TITLE SHEET

FEDERAL ROAD REGION NO	DIVISION	PROJECT NO	SHEET NO
9	COLORADO	S 0089 (4)	1

(R-1) 4-20-71 D.H.H.

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS — STATE OF COLORADO

PLAN AND PROFILE OF ~~PROPOSED~~ COMPLETED

FEDERAL AID PROJECT NO. S 0089 (4)

STATE HIGHWAY NO. 89

PROWERS COUNTY

AS CONSTRUCTED
REVISED DATE 9-16-71

CONVENTIONAL SIGNS

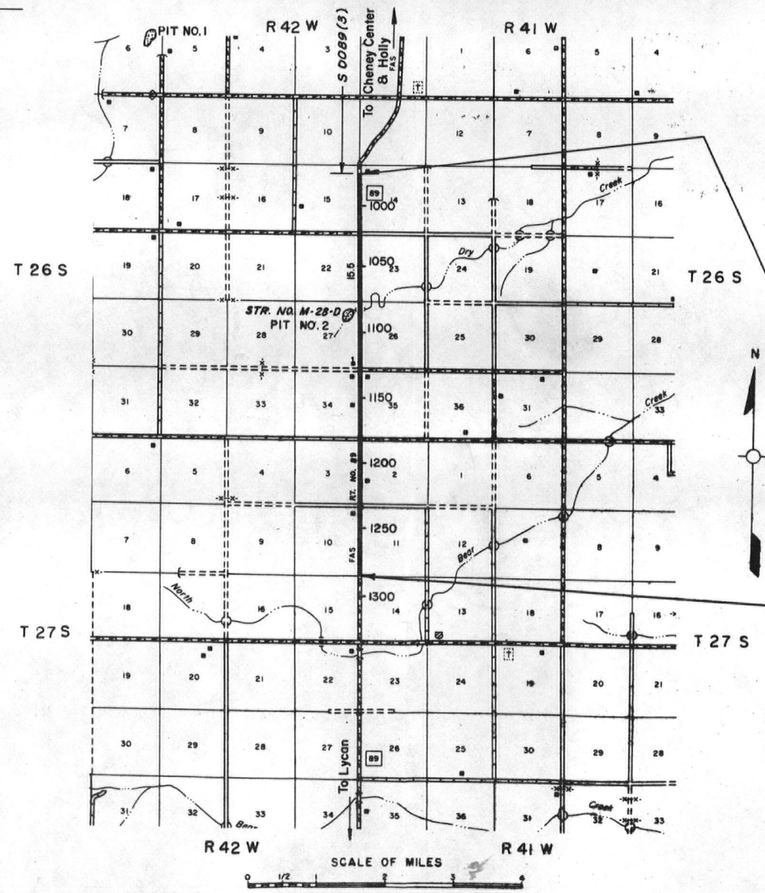
CENTER LINE
COUNTY LINE
TOWNSHIP OR RANGE LINE
LAND LINES — SECTION LINE — ¼ SECTION LINE — ⅛ SECTION LINE
CITY LIMITS
RAILROAD — PLAN SHEET — TITLE SHEET
BARBED WIRE FENCE
WOVEN WIRE - COMBINATION FENCE
TELE. & TELEG. LINE — TO BE REMOVED
POWER LINE — RELOCATED
PRESENT ROAD (PLAN SHEETS)
RIGHT OF WAY LINE — R O W MARKER
ACCESS POINTS (FREEWAYS)
C OF A LINE (CONTROL OF ACCESS)
ACCESS DENIED BY DEED — 24' OP — OP: OPENING — 16' OP
TOP OF CUTS
TOE OF FILLS
DETOUR
UNDERGROUND TELE. CABLE — T — T — T

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
NET LENGTH OF PROJECT } 31,022.1 FT. = 5.875 MI.



INDEX OF SHEETS

TABULATION OF LENGTH AND DESIGN DATA

STATION	ROADWAY LIN. FT.	MAJOR STRUCTURE LIN. FT.
974+77.9 Begin S 0089(4) = 974+77.9 End S 0089(3)	10,099.0	
1075+76.9 Begin C.B.C. Str. No. M-28-D		26.2
1076+03.1 End C.B.C.	20,896.9	
1285+00 End S0089(4)		
TOTALS	30,995.9	26.2

SUMMARY	LIN. FT.	MILES
Roadway	30,995.9	5.870
Major Structure	26.2	0.005
TOTALS (NET AND GROSS LENGTH)	31,022.1	5.875

DESIGN DATA

Maximum Degree of Curve	Tangent
Maximum Grade	1.76 %
Minimum S.S.D. - Horizontal	>900'
Minimum S.S.D. - Vertical	730'
Maximum Design Speed	70 M.P.H.
1991 Design Traffic Vol.	ADT 310 / DHV 37

PROJECT STARTED - MAY 10, 1971
PROJECT COMPLETED - SEPTEMBER 16, 1971
CONTRACTOR - ROCKY MOUNTAIN OIL PAVING INC.
RESIDENT ENGINEER - L.D. MULLER

"As Constructed" No Revisions
Sheets 2, 7-9, 13-14 & 16-18

STA. 974+77.9 BEGIN S 0089 (4) =
STA. 974+77.9 END S 0089 (3)

STA. 1285+00 END S 0089(4)

SEE SPECIAL PROVISIONS FOR NOTICE TO BIDDERS

DIVISION OF HIGHWAYS
APPROVED
Lohan E. Shumate 4-7-71
CHIEF ENGINEER DATE
By: L.L. Bowen Dep. Ch. Engr.

DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
APPROVED: DATE
DIVISION ENGINEER

DIVISION OF HIGHWAYS
APPROVED
Lohan E. Lee 10-25-71
DIST. CONST. ENGR. DATE

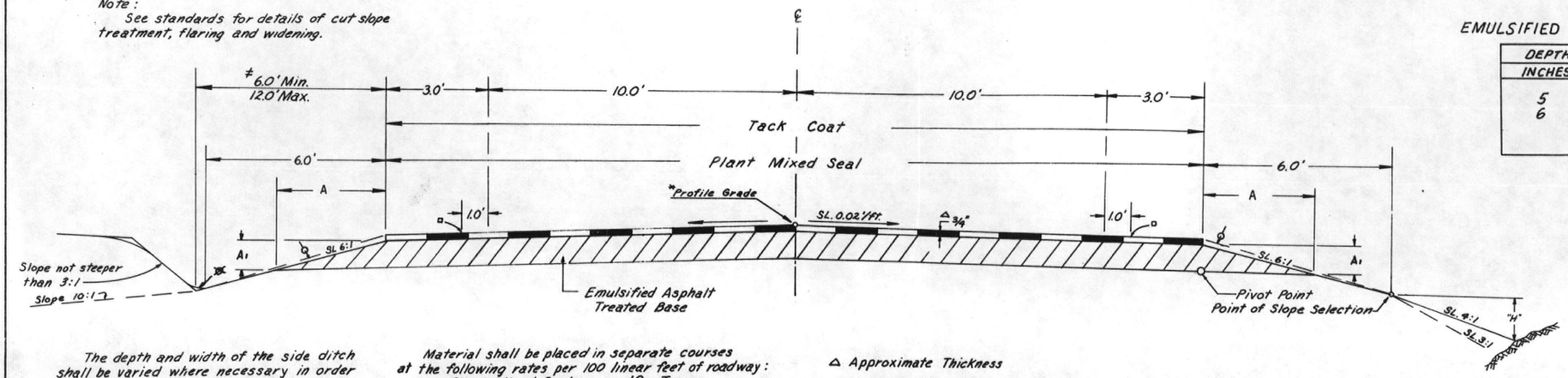
D.H.H.

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS – STATE OF COLORADO
FORM D.O.H. 126
JULY, 1968

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S 0089(4)	2	

TYPICAL SECTION

Note:
See standards for details of cut slope treatment, flaring and widening.



EMULSIFIED ASPHALT TREATED BASE

DEPTH INCHES	A FEET	A1 FEET
5	2.8	0.5
6	3.4	0.6

Fill Slopes

Slope 4:1 where "H" is 3' or less.
Slope *3:1 where "H" is over 3'.
*In special cases, slope may be steepened.

The depth and width of the side ditch shall be varied where necessary in order to provide proper drainage.

Excavation below 6:1 slope and/or 10:1 slope will not be permitted.

⊠ Break points on slopes and in bottom of ditches shall be rounded on construction for a pleasing appearance.

Material shall be placed in separate courses at the following rates per 100 linear feet of roadway:

Plant Mixed Seal	12	Tons
5" Emul. Asph. Treat. Base	80	Tons
6" Emul. Asph. Treat. Base	98	Tons

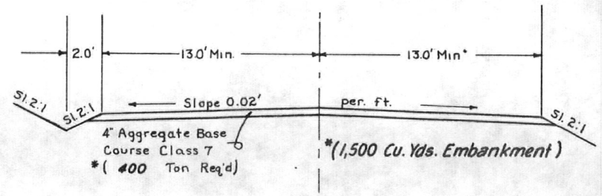
△ Approximate Thickness

□ Location of 3" wide solid white painted stripe.

≠ 8.0' used for preliminary.

ϕ The Contractor will be required to place suitable material to this line after completion of sealing operation.

Typical Section for Detour



* Quantities for information only.

Note: Detour drainage structures to be furnished by State Forces.

GENERAL NOTES

For preliminary plan quantities of Bituminous Materials the following rates of application were used:

Tack Coat, Emul. Asph. @ 0.10 Gals. per Sq. Yd. (Diluted)
Plant Mixed Seal @ 82.5 Lbs. per Sq. Yd. per 0.75 Inch Thickness

Rates of application shall be as determined by the Engineer at the time of application.

Flexible conduits on this project with helical corrugations, joined by dimpled connecting bands, shall use a sealing compound or gasket with the connecting band.

The Type of Compaction for reconditioning shall be AASHO T-99.

Depth of Moisture-Density control for Grading Sections shall be as follows:

Full depth of all embankments.

The Contractor shall conduct his operations so that a minimum of existing vegetation, adjacent to the roadway, is destroyed.

Plain water shall be used as a dust palliative where required. Locations shall be as ordered.

Road approaches which require Plant Mixed Seal shall be tacked and a ¾" thickness of P.M. Seal placed as follows:

Public approaches and entrances to buildings or residences shall be sealed 50'ft. out from edge of shoulder or to the Right of Way line, whichever is less. Field entrances shall be sealed 4ft. out from edge of shoulder.

Approaches shall have Emulsified Asphalt Treated Base.

Guard posts, signs and delineators will be removed by State Forces.

It is estimated that 500 Hours of Flagging for controlling traffic will be required for this project.

Ski-type device 30 feet in length or short shoe shall be furnished with the automatic control system of each bituminous paver.

It is estimated that 264 gal. of Pavement Marking Paint will be required for this project. This quantity includes the following:

White Paint . . . . . 259 gal.
Yellow Paint . . . . . 5 gal.

The Engineer will establish all terminal points for no-passing zones on the project.

DEPARTMENT OF
STATE OF COLORADO
FORM D.O.H. 714 (LINEN)
REV. OCT 1967

SUMMARY OF ~~APPROXIMATE~~ FINAL QUANTITIES

AS CONSTRUCTED
REVISED DATE 9-16-71

FEDERAL ROAD RIBBON NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S 0089(4)	3	

INDEX BOOK	INDEX PAGE	INDEX SHEET	CONTRACT	CONTRACT ITEM		UNIT	ROADWAY	FINAL		MAJOR STRUCTURE M-28-D	FINAL						PROJECT TOTALS	FINAL PROJECT TOTALS	DIFF.	
2	31,35		202	Removal of Structure		Each	1	2									1	2	+1	
2	18		202	Removal of Bridge		Each				1	1						1	1	0	
2	17		202	Removal of Fence		Lin.Ft.	400	400									400	400	0	
2	53		203	Unclassified Excavation		Cu. Yd.	1,000	1,128									1,000	1,128	+128	
		5	203	Borrow		Cu. Yd.	15,000	12,959									15,000	12,959	-2,041	
		5	203	Compaction (AASHO T99)		Cu. Yd.	12,000	12,114									12,000	12,114	+114	
		5	204	Haul		Yd. Mi.	3,700	4,284									3,700	4,284	+584	
		5	204	Haul		Ton Mi.	276,000	265,930									276,000	265 930	-10,070	
		4	206	Structure Excavation		Cu. Yd.	230	229		60	153						290	382	+92	
		4	206	Structure Backfill (Class 2)		Cu. Yd.	145	140		185	276						330	416	+86	
FORM		7½	209	Wetting		M Gal.	1,330	1,632									1,330	1,632	+302	
2	40		210	Reset Mailbox Structure		Each	2	2									2	2	0	
		5	303	Emulsified Asphalt Treated Base (Class 7)		Ton	34,200	32,983.25									34,200	32,983.25	-1,216.75	
FORM	305		306	Reconditioning		Mile	5.5	5.50									5.5	5.50	0	
		5	410	Plant Mixed Seal Coat (Type B)(Haul and Asphalt)		Ton	4,000	4,049.00									4,000	4,049.00	+49.00	
FORM		49	411	Emulsified Asphalt (CSS-1)		Gal.	406,000	359,292									406,000	359,292	-46,708	
		4	601	Concrete Class A		Cu. Yd.				152	151.05						152	151.05	-0.95	
		4	602	Reinforcing Steel		Lb.				14,300	14,248						14,300	14,248	-52	
		4	603	43 x 27 Inch Corrugated Steel Pipe Arch		Lin.Ft.	8	8									8	8	0	
		5	606	End Anchorage Type 1		Each	4	4									4	4	0	
		5	606	Guard Rail Type 3		Lin.Ft.	500	500									500	500	0	
		4	607	End Post		Each	3	2									3	2	-1	
		4	607	Corner and Line Brace Post		Each	4	3									4	3	-1	
		4	607	Fence Barbed Wire with Metal Posts		Lin.Ft.	400	434									400	434	+34	
FORM		7½	614	Flagging		Hour	500	952									500	952	+452	
2	44		614	Pavement Marking Paint		Gal.	264	230									264	230	-34	
		4	617	18 Inch Culvert Pipe		Lin.Ft.	410	410									410	410	0	
		4	617	24 Inch Culvert Pipe		Lin.Ft.	298	298									298	298	0	
2	41		620	Field Office, Deleted By C.O. 15609		Each	1	0									1	0	-1	
2	42		620	Field Laboratory		Each	1	1									1	1	0	
2	43		620	Sanitary Facility		Each	1	1									1	1	0	
FORM	305		621	Maintenance of Detours		L.S.	●										●	●	○	
FORM	305		626	Mobilization		L.S.	●										●	●	○	
				STATE FORCES																
2	7,39			Furnishing and Installing Identification Sign		Each	2	2									2	2	○	
				Signing (Non Federal Aid)		L.S.	●										●			
				RIGHT OF WAY																
				Easements		L.S.	●										●			
				SALVAGE MATERIAL																
				Salvage Bridge Timber Sta. 1075+90		L.S.	●										●			

DEPARTMENT OF HIGHWAYS, STATE OF COLORADO
FORM D. O. H. 125 (LINEN)
REV.. OCT. 1967

STRUCTURE QUANTITIES

AS CONSTRUCTED
REVISED DATE 9-16-71

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLORADO	S 0089(4)	4

INDEX BOOK	INDEX PAGE	INDEX SHEET	LOCATION	UNCLASSIFIED EXCAVATION CUBIC YARD EXCAV.	UNCLASSIFIED EXCAVATION CUBIC YARD EMB.	UNCLASSIFIED EXCAVATION CUBIC YARD DITCH	STRUCTURE EXCAVATION CUBIC YARD	STRUCTURE BACKFILL CUBIC YARD CL. 2	REMOVAL OF STRUCTURE EACH	E.A.T.B. (CLASS 7) TON	P.M. SEAL (TYPE B) TON			CONCRETE CUBIC YARD CL. A	REINFORCING STEEL LB.	HAUL YARD MILE	CULVERT PIPE LINEAR FEET 18"	CULVERT PIPE LINEAR FEET 24"	"H" OVER CULV. FT.	SLOPE AND DITCH PAVING CUBIC YARD	END SECTION EACH	MISCELLANEOUS
			~~974+77.9~~							~~*40~~	~~*6~~											1 - Identification Sign (State Forces)
2	7		974+77.9																			
2	8		987+15				8	5		~~17~~	~~2~~						30		2			
2	9		995+35				6	5		~~17~~	~~2~~						30		2			
2	10		1007+70				9	5		~~17~~	~~2~~						30		2			
2	11		1022+17.6		30					~~110~~	~~28~~					36						
2	12		1023+00		12		30	15								15		62	3			
2	13		1046+00		12		38	15								9		64	3			
2	14		1048+70		30					~~17~~	~~2~~					20			1			
2	14		1048+75		30		6	5		~~17~~	~~2~~					20	30		1			
2	15		1071+60				11	5		~~17~~	~~4~~						30		~~400~~ 434			Remove 400 Lin. Ft. Fence - Build ~~400~~ Lin. Ft. BW Fence
2	17		1072+ to 1075+				~~ø153~~	~~ø276~~						~~ø15+1~~	~~ø14,292~~							#1 - Remove Bridge 2 - End Posts
2	18		1075+90				60	183						151.05	14,248							Maintenance of Detours - Lump Sum
2	16		1072+60 to 1078+60																			3 - Corner & Line Brace Posts
2	20		1101+57		30					~~17~~	~~2~~					10						
2	21		1102+55		30		6	5		~~17~~	~~2~~					11	30		1			
2	22		1125+00		12		34	15								11		62	3			
2	23		1125+90				7	5		~~17~~	~~4~~						30		1			
2	24		1128+12				6	7		~~110~~	~~28~~						50		1			
2	25		1129+80		30					~~17~~	~~8~~					26						
2	26		1154+ to 1156+		50											68						
2	27		~~1154+40~~							~~17~~	~~4~~											
			~~1157+00~~							~~17~~	~~4~~											
			~~1157+80~~							~~17~~	~~4~~											
			~~1158+50~~							~~17~~	~~4~~											
			~~1181+21~~							~~55~~	~~14~~											
			~~1181+30~~							~~55~~	~~14~~											
2	28		1181+55 ~~1181+75~~		12		12	13								25		54	1			
2	29		1207+60		30		10	5		~~17~~	~~2~~					70	30		1			
2	30		1207+90				2	5		~~17~~	~~2~~						30		1			
2	31		1216+35		30		8	5	1	~~17~~	~~8~~					75	30		1			
2	32		~~1234+00~~							~~55~~	~~14~~											
2	33		~~1234+14~~							~~55~~	~~14~~					38		56	2			
2	34		1234+50		12		23	13									30		1			
2	35		1236+95				7	5	1	~~17~~	~~4~~								1			8 Lin. Ft. 43"x27" C.S.P.A.
2	36		~~1247+60~~							~~17~~	~~4~~								1			
2	37		1256+65				1	2														1 - Identification Sign (State Forces)
2	38		1273+95		30		5	5		~~17~~	~~2~~					108	30					2 - Reset Mailbox Structure
2	39		1285+00																			
2	40		ENTIRE PROJECT		~~380~~				2	*	*					~~542~~						
			TOTALS		~~320~~		229	140	+	~~820~~	~~186~~					~~444~~	410	298				

ø Not included in Roadway Quantities * Included in Roadway Quantities

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS — STATE OF COLORADO
FORM D.O.H. 126
JULY, 1968

AS CONSTRUCTED
REVISED DATE 9-16-71

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	5	

SURFACE COURSE PLAN

STATION To STATION	SOURCE	TONS USED PLANT MIX SEAL (TYPE B) TOP LAYER	TONS USED PLANT MIX SEAL (TYPE B) FINAL
974 + 00 ~ 1015 + 00	UNDESIGNATED	492	521.50
1015 + 00 ~ 1022 + 17		86	91.25
1022 + 17 ~ 1025 + 00		34	35.95
1025 + 00 ~ 1285 + 00		3,120	3,400.30
FROM STRUCTURE QUANTITIES		186	*
TOTALS:		3,918	4,049.00

GUARD RAIL

STA. To STA.	SIDE	GUARD RAIL TYPE 3 LIN. FT.	GUARD RAIL FINAL
1074 + 42 To 1076 + 93	Rt.	250	250
1074 + 87 To 1077 + 38	Lt.	250	250
TOTAL:		500	500

NOTE: TYPE I END ANCHORAGE ON EACH END, TOTAL 4 REQUIRED. W = 4' Bk #2, Page 19 Total 4 Placed

BASE COURSE PLAN

STATION To STATION	SOURCE	THICK	TONS USED EMULSIFIED TREATED BASE (CLASS 7)	TONS USED ASPHALT TREATED BASE FINAL	★ HAUL - TON MILE EMULSIFIED TREATED BASE (CLASS 7)	★ HAUL - TON MILE ASPHALT TREATED BASE FINAL
974 + 00 ~ 1015 + 00	Pit No. 1	6"	4,018	4,393.25	25,736	28,261
1015 + 00 ~ 1022 + 17		5"	574	700.60	3,426	4,181
1022 + 17 ~ 1025 + 00		5"	226	470.15	1,339	2,786
1025 + 00 ~ 1285 + 00		6"	25,480	27,413.25	214,433	230,702
ESTIMATED FOR CORRECTION:						
IRREGULARITIES IN SUBGRADE			3,030	*	24,493	*
FROM STRUCTURE QUANTITIES			820	*	6,492	*
TOTALS:			34,148	32,983.25	275,919	265,930

NOTE ~ STABILIZATION BASED ON:

1. EDLA 18K 6.0
2. REGIONAL FACTOR 1.25
3. SERVICEABILITY INDEX 2.00
4. PLANT MIXED SEAL (TYPE B) 0.25
5. EMULSIFIED ASPHALT TREATED BASE (CL. 7) . . 0.23 (R_s = 96)

* INCLUDED IN ROADWAY QUANTITIES

★ FROM TON-MILE HAUL WORK SHEETS

SUMMARY OF EARTH WORK QUANTITIES

INDEX Book	Page	Sheet		CU. YD.	FINAL CU. YD.
			UNCLASSIFIED EXCAVATION:		
2	53		STRIPPING (REMOVING OVERBURDEN)	400	564
2	53		STRIPPING (REPLACING OVERBURDEN)	400	564
			TOTAL:	800	1,128
			BORROW:		
		19,20	FOR ROADWAY EMBANKMENT	12,943	12,553
		19,20	~~EST. FOR SUBSIDENCE~~	~~1,294~~	
		19,20	STRUCTURE QUANTITIES AS EMB.	376	406
			TOTAL:	14,613	12,959
			COMPACTION:		
21-24			EMBANKMENT (NET)	11,002	11,734
4			STRUCTURE QUANTITIES AS EMB. (NET)	320	380
			TOTAL:	11,322	12,114
			HAUL:	Yd. Mi.	
Mass Diag. 3			BORROW	2,908	3,742
			~~EST. FOR SUBSIDENCE~~	~~291~~	
4			FROM LIST OF STRUCTURES	444	542
			TOTAL:	3,643	4,284

ROADWAY QUANTITIES BALANCE:

	Cu. Yd.
BORROW	12,943
~~BORROW × FACTOR~~	11,002
~~EMBANKMENT NET (ROADWAY FROM ELECTRONIC COMPUTER)~~	~~11,002~~

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS — STATE OF COLORADO
FORM D.O.H. 126
JULY, 1968

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089(4)	6	

AS CONSTRUCTED
REVISED DATE 9-16-71

PIT NO. 2

Owner : Melvin Rushton, Holly, Colorado 81047

Location : Northeast ¼ Northeast ¼ Sec. 27, T. 26-S, R. 42 W.

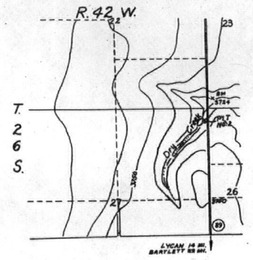
Use : Borrow

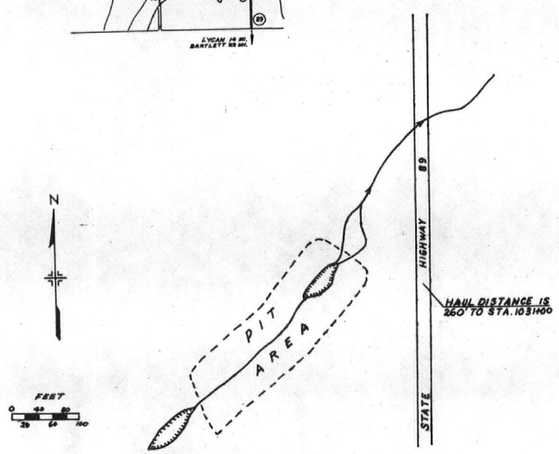
Quantity Available : 30,000 Cu. Yds.

Stripping : ~~800~~ ø1,128 Cu. Yds.

Haul Distance : 260' Feet to Sta. 1081+00

ø Includes Remove and Replace Overburden.





LOG OF PIT

March 19, 1971 Sample No. 1412

Test No.	Depth in Feet	Description of Test Hole Material
1	0.0-10.0+	Sandy Clay

PIT NO. 1

Owner : Mr. Howard C. Plunkett, Coolidge, Kansas 67836

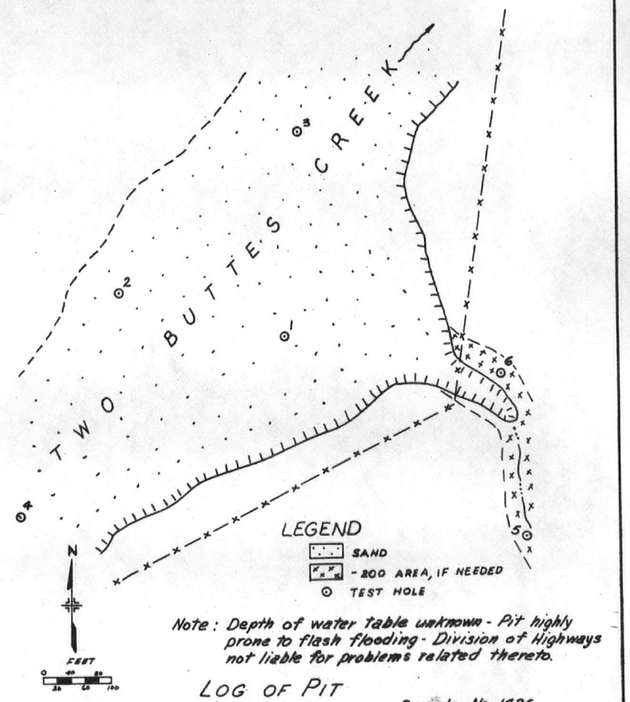
Location : Part of the East ½ of the N.E. ¼ Sec. 6, T. 26 S., R. 42 W.

Use : Emulsified Asphalt Treated Base.

Quantity Available : 46,000 Cu. Yds.

Stripping : None

Haul Distance : 5.90 Miles to Sta. 1022+17



Note : Depth of water table unknown - Pit highly prone to flash flooding - Division of Highways not liable for problems related thereto.

LOG OF PIT

March 4, 1971 Sample No. 1426

Test No.	Depth in Feet	Description of Test Hole Material
1	0.0 - 6.1	Sand : well-graded, some fine gravel, some silt & clay
1A	6.1 - 9.0	Sand : medium to course-grained, gravelly, clay balls up to about 2" in diameter
1B	9.0-+	Sand : fine, very silty & clayey
2	0.0 - 5.7	Sand : fine to medium-grained, trace of fine gravel
2A	5.7 - 6.7+	Sand : fine to medium-grained, silty, clayey
3	0.0 - 5.0+	Sand : fine to medium-grained, trace of pebbles, some silt
4	0.0 - 6.3+	Sand : fine to medium-grained, some silt
5	0.0 - 2.8	Sand : fine, silty, clayey
5A	2.8-+	Sand : fine, silty, clean
6	0.0 - 3.4+	Silt & Fine Sand : Clayey

T. OF HIGHWAYS
H 137

TRACING
-PLAIN

Initial	Date
WWD	5-1-54
WND	5-1-54
TJM	5-4-54
TJM	5-18-54
MGD	8-6-54

STANDARD M-601-A
SPECIAL FOR THIS PROJECT

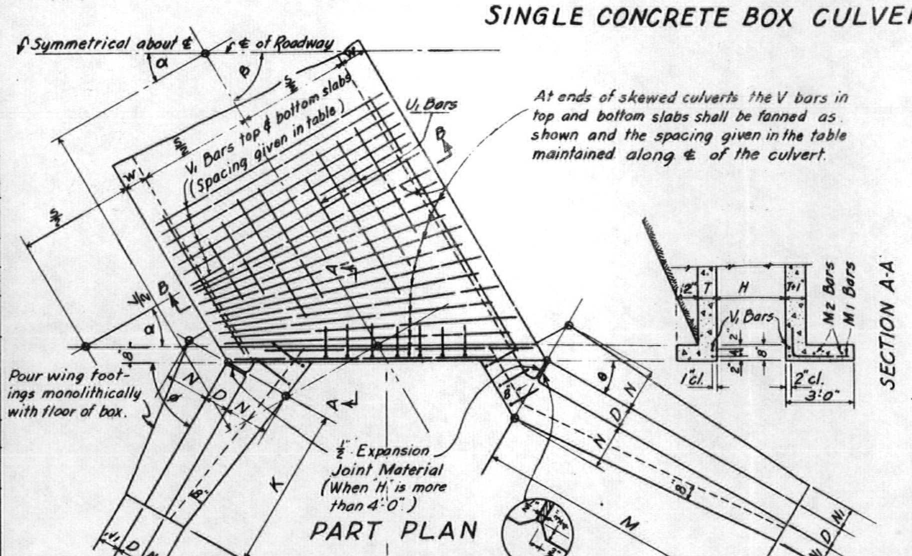
FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLORADO	S 0089(4)	7

SINGLE CONCRETE BOX CULVERT

Dimensions & Quantities (see Wingwall Standard for Wings)

Height of Fill Allowed	Type	Span S	Height H	Slab T	Wall w	V1 Size	V1 Spa.	W1 Size	W1 Spa.	No. bars required U1	No. bars required M1	One Lin. Ft. of Box Concrete Cu. Yds.	One Lin. Ft. of Box Steel Lbs.	Two Headwalls Concrete Cu. Yds.	Two Headwalls Steel Lbs.
35'-0"	2A	2'-0"	2'-0"	6"	8"	3/4"φ	12"	1/2"φ	12"	8	8	0.232	17.5	1.30	81
30'-0"	3A	3'-0"	2'-0"	7"	8"	7/8"φ	12"	1/2"φ	12"	10	8/Cos α	0.299	26.3	1.50	119
			3'-0"							12		0.349	29.0	1.65	123
20'-0"	4A	4'-0"	2'-0"	7½"	8"	7/8"φ	12"	1/2"φ	12"	12	10/Cos α	0.362	31.8	1.75	150
			3'-0"							14		0.412	34.6	1.90	154
			4'-0"							16		0.461	37.3	2.10	158
16'-0"	5A	5'-0"	3'-0"	8"	8"	3/4"φ	8"	1/2"φ	8"	16	12/Cos α	0.481	45.3	2.20	153
			4'-0"							18		0.530	48.7	2.40	157
			5'-0"							20		0.579	52.0	2.60	161
20'-0"	5B	5'-0"	3'-0"	8½"	8"	3/4"φ	8"	1/2"φ	8"	16	12/Cos α	0.500	45.5	2.20	153
			4'-0"							18		0.549	48.8	2.40	157
			5'-0"							20		0.598	52.2	2.60	161
14'-0"	6A	6'-0"	4'-0"	8½"	8"	3/4"φ	8"	1/2"φ	8"	20	14/Cos α	0.605	54.7	2.65	180
			5'-0"							22		0.654	58.1	2.85	184
			6'-0"							24		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"φ	8"	5/8"φ	8"	20	14/Cos α	0.671	72.4	2.70	223
			5'-0"							22		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
12'-0"	7A	7'-0"	4'-0"	9"	9"	3/4"φ	7"	1/2"φ	7"	22	16/Cos α	0.720	68.2	3.05	208
			5'-0"							24		0.776	71.9	3.25	212
			6'-0"							26		0.832	75.5	3.40	216
			7'-0"							28		0.887	79.2	3.70	220
15'-0"	7B	7'-0"	4'-0"	10"	9"	7/8"φ	8"	5/8"φ	8"	22	16/Cos α	0.772	81.0	3.05	257
			5'-0"							24		0.827	85.5	3.25	262
			6'-0"							26		0.883	90.0	3.45	268
			7'-0"							28		0.938	94.5	3.75	273
20'-0"	7C	7'-0"	4'-0"	11"	9"	7/8"φ	7"	5/8"φ	7"	22	16/Cos α	0.826	91.1	3.10	257
			5'-0"							24		0.881	96.0	3.30	263
			6'-0"							26		0.937	101.0	3.50	268
			7'-0"							28		0.992	106.0	3.75	274
10'-0"	8A	8'-0"	4'-0"	9½"	10"	3/4"φ	7"	1/2"φ	7"	24	18/Cos α	0.844	75.8	3.40	235
			5'-0"							26		0.905	79.5	3.60	239
			6'-0"							28		0.966	83.2	3.80	243
			7'-0"							30		1.027	86.8	4.10	247
			8'-0"							32		1.089	90.5	4.40	251
16'-0"	8B	8'-0"	4'-0"	11½"	10"	7/8"φ	7"	5/8"φ	7"	24	18/Cos α	0.963	100.9	3.50	292
			5'-0"							26		1.025	105.9	3.70	297
			6'-0"							28		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
20'-0"	8C	8'-0"	4'-0"	12½"	10"	7/8"φ	6"	5/8"φ	6"	24	18/Cos α	1.023	115.8	3.55	292
			5'-0"							26		1.084	121.4	3.75	298
			6'-0"							28		1.146	126.9	3.95	304
			7'-0"							30		1.208	132.5	4.25	309
			8'-0"							32		1.270	138.1	4.50	315
7'-0"	9A	9'-0"	5'-0"	10"	11"	7/8"φ	8"	5/8"φ	8"	28	20/Cos α	1.040	102.7	4.00	326
			6'-0"							30		1.108	107.1	4.20	331
			7'-0"							32		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
14'-0"	9B	9'-0"	5'-0"	12"	11"	7/8"φ	6"	5/8"φ	6"	28	20/Cos α	1.174	131.9	4.10	327
			6'-0"							30		1.242	137.5	4.30	333
			7'-0"							32		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
20'-0"	9C	9'-0"	5'-0"	14"	11"	1"φ	7"	3/4"φ	7"	28	20/Cos α	1.309	150.4	4.20	401
			6'-0"							30		1.377	156.9	4.40	408
			7'-0"							32		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
5'-0"	10A	10'-0"	6'-0"	10½"	12"	7/8"φ	8"	1/2"φ	8"	32	22/Cos α	1.260	107.7	4.60	355
			7'-0"							34		1.334	111.0	4.90	358
			8'-0"							36		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
10'-0"	10B	10'-0"	6'-0"	12"	12"	7/8"φ	7"	5/8"φ	7"	32	22/Cos α	1.369	130.4	4.70	367
			7'-0"							34		1.443	135.4	5.00	372
			8'-0"							36		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
16'-0"	10C	10'-0"	6'-0"	14"	12"	1"φ	8"	3/4"φ	8"	32	22/Cos α	1.518	150.7	4.80	449
			7'-0"							34		1.593	156.6	5.10	456
			8'-0"							36		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
5'-0"	11A	11'-0"	6'-0"	11"	12"	7/8"φ	7"	1/2"φ	7"	34	24/Cos α	1.367	128.6	4.95	383
			7'-0"							36		1.441	132.2	5.25	387
			8'-0"							38		1.515	135.9	5.55	391
			9'-0"							40		1.589	139.6	5.90	395
			10'-0"							42		1.664	143.1	6.25	399
9'-0"	11B	11'-0"	6'-0"	12½"	12"	1"φ	8"	5/8"φ	8"	34	24/Cos α	1.490	148.3	5.00	467
			7'-0"							36		1.564	152.8	5.30	472
			8'-0"							38		1.638	157.3	5.65	478
			9'-0"							40		1.712	161.8	6.00	483
			10'-0"							42		1.783	166.4	6.35	489
13'-0"	11C	11'-0"	6'-0"	14"	12"	7/8"φ	6"	5/8"φ	6"	34	24/Cos α	1.608	159.5	5.10	396
			7'-0"							36		1.682	165.1	5.40	401
			8'-0"							38		1.756	170.7	5.70	407
			9'-0"							40		1.830	176.2	6.10	412
			10'-0"							42		1.904	181.8	6.45	418
5'-0"	12A	12'-0"	6'-0"	12"	12"	7/8"φ	7"	1/2"φ	7"	36	26/Cos α	1.525	137.4	5.25	411
			7'-0"							38		1.599	141.0	5.60	415
			8'-0"							40		1.673	144.7	5.90	419
			9'-0"							42		1.747	148.4	6.25	423
			10'-0"							44		1.821	152.0	6.60	427
10'-0"	12B	12'-0"	6'-0"	14"	12"	1"φ	7"	5/8"φ	7"	36	26/Cos α	1.697	177.7	5.40	502
			7'-0"							38		1.772	182.7	5.70	508
			8'-0"							40		1.846	187.7	6.00	513
			9'-0"							42		1.920	192.6	6.40	519
			10'-0"							44		1.994	197.6	6.70	524
4'-0"	13A	13'-0"	6'-0"	12½"	12"	7/8"φ	7"	1/2"φ	7"	38	28/Cos α	1.645	146.0	5.60	442
			7'-0"							40		1.720	149.7	5.90	446
			8'-0"							42		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
8'-0"	13B	13'-0"	6'-0"	14"	12"	1"φ	7"	5/8"φ	7"	38	28/Cos α	1.787	188.4	5.70	538
			7'-0"							40		1.861	193.3	6.00	543
			8'-0"							42		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
4'-0"	14A	14'-0"	6'-0"	13½"	12"	1"φ	8"	5/8"φ	8"	40	30/Cos α	1.827	177.2	5.95	571
			7'-0"							42		1.901	181.7	6.25	577
			8'-0"							44		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
8'-0"	14B	14'-0"	6'-0"	15"	12"	1"φ	7"	5/8"φ	7"	40	30/Cos α	1.975	199.5	6.05	572
			7'-0"							42		2.049	204.5	6.40	578
			8'-0"							44		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

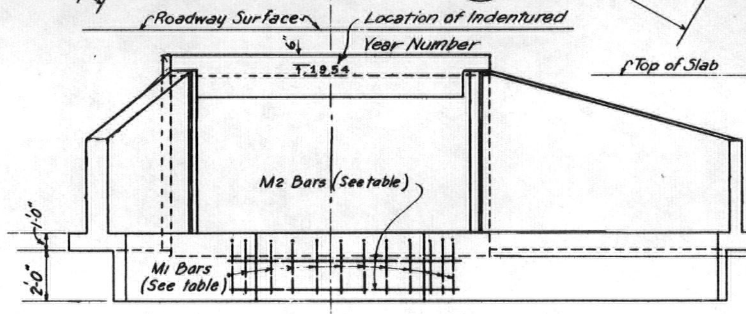
Quantities for one culvert shall be (quantity for one lin. ft. of box times L) plus (quantity for two Head Walls) plus (quantities for four wings).



