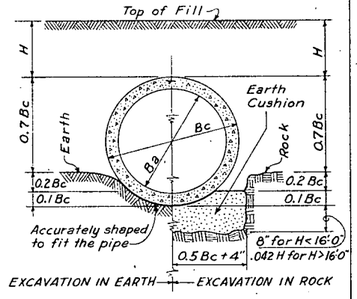
FIRST CLASS BEDDING IN TRENCHES



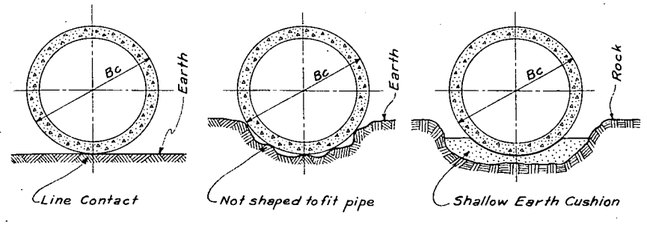
FIRST CLASS BEDDING IN FILLS



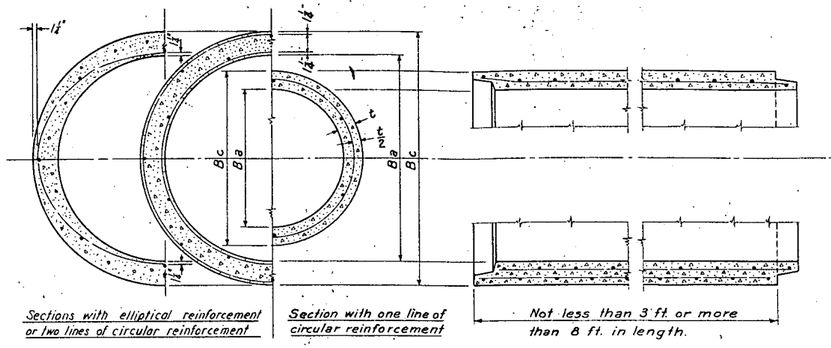
ORDINARY BEDDING IN TRENCHES



ORDINARY BEDDING IN FILLS



IMPERMISSIBLE BEDDINGS IN TRENCHES OR FILLS
THESE THREE TYPES SHALL NOT BE USED



Sections with elliptical reinforcement or two lines of circular reinforcement

Section with one line of circular reinforcement

Not less than 3 ft. or more than 8 ft. in length.

PIPE CROSS SECTIONS

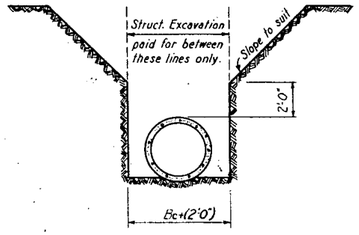
Where two lines of steel are contemplated a single line placed elliptically may be used, and the area of this shall be at least 50 % of the total steel area required for two lines of reinforcement. Pipe with elliptical reinforcing shall have the word "Top" or "Bottom" clearly stenciled on the inside of the pipe at the correct place to indicate the proper position when laid.

LONGITUDINAL SECTIONS

If machine made pipe is used a modified bell will be acceptable to the department.

CONCRETE COLLAR

Where the flow line grade of the pipe is 10% or greater, all pipe shall be the bell and spigot type or shall be tongue and groove pipe with concrete collars as detailed above or a type approved in writing by the Engineer.



Where it is necessary to bed the pipe in a deep trench the contractor may, for his own convenience and at his own expense, slope the cut from a point 2'-0" above the top of the pipe as shown above.
Note: For Concrete Sewer Pipe Structural Excavation is not a separate pay item.

