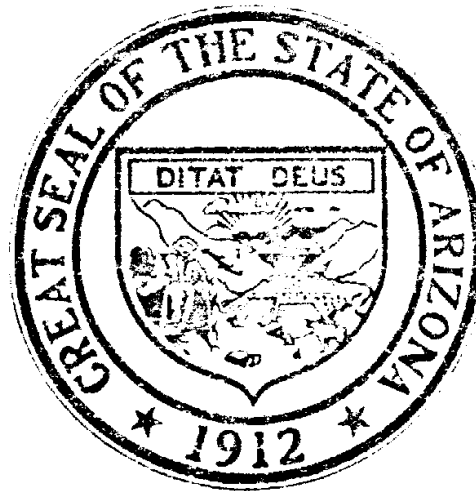


*Tom Conner*



# ARIZONA HIGHWAY DEPARTMENT

ROADWAY CONSTRUCTION

STANDARDS

1969

" C "

HIGHWAY PLANS SERVICES

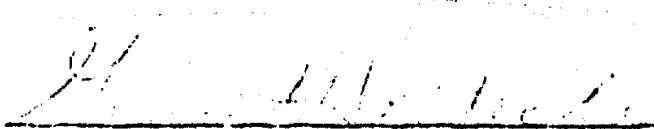
**ARIZONA HIGHWAY DEPARTMENT  
OFFICE MEMO**

September 30, 1970

**TO:** All Holders of 1969 Construction Standards  
**FROM:** GRANT HEIDECKER  
Engineer of Plans  
**SUBJECT:** Revision of Standard C-15.05

Existing 3/4" grate support dimension has been  
revised to: 3/4" for LW or LB grates; 3" for TW or TB grates.

Revision is effective immediately.

  
GRANT HEIDECKER  
Engineer of Plans

GH:sd

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				C-21.03	
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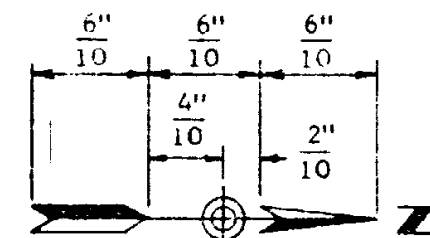
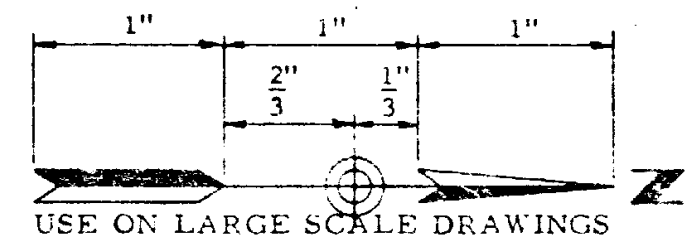
GENERAL NOTE: The term Plans, as used herein, shall refer to the Roadway Construction Plans.

STATE OR NATIONAL LINE	-----
COUNTY LINE	-----
TOWNSHIP OR RANGE LINE	-----
SECTION LINE	-----
QUARTER SECTION LINE	-----
FOREST OR RESERVATION LINE	----- Shading on inside of line
HIGHWAY R/W LINE	----- BLU ZIP NO. 333 & CHART PAK 256 TAA 1" WIDE
CONTROL OF ACCESS LINE	----- Shading on outside of line
UNFENCED PROPERTY	----- Blu-Zip No. 113
CITY LIMITS	-----
SECTION AND QUARTER CORNERS	----- Depressed for driveway
COMBINED CURB & GUTTER	----- 20' OC Existing
SIDE ROAD TURNOUT	----- (1)-(2) ----- New Existing
GROUND LINE	-----
EXISTING ROAD	----- (2) ----- Width & type Blu-Zip No. 438
OBLITERATE PAVEMENT	----- (2) ----- Blu-Zip No. 340
NEW CONCRETE PAVEMENT	----- (1) ----- Blu-Zip No. 309
NEW BIT. MIX. PAVEMENT	----- (1) ----- Blu-Zip No. 310
EXISTING PAVEMENT	----- (2) -----
BIT. PAVEMENT (SECTION)	-----
P.C. CONCRETE (SECTION)	-----
AGGREGATE BASE	-----
SELECT MATERIAL	-----
SUBGRADE SEAL	-----

TREES AND SHRUBS	-----
TRAFFIC SIGN	-----
ADVERTISING SIGN	----- Large Small
GUARD RAIL	----- New Existing
BARRIER POST - HAZARD MARKER	-----
STANDARD BARBED WIRE FENCE	----- Gate
WOOD FENCE	-----
FABRIC WIRE FENCE	-----
CATTLE GUARD	----- (1)-(2) ----- New Existing
CHANNEL OR DITCH	-----
DYKE OR LEVEE	-----
BANK PROTECTION	-----
RETAINING WALL	-----
PIPE CULVERTS	----- (1)-(2) ----- New Existing
REINF. CONC. BOX CULV.	----- (1)-(2) ----- New Existing
C.M.P. DOWNDRAIN	----- 1-Way 2-Way
CONCRETE SPILLWAY	----- 1-Way 2-Way
DROP INLET OR CATCH BASIN	-----
MANHOLE	----- New Exist. To be Adjusted
FIRE HYDRANT	----- New Exist.
VALVE(WATER OR GAS)	----- W G
METER BOX	-----
TELEPHONE BOOTH	-----
STREET LIGHT	----- On. Ext. Arm
DOWN GUY AND ANCHOR	-----
TELEPHONE OR TELEGRAPH LINE	-----
POWER LINE OR JOINT LINE	-----
WATER LINE	----- W ----- 2"
GAS LINE	----- G ----- 3"
IRRIGATION LINE	----- IRR ----- 12"
STORM DRAIN	----- SD ----- 30"
SANITARY SEWER	----- S ----- 8"

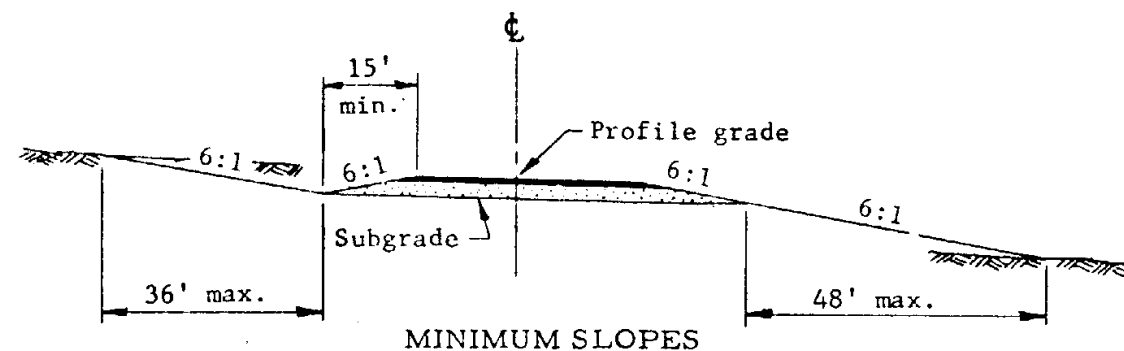
B. P. R. REGION	STATE	PROJ. NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
7	ARIZ.				
7 1/2" / 10	5" / 10	1 5" / 10	5" / 10	5" / 10	1" / 4

RAILROAD CROSSING SIGNS	----- Advance Warning X Buck Flashing Light
RAILROAD TRACK	-----
WELL OR PUMP HOUSE	-----
SURVEY MONUMENT	----- (1)-(2) ----- New Exist.
R/W MARKER	----- (1)-(2) ----- New Exist.
MILE POST	----- New Exist.
ANGLE POINT AND ANGLE	----- (1)-(2) ----- New Exist.

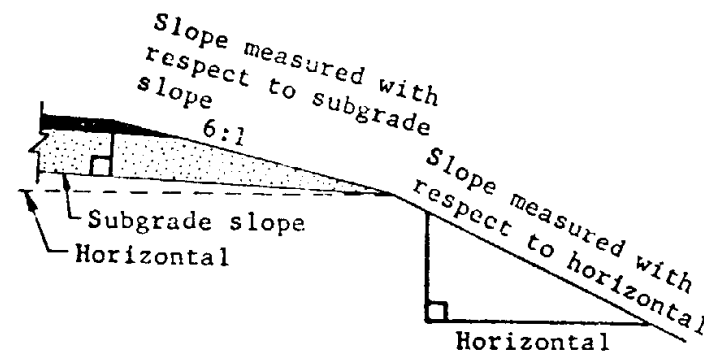


(1) New: No. 1 Rapidograph line width.  
(2) Existing: No. 00 Rapidograph line width.  
(Back of plan sheet)

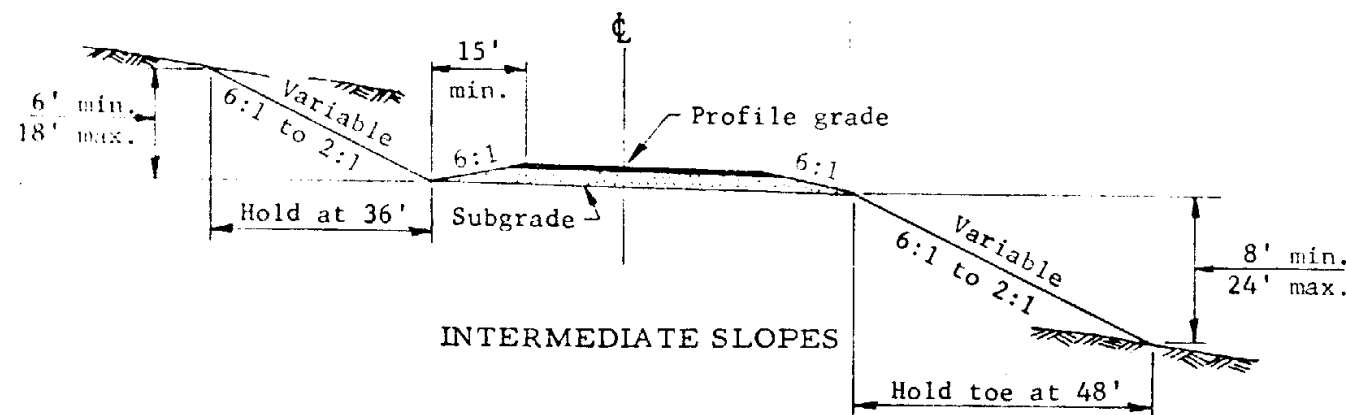
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev. 12-5-68
PLANS SYMBOLS			
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Traced			
Checked	J.P.O. 9/10 5-68		
Approved Engr. Plans	8/12/68 5-68		



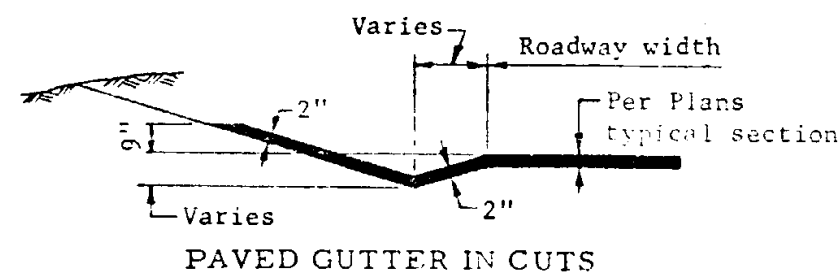
MINIMUM SLOPES



DETAIL ILLUSTRATING  
SUBGRADE & EMBANKMENT  
SLOPE CONTROL

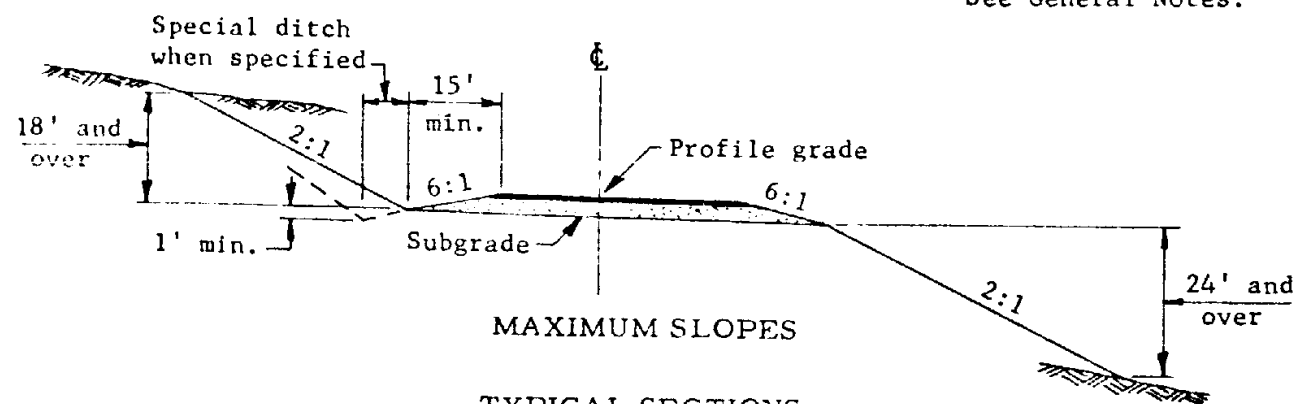


INTERMEDIATE SLOPES



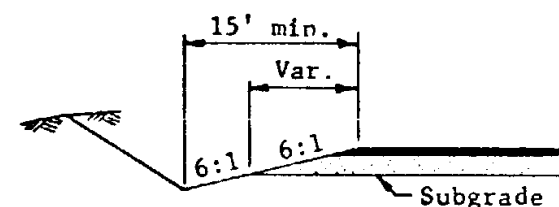
PAVED GUTTER IN CUTS

NOTE: Std. slope  
rounding not shown.  
See General Notes.



MAXIMUM SLOPES

TYPICAL SECTIONS



MINIMUM DITCH CONDITION

#### GENERAL NOTES

The desirable maximum embankment slope rate shall be 4:1 within interchange and grade separation areas.

See Plans for details of; roadway width, cut ditch, type and thickness of roadway surfacing, and superelevation.

Standard cut and embankment slopes as shown on this sheet may be superseded by special slopes where shown on Plans.

For cuts up to 6' use 5' semi-tangents for slope rounding. For each additional foot of cut add 1' to semi-tangent to 11' maximum.

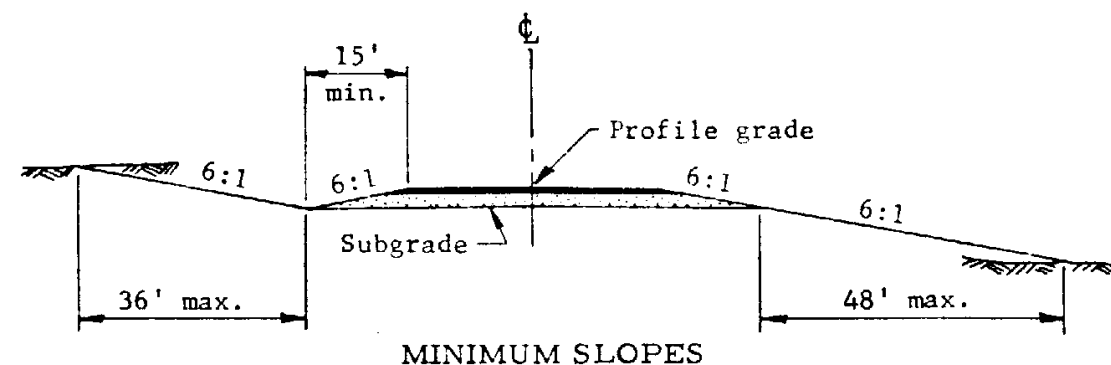
Should median slopes intersect see design supplement sheet.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## SLOPES INTERSTATE AND CLASS A-A ROADWAYS

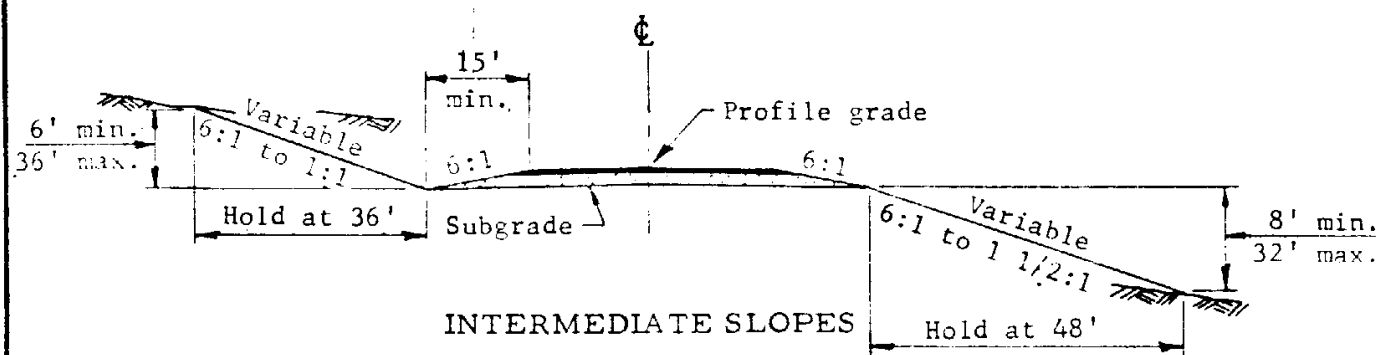
Drawn	R.A.F. 11-67	Drawing No.  <b>C-2.01</b>
Traced	R.A.F. 11-67	
Checked	J.P.O.	
Approved Engr. Plans	<i>Heide</i> 5-68	

Rev

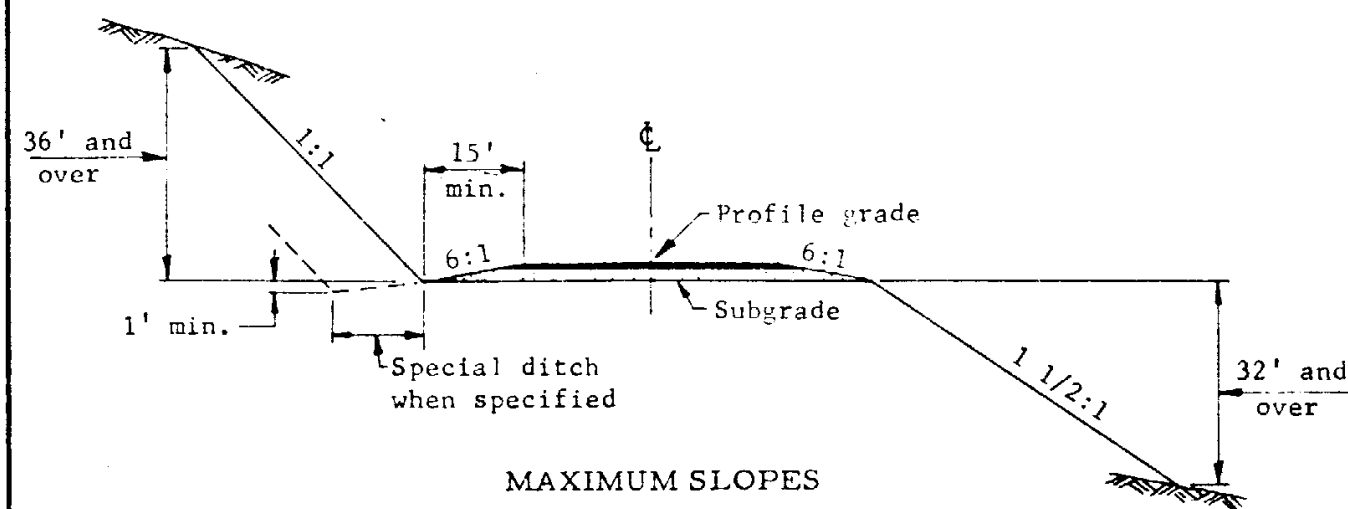


MINIMUM SLOPES

NOTE: Std. slope rounding not shown. See General Notes.

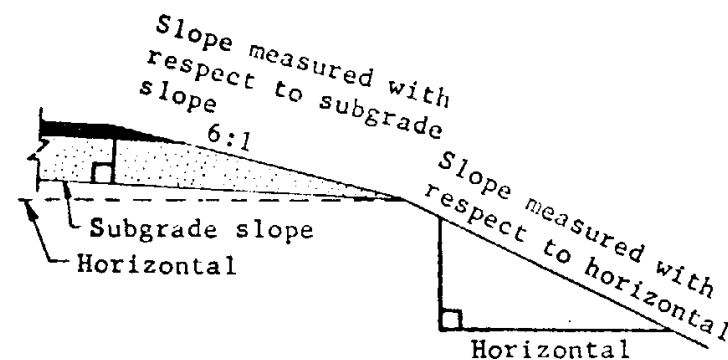


INTERMEDIATE SLOPES



MAXIMUM SLOPES

TYPICAL SECTIONS



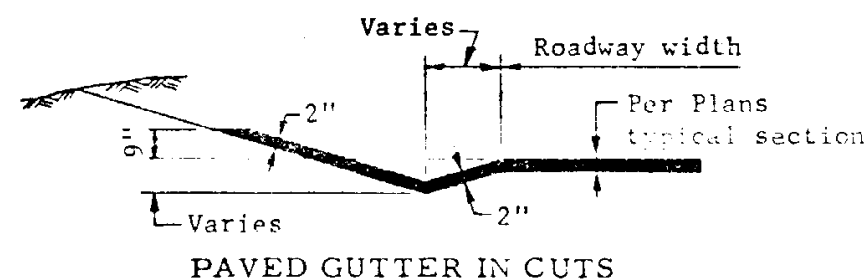
DETAIL ILLUSTRATING  
SUBGRADE & EMBANKMENT  
SLOPE CONTROL

#### GENERAL NOTES

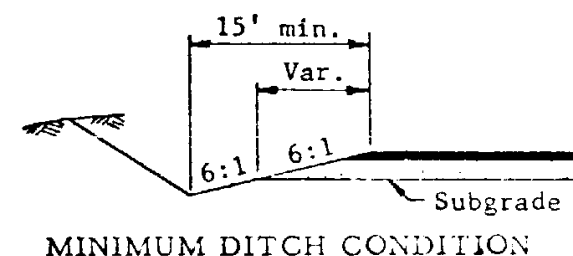
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For cuts up to 6' use 5' semi-tangents for slope rounding. For each additional foot of cut add 1' to semi-tangent to 11' maximum.

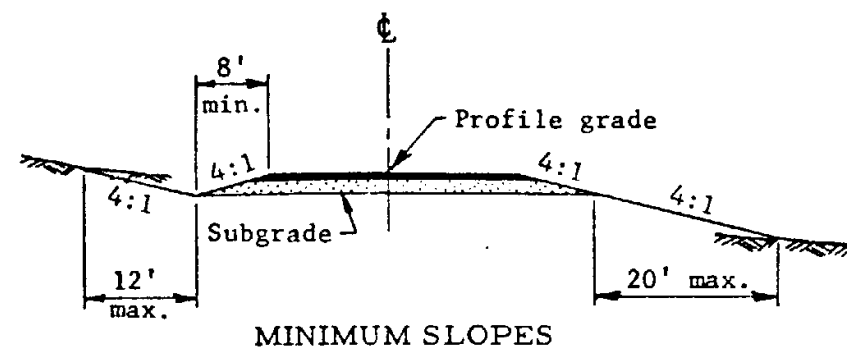


PAVED GUTTER IN CUTS



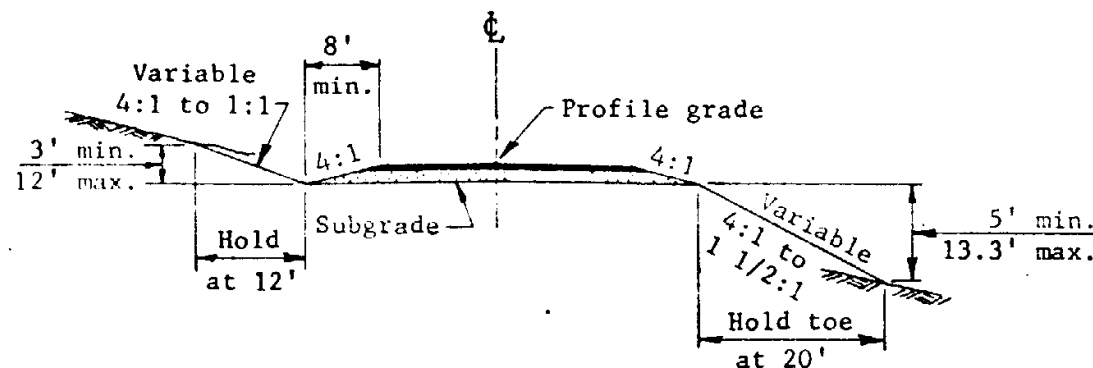
MINIMUM DITCH CONDITION

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
SLOPES CLASS A & B ROADWAYS			
Drawn	S.L.T. 11-67	Drawing No. <b>C-2.02</b>	
Traced	R.A.F. 11-67		
Checked	J.P.O. 11-67		
Approved Engr. Plans	Chadwick 5-68		

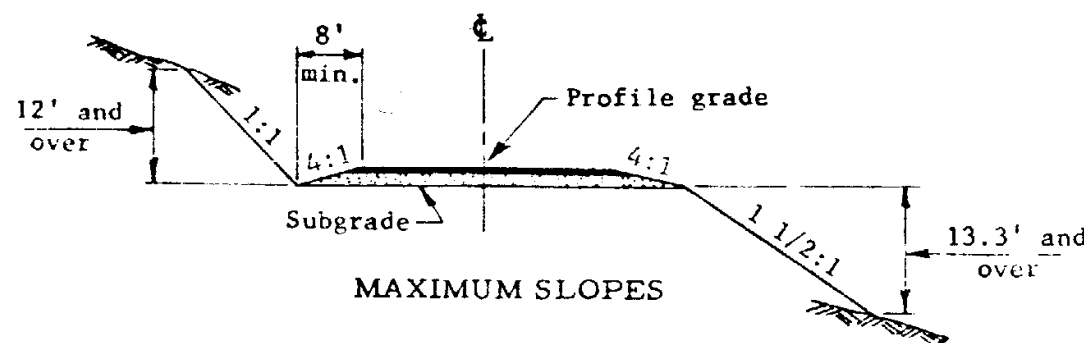


MINIMUM SLOPES

NOTE: Std. slope rounding not shown.  
See General Notes.