At ends of skewed culverts the V bars in top and bottom slabs shall be fanned as shown and the spacing given in the table maintained along ℄ of the culvert.

PART PLAN

SECTION A-A



END ELEVATION

Note: All wing faces to receive Class I finish

Bar List for Culvert & Headwalls (See Wingwall Standard for Wings)

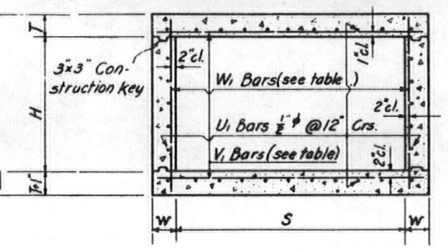
Mark	Size	No. Req'd.	Type	Length
V1	See table	10 + 24L/Spa.	I	S+2w-6"
W1	See table	6 + 24L/Spa.	I	H+2T-5"
U1	1/2"φ	See table	I	L+1'-0"
M1	1/2"φ	See table	II	3'-6"
M2	1/2"φ	4	I	(S+2w-6")/Cos α

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

(Bar dimensions are out to out of bar)

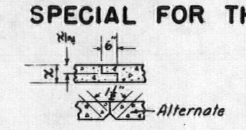
Possible Combinations (Span & Height)

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'	

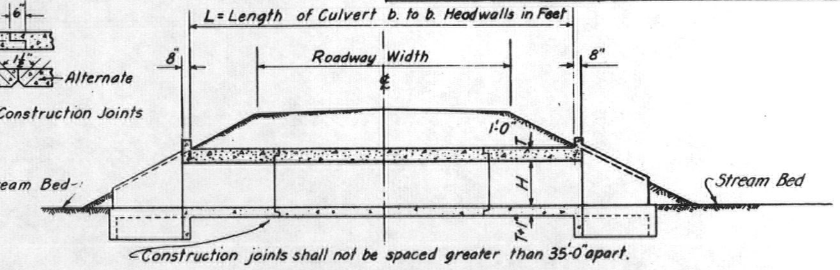


Bar dimensions are to ℄ of bar unless marked "cl" (clear).

SECTION B-B



Detail of Construction Joints



TYPICAL SECTION THROUGH CULVERT

REVISIONS		

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

DOUBLE CONCRETE BOX CULVERT

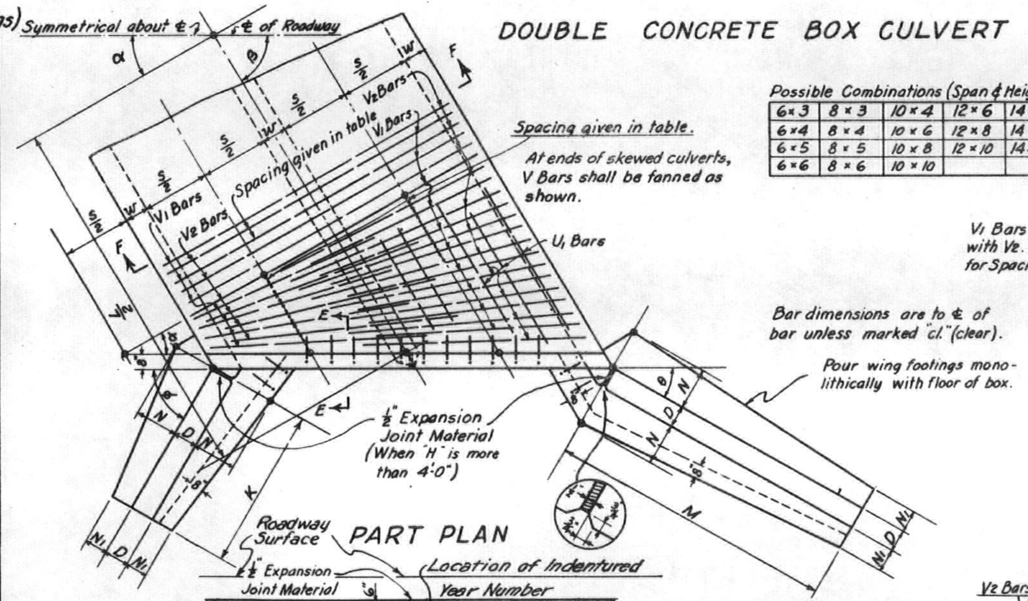
SPECIAL FOR THIS PROJECT

Dimensions & Quantities (see Wingwall Standard for Wings)

Height of fill allowed	Type	Span S	Height H	Slab T	Wall W	V1	V2	W1 Size	W1 Spac.	No. Bars Required U1	No. Bars Required M1	One Lin. Ft. of Box Concrete Cu. Yds.	One Lin. Ft. of Box Steel Lbs.	Two Headwalls Concrete Cu. Yds.	Two Headwalls Steel Lbs.
10'-0"	6-6-A	6'-0"	3'-0"	8½"	8"	1/2"φ	5/8"φ	1/2"φ	12"	48	32/Cos α	1.000	112.3	3.85	327
			4'-0"			5½" Spa.			12"	52		1.073	117.7	4.60	335
			5'-0"						12"	56		1.148	123.1	4.85	343
			6'-0"						12"	60		1.222	128.5	5.05	351
15'-0"	6-6-B	6'-0"	3'-0"	9½"	8"	1/2"φ	5/8"φ	1/2"φ	12"	48	32/Cos α	1.087	120.3	4.45	329
			4'-0"			5" Spa.			12"	52		1.161	125.7	4.65	337
			5'-0"						12"	56		1.235	131.1	4.90	346
			6'-0"						8"	60		1.309	141.4	5.10	353
20'-0"	6-6-C	6'-0"	3'-0"	10½"	8"	1/2"φ	5/8"φ	1/2"φ	12"	48	32/Cos α	1.173	130.0	4.50	331
			4'-0"			4½" Spa.			12"	52		1.247	135.4	4.75	339
			5'-0"						10"	56		1.321	142.5	4.95	347
			6'-0"						7"	60		1.395	152.4	5.15	355
10'-0"	8-8-A	8'-0"	3'-0"	10"	10"	5/8"φ	3/4"φ	5/8"φ	12"	60	40/Cos α	1.477	174.4	5.80	506
			4'-0"			6" Spa.			12"	64		1.569	179.8	6.05	514
			5'-0"						12"	68		1.662	185.2	6.30	522
			8'-0"						12"	80		1.940	206.4	7.05	545
15'-0"	8-8-B	8'-0"	3'-0"	11"	10"	5/8"φ	3/4"φ	1/2"φ	12"	60	40/Cos α	1.592	188.6	5.90	508
			4'-0"			5½" Spa.			12"	64		1.684	192.0	6.15	516
			5'-0"						12"	68		1.777	197.4	6.40	524
			6'-0"						8"	72		1.869	207.9	6.65	533
20'-0"	8-8-C	8'-0"	3'-0"	12½"	10"	5/8"φ	3/4"φ	1/2"φ	12"	60	40/Cos α	1.763	202.0	6.00	513
			4'-0"			5" Spa.			12"	64		1.856	207.4	6.30	521
			5'-0"						10"	68		1.948	214.6	6.55	529
			6'-0"						7"	72		2.041	225.7	6.75	537
5'-0"	10-10-A	10'-0"	4'-0"	10"	12"	5/8"φ	7/8"φ	5/8"φ	15"	78	48/Cos α	1.935	228.3	7.40	714
			6'-0"			7" Spa.			15"	86		2.157	239.8	7.95	733
			8'-0"						12"	94		2.380	255.2	8.70	752
			10'-0"						9"	102		2.602	275.5	9.55	771
10'-0"	10-10-B	10'-0"	4'-0"	12"	12"	5/8"φ	7/8"φ	5/8"φ	15"	78	48/Cos α	2.220	231.0	7.65	721
			6'-0"			7" Spa.			15"	86		2.442	242.5	8.20	740
			8'-0"						12"	94		2.664	258.0	8.90	759
			10'-0"						8"	102		2.886	282.6	9.75	778
15'-0"	10-10-C	10'-0"	4'-0"	14"	12"	5/8"φ	7/8"φ	5/8"φ	15"	78	48/Cos α	2.503	260.8	7.85	727
			6'-0"			6" Spa.			12"	86		2.725	275.6	8.40	746
			8'-0"						9"	94		2.947	295.0	9.15	765
			10'-0"						6"	102		3.170	325.5	10.00	784
5'-0"	12-12-A	12'-0"	6'-0"	12"	12"	5/8"φ	7/8"φ	5/8"φ	15"	98	56/Cos α	2.751	278.9	9.35	857
			8'-0"			7" Spa.			12"	106		2.973	294.5	10.05	876
			10'-0"						9"	114		3.195	315.0	10.90	895
10'-0"	12-12-B	12'-0"	6'-0"	14"	12"	5/8"φ	7/8"φ	5/8"φ	15"	98	56/Cos α	3.083	313.5	9.60	864
			8'-0"			6" Spa.			12"	106		3.305	329.2	10.30	883
			10'-0"						8"	114		3.528	354.1	11.15	902
15'-0"	12-12-C	12'-0"	6'-0"	16"	12"	5/8"φ	7/8"φ	5/8"φ	12"	98	56/Cos α	3.416	365.1	9.85	870
			8'-0"			5" Spa.			9"	106		3.638	384.7	10.55	889
			10'-0"						6"	114		3.860	415.7	11.40	908
5'-0"	14-14-A	14'-0"	6'-0"	15"	12"	5/8"φ	7/8"φ	5/8"φ	15"	110	64/Cos α	3.633	356.2	10.95	984
			8'-0"			6" Spa.			12"	118		3.855	372.0	11.60	1003
			10'-0"						9"	126		4.077	392.9	12.50	1023
10'-0"	14-14-B	14'-0"	6'-0"	16"	12"	5/8"φ	7/8"φ	5/8"φ	13"	110	64/Cos α	3.824	409.4	11.05	988
			8'-0"			5" Spa.			12"	118		4.046	425.2	11.75	1007
			10'-0"						8"	126		4.269	450.5	12.65	1026

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.



Spacing given in table.

At ends of skewed culverts, V Bars shall be fanned as shown.

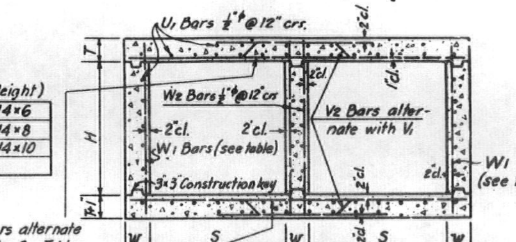
Bar dimensions are to ℄ of bar unless marked "cl." (clear).

Pour wing footings monolithically with floor of box.

PART PLAN

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		



V1 Bars alternate with V2. See Table for Spacing.

SECTION F-F

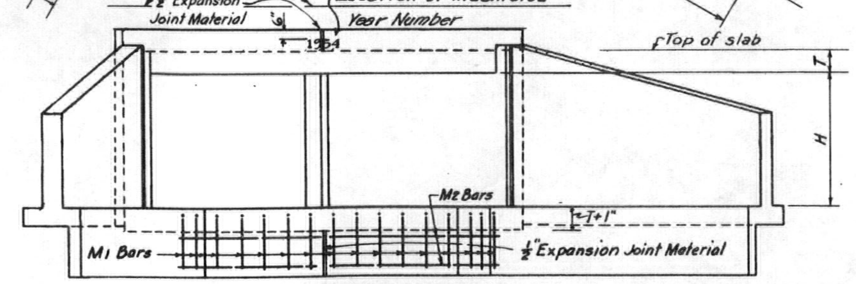
Bar List for Culvert and Two Headwalls (See Wingwall Std. for Wings)

Mark	Size	Number Required	Type	ℓ	Total Length
V1	See Table	24(L+2)/Spacing	I	S+1.5w+4"	ℓ
V2			II	0.75S+4"	2ℓ+m
W1			I	H+2T-4"	ℓ
W2	1/2"φ	2(L+2)	I	H+2T-4"	ℓ
U1	1/2"φ	See Table	I	L+12"	ℓ
M1	1/2"φ	See Table	III		3'-6"
M2	1/2"φ	8	I	(S+1.5w)/Cos α	ℓ

Type I; Type II: n = T-5, m = 1.41n; Type III (2'-6", 1'-0")

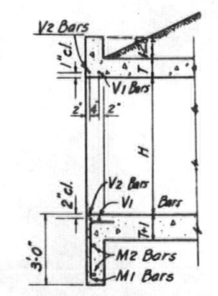
(Bar dimensions are out to out of bar.)

For General Notes, Loading and Design Data, see Wingwall Std.



END ELEVATION

Note: All wing faces to receive Class I finish.



SECTION E-E

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

SINGLE AND DOUBLE CONCRETE BOX CULVERTS

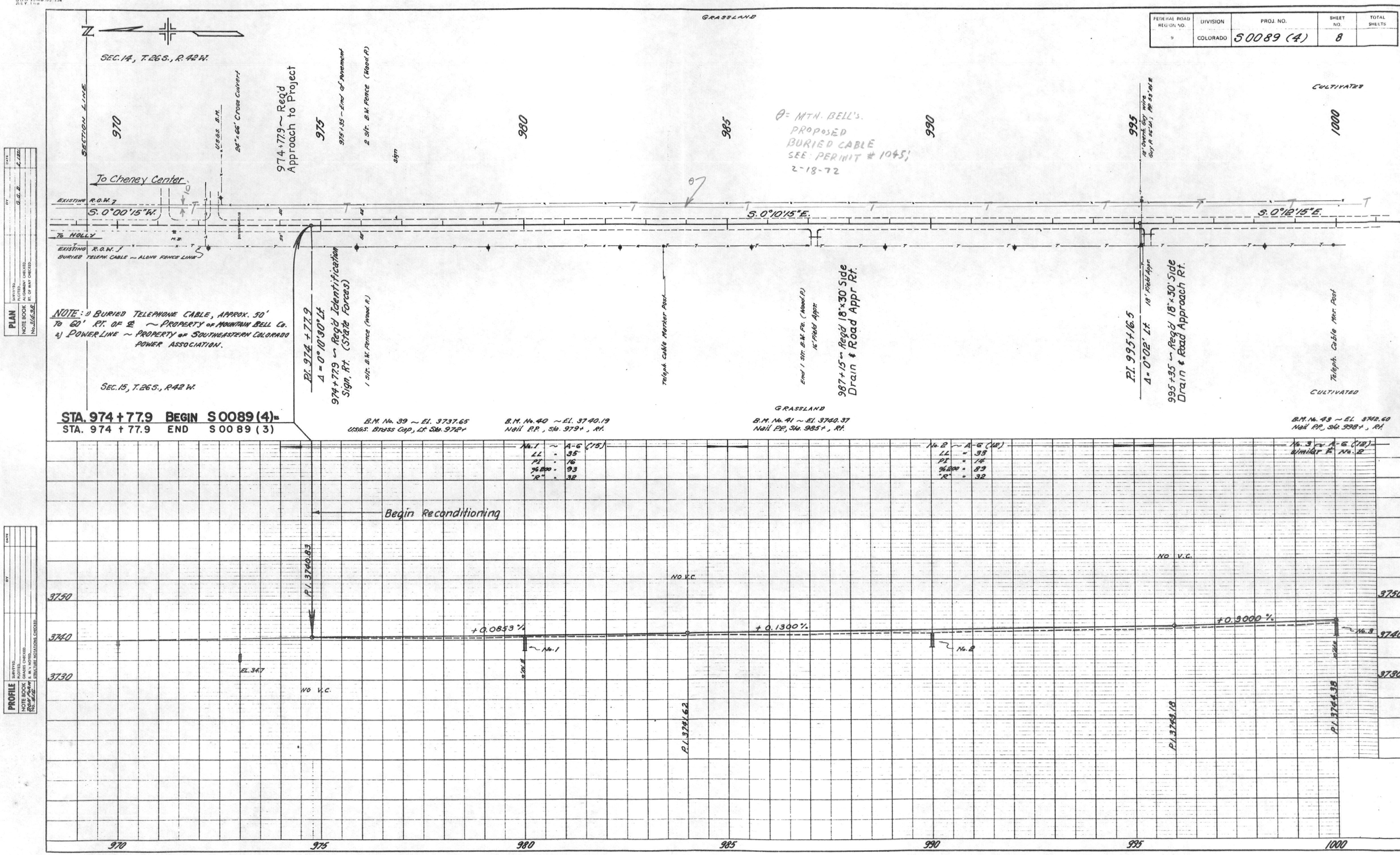
(FOR SIZES SEE TABLE OF POSSIBLE COMBINATIONS)

Designed by: W.W.D.	Approved by [illegible]
Made by: W.W.D.	Bridge Engineer
Checked by: T.J.M.	Date: July 1, 1965

STANDARD M-601-A

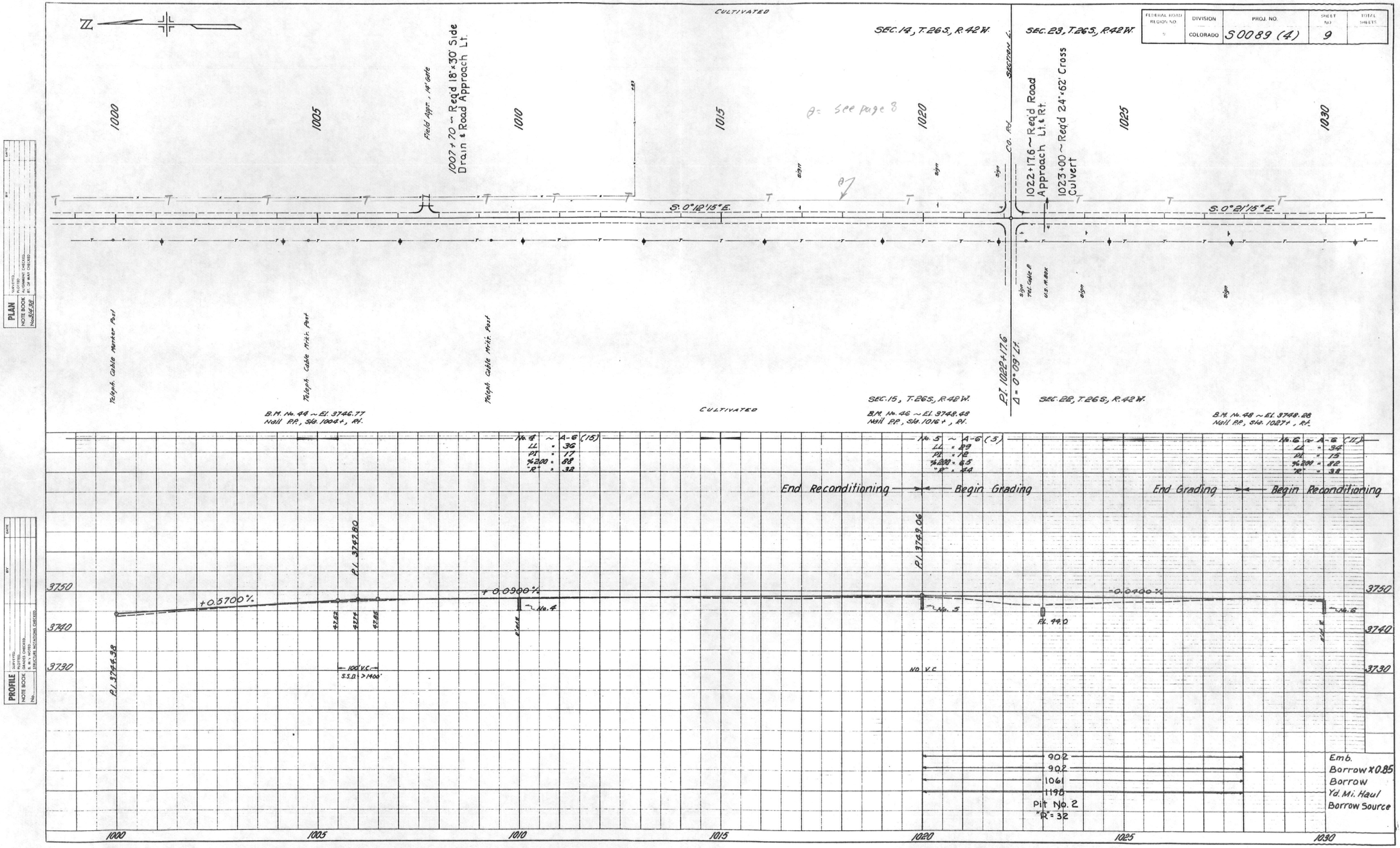
F. HOECKEL CO., DENVER 500-5-1-51

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS - STATE OF COLORADO



STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS - STATE OF COLORADO

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S 0089 (4)	9	



STATE OF COLORADO
DIVISION OF HIGHWAYS
FORM NO. 134
JULY, 1968

AS CONSTRUCTED
REVISED DATE 9-16-71

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	10	

PLAN
SURVEYED
PLOTTED
NOTE BOOK
No.

PROFILE
SURVEYED
PLOTTED
NOTE BOOK
GRADE CHECKED
No.
B.M.'s NOTED
STRUCTURE SECTIONS CHECKED

BY DATE

CULTIVATED

θ = see page 8

1030 1035 1040 1045 1050 1055 1060

1046+00 ~ Req'd 24"×64' Cross Culvert.

Field Appr. 1048+70 ~ Req'd Road Approach Lt.

1048+75 ~ Req'd 18"×30' Side Drain & Road Appr Rt.
Field Appr.
Telegh. Cable Marker Post

Telegh. Cable Mrkr. mounted on RP

S. 0°21'15"E.

P.I. 1059+20.8
Δ = 0°18'30" Rt.

B.M. No. 49 ~ El. 3745.90
Nail in RP, Sta. 1033+, Rt.

B.M. No. 51 ~ El. 3743.34
Nail in RP, Sta. 1046+, Rt.

CULTIVATED

B.M. No. 53 ~ El. 3744.91
Nail in RP, Sta. 1059+, Rt.

No. 7 ~ A-6 (14)
LL = 36
PI = 17
#200 = 85
"2" = 32

No. 8 ~ A-6-14
Similar to No. 7

No. 9 ~ A-6 (12)
LL = 34
PI = 16
#200 = 84
"2" = 32

100' V.C.

46.36 46.1 46.05

-0.5200 %

-0.1000 %

P.I. 3746.10

~ No. 7

44.80 44.81 44.93

F.L. = 39.7

P.I. 3744.75

+0.3600 %

~ No. 8

P.I. 3747.55

46.73 47.00 46.37

-0.5400 %

~ No. 9

7.46.8

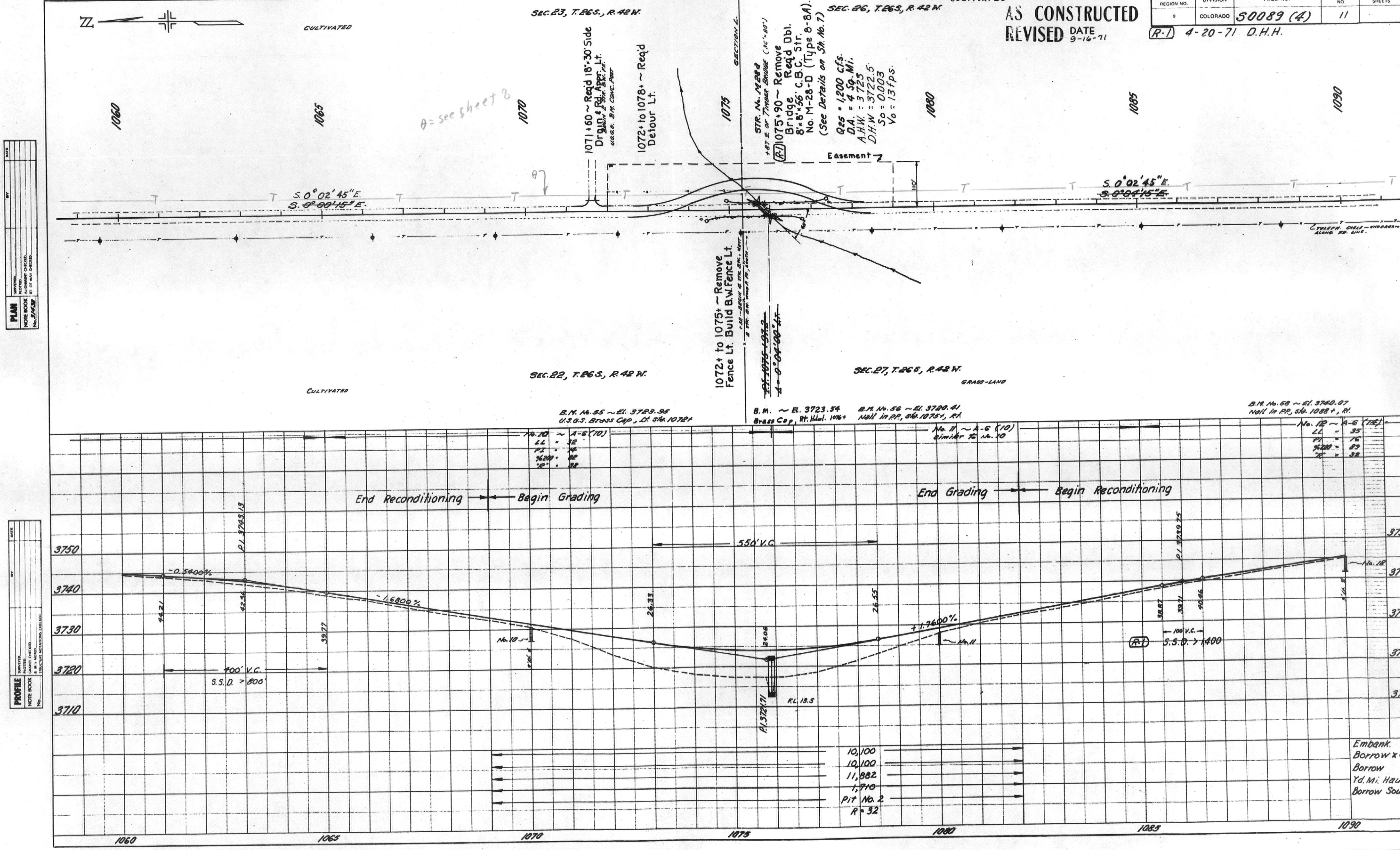
400' V.C.
S.S.D. = > 900'

3750
3740
3730

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS STATE OF COLORADO
D.O.H. FORM NO. 134
JULY, 1968

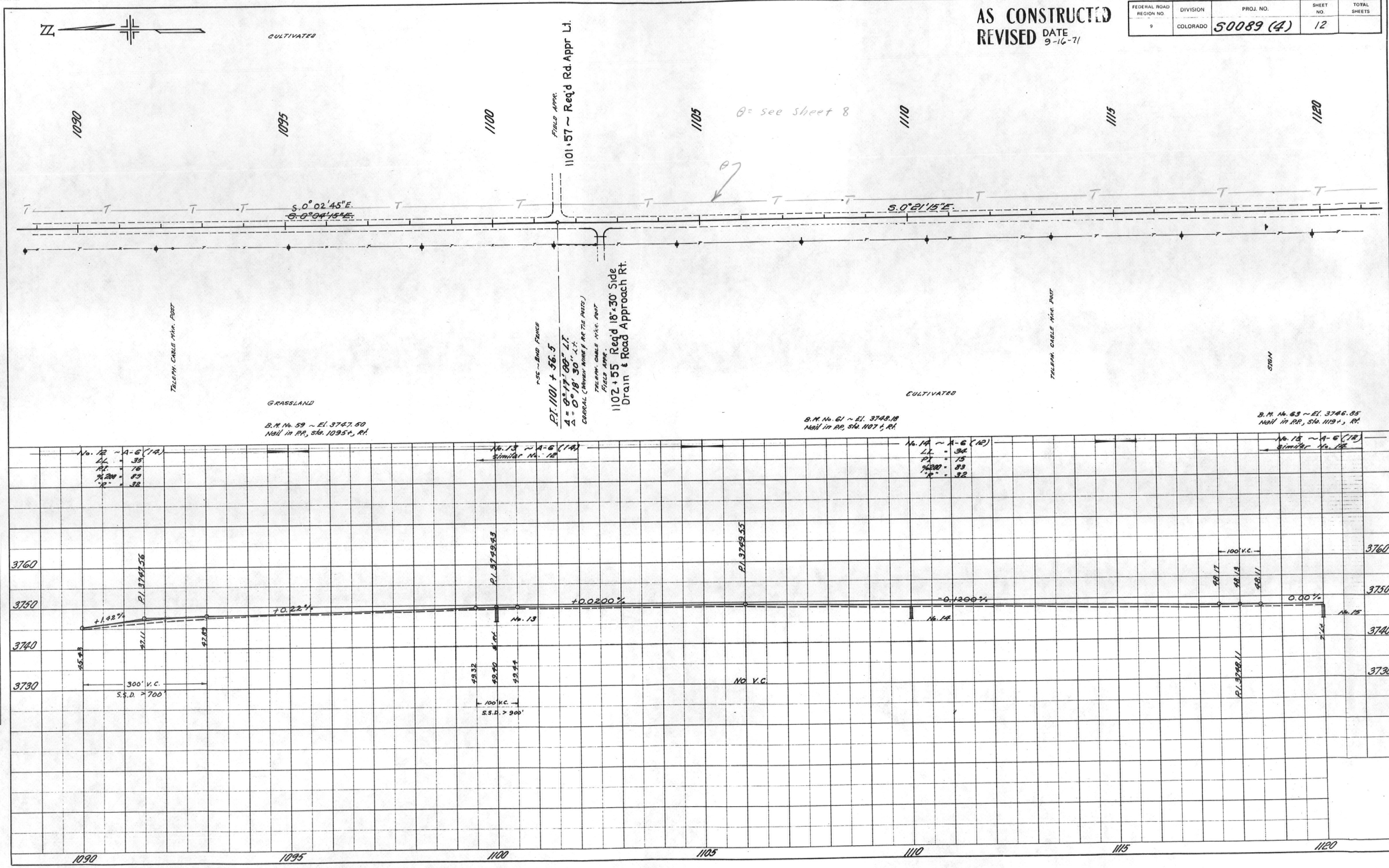
FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	11	

AS CONSTRUCTED
REVISED DATE 9-16-71
(R-1) 4-20-71 D.H.H.



FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	12	

AS CONSTRUCTED
REVISED DATE 9-16-71



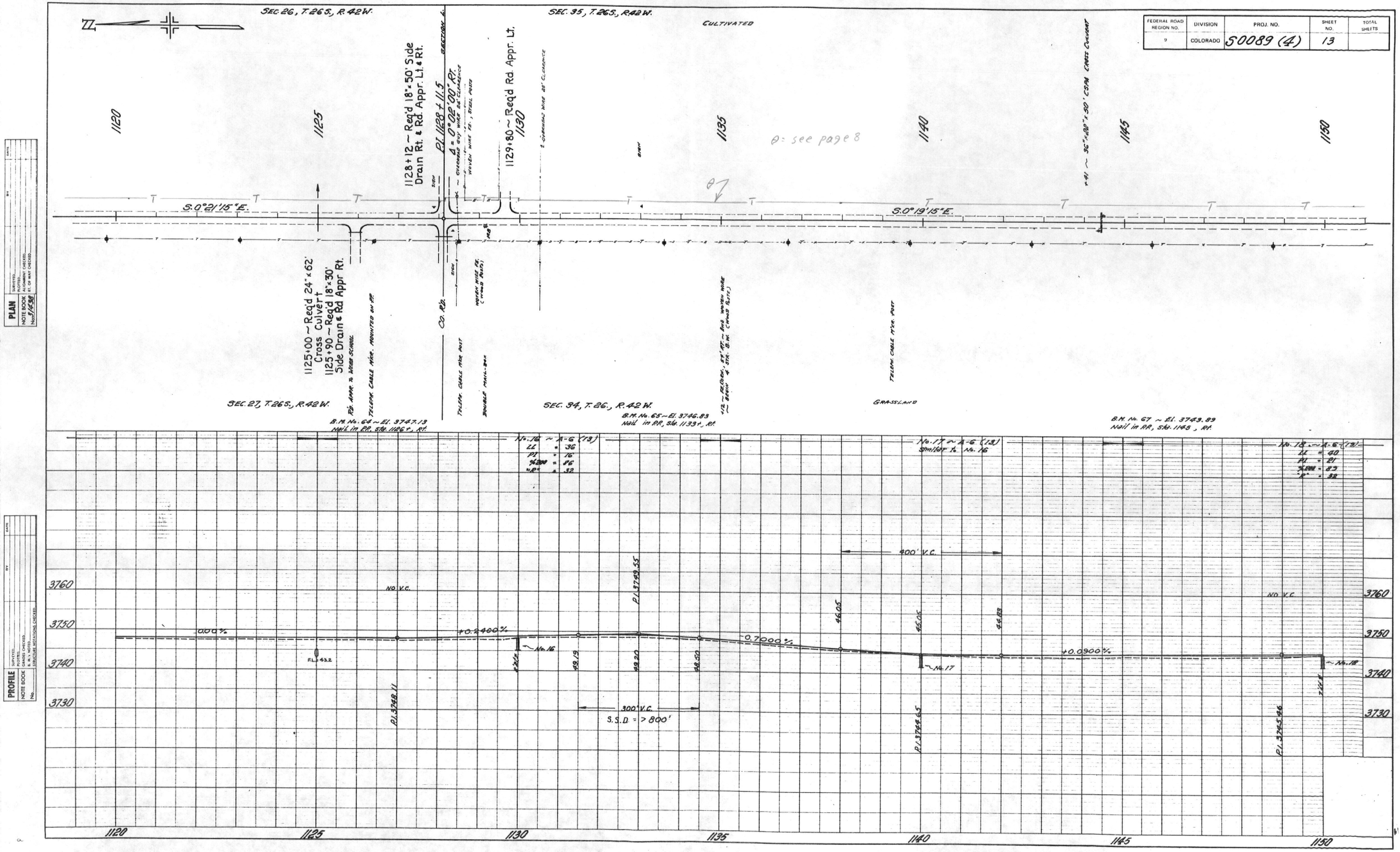
PLAN	BY	DATE
NOTE BOOK No. 31438		
SURVEYED		
PLOTTED		
ALIGNMENT CHECKED		
RT. OF WAY CHECKED		

PROFILE	BY	DATE
NOTE BOOK No.		
SURVEYED		
PLOTTED		
GRADES CHECKED		
B.M. NOTED		
STRUCTURE NOTATIONS CHECKED		

D.O.H. FORM NO. 134 JULY, 1968

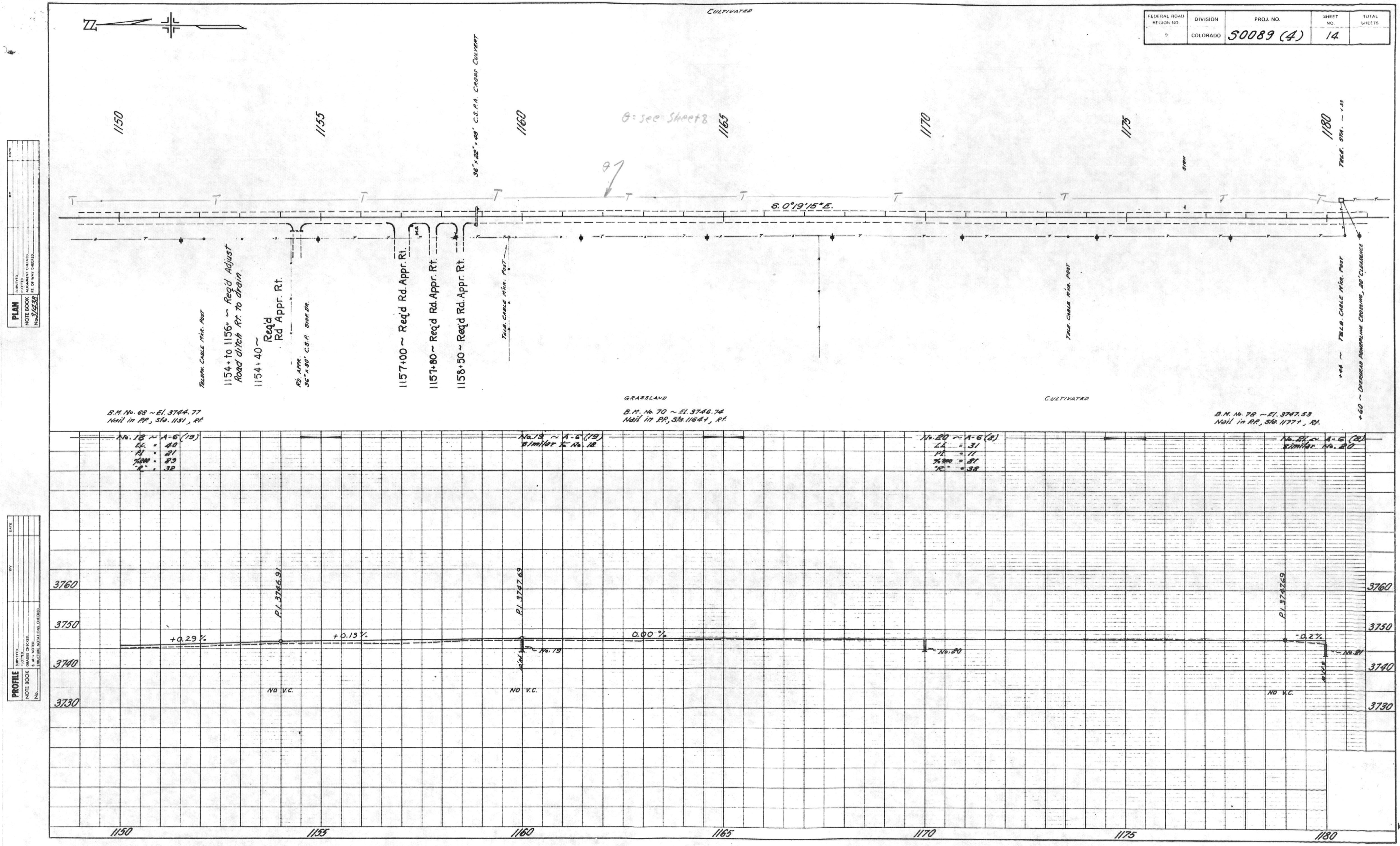
STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS · STATE OF COLORADO
C.D.H. FORM NO. 134
JULY, 1968

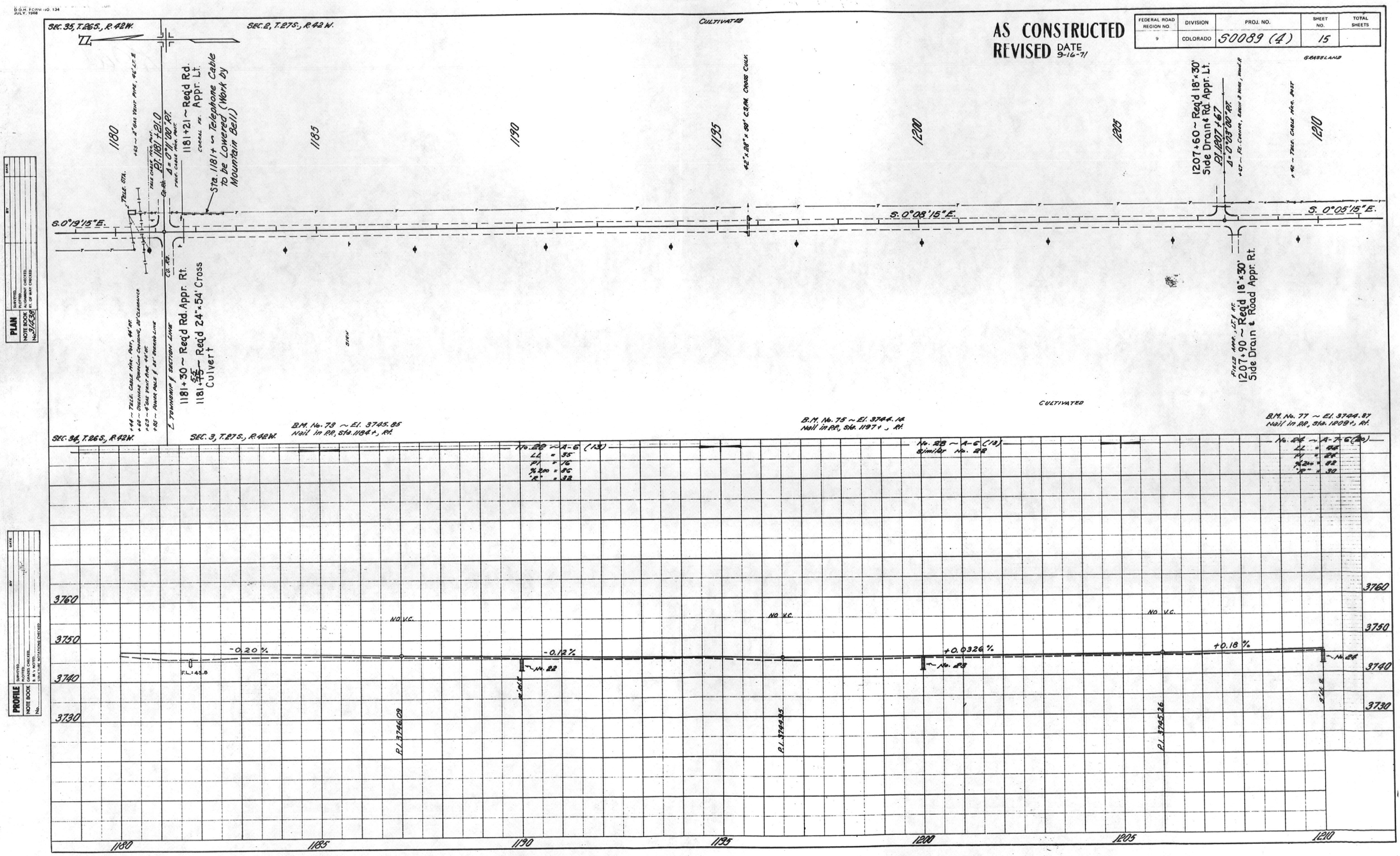
FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	13	



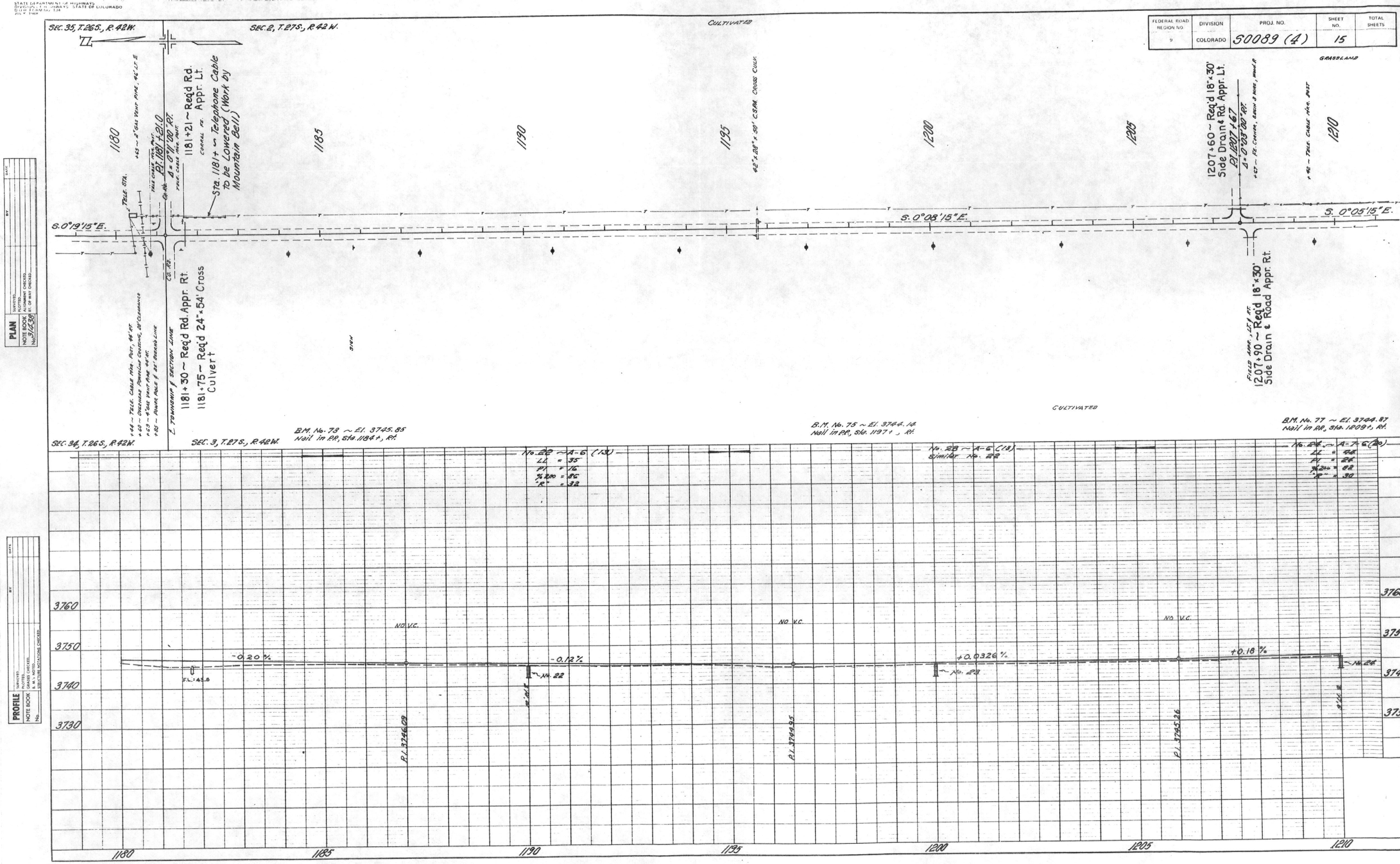
STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS STATE OF COLORADO
D.O.H. FORM NO. 134
JULY, 1968

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	14	



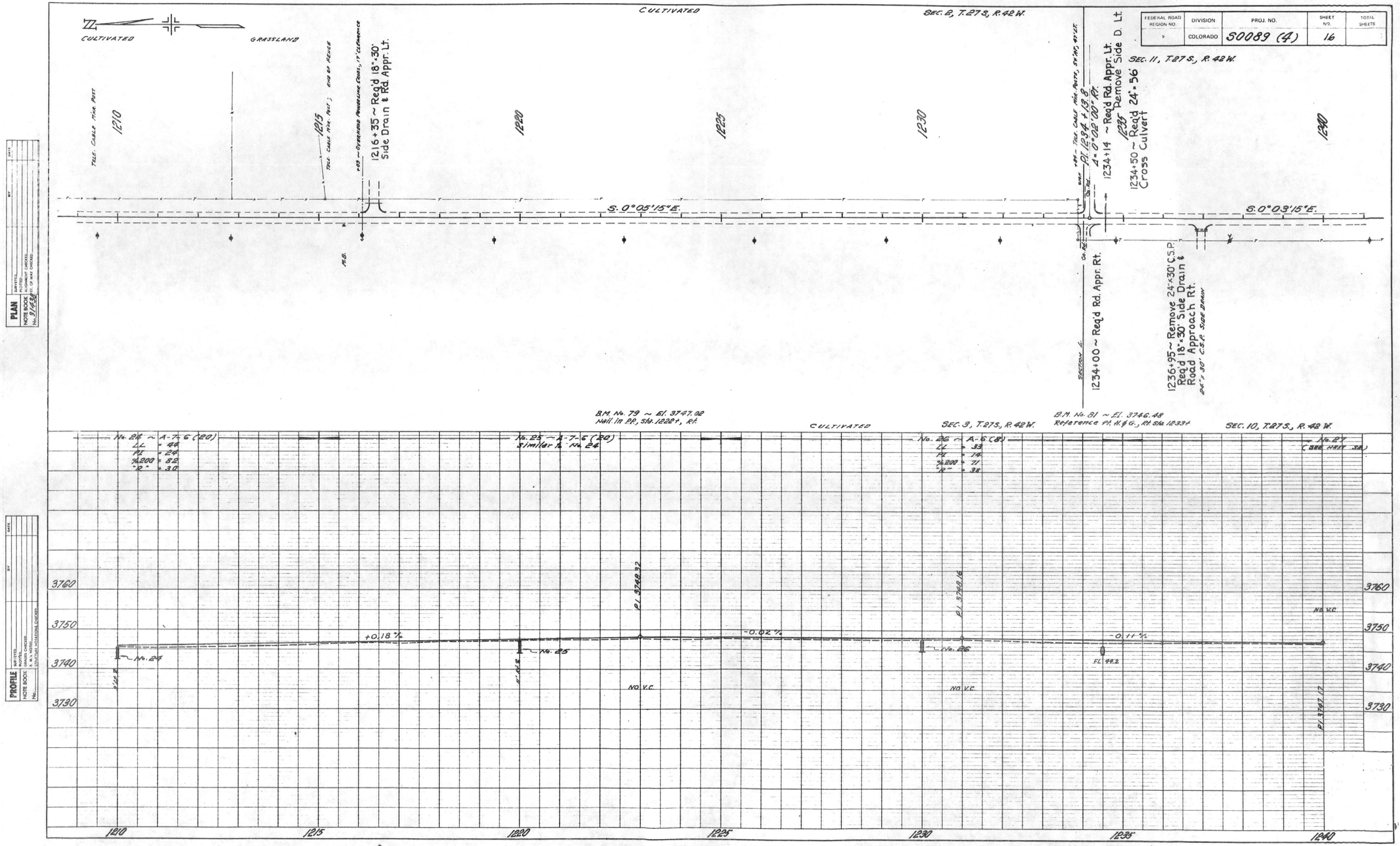

D.O.H. FORM NO. 134 JULY, 1968
AS CONSTRUCTED
REVISED DATE 9-16-71
FEDERAL ROAD REGION NO. 9
DIVISION COLORADO
PROJ. NO. 50089 (4)
SHEET NO. 15
TOTAL SHEETS
SEC. 35, T.26S., R.42W.
SEC. 2, T.27S., R.42W.
CULTIVATED
S.0°19'15"E.
S.0°08'15"E.
S.0°05'15"E.
1181+21 ~ Req'd Rd. Appr. Lt.
Sta. 1181+ ~ Telephone Cable to be Lowered (Work by Mountain Bell)
P.I. 1181+21.0
Δ = 0°11'00" Rt.
1181+30 ~ Req'd Rd. Appr. Rt.
1181+75 ~ Req'd 24"x54' Cross Culvert
1207+60 ~ Req'd 18"x30' Side Drain & Rd Appr. Lt.
P.I. 1207+67
Δ = 0°03'00" Rt.
1207+90 ~ Req'd 18"x30' Side Drain & Road Appr. Rt.
1180
1185
1190
1195
1200
1205
1210
GRASSLAND
CULTIVATED
PLAN
NOTE BOOK No. 3/638
SEC. 34, T.26S., R.42W.
SEC. 3, T.27S., R.42W.
B.M. No. 73 ~ El. 3745.85 Nail in P.P., Sta. 1184+, Rt.
B.M. No. 75 ~ El. 3744.14 Nail in P.P., Sta. 1197+, Rt.
B.M. No. 77 ~ El. 3744.87 Nail in P.P., Sta. 1209+, Rt.
No. 22 ~ A-6 (13)
LL = 35
PI = 16
% 200 = 86
"R" = 32
No. 23 ~ A-6 (13) Similar No. 22
No. 24 ~ A-7-6 (20)
NO V.C.
-0.20 %
-0.12 %
+0.0326 %
+0.18 %
F.L. 43.8
P.I. 3746.09
P.I. 3744.35
P.I. 3745.26
3760
3750
3740
3730
PROFILE
NOTE BOOK No.
1180
1185
1190
1195
1200
1205
1210

STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS · STATE OF COLORADO



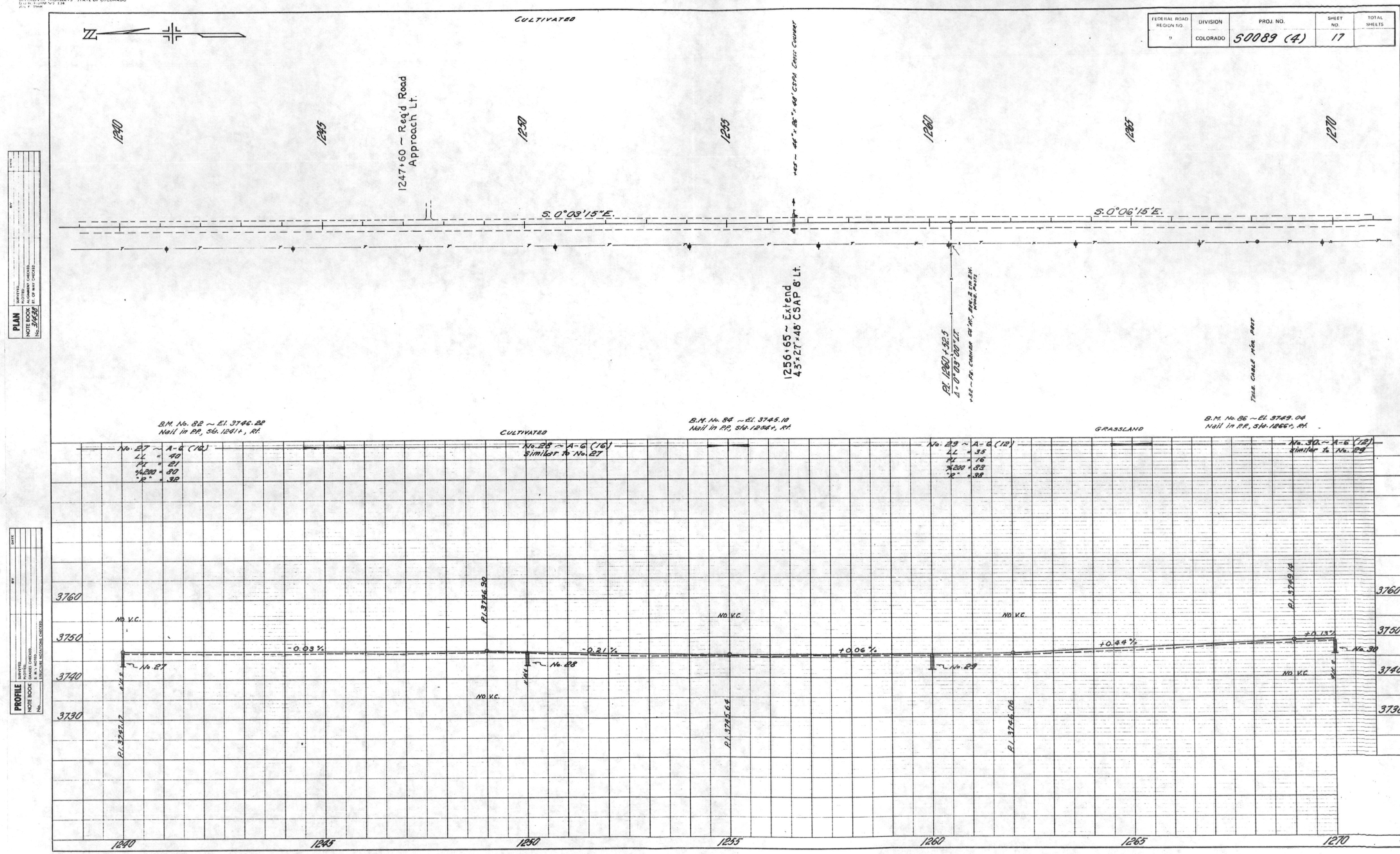
STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS - STATE OF COLORADO
D.T.H. FORM NO. 134
JULY, 1968

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	16	



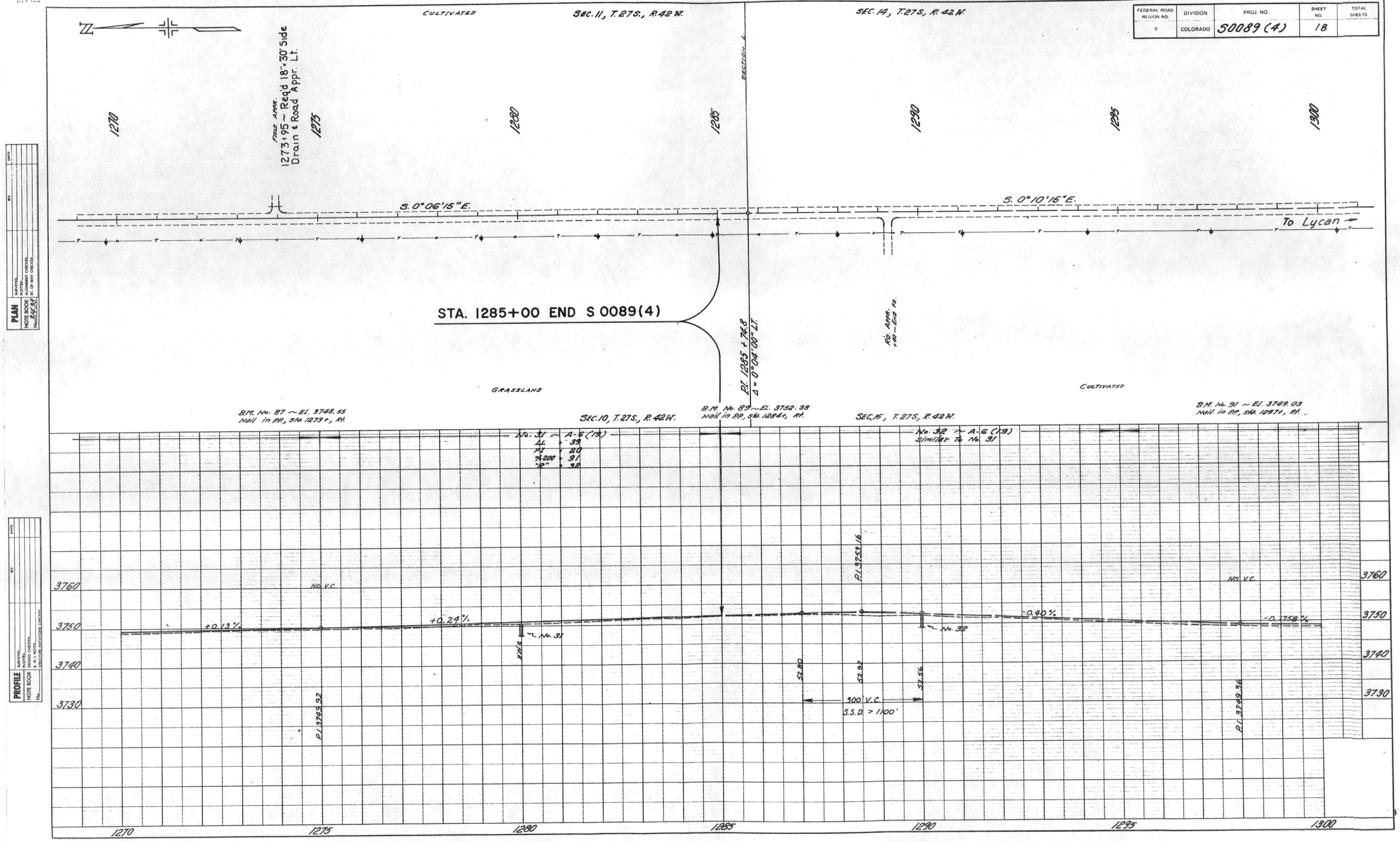
STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS STATE OF COLORADO

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	17	



STATE DEPARTMENT OF HIGHWAYS
DIVISION OF HIGHWAYS STATE OF COLORADO
D.O.H. FORM NO. 134
JULY 1968

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	S0089 (4)	18	



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

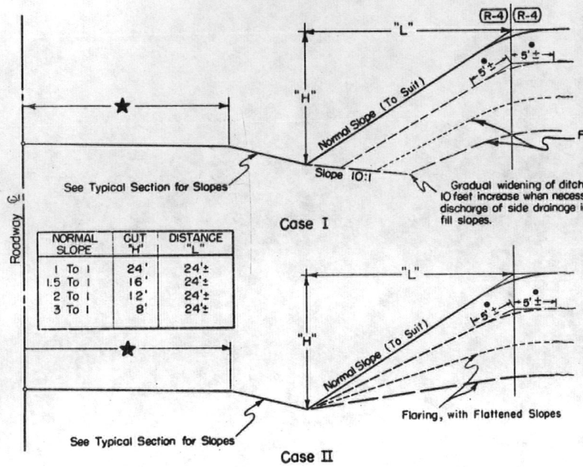
STANDARD M-203-B

(JULY 1, 1965)

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLO.		

REVISIONS			
(R-1)	2-6-68	Median Cross Over	MRH
(R-2)	7-30-68	Dept. Name	MRH
(R-3)	4-1-69	Widening for Guard Rail	MRH
(R-4)	4-27-70	Cut Slope and Note	MRH

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.

* CUT SLOPE TREATMENT IN EARTH CUTS: The intersection of cut slopes with the existing ground shall be rounded in earth cuts, beginning outside the slope stake and extending down the cut slope. The exact dimension will be determined by the Engineer based on the type of material encountered.

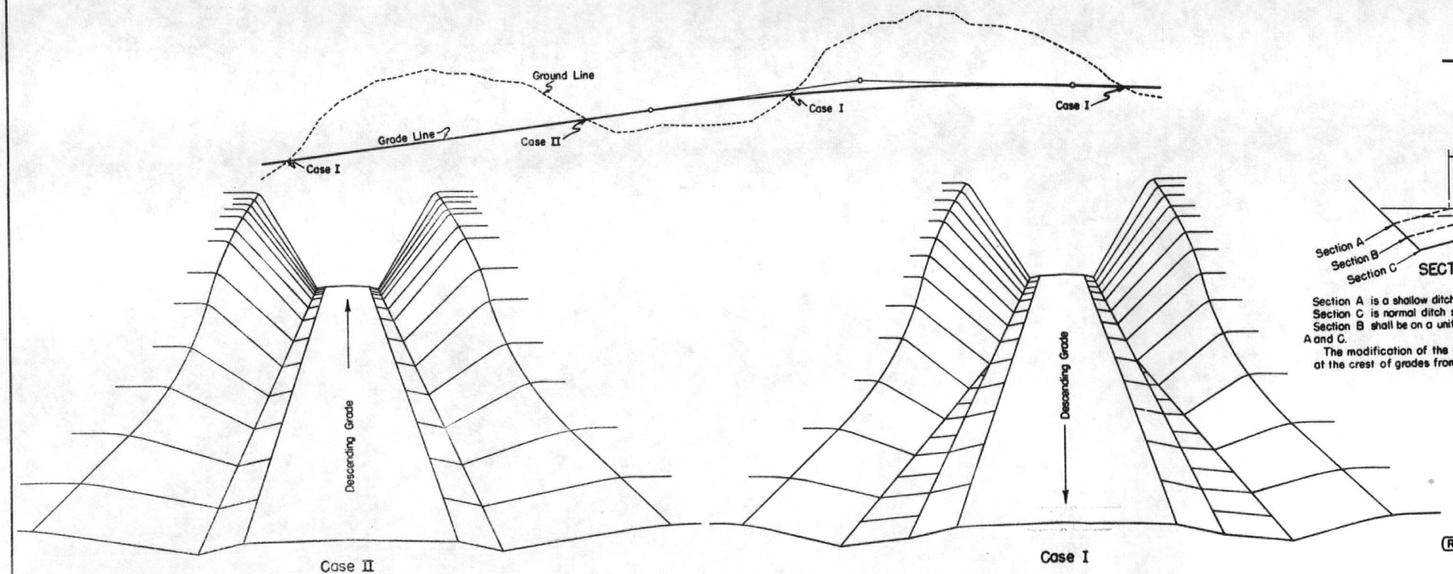
Quantities shall be included in "Unclassified Excavation".