Ba Int. Diameter (Inches)	* Bc Ext. Diameter (Inches)	Three Edge Bearing Method: Crack Point (Pounds)	Three Edge Bearing Method: Ultimate Load (Pounds)	Max. depth of fill "H" in ft. for 3 types of bedding: Concrete Cradle: Pipe in Trench	Concrete Cradle: Pipe in Fills	First Class: Pipe in Trench	First Class: Pipe in Fills	Ordinary: Pipe in Trench	Ordinary: Pipe in Fills
Reinforced Conc. Culv. Pipe Class III - A.S.T.M. C 76									
12	16	2250	3500	No Limit	30	No Limit	19	No Limit	16
15	19½	2625	4065		28		18		15
18	23	3000	4500		28		18		15
24	30	3000	5000		22	44	14	18	12
30	37	3375	5750		21	25	14	15	12
36	44	4050	6600	54	21	17	14	14	12
42	51	4725	7350	47	22	17	14	13	12
48	58	5400	8000	46	22	17	14	13	12
54	65	5850	9000	38	22	17	14	12	12
60	72	6000	10000	32	21	15	14	11	12
66	79	6300	11000	28	20	15	13	10	12
72	86	6600	12000	26	20	14	13	10	11
84	100	"	"	24	20	13	13	10	11
Reinforced Conc. Culv. Pipe Class II - A.S.T.M. C 76									
24	30	4000	6000	No Limit	29	No Limit	18	No Limit	15
30	37	5000	7500		30	No Limit	19	48	16
36	44	6000	9000		30	40	19	22	16
42	51	7000	10500		31	40	20	22	17
48	58	8000	12000		31	37	20	23	17
54	65	9000	13500		32	36	20	23	17
60	72	9000	15000		29	28	19	20	15
66	79	9500	16500	128	28	26	19	18	16
72	86	9900	18000	64	28	24	18	17	15
84	100	"	"	46	28	22	18	16	15
Reinforced Conc. Sewer Pipe Class as called for on Plans - A.S.T.M. C 76									
12	16	1800	2700	No Limit	24	No Limit	15	25	18
15	19½	2000	3000		22	No Limit	14	19	12
18	23	2200	3300		21	48	13	16	11
21	26½	2400	3600		20	28	13	14	11
24	30	2400	3600		18	18	12	12	10
27	33	2550	3800		18	17	11	11	10
30	37	2700	4050		17	15	11	10	9
33	40½	2850	4300	49	17	14	11	10	9
36	44	3000	4500	22	16	11	11	8	9
42	51	3200	4800	19	16	10	10	7	9
48	58	3400	5100	17	15	9	10	7	9
54	65	3700	5550	17	15	9	10	7	8
60	72	4000	6000	16	15	9	10	7	8
66	79	4250	6350	16	15	9	10	6	8
72	86	4500	6750	15	15	8	10	6	8
Std. Str. Unreinforced Conc. Sewer Pipe - A.S.T.M. C 14									
4	5 3/8	1000		No Limit	35	No Limit	24		20
6	7 1/4	1100			31		20		17
8	9 1/2	1300			28		18	No Limit	15
10	11 3/4	1400			25		16	27	13
12	14	1500			23		14	19	12
15	17½	1750			21		13	16	11
18	21	2000			21		13	15	11
21	24½	2200			20	27	12	14	11
24	28½	2400			19	22	12	13	10

* Note: External diameter of pipe shown in the table is approximate only, having been determined by using 3000 lbs. per sq. in. concrete. If greater strength concrete is used this diameter may be decreased accordingly.

Minimum Depth of Fill over Concrete Pipe.
Main Roadways ..... 2 Foot
Approach Roadways ..... 1 Foot

GENERAL NOTES

All work shall be done according to the Standard Specifications of the Colorado State Highway Department applicable to the project.

The type of Pipe Joint used and the field construction there-of to make the joint reasonably water-tight shall be submitted to the Department for approval.

Unless otherwise noted the type of bedding shall be Ordinary Bedding. When the maximum fill height as noted hereon, for this type of bedding, is exceeded then that type of bedding which is indicated by the allowable fill height shall be used.

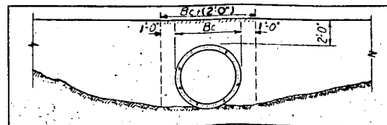
All culverts shall have headwalls or flared end sections if and as shown on the plans in accordance with Department Standards.

For size, type and location of pipe see plan sheets for project.

Supporting soils shall be composed of firm and uniform material throughout the entire length of Culvert. The soil shall be accurately shaped to fit the Pipe in accordance with the bedding conditions shown.

The Pipe shall be laid with the Bell or Groove end placed upstream.

For Std. Methods of Structure Backfill See Std. M-60-B.