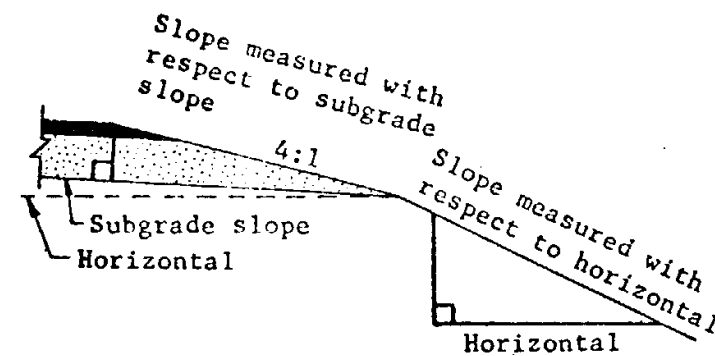


INTERMEDIATE SLOPES

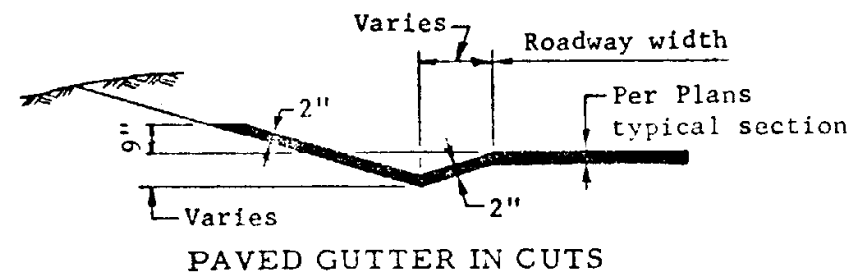


MAXIMUM SLOPES

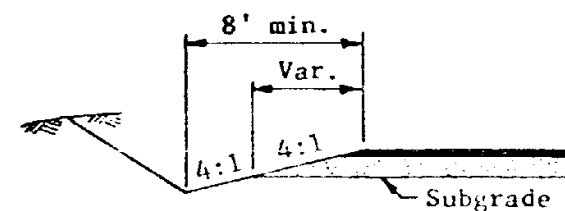
TYPICAL SECTIONS



DETAIL ILLUSTRATING  
SUBGRADE & EMBANKMENT  
SLOPE CONTROL



PAVED GUTTER IN CUTS



MINIMUM DITCH CONDITION

#### GENERAL NOTES

See Plans for details of; roadway width, cut ditch, type and thickness of roadway surfacing, superelevation, and curve widening.

Standard cut and embankment slopes as shown on this sheet may be superseded by special slopes where shown on Plans.

For cuts up to 6' use 5' semi-tangents for slope rounding. For each additional foot of cut add 1' to semi-tangent to 11' maximum.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

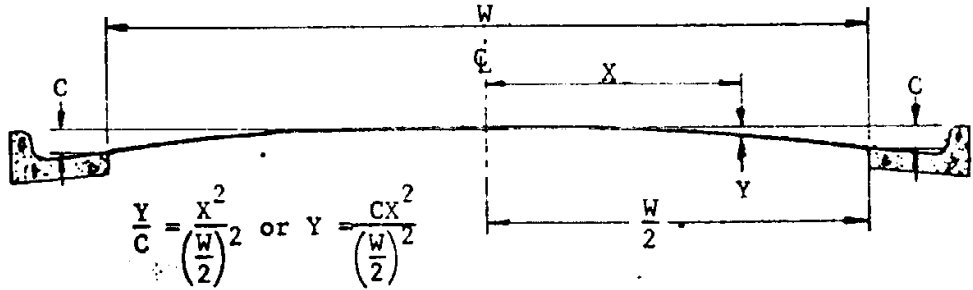
## SLOPES CLASS C & D ROADWAYS

Drawn	S.L.T. 11-67	Drawing No. <b>C-2.03</b>
Traced	R.A.F. 11-67	
Checked	J.P.O. 11-67	
Approved Engr. Plans	<i>[Signature]</i>	

CUMULATIVE PERCENT OF CROWN "C" FOR EACH FOOT RIGHT OR LEFT OF C

X →	2'	4'	6'	8'	10'	12'	14'	16'	18'	20'	22'	24'	26'	28'	30'	32'	34'	36'	38'	40'	42'	44'
90	0.20	0.79	1.78	3.16	4.94	7.11	9.68	12.64	16.00	19.75	23.90	28.44	33.38	38.72	44.44	50.57	57.09	64.00	71.31	79.01	87.11	95.61
88	0.21	0.83	1.86	3.31	5.17	7.44	10.12	13.22	16.74	20.66	25.00	29.75	34.92	40.50	46.49	52.89	59.71	66.94	74.59	82.64	91.12	C
86	0.22	0.87	1.95	3.46	5.41	7.79	10.60	13.85	17.52	21.63	26.18	31.15	36.56	42.40	48.67	55.38	62.52	70.09	78.10	86.53	95.40	C
84	0.23	0.91	2.04	3.63	5.67	8.16	11.11	14.51	18.37	22.68	27.44	32.65	38.32	44.44	51.02	58.05	65.53	73.47	81.86	90.70	C	
82	0.24	0.95	2.14	3.81	5.95	8.57	11.66	15.23	19.27	23.80	28.79	34.27	40.21	46.64	53.54	60.92	68.77	77.10	85.90	95.18		
80	0.25	1.00	2.25	4.00	6.25	9.00	12.25	16.00	20.25	25.00	30.25	36.00	42.25	49.00	56.25	64.00	72.25	81.00	90.25	C		
78	0.26	1.05	2.37	4.20	6.57	9.47	12.89	16.83	21.30	26.30	31.82	37.87	44.44	51.54	59.17	67.32	76.00	85.21	94.94			
76	0.28	1.11	2.49	4.43	6.93	9.97	13.57	17.73	22.44	27.70	33.52	39.89	46.81	54.29	62.33	70.91	80.06	89.75	C			
74	0.29	1.17	2.63	4.67	7.30	10.52	14.32	18.70	23.67	29.22	35.35	42.07	49.38	57.27	65.74	74.80	84.44	94.67				
72	0.31	1.23	2.78	4.94	7.72	11.11	15.12	19.75	25.00	30.86	37.35	44.44	52.16	60.49	69.44	79.01	89.20	C				
70	0.33	1.31	2.94	5.22	8.16	11.76	16.00	20.90	26.45	32.65	39.51	47.02	55.18	64.00	73.47	83.59	94.37					
68	0.35	1.38	3.11	5.54	8.65	12.46	16.95	22.15	28.03	34.60	41.87	49.83	58.48	67.82	77.85	88.58	C					
66	0.37	1.47	3.30	5.87	9.18	13.21	17.99	23.49	29.73	36.71	44.41	52.86	62.03	71.94	82.59	93.97						
64	0.39	1.56	3.52	6.25	9.77	14.06	19.14	25.00	31.64	39.06	47.27	56.25	66.02	76.56	87.89	C						
62	0.42	1.66	3.75	6.66	10.41	14.98	20.40	26.64	33.71	41.62	50.36	59.94	70.34	81.58	93.65							
60	0.44	1.78	4.00	7.11	11.11	16.00	21.78	28.44	36.00	44.44	53.78	64.00	75.11	87.11	C							
58	0.48	1.90	4.28	7.61	11.89	17.12	23.31	30.44	38.52	47.56	57.55	68.49	80.38	93.22								
56	0.51	2.04	4.59	8.16	12.76	18.37	25.00	32.65	41.33	51.02	61.73	73.47	86.22	C								
54	0.55	2.19	4.94	8.78	13.72	19.75	26.89	35.12	44.44	54.87	66.39	79.01	92.73									
52	0.59	2.37	5.33	9.47	14.79	21.30	28.99	37.87	47.93	59.17	71.60	85.21	C									
50	0.64	2.56	5.76	10.24	16.00	23.04	31.36	40.96	51.84	64.00	77.44	92.16										
48	0.69	2.78	6.25	11.11	17.36	25.00	34.03	44.44	56.25	69.44	84.03	C										
46	0.76	3.02	6.81	12.10	18.90	27.22	37.05	48.39	61.25	75.61	91.49											
44	0.83	3.31	7.44	13.22	20.66	29.75	40.50	52.89	66.94	82.64	C											
42	0.91	3.63	8.16	14.51	22.68	32.65	44.44	58.05	73.47	90.70												
40	1.00	4.00	9.00	16.00	25.00	36.00	49.00	64.00	81.00	C												
38	1.11	4.43	9.97	17.73	27.70	39.89	54.29	70.91	89.75													
36	1.23	4.94	11.11	19.75	30.86	44.44	60.49	79.01	C													
34	1.38	5.50	12.46	22.15	34.60	49.83	67.82	88.58														
32	1.56	6.25	14.06	25.00	39.06	56.25	76.56	C														
30	1.78	7.11	16.00	28.44	44.44	64.00	87.11															
28	2.04	8.16	18.37	32.65	51.02	73.47	C															
26	2.37	9.47	21.30	37.87	59.17	85.21																
24	2.78	11.11	25.00	44.44	69.44	C																
22	3.31	13.22	29.75	52.89	82.64																	
20	4.00	16.00	36.00	64.00	C																	
18	4.94	19.75	44.44	79.01																		
16	6.25	25.00	56.25	C																		
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FORMULA



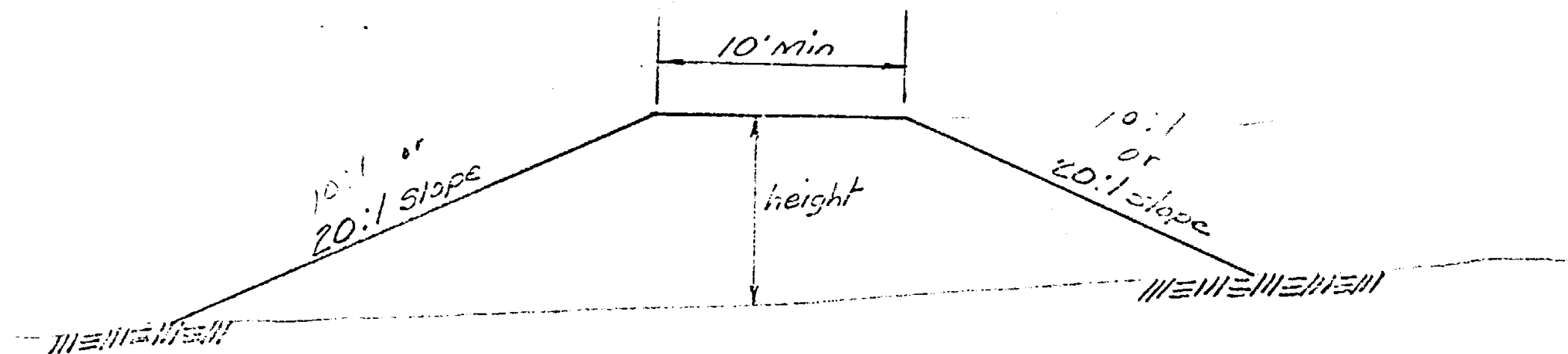
USE OF TABLE

Example:  
Assume W = 40 ft. and C = 0.45 ft.  
Find Y for X = 8 ft.  
  
Table shows Y = 16.00% of C,  
or 0.16 X 0.45' = 0.072 ft.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev. 12-5-68
PARABOLIC CROWN FORMULA AND TABLE		
Drawn	L.McD. 6-41	Drawing No.
Traced	S.L.T. 7-67	
Checked	J.P.O. JPO 5-68	
Approved		
Engr. Plans	Heister 5-68	
		C-2.04

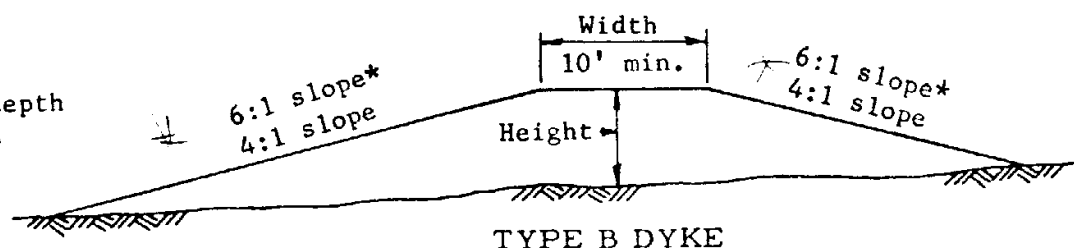
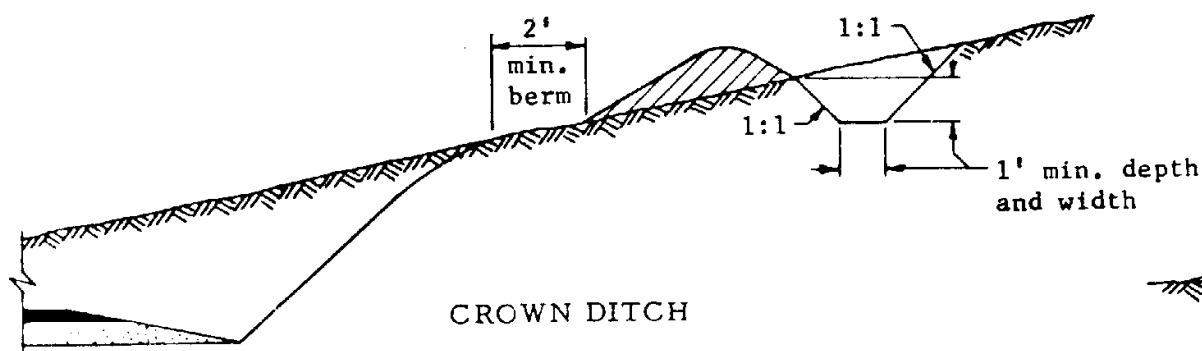
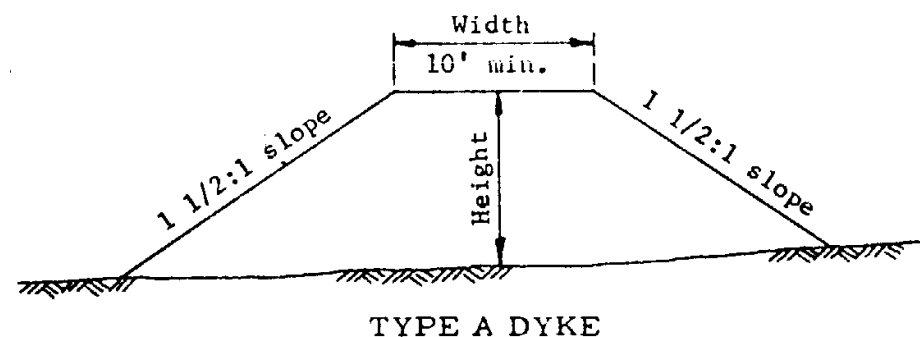
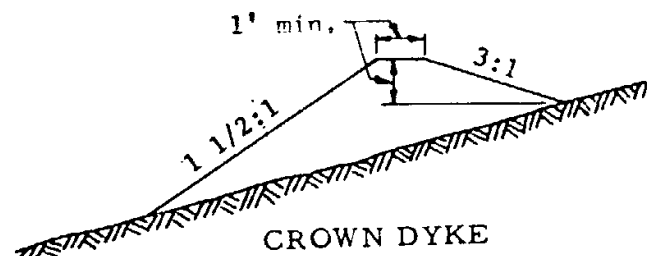


Curb height  
 9" height  
 over 10' on 20:1 slope



Median Barrier  
 Std C-3.01 Type M modified

54  
 3  
 9  
 66  
 1/2"



\* TYPE M DYKE

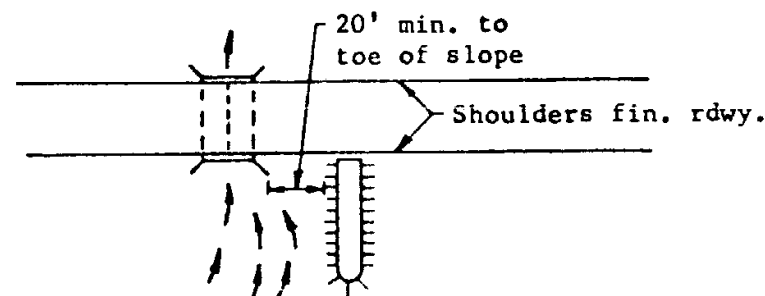
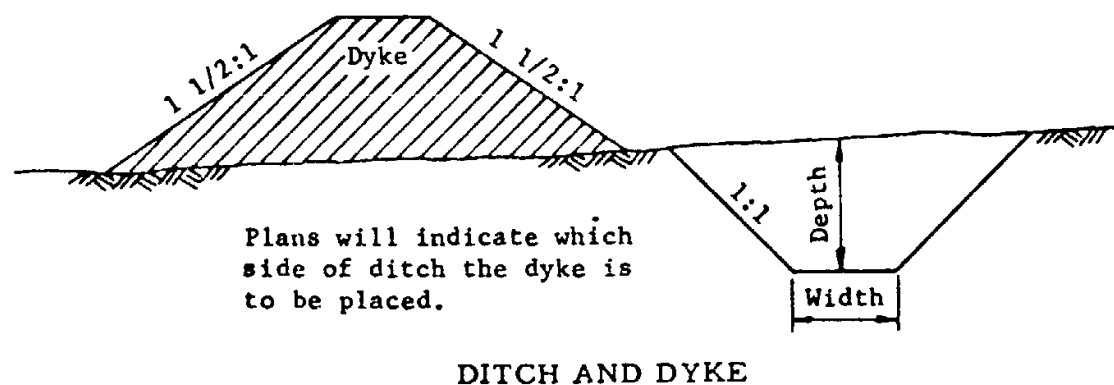
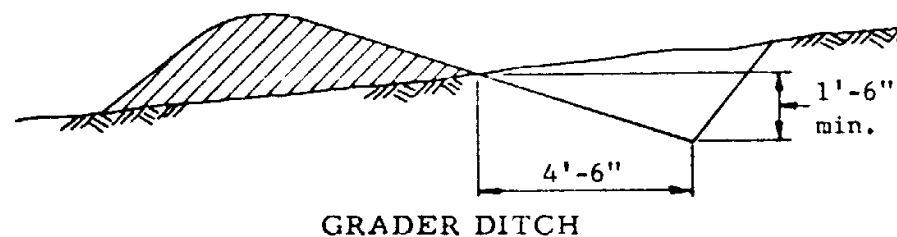
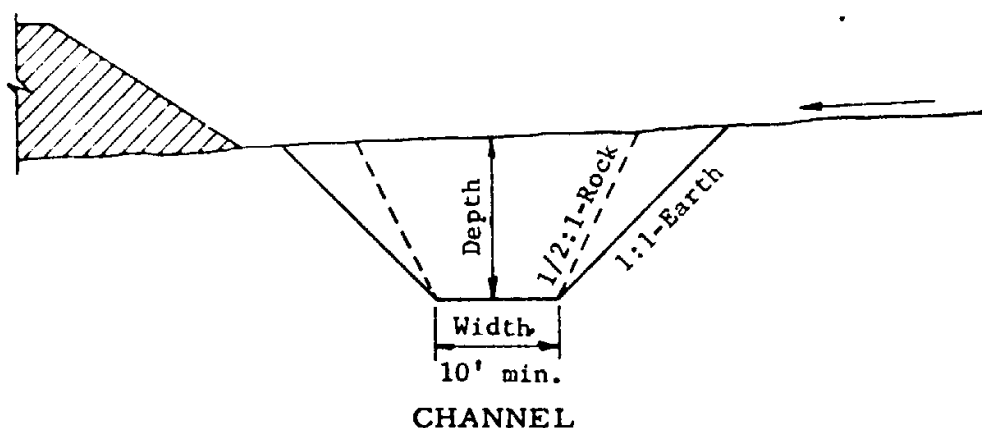
#### GENERAL NOTES

Bituminous or soil cement protection shall be applied to dyke surfaces as called for on Plans.

Dimensions of ditches and dykes, as shown on Plans, are width, depth or height and length.

Grader Ditches and crown ditches or dykes shall be constructed with a minimum grade to prevent excessive erosion. Ditch outlets should be provided where possible.

Ditch sections shown may be varied by the Engineer.



TYPICAL DYKE INSTALLATION AT STRUCTURE

Place dykes at structures to create a water cushion.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## DITCHES AND DYKES

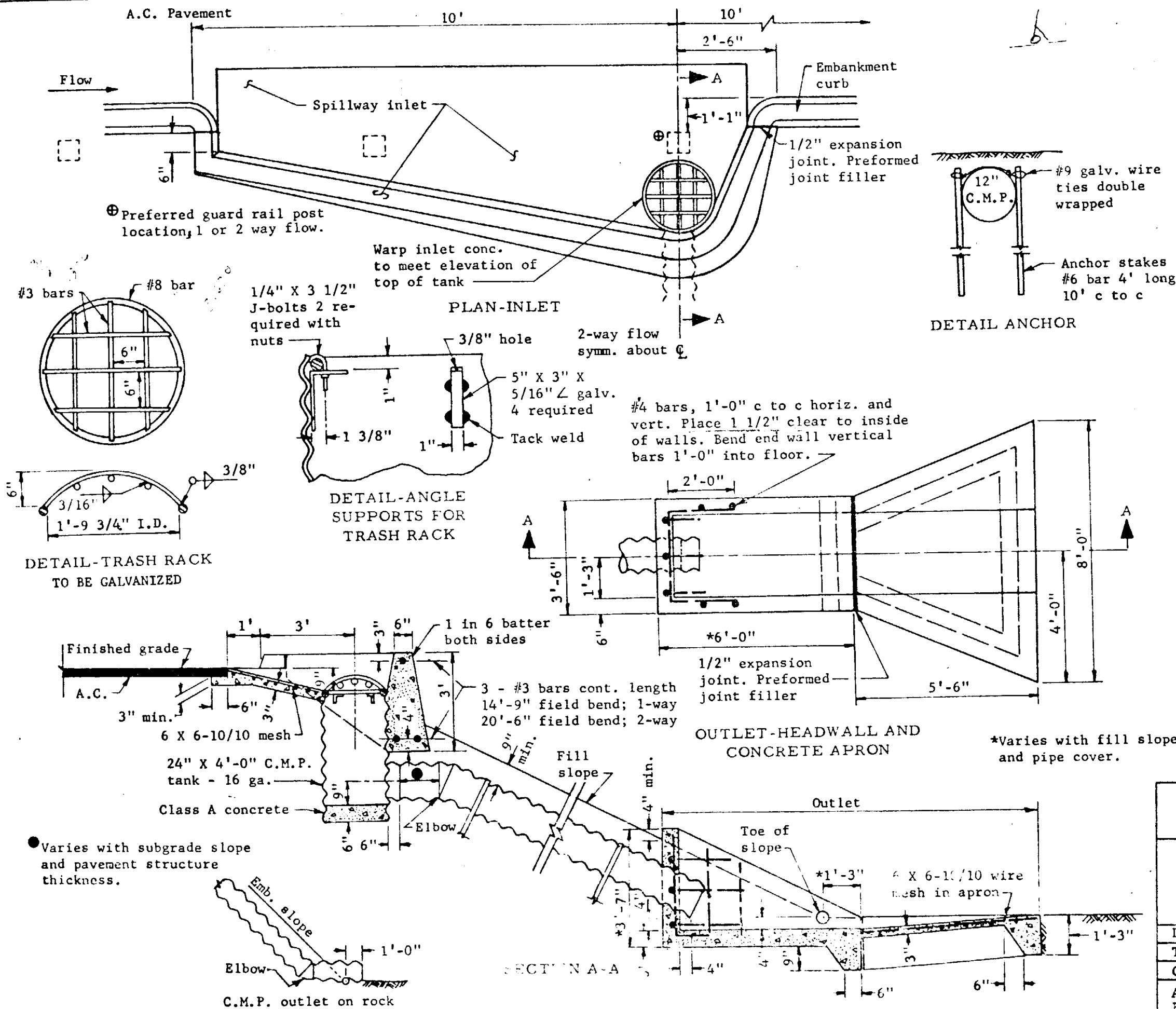
Drawn	G.H.	12-45
Traced	R.A.F.	10-67
Checked	J.P.O.	8PO 5-68
Approved		
Engr. Plans	M. Heidecker 5-68	

Drawing No.

C-3.01

Rev

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 9-27-66 11-4-68 5-14-69 2-25-70
CONCRETE SPILLWAY, INLET & OUTLET. EMBANKMENT CURB			
Drawn	L.O.M.	1-64	Drawing No.  <b>C-4.01</b>
Traced	R.A.F.	9-68	
Checked	J.P.O.	8-80 12-68	
Approved Engr. Plans	Schneider 1-79		



**GENERAL NOTES**

Use 12", 16 ga. corrugated pipe.

24" X 4'-0" C.M.P. tank, 6" 6" X 1'-0" C.M.P. stub and angle supports shall be shop fabricated and galvanized in accordance with AASHTO M 36.

Round all exposed concrete corners.

See Detail for rock installation.

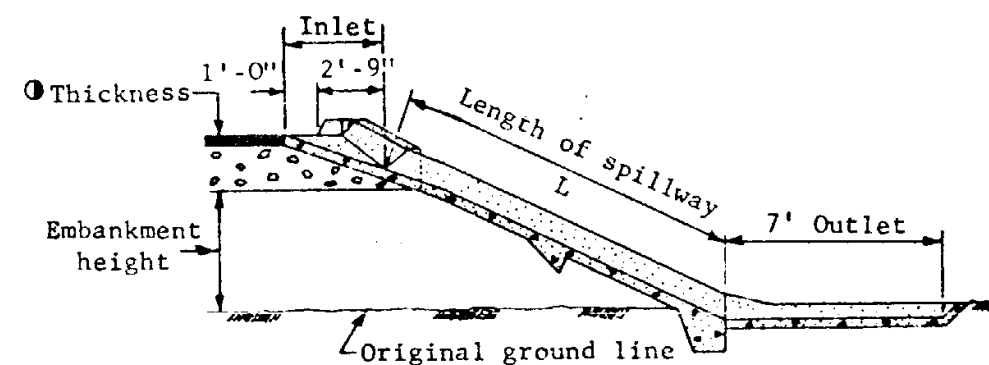
Coupling bands for pipe 21" dia. and smaller may be 18 ga.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 9-24-68 11-14-68
SPILLWAY INLET C.M.P. DOWNDRAIN OUTLET			
Drawn	L.O.M. & D.G.	Drawing No.  <b>C-4.02</b>	
Traced	S.L.T. & R.A.F.		
Checked	J.P.O. 800 5-68		
Approved Engr. Plans	L.H. Hatcher 5-68		

C-2.02 Slopes																																
C-2.01 Slopes																																
	Embankment Height																															
0	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'	21'	22'	23'	24'	25'	26'	27'	28'	29'	30'	31'	32'				
12"	32	37	43	49	50																											
13"	33	38	44		51																											
14"						52																										
15"	34	39	45				53																									
16"								54																								
17"	35	40	46						55																							
18"										56																						
19"	36	41	47								57																					
20"												58																				
21"	37	42	48										59																			
22"														60																		
23"	38	43	49												61																	
24"																62																
25"	39	44	50														63															
26"																		64														
27"	40	45	51																65													
28"																				66												
29"	41	46	52																		67											
30"																						68										
31"	42	47	53																				69									
32"																								70								
33"	43	48	54																						71							
34"																										72						
35"	44	49	55																													
36"																																

C-2.03 Slopes												
Embankment Height												
12"	5'	6'	7'	8'	9'	10'	11'	12'	13'			
13"	22											
14"		23										
15"			24									
16"				25								
17"					26							
18"						27						
19"							28					
20"								29				
21"									30			
22"										31		
23"											32	
24"												33
25"												
26"												
27"												
28"												
29"												
30"												
31"												
32"												
33"												
34"												
35"												
36"												

Thickness of pavement structure



# GENERAL NOTES

For C-2.01 slopes with emb. height over 24', L = L for 24' emb. height from table + 2.24(emb. height - 24).  
 For C-2.02 slopes with emb. height over 32', L = L for 32' emb. height from table + 1.8(emb. height - 32).  
 For C-2.03 slopes with emb. height over 13', L = L for 13' emb. height from table + 1.8(emb. height - 13).