★ WIDENING AT BRIDGE APPROACHES: Roadway embankment at bridge approaches shall be so constructed that base of surfacing at shoulder point is a minimum of 2 ft. beyond the edge of bridge deck. Where widening is necessary to achieve this result it shall take place gradually over a distance of 300 ft. (R-4)

WIDENING FOR BITUMINOUS CURB (Only where Guard Rail is required); See appropriate M-Standard for Guard Rail. (R-3)

(R-4)

PLAN OF FLARING IN EARTH CUTS

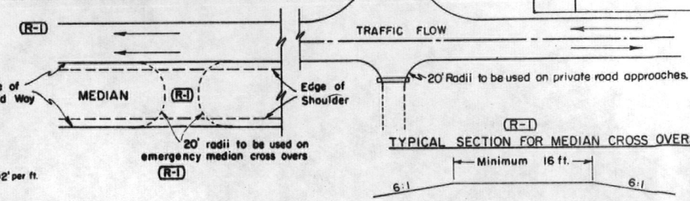


TYPICAL PLANS FOR SIDE APPROACH ROADS AND EMERGENCY MEDIAN CROSS OVERS

(R-1)

Where practical Side Drains are to be placed in line with the roadway ditches.

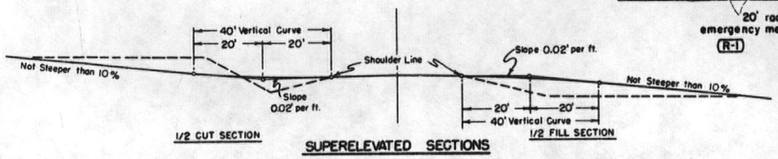
50' Radii to be used on all intersecting roads except private approaches. Radii may be varied to suit field conditions.



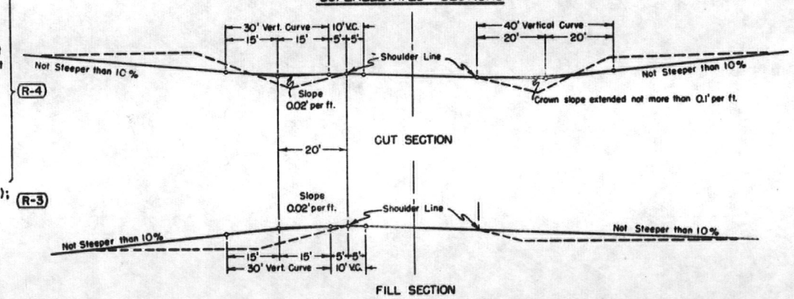
(R-1)

TYPICAL SECTION FOR MEDIAN CROSS OVERS

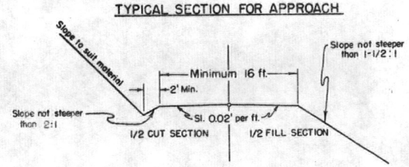
STANDARD CROWNED SECTION



SUPERELEVATED SECTIONS



TYPICAL SECTION FOR APPROACH

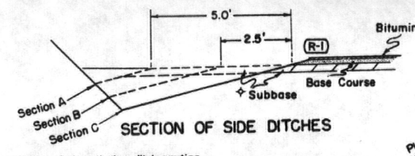


NOTE:
Road Approaches shall conform to the above details unless otherwise indicated on plans. The width of the crowned section shall not be less than the width of the crowned section of the existing approach road and the new construction shall not be less than 16 feet in width.

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)

✧ To be constructed thru widened sections when called for on plans for normal roadway section.

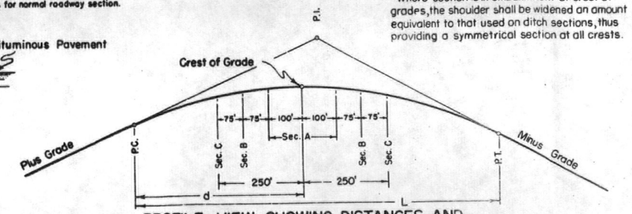


SECTION OF SIDE DITCHES

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

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



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

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.

GENERAL NOTES

(R-2)

All work shall be done in accordance with the Standard Specifications applicable to the Project.

All side approach roads to the Project shall be Gravel Surfaced with a 4 inch thickness of Aggregate Base Course extending approximately to the Right of Way Line. Estimated tonnage and class of material required for this operation are shown in the Aggregate Base Course Plan.

(R-4) 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 flatter than the maximum shown are to be used wherever feasible.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

APPROACH ROADS, FLARING, CUT SLOPE TREATMENT, BRIDGE & CREST WIDENING

Designed by A.Z.
Made by SJM & ABH
Checked by C.R.S.

Approved by [signature]
Staff Design Engr.
Date: July 1, 1965.

STANDARD TYPES of DITCHES and CONSTRUCTION METHODS

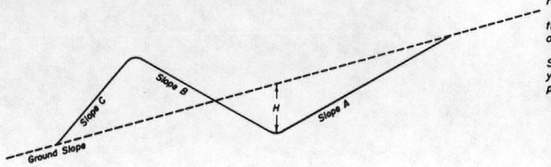
STANDARD M-203-C

(JULY 1, 1965)

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.
9.	COLO.		

DETAILS for CONTOUR INTERCEPTING DITCHES

Typical Section for Contour Intercepting Ditches



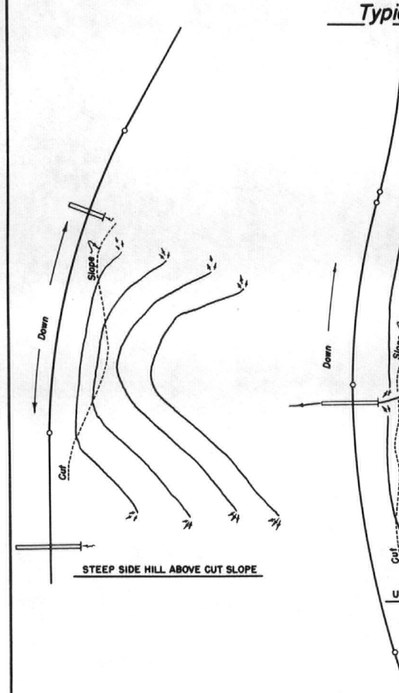
PURPOSE & USE OF THE TABLE

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.

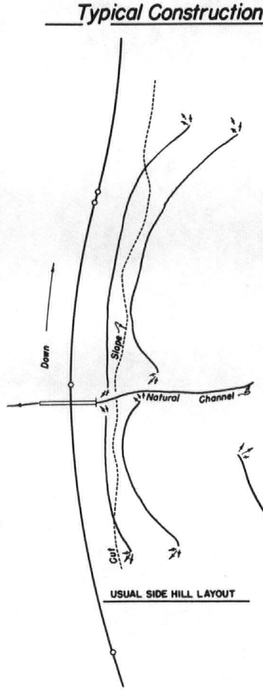
Foremost consideration in constructing these ditches is given first to the natural ground line slope confronted in construction, thence to the other values shown on the Typical Section.

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.

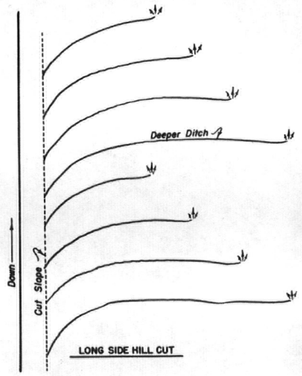
Typical Construction Layouts



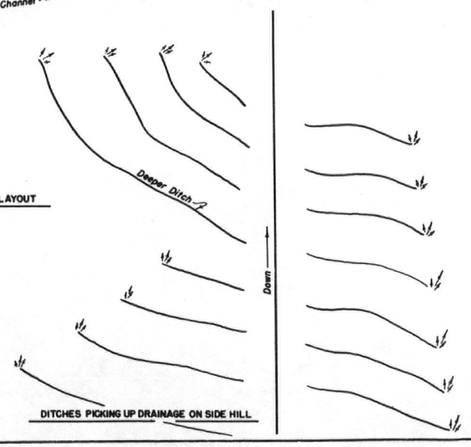
STEEP SIDE HILL ABOVE CUT SLOPE



USUAL SIDE HILL LAYOUT



LONG SIDE HILL CUT



DITCHES PICKING UP DRAINAGE ON SIDE HILL

Scale of Sketches in Feet

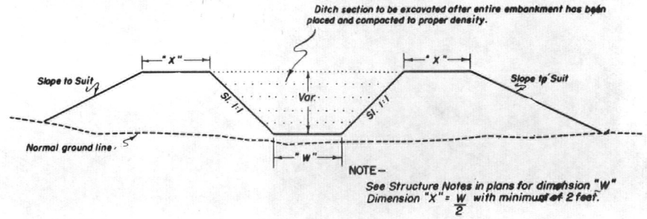
100 0 100 200 300 400

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.*

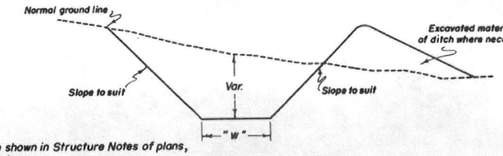
TYPICAL SECTIONS for DRAINAGE, IRRIGATION DITCHES and CHANNEL CHANGES



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

REVISIONS			
R-1	7-23-68	Dept. Nome	M.R.H.

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications 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

R-1

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.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

DITCH TYPES

Designed by C.G.M.	Approved by L. E. Olson
Made by C.G.M.	Staff Design Engr.
Checked by	Date: July 1, 1965

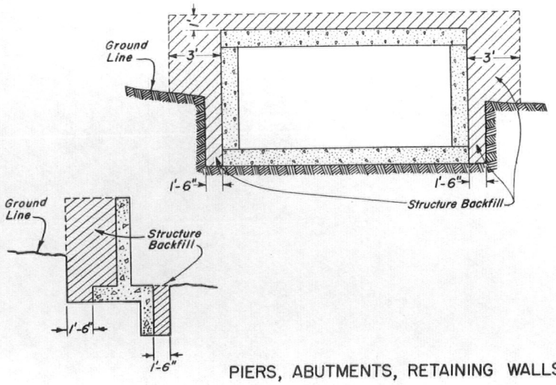
STANDARD M-206-AA

(MARCH 1, 1971)
(SHEET 1 OF 2)

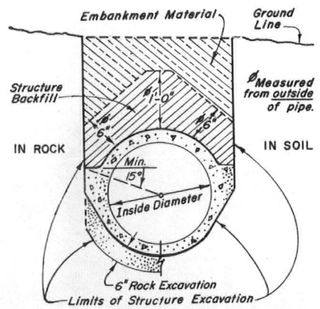
FED. ROAD REGION NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLO.		

REVISION		

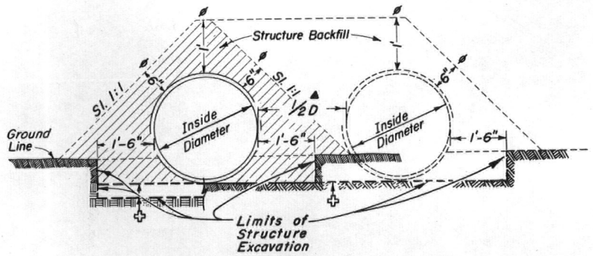
CONCRETE BOX CULVERTS & WINGWALLS



CAST IN PLACE CONDUIT

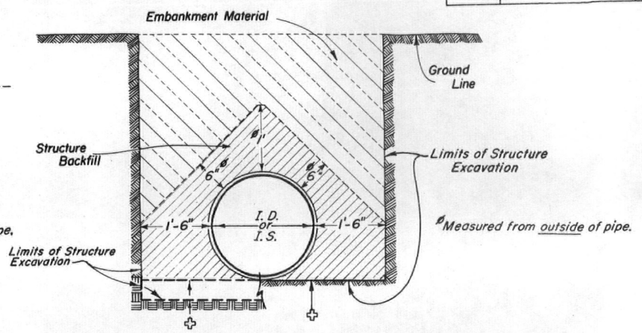


CIRCULAR CONDUIT



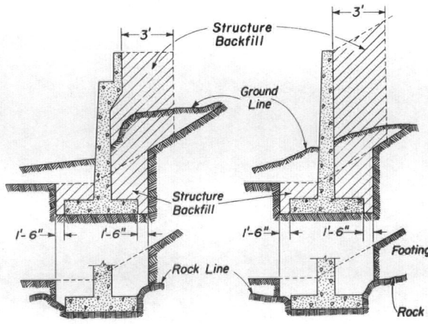
Measured from outside of pipe.

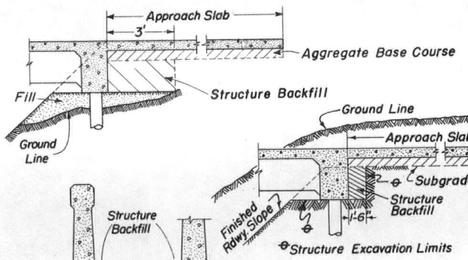
SIPHONS OR CONDUIT IN TRENCH



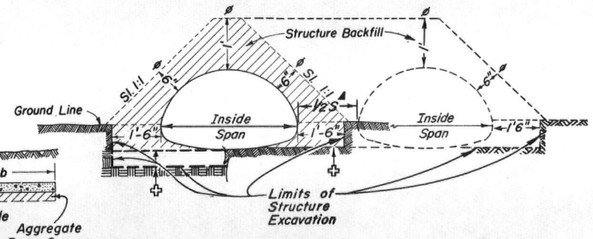
PIERS, ABUTMENTS, RETAINING WALLS ETC.

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.

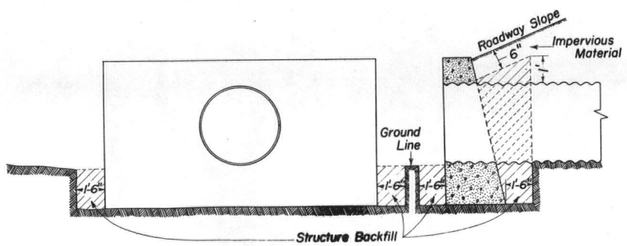




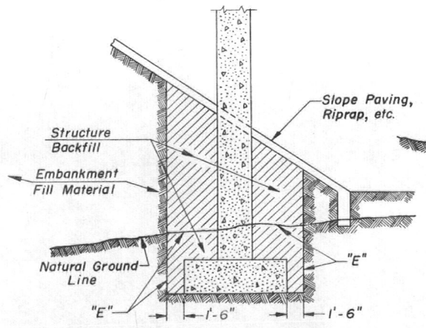
ELLIPTICAL OR ARCH CONDUIT



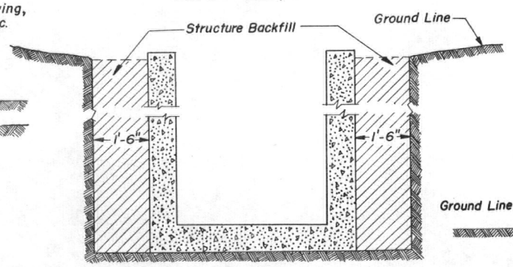
HEADWALLS AND END OF CULVERTS

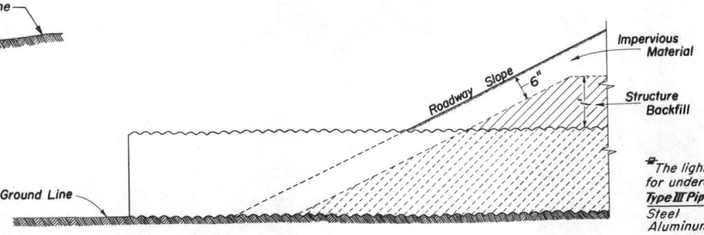


DROP INLETS, DIVISION BOXES, INTERCEPTING HEADWALLS, ETC.



Note:
"E" = Limits of Structure Excavation

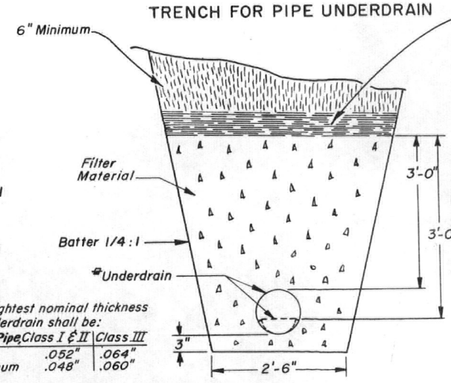




The lightest nominal thickness for underdrain shall be:

Type III Pipe	Class I & II	Class III
Steel	.052"	.064"
Aluminum	.048"	.060"

TRENCH FOR PIPE UNDERDRAIN



NOTES:

▲ When two or more conduits are laid side by side they shall be spaced so that the adjacent pipes will be ½I.D., ½I.S. or 3 feet apart (including wall thickness), whichever is less. Minimum spacing shall be not less than 1 foot between outside walls of pipe.
For additional culvert installation details see M Standards for metal, concrete, or structural plate pipe culverts.

✣ Bottom of trench as excavated. For applicable limits of Structure Excavation, see bedding details on standards for culverts.

GENERAL NOTES

All work shall be done according to the Standard Specifications applicable to the Project.

Where the roadway cross section is in fill, excavation for concrete footings (except those in rock or those on piles) and for box culverts shall be done according to the following:
Embankment shall be built up and compacted to a point one foot above the bottom of the box or one foot above the bottom of the footing. The trench shall then be excavated to accommodate construction of the box or footing.

Excavation and backfill patterns different from those indicated on these sheets will be shown elsewhere on the plans.

Excavation for structure installation shall be classified as "Structure Excavation" unless otherwise shown on plans.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

EXCAVATION AND BACKFILL FOR STRUCTURES

Designed by H.E.P.	Approved by: E. O'Brien
Made by D.M.E.	Staff Design Engr.
Checked by L.E.O.	Date: March 1, 1971

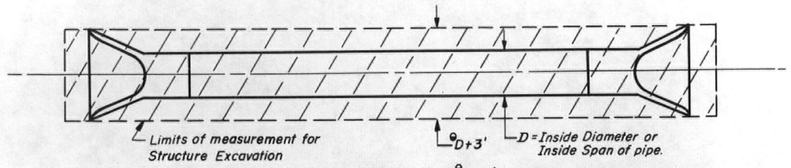
STANDARD M-206-AA

(MARCH 1, 1971)
(SHEET 2)

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO			

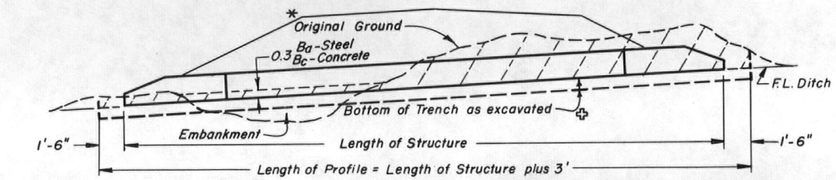
	REVISIONS:	

STRUCTURE EXCAVATION MEASUREMENT FOR PIPE CULVERTS



PLAN

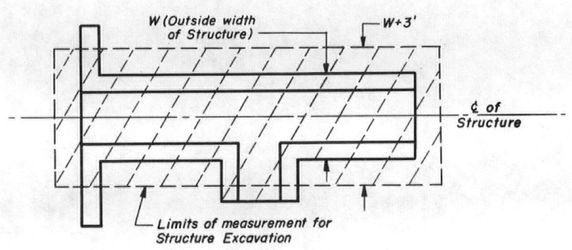
*D+6' for structural plate pipe culverts.



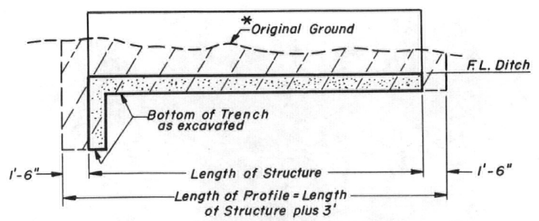
PROFILE

✣ For applicable limits of Structure Excavation, see bedding details on standards for metal, reinforced concrete and structural plate pipe culverts.

STRUCTURE EXCAVATION MEASUREMENT FOR DIVERSION OR DIVISION BOXES

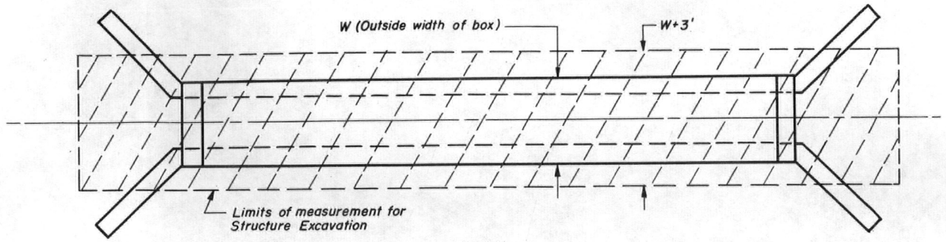


PLAN



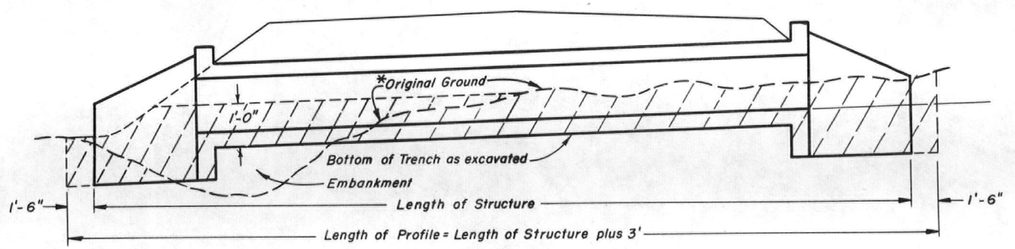
PROFILE

STRUCTURE EXCAVATION MEASUREMENT FOR CONCRETE BOX CULVERTS



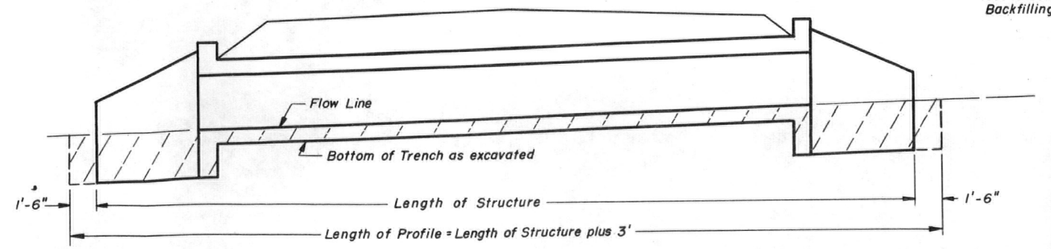
PLAN

Without Channel Change or Channel Improvement



PROFILE

With Channel Change or Channel Improvement



PROFILE

* Along ℄ of Structure

Areas to be used for Structure Excavation computations.

NOTE:
See Sheet 1 for General Notes and Backfilling Details.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

EXCAVATION AND BACKFILL FOR STRUCTURES

Designed by: M.R.H.	Approved by: [signature]
Made by: H.P.B.	Staff Design Engr.
Checked by:	Date: March 1, 1971

STANDARD M-500-A

(JULY 1, 1965)

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLO.		

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 1950

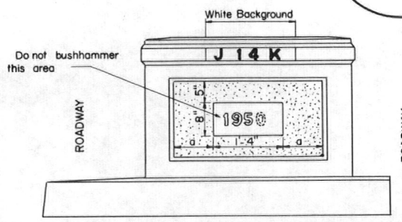
a b c d e f g h i j k l m n o p q r s t u v w x y z

Scale in inches 0 1 2 3

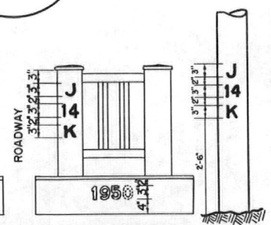
SAMPLE BRIDGE NUMBER

SAMPLE YEAR NUMBER

SECTION

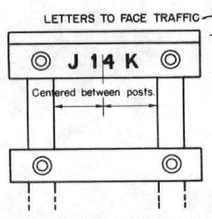


TYPICAL FOR CONCRETE END POST

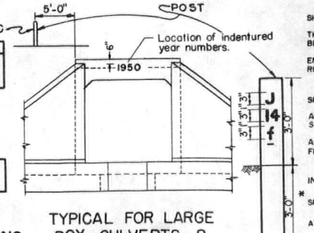


TYPICAL FOR STEEL HANDRAIL END POST

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 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 3/8" 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 WITH "EXTERIOR BLACK PAINT" AS SPECIFIED IN SECTION 708 - PAINTS, OR AN ACCEPTABLE EQUIVALENT. 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 SEPARATE ITEMS.

* 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.

IN ADDITION TO THE REQUIREMENTS STATED ABOVE, STRUCTURE NUMBERS FOR HIGHWAYS PASSING UNDER CROSSROADS ARE TO BE PLACED AT THE FOLLOWING POINTS:

(A) FOR STRUCTURES OF 3 OR MORE SPANS, THE STRUCTURE NUMBER SHALL BE STENCILED, FACING TRAFFIC, ON THE OUTSIDE FACE OF THE END COLUMN OF THE RIGHT-HAND PIER.

(B) FOR 2-SPAN STRUCTURES, THE STRUCTURE NUMBER SHALL BE STENCILED, FACING TRAFFIC, ON THE OUTSIDE FACE OF EACH END COLUMN IN THE CENTER PIER.

STRUCTURE NO._____

REVISIONS		

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO

LETTERS AND FIGURES FOR STRUCTURE NUMBERS

Designed by	Approved by C.D. Marshall
Made by	Bridge Engineer
Checked by	Date: July 1, 1965

STANDARD M-601-C

(SHEET 1 OF 2 SHEETS)
(JULY 1, 1965)

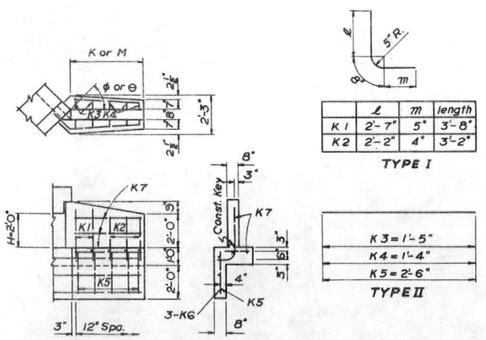
FED. ROAD REG. NO.	DIVISION	PROJECT. NO.	SHEET NO.
9	COLO.		

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

β	α	φ	θ	H= 2'-0"		H= 3'-0"		H= 4'-0"		H= 5'-0"		H= 6'-0"	
				K	M	K	M	K	M	K	M	K	M
45°	45°	67°30'	22°30'	3'-3"	8'-0"	4'-6"	11'-0"	6'-0"	14'-9"	7'-6"	18'-0"	8'-9"	21'-0"
60°	30°	60°	30°	3'-6"	6'-0"	5'-0"	8'-6"	6'-6"	11'-3"	8'-0"	14'-0"	9'-3"	16'-0"
75°	15°	52°30'	37°30'	3'-9"	5'-0"	5'-6"	7'-0"	7'-3"	9'-3"	8'-9"	11'-6"	10'-0"	13'-3"
90°	0°	45°	45°	4'-3"	4'-3"	6'-0"	6'-0"	8'-0"	8'-0"	10'-0"	10'-0"	11'-6"	11'-6"
105°	15°	37°30'	52°30'	5'-0"	3'-9"	7'-0"	5'-6"	9'-3"	7'-3"	11'-6"	8'-9"	13'-3"	10'-0"
120°	30°	30°	60°	6'-0"	3'-6"	8'-6"	5'-0"	11'-3"	6'-6"	14'-0"	8'-0"	16'-0"	9'-3"
135°	45°	22°30'	67°30'	8'-0"	3'-3"	11'-0"	4'-6"	14'-9"	6'-0"	18'-0"	7'-6"	21'-0"	8'-9"

β equals the angle between ℄ of culvert & ℄ of roadway. α equals the angle between ℄ of culvert and a line normal to ℄ of roadway. (R-3)
φ and θ are angles between the wingwall and a line parallel with the ℄ of roadway.

EXAMPLE FOR USING THE ABOVE TABLE. Suppose a stream makes an angle of β=65° with the ℄ of roadway, then, from the table, select the nearest angle, β= 60°, then α, φ, & θ equal 30°, 60°& 30° respectively. If the desired height "H" of culvert is 6'-0", then K & M will be 9'-3" and 16'-0". Locate the WING DETAIL WHEN H=6'-0" on this sheet.



	ℓ	m	length
K1	2'-7"	5"	3'-8"
K2	2'-2"	4"	3'-2"

TYPE I

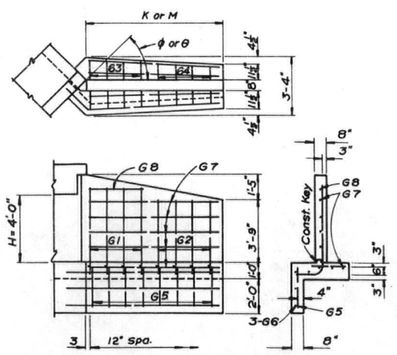
K3 = 1'-5"
K4 = 1'-4"
K5 = 2'-6"

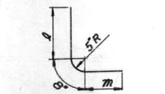
TYPE II

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

When φ or θ equals	Number of bars required: K1 ½"φ Type I	K2 ½"φ Type I	K3 ½"φ Type II	K4 ½"φ Type II	K5 ½"φ Type II	Length of bars: 3-K6 ½"φ Type II	4-K7 ½"φ Type II	Quantities for One Wing: Concrete Cu.Yd.	Steel Lb.
22°30'	4	4	4	4	8	9'-10"	7'-8"	1.47	80
30°	3	3	3	3	6	7'-4"	5'-8"	1.10	59
37°30'	3	2	3	2	5	6'-1"	4'-8"	0.92	50
45°	2	3	2	3	5	5'-2"	3'-11"	0.78	45
52°30'	2	2	2	2	4	5'-1"	3'-5"	0.69	39
60°	2	2	2	2	4	4'-6"	3'-2"	0.64	37
67°30'	2	2	2	2	4	4'-0"	2'-11"	0.60	36

WING DETAIL WHEN H= 2'-0"





	ℓ	m	length
G1	4'-9"	1'-0"	6'-5"
G2	3'-11"	9"	5'-4"

TYPE I

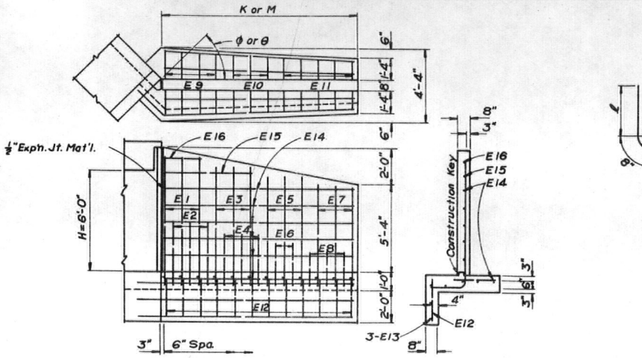
G3 = 2'-0"
G4 = 1'-10"
G5 = 2'-6"

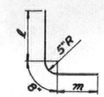
TYPE II

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

When φ or θ equals	Number of bars required: G1 ½"φ Type I	G2 ½"φ Type I	G3 ½"φ Type II	G4 ½"φ Type II	G5 ½"φ Type II	Length of bars: 3-G6 ½"φ Type II	8-G7 ½"φ Type II	1-G8 ½"φ Type II	Quantities for One Wing: Concrete Cu.Yd.	Steel Lb.
22°30'	6	9	6	9	15	17'-4"	14'-5"	5'-2"	3.97	219
30°	5	7	5	7	12	13'-2"	10'-11"	4'-2"	3.03	170
37°30'	4	6	4	6	10	10'-10"	8'-11"	3'-2"	2.49	141
45°	4	4	4	4	8	9'-4"	7'-8"	3'-2"	2.15	118
52°30'	3	5	3	5	8	9'-0"	6'-11"	2'-2"	1.95	112
60°	3	4	3	4	7	7'-10"	6'-2"	2'-2"	1.75	99
67°30'	3	3	3	3	6	7'-0"	5'-8"	2'-2"	1.61	88

WING DETAIL WHEN H= 4'-0"





	ℓ	m	length
E1	7'-0"	1'-5"	9'-1"
E2	3'-4"	10"	4'-10"
E3	6'-6"	1'-4"	8'-6"
E4	2'-8"	9"	4'-1"
E5	6'-0"	1'-2"	7'-10"
E6	2'-2"	8"	3'-6"
E7	5'-6"	1'-1"	7'-3"
E8	1'-8"	7"	2'-11"

TYPE I

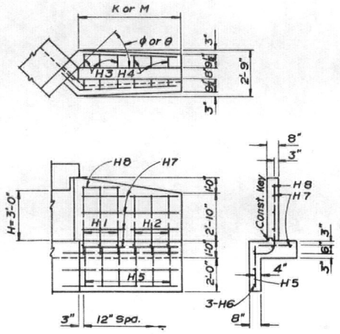
E9 = 2'-6"
E10 = 2'-4"
E11 = 2'-2"
E12 = 2'-6"