If the desired fill height for pipe in a fill exceeds that given in the table, new embankment may be constructed to an elevation of two feet above the top of the pipe; a trench may then be excavated in the embankment and the pipe installed in accordance with a pipe in a trench. This work shall conform to the requirements for "Embankments" as shown in the specifications.

	Initial	Date
Designed By	W.W.D.	3-1-52
Detailed By	P.C.	3-1-52
Quantities By	W.W.D.	3-5-52
Checked By	P.C.	3-7-52
Approved By	L.W.F.	3-10-52
Revised By	P.C.	3-14-52

COLORADO DEPARTMENT OF HIGHWAYS

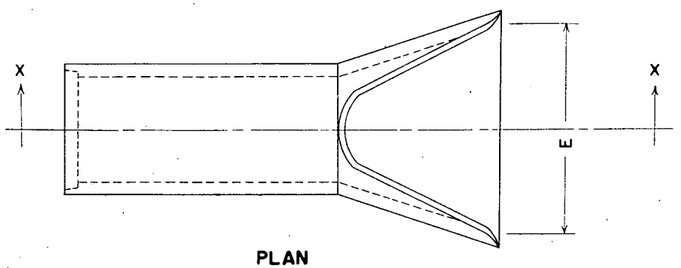
REINF. CONCRETE CULVERT PIPE
STD. STRENGTH 12", 15", 18", 24", 30", 36", 42", 48", 54", 60", 66", 72", 84"
EXTRA STR. 24", 30", 36", 42", 48", 54", 60", 66", 72", 84"

CONCRETE SEWER PIPE
REINF. 12", 15", 18", 21", 24", 27", 30", 33", 36", 42", 48", 54", 60", 66", 72".
UNREINF. 4", 6", 8", 10", 12", 15", 18", 21", 24".

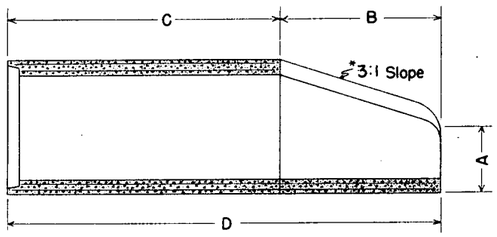
Designed by W.W.D.
Made by W.W.D.
Checked by P.C.

Approved by [signature]
Bridge Engineer
Date: Mar. 17, 1958.

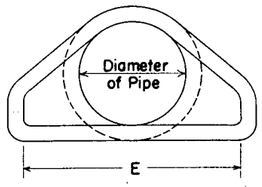
FLARED END SECTION FOR CONCRETE PIPE



PLAN

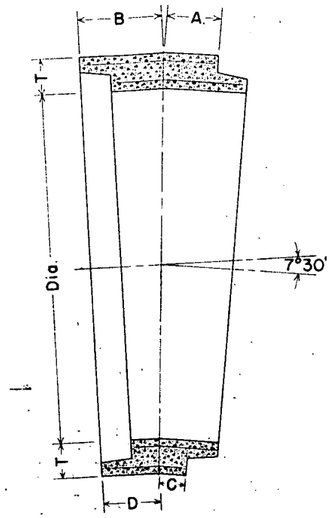


SECTION X-X



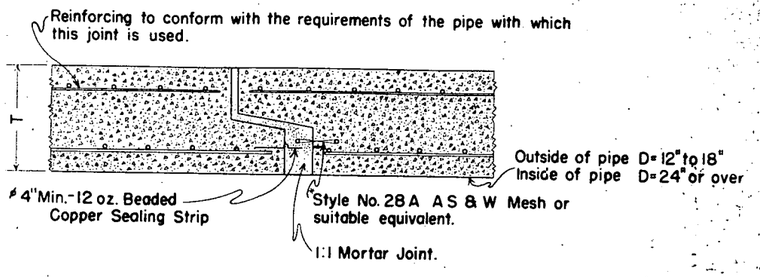
END VIEW

7°30' ANGLE SECTION FOR CONCRETE PIPE



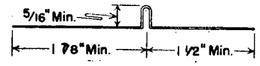
COPPER EXPANSION JOINT FOR CONCRETE PIPE

(WHEN REQUIRED ON PLANS)



*When Welded Rectangular Mesh is used for the reinforcing steel in the pipe the inner line of Mesh may be extended into the joint space instead of using a separate strip of Triangular Mesh.