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## CONCRETE SPILLWAY LENGTH TABLE

Drawn	D.G. 12-67	Drawing No.  <b>C-4.03</b>
Traced	D.G. 1-68	
Checked	J.P.O. 9-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

Rev

		C-2.01 Slopes																C-2.02 Slopes															
		Embankment Height																															
●		7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'	21'	22'	23'	24'	25'	26'	27'	28'	29'	30'	31'	32'						
12"	(32)	(38)																															
13"			(46)																														
14"		(40)																															
15"	(34)			(48)																													
16"					(50)																												
17"																																	
18"		(42)																															
19"	(36)																																
20"																																	
21"																																	
22"		(44)																															
23"	(38)																																
24"																																	
25"																																	
26"		(46)																															
27"	(40)																																
28"																																	
29"																																	
30"		(48)																															
31"	(42)																																
32"																																	
33"																																	
34"		(50)																															
35"	(44)																																
36"																											(70)						

GENERAL NOTES

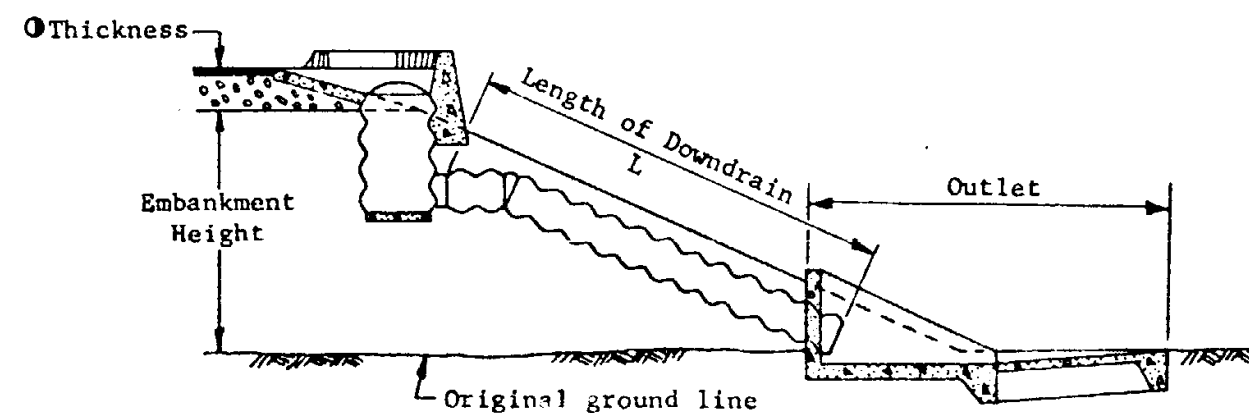
For C-2.01 slopes with emb. height over 24', L = L for 24' emb. height from table + 2.24(emb. height - 24).

For C-2.02 slopes with emb. height over 32', L = L for 32' emb. height from table + 1.8(emb. height - 32).

For C-2.03 slopes with emb. height over 13', L = L for 13' emb. height from table + 1.8(emb. height - 13).

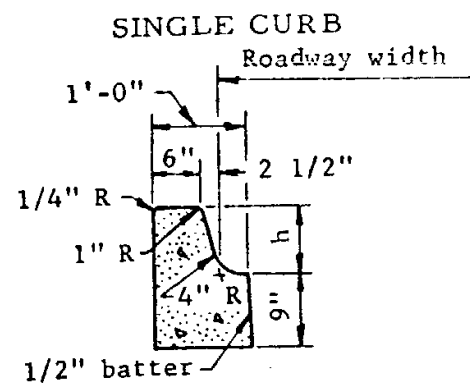
		C-2.03 Slopes										
		Embankment Height										
●		5'	6'	7'	8'	9'	10'	11'	12'	13'		
12"			(16)									
13"	(14)								(20)			
14"												
15"												
16"				(18)								
17"												
18"	(16)								(22)			
19"												
20"												
21"												
22"			(20)									
23"												
24"	(18)								(24)			
25"												
26"												
27"												
28"			(22)									
29"												
30"	(20)								(26)			
31"												
32"												
33"			(24)									
34"	(22)											
35"									(28)			
36"				(26)						(30)		

● Thickness of pavement structure



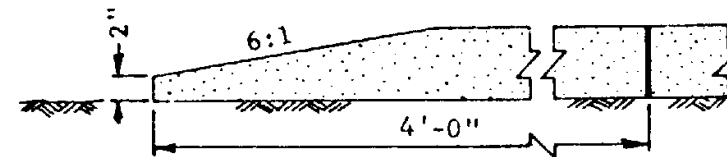
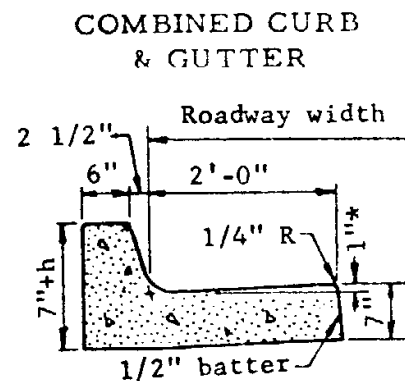
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
C.M.P. DOWNDRAIN LENGTH TABLE			
Drawn	J.W. & D.G. 2-67	Drawing No.	
Traced	R.A.F. 12-67		
Checked	J.P.O. 800 5-68		
Approved Engr. Plans	Hyde 5-68		
		C-4.04	

NOTE: Radii shown for single curbs are typical throughout for respective type.  
h=curb height as shown on Plans.

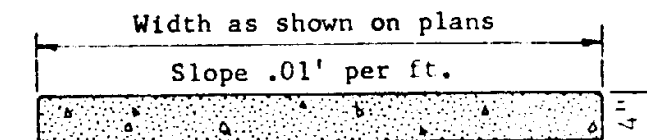


TYPE "A"

For 6" curb height or over

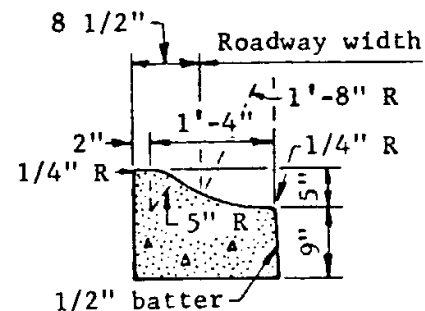


CURB TERMINAL SECTION

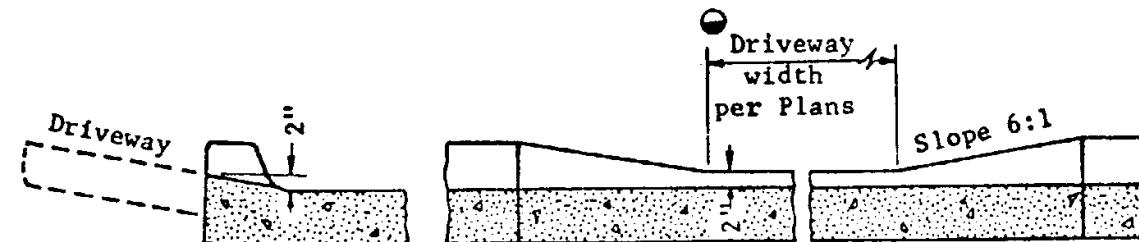
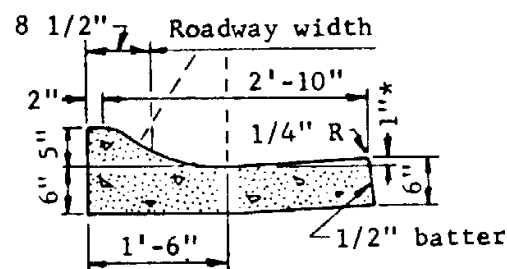


Sidewalk shall be single course Class A concrete, sweat finished and jointed with a 1/4" deep jointing tool at centers approximately equal to the width of the sidewalk. Sidewalk shall be scored to a depth of 1" at intervals matching the joints in the adjacent curb. Sidewalk shall be edged with a 1/4" radius edging tool.

CONCRETE SIDEWALK

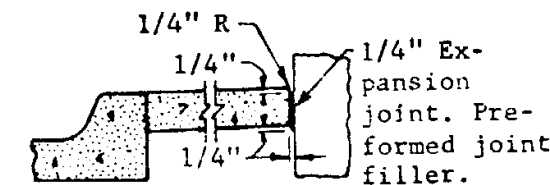


TYPE "E"



Center joint required if driveway width over 20'

DEPRESSED CURB FOR DRIVEWAY ENTRANCE



SIDEWALK EXPANSION JOINT

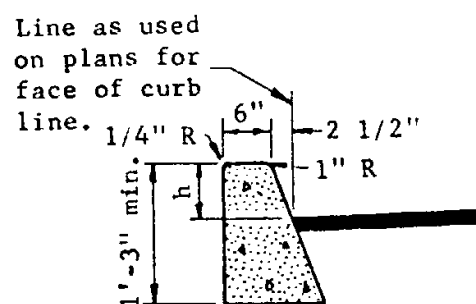
GENERAL NOTES

All curbs and gutters shall be single course, Class A concrete unless otherwise noted on plans. All curbs shall be trowel finished.

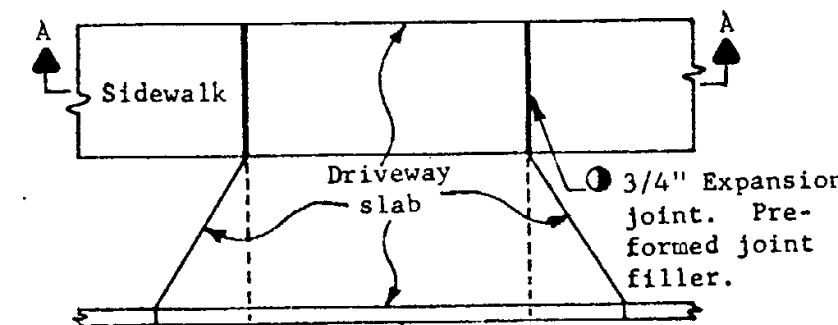
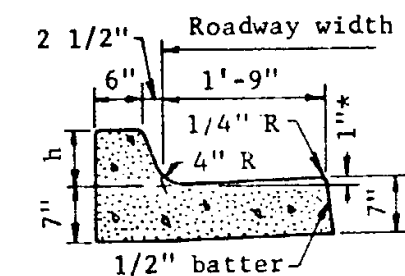
All gutter flow lines shall be troweled to an accurate grade for a width of 9".

Curbs, or curb and gutter, shall have a 1/4" joint extending all the way through the concrete at locations matching the joints in adjacent P.C.C. pavement; at approximately 15' centers when adjacent pavement is bituminous and at tangent points in curb returns and at structures. The joints may be open or with redwood filler left in place.

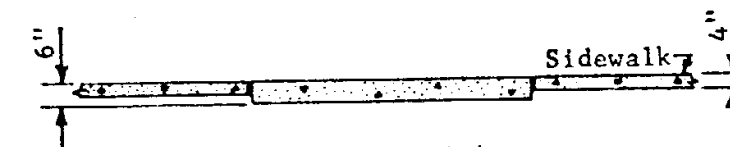
\* When curb and gutter is located with the roadway section sloping away from the curb, the gutter slope shall match the roadway slope.



TYPE "G"



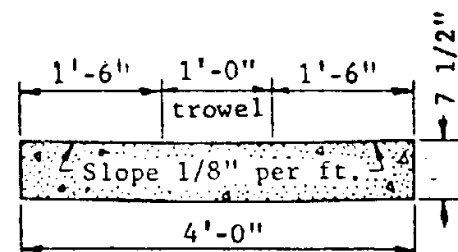
PLAN



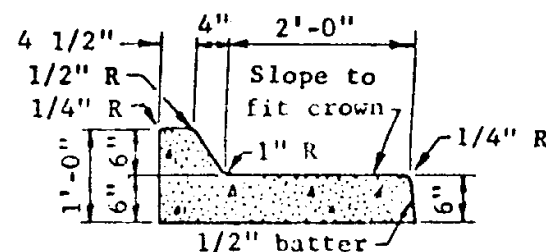
SECTION A-A

Joint is required between driveway slab and adjacent sidewalk.

SIDEWALK AT DRIVEWAY



VALLEY GUTTER



TYPE "H"

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CURB, GUTTER, SIDEWALK & DRIVEWAY DETAILS			
Drawn	O.K.	3-1935	Drawing No.  <b>C-5.01</b>
Traced	R.A.F.	6-8-67	
Checked	J.P.O.	8PC 5-68	
Approved			
Engr. Plans			

Shaded to be constructed as gutter. (sq.ft.)/4' ft.

R as shown on plans

1/4" joint. Std. C-5.01 (Typ.)

1/4" joint. Type "H", Std. C-7.02

Curb Gutter

Valley gutter

4"

A diagram of a quarter-circle fillet. The fillet is defined by two concentric quarter-circles. The outer radius is labeled  $R$  as shown on plans. The length of the fillet along the outer arc is labeled  $L$ . The thickness of the fillet is labeled  $A$ . The fillet is shown in a corner formed by two perpendicular surfaces, indicated by dashed lines.

## CURB & GUTTER MEASUREMENT ON CURVES

- 
- Diagram illustrating the layout of a gutter system, showing various components and dimensions:
- Top Left:** A detail view of a gutter cross-section showing a height of  $4'$ .
  - Main Diagram:** A plan view of a gutter system layout.
    - Center:** The central point of the gutter system, marked with a circle and labeled "Center".
    - Normal crown:** The outer edges of the gutter system, labeled "Normal crown".
    - Gutter grade:** The slope of the gutter, labeled "Gutter grade".
    - 1/4 Line:** The line connecting the corners of the gutter system, labeled "1/4 Line".
    - Mean elev. between grade break and  $\phi$ :** The average elevation between a grade break and a specific point, labeled "Mean elev. between grade break and  $\phi$ ".
    - Straight grade when valley gutter is used:** The section of the gutter system where a straight grade is used, labeled "Straight grade when valley gutter is used".
    - Dimensions:** Various dimensions are shown, including  $1/4$  Line,  $1/4$  F,  $1/8$  e,  $1/2$  e,  $7/8$  e,  $1/4$  a,  $1/8$  a,  $1/4$  b,  $1/8$  b,  $1/2$  d,  $7/8$  d, and  $1/8$  d.
    - Grade = 3-1/2% max.:** The maximum allowable gutter grade, labeled "Grade = 3-1/2% max.".
  - Section Labels:** The diagram is divided into two sections, labeled "SECTION A-A" and "SECTION B-B".

### STREET INTERSECTION GRADES

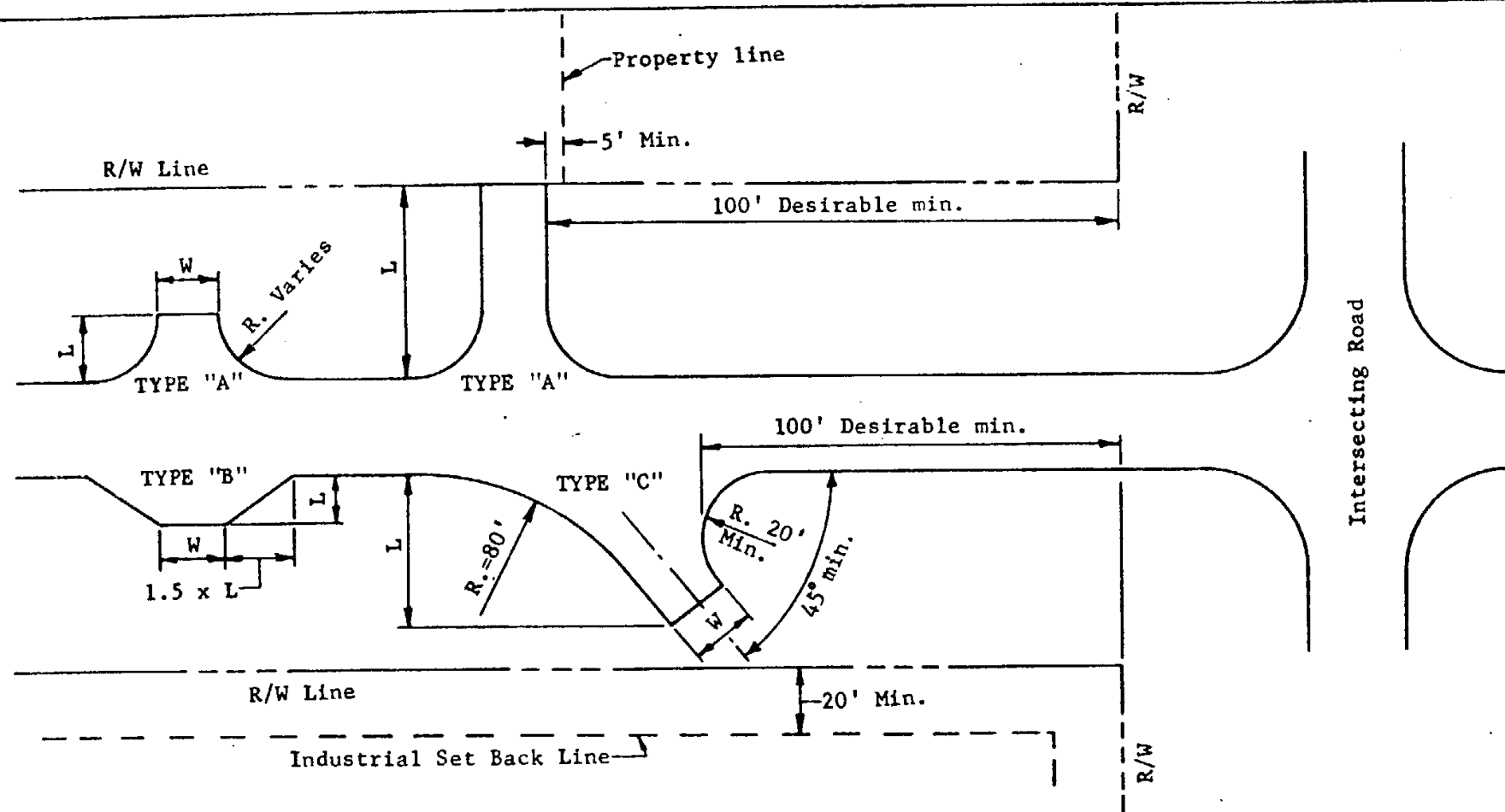


SECTION A-A      SECTION B-B

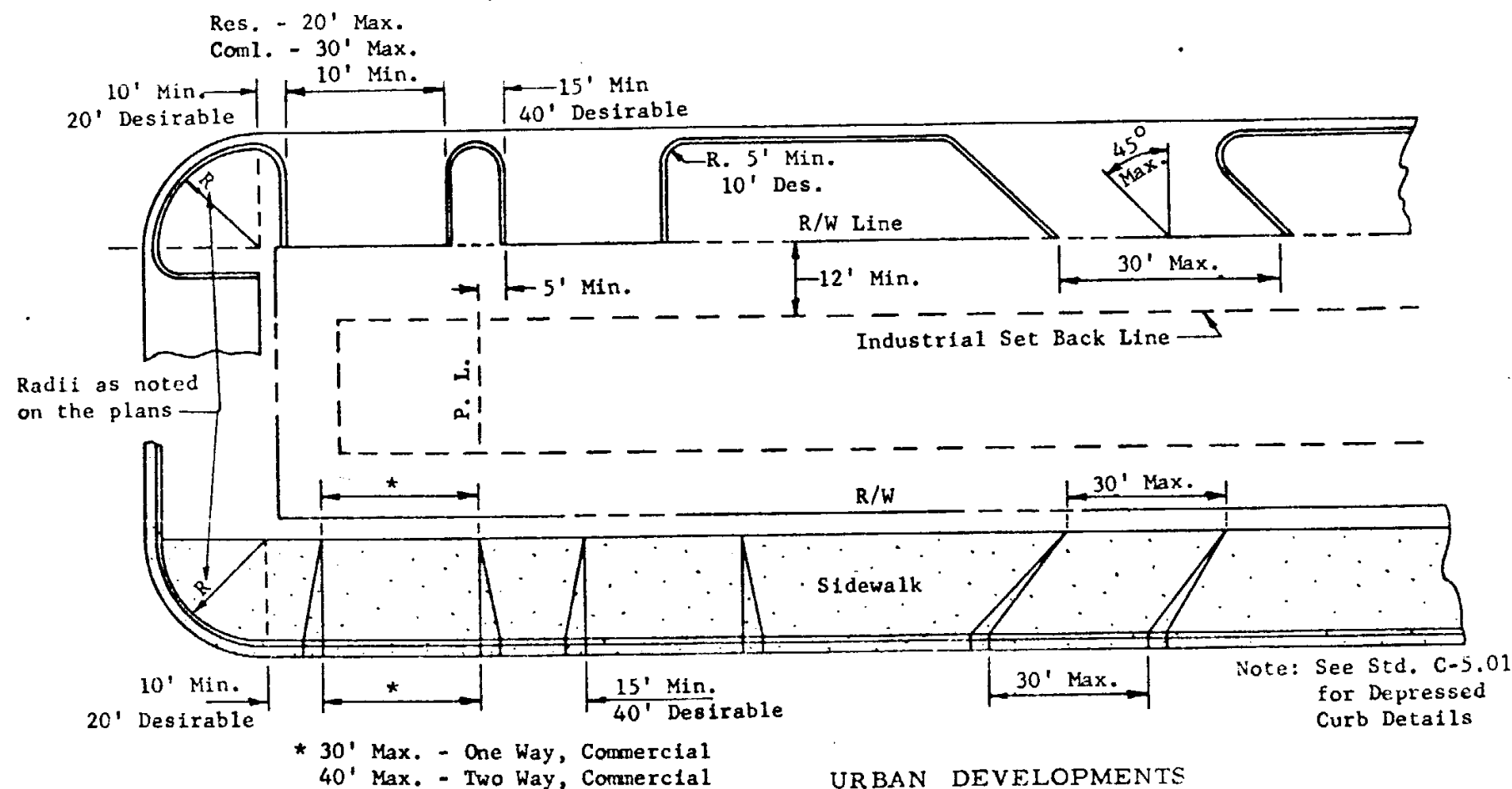
To determine the value of F,  
see roadway typical section.  
For Curb and Gutter details,  
see Std. C-5.01.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
CURB & GUTTER MEASUREMENT & STREET INTERSECTION GRADES		
Drawn	O.K. & W.M.D.	Drawing No.  C-5.02
Traced	R.A.F. 9-16-66	
Checked	J.P.O. JPO 5-68	
Approved Engr. Plans	St. Schneider 5-68	





#### RURAL DEVELOPMENTS



#### GENERAL NOTES

Paved Turnouts: W=10' Minimum & 40' Maximum.  
Plans notation will be W x L, Surface Material, Type & Standard.  
Example: 16' x 30' A.C.T.O. Type "A" Standard C-6.01.

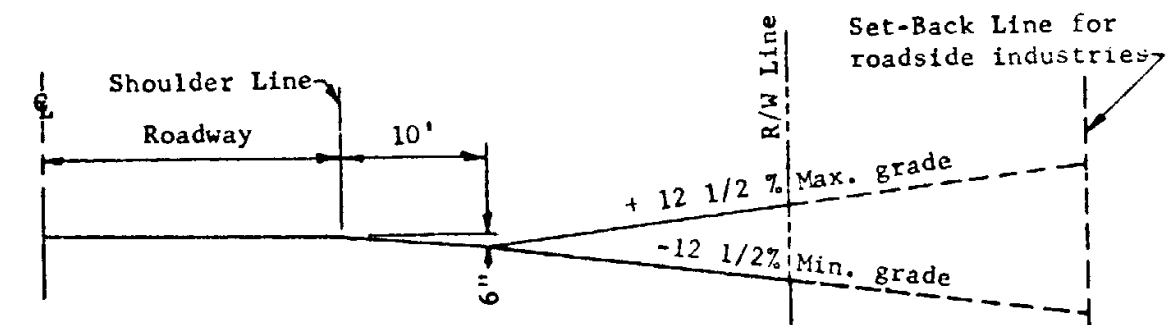
Base material shall be the same as that shown for main roadway, unless otherwise noted.

Excavation or Embankment for turnouts shall be included in quantities for main roadway.

Dimensions indicated as minimum shall be avoided wherever possible in favor of those indicated as desirable

Curbed driveways and depressed curbs shall be located as noted on Plans or as directed by the Engineer.

All radii shown are to back of curb.