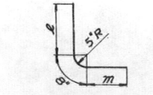
TYPE II

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

When φ or θ equals	Number of bars required: E1 ½"φ Type I	E2 ½"φ Type I	E3 ½"φ Type I	E4 ½"φ Type I	E5 ½"φ Type I	E6 ½"φ Type I	E7 ½"φ Type I	E8 ½"φ Type I	E9 ½"φ Type II	E10 ½"φ Type II	E11 ½"φ Type II	E12 ½"φ Type II	Length of bars: 3-E13 ½"φ Type II	9-E14 ½"φ Type II	1-E15 ½"φ Type II	1-E16 ½"φ Type II	Quantities for One Wing: Concrete Cu.Yd.	Steel Lb.
22°30'	6	5	5	5	5	5	5	5	6	7	8	21	24'-3"	20'-8"	10'-2"	5'-2"	7.30	430
30°	4	4	4	4	4	4	4	3	5	5	6	16	18'-5"	15'-8"	7'-2"	3'-2"	5.56	326
37°30'	4	3	3	3	3	3	4	4	4	5	5	14	15'-3"	12'-11"	6'-2"	3'-2"	4.60	278
45°	3	3	3	3	3	2	3	3	4	3	5	12	13'-2"	11'-2"	5'-2"	2'-2"	3.99	240
52°30'	3	2	2	3	3	2	2	2	3	4	3	10	12'-1"	9'-8"	4'-2"	2'-2"	3.47	202
60°	3	2	2	2	2	2	3	3	3	3	4	10	10'-10"	8'-11"	4'-2"	2'-2"	3.21	194
67°30'	3	2	2	2	2	2	2	2	3	3	3	9	9'-11"	8'-5"	4'-2"	2'-2"	3.04	180

WING DETAIL WHEN H= 6'-0"





	ℓ	m	length
H1	3'-6"	8"	4'-10"
H2	3'-0"	6"	4'-2"

TYPE I

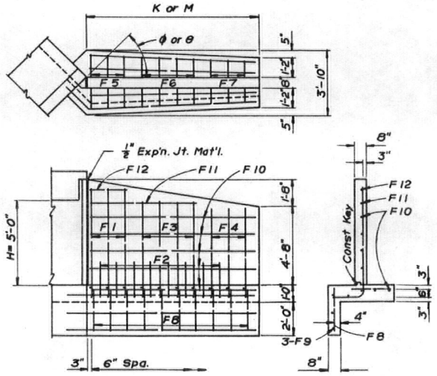
H3 = 1'-9"
H4 = 1'-7"
H5 = 2'-6"

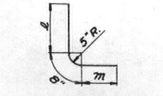
TYPE II

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

When φ or θ equals	Number of bars required: H1 ½"φ Type I	H2 ½"φ Type I	H3 ½"φ Type II	H4 ½"φ Type II	H5 ½"φ Type II	Length of bars: 3-H6 ½"φ Type II	5-H7 ½"φ Type II	1-H8 ½"φ Type II	Quantities for One Wing: Concrete Cu.Yd.	Steel Lb.
22°30'	6	5	6	5	11	13-2	10-8	5-2	2.47	131
30°	5	4	5	4	9	10-2	8-2	4-2	1.91	104
37°30'	4	3	4	3	7	8-4	6-8	3-2	1.57	82
45°	3	3	3	3	6	7-1	5-8	2-2	1.35	70
52°30'	3	3	3	3	6	7-0	5-2	2-2	1.23	68
60°	3	2	3	2	5	6-2	4-8	2-2	1.12	59
67°30'	3	2	3	2	5	5-4	4-2	2-2	1.01	56

WING DETAIL WHEN H= 3'-0"





	ℓ	m	length
F1	6'-0"	1'-2"	7'-10"
F2	2'-3"	11"	3'-10"
F3	5'-4"	1'-0"	7'-0"
F4	4'-10"	11"	6'-5"

TYPE I

F5 = 2'-3"
F6 = 2'-1"
F7 = 2'-0"
F8 = 2'-6"

TYPE II

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

When φ or θ equals	Number of bars required: F1 ½"φ Type I	F2 ½"φ Type I	F3 ½"φ Type I	F4 ½"φ Type I	F5 ½"φ Type II	F6 ½"φ Type II	F7 ½"φ Type II	F8 ½"φ Type II	Length of bars: 3-F9 ½"φ Type II	8-F10 ½"φ Type II	1-F11 ½"φ Type II	1-F12 ½"φ Type II	Quantities for One Wing: Concrete Cu.Yd.	Steel Lb.
22°30'	6	14	7	5	6	7	5	18	20'-11"	17'-8"	12'-2"	5'-2"	5.61	328
30°	5	11	5	4	5	5	4	14	16'-2"	13'-8"	9'-2"	4'-2"	4.36	254
37°30'	4	9	4	4	4	4	4	12	13'-3"	11'-2"	7'-2"	3'-2"	3.58	211
45°	3	8	4	3	3	4	3	10	11'-6"	9'-8"	6'-2"	2'-2"	3.11	180
52°30'	3	7	3	3	3	3	3	9	10'-8"	8'-5"	5'-2"	2'-2"	2.72	160
60°	3	6	2	3	3	2	3	8	9'-6"	7'-8"	4'-2"	2'-2"	2.49	143
67°30'	3	6	3	2	3	3	2	8	8'-7"	7'-2"	5'-2"	2'-2"	2.33	140

WING DETAIL WHEN H= 5'-0"

LOADING DATA INTERSTATE ALTERNATE
LIVE LOAD: A.A.S.H.O. (HS 20 – 44)
DEAD LOAD: CONCRETE 150 POUNDS PER CUBIC FOOT
EARTH 84 POUNDS PER CUBIC FOOT

(R-2) DESIGNING DATA
A.A.S.H.O. 1965 UNIT STRESS, EXCEPT AS NOTED
Reinforcing Steel fs 20000 lbs. per sq. in.
Structural Steel fs 18000 lbs. per sq. in.
fc 1200 lbs. per sq. in.
n 10

GENERAL NOTES

ALL WORK SHALL BE DONE ACCORDING TO THE STANDARD SPECIFICATIONS APPLICABLE TO THE PROJECT.

ALL CONCRETE SHALL BE CLASS "A"
ALL WING SURFACES TO RECEIVE CLASS 1 FINISH.
WING FOOTINGS & FLOOR OF BOX SHALL BE POURED MONOLITHICALLY.
FOOTINGS IN ROCK SHALL BE POURED OUT TO ROCK AND NOT FORMED
SOUNDING 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 RE-DESIGN IS NECESSARY.
(R-3) EACH REINFORCING STEEL BAR SHALL BE TAGGED WITH THE NUMBER DESIGNATION AND THE STATION NUMBER OF THE PROJECT. SECONDARY BARS
(R-2) WHEN SPLICED SHALL LAP 24 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 FOOTING AND WALL ARE POURED MONOLITHICALLY.
ALL CONSTRUCTION KEYS SHOWN BETWEEN FOOTINGS AND WALLS ARE 3" X 3".

STEEL WEIGHTS INCLUDE 1% ± FOR OVERRUN.
EXPANSION JOINT MATERIAL IS TO BE INCLUDED IN THE PRICE OF CLASS "A" CONCRETE. AND SHALL
(R-2) CONFORM TO A A S H O DESIGNATION M-213.
FOR CULVERTS REQUIRED AND GOVERNING DIMENSIONS SEE "LIST OF STRUCTURES".
(R-1) WHEN EXCAVATING FOR FOOTINGS THE FINAL SURFACE ELEVATION SHALL BE UNDISTURBED NATURAL OR COMPACTED SOIL.

STRUCTURE NO._____

REVISIONS			
(R-1)	7-17-67	General Note	M.R.H.
(R-2)	7-15-68	General Note & Dept. Name	M.R.H.
(R-3)	10-25-68	General Note & Table Note	M.R.H.

(R-2)

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

WINGWALLS FOR
CONCRETE BOX CULVERTS
4:1 SIDE SLOPES

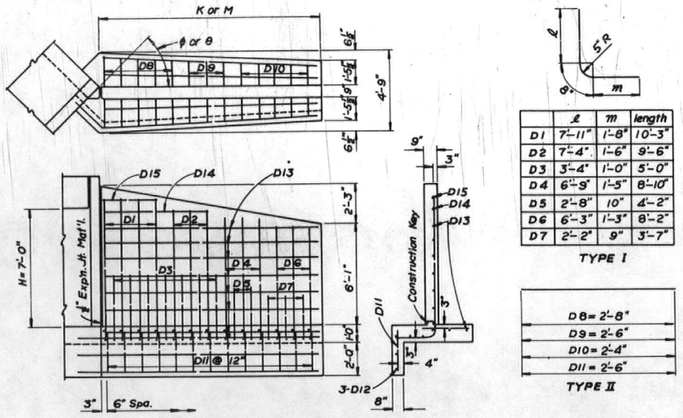
Designed by L.D.P
Made by J.W.M & R.L.S
Checked by A.I.T & D.S.K
Approved by _____ Bridge Engineer
Date: July 1, 1965

STANDARD M-601-C

(SHEET 2)

(JULY 1, 1965)

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLO.		



WING DETAIL WHEN H= 7'-0"

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

TYPE I

D8= 2'-8"
D9= 2'-6"
D10= 2'-4"
D11= 2'-6"

TYPE II

When ϕ or θ equals	Number of bars required											Length of bars				Quantities for One Wing	
	D1 Type I	D2 Type I	D3 Type I	D4 Type I	D5 Type I	D6 Type I	D7 Type I	D8 Type II	D9 Type II	D10 Type II	D11 Type II	3-D12 Type II	11-D13 Type II	1-D14 Type II	1-D15 Type II	Concrete Cu.Yd.	Steel Lb.
22°30'	7	6	12	6	6	5	5	8	7	9	24	27'-4"	23'-5"	12'-2"	6'-2"	9.62	592
30°	5	5	9	5	5	4	4	6	6	7	19	20'-11"	17'-11"	9'-2"	4'-2"	7.39	457
37°30'	4	4	8	4	3	3	3	5	5	5	15	17'-2"	14'-8"	7'-2"	3'-2"	6.07	368
45°	4	3	7	3	2	3	3	5	3	5	13	14'-10"	12'-8"	6'-2"	3'-2"	5.26	321
52°30'	3	3	6	3	2	3	3	4	4	4	12	13'-10"	11'-2"	5'-2"	2'-2"	4.66	287
60°	3	3	5	3	3	2	2	4	3	4	11	12'-3"	10'-2"	5'-2"	2'-2"	4.25	262
67°30'	3	3	5	2	3	2	2	4	3	3	10	11'-4"	9'-8"	5'-2"	2'-2"	4.05	245

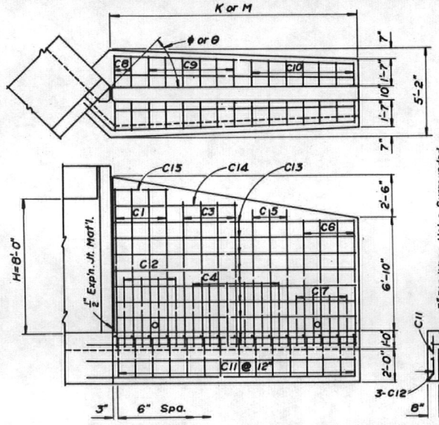
BAR LIST & QUANTITIES FOR ONE WING WHEN H= 7'-0"

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

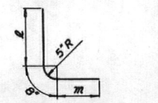
β	α	ϕ	θ	H= 7'-0" K	H= 7'-0" M	H= 8'-0" K	H= 8'-0" M	H= 9'-0" K	H= 9'-0" M	H= 10'-0" K	H= 10'-0" M
45°	45°	67°30'	22°30'	10'-0"	23'-9"	11'-0"	26'-9"	12'-3"	29'-6"	13'-6"	32'-3"
60°	30°	60°	30°	10'-6"	18'-3"	11'-9"	20'-6"	13'-0"	23'-9"	14'-3"	24'-9"
75°	15°	52°30'	37°30'	11'-6"	15'-0"	13'-0"	16'-9"	14'-3"	18'-6"	15'-9"	20'-3"
90°	0°	45°	45°	13'-0"	13'-0"	14'-6"	14'-6"	16'-0"	16'-0"	17'-6"	17'-6"
105°	15°	37°30'	52°30'	15'-0"	11'-6"	16'-9"	13'-0"	18'-6"	14'-3"	20'-3"	15'-9"
120°	30°	30°	60°	18'-3"	10'-6"	20'-6"	11'-9"	23'-9"	13'-0"	24'-9"	14'-3"
135°	45°	22°30'	67°30'	23'-9"	10'-0"	26'-9"	11'-0"	29'-6"	12'-3"	32'-3"	13'-6"

R-3 β equals the angle between ℄ of culvert and ℄ of roadway. α equals the angle between ℄ of culvert and a line normal to ℄ of roadway. ϕ and θ are angles between the wingwall and a line parallel with the ℄ of roadway.

EXAMPLE FOR USING THE ABOVE TABLE. Suppose a stream makes an angle of β=65° with ℄ of roadway, then, from the table, select the nearest angle β=60°, then α, ϕ, & θ equal 30°, 60°, & 30° respectively. If the desired height "H" of culvert is 8'-0", then "K" & "M" will be 11'-9" & 20'-6". Locate the WING DETAIL WHEN H=8'-0" on this sheet.



WING DETAIL WHEN H= 8'-0"



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

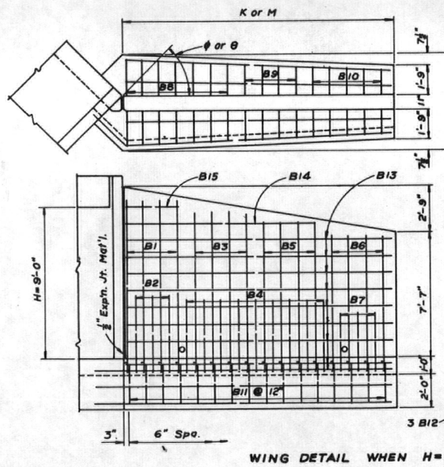
TYPE I

C8= 3'-0"
C9= 2'-9"
C10= 2'-6"
C11= 2'-6"

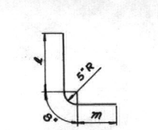
TYPE II

When ϕ or θ equals	Number of bars required											Length of bars				Quantities for One Wing	
	C1 Type I	C2 Type I	C3 Type I	C4 Type I	C5 Type I	C6 Type I	C7 Type I	C8 Type II	C9 Type II	C10 Type II	C11 Type II	3-C12 Type II	12-C13 Type II	1-C14 Type II	1-C15 Type II	Concrete Cu.Yd.	Steel Lb.
22°30'	8	7	6	12	6	7	7	5	10	12	27	30'-8"	26'-5"	13'-2"	7'-2"	12.53	779
30°	6	5	5	10	4	6	5	4	7	10	21	23'-5"	20'-2"	10'-2"	5'-2"	9.60	601
37°30'	5	4	4	8	4	4	4	3	6	8	17	19'-1"	16'-5"	8'-2"	4'-2"	7.84	487
45°	4	4	4	6	3	4	4	2	6	7	15	16'-6"	14'-2"	7'-2"	3'-2"	6.79	424
52°30'	4	3	3	6	3	3	3	2	5	6	13	15'-6"	12'-8"	6'-2"	3'-2"	6.08	374
60°	4	3	2	6	3	3	2	2	4	6	12	13'-8"	11'-5"	5'-2"	3'-2"	5.50	341
67°30'	3	3	3	5	2	3	2	2	4	5	11	12'-5"	10'-8"	5'-2"	2'-2"	5.15	315

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



WING DETAIL WHEN H= 9'-0"



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

TYPE I

B8= 3'-3"
B9= 2'-9"
B10= 2'-7"
B11= 2'-6"

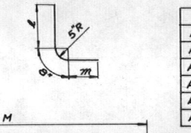
TYPE II

When ϕ or θ equals	Number of bars required											Length of bars				Quantities for One Wing	
	B1 Type I	B2 Type I	B3 Type I	B4 Type I	B5 Type I	B6 Type I	B7 Type I	B8 Type II	B9 Type II	B10 Type II	B11 Type II	3-B12 Type II	12-B13 Type II	1-B14 Type II	1-B15 Type II	Concrete Cu.Yd.	Steel Lb.
22°30'	7	6	8	16	8	7	7	13	8	9	30	33'-9"	29'-2"	22'-2"	6'-2"	15.93	930
30°	5	5	7	13	6	6	5	10	7	7	24	27'-0"	23'-5"	17'-2"	4'-2"	12.82	742
37°30'	4	4	5	10	5	5	4	8	5	6	19	21'-1"	18'-2"	13'-2"	3'-2"	9.98	580
45°	4	3	4	9	4	4	3	7	4	5	16	18'-2"	15'-8"	11'-2"	3'-2"	8.63	495
52°30'	3	3	4	8	4	4	3	6	4	5	15	17'-0"	13'-11"	10'-2"	2'-2"	7.69	453
60°	3	3	4	7	3	3	2	6	3	4	13	15'-1"	12'-8"	9'-2"	2'-2"	7.01	406
67°30'	3	2	3	7	4	3	3	5	3	5	13	13'-9"	11'-11"	9'-2"	2'-2"	6.61	385

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

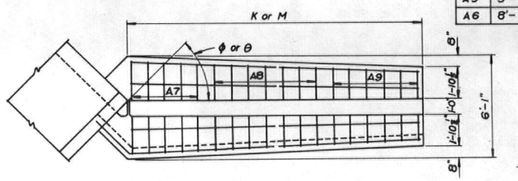
A7= 3'-5"
A8= 3'-2"
A9= 2'-9"
A10= 2'-6"

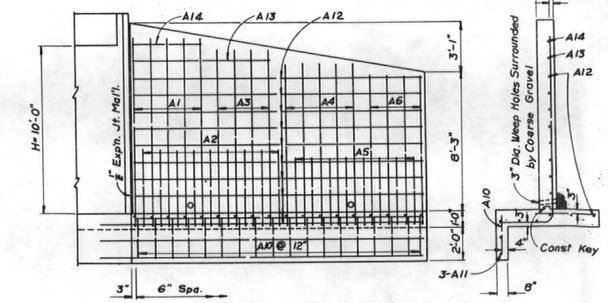
TYPE II



	ℓ	m	length
A1	10'-8"	2'-5"	13'-9"
A2	4'-1"	1'-6"	6'-3"
A3	9'-11"	2'-3"	12'-10"
A4	9'-2"	2'-1"	11'-11"
A5	3'-7"	1'-4"	5'-7"
A6	8'-5"	1'-11"	11'-0"

TYPE I





WING DETAIL WHEN H=10'-0"

When ϕ or θ equals	Number of bars required											Length of bars				Quantities for One Wing	
	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		3-A11 Type II	13-A12 Type II	1-A13 Type II	1-A14 Type II	Concrete Cu.Yd.	Steel Lb.
22°30'	9	16	8	8	16	8	10	12	11	33		36'-10"	31'-11"	16'-2"	8'-2"	19.74	1224
30°	7	12	6	6	12	6	7	10	8	25		28'-2"	24'-5"	12'-2"	6'-2"	15.14	930
37°30'	6	10	5	5	10	5	6	8	7	21		23'-1"	19'-11"	10'-2"	5'-2"	12.39	775
45°	5	9	4	5	8	4	5	7	6	18		19'-9"	17'-2"	8'-2"	4'-2"	10.71	665
52°30'	5	8	3	4	7	4	5	6	5	16		18'-9"	15'-5"	7'-2"	4'-2"	9.63	597
60°	4	7	4	3	7	4	4	6	5	15		16'-6"	13'-11"	7'-2"	3'-2"	8.72	543
67°30'	4	7	3	4	6	3	4	5	5	14		15'-2"	13'-2"	6'-2"	3'-2"	8.26	515

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

REVISIONS		
R-2	7-15-68	Dept. Name M.R.H.
R-3	10-25-68	Table Note M.R.H.

R-2

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

WINGWALLS FOR
CONCRETE BOX CULVERT
4:1 SIDE SLOPES

Designed by L.D.P. | Approved by
Made by JW & RLS | Bridge Engineer
Checked by A.T. & J.S.M. | Date: July 1, 1965

STRUCTURE NO._____

STANDARD M-603-M
(MARCH 20, 1967)

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO			

REVISIONS			
R-1	4-5-68	Added notes.	M.R.H.
R-2	7-23-68	Dept. Name. & Ø Note	M.R.H.
R-3	2-11-71	Thickness Tables, General Notes.	M.R.H.

FILL HEIGHT & THICKNESS TABLES FOR METAL CULVERT PIPE (RIVETED, WELDED OR HELICAL FABRICATION) (R-3)

TABLE I
CORRUGATED STEEL PIPE
(2"x1/2") OR (2·2/3"x1/2") CORRUGATIONS

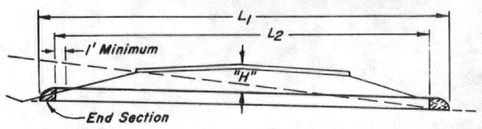
PIPE SIZE (B_a) Inches	AREA (Sq.Ft.)	HEIGHT OF FILL OVER TOP OF PIPE IN FEET: 1 to 10	10+ to 15	15+ to 20	20+ to 25	25+ to 30	30+ to 35	35+ to 40	40+ to 45	45+ to 50	50+ to 55	55+ to 60	60+ to 70	70+ to 80	80+ to 90	90+ to 100
		THICKNESS IN INCHES														
12	0.8	.064	.064	.064	.064	.064	.064	.064	.064	.064	.064	.064	.064	.064	.079	.109
15	1.2	.064	.064	.064	.064	.064	.064	.064	.064	.064	.064	.064	.079	.109	.109	.138
18	1.8	.064	.064	.064	.064	.064	.064	.064	.064	.064	.079	.079	.109	.109	.138	.168
24	3.1	.064	.064	.064	.064	.064	.079	.109	.138	.138	.168					
30	4.9	.064	.064	.064	.064	.079	.079	.109	.109	.138	.168					
36	7.1	.064	.064	.064	.064	.079	.079	.109	.138	.168						
42	9.6	.064	.064	.064	.064	.064	.079	.109	.109							
48	12.6	.064	.064	.064	.064	.079	.079	.109	.168							
54	15.9	.079	.079	.079	.079	.079	.109	.109								
60	19.6	.109	.109	.109	.109	.109	.109	.138								
66	23.8	.109	.109	.109	.109	.138	.138	.168								
72	28.3	.138	.138	.138	.138	.168										
78	33.0	.168	.168	.168	.168											
84	38.0	.168	.168	.168												

----See General Note.

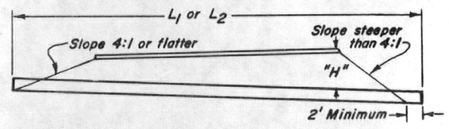
TABLE II
CORRUGATED STEEL PIPE ARCH
(2"x1/2") OR (2·2/3"x1/2") CORRUGATIONS

PIPE SIZE Span-Rise (Inches)	AREA (Sq.Ft.)	CORNER RADIUS (Inches)	HEIGHT OF FILL OVER TOP OF PIPE IN FEET: 1.5 to 7	7+ to 8	8+ to 9	9+ to 10	10+ to 12	12+ to 13
			THICKNESS IN INCHES					
18 x 11	1.1	3 1/2	.064	.064	.064	.064	.064	.064
22 x 13	1.6	4	.064	.064	.064	.064	.064	
25 x 16	2.2	4	.064	.064	.064	.064		
29 x 18	2.8	4 1/2	.064	.064	.064			
36 x 22	4.4	5	.064	.064	.064			
43 x 27	6.4	5 1/2	.064					
50 x 31	8.7	6	.079					
58 x 36	11.4	7	.109					
65 x 40	14.3	8	.109					
72 x 44	17.6	9	.138					

METAL CULVERT WITH END SECTIONS



METAL CULVERT WITHOUT END SECTIONS



"H" = Maximum height of fill over top of Culvert, including pavement.

L_1 = Length of Culvert to be measured when placed in accordance with Section 617.

L_2 = Length of pipe to be measured when placed in accordance with Section 603.

(R-1) *Length of extension, when placed in accordance with Section 617, shall be the actual number of feet of new culvert required.*

TABLE III
CORRUGATED STEEL PIPE
RIVETED OR HELICAL FABRICATION — 3" x 1" CORRUGATIONS

PIPE SIZE (B_a) Inches	AREA (Sq.Ft.)	HEIGHT OF FILL OVER TOP OF PIPE IN FEET: 1 to 10	10+ to 15	15+ to 20	20+ to 25	25+ to 30	30+ to 35	35+ to 40	40+ to 45	45+ to 50	50+ to 55	55+ to 60	60+ to 70	70+ to 80
		THICKNESS IN INCHES												
36	7.1	.064	.064	.064	.064	.064	.079	.079	.109	.109	.109	.109	.138	.168
42	9.6	.064	.064	.064	.064	.079	.079	.079	.109	.109	.109	.109	.138	.168
48	12.6	.064	.064	.064	.079	.079	.079	.109	.109	.109	.138	.168		
54	15.9	.064	.064	.064	.079	.079	.109	.109	.138	.168				
60	19.6	.064	.064	.064	.079	.109	.109	.109	.138					
66	23.8	.064	.064	.079	.079	.109	.109	.138						
72	28.3	.064	.064	.079	.109	.109	.109	.138						
78	33.0	.064	.064	.079	.109	.109	.138	.168						
84	38.0	.079	.079	.079	.109	.109								
90	44.0	.079	.079	.109	.109	.109								
96	50.3	.109	.109	.109	.109	.138								
102	57.0	.109	.109	.109	.109									
108	64.0	.109	.109	.109	.138									
114	70.9	.138	.138	.138	.168									
120	78.6	.138	.138	.138	.168									

----See General Note.

5/16" rivets or helical fabrication shall be used on pipes with thickness to the left of or above the heavy solid line.

3/8" rivets or helical fabrication shall be used on pipes with thickness to the right of or below the heavy solid line.

TABLE IV
CORRUGATED STEEL PIPE
* SPOT WELDED OR BOLTED (1/2" ASTM A 325 BOLTS) FABRICATION — 3" x 1" CORRUGATIONS

PIPE SIZE (B_a) Inches	AREA (Sq.Ft.)	HEIGHT OF FILL OVER TOP OF PIPE IN FEET: 1 to 10	10+ to 15	15+ to 20	20+ to 25	25+ to 30	30+ to 35	35+ to 40	40+ to 45	45+ to 50	50+ to 55	55+ to 60	60+ to 70	70+ to 80	80+ to 90	90+ to 100
		THICKNESS IN INCHES														
36	7.1	.064	.064	.064	.064	.064	.064	.064	.079	.079	.079	.109	.109	.109	.109	.138
42	9.6	.064	.064	.064	.064	.064	.064	.064	.079	.079	.109	.109	.109	.138	.168	
48	12.6	.064	.064	.064	.064	.064	.079	.079	.079	.109	.109	.109	.138	.168		
54	15.9	.064	.064	.064	.064	.064	.079	.079	.109	.109	.138	.138				
60	19.6	.064	.064	.064	.064	.064	.079	.079	.109	.109	.138	.168				
66	23.8	.064	.064	.064	.064	.079	.079	.109	.109	.138	.168					
72	28.3	.064	.064	.064	.064	.079	.079	.109	.109	.138	.168					
78	33.0	.064	.064	.064	.079	.079	.109	.109	.138	.168						
84	38.0	.079	.079	.079	.079	.109	.109	.138								
90	44.0	.079	.079	.079	.079	.109	.109	.138								
96	50.3	.109	.109	.109	.109	.109	.138	.168								
102	57.0	.109	.109	.109	.109	.109	.138	.168								
108	64.0	.109	.109	.109	.109	.109	.138									
114	70.9	.138	.138	.138	.138	.138	.138									
120	78.6	.138	.138	.138	.138	.138										

----See General Note.

** 3/8" rivets may be used on pipes with thickness to left of or above the heavy solid line.*
7/16" rivets may be used on pipes with thickness to right of or below the heavy solid line.

TABLE V
CORRUGATED STEEL PIPE ARCH
(R-2) — 3" x 1" CORRUGATIONS

PIPE SIZE Span-Rise (Inches)	AREA (Sq.Ft.)	CORNER RADIUS (Inches)	HEIGHT OF FILL OVER TOP OF PIPE IN FEET: 1.5 to 10	10+ to 11	11+ to 12	12+ to 14	14+ to 15
			THICKNESS IN INCHES				
43 x 27	6.4	7 3/4	.064	.064	.064		
50 x 31	8.7	9	.064	.064	.064		
58 x 36	11.4	10 1/2	.064	.064	.064		
65 x 40	14.3	12	.064	.064	.064		
72 x 44	17.6	13 1/4	.064	.064	.064		
73 x 55	22.0	18	.064	.064	.064	.064	.064
81 x 59	26.0	18	.079	.079	.079	.079	.079
Ø 87 x 63	31.0	18	.079	.079	.079	.079	
Ø 95 x 67	35.0	18	.109	.109	.109		
Ø 103 x 71	41.0	18	.109	.109			

TABLE VI
CORRUGATED ALUMINUM PIPE
2·2/3" x 1/2" CORRUGATIONS

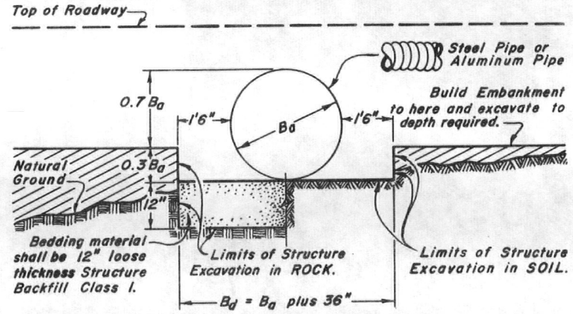
PIPE SIZE (B_a) Inches	AREA (Sq.Ft.)	HEIGHT OF FILL OVER TOP OF PIPE IN FEET: 1 to 10	10+ to 15	15+ to 20	20+ to 25	25+ to 30	30+ to 35	35+ to 40	40+ to 45	45+ to 50	50+ to 55	55+ to 60	60+ to 70	70+ to 80
		THICKNESS IN INCHES												
12	0.8	.060	.060	.060	.060	.060	.060	.060	.075	.105	.105	.105	.105	.105
18	1.8	.060	.060	.060	.060	.060	.075	.105	.135	.164	.164			
24	3.1	.060	.060	.060	.075	.135								
30	4.9	.060	.060	.060	.105	.105	.164							
36	7.1	.060	.060	.075	.105	.164								
42	9.6	.075	.075	.105	.075	.105	.105	.164						
48	12.6	.105	.105	.105	.105	.135	.164	.164						
54	15.9	.105	.105	.135	.164	.164								
60	19.6	.135	.135	.164										
66	23.8	.135	.164											
72	28.3	.164												

----See General Note.

TABLE VII
CORRUGATED ALUMINUM PIPE ARCH
2·2/3" x 1/2" CORRUGATIONS

PIPE SIZE Span-Rise (Inches)	AREA (Sq.Ft.)	CORNER RADIUS (Inches)	HEIGHT OF FILL OVER TOP OF PIPE IN FEET: 1.5 to 7	7+ to 9	9+ to 11	11+ to 13	13+ to 14	14+ to 15
			THICKNESS IN INCHES					
18 x 11	1.1	4 3/4	.060	.060	.060	.060	.060	.060
22 x 13	1.6	4 3/4	.060	.060	.060	.060	.060	
25 x 16	2.2	4 1/2	.060	.060	.060	.060		
29 x 18	2.8	4 1/2	.060	.060	.060			
36 x 22	4.4	5	.060	.060				
43 x 27	6.4	5 1/2	.075					
50 x 31	8.7	6	.105					
58 x 36	11.4	7	.135					
65 x 40	14.3	8	.135					
72 x 44	17.6	9	.164					

INSTALLATION OF METAL CULVERT PIPE



NOTE: Spacing for multiple pipe installations shall conform to the details shown on M Standard for Excavation and Backfill for Structures.

GENERAL NOTES (R-3)

All work shall be done in accordance with the Standard Specifications applicable to the project.

The tables on this sheet show minimum gages for structural requirements only. They are intended for use only where corrosive and/or abrasive conditions are negligible. Heavier metal and/or protective coatings shall be used where site investigations indicate corrosive and/or abrasive conditions.

▼ *Pipe arch with equal periphery and with span and rise dimensions approximately equal to those required by plans will be permitted.*

During construction, adequate cover (4') shall be provided to protect the structure from damage.

Pipe shall be placed with longitudinal seams at the sides or quarter points but not along top of vertical axis.

The minimum depth of fill excluding pavement over corrugated metal pipe culverts shall be as staked by the Engineer but in no case shall it be less than shown in the following tabulation:

Diameter of Culvert (B_a)	Minimum Allowable Cover
96" and smaller	1 foot
102" and larger	2 feet
Pipe Arch	1.5 feet

Structural plate pipes of equal or larger diameter, conforming to Section 510 of the Standard Specifications, may be substituted for the pipes shown on this sheet at no additional cost to the State.

NOTES FOR TABLES

---- *Pipes with thickness to right of or below the heavy dashed line shown in the tables on this sheet, shall be elongated 5 percent on the vertical axis as installed. (Tables I, III, IV and VI)*

Maximum fill heights shown are for bearing pressures of 2 tons per square foot. (Tables II, V and VII)

Fill heights greater than 90' shall be used only after thorough investigation of foundation material. (Tables I and IV.)

Variations from corner radii shown will be acceptable provided the pipe is of sufficient strength to support it's designated fill height. (Tables II, V, and VII)

GENERAL NOTES (Continued) (R-1)

When a culvert is to be extended with pipe of different material, the connection shall conform to the detail on plans or be approved.