øCOPPER SEALING STRIP



øCopper Sealing Strips shall be made from sheet copper, 4" min. width, bent as shown and weighing 12 oz. per sq.ft. Both legs of strip shall be perforated in a satisfactory manner to secure bond. Each sealing strip shall be continuous around each pipe joint with a 1¼" end lap.

DIMENSIONS FOR FLARED END SECTIONS

DIAMETER	A	B	C	D	E
12"	4"	2'-0"	4'-0⅞"	6'-0⅞"	2'-0"
15"	6"	2'-3"	3'-10"	6'-1"	2'-6"
18"	9"	2'-3"	3'-10"	6'-1"	3'-0"
24"	9½"	3'-7½"	4'-6"	8'-1½"	4'-0"
30"	1'-0"	4'-6"	3'-7¾"	8'-1¾"	5'-0"
36"	1'-3"	5'-3"	2'-10¾"	8'-1¾"	6'-0"
42"	1'-9"	5'-3"	2'-11"	8'-2"	6'-6"
48"	2'-0"	6'-0"	2'-2"	8'-2"	7'-0"
54"	2'-6"	6'-0"	2'-3"	8'-3"	7'-6"
*60"	2'-6"	5'-0"	3'-3"	8'-3"	8'-0"

*60" end section is based on a slope of 2:1

DIMENSIONS FOR 7°30' ANGLE SECTIONS

DIAMETER OF PIPE	LENGTH ON OUTSIDE OF PIPE				AVERAGE LAYING LENGTH ON ℄
	A	B	C	D	
12"	4½"	4½"	3½"	3½"	8"
15"	5½"	5⅛"	4¼"	3⅞"	9⅜"
18"	3½"	6½"	2"	5"	8½"
24"	4"	6½"	2"	4 9/16"	8½"
30"	4½"	7"	2"	4½"	9"
36"	4⅞"	8 7/16"	2"	5 9/16"	10 7/16"
42"	6"	9½"	2⅝"	6⅛"	12⅛"
48"	7"	11"	3 3/16"	7 5/16"	14 3/16"
54"	8⅛"	12⅛"	4"	8"	16⅛"
60"	9⅛"	14"	4⅜"	9¼"	18⅜"

A, B, C and D apply to Tongue and Groove type of Joint only and can be varied for other types of Joints.

GENERAL NOTES

Joints other than Tongue and Groove may be used for Flared End Sections, 7°30' Angle and for the Copper Expansion Joint but all Joints for any one pipe structure must be uniform.

Concrete, wall thickness and reinforcing steel in Flared End Sections and 7°30' Angle Sections must conform with the requirements of the pipe with which they are used.

Alternate types of expansion joints may be substituted for the expansion joint shown on this sheet after approval by the Department.

Flared end sections are to be furnished with tongue or groove, and/or bell or spigot as required, in order that joints may be laid with the bell or groove end upstream.

COLORADO
DEPARTMENT OF HIGHWAYS
STANDARD
FLARED END SECTION
7°30' ANGLE SECTION
AND
COPPER EXPANSION JOINT
FOR
ø CONCRETE PIPE STRUCTURES

Designed by R.S.M.	Approved by
Made by J.M.K.	
Checked by R.S.M.	Date: January 14, 1948

FED. ROAD DIST. NO.	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS
3	COLO.	I 25-2(44)150	22	

DETAILS OF INTERCHANGE STA. 311+ ON S.H. NO. 1

GRID NORTH
ORIGINAL SCALE · 1"=100'

MATCH LINE SEE BELOW

MATCH LINE

BOUNDARY City of Colorado Springs Power Line

U.S. AIR ACADEMY Access Controlled by Air Force Academy

S.H. NO. 1

RAMP 80A
Δ = 51° 27' 50"
D = 10° 25'
R = 550.04'
T = 265.99'
L = 494.08'

RAMP 80B
Δ = 92° 27' 26"
D = 19° 00'
R = 301.56'
T = 314.23'
L = 486.09'

RAMP 80C ONE WAY
RAMP 80D ONE WAY
RAMP 80E
RAMP 80F ONE WAY
RAMP 80G
RAMP 80H ONE WAY
RELOCATED "ROAD (85-87)"
ROAD 80
ROAD 85-87