TYPICAL SECTION AT RURAL DRIVEWAY ENTRANCE  
See Std. C-5.01 for Depressed Curb Details

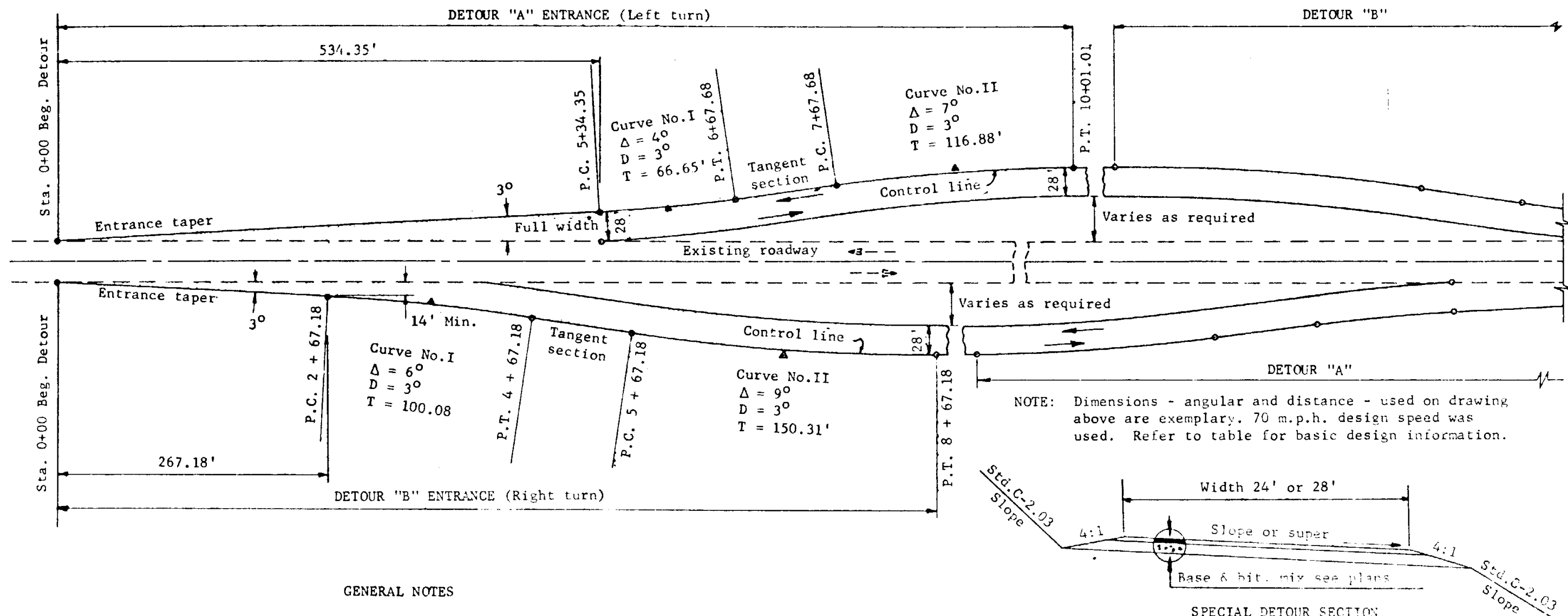
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

### TURNOUT & DRIVEWAY LAYOUT

Drawn	L. O. Moe 2-64	Drawing No.
Traced	R.A.F. 11-18-66	
Checked	J.P.O. 8-20-68	
Approved		
Engr. Plans	H. H. H. 5-68	

C-6.01

Rev



#### GENERAL NOTES

Detour "A" entrance shall be used where approaching vehicle must turn left. Detour "B" shall be used where approaching vehicle must turn right. Detour from a horizontal curve: On the inside of the curve the detour take off shall be a curve, see table. On the outside a tangent take off shall be used. A vertical curve may be required to effect a smooth grade change.

The design speed shall be comparable between vertical and horizontal alignment.

The entrance design speed of a detour shall not be less than the normal posted speed of the existing roadway. The design speed for the remainder of the detour may be 20 m.p.h. less than the normal posted speed.

Any intermediate detour entrance may be designed on the basis of normal posted speed less 20 m.p.h. where visible construction activity has slowed traffic for the preceding 1/4 mile.

The minimum width of the detour shall be 28' for existing roadways 34' or wider and a minimum of 24' for existing roadways less than 34' in width.

The entrance taper for Detour "A" shall be extended until full detour width is attained. For Detour "B" the entrance taper shall be extended until a minimum of 14' is attained beyond the edge of existing roadway.

Any deviation from this standard must be approved by the Plans Engineer and Traffic Engineer and the Engineer shall submit the alignment and profile of the proposed change for their review.

Tangent Roadway		Curved Roadway			Entrance Design Speed	Max. Horizontal Curvature			
Entrance Design Speed	Entr. Taper Def'l. Angle	Exist. Horiz. Curve	Detour "A" Take off Curve	Detour "B" Take off Curve		Curve No. 1		Curve No. II	
						D	Superelev.	D	Superelev.
70	3°	1°	2°	2°30'	70	3°	.05'/ft.	3°	.03'/ft.
60	3°	2°	3°	3°30'	60	3°	.02'/ft.	4°	.04'/ft.
50	4°	3°	4°	5°	50	4°	.015'/ft.	6°	.04'/ft.
40	6°	4°	5°	6°	40	6°	.015'/ft.	10°	.04'/ft.
30	10°	5°	6°	7°	30	10°	.015'/ft.	18°	.04'/ft.
		6°	7°	8°					
		7°	8°	9°					
		8°	9°	10°					

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION	
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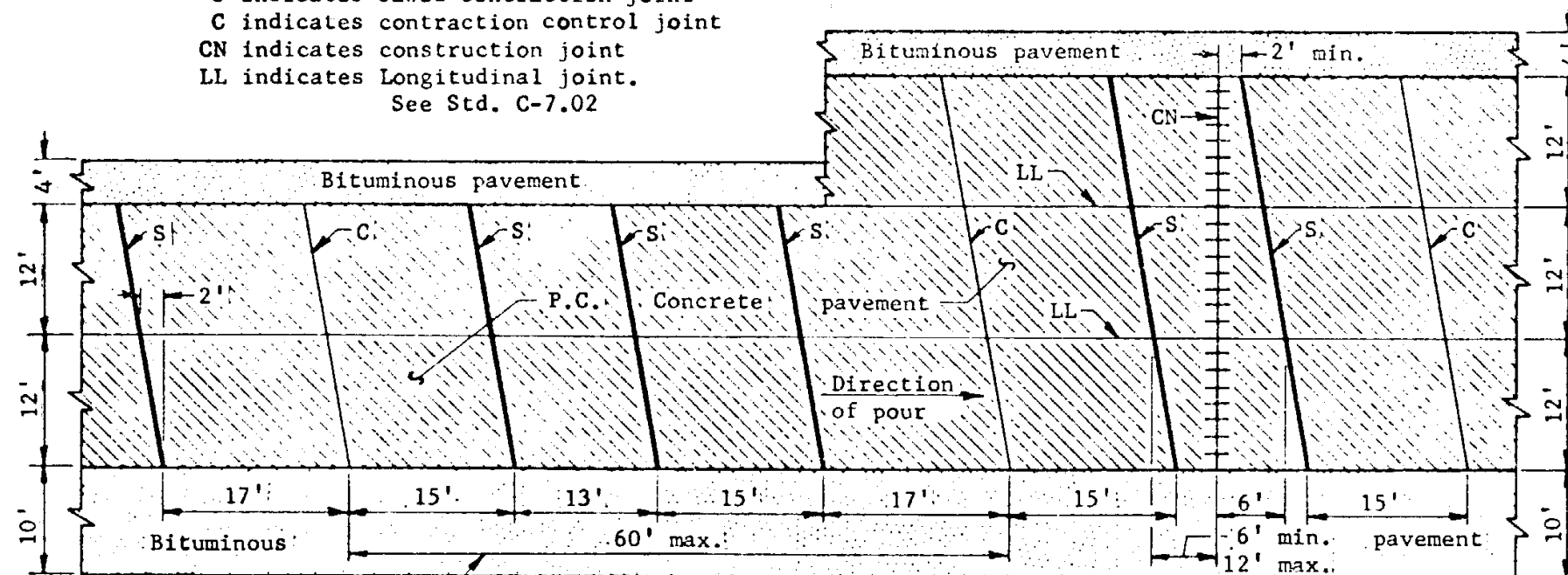
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

Rev  
12-03

#### DETOUR ENTRANCE DESIGN TABLE

Drawn	J.P.O. 12-64	Drawing No.  C-6.02
Traced	R.A.F. 12-65	
Checked	J.P.O. 8-5-68	
Approved Engr. Plans	H. H. H. 5-68	

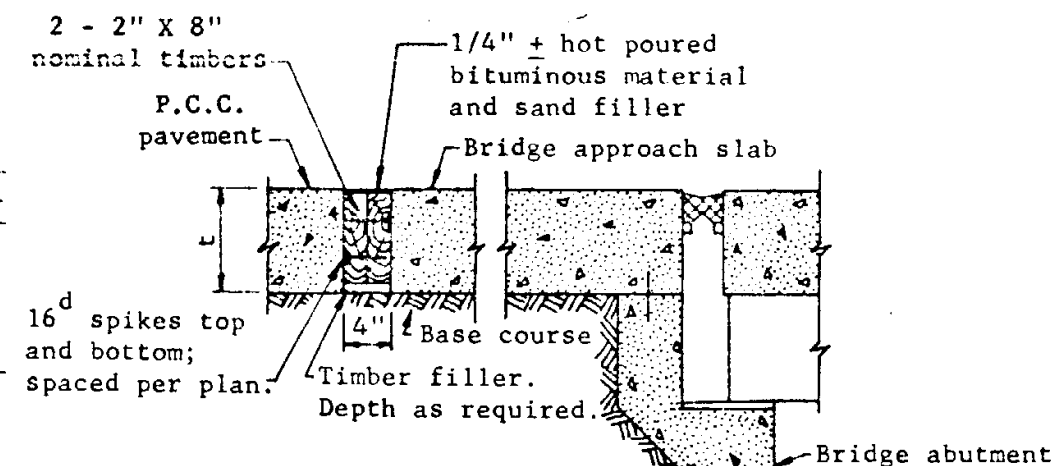
S indicates sawed contraction joint  
C indicates contraction control joint  
CN indicates construction joint  
LL indicates Longitudinal joint.  
See Std. C-7.02



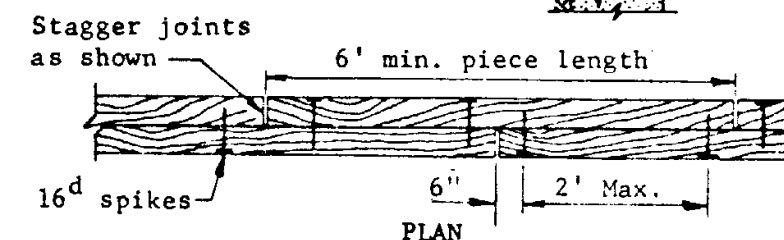
Typical joint sequence

PLAN

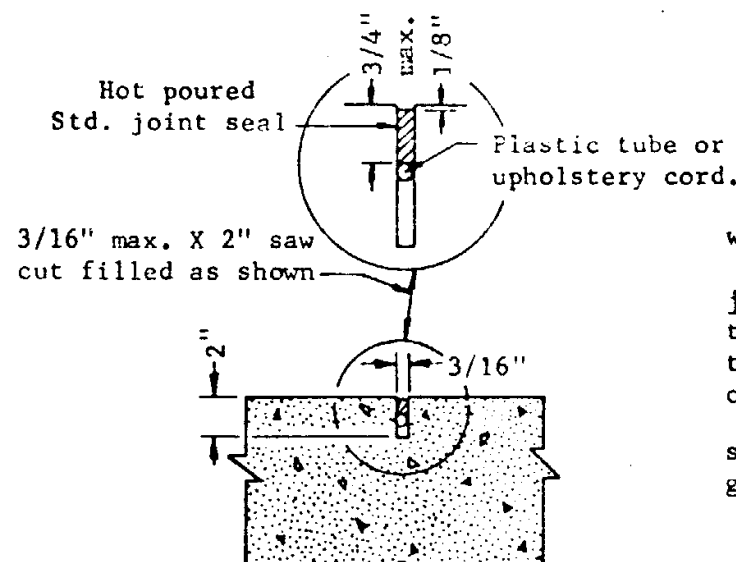
See General Notes



SECTION



TRANSVERSE EXPANSION JOINT AT  
BRIDGE APPROACH SLAB



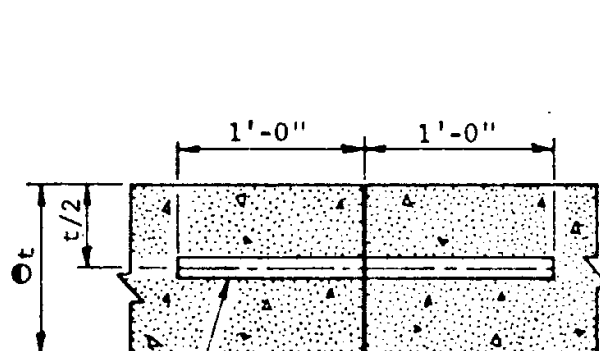
SAWED TYPE  
CONTROL JOINT

#### GENERAL NOTES

All transverse joints shall be in line with joints in adjacent slabs.

At intersection of side roads or streets, joints shall be placed to give the intersection a symmetrical appearance while conforming to the cross section of the intersecting road or street.

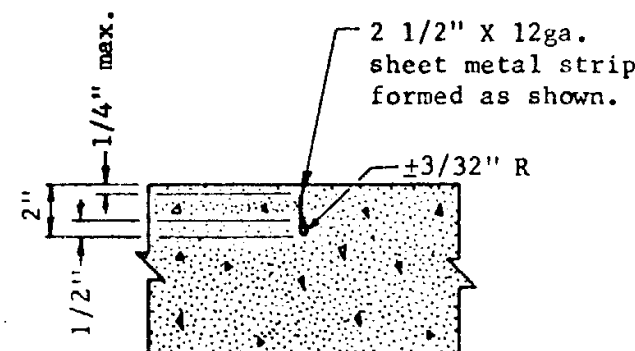
Timbers used in transverse expansion joint shall be rough redwood and conform to commercial grade.



Indicates P.C.C. thickness

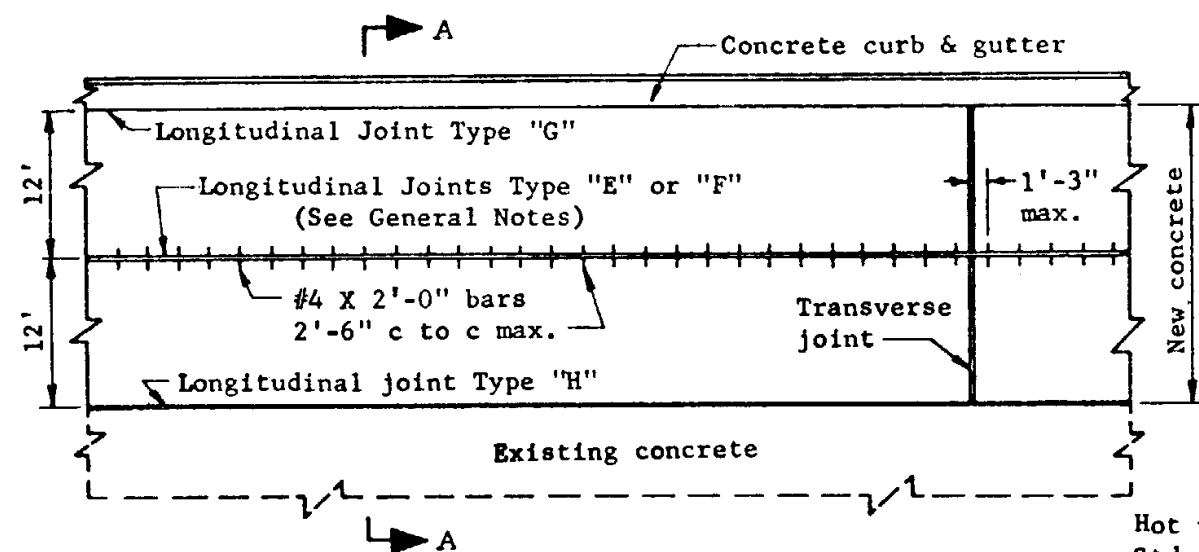
CONSTRUCTION JOINT

To be used at end of pour

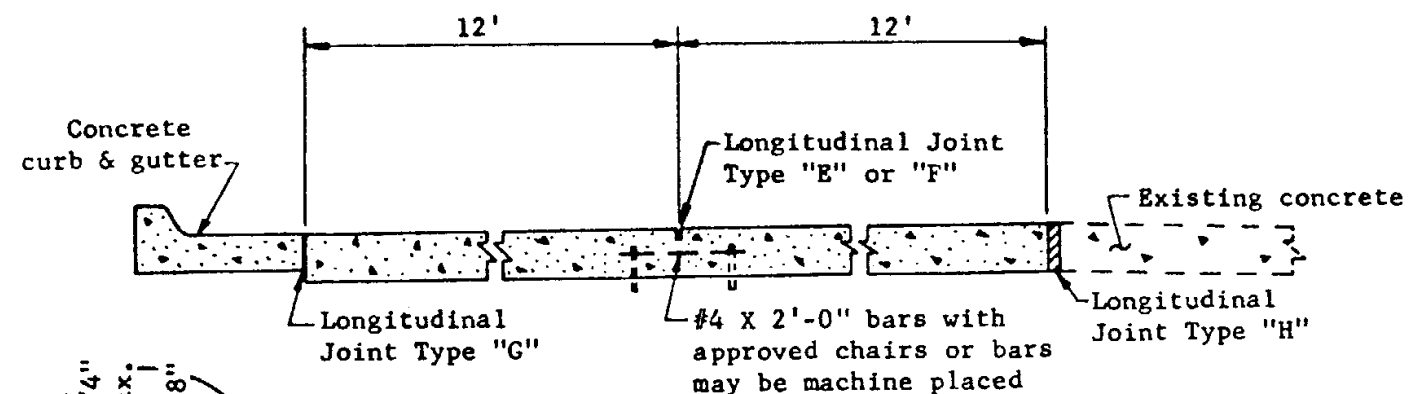


INSERT TYPE  
CONTROL JOINT

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
PORTLAND CEMENT CONCRETE PAVEMENT TRANSVERSE JOINTS			
Drawn	L.O.M.	Drawing No.  C-7.01	
Traced	R.A.F. 12-66		
Checked	J.P.O. 9/10 5-68		
Approved Engr. Plans	8/11/68 5-68		



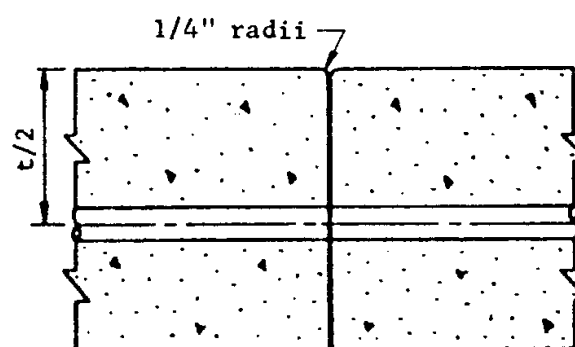
PLAN



SECTION A-A

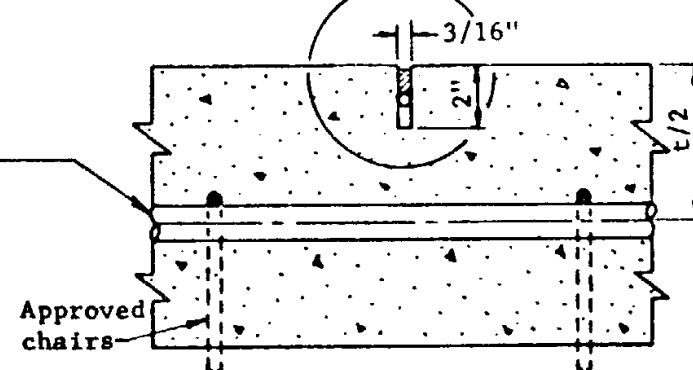


Hot poured Std. joint seal.  
3/16" max. X 2" saw cut filled as shown

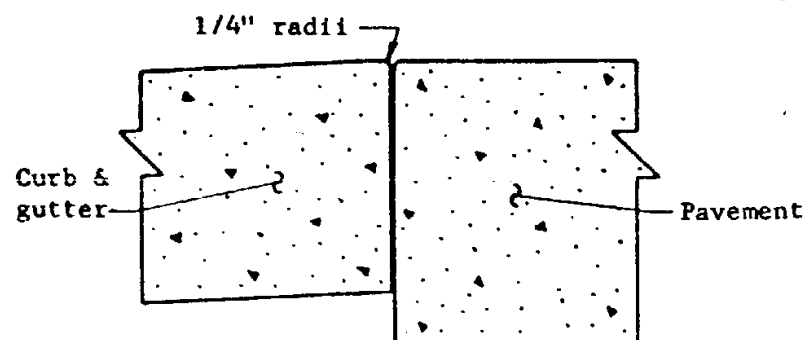


JOINT TYPE "E"

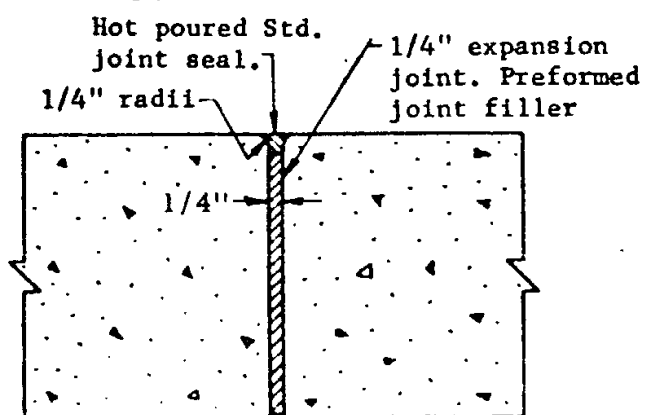
Note:  
"t" indicates pavement thickness



JOINT TYPE "F"



JOINT TYPE "G"



JOINT TYPE "H"

LONGITUDINAL JOINT DETAILS

# GENERAL NOTES

All bars used in joints shall be deformed. They shall be held securely in place, parallel to the subgrade and perpendicular to roadway centerline.

All formed longitudinal joints shall be finished with an edging tool not less than 1'-0" wide and 1'-6" long.

In slip form type pavement construction, Longitudinal Joint Type "F" shall be used. In fixed form type construction either Longitudinal Joint Type "E" or "F" may be used.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

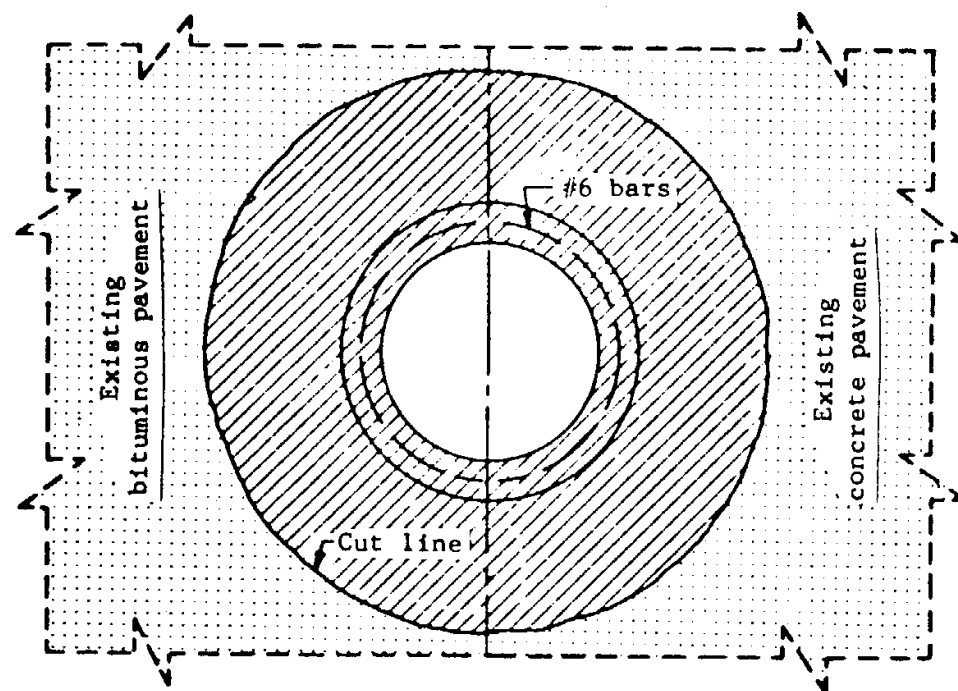
PORTLAND CEMENT  
CONCRETE PAVEMENT  
LONGITUDINAL JOINTS

Drawn O.K.  
Traced R.A.F. 12-66  
Checked J.P.O. JPO 5-68  
Approved Engr. Plans H. H. H. 5-68

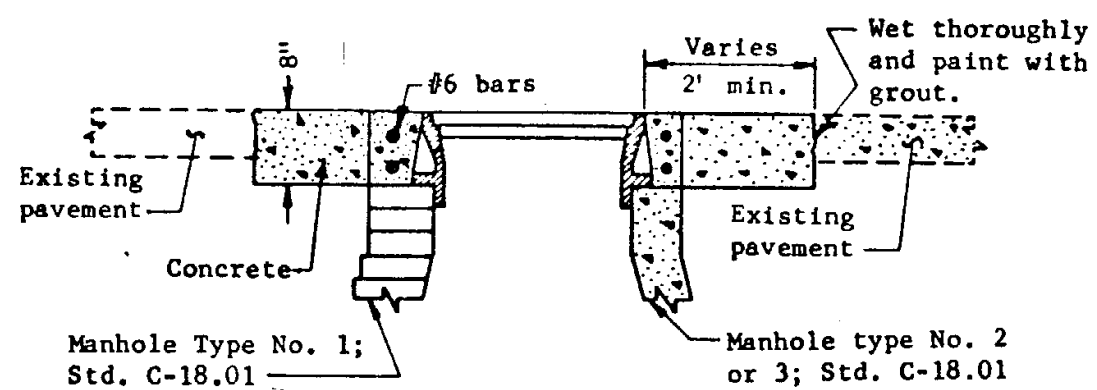
Drawing No.

C-7.02

Rev.