(R-2) *Ø May not be available. The designer should contact supplier before calling for the sizes denoted by this symbol.*

(R-2)

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

METAL CULVERT PIPE
H-20 LOADING

Designed by M.R.H.	Approved by L. E. O.
Made by J.R.B.	Staff Design Engineer
Checked by R.S.M.	Date: March 20, 1967

STANDARD M-603-RC

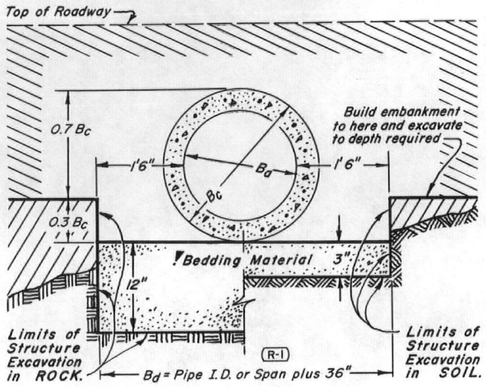
(MARCH 20, 1967)

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	T. SHEETS
9	COLORADO			

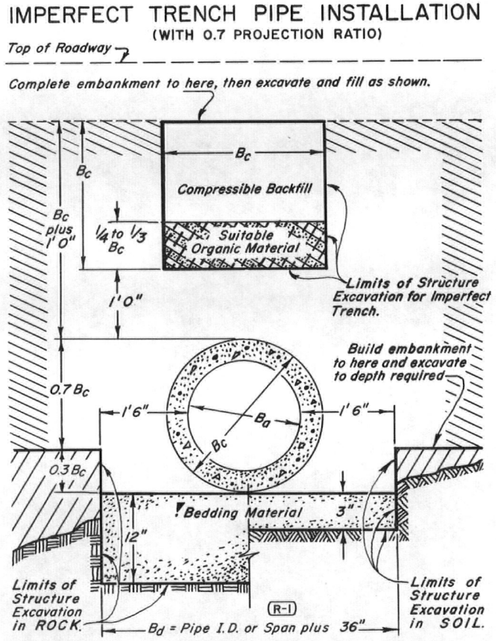
REVISIONS			
R-1	4-19-68	Added Arch and Elliptical Pipe. Gen. Notes.	M.R.H.
R-2	7-23-68	Dept. Name.	M.R.H.
R-3	3-1-71	GN's for B bed and NRCP. Cl. 2 bed mat'l.	M.R.H.

(R-1) **NOTE:** B_c Is the outside dimension for diameter, span or rise.

PIPE INSTALLATION
(WITH 0.7 PROJECTION RATIO)



IMPERFECT TRENCH PIPE INSTALLATION
(WITH 0.7 PROJECTION RATIO)



Bedding Material for SOIL shall be 3" loose thickness Structure Backfill Class 2. (R-3)
Bedding Material for ROCK shall be 12" loose thickness Structure Backfill Class 1.

(R-1)

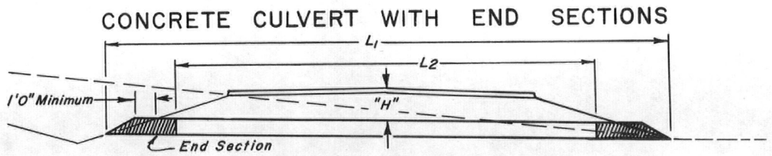
DIMENSIONS FOR REINFORCED CONCRETE PIPE
(For Information Only)

CIRCULAR			ARCH				(VE) VERTICAL ELLIPTICAL				(HE) HORIZONTAL ELLIPTICAL			
▲ PIPE SIZE-B_a (In. I.D.)	Wall Thickness (Inches)	0.3 B_c (Outside Dia.) (Feet)	⌀ Span (Inches)	⌀ Rise (Inches)	Wall Thickness (Inches)	0.3 Outside Rise (Feet)	Span (Inches)	Rise (Inches)	Wall Thickness (Inches)	0.3 Outside Rise (Feet)	Span (Inches)	Rise (Inches)	Wall Thickness (Inches)	0.3 Outside Rise (Feet)
12	2	0.40												
15	2-1/4	0.49	18	11	2-1/4	0.39								
18	2-1/2	0.58	22	13	2-1/2	0.45					23	14	2-3/4	0.49
21	2-3/4	0.66	25	16	2-3/4	0.54								
24	3	0.75	29	18	3	0.60					30	19	3-1/4	0.66
27	3-1/4	0.84									34	22	3-1/2	0.73
30	3-1/2	0.92	36	22	3-1/2	0.73					38	24	3-3/4	0.79
33	3-3/4	1.01									42	27	3-3/4	0.86
36	4	1.10	43	27	4	0.88	29	45	4-1/2	1.35	45	29	4-1/2	0.95
39							32	49	4-3/4	1.46	49	32	4-3/4	1.04
42	4-1/2	1.28	50	31	4-1/2	1.00	34	53	5	1.58	53	34	5	1.10
48	5	1.45	58	36	5	1.15	38	60	5-1/2	1.78	60	38	5-1/2	1.23
54	5-1/2	1.62	65	40	5-1/2	1.28	43	68	6	2.00	68	43	6	1.38
60	6	1.80	72	44	6	1.40	48	76	6-1/2	2.23	76	48	6-1/2	1.53
66	6-1/2	1.97					53	83	7	2.43	83	53	7	1.68
72	7	2.15	88	54	7	1.70	58	91	7-1/2	2.65	91	58	7-1/2	1.83
78	7-1/2	2.32					63	98	8	2.85	98	63	8	1.98
84	8	2.50	102	62	8	1.95	68	106	8-1/2	3.08	106	68	8-1/2	2.13
90	8-1/2	2.68	115	72	8-1/2	2.23	72	113	9	3.28	113	72	9	2.25
96	9	2.85	122	77	9	2.38	77	121	9-1/2	3.50	121	77	9-1/2	2.40
102	9-1/2	3.02					82	128	9-3/4	3.69	128	82	9-3/4	2.54
108	10	3.20	138	87	10	2.68	87	136	10	3.90	136	87	10	2.68

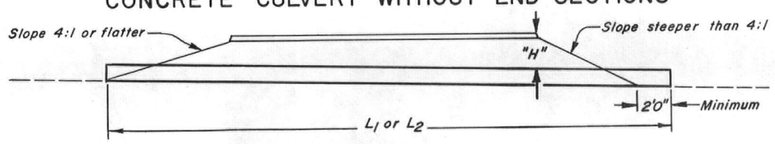
▲ Also equivalent round dimension for Arch and Elliptical pipe.

⌀ Sizes shown are for identification purposes only. Actual sizes shall conform to those listed in Fig. 1 of ASTM Spec. C 506.

CONCRETE CULVERT WITH END SECTIONS



CONCRETE CULVERT WITHOUT END SECTIONS



"H" = Maximum height of fill over top of Culvert, including pavement.
L_1 = Length of Culvert to be measured when placed in accordance with Section 617.
L_2 = Length of Pipe to be measured when placed in accordance with Section 603.

(R-1) Length of extension, when placed in accordance with Section 617, shall be the actual number of feet of new culvert required.

(R-1)

HEIGHTS OF FILL OVER REINFORCED CONCRETE PIPE
— ALL SIZES —

TYPE OF PIPE	HEIGHT OF FILL OVER TOP OF PIPE IN FEET — CLASS OF PIPE (0.01" Crack D-Load)				
	Class II / Class VE II / Class HE II — 1000 D	Class III / Class VE III / Class HE III — 1350 D	Class IV / Class VE IV / Class HE IV — 2000 D	Class V / Class VE V — 3000 D	Class VE VI — 4000 D
PIPE INSTALLATION WITH 0.7 PROJECTION RATIO					
CIRCULAR	Min. to 18	Min. to 25	25+ to 37	37+ to 45	
ARCH	Min. to 18	Min. to 25	25+ to 37		
VERTICAL ELLIPTICAL	Min. to 18	Min. to 25	25+ to 37	37+ to 45	45+ to 62
HORIZONTAL ELLIPTICAL	Min. to 18	Min. to 25	25+ to 37		
PIPE INSTALLATION WITH IMPERFECT TRENCH					
ALL TYPES	up to 35	up to 48	48+ to 75	75+ to 96	

(R-3)

GENERAL NOTES

All work shall be done in accordance with the Standard Specifications applicable to the project.

Minimum cover excluding pavement shall be 1 foot.

Fill heights greater than maximum allowed in the Heights of Fill Table on this sheet will require special design of structure.

Pipe design is based on safety factor of 1.33 on ultimate strength.

The heights of fill over top of pipe are based on unit weight of soil at 120 lbs. per cubic foot.

Pipe Class is determined from .01 inch crack D-load.

Bedding is Class B (Modified) with Settlement Ratio $R_{sd} = 0.0$ (Yielding Bed).

Changes in design factors will require compensating change in pipe design.

Minimum wall thickness dimensions are based on AASHO Designation M 170 (Wall B) for Circular Pipe, AASHO Designation M 206 for Arch Pipe and AASHO Designation M 207 for Elliptical Pipe.

Spacing for multiple pipe installations shall conform to the details shown on M Standard for Excavation and Backfill for Structures.

When a culvert is to be extended with pipe of different material, the connection shall conform to the detail on plans or be approved.

NONREINFORCED CONCRETE PIPE

Nonreinforced Concrete Pipe is required to meet the same D-Load to produce the ultimate load under the three-edge-bearing method as specified for Reinforced Concrete Pipe in accordance with AASHO M-170. Wall thickness of pipe may be increased as required to meet D-Load requirement.

All requirements for Reinforced Concrete Pipe, except those referring to reinforcement shall apply to Nonreinforced Concrete Pipe.

(R-2)

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

REINFORCED CONCRETE PIPE

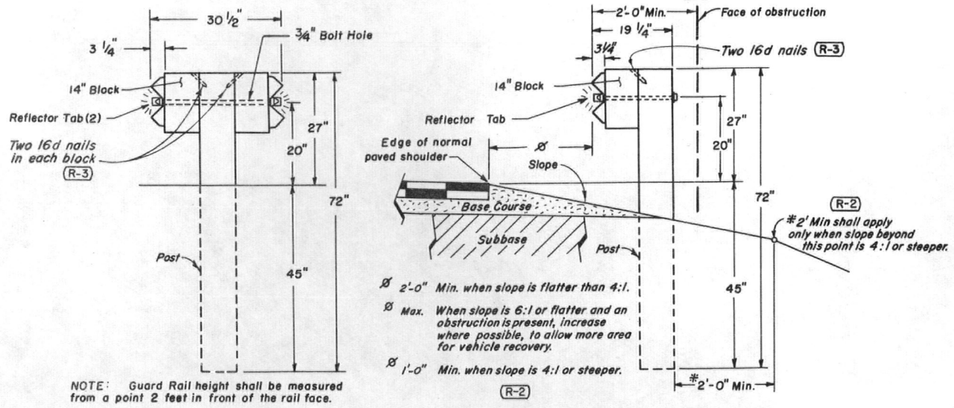
Designed by M.R.H.	Approved by [signature]
Made by J.R.B.	Staff Design Eng'r.
Checked by R.S.M.	Date: 4-19-68

FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	SHEETS
9	COLORADO			

STANDARD M-606-AB

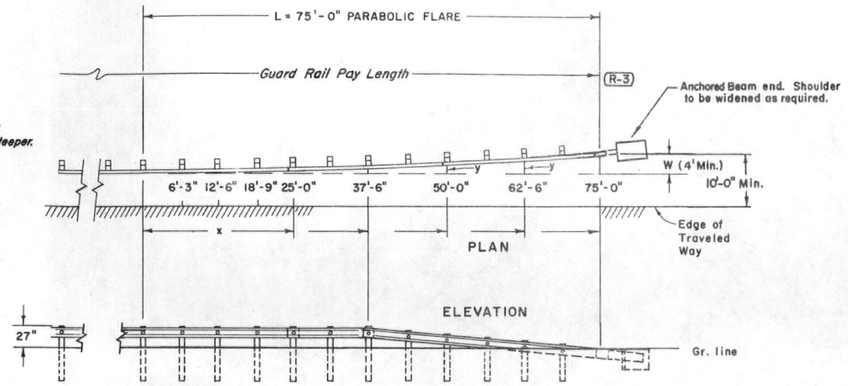
(MARCH 1, 1968)
(SHEET 1 OF 3)

REVISIONS			
R-1	7-10-68	Add typical post & obstr.	M.R.H.
R-2	4-1-69	Widening. Bevel. Gen. notes.	M.R.H.
R-3	2-18-70	Pay length. Blocks. Gen. Notes.	M.R.H.
R-4	11-25-70	Timber, Hole and Gen. Notes.	M.R.H.



TYPICAL POST INSTALLATIONS

(See Table for Post & Block Cross Section) R-4



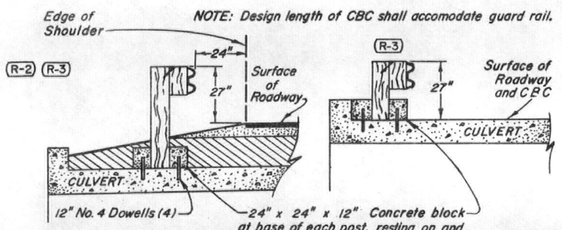
PARABOLIC TRANSITION & END TREATMENT

TABLE OF OFFSETS FOR 75' PARABOLIC FLARES

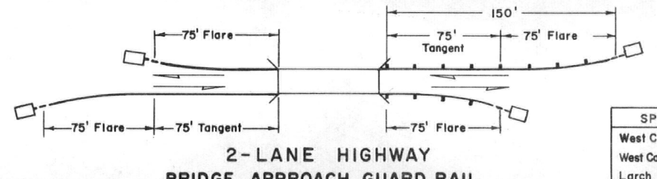
x	y W=4'	W=5'	W=10'	W=12'	W=14'	W=16'
12'-6"	0.11	0.14	0.28	0.33	0.39	0.44
25'-0"	0.44	0.55	1.11	1.33	1.56	1.78
37'-6"	1.00	1.25	2.50	3.00	3.50	4.00
50'-0"	1.78	2.22	4.44	5.33	6.23	7.11
62'-6"	2.78	3.48	6.95	8.34	9.73	11.11
75'-0"	4.00	5.00	10.00	12.00	14.00	16.00

LEGEND

W = Full parabolic offset.
L = Length of parabolic transition.
x = Longitudinal dist. from beginning of flare.
y = Offset = $W \cdot x^2/L^2$

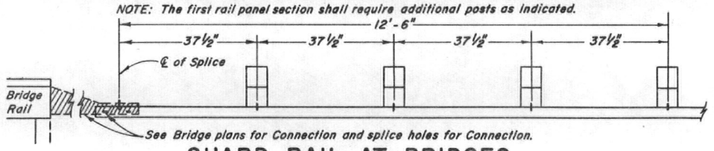


GUARD RAIL ACROSS CONCRETE BOX CULVERT

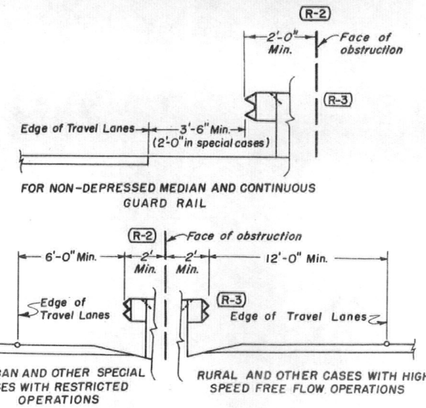


2-LANE HIGHWAY
BRIDGE APPROACH GUARD RAIL

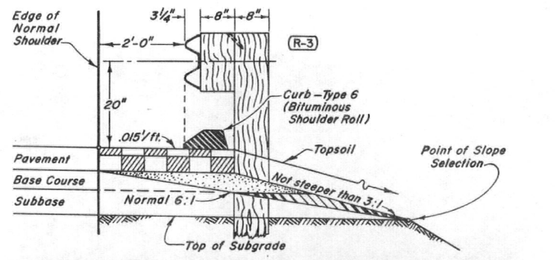
NOTE: For divided highways see Sheet No. 2.



GUARD RAIL AT BRIDGES



R-1 GUARD RAIL FOR OBSTRUCTIONS IN MEDIAN
(See Sheet No. 3)



GUARD RAIL WITH BITUMINOUS CURB
(Showing Typical Shoulder Widening) R-2

GENERAL NOTES

R-4

All work shall be done in accordance with the Standard Specifications applicable to the project.

All timber shall be close grained Douglas Fir of the Coast Region, Dense Longleaf or Shortleaf Southern Pine, Lodgepole Pine, Ponderosa Pine, Western Hemlock, or Larch, and shall conform to the following grading specifications and requirements:

SPECIES	POST & BLOCK CROSS SECTION	FOHC	GRADING RULES
West Coast D. F.	6" x 8"	Yes	WCLA Par. 125 b
West Coast Hemlock	6" x 8"	Yes	WCLA Par. 225 b
Larch	6" x 8"	Yes	WWPA Par. 80.11
Southern Pine	6" x 8"	No	SPA Par. 253
Lodgepole Pine	8" x 8"	No	WWPA Par. 80.11
Ponderosa Pine	8" x 8"	No	WWPA Par. 80.11

WCLA — Standard Grading Rule 15, Grading and Dressing rules of West Coast Douglas Fir, issued by the West Coast Lumber Inspection Bureau.

WWPA — Standard Grading Rules, published by Western Wood Products Association.

SPA — Standard Grading Rules for Southern Pine Lumber, issued by the Southern Pine Inspection Bureau.

FOHC — Free of Heart Centers. See paragraph 612 c of WCLA.

NOTE — 6"x 8" Posts and Blocks shall be installed with the 6" dimension parallel to the roadway.

All timber shall be rough, square cut and full sawn.

At the time the post or block is installed, any seasoning check which extends the full length of the piece shall not exceed one-quarter inch in width at its' maximum width.

Blocks shall be cut from timber of the same cross section and species as the posts.

Timber shall be incised and pressure treated in accordance with AASHO Designation M 133, except that blocks need not be incised. Post bolt holes are to be drilled before treatment is applied.

The preservative shall be either (a) Creosote or (b) Pentachlorophenol in a petroleum carrier (liquid or L.P. gas).

Posts shall be spaced at 6'-3" center-to-center except when otherwise designated on this Standard or in the guardrail tabulation on the plans.

Where pedestrian hazard exists and sidewalk is constructed on the roadway shoulder, guard rail shall be placed between the sidewalk and the edge of traffic lane.

Guard rail plate shall not be lighter than No. 12 U.S. Standard Gage. 25' length of rail panels will be permitted.

Metal plate guard rail shall be painted in accordance with standard specifications or shall be galvanized in accordance with AASHO Designation M-111 or with ASTM Designation A 525, Coating Class 2.50.

Posts used for vertical transition shall be adjusted in length so that a minimum of 45" will be buried.

Standard galvanized wrought steel washers shall be used under all bolt heads or nuts coming in contact with wood posts.

Concrete shall be Class "A" or Class "B".

Blocks shall be toenailed to posts with two 16 penny galvanized nails in the top of each block.

If posts are cut in the field, cut ends shall receive 2 coats of hot creosote.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

GUARD RAIL TYPE 3

Designed by M.R.H.
Made by J.R.B.
Checked by R.S.M.
Approved by K.C.
Staff Design Engineer
Date: March 1, 1968

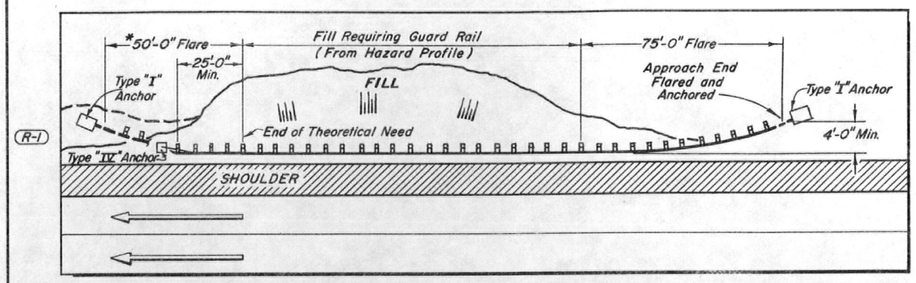
STANDARD M-606-AB

(MARCH 1, 1968)

(SHEET 2)

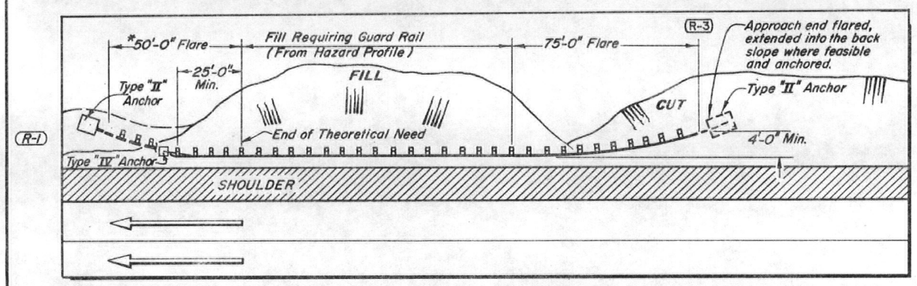
FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO			

REVISIONS			
R-1	7-10-68	Add end anchorage	M.R.H.
R-2	4-1-69	Bridge exit guard rail note	M.R.H.
R-3	2-18-70	Pay length	M.R.H.
R-4	11-25-70	Timber dimension.	M.R.H.

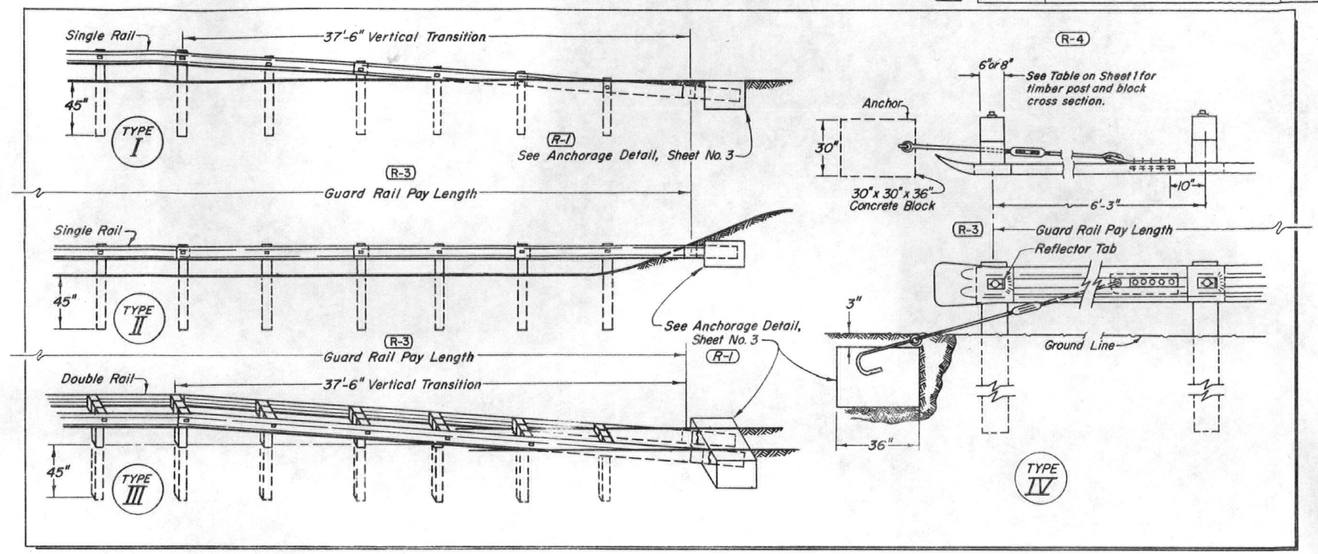


GUARD RAIL INSTALLATION — ROADSIDE FILL CONDITION

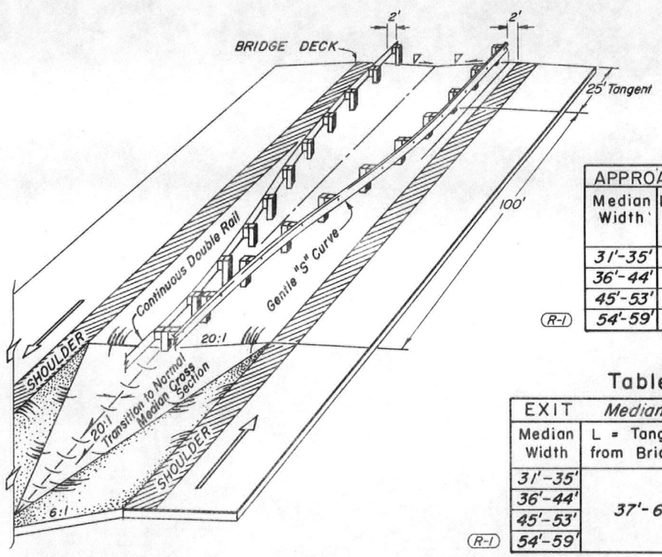
NOTES:
* 2-Lane Highways — The exit end of Guard Rail shall extend 50 feet past the end of theoretical need and shall be flared and anchored.



GUARD RAIL INSTALLATION — ROADSIDE CUT TO FILL CONDITION



TYPICAL END ANCHORAGE



21' to 30' MEDIAN

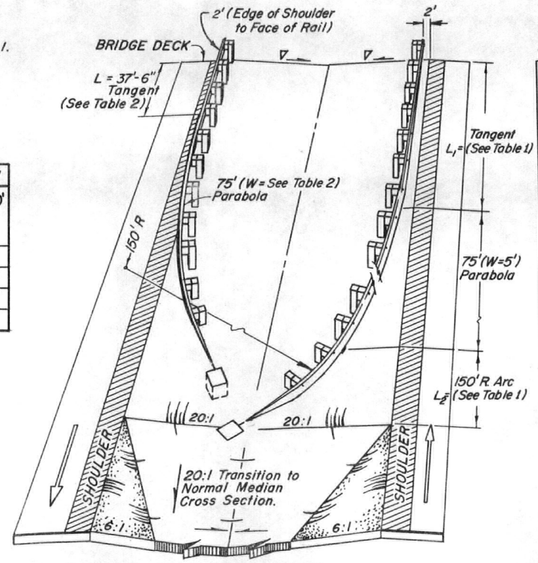
R-2
▽Not steeper than 20:1.

Table 1

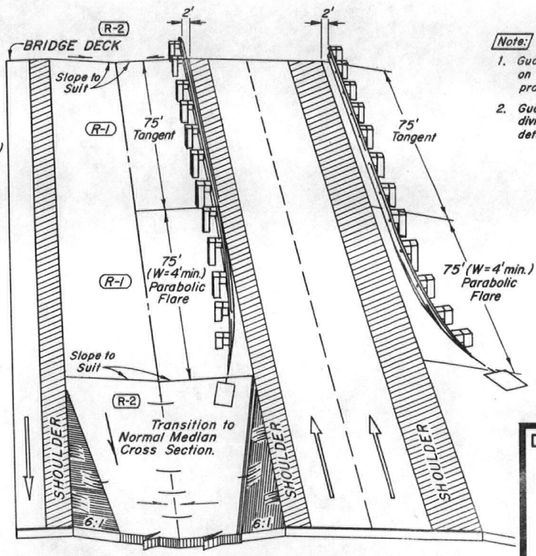
APPROACH Median Guard Rail			
Median Width	L_1=Tangent from Bridge	75' Parabolic Flare	L_2 = 150' Radius Arc
	then	then	then
31'-35'	50'-0"	W = 5'	25'-0"
36'-44'	25'-0"		50'-0"
45'-53'	12'-6"		62'-6"
R-1 54'-59'	0'-0"		75'-0"

Table 2

EXIT Median Guard Rail		
Median Width	L = Tangent from Bridge	75' Parabolic Flare, W=
		then
31'-35'	37'-6"	10'
36'-44'		12'
45'-53'		14'
R-1 54'-59'		16'



R-1 31' to 59' MEDIAN



R-1 MEDIAN 60' AND OVER

R-2

Note: EXIT FROM BRIDGES:

1. Guard rail for OUTSIDE shoulders at exit end of bridges on divided highways to be determined from hazard profile.
2. Guard rail for INSIDE shoulders at exit end of bridges on divided highways with medians 60' and over to be determined from hazard profile.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

GUARD RAIL
TYPE 3

Designed by	M.R.H.	Approved by	
Made by	J.R.B.	Staff Design Engineer	
Checked by	R.S.M.	Date:	March 1, 1968

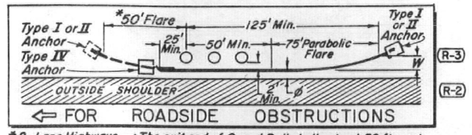
GUARD RAIL AT BRIDGE APPROACH

STANDARD M-606-AB

(MARCH 1, 1968)
(SHEET 3)

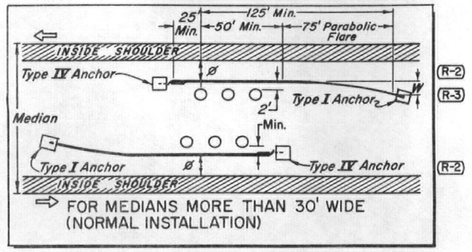
FEDERAL ROAD REGION NO.	DIVISION	PROJ. NO.	SHEET NO.	TOT. SHEETS
9	COLORADO			

REVISIONS			
R-1	7-10-68	Entire sheet redone.	M.R.H.
R-2	4-1-69	Recovery area. Delete timber bevel. Refl. tab.	M.R.H.
R-3	2-18-70	Pay Length.	M.R.H.
R-4	11-25-70	Block at pier.	M.R.H.

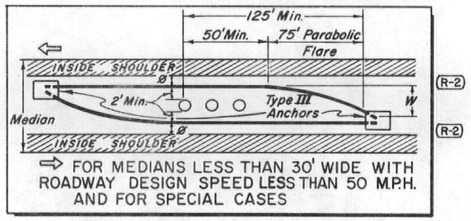


⇦ FOR ROADSIDE OBSTRUCTIONS

*2-Lane Highways — The exit end of Guard Rail shall extend 50 ft. past the end of theoretical need and shall be flared and anchored.

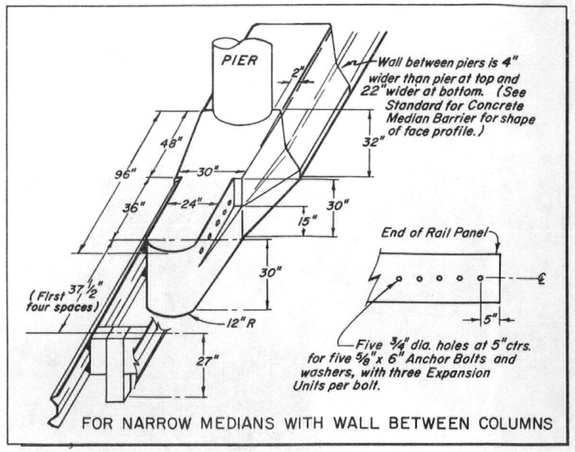


⇨ FOR MEDIANS MORE THAN 30' WIDE (NORMAL INSTALLATION)

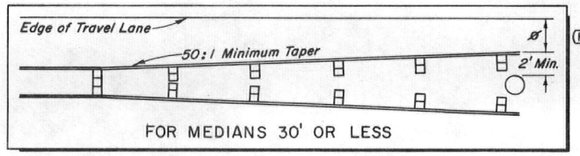


⇨ FOR MEDIANS LESS THAN 30' WIDE WITH ROADWAY DESIGN SPEED LESS THAN 50 M.P.H. AND FOR SPECIAL CASES

NON-CONTINUOUS RAIL



FOR NARROW MEDIANS WITH WALL BETWEEN COLUMNS

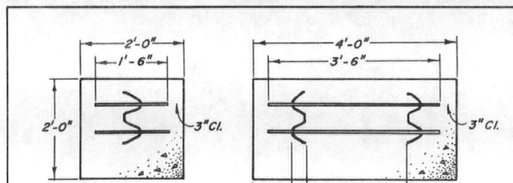


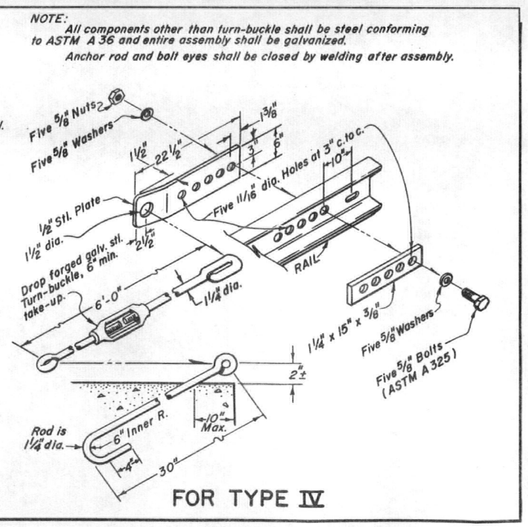
FOR MEDIANS 30' OR LESS

CONTINUOUS RAIL

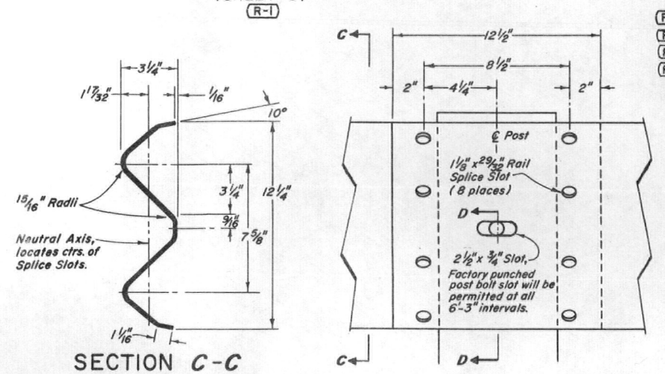
Ø When slope is 6:1 or flatter and an obstruction is present, increase where possible, to allow more area for vehicle recovery. (R-2)

TYPICAL GUARD RAIL FOR OBSTRUCTIONS





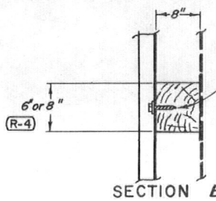
DETAILS FOR TYPICAL END ANCHORAGE



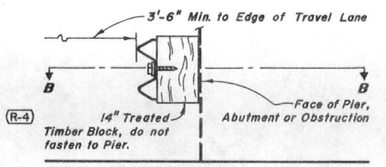
SECTION C-C

SECTION D-D

DETAIL OF RAIL AND SPLICE



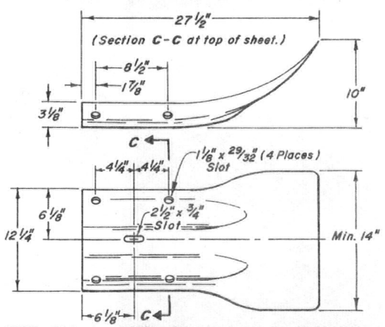
SECTION B-B



FOR NARROW MEDIANS

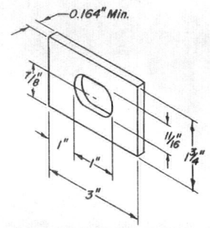
(To be used only when 2' min. clearance cannot be obtained.)