℄ (85-87)
Δ = 61° 00' RT.
D = 2° 00'
T = 1687.6'
L = 3050.0'
R = 2865.0'

℄ (85-87)
Δ = 73° 45' LT.
T = 2274.8'
E = 717.6'
Δc = 68° 45'
Dc = 2° 00'
Tc = 1459.9'
Lc = 3437.5'
Rc = 2865.0'
θs = 2° 30'
Ls = 250'
L.T. = 166.68'
ST = 83.35'

Xc = 249.95
Yc = 3.64

Turning Movement Count
Traffic Legend
1,687 = DHV 20 Years Hence

South Entrance to Air Force Academy
S.H. No. 1 (U.S. 85-87) To Monument & Denver
S.H. No. 1 (U.S. 85-87) To Colo. Springs
Local Road to Homes

COLORADO DEPARTMENT OF HIGHWAYS
Form C. D. H. 134
Jan. 1958

RAMP 80G & RAMP 80H

FED. ROAD REG. NO	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	I 25-2 (44) 150	23	

NOTE:
Alignment and Grades as shown are subject to modification during construction after approval by the Denver Office.

PLAN — SURVEYED / PLOTTED / NOTE BOOK / NO. 22069 — BY / DATE — ALIGNMENT CHECKED / R.I. OF WAY CHECKED

PROFILE — SURVEYED / PLOTTED / NOTE BOOK / NO. 22069 — BY / DATE — GRADES CHECKED / B. M. = NOTED / STRUCTURE QUANTITIES CK'D.

1 - 9+00 ± Remove Flared End Section Rt. & Extend 24"x 274' RCCP, 30° Rt. ± No.12 Conc. Inlet (H= 5'-6") in Curb Lt. ± 24"x 2' RCCP Lt. Reset Flared End Section. Inlet Lt.

2 - 2+50 ± Reqd. 24"x 92' RCCP Cross Culv. with Flared End Sections.

3 - 8+75 ± Reqd. 24"x 54' RCCP Cross Culv. with Flared End Section Lt. Reset Flared End Section Rt. from Sta. 9+40.

4 - 9+40 ± Remove Flared End Section Lt. & Extend 24"x 170' RCCP 20° Rt. ± No.12 Conc. Inlet (H=4'-6") in Curb Rt. Reset Flared End Section Rt. of Sta. 8+75.

RAMP 80B
RAMP 80A
ROAD 80 ℄
Air Academy
RAMP 80G
RAMP 80H
ONE WAY
INSIDE EDGE Δ = 270° R = 220' L = 1036.72'
0+00 51' Rt. STA. 166+60.18 (Rd. 80)
0+00 51' Lt. STA. 166+60.18 (Rd. 80)
10+36.7 75' Rt. STA. 308+55.57 on (Rd 85-87)
10+36.7 75' Rt. STA. 313+97.57 on (Rd 85-87)
24"x 284' RCCP
24"x 274' RCCP
24"x 170' RCCP
169+55.18 (Road 80)
ROAD 85-87 ℄
← Colo. Springs
Denver →
MH. w/ Solid Cover
MH. w/ Curb Inlet 12'x14' RCCP
24"x 245' RCCP
24"x 329' RCCP
36"x 160' RCCP
Drop Inlet
24"x 239' RCCP
M.H. w/ Curb Inlet
311+26.57 (85-87)

RAMP 80 G

6470 / 6460 / 6450 / 6440 / 6430

0+00 51' Rt. Sta. 166+60.18 (Rd 80)
P.I. 6466.6
2.20%
68.8
66.05
62.2
200' V.C.
NPS.D = 375'
4%
42.4
39.7
40.25
200' V.C.
10+36.7 75' Rt. Sta. 308+55.57 on (85-87)
-2.25%
P.I. 6438.0

1.15	
11,637	140
13,384	
145,684	
9,219	
13,244	
Pit #1	

0 5 10

Pit No 1 ← U.S. Air Force ± 1 mile from center of interchange, near Kettle Creek on N.W. Side of S.H. #1.