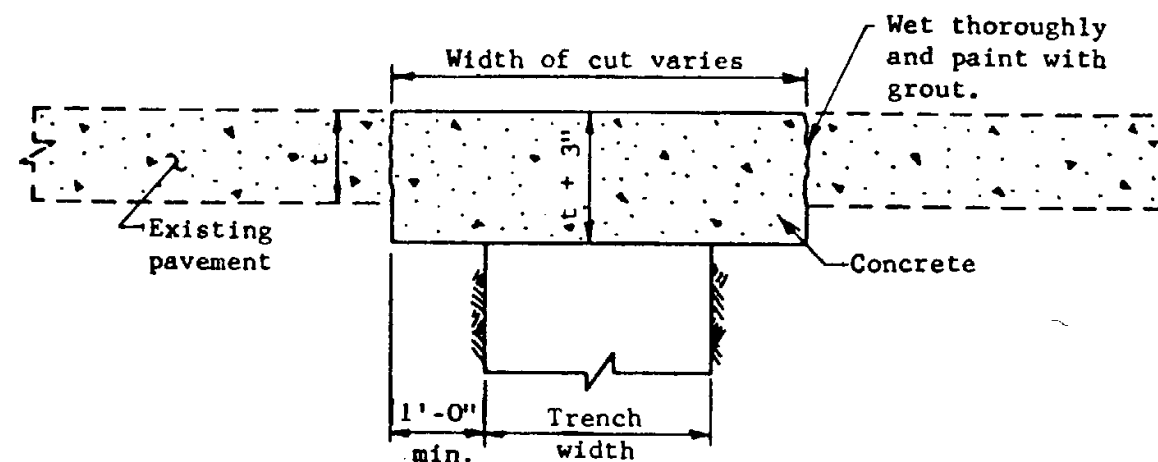


PLAN

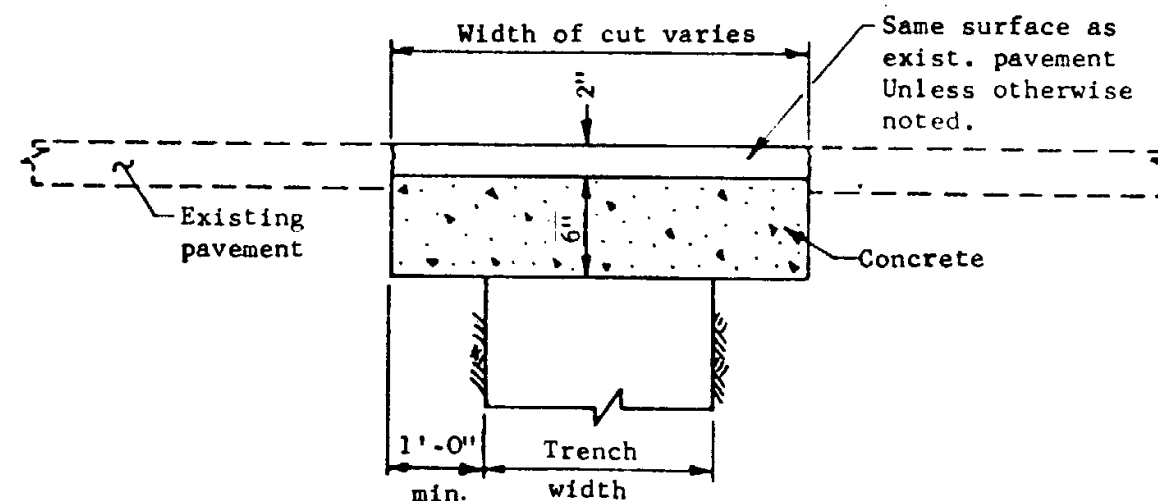


SECTION

PAVEMENT CUT REPLACEMENT FOR MANHOLE



CUT IN CONCRETE PAVEMENT

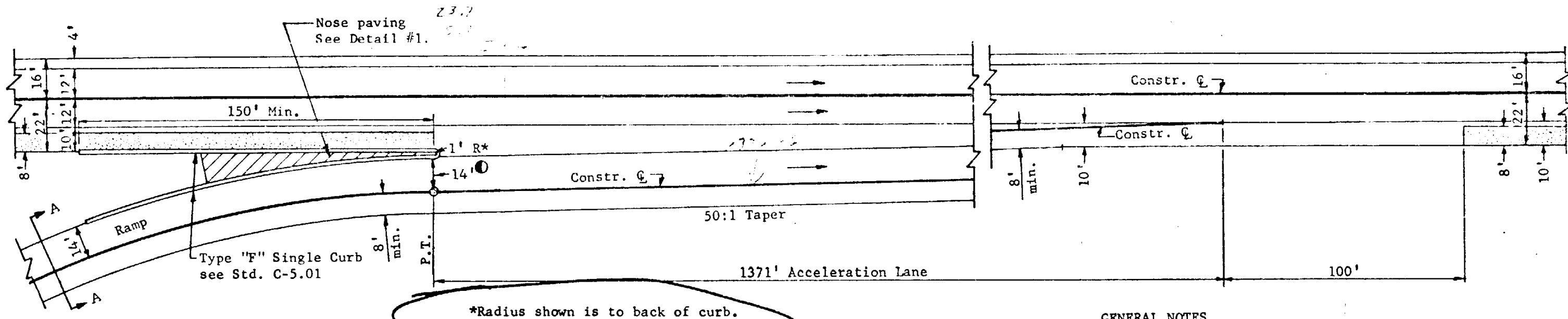


CUT IN BITUMINOUS PAVEMENT

GENERAL NOTES  
All concrete shall be Class A.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
PAVEMENT CUT REPLACEMENT			
Drawn	O.K.	Drawing No.  C-7.03	
Traced	R.A.F. 12-5-66		
Checked	J.P.O. <i>JPO 5-68</i>		
Approved Engr. Plans	<i>H. H. H. H. H. 5-68</i>		



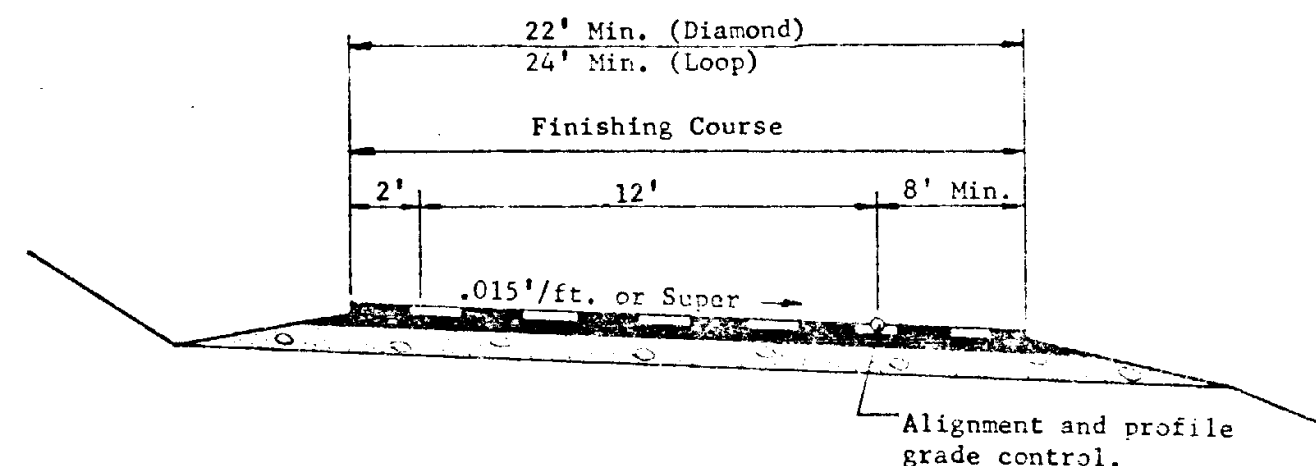
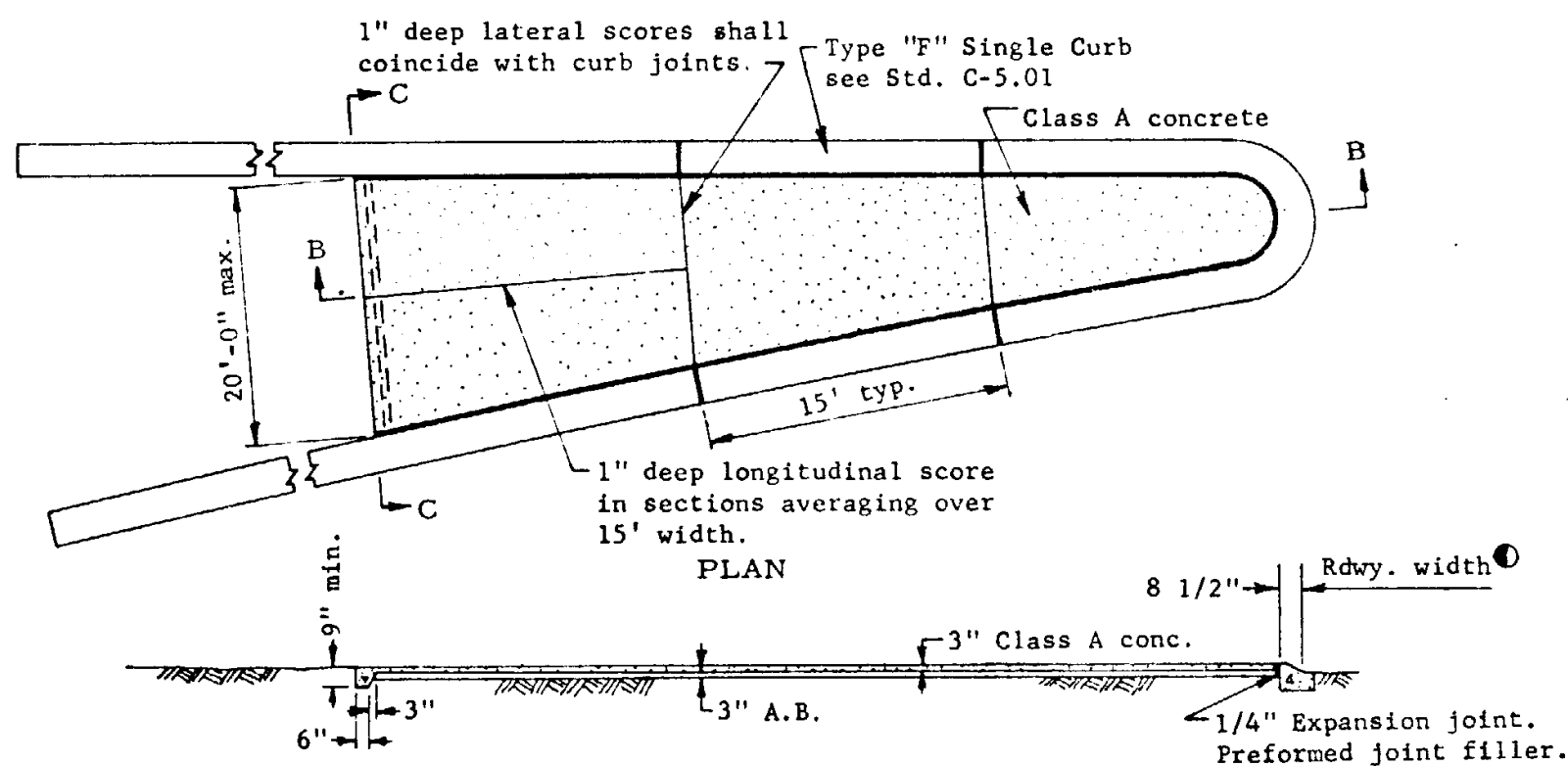


**GENERAL NOTES**

The 50:1 taper and corresponding offsets shall also apply when the main roadway has curvature or combined tangent and curvature.

Shaded areas indicate differential shoulder delineation.

See Pavement Marking Standards for stripe details.



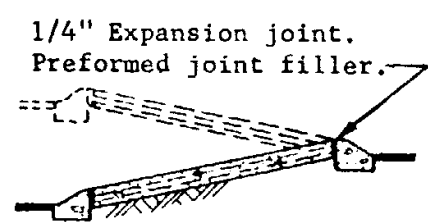
**SECTION A-A**

Base course and paving shall be as shown on the plans.

**SECTION B-B**

**NOTE:** All joints and scores shall be edged with a 1/4" radius tool.

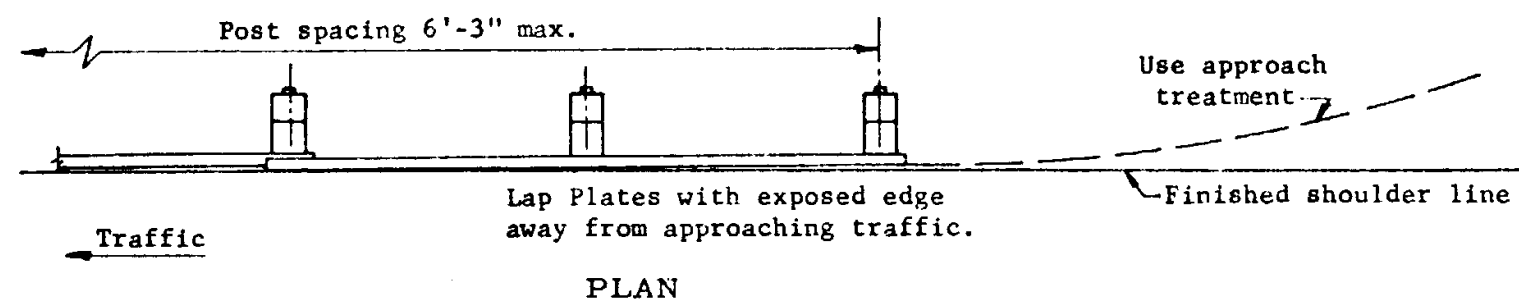
Extend nose paving to a 20' max. width or 30' in length measured from the nose, but in no case shall the paving extend beyond curb end.



**SECTION C-C**

**DETAIL #1 - NOSE PAVING**

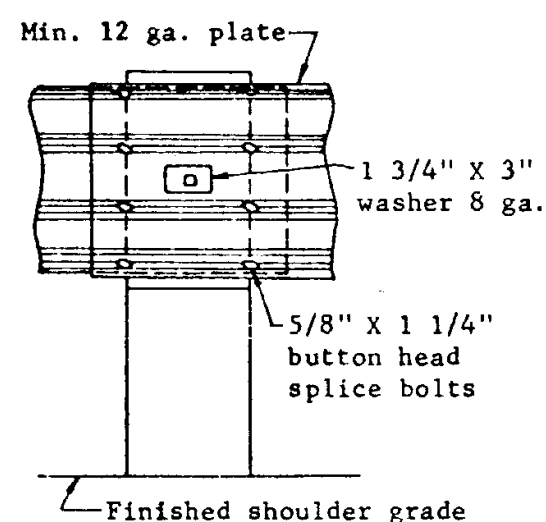
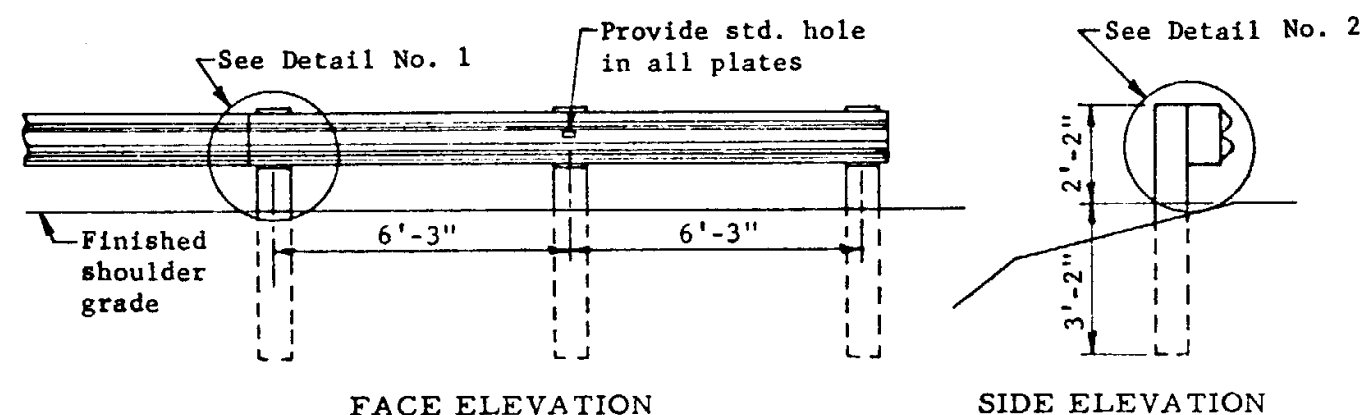
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
TYPICAL ENTRANCE RAMP TERMINAL			
Drawn	C.B. 3-68	Drawing No. <b>C-8.02</b>	
Traced	S.L.T. 8-67		
Checked	J.P.O. 9-68		
Approved Engr. Plans	K. Hinderker 5-68		



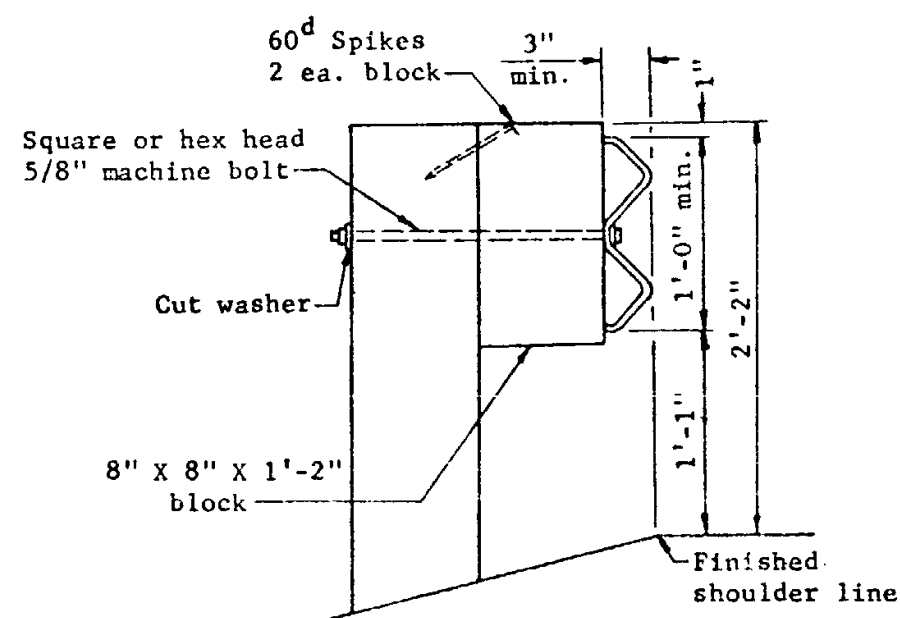
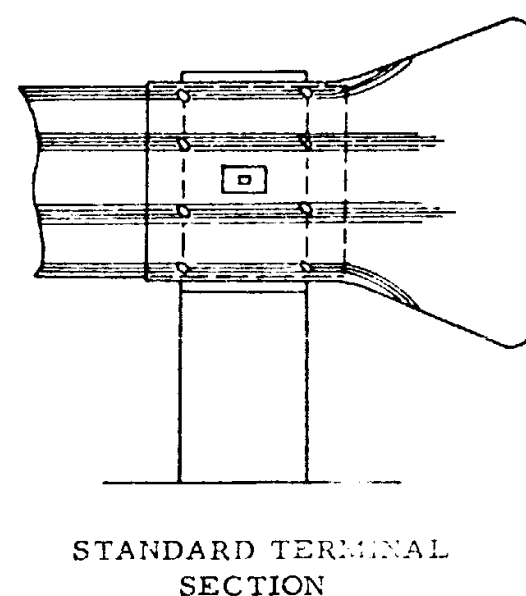
**GENERAL NOTES**

Posts and blocks shall be nominal 8" X 8" rough, pressure treated and unpainted. Holes shall be bored before treatment.

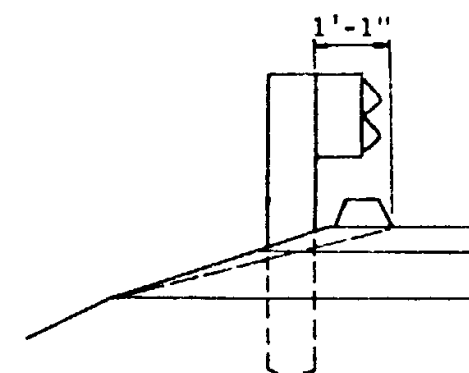
All guard rail plate, fittings, hardware, etc. shall be galvanized.



DETAIL NO. 1



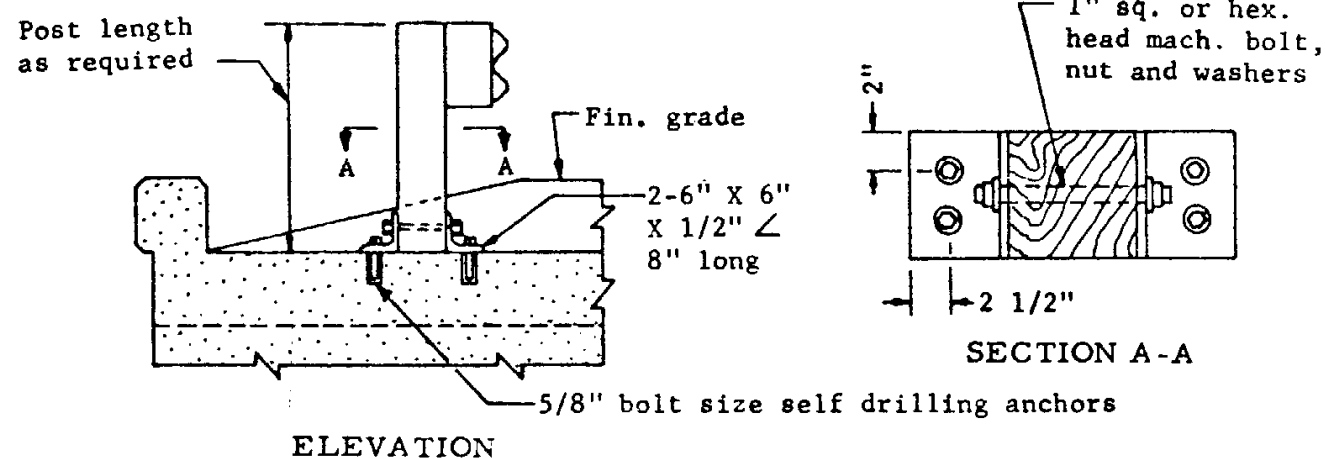
DETAIL NO. 2



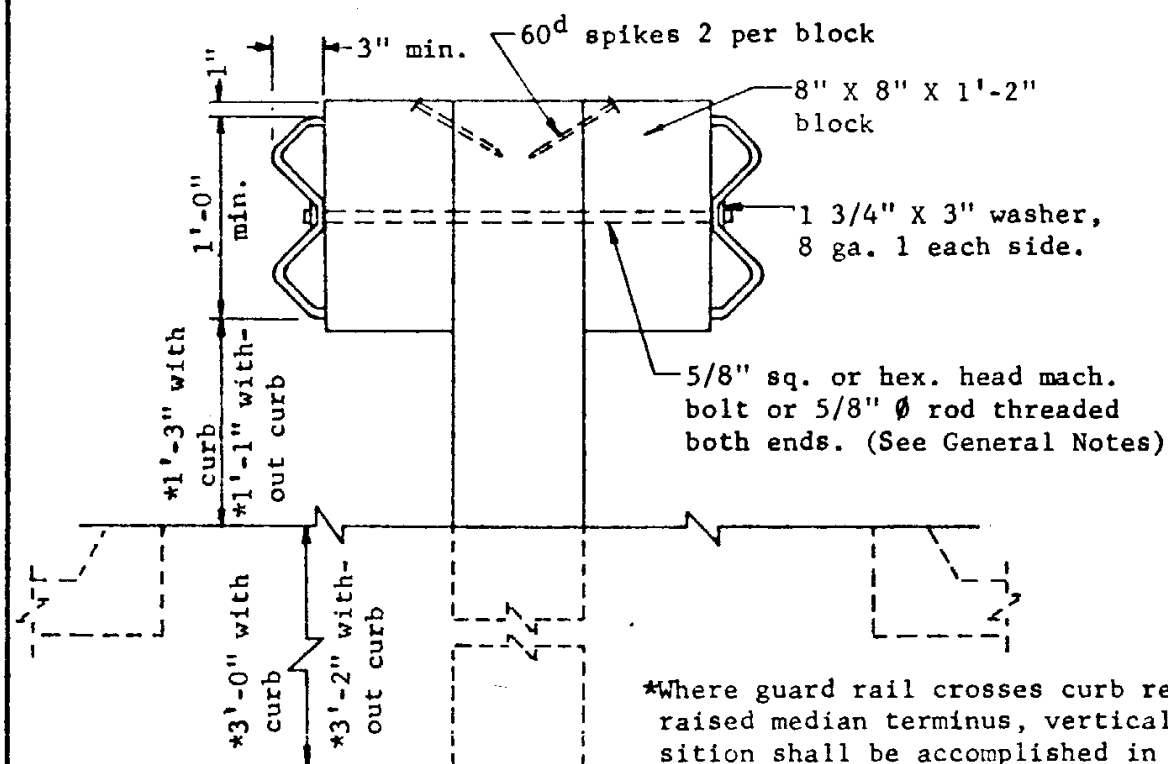
Installation of Guard Rail in embankment curb sections.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
GUARD RAIL-STEEL SINGLE FACE DETAILS			
Drawn	D.G.	Drawing No.  <b>C-10.01</b>	
Traced	S.L.T. 6-67		
Checked	J.P.O. 8/5-68		
Approved Engr. Plans	4/11/68 5-68		