R-4 SEE TABLE ON SHEET 1 FOR TIMBER CROSS SECTION

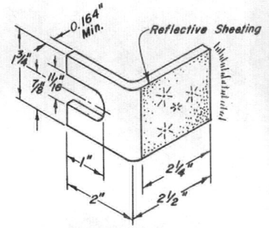


NOTE: Slots shown shall match outer 4 and center Rail-end slots.

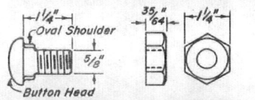
DETAIL OF TERMINAL SECTION



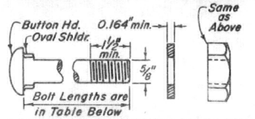
RECTANGULAR WASHER DETAIL



REFLECTOR TAB DETAIL



SPLICE BOLT & HEX NUT
(NEED 8 PER SPLICE, 4 PER TERMINAL)

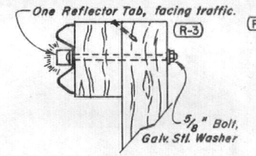


POST BOLT, WASHER & HEX NUT

TABLE OF POST BOLT SIZES

Block / Post	RAIL	BOLT SIZE
8" 8" 8"	Double	⅝" x 25¾"
8" 8"	Single	⅝" x 17½"

R-4 NOTE: When 6" x 8" timber is used, the 8" dimension shall be perpendicular to the roadway.



NOTE: Reflector Tab shall be installed on alternate posts or at max. 12'-6" spacing, beginning at the 3rd post from the buried anchor. (R-2)

INSTALLATION DETAIL OF REFLECTOR TAB

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

GUARD RAIL
TYPE 3

Designed by M. R. H.	Approved by C. E. S.
Made by J. R. B.	Staff Design Engineer
Checked by R. S. M.	Date: March 1, 1968

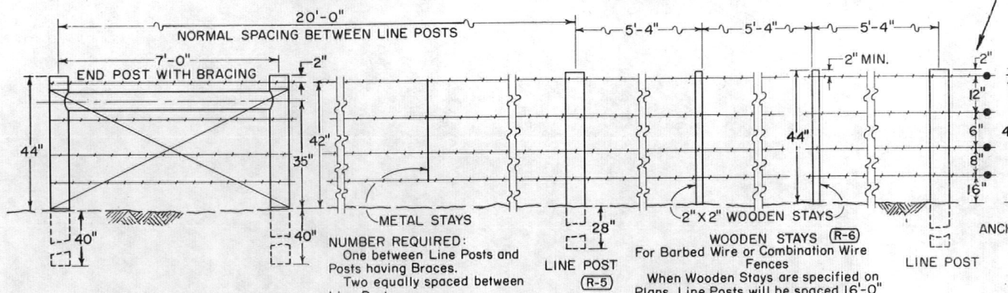
STANDARD M-607-A

(SHEET 1 OF 2 SHEETS)
(JULY 1, 1965)

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLORADO		

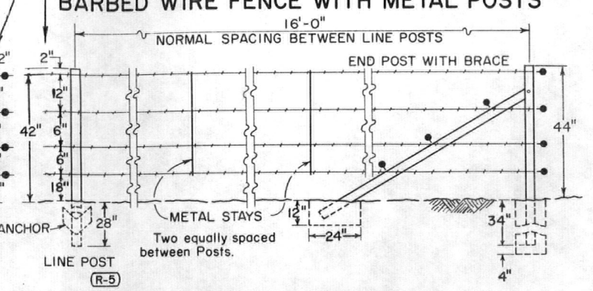
	REVISIONS	
R-1	8-2-66 Vertical Dimensions and Note	M.R.H.
R-2	12-8-66 Vert. Dims., Std. and Alternate	M.R.H.
R-4	5-6-68 Eyebolt Note and Title Block	M.R.H.
R-5	7-25-69 Revise post lengths	M.R.H.
R-6	9-15-69 Stays	M.R.H.

BARBED WIRE FENCE WITH WOODEN POSTS (R-1)

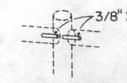


STANDARD INSTALLATION — (R-2) ALTERNATE (For blow-sand and tumbleweed areas, if desired by landowner.) (R-1)

BARBED WIRE FENCE WITH METAL POSTS



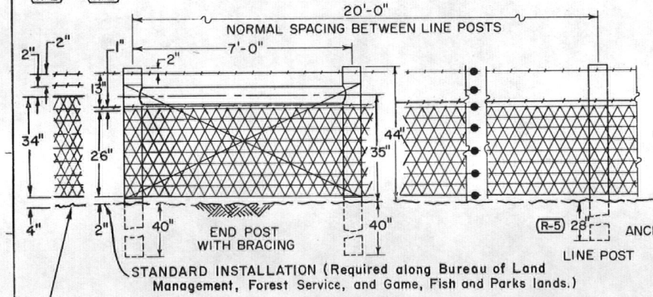
CROSS BRACE DOWELING DETAIL



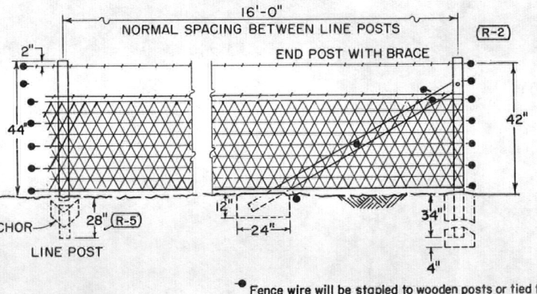
Bore a 3/8" X 2" Hole in each Post and Brace to receive the Pins. Wrap the ends of the Braces tightly with several turns of 12 1/2 ga. smooth Galv. Wire to prevent splitting or Notch Post and Nail with 40 d Common Nails.

(R-1) NOTE: See Sheet 2 for General Notes.

COMBINATION WIRE FENCE WITH WOODEN POSTS (R-1)

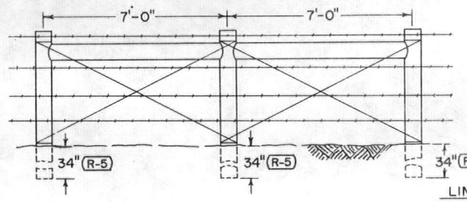


COMBINATION WIRE FENCE WITH METAL POSTS (R-1)



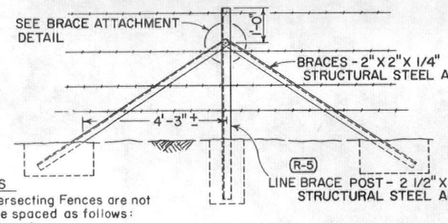
● Fence wire will be stapled to wooden posts or tied to metal posts as shown marked ● on barbed wire or combination wire fence details.

LINE BRACES

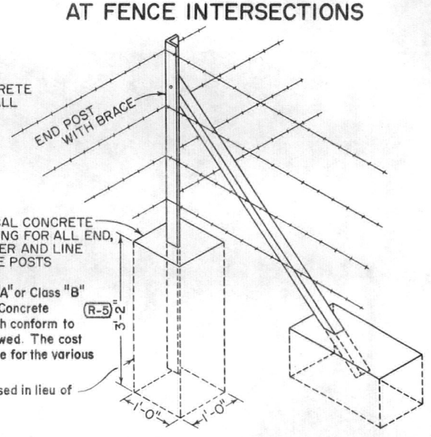


LINE BRACES

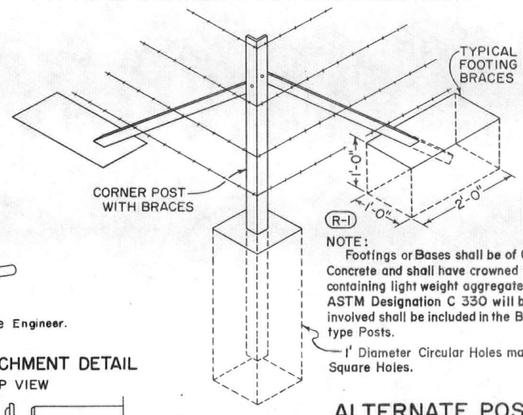
When Gates, Angles, Corners or Intersecting Fences are not specified therein, Line Braces shall be spaced as follows:
Metal Posts - 800' Intervals
Wooden Posts - 1,400' Intervals



TYPICAL INSTALLATION AT FENCE INTERSECTIONS

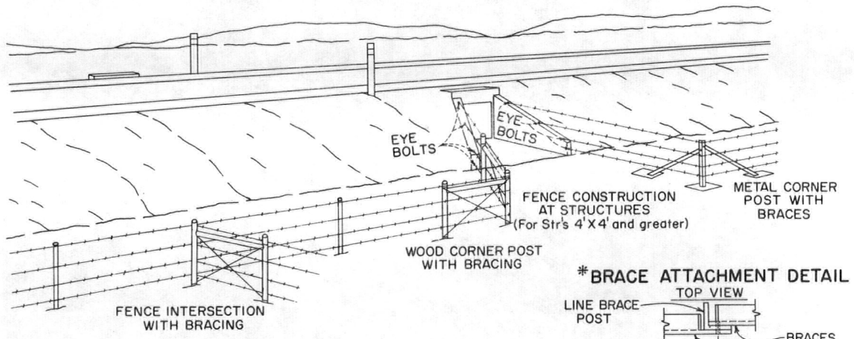


TYPICAL CORNER POST INSTALLATION



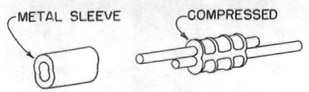
NOTE:
Footings or Bases shall be of Class "A" or Class "B" Concrete and shall have crowned tops. Concrete containing light weight aggregates which conform to ASTM Designation C 330 will be allowed. The cost involved shall be included in the Bid Price for the various type Posts.
1' Diameter Circular Holes may be used in lieu of Square Holes.

ILLUSTRATIVE SKETCH SHOWING TYPICAL EXAMPLES FOR CONSTRUCTING FENCES



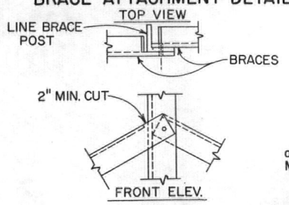
NOTE:
At all structures of 4'x4' and over, the fence shall be ended at eye-bolts in the wings of the structure. Where the type of structure prohibits the use of eye-bolts, an end post with brace shall be used.
Eye-bolts shall be made of 1/2" round bars with a minimum of six (6) inches of body length embedded in the concrete (hooked or bent) and a minimum of 1" inside eye diameter. (R-4)
Eye-bolts shall be furnished and installed by the Contractor. Cost of eye bolts will be included in the contract price for fencing.

ACCEPTABLE WIRE SPLICE

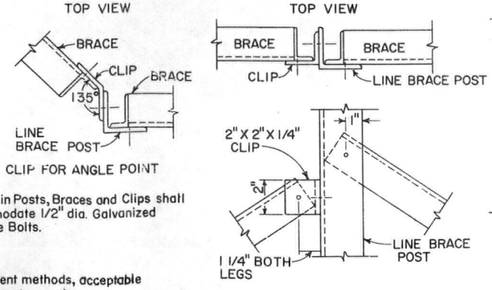


Splicing Sleeve shall be approved by the Engineer.

*BRACE ATTACHMENT DETAIL



*ALTERNATE BRACE ATTACHMENT DETAIL

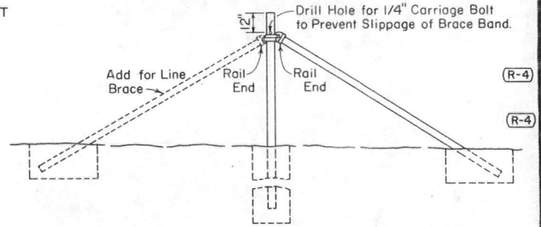


Holes in Posts, Braces and Clips shall accommodate 1/2" dia. Galvanized Machine Bolts.

*Alternate attachment methods, acceptable to the Engineer, may be used.

ALTERNATE POST

(FOR END, CORNER OR LINE BRACE POSTS)



DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

WIRE FENCES AND GATES

(R-1)

Designed by	L.E.O.	Approved by	L.E. Olson
Made by	T.E.F.	Staff Des. Engr.	
Checked by	E.E.O.	Date:	July 1, 1965

STANDARD M-607-A

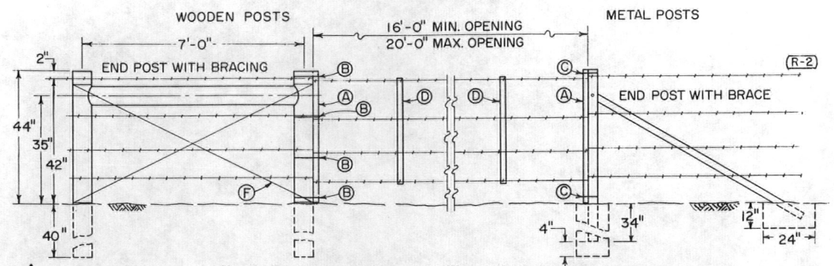
(SHEET 2)

(JULY 1, 1965)

FED. ROAD REG. NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLO.		

REVISIONS			
R-1	8-2-66	Vert. Dims. & Gen'l. Notes	M.R.H.
R-2	12-8-66	Vert. Dims., Std. and Alternate	M.R.H.
R-3	2-6-67	Gate and General Notes	M.R.H.
R-4	5-6-68	General Notes and Title Block	M.R.H.
R-5	7-25-69	Revise post lengths, Gen. notes	M.R.H.
R-6	9-15-69	General Notes	M.R.H.

(R-1) ▲BARBED WIRE GATE



▲ For Combination Wire Gate use 34" Mesh and (R-1) 1 strand of Barbed Wire. Extend Wooden Stays to Ground.

Ⓐ 2"X4"X4' Wooden Stays.

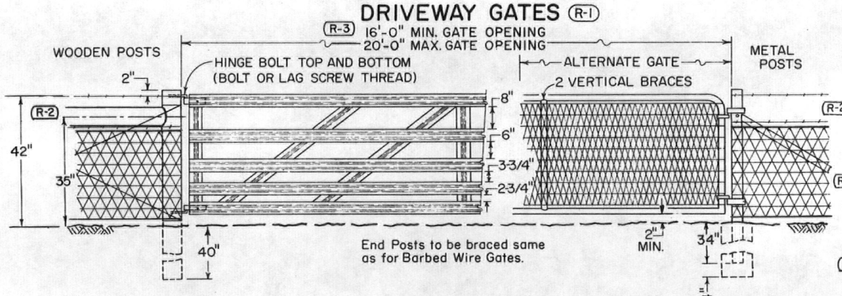
Ⓑ 4 - No. 12 1/2 Ga. Wire Loops to act as Hinges.

Ⓒ No. 12 1/2 Ga. Wire Loops.

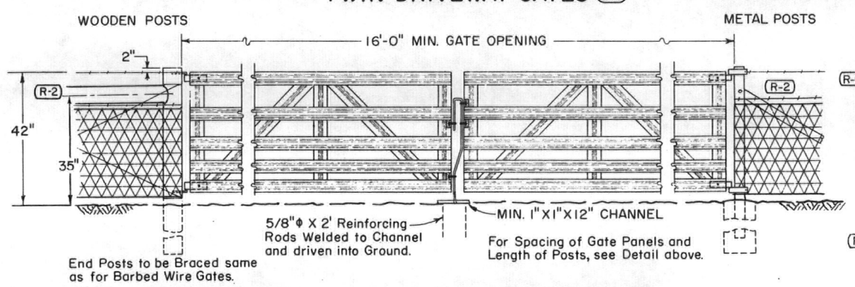
Ⓓ 2-2"X2" Wooden Stays equally spaced.

Ⓕ No. 12 1/2 Ga. Brace Wire.

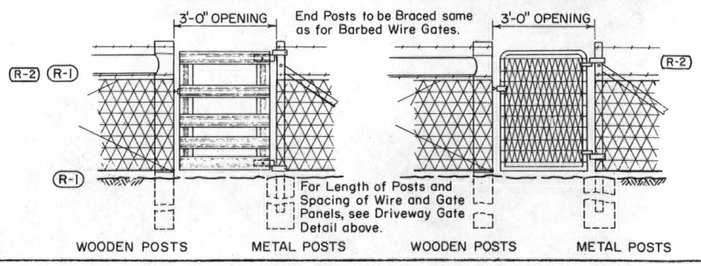
DRIVEWAY GATES (R-1)



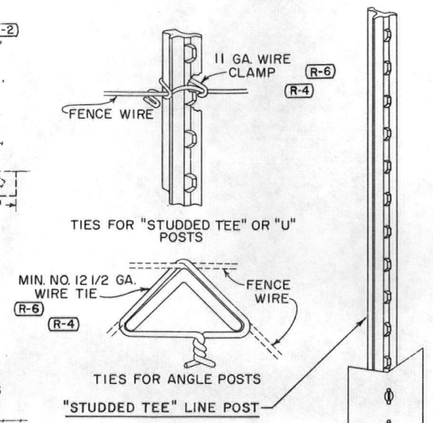
TWIN DRIVEWAY GATES (R-1)



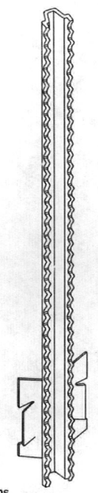
WALK GATE — ALTERNATE WALK GATE



FENCE WIRE TIES

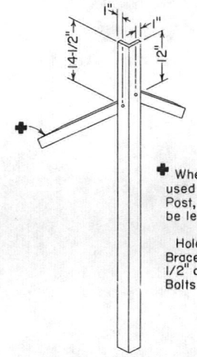


TYPICAL METAL POSTS



ALTERNATE LINE POST ("U" POST)

ANGLE POST (FOR END, CORNER AND LINE BRACE)

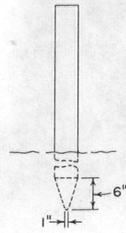


✚ When Post is to be used for an End Post, this Brace will be left off.

Holes in Angle Posts and Braces shall accommodate 1/2" dia. Galvanized Machine Bolts.

DETAILS FOR HOLE SPACING

POST POINTING DETAILS



Where field conditions permit, Wooden Posts may be pointed and driven in lieu of setting and tamping, at the option of the Contractor.
Pointing shall be in conformity with details shown at left.
Driving methods shall not damage Post.

GENERAL NOTES

(R-5) All work shall be done in accordance with the Standard Specifications applicable to the Project. All material dimensions and weights on this standard are nominal unless otherwise indicated.

(R-1) At each location where an electric transmission, distribution or secondary line crosses a wood post fence the Contractor shall furnish and install a ground conforming to Section 9 of the National Electric Safety Code.

(R-2) Dimensions shown for "Standard" and "Alternate" apply for both wooden and metal post fence.

Fence wire shall be ended, double wrapped and tied off at end posts, angle posts and line brace posts. Fence to be continued shall then be restarted in like manner.

Fence wire to be placed on either road or field side of posts depending on local conditions, i.e. on curves the wire should be placed on the side of the post which would prevent tension on fence ties. This will also apply where wind drift, tumble weeds or other conditions would exert unusual pressure against the wire.

(R-6) WOOD POSTS:

All line posts shall have a min. dia. of four (4) inches & be 6'-0" long. Min.

All end, corner, intersection and brace posts shall have a minimum diameter of five (5) inches and be 7'-0" long.

Fence wire will be stapled to wooden posts or tied to metal posts as shown marked -● on barbed wire or combination wire fence details. Staples shall be No. 9 wire min. at least 1 1/2 inches long.

METAL POSTS:

All posts and braces shall be of the types and weights shown or acceptable equivalents.

Holes to be provided in end, corner and gate posts as detailed.

(R-5) CORNER AND LINE BRACE POSTS:
Type - 2 1/2" X 2 1/2" X 1/4" Structural Steel Angles.
Weight - 3.81 lbs./lin. ft.
Length - 6'-6" Min.
No. of Braces - 2

(R-5) LINE POSTS:
Type - "Studded Tee" or "U".
Weight - 1.28 lbs./lin. ft. (without Anchor)
Length - 6'-0" Min.
Anchor - Securely fastened, with bearing surface sufficient to resist movement of post. Weight - 0.57 lb. Min.

(R-5) END POSTS:
Type - 2 1/2" X 2 1/2" X 1/4" Structural Steel Angles.
Weight - 3.81 lbs./lin. ft.
Length - 6'-6" Min.
No. of Braces - 1

(R-5) BRACES: (For Corner, End or Line Brace Posts)
Type - 2" X 2" X 1/4" Structural Steel Angles.
Weight - 3.08 lbs./lin. ft.
Length - Same as corner and end posts used.

Posts shall meet requirements of Par. 4.5 of U.S. Dept. of Commerce Commercial Standard 184-51. Acceptable material includes re-rolled railroad rails.

ALTERNATES:

(R-4) END, CORNER AND LINE BRACE POSTS
Type - 2 1/2" Std. Galvanized Pipe.
Weight - 5.79 lbs./lin. ft. ± 5%

(R-4) BRACES:
Type - 1 3/8" O.D. Tubular Steel with 2 1/2" Brace Band, Hinge Bolt and 1 3/8" I.D. Rail End; all Galvanized.
Weight - 1.6 lbs./lin. ft. ± 5%
Length - 6'-6" Min.

(R-1) BARBED WIRE:
Steel barbed wire shall conform to ASTM Designation A 121, 12 1/2 Gauge with Class I coating.
Aluminum barbed wire shall conform to ASTM Designation B 211, with alloy 5052-O for the line wire and alloy 5052-H38 for the barbs.

(R-5) 4" x 4" WIRE MESH
Wire mesh used in combination wire fence as shown shall be galvanized and conform to the following:

	STANDARD	ALTERNATE
Width	26"	34"
Weight - Lbs/Lin. Ft.	0.54	0.76

Horizontal Wires ..... 2 Strands, No. 12 1/2 gage.
Cross Wires ..... 1 Strand, No. 14 1/2 gage Min.
Fabrication: cross wires to be woven with horizontal wires making a one piece fabric.

GATES:

(R-5) DRIVEWAY GATES:
Height-approximately 42" (5 panels) --- Width of gate opening - 16'-0" Min.
Weight - Galvanized Steel, 75 lbs. ------ Tempered Aluminum, 45 lbs.
Ⓘ Gates to be of Riveted construction as follows: Min. 4 No. 10 rivets at each right angle connection and where diagonal braces connect to horizontal panels; Min. 3 No. 10 rivets where diagonal braces connect to top and bottom panels.

(R-5) ALTERNATE DRIVEWAY GATES:
Height - 42"
Weight - Not less than 90 lbs. complete with latch and hinges.
Width of gate opening - 16'-0"
Gate Frame - 1" I.D. Standard Galvanized Pipe or acceptable equivalent and shall be of all welded construction.
Mesh to be of same construction as shown for 4" x 4" wire mesh except it shall be 2" x 4" mesh.

(R-5) Ⓘ WALK GATES:
Height - approx. 42" (5 panels)
Weight - {Galvanized Steel, 16 lbs. / Tempered Aluminum, 10 lbs.}
Width of gate opening - 3'-0"

(R-6) All fence wire ties, clips, clamps, staples and other wire appurtenances shall be galvanized in accordance with ASTM Designation A 116, Class 1.

(R-1) ALTERNATE WALK GATES:
Height - 42"
Weight - Not less than 18 lbs. complete with latch and hinges.
Width of gate opening - 3'-0"
Gate Frame - 3/4" I.D. Standard Galvanized Pipe or acceptable equivalent and shall be of all welded construction.
Mesh to be of same construction as shown for Driveway Gate.

Alternate equivalent standard metal gates other than shown will be acceptable subject to the Engineer's approval.

In lieu of galvanized finish on gate frames, Cadmium Plated pipe or Aluminum painting will be considered to be equivalent.

LATCHES AND HINGES:
Galvanized steel or Aluminum of standard make.
Hinges shall be placed as shown, to prevent theft.
In lieu of standard make latches it will be permissible to use an electro-galvanized chain, eyebolt and snaphook type latch. Eyebolt, chain and snaphook assembly to be secured to latch side of gate. Gate closure effected by wrapping chain around end post and snapping hook into chain.

(R-6) WOODEN STAYS
Wooden stays shall be untreated native timber. Stay dimensions, including length, shall have a tolerance of ± 1/4".

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

(R-4)
(R-4)

WIRE FENCES AND GATES

(R-1)

Designed by	L.E.O.	Approved by	L.E. Olson
Made by	T.E.F.	Staff Des. Engr.	
Checked by	E.E.O.	Date:	July 1, 1965

STANDARD M-614-A

(JULY 1, 1965)

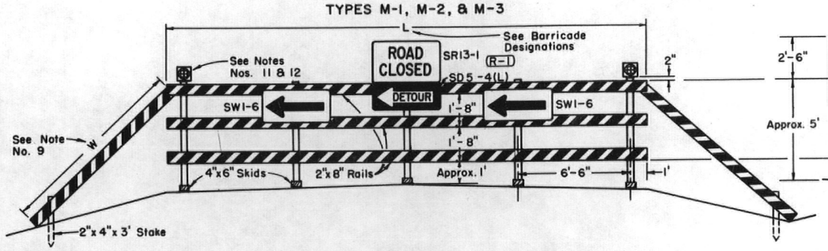
FEDERAL ROAD REGION NO.	DISTRICT	PROJECT NO.	SHEET NO.
9	COLORADO		

REVISIONS			
(R-1)	11-15-68	Rev. Dept. Name & Code Nos.	JLS
(R-2)	4-23-69	Rev. Code No. & Notes	JLS

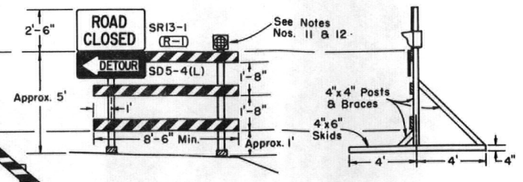
CLASS I BARRICADES
(3 RAILS)

MOVABLE

TYPES M-1, M-2, & M-3

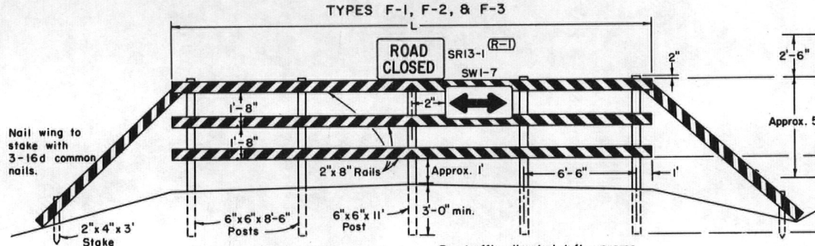


TYPE M-4



FIXED

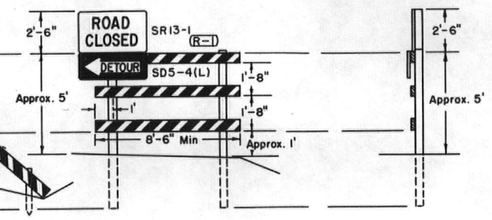
TYPES F-1, F-2, & F-3



For traffic diverted right, reverse angle of stripes this side and in lieu of sign SW1-7 use sign SW1-6. See Note No. 5.

For traffic diverted left, reverse angle of stripes this side and in lieu of sign SW1-7 use sign SW1-6. See Note No. 5.

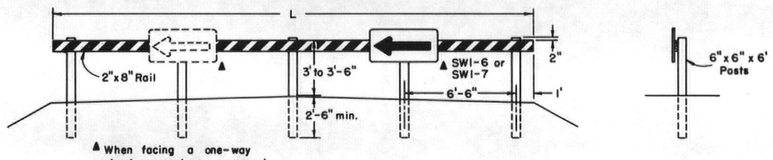
TYPE F-4



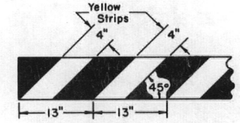
CLASS II BARRICADE
(1 RAIL)

FIXED

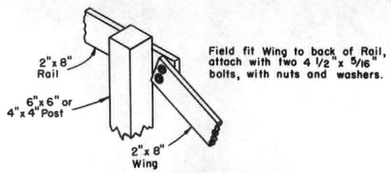
TYPE F-6



▲ When facing a one-way street or roadway a second SW1-6 or SW1-7 may be required. See Note No. 3.

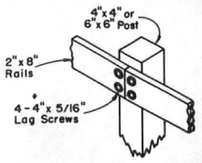


DETAIL OF RAIL AND WING STRIPING



Field fit Wing to back of Rail, attach with two 4 1/2" x 9/16" bolts, with nuts and washers.

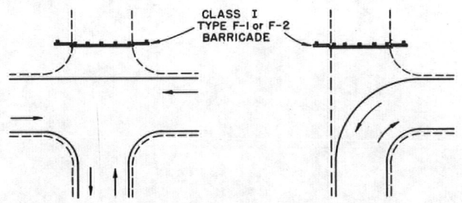
REAR VIEW OF BARRICADE SHOWING WING ATTACHED
(See Note No. 9)



All Lag Screws to be countersunk so that signs may be mounted flush against rail.

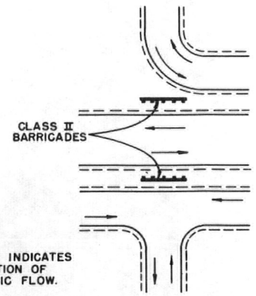
METHOD OF ATTACHING PLANKING TO POSTS AT JOINTS

SITUATION A



SITUATION B

SITUATION C



INDICATES DIRECTION OF TRAFFIC FLOW.

GENERAL NOTES

1. All work shall be done in accordance with the Standard Specifications applicable to the Project.
(R-2) 2. All signs and sign materials shall conform to the standards set forth in the "Manual on Uniform Traffic Control Devices for All Classes of Streets and Highways" published by the Division of Highways and this standard.
3. The various types and combinations of approved Signs and Beacons for Barricades required for each project shall be governed by field conditions and subject to approval by the Engineer. All traffic controls shall be placed for best visibility and legibility and maintained in good condition at all times. Oversigning is to be avoided.
(R-2) 4. Painting shall conform with Subsection 508.08 of the Standard Specifications. All skids, braces, and posts shall be painted with 2 coats of "Exterior Black Paint." Planking and wings on all barricades shall be painted with 2 coats of "Exterior Black Paint" on all sides before adding reflective strips. Reflective strips shall be "cut from smooth surface yellow reflective sheeting" of a type approved by the Division.
5. Each barricade rail shall be striped on the face side only with reflective yellow strips slanting downward at a 45° angle toward the side to which traffic is to turn or pass. See "DETAIL OF RAIL AND WING STRIPING."
6. When barricades are designated on plans the portion of the posts below ground line shall either be dipped in or painted with hot creosote oil. The portion of the post above ground line shall be painted with 2 coats of "Exterior Black Paint."
7. All skids, braces, and posts shall be nailed together with No. 20d nails. All screws, bolts, nuts, and washers shall be galvanized or cadmium plated. Skids (bases) of movable barricades shall be weighted where necessary to provide stability.
(R-2) 8. All timber shall be Standard Grade or better, S4S, Douglas Fir or Larch, as described in the 1965 Standard Grading Rules published by the Western Wood Products Association, and shall conform to paragraph 123c for the rails and paragraphs 122c and 125c for the posts.
9. Detachable extension wings for bypassing of construction equipment are permitted. "W" is variable, length shall be adequate to provide closing of borrow pit and/or shoulder as required.
(R-2) 10. Alternate materials or other reflective elements on Traffic signs or Barricades will be permitted only after approval of such material by the Division in writing.
11. A Flashing Beacon for use on Barricades is a section of a standard traffic signal head or a similar-type device having a yellow lens in the face, which is illuminated by intermittent flashes. Where commercial power is not available, the beacon may be adapted to operate from storage batteries. Each signal unit lens shall have a visible diameter of not less than 8 inches. Each unit complete shall be of such design as to render the lens when illuminated clearly visible to traffic facing the signal at all distances up to 1000 feet under all atmospheric conditions except dense fog. The color of the yellow lens for caution shall be in accordance with Technical Report No. 1 of the Institute of Traffic Engineers. All beacon flashers shall be equipped with filters for suppression of radio interference. The illuminating element in a flashing yellow beacon shall be flashed at a rate of not less than 50 times nor more than 60 times per minute. The illuminated period of each flash shall be not less than half and not more than two-thirds of the total cycle. The use of Flashing Beacons will be governed by field conditions. Flashing Beacons when warranted generally should be operated continuously throughout the 24 hours of the day. Warrant for Flashing Beacons may be found in Sec. 3G of the "Manual on Uniform Traffic Control Devices for Streets and Highways" published by the U.S. Department of Commerce, Bureau of Public Roads, June, 1961 (or latest revision).
12. Flashers are portable, power-operated, lens-directed, enclosed lights, illuminated by rapid intermittent flashes of short duration. Flashers may be used in connection with barricades when approved by the Engineer. An array of random flashers which tends to obscure rather than delineate the traveled way will not be permitted. The use of flashers on a job will be governed by Sec. 5D of the "Manual on Uniform Traffic Control Devices for Streets and Highways" published by the U.S. Department of Commerce, Bureau of Public Roads, June, 1961 (or latest revision). The color of the light emitted by a flasher shall be yellow.
13. Flashing Beacons and Flashers, when used, shall be positioned above the top rail of the barricades to produce the most effective results.
14. Barricades used as "Traffic Controls for Highway Construction" are not to be paid for separately.
15. Barricades will be paid for separately when designated on plans as bid items.
16. For additional general information on control of traffic through work areas refer to the "Manual on Uniform Traffic Control Devices for Streets and Highway", Part V, published by the U.S. Department of Commerce, Bureau of Public Roads, June, 1961 (or latest revision).

BARRICADE DESIGNATIONS

	Class	Type Movable	Type Fixed	Roadway Width	L	Description
(R-1)	I	M-1	F-1	26'-34'	28'	Barricade complete with SR13-1 sign and SW1-6 or SW1-7 signs as required.
(R-2)	I	M-2	F-2	35'-44'	41'	Barricade complete with SR13-1 sign and SW1-6 or SW1-7 signs as required.
(R-1)	I	M-3	F-3	Variable	28'	Barricade (without extension wings) complete with SR13-1 sign and SW1-6 or SW1-7 signs as required.
	I	M-4	F-4	Variable	Variable 8'-6" min.	Wing Barricade (signs only as appropriate).
	II	—	F-6	Variable	28'	Barricade complete with appropriate signs.