RAMP 80 H

6470 / 6460 / 6450 / 6440

706
0+00 51' Lt. Sta. 166+60.18 (Rd 80)
-1.644%
F.L. 58.5
F.L. 53.9
551
10+36.7 75' Rt. Sta. 313+97.57 (85-87)

5,152	81	1.15	Factor
3,924	70	1,012	Excavation
63,164	81	6	Embankment
3,940		886	Embank. X Factor
5,924		1,018	Sta. Yd. Overhaul
Pit #1			Yd. Mi. Overhaul
			Borrow
			Borrow Source

0 5 10

DIETZGEN 22RCA

RAMP 80D

FED. ROAD REG. NO	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	I25-2(44)150	24	

PLAN — SURVEYED — PLOTTED — NOTE BOOK — NO. 22069 — ALIGNMENT CHECKED — RT. OF WAY CHECKED — DATE

PROFILE — SURVEYED — PLOTTED — NOTE BOOK — NO. 22069 — GRADES CHECKED — B. M.'s NOTED — STRUCTURE NOTATIONS CHKD — DATE — BY

P.C. 0+00.39' Rt. Sta. 181+99 on Road 80

Δ = 44° 55' 12"
D = 11° 00'
T = 215.34'
L = 408.36'
R = 520.91

4+18 ∞ Reqd 24"x72" R.C.C.P Cross Culv. with Flared End Sections

P.T. 4+08.4

RAMP 80D One Way S. 82° 44' E.

RAMP 80C

RAMP 80F

24" R.C.C.P.

℄ ROAD 80

P.I. 2+15.54 (Ramp 80.0)

12+50 ∞ Reqd 36"x96" R.C.C.P Cross Culv. with Flared End Sections.

12+50 ∞ Reqd Metal Embankment Protector (Type 3) & 12"x38" C.M.P. with Conc. Apron L.F.

63 ~~70~~ 14+~~70~~ Reqd 24"x62" R.C.C.P. Cross Culvert with Flared End Sections, Ditches

P.C. 13+04.87

Δ = 50° 20' 06"
D = 10° 30'
T = 256.41'
L = 479.38'
R = 545.71'

70' 301+83.40 BK.
15' 271+33.40 P.C. VARIES

220' TAPER

300' DECELERATION LANE

Δ = 17° 44' 25"
R = 1910.08'
(S.A.E.)

235

Colorado Springs

← Denver

P.I. 15+61.3 (Ramp 80.0)

℄ S.H. 1 (I-25 85-87)

24"x48" R.C.C.P.

24"x64" R.C.C.P.

Drop Inlet

RAMP 80B

RAMP 80D

6460 / 6450 / 6440 / 6430 / 6420

Sta. 56+51.99 (Ad 80)
0.00 - 39' Rt.

+3.53 %
+1.30%
-3.01 %
-0.53 %
1.66%

P.I. 64+52.22
P.I. 64+45.12
P.I. 64+33.34
P.I. 62+35.72

64.52
66.42
49.80
49.59
14.76
40.24
36.65
34.93
33.87
33.08
31.08

F.L. 28.2
F.L. 28.0
F.L. 28.9

17° 44' 25" Rt.
Sta. 298+50.0 (SH. 41)

200 V.C.
N.P.S.D. = 425'

500 V.C.
N.P.S.D. = 440

300' V.C.

200 V.C.
N.P.S.D. = 745'

Factor	1.15
Excavation	44,524
Embankment	51,204
Embank. X Factor	563,244
Sta. Yd. Overhaul	50,910
Yd.-Mi. Overhaul	51,204