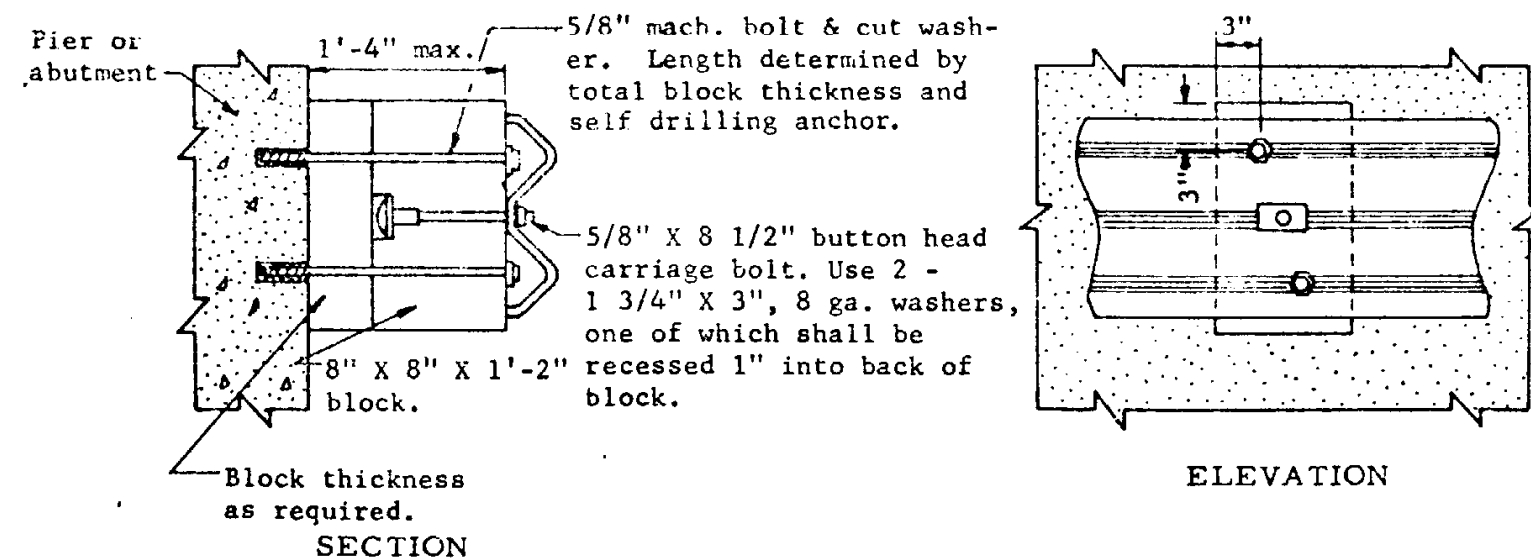


DETAIL NO. 1 - GUARD RAIL POST INSTALLATION ON STRUCTURES

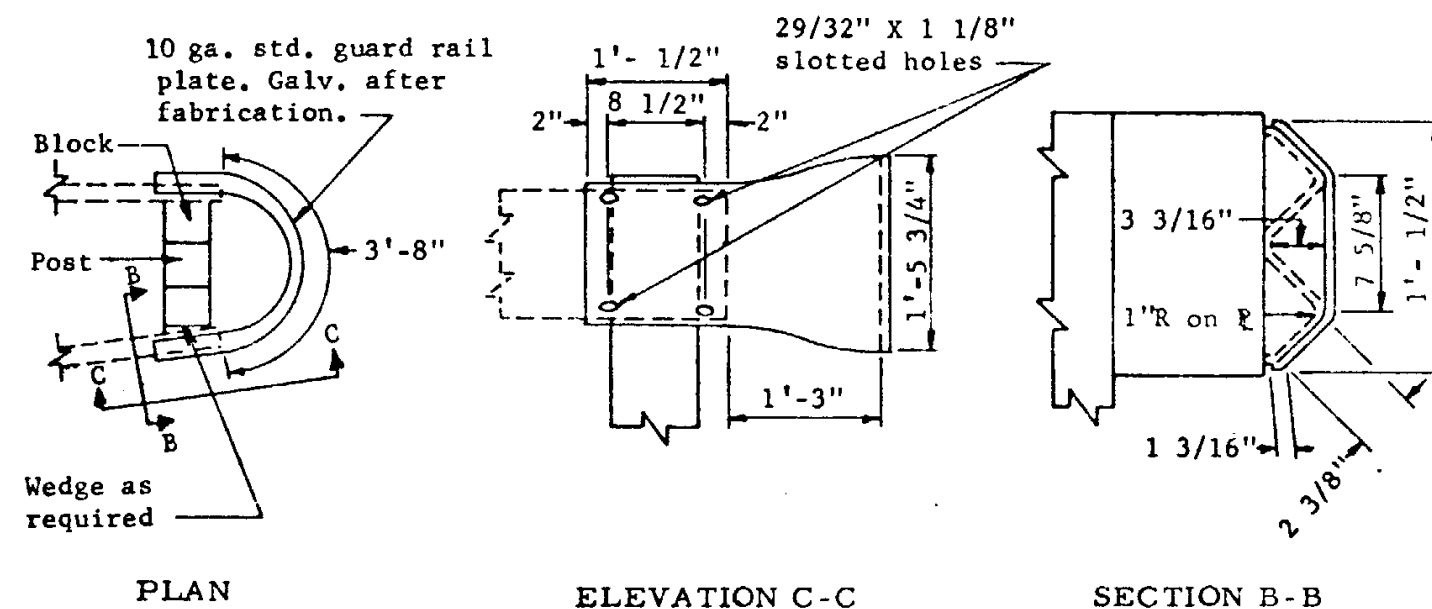


DETAIL NO. 2 - MEDIAN BARRIER

\*Where guard rail crosses curb return at raised median terminus, vertical transition shall be accomplished in 12'-6" horizontally. Ream rail bolt holes as required.



DETAIL NO. 3 - ATTACHMENT OF GUARD RAIL TO PIERS



DETAIL NO. 4 - SPECIAL TERMINAL SECTION

#### GENERAL NOTES

For other applicable guard rail details, see Std. C-10.01.

Bolt ends shall not project more than 1 1/2" beyond face of block. If adjustment shortening is required, threads shall be left in functional condition.

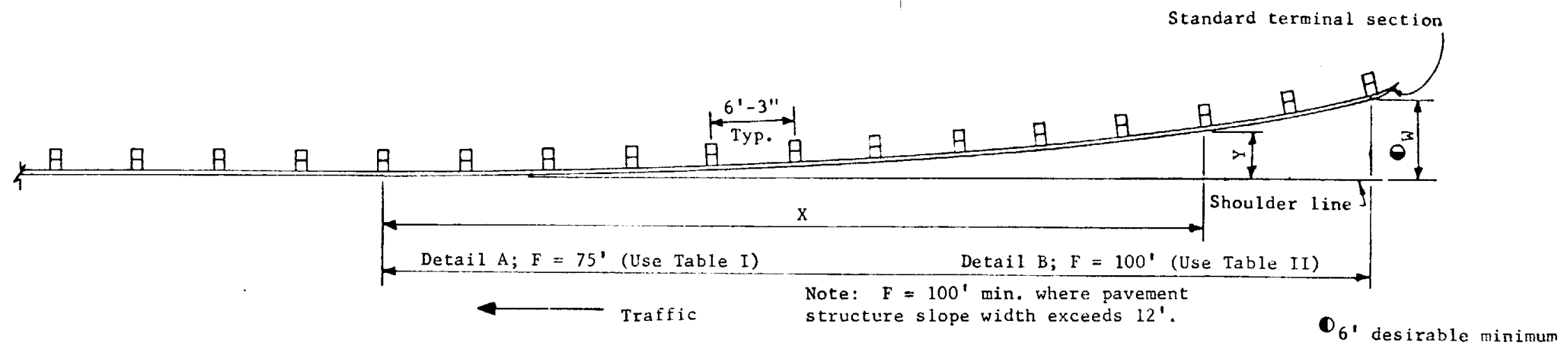
5/8" bolt size self drilling anchors shall have a min. 1500# pull out strength in 2500 p.s.i. concrete in accordance with manufacturer's specifications.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

### GUARD RAIL - STEEL MISCELLANEOUS DETAILS

Drawn	D.G. 5-67	Drawing No. <b>C-10.02</b>
Traced	S.L.T. 9-67	
Checked	J.P.O. 8/20/68	
Approved Engr. Plans	5/6/68	

Rev



#### GENERAL NOTES

When the value of W and/or F is different than values shown in the tables, use the formula to compute applicable Y values.

Where necessary, dimension F may be increased to provide better alignment and grade.

TABLE I

X	Y (Feet)			
	W			
	3'-0"	4'-0"	5'-0"	6'-0"
12'-6"	0.08	0.11	0.14	0.17
25'-0"	0.33	0.44	0.55	0.67
37'-6"	0.75	1.00	1.25	1.50
50'-0"	1.33	1.78	2.22	2.67
62'-6"	2.08	2.78	3.42	4.11
75'-0"	3.00	4.00	5.00	6.00

TABLE II

X	Y (Feet)					
	W					
	5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"
12'-6"	0.08	0.09	0.11	0.12	0.14	0.16
25'-0"	0.31	0.37	0.44	0.50	0.56	0.62
37'-6"	0.70	0.84	0.99	1.13	1.27	1.41
50'-0"	1.25	1.50	1.75	2.00	2.25	2.50
62'-6"	1.90	2.28	2.66	3.01	3.42	3.91
75'-0"	2.81	3.39	3.94	4.50	5.06	5.62
87'-6"	3.81	4.57	5.34	6.10	6.86	7.66
100'-0"	5.00	6.00	7.00	8.00	9.00	10.00

$Y = (W)X^2/F^2$  = Offset from shoulder line to guard rail.

W = Distance between shoulder line and desired location of end of guard rail.

F = Length of flared guard rail.

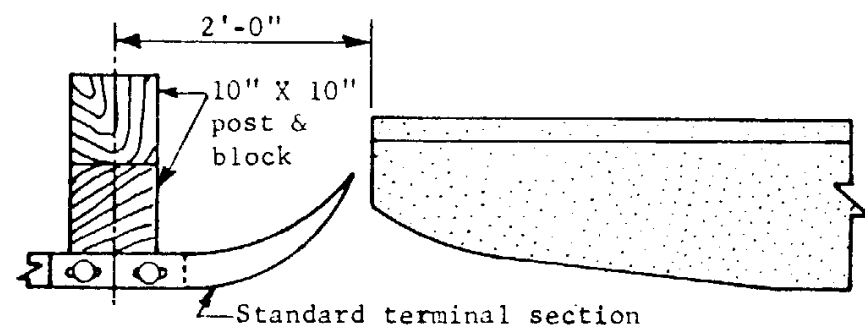
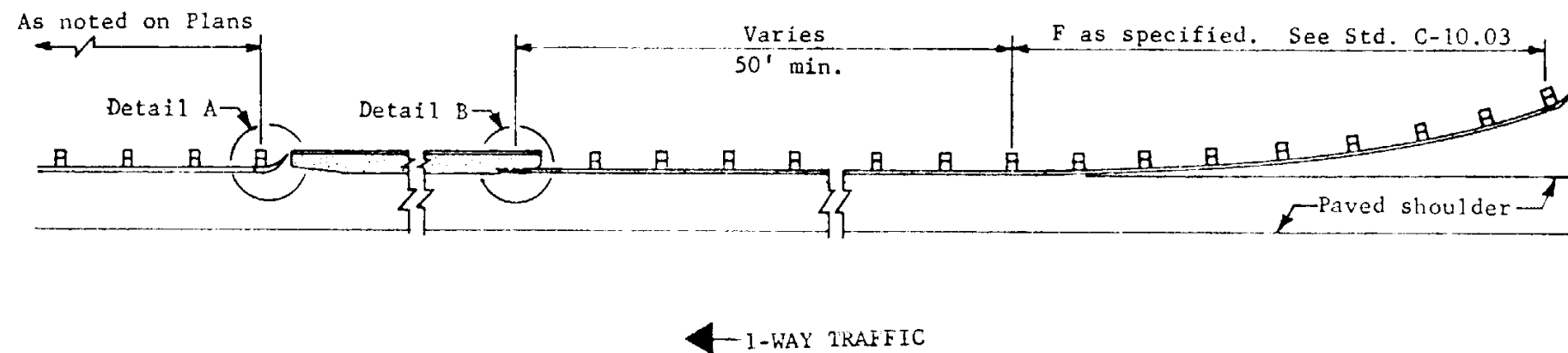
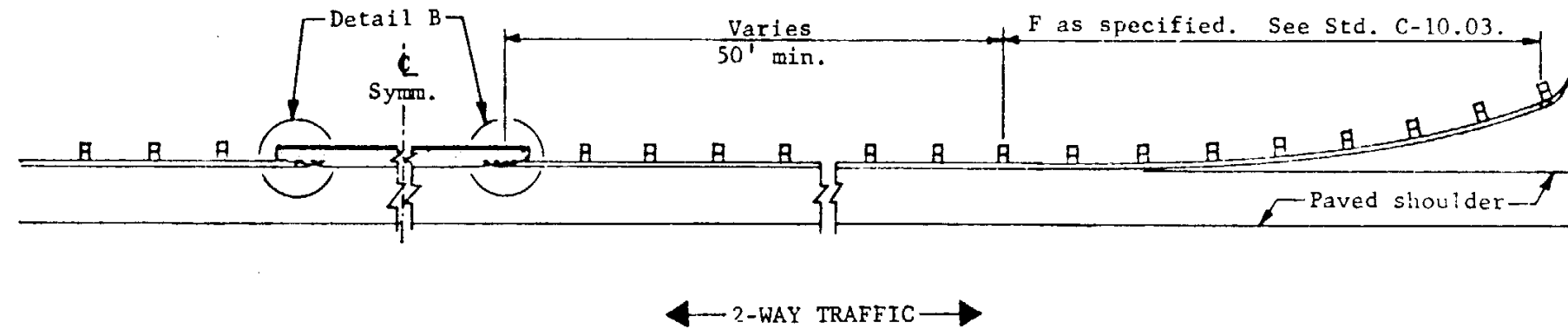
X = Distance from beginning of parabolic flare.

6'-0" indicates the preferred value.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

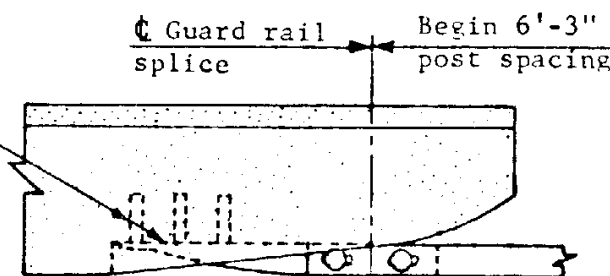
## GUARD RAIL-STEEL APPROACH END TREATMENT

Drawn	D.G.	Drawing No. <b>C-10.03</b>
Traced	D.G. 4-3-67	
Checked	J.P.O. 980 5-68	
Approved Engr. Plans	H. H. H. 5-68	



DETAIL A

Guard rail end shoe and connection bolts. See Detail C and General Notes.



DETAIL B

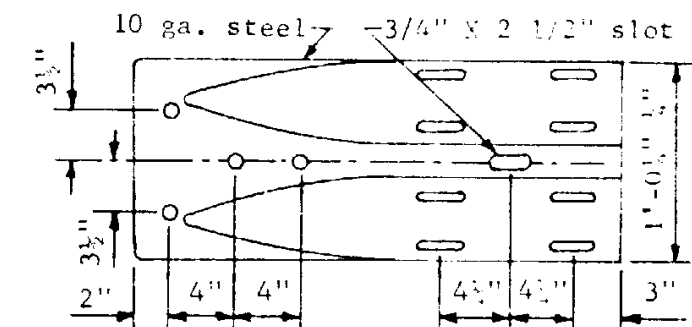
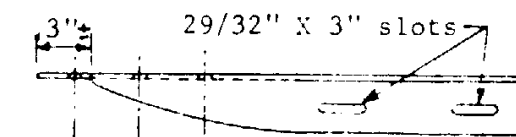
#### GENERAL NOTES

Where necessary, dimension F may be increased to provide better alignment and grade.

Connect end shoe to dado with 7/8" high strength bolts set in internally threaded tubular expansion anchors having an externally slit expansion element and a single cone expander. Tensile proof test load in 2500 p.s.i. concrete shall be 6500 lbs.

The guard rail end shoe shall be galvanized after fabrication in accordance with A.S.T.M. specification A123.

For other construction details of guard rail attachment to bridge, see Plans.



DETAIL C

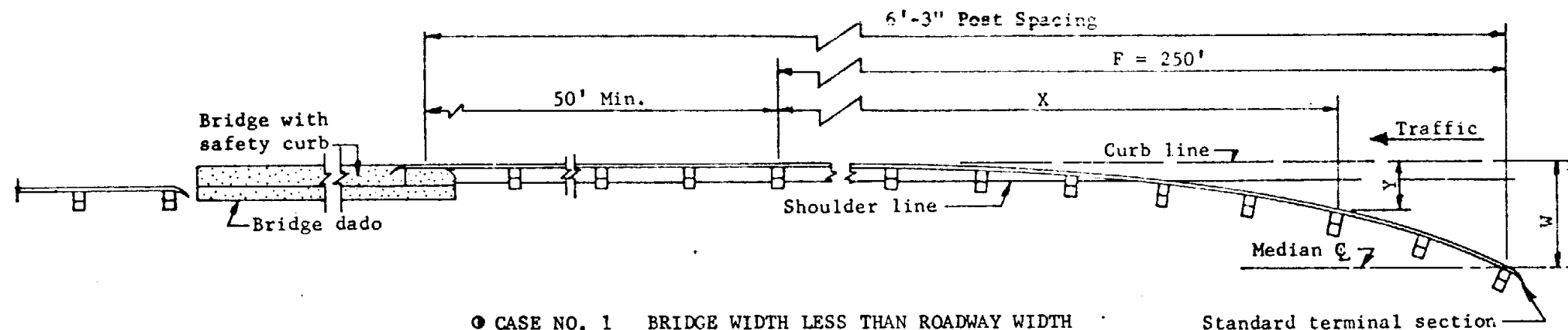
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

### GUARD RAIL-STEEL DETAIL AT BRIDGE APPROACHES

Drawn	D.G. 11-27-68	Drawing No.
Traced	D.G. 12-2-68	
Checked	J.P.O. 9/10 12-68	
Approved		
Engr. Plans	Blumhagen 12-68	

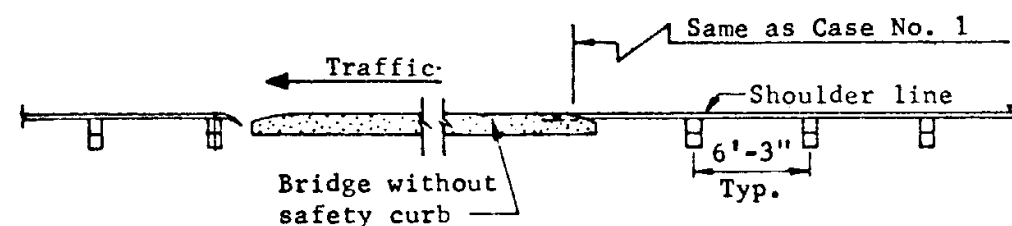
C-10.04

Rev  
12-2-68

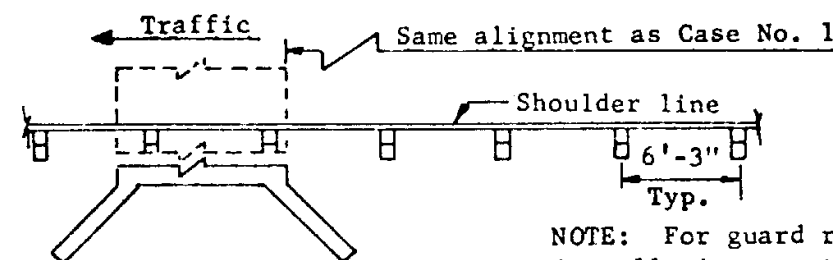


● CASE NO. 1 BRIDGE WIDTH LESS THAN ROADWAY WIDTH

Standard terminal section



● CASE NO. 2 BRIDGE WIDTH EQUALS ROADWAY WIDTH



● CASE NO. 3 BOX CULVERT

● One way roadway shown. For two way roadway, use symm. guard rail flare and fixed dado attachment at trailing end of bridge.

X	Y(Feet)				
	W				
	26'	30'	34'	38'	42'
12'-6"	.065	.075	.085	.095	.105
25'-0"	.260	.300	.340	.38	.42
37'-6"	.585	.675	.765	.86	.95
50'-0"	1.040	1.200	1.360	1.52	1.68
62'-6"	1.625	1.875	2.125	2.38	2.63
75'-0"	2.340	2.700	3.060	3.42	3.78
87'-6"	3.185	3.675	4.165	4.66	5.15
100'-0"	4.16	4.800	5.440	6.08	6.72
112'-6"	5.265	6.075	6.885	7.70	8.51
125'-0"	6.500	7.500	8.500	9.50	10.50
137'-6"	7.865	9.075	10.285	11.50	12.71
150'-0"	9.360	10.800	12.240	13.68	15.12
162'-6"	10.985	12.675	14.365	16.06	17.75
175'-0"	12.740	14.700	16.660	18.62	20.58
187'-6"	14.625	16.875	19.125	21.38	23.63
200'-0"	16.640	19.200	21.760	24.32	26.88
212'-6"	18.785	21.675	24.565	27.46	30.35
225'-0"	21.060	24.300	27.540	30.78	34.02
237'-6"	23.465	27.075	30.685	34.28	37.88
250'-0"	26.00	30.00	34.00	38.00	42.00

Formula:  $Y = (W) \frac{X^2}{F^2}$

W = Distance between curb line extended (Case No. 1), or shoulder line (Case Nos. 2 & 3), and median center line.

F = Length of flared portion of guard rail.

X = Distance from beginning of parabolic flare to any 12'-6" multiple of parabolic flare.

Y = Offset from curb line or shoulder line to face of guard rail.

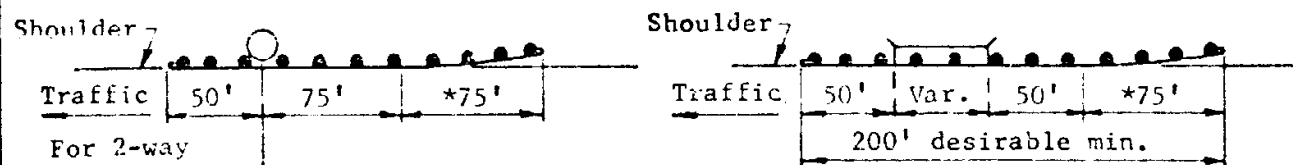
#### GENERAL NOTES

When the value of W and/or F is different than values shown in the table, use the formula to compute applicable Y values.

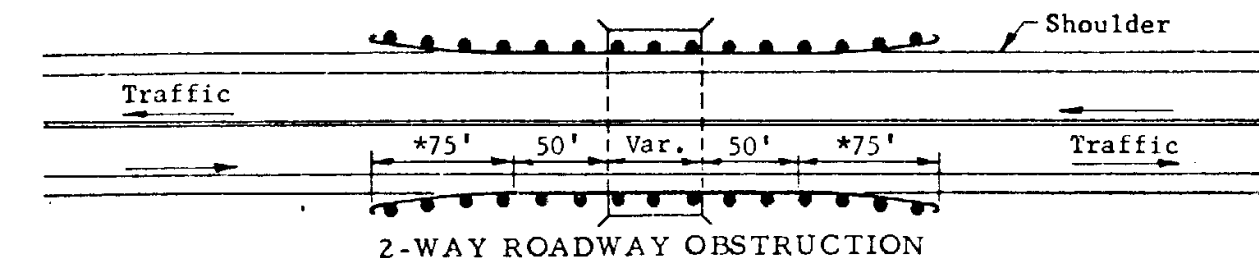
For construction details of guard rail attachment to bridge, see Std. C-10.04 and Plans.

Where necessary, dimension F may be increased to provide better alignment and grade.