(R-1)

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

TIMBER BARRICADES

Designed By: D.R.W.	Approved By:
Made By: JLS	Date: JULY 1, 1965
Checked By: J.B.	

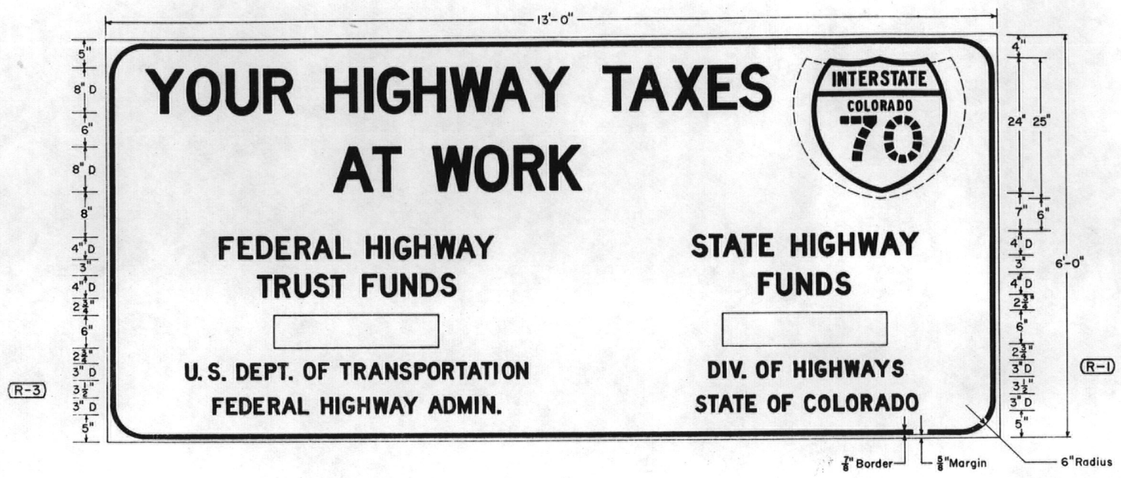
STANDARD M-614-IC

JULY 5, 1968

(SHEET 1 OF 2 SHEETS)

FEDERAL ROAD REGION NO.	DISTRICT	PROJ. NO.	SHEET NO.	TOT. SHEETS
9	COLORADO			

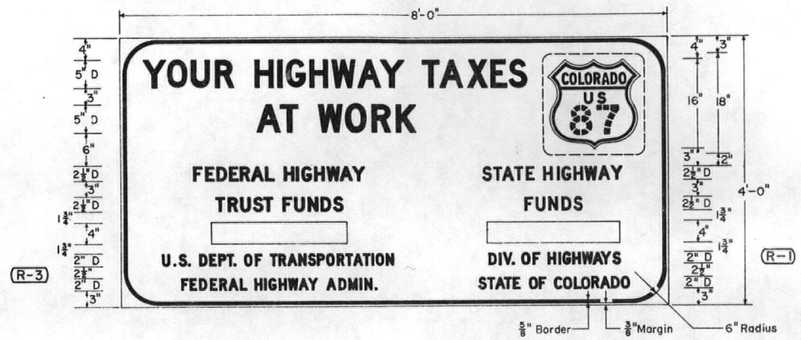
REVISIONS			
(R-1)	7-26-68	Rev. Legend and Notes	G.W.F.
(R-2)	5-20-69	Rev. Lateral Placement	J. J. B.
(R-3)	9-25-70	Rev. Legend	J. J. B.



ALTERNATE LEGEND

4"D FEDERAL

4"D FUNDS

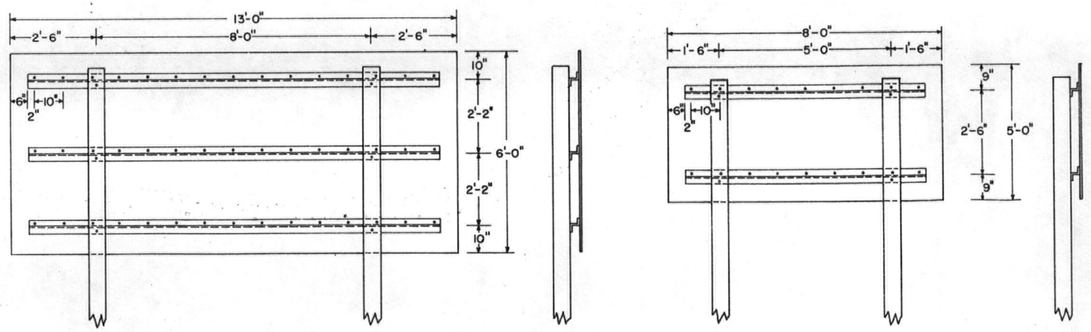


ALTERNATE LEGEND

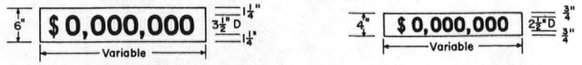
2½"D FEDERAL

2½"D FUNDS

FABRICATION DETAILS



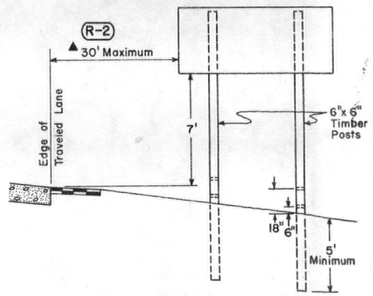
"AMOUNT OF FUNDS" PLAQUE DETAILS



GENERAL NOTES

1. These signs shall be furnished and installed by state forces.
2. All work shall be done in accordance with Standard Specifications applicable to the Project.
3. Signs are to be placed facing traffic approaching the Project. They shall be installed at a location where they will not obscure or detract from the effectiveness of other official signs.
4. ▲ The lateral placement may be reduced to a minimum of 2 ft. outside of the shoulder edge where necessary to fit field conditions.
5. When these signs are used on Beautification Projects, the words "HIGHWAY" and "TRUST" in lines 3 and 4 shall be deleted and the words "FEDERAL" and "FUNDS" shall be used in accordance with the spacing as shown under "Alternate Legend".
6. Sign panel shall be fabricated with ¾" plywood.
7. Route Marker plaques and "Amount of Funds" plaques shall be sheet aluminum 0.080" min. thickness.
8. Signs shall have a screen processed black legend and border on a plain white background. "Amount of Funds" plaques shall have a screen processed black legend on a plain white background.
9. Route Marker plaques shall be plain as indicated on the applicable standards.
10. Backing zees shall be 3" x 2¾" x ¼". Steel zees shall weigh 6.7 lbs. per ft. and aluminum zees shall be of 6061-T6 alloy weighing 2.33 lbs. per ft.
11. Posts shall be 6"x 6", S4S timber, painted white.
12. Each timber post shall be provided with two 2" diameter holes through the neutral axis, one at 6" and one at 18" above the ground level. The inside portion of each 2" diameter hole shall be painted white.
13. Panels shall be fastened to backing zees with ¼" thrust head lockbolt fasteners.
14. Backing zees shall be fastened to posts with ⅜" machine bolts.
15. Route Marker plaques and "Amount of Funds" plaques shall be fastened to the sign panels with ⅝" #9 round head wood screws.
16. Exposed lockbolt fastener heads and wood screw heads on the face of the sign shall be dipped or painted to match the surrounding color.
17. The underground portion of each timber post shall be treated with creosote.
18. Where a third governmental agency is shown as participating, its official name should be included centrally in lines 6, 7, and 8.
19. (R-1) It will not be necessary to change DEPT. to DIV. on any existing signs.

INSTALLATION DETAIL



DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

STANDARD CONSTRUCTION IDENTIFICATION SIGNS

Designed By:	J.L.S.	Approved By:	Traffic Engineer
Made By:	F.J.B.		
Checked By:	G.W.F.	Date:	July 5, 1968

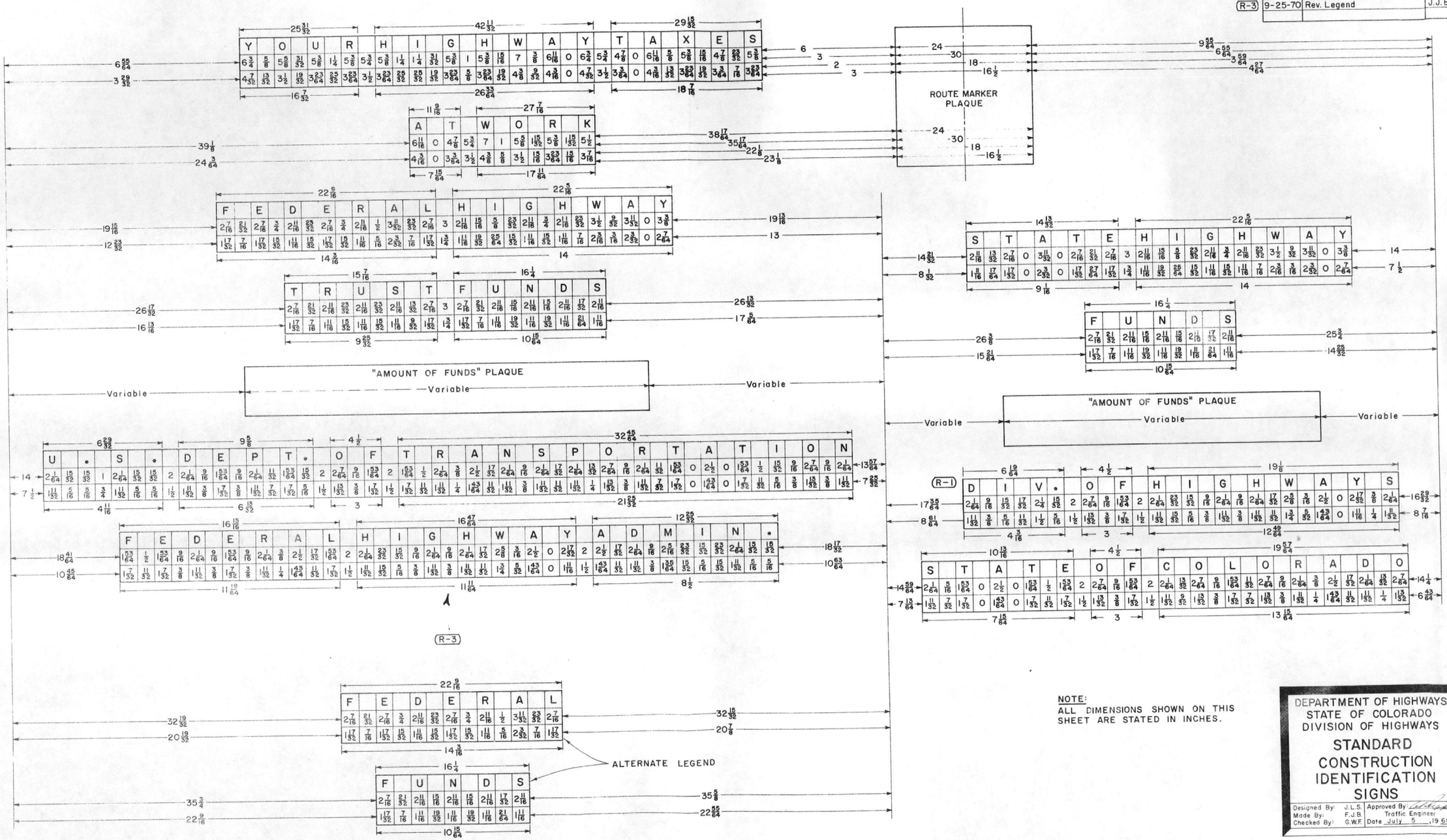
STANDARD M-614-IC

JULY 5, 1968

(SHEET 2 OF 2 SHEETS)

FEDERAL ROAD REGION NO.	DISTRICT	PROJ NO.	SHEET NO.	TOTAL SHEETS
9	COLORADO	[redacted]		

REVISIONS			
R-1	7-26-68	Rev. Legend	G.W.F.
R-2	5-20-69	Rev. Lateral Placement	J.J.B.
R-3	9-25-70	Rev. Legend	J.J.B.



NOTE:
ALL DIMENSIONS SHOWN ON THIS SHEET ARE STATED IN INCHES.

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

STANDARD CONSTRUCTION IDENTIFICATION SIGNS

Designed By:	J.L.S.	Approved By:	Traffic Engineer
Made By:	F.J.B.		
Checked By:	G.W.F.	Date	July 5, 1968

STANDARD M-614-TB

(SHEET 1 OF 3 SHEETS)

(JULY 1, 1965)

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLORADO		

REVISIONS			
R-1	7-12-67	Note 23	G.W.F.
R-2	7-8-68	Rev. Break-away, Placement,	
		Code Nos, & Dept. Name	G.W.F.
R-3	12-24-68	Rev. U.S. Shields	J.L.S.

Typical Signing Where Traffic Is Prohibited Along Construction

Typical Signing Where Traffic Is Permitted Along Construction

NOTE:

See Sheet 2 for detailed drawings of signs.
See Sheet 3 for General Notes applicable to Sheets 1 and 2.

TOP VIEW

Sign Placement

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

TRAFFIC SIGNING FOR HIGHWAY CONSTRUCTION

Designed By: D.R.W.
Mode By: J.L.S.
Checked By: J.B.

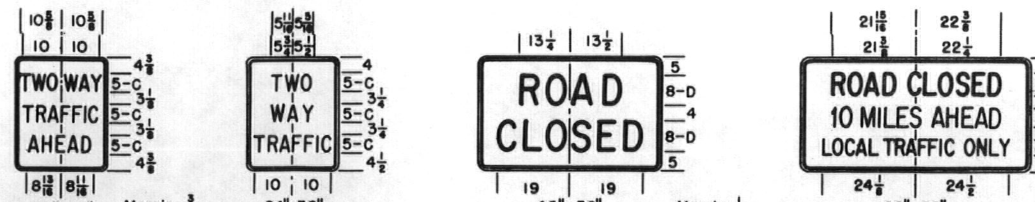
Approved By: Traffic Engineer
Date: AUGUST 9, 1965

STANDARD M-614-TB
(SHEET 2 OF 3 SHEETS)
(JULY 1, 1965)

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLORADO	[redacted]	

	REVISIONS		
(R-1)	7-12-67		M.R.H.
(R-2)	7-8-68	Rev. Code No. & Dept. Name	G.W.F.
(R-3)	12-24-68	Added Notes	J.L.S.

REGULATORY SIGNS
See Note No. 9



24"x30" SR6-3

Margin: $\frac{3}{8}$
Border: $\frac{5}{8}$
Corner Radius: $1\frac{1}{2}$

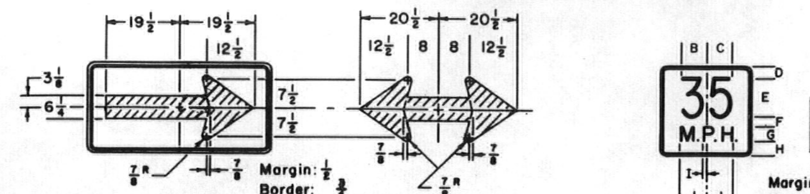
24"x30" SR6-5

48"x30" SR13-1

Margin: $\frac{1}{2}$
Border: $\frac{3}{4}$
Corner Radius: $1\frac{7}{8}$

60"x30" SR13-1A

WARNING SIGNS
See Note No. 10



48"x24" SW1-6

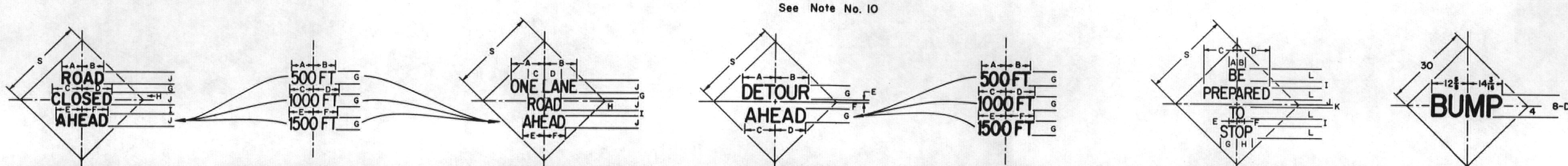
Margin: $\frac{1}{2}$
Border: $\frac{3}{4}$
Corner Radius: $1\frac{7}{8}$

48"x24" SW1-7

	Panel	A	B	C	D	E	F	G	H	I	J
SW13-1	18"x18"	3/8	5 1/2	5 5/16	2 1/4	8-C	2	3-E	2 3/4	3/4	5 3/16
XW13-1	24"x24"	5/8	6 5/8	6 9/16	3 1/4	10-C	2 3/4	4-E	4	15/16	6 7/8

Margin: $\frac{3}{8}$
Border: A
Corner Radius: $1\frac{1}{2}$

WARNING SIGNS
See Note No. 10



	S	A	B	C	D	E	F	G	H	I	J
SW14-3	48	11 1/4	12 1/16	16 9/16	16 5/8	14 5/8	14 5/8	4 3/4	4 9/16	5 3/16	7-D
CW14-3	36	8 1/16	8 5/8	11 13/16	11 7/8	10 1/2	10 1/2	3 3/8	3 1/4	3 3/4	5-D

	S	A	B	C	D	E	F	G
SW14-3A, SW14-4A	48	12	12 1/16	13 1/8	14 1/8	13 1/4	13 5/8	7-C
CW14-3A, CW14-4A	36	8 9/16	8 5/8	9 3/8	10 1/8	9 1/2	9 3/4	5-C

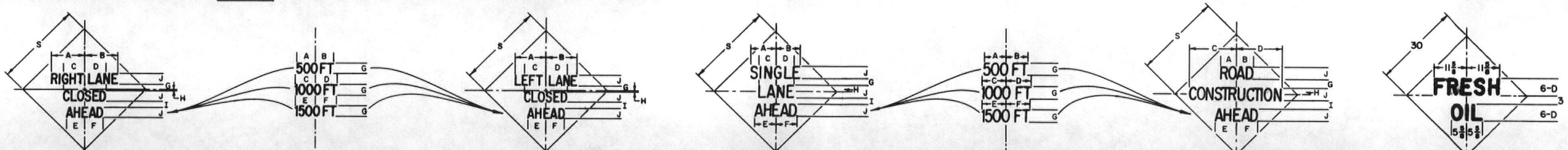
	S	A	B	C	D	E	F	G	H	I	J
SW14-4	48	18 1/2	17 7/8	9 3/16	9 3/8	11 7/8	11 7/8	3 1/8	5 1/4	3 1/8	7-C
CW14-4	36	13 3/16	12 3/4	6 9/16	6 1/2	8 1/2	8 1/2	2 1/4	3 3/4	2 1/4	5-C

	S	A	B	C	D	E	F	G
SW14-2	48	18 3/16	18 5/16	16 3/4	16 3/4	1 1/4	3 1/2	8-D
CW14-2	36	13 5/8	13 3/4	12 9/16	12 9/16	13/16	2 5/8	6-D

	S	A	B	C	D	E	F	G
SW14-2A	48	13 3/4	13 3/4	15	16 3/16	15 1/8	15 9/16	8-C
CW14-2A	36	10 5/16	10 5/16	11 1/4	12 1/8	11 3/8	11 11/16	6-C

	S	A	B	C	D	E	F	G	H	I	J	K	L
SW14-7B	36	2 15/16	3 9/64	13 17/32	13 49/64	2 31/32	2 61/64	6 11/32	6 21/64	3	2	1	5-C

SW8-1



	S	A	B	C	D	E	F	G	H	I	J
SW14-6(R)	48	18 3/16	18 7/16	11 3/4	11 3/4	10 1/4	10 1/4	2 7/8	7/16	3 5/16	6-C
CW14-6(R)	36	15 3/16	15 3/8	9 13/16	9 13/16	8 9/16	8 9/16	2 3/8	3/8	2 3/4	5-C

	S	A	B	C	D	E	F	G
SW14-6A(R), SW14-6A(L)	48	10 5/16	10 3/8	11 1/4	12 1/8	11 3/8	11 11/16	6-C
CW14-6A(R), CW14-6A(L)	36	8 5/8	8 5/8	9 3/8	10 1/8	9 1/2	9 3/4	5-C

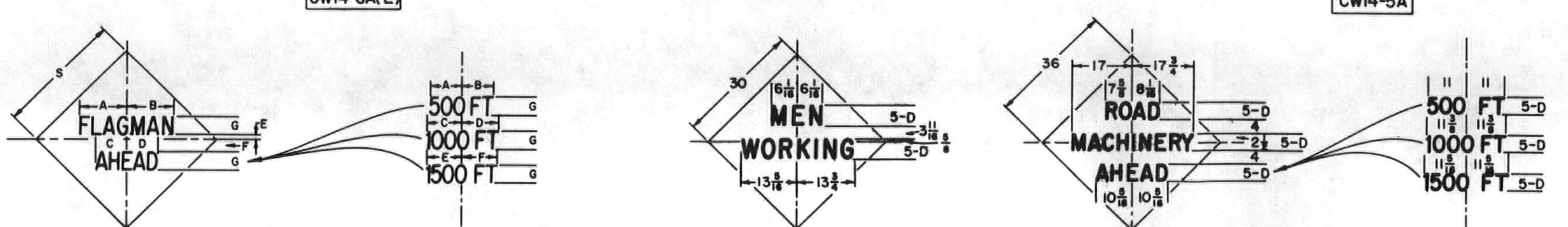
	S	A	B	C	D	E	F	G	H	I	J
SW14-6(L)	48	17 1/8	17 1/8	11 3/4	11 3/4	10 1/4	10 1/4	2 7/8	7/16	3 5/16	6-C
CW14-6(L)	36	14 1/4	14 1/4	9 13/16	9 13/16	8 9/16	8 9/16	2 3/8	3/8	2 3/4	5-C

	S	A	B	C	D	E	F	G	H	I	J
SW14-5	48	13 13/16	13 9/16	9 7/16	10 1/16	11 7/8	11 7/8	3 11/16	3 1/2	3 9/16	7-C
CW14-5	36	11	10 3/4	8	8 1/4	10 7/8	10 7/8	2 5/8	2 1/2	2 9/16	5-D

	S	A	B	C	D	E	F	G
SW14-1A, SW14-5A	48	12	12 1/16	13 1/8	14 1/8	13 1/4	13 5/8	7-C
CW14-1A, CW14-5A	36	8 9/16	8 5/8	9 3/8	10 1/8	9 1/2	9 3/4	5-C

	S	A	B	C	D	E	F	G	H	I	J
SW14-1	48	9	9 3/16	26	25 9/16	11 7/8	11 7/8	4 13/16	3 1/2	4 13/16	7-C
CW14-1	36	6 3/4	6 7/8	19	18 1/2	8 1/2	8 1/2	3 3/4	2 1/2	3 3/4	5-C

SW8-6



	S	A	B	C	D	E	F	G
SW14-7	48	18	18	11 7/8	11 7/8	1 1/2	4 3/4	7-C
CW14-7	36	15 7/16	15 7/16	10 3/16	10 3/16	1 5/16	4 1/16	6-C

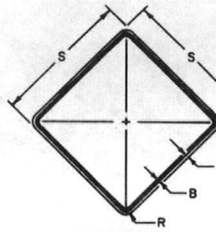
	S	A	B	C	D	E	F	G
SW14-7A	48	12	12 1/16	13 1/8	14 1/8	13 1/4	13 5/8	7-C
CW14-7A	36	10 5/16	10 5/16	11 1/4	12 1/8	11 3/8	11 11/16	6-C

SW15-1

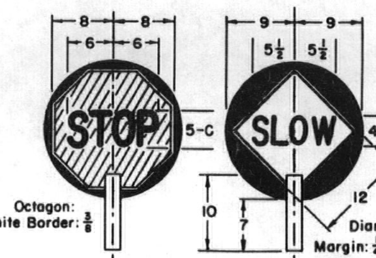
SW15-2

SW15-2A

PLATE DETAILS



S	M	B	R
30	1/2	3/4	1 7/8
36	5/8	7/8	2 1/4
48	3/4	1 1/4	3



Octagon: White Border: $\frac{3}{8}$

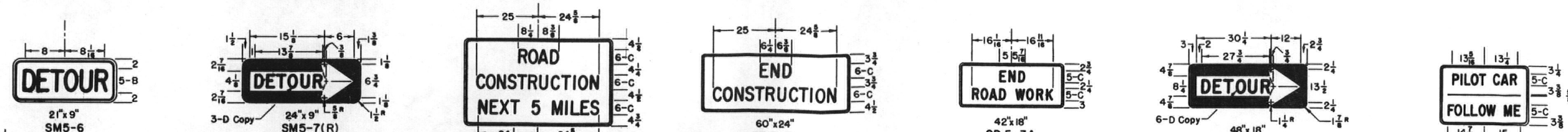
Diamond: Margin: $\frac{1}{4}$ Border: $\frac{1}{4}$ Corner Radius: $\frac{3}{4}$

FLAGMAN SIGN
See Notes No. 20 and 22

NOTES:
SEE SHEET 1 FOR TYPICAL SIGNING AND SIGN PLACEMENT. SEE SHEET 3 FOR GENERAL NOTES APPLICABLE TO SHEETS 1 AND 2.

ALL DIMENSIONS THAT ARE NOT LABELED ARE IN INCHES.

GUIDE SIGNS
See Note No. 11



Margin: $\frac{3}{8}$
Border: $\frac{5}{8}$
Corner Radius: $1\frac{1}{2}$

21"x9" SM5-6

3-D Copy

24"x9" SM5-7(R) SM5-7(L)

(R-3) Reverse Dimensions for Left Designation

Margin: $\frac{1}{2}$
Border: $\frac{3}{4}$
Corner Radius: $1\frac{7}{8}$

60"x36" SD5-2

Margin: $\frac{3}{8}$
Border: $\frac{5}{8}$
Corner Radius: $1\frac{1}{2}$

60"x24" SD5-3

Margin: $\frac{3}{8}$
Border: $\frac{5}{8}$
Corner Radius: $1\frac{1}{2}$

42"x18" SD5-3A

6-D Copy

48"x18" SD5-4(R) SD5-4(L)

(R-3) Reverse Dimensions for Left Designation

Margin: $\frac{3}{8}$
Border: $\frac{5}{8}$
Corner Radius: $1\frac{1}{2}$

36"x24" SD5-5

(R-2)

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

TRAFFIC SIGNING FOR HIGHWAY CONSTRUCTION

Designed By: D.R.W.
Made By: H.B.D.
Checked By: J.B.

Approved By: [signature] Traffic Engineer
Date: AUGUST 9, 1965

STANDARD M-614-TB (SHEET 2)

FEDERAL ROAD REGION NO.	DIVISION	PROJECT NO.	SHEET NO.
9	COLORADO	[redacted]	

REVISIONS			
R-1	7-12-67	Added Note 23	G.W.F.
R-2	7-8-68	Rev. Note 23 & Dept. Name-	
		Deleted Note	G.W.F.
R-3	12-24-68	Rev. Note No. 18	J.L.S.

STANDARD M-614-TB

(SHEET 3 OF 3 SHEETS)

(JULY 1, 1965)

GENERAL NOTES

1. All work shall be done in accordance with: (a) the Standard Specifications applicable to the Project, and (b) the "Manual on Uniform Traffic Control Devices for all Classes of Streets and Highways" published by the Department of Highways.

2. 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 (including connecting roads) with well-maintained Barricades, Warning, and Guide Signs. All Barricades and Signs shall be moved, added to, changed or removed as required during the progress of construction and removed entirely when the Project is completed.

3. Where traffic is prohibited from the Project the Detour will be marked by the Department except that the Contractor shall provide, erect and maintain Barricades, complete, (when required) at the ends of the Project, ends of the Detour and connecting roads. All U.S. or State Route Markers required for the Project will be furnished and installed by the Department. The location and positioning of Warning Signs, Barricades, and Regulatory Signs shall be as recommended by the appropriate District Engineering Forces of the Department.

4. Work on the Project shall not be started until all required signs are in place and approved by the Engineer. Where speed control appears necessary such speed control shall be requested from the Engineer by the Contractor. Control of speed through a construction zone may be achieved by Advisory Speed plates in conjunction with Warning Signs (SWI3-I for use with 30" Warning Signs and XWI3-I for use with 36" and 48" Warning Signs). The Advisory Speed plate is to be posted only at those locations where the safe speed is lower than the imposed Regulatory speed limit.

5. All Signs and Barricades shall be placed for best visibility and legibility, maintained in good condition and kept clean and free of dirt at all times. Contractor's and Engineer's vehicles and equipment must be parked so that signs and barricades are visible to approaching traffic at all times.

6. Where two identical signs are used for dual posting they are to be staggered on the two sides of the roadway for a minimum distance of 75' to avoid a tunneling effect.

7. Examples for marking Projects, as shown on Sheet 1, are typical of signs required and are subject to alteration to fit actual conditions encountered in the field. Locations for control devices are to be staked by the Engineer. In all cases Warning signs are to be placed well in advance of the hazard, the distance depending on topography and existing approach speeds. 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.

8. Desirable sizes for signs are shown on Sheet 1 of this Standard. Larger or smaller signs shall be used where warranted. Detailed dimensions for signs normally used in connection with construction are shown on Sheet 2 of this Standard. For information on standard roadway signs not detailed on this Standard see the "Manual on Uniform Traffic Control Devices for all Classes of Streets and Highways" published by the Department of Highways.

9. Signs with the prefix "R" in the sign code are Regulatory signs and as such impose legal compulsions or restrictions on drivers and should only be used as authorized by the Engineer.

10. Signs with the prefix "W" in the sign code are Warning signs and are used to alert traffic to existing or potentially hazardous conditions.

11. (R-1) (R-2) Signs with the prefix "D" or "M" in the sign code are Guide signs. Those with the prefix "D" convey general information and those with the prefix "M" are used for marking the traffic route.

12. All signs shall be reflectorized unless otherwise specified on plans. Regulatory and Guide signs (unless otherwise specified) shall have a screen processed black legend and border on a white flexible reflective sheeting, non-exposed lens background. The back side of Regulatory and Guide signs shall be painted with two coats of "Exterior Sign White Paint." Warning signs shall have a screen processed black legend and border on a highway yellow flexible reflective sheeting, non-exposed lens background. The back side of Warning signs shall be painted with two coats of "Federal Yellow Synthetic Sign Enamel."

13. Painting for wood surfaces shall conform with Section 508 of the Standard Specifications.

14. Posts for regulatory, warning, and guide signs will normally be 4"x 4" or 6"x 6" and shall conform to the Standard Specifications for Untreated Timber-S4S. Timber shall conform to Construction grade Paragraph 123B or 125B of Standard No. 15 Grading & Dressing Rules for West Coast Douglas Fir (1956) or Dense Structural 58 and LL Structural 58 Paragraph 284 or 285 of 1956 Grading Rules for Southern Pine. Posts shall be painted with one coat of "White Wood Primer" and one coat of "Outside White Paint."

15. Sign panels furnished by the Contractor for use only during construction may be fabricated from plywood, aluminum, steel or other suitable material but shall be stable and durable enough to meet other requirements of this Standard.

16. All material shall be sound and durable. Barricades, signs, symbols, and lettering shall be of good workmanship. Uneven lettering will not be accepted.

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

18. (R-3) Lanterns and Torches - Lanterns, with red globes, shall be used only in low speed urban areas. Open-flame torches shall not be used under any circumstances.

19. Barricades, Flashing Beacons and Flashers - Refer to appropriate "M" Standard (Timber Barricades) for details.

20. Flagman Sign - This sign shall have a black painted background on both sides to form a contrast for the octagonal Stop sign and the diamond Warning sign. The "STOP" sign shall be fabricated by reverse screen process using transparent red paint on smooth surface silver reflective sheeting. The "SLOW" side of the Flagman Sign shall be black process paint on smooth surface yellow reflective sheeting. Handle to be grooved on one side to indicate reading of sign to Flagman.

21. Sign "A": This is the first advance warning sign and shall be placed 1,500 feet ahead of Barricade or project terminal. Postings are required on both sides of the roadway on divided highways. Dual posting is required where warranted on two-lane, two-way highways.
Sign "B": This is the second advance warning sign and shall be placed 1,000 feet ahead of barricade or project terminal. Postings are required on both sides of the roadway on divided highways and singly on two-lane, two-way highways.
Sign "C": This is the third advance warning sign in cases where barricades are used and shall be placed 500 to 750 feet ahead of barricade or potentially hazardous condition. Postings are required on both sides of the roadway on divided highways and singly on two-lane, two-way highways.
Sign "D": SD5-2 - This sign shall be placed to mark the beginning of a Project of more than 2 miles in extent, where traffic is maintained through the project. It shall be placed singly and near the beginning of construction.
Sign "E": SD5-3 - This sign shall be placed to mark the end of the Project. It shall be placed singly and may be placed opposite barricade if desirable.
Sign "F": Construction identification signs shall be furnished and installed by the Department on all Federal-Aid and Forest Highway Projects where actual construction is in progress and visible to highway users. These signs should be located so as not to obscure or detract from the effectiveness of other official signs. Where two or more projects are contiguous the appropriate data may be included in one set of signs. Refer to appropriate "M" Standard (Identification Signs) for sign details.
Signs A through F shall be furnished, installed and maintained by the Department.

22. When Flags are used in lieu of the Flagman Sign, they shall be a minimum of 18"x18", made of a good grade of bright red material, and fastened securely to a staff of approximately 3 foot length. The free edge should be weighted to insure that the flag will hang vertically, even in heavy winds.

23. (R-1) (R-2) Each 6"x6" timber sign post shall be provided with two 2" diameter holes through the neutral axis normal to the roadway, one hole at 6" and one hole at 18" above the ground level. The 4"x4" timber posts shall not be provided with any type of break-away device. The inside portion of each 2" diameter hole shall be painted white. The underground portion of each timber post shall be treated with creosote.

(R-2)

(R-2)

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
DIVISION OF HIGHWAYS

TRAFFIC SIGNING FOR HIGHWAY CONSTRUCTION

Designed By: D.R.W.	Approved By: [signature] Traffic Engineer
Mode By: J.L.S.	Date: AUGUST 9, 1965
Checked By: J.B.	