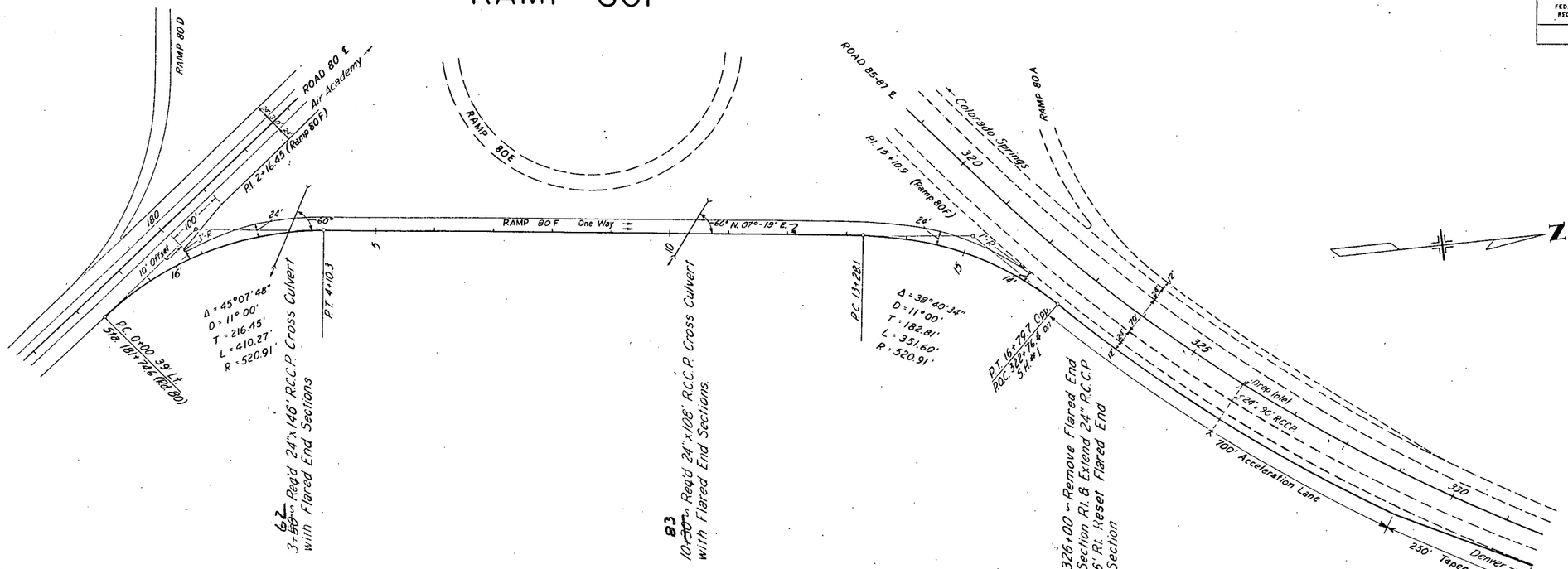
Pit No. 1 — U.S. Air Force — 1 Mile from center of Interchange near Kettle Creek

Form C. D. H. 134
Jan. 1958

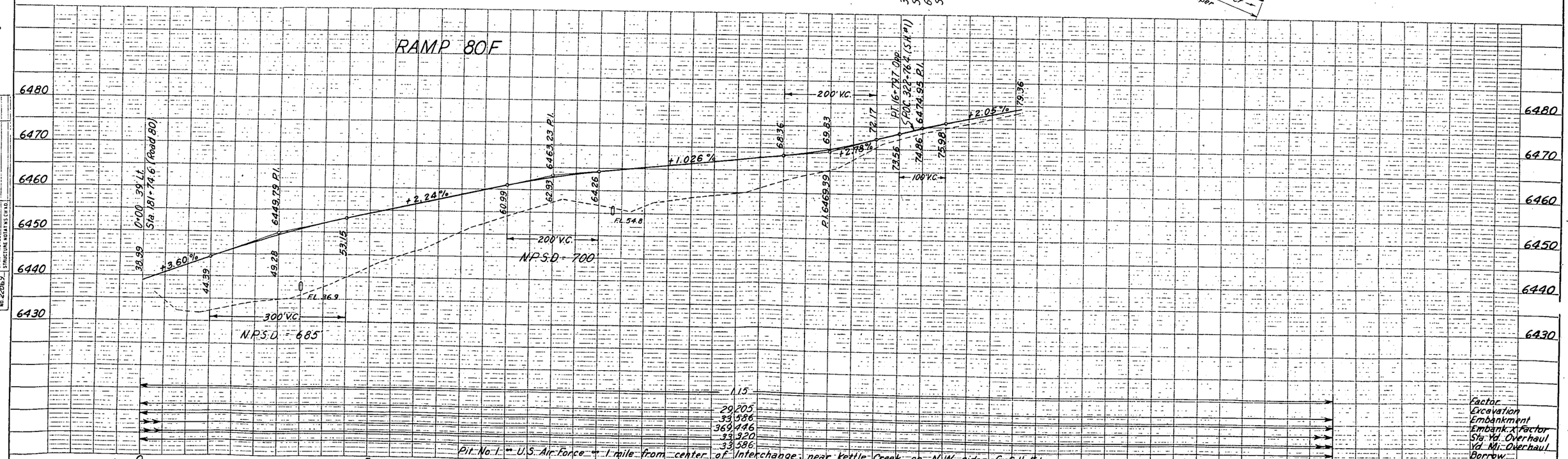
RAMP 80F

FED. ROAD REG. NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	I 25-2(44)150	25	