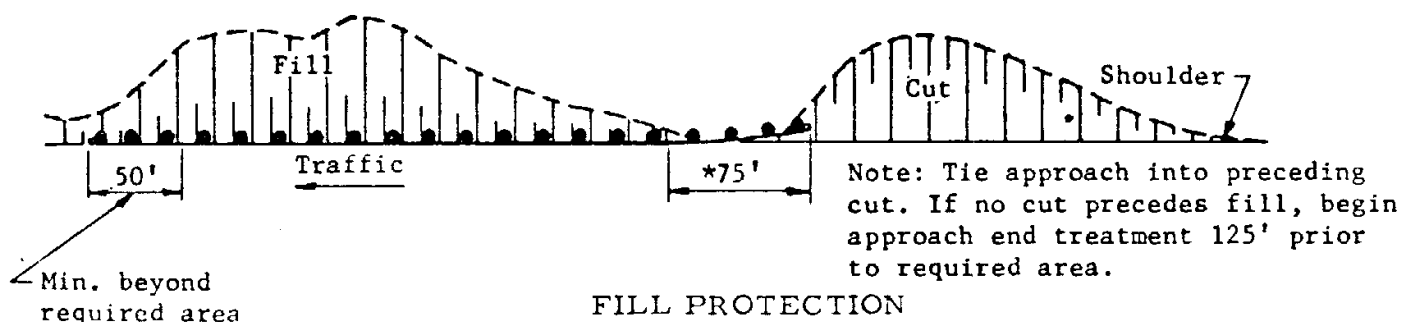
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
GUARD RAIL-STEEL FLARE TO MEDIAN		
Drawn	D.G.	Drawing No.  <b>C-10.05</b>
Traced	S.L.T. 9-67	
Checked	J.P.O. 9PO 5-68	
Approved Engr. Plans	<i>[Signature]</i>	



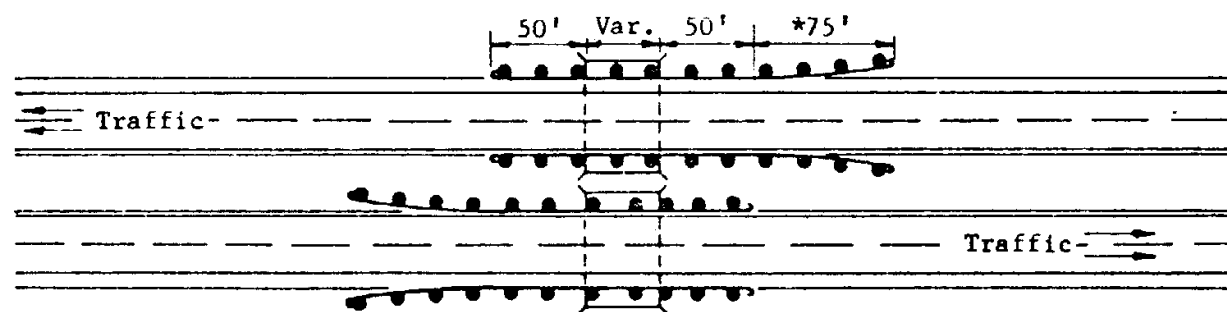
ISOLATED INSTALLATION  
1-Way Roadway



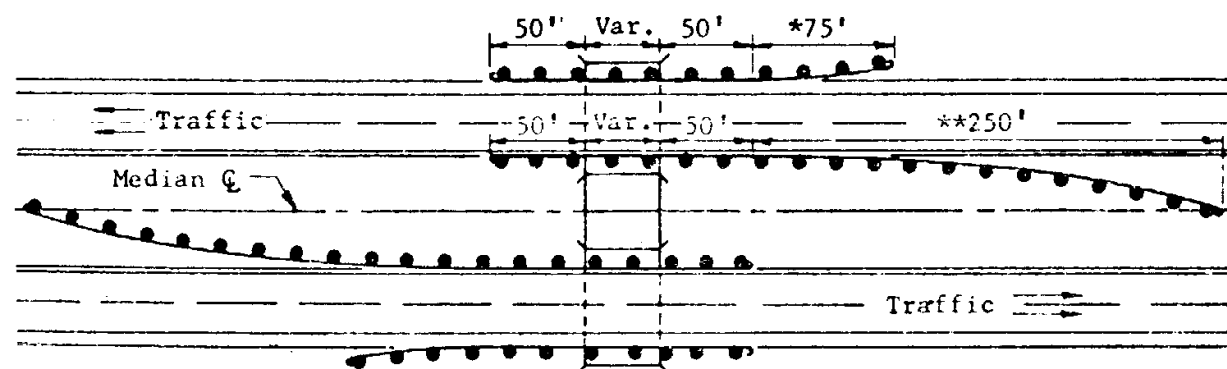
2-WAY ROADWAY OBSTRUCTION



FILL PROTECTION

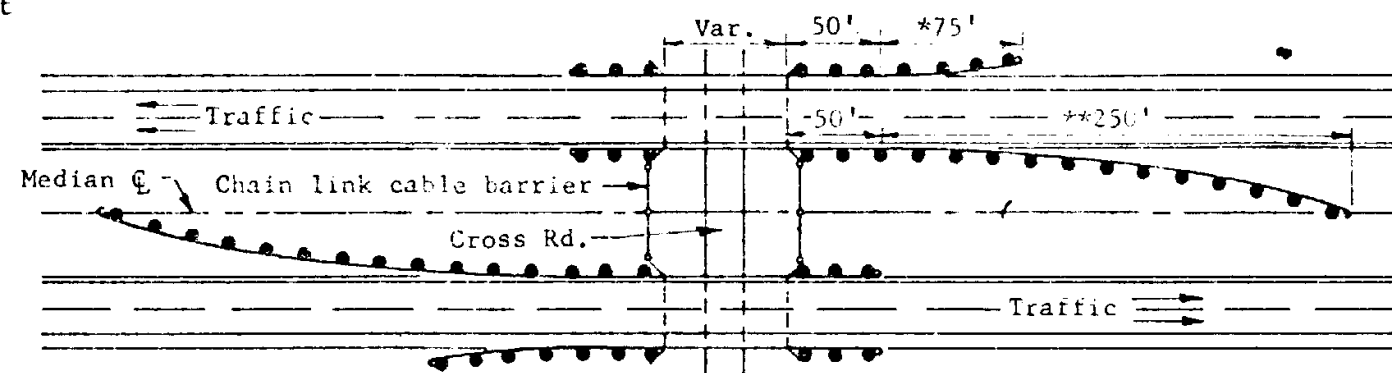


BOX CULVERT WITH DRIVABLE MEDIAN



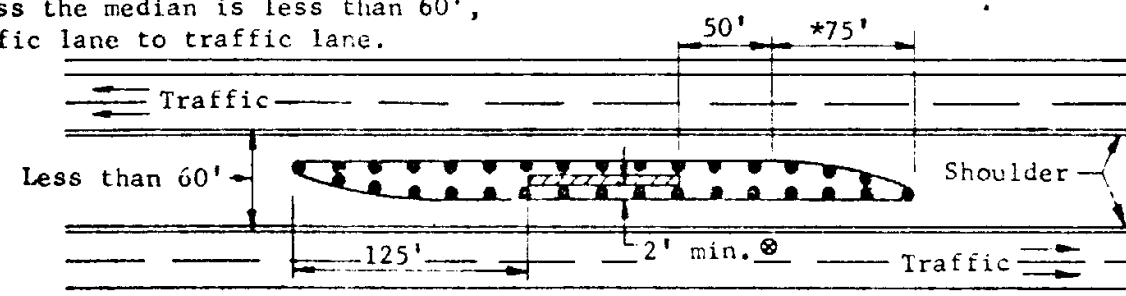
BOX CULVERT WITHOUT DRIVABLE MEDIAN

\* Min. Std. approach  
end treatment  
\*\* Std. median  
flare



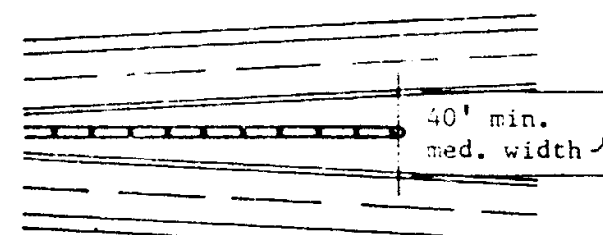
BRIDGE STRUCTURE WITH CROSS ROAD

No guard rail is normally required  
unless the median is less than 60',  
traffic lane to traffic lane.

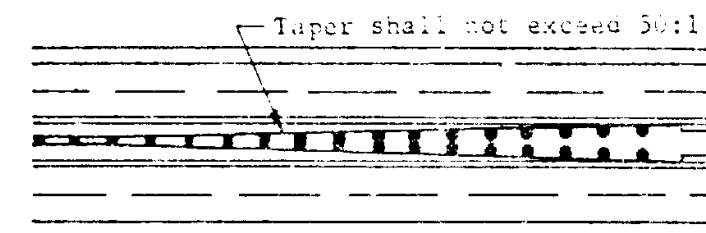


⊗ If distance from face of pier to face of  
guard rail is less than 2' attach guard  
rail to pier.

MEDIAN BRIDGE OR SIGN STANDARDS



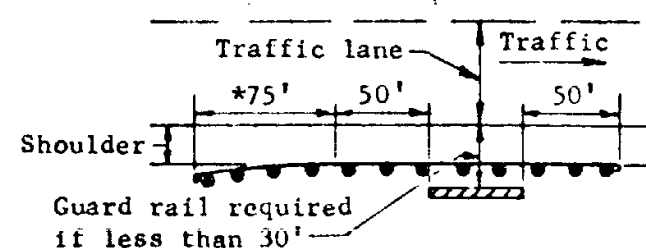
MEDIAN BARRIER TERMINUS



BARRIER TRANSITION AT OVERPASS

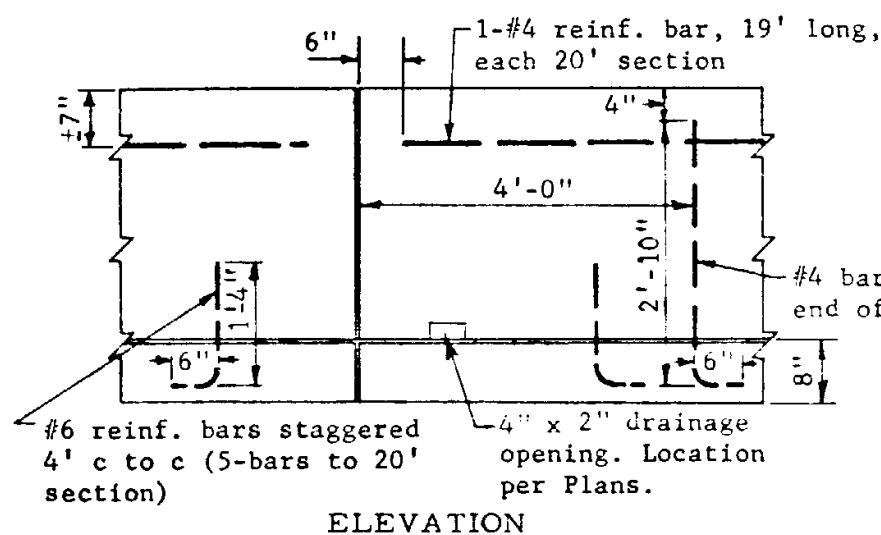
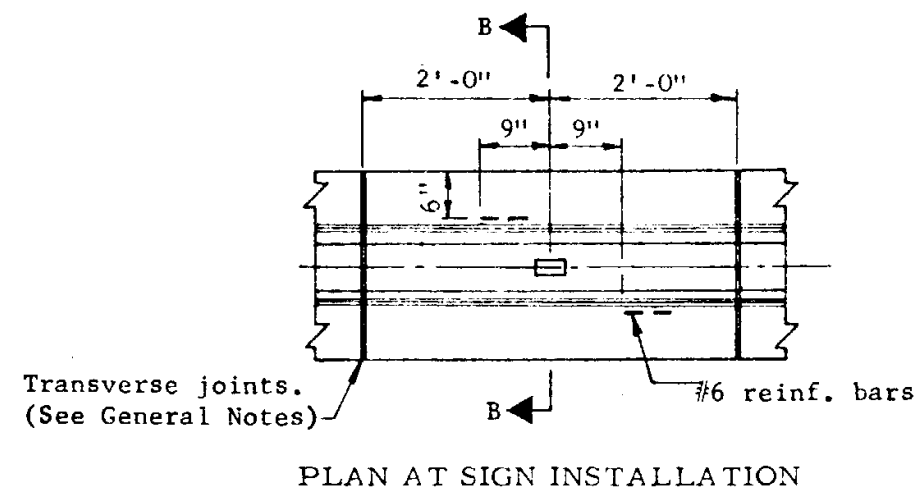
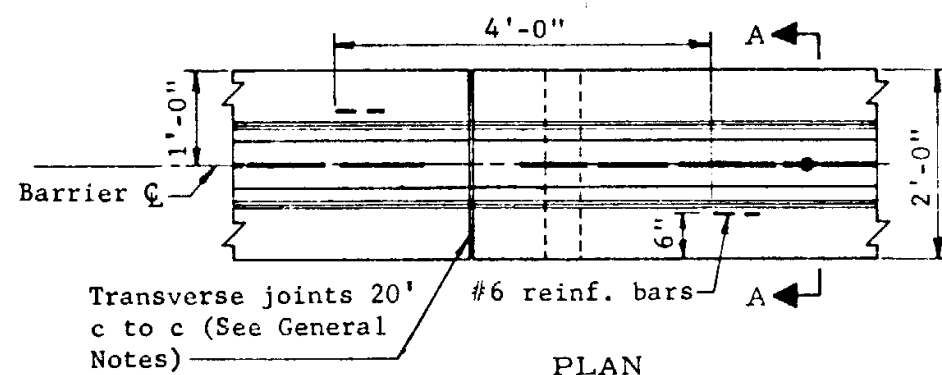
#### GENERAL NOTES

These drawings DO NOT establish warrants  
for guard rail installation.  
Post spacing shall be 6'-3" throughout.

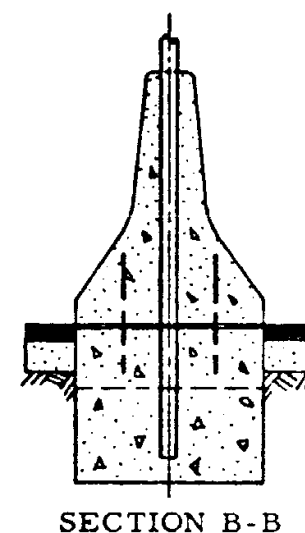
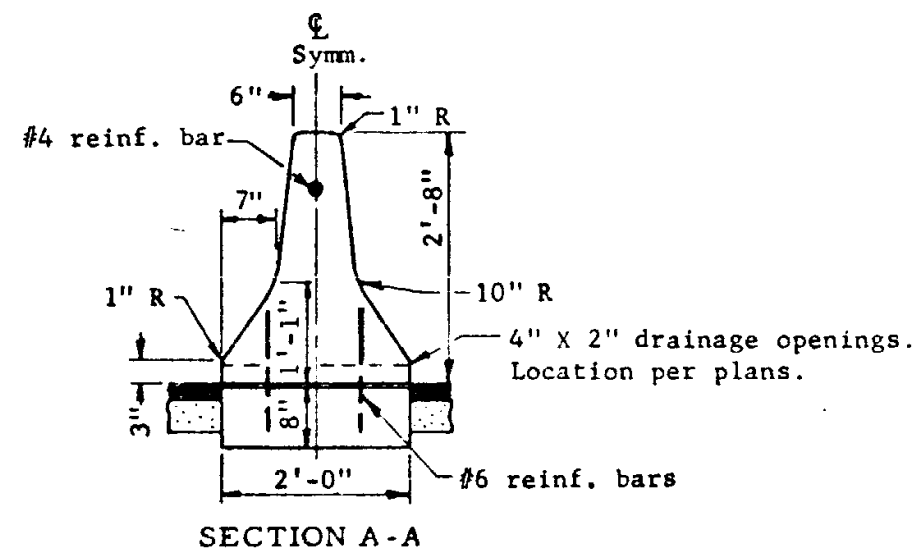
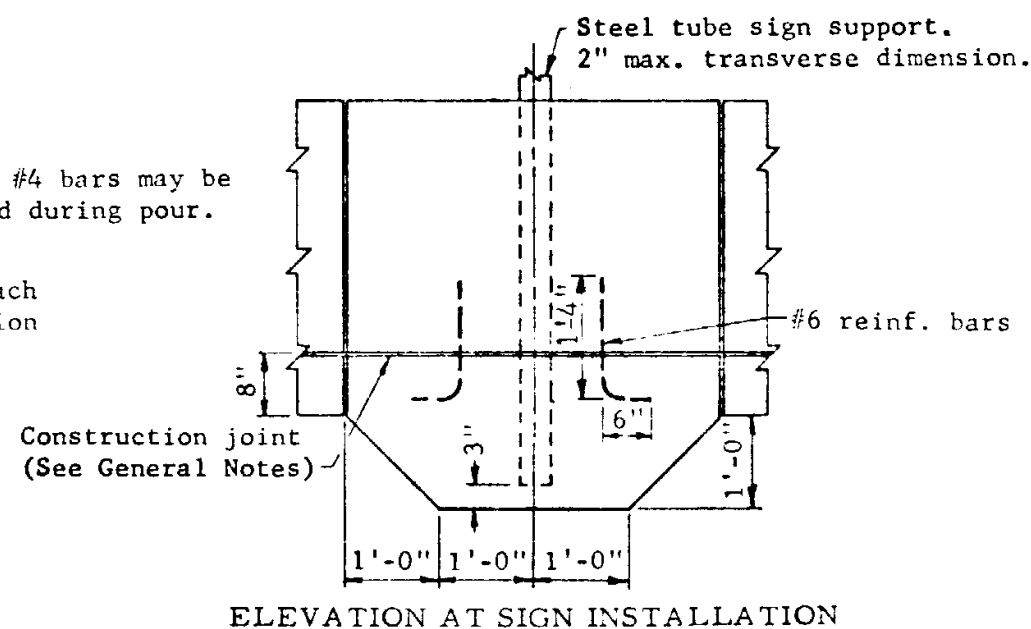


PIER, ABUTMENT OR SIGN BASE  
RIGHT SIDE OF ROADWAY

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 12-5-68
GUARD RAIL-STEEL TYPICAL INSTALLATIONS			
Drawn	S.L.T., R.A.F.	Drawing No.	
Traced	R.A.F. 9-67		
Checked	J.P.O. 8-68		
Approved			
Engr. Plans	8-68		
C-10.06			



Note: #4 bars may be placed during pour.



#### GENERAL NOTES

All concrete shall be Class A.

Transverse joints shall extend through the foundation slab. For continuous or sectional construction, use a 1/4" open joint. Edge joints with a 1/4" radius tool.

Construction joint and #6 bars may be eliminated when barrier and foundation slab are poured monolithic.

For details of transition at terminals and structures, see Std. C-10.09.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## MEDIAN BARRIER CONCRETE

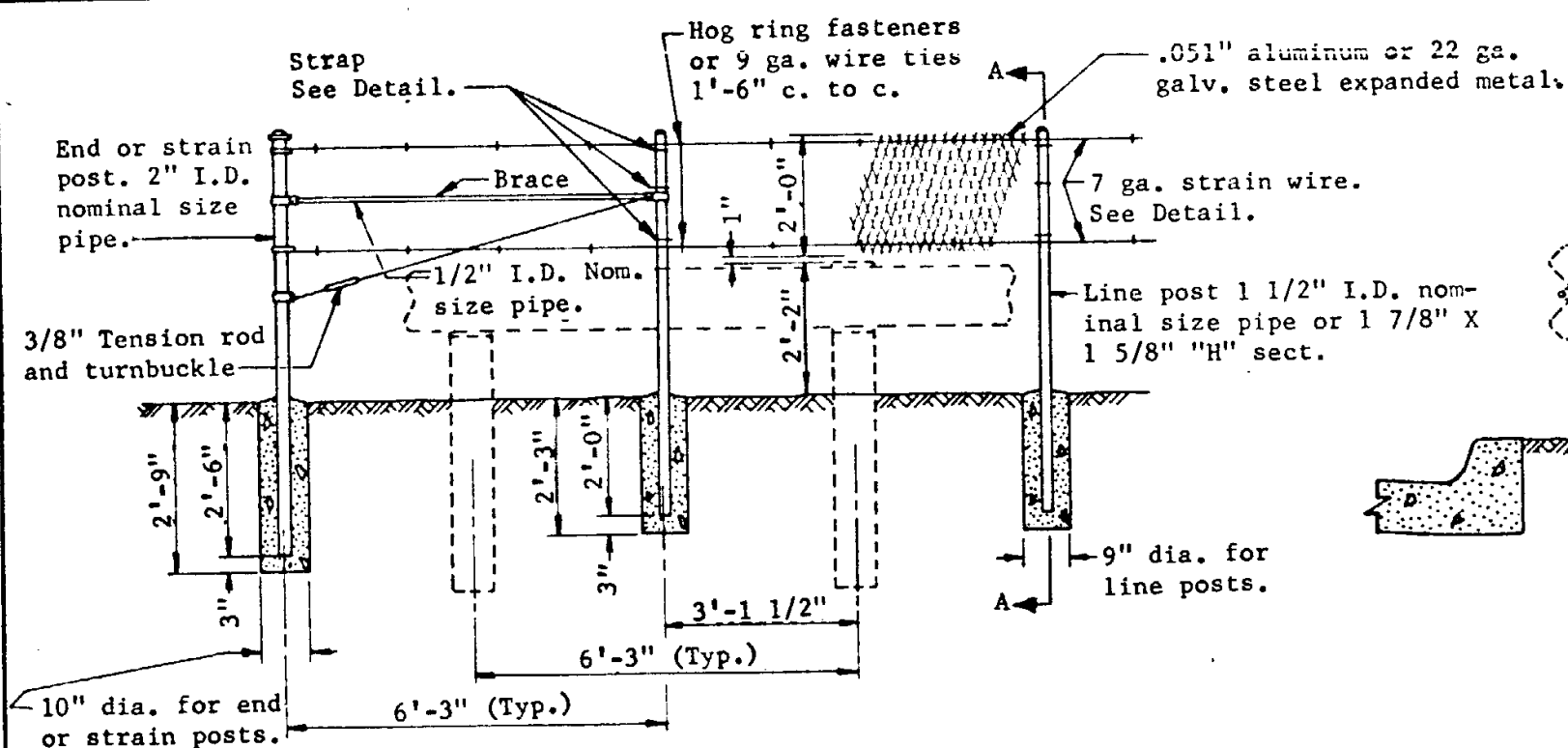
Drawn	D.G.
Traced	R.A.F. 8/67
Checked	J.P.O. 8/68
Approved	
Engr. Plans	ELM/10/10/5-68

Drawing No.

C-10.08

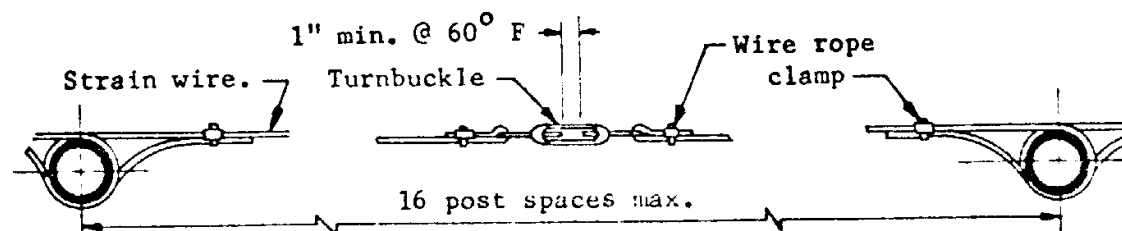
Rev



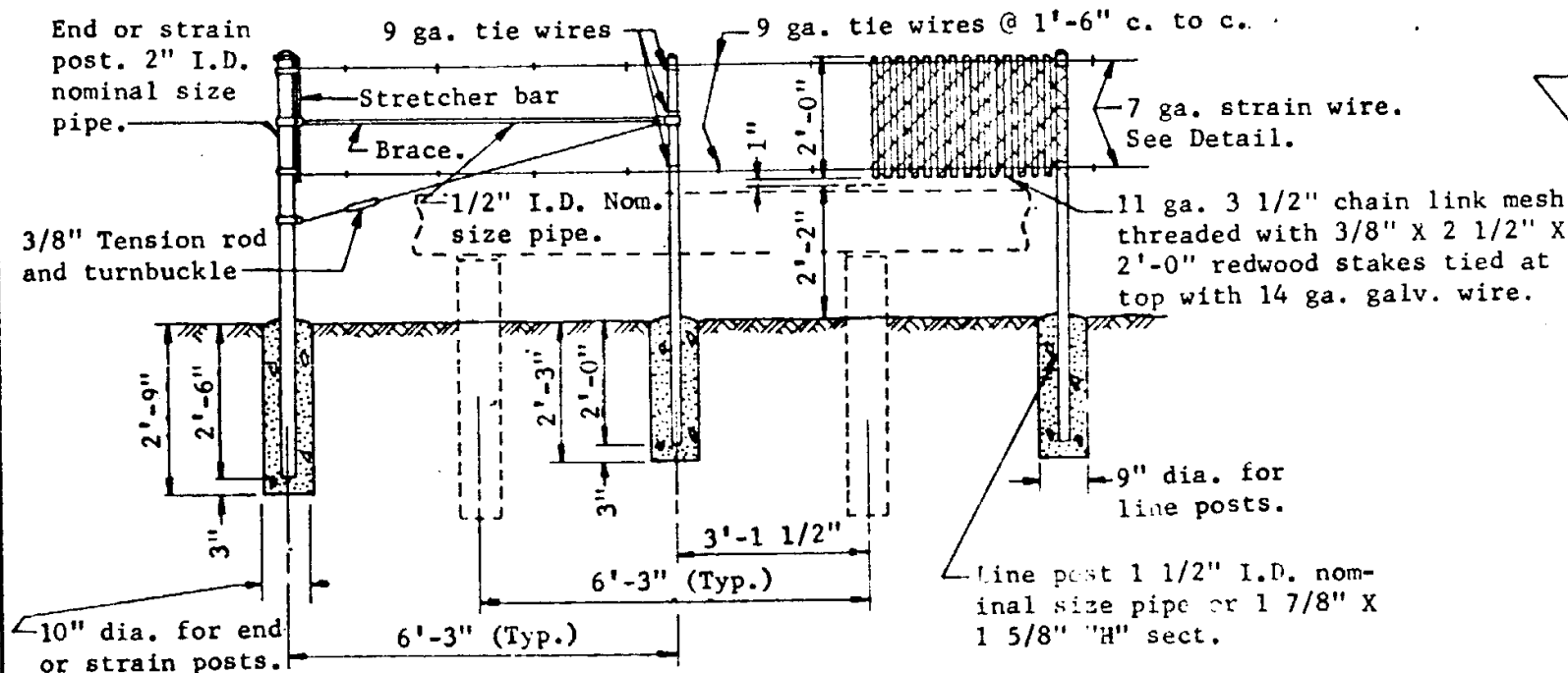


EXPANDED METAL GLARE SCREEN

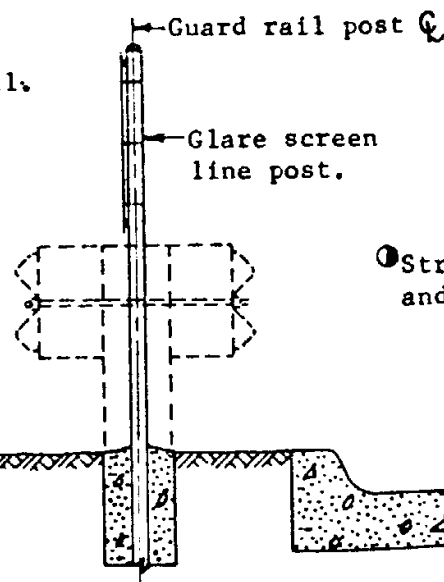
Note: Place intermediate strain posts at 500' (max.) intervals with brace and tension rod each side. If chain link fence type is used, place stretcher bar on each side.



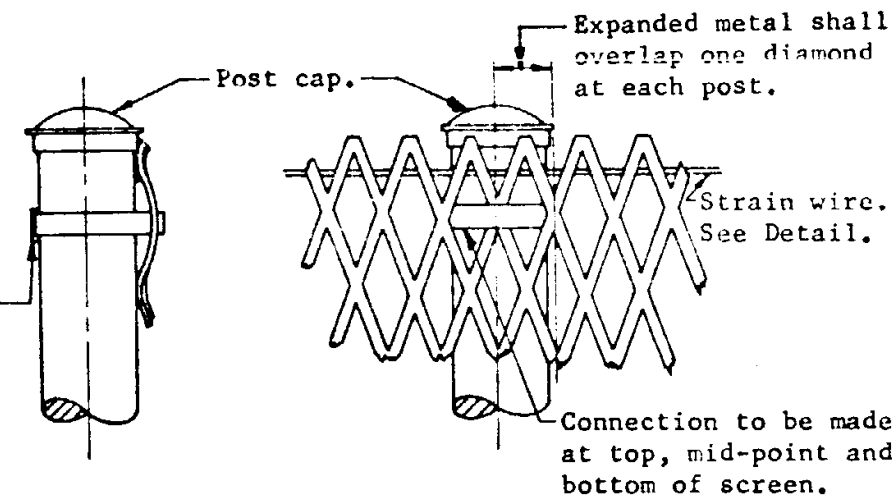
STRAIN WIRE DETAIL



CHAIN LINK FENCE GLARE SCREEN



SECTION A-A



EXPANDED METAL POST CONNECTION DETAIL  
① Stainless steel strapping with aluminum expanded metal.  
Galvanized steel strapping with steel expanded metal.