PLAN
SURVEYED
PLOTTED
NOTE BOOK
NO. 22069
DATE
BY
ALIGNMENT CHECKED
RT. OF WAY CHECKED



PROFILE
SURVEYED
PLOTTED
NOTE BOOK
NO. 22069
DATE
BY
ALIGNMENT CHECKED
B.M.'s NOTED
STRUCTURE NOTATIONS CHKD.



Factor	Excavation	Embankment	Embank. X Factor	Sta. Yd. Overhaul	Yd. Mi. Overhaul	Borrow	Borrow Source
1.15							
	29,205						
	33,586						
	369,446						
	33,320						
	33,586						

Pit No 1 - U.S. Air Force - 1 mile from center of Interchange; near Kettle Creek on N.W. side of S.H. #1.

DIETZGEN 2010A

COLORADO DEPARTMENT OF HIGHWAYS
Form C. D. H. 134
Jan. 1958

ROAD 80

FED. ROAD REG. NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLO.	I 25-2(44)150	26	

PLAN — NOTE BOOK NO. 22069 — BY — DATE
SURVEYED — PLOTTED — LAYOUT CHECKED — RT. OF WAY CHECKED

PROFILE — NOTE BOOK NO. 22069 — BY — DATE
SURVEYED — PLOTTED — GRADES CHECKED — B. M.* NOTED — STRUCTURAL NO(S) VS CH'D

RAMP 80H
Air Academy
PRESENT ROAD 80
24'-30"-24'
RAMP 80G
24"x 28'4 R.C.C.P.
Colorado Springs
S.H. 1 (U.S. 85-87)
M.H., Solid Cover
24" R.C.C.P.
RAMP 80C
169+55.18 on Road 80
Elev 6472.98
Denver
24" R.C.C.P.
24'-24" R.C.C.P.
Drop Inlet
171+05.68
172+27.21
RAMP 80E
175
170
RAMP 80F
A.T.&T. Co.
City of Colorado Springs Power Line
BOUNDARY
250
180
182+40 ± Reqd Metal Embankment Protector (Type 3) & 12"x22" C.M.P. with Conc Apron Lt. & Metal Embankment Protector (Type 3) & 12"x34" C.M.P. with Conc Apron Rt.
CREEK
183'± Remove Barbed Wire Cross Fence
- Future Construction - to be Constructed by County Forces
Area denied to traffic by Striping
Reversing 1°30' Curves
N. 37°48'48" W.
Sta. 178+80 ±
200' R
G.R.
RAMP 80D
250
U.S. AIR ACADEMY
(Access Controlled by Air Force Academy)
181+50 ± Reqd 10'x6'x88' Box Culvert (Type 10A) Channel Improvment Lt. & Rt. (W=12')
182+80 ± Reqd Type "B" Conc. Apron Rt.
Grouted Rubble Slope Paving.
Median Inlet (H=3'-6") with 18"x70' R.C.C.P. Culv. with Flared End Section & Conc. Apron Rt.
PINE
10
CLEARING & GRUBBING
183+ to 185+ ± Scrub Brush
185
190
50'
50'

Contr. Bridge 169+55.18 & Pier Elev 6472.98
+0.5554%
Pl 6479.80
72.57
73.79
66.70
400' V.C.
NPSD = 355'
-4.10%
42.0
35.50
32.0
END CONSTRUCTION
F.L. 27.5
-0.90%
Pl 6443.90
115
460
402
460
66,409
76,372
839,190
65,882
76,290
Pit #1
82
Pit No. 1 ~ U.S. Air Force ± 1 mile from center of Interchange, near Kettle Creek on N.W. side of S.H. #1
Factor
Excavation
Embankment
Embank. X Factor
Sta. Yd. Overhaul
Yd. M. Overhaul
Borrow:
Borrow Source
6480
6470
6460
6450
6440
6430
6420
165
170
175
180
185
40

DIETZGEN 85