#### GENERAL NOTES

For guard rail details, see appropriate Guard Rail Standard.

There shall be no connection made between the glare screen and the guard rail.

All steel materials, except stainless, shall be galvanized in accordance with ASTM A-123.

All pipe posts shall be capped.

All concrete shall be Class A.

Expanded metal shall be 0.250" strand width with 1.33" X 4.0" bridge dimensions on tangents and 0.188" strand width with 0.93" X 2.0" bridge dimensions on curves.

ALTERNATE END POST TENSION ROD LOCATION

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

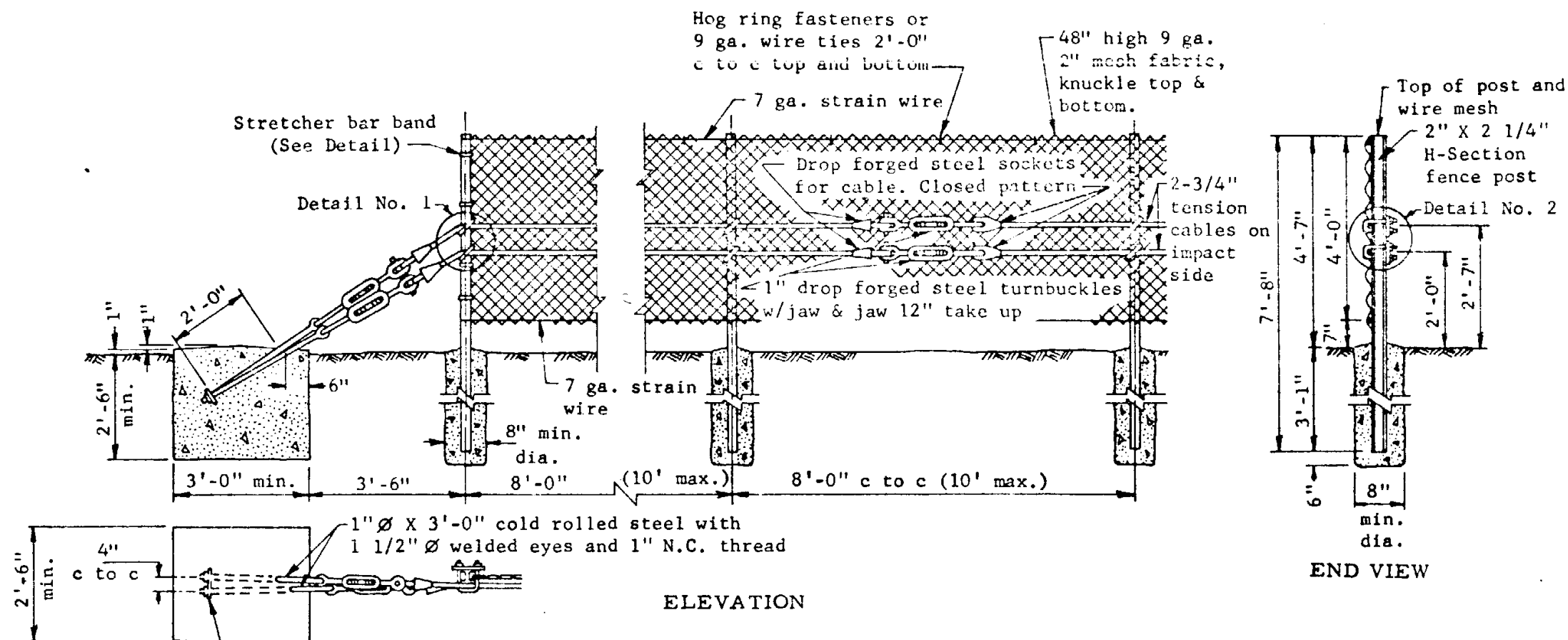
## MEDIAN GLARE SCREEN

Drawn	R.A.F.	4-67
Traced	S.L.T.	7-67
Checked	J.P.O.	9PO 5-68
Approved	Engr. Plans	

Drawing No.  
**C-10.10**

Rev





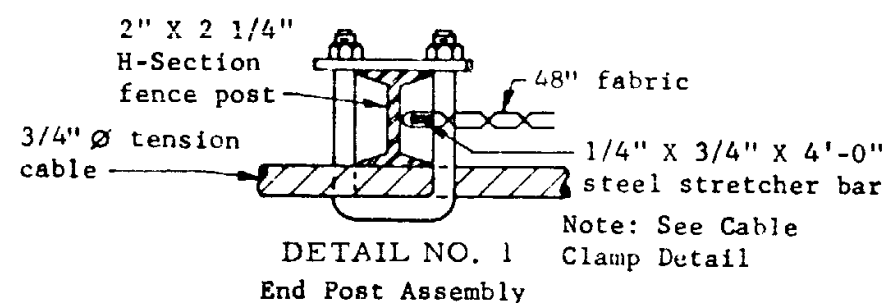
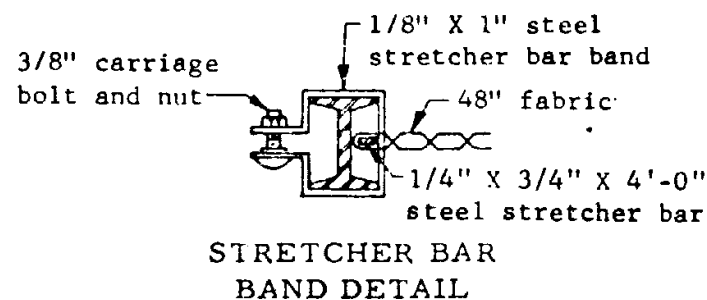
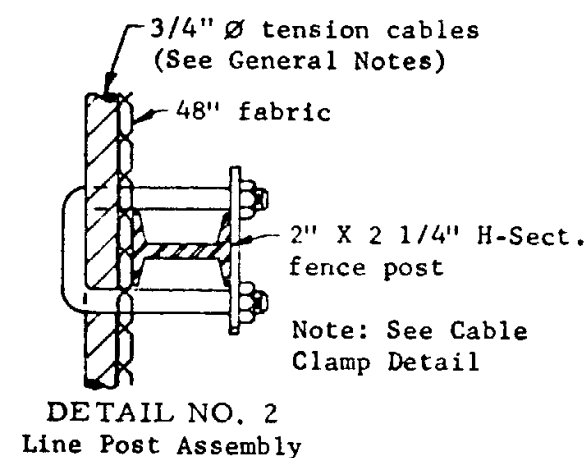
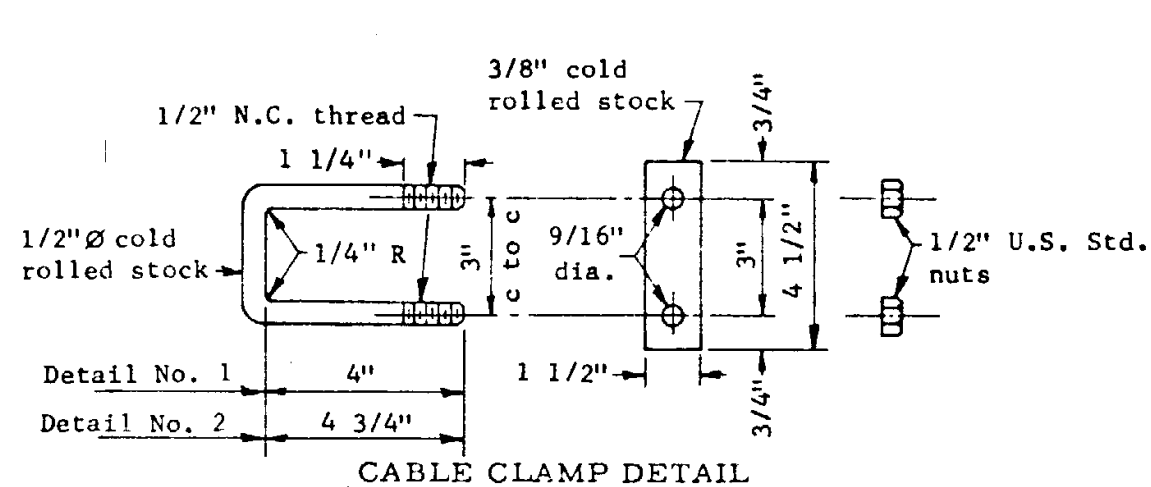
#### GENERAL NOTES

All concrete shall be Class A.

All material and fittings shall be galvanized in accordance with ASTM A 123.

3/4" tension cables shall be pre-formed, 6 X 19, hemp core, galvanized, right regular lay and of improved plow steel.

Fittings not specifically detailed shall be of approved, heavy duty design.



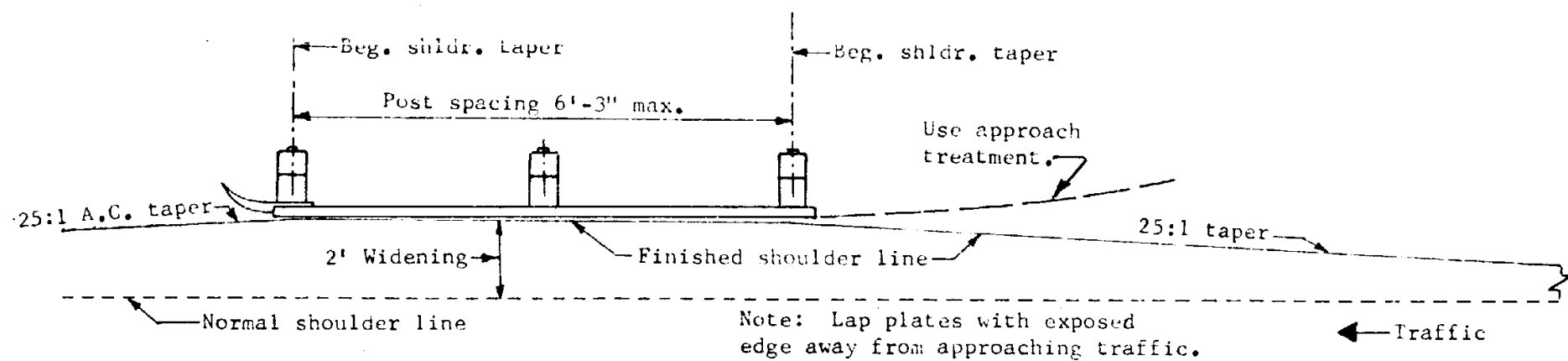
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## CHAIN LINK CABLE BARRIER FENCE

Drawn	D.G.
Traced	R.A.F. 2-68
Checked	J.P.O. 800 5-63
Approved Engr. Plans	<i>Widener</i>

Drawing No.  
**C-10.11**

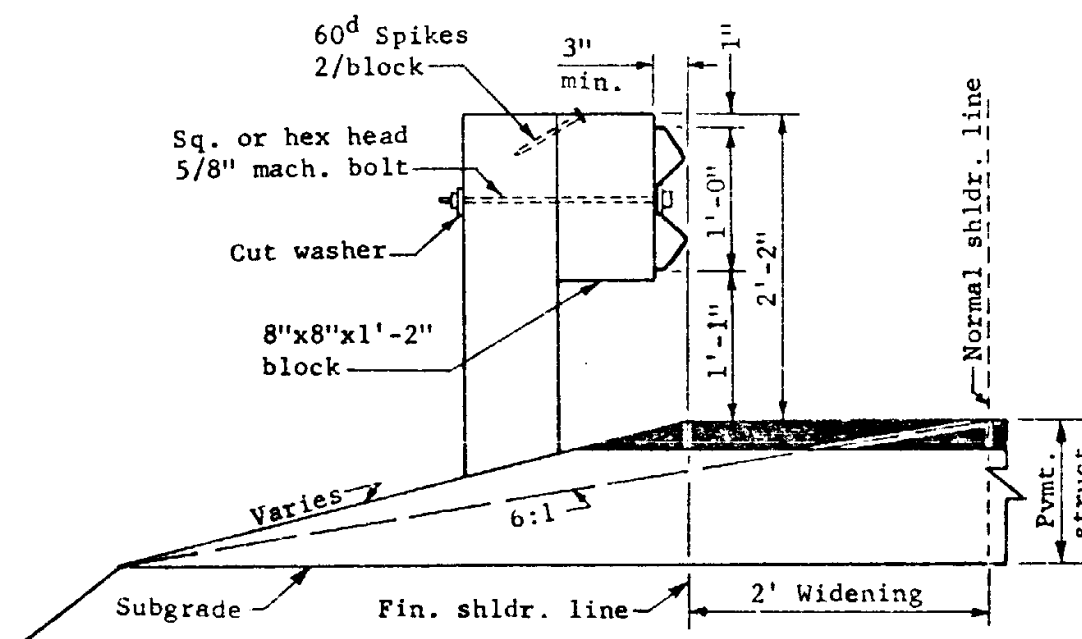
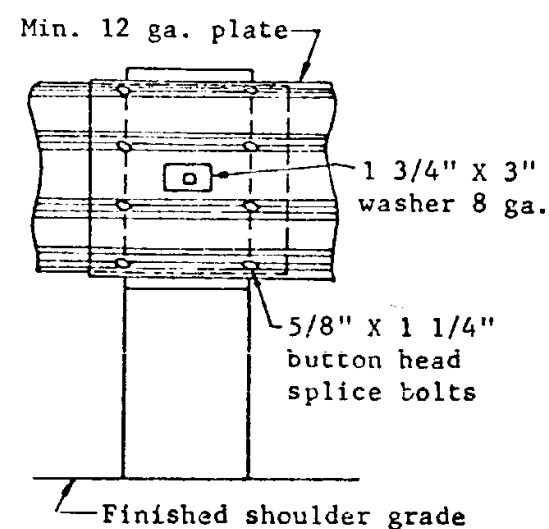
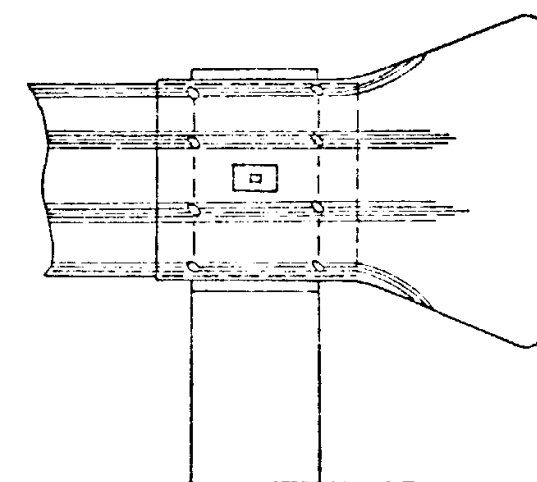
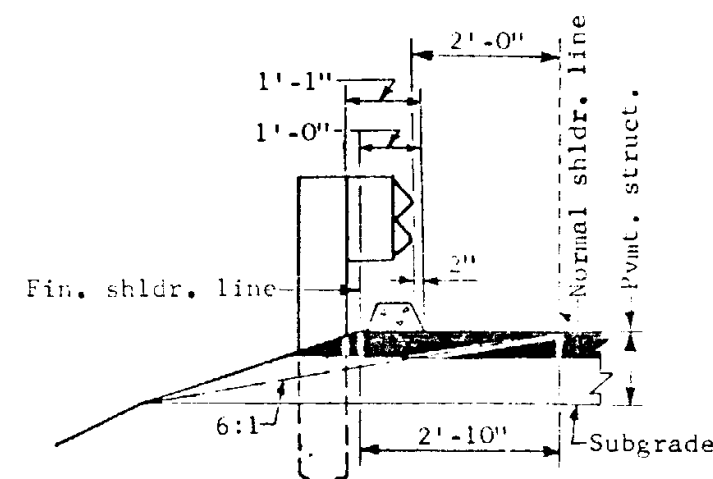
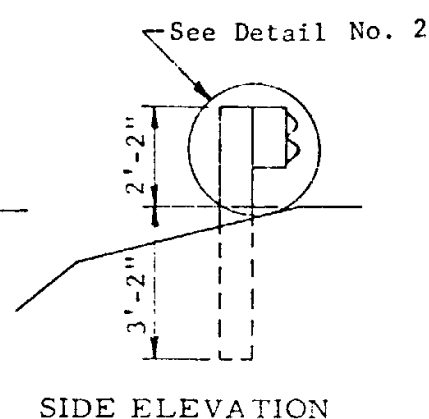
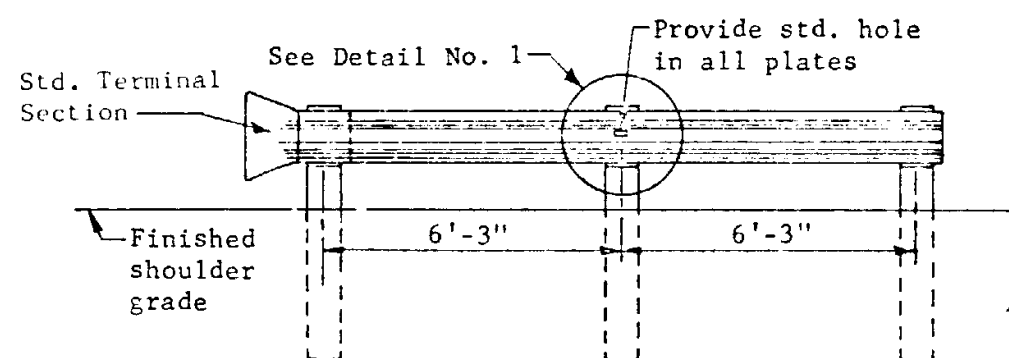
Rev



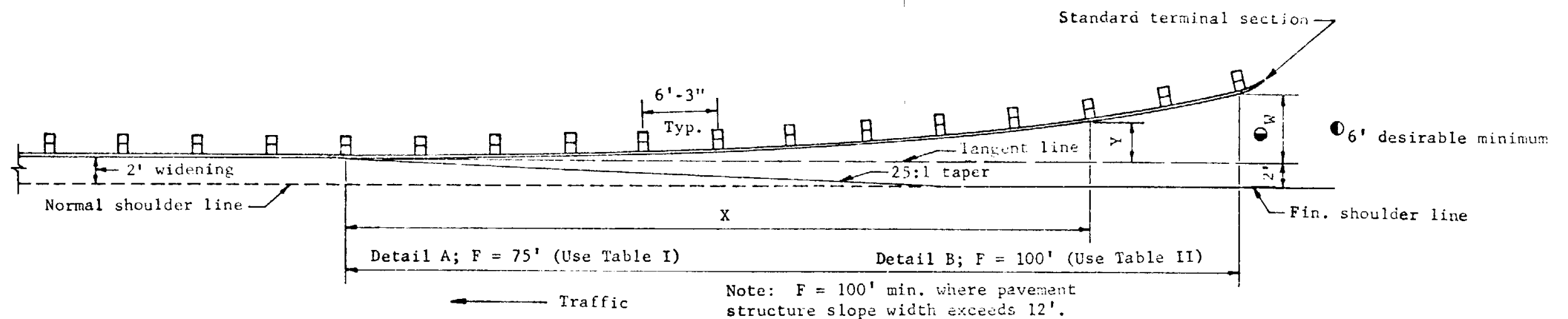
GENERAL NOTES

Posts and blocks shall be nominal 8" X 8" rough, pressure treated and unpainted. Holes shall be bored before treatment.

All guard rail plate, fittings, hardware, etc. shall be galvanized.



ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
GUARD RAIL-STEEL SINGLE FACE AND PAVEMENT WIDENING DETAILS			
Drawn	D.G.	Drawing No. <b>C-10.21</b>	
Traced	S.L.T., D.G. 12-69		
Checked	J.P.O.		
Approved Engr. Plans			



#### GENERAL NOTES

When the value of W and/or F is different than values shown in the tables, use the formula to compute applicable Y values.

Where necessary, dimension F may be increased to provide better alignment and grade.

TABLE I

X	Y (Feet)			
	W			
	3'-0"	4'-0"	5'-0"	6'-0"
12'-6"	0.08	0.11	0.14	0.17
25'-0"	0.33	0.44	0.55	0.67
37'-6"	0.75	1.00	1.25	1.50
50'-0"	1.33	1.73	2.22	2.67
62'-6"	2.08	2.78	3.42	4.11
75'-0"	3.00	4.00	5.00	6.00

TABLE II

X	Y (Feet)					
	W					
	5'-0"	6'-0"	7'-0"	8'-0"	9'-0"	10'-0"
12'-6"	0.08	0.09	0.11	0.12	0.14	0.16
25'-0"	0.31	0.37	0.44	0.50	0.56	0.62
37'-6"	0.70	0.84	0.99	1.13	1.27	1.41
50'-0"	1.25	1.50	1.75	2.00	2.25	2.50
62'-6"	1.90	2.28	2.66	3.01	3.42	3.81
75'-0"	2.81	3.39	3.94	4.50	5.06	5.62
87'-6"	3.81	4.57	5.34	6.10	6.86	7.66
100'-0"	5.00	6.00	7.00	8.00	9.00	10.00

$Y = (W)X^2/F^2$  = Offset from Tangent line to guard rail.

W = Distance between Tangent line and desired location of end of guard rail.

F = Length of flared guard rail.

X = Distance from beginning of parabolic flare.

indicates the preferred value.

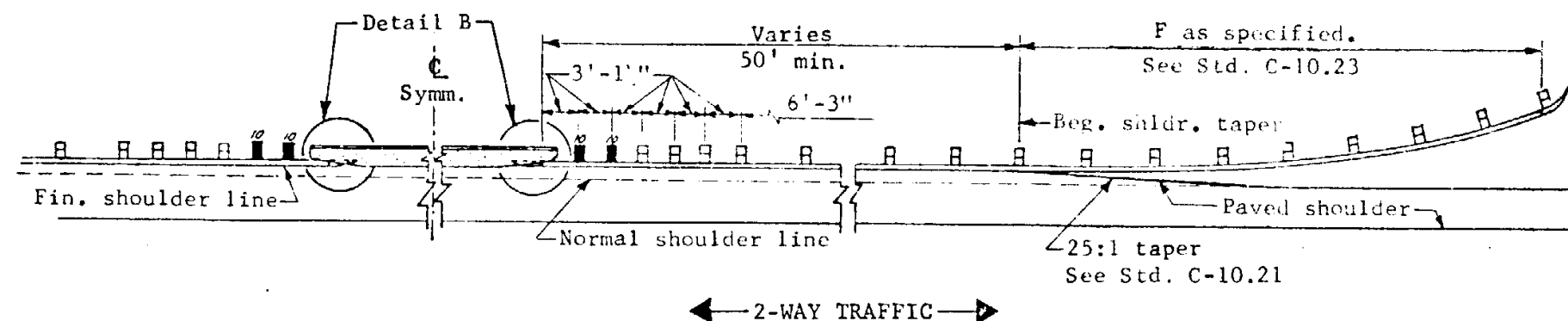
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## GUARD RAIL-STEEL APPROACH END TREATMENT

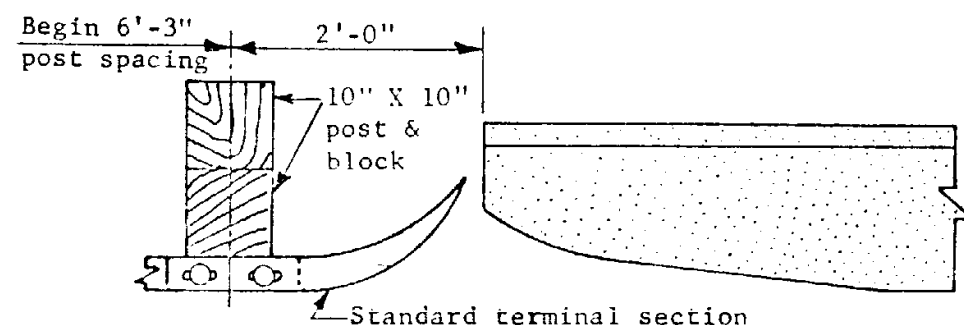
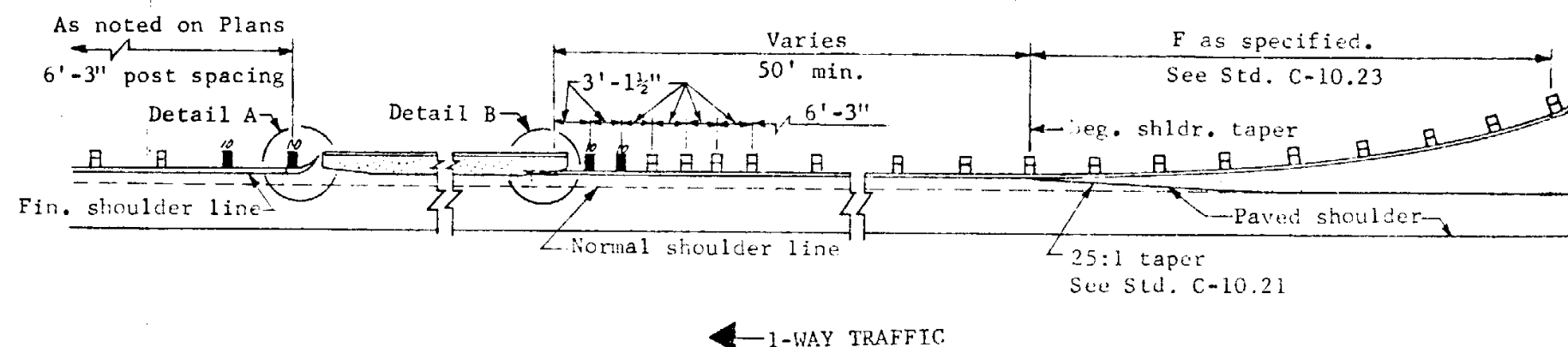
Drawn D.G.  
Traced S.L.T., D.C. 12-69  
Checked J.P.C.  
Approved  
Engr. Plans

Drawing No.  
**C-10.23**

Rev

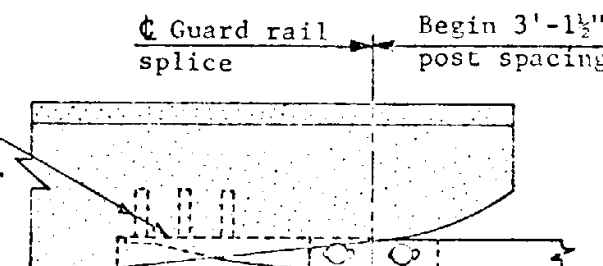


NOTE: Indicates 10"x10" post & block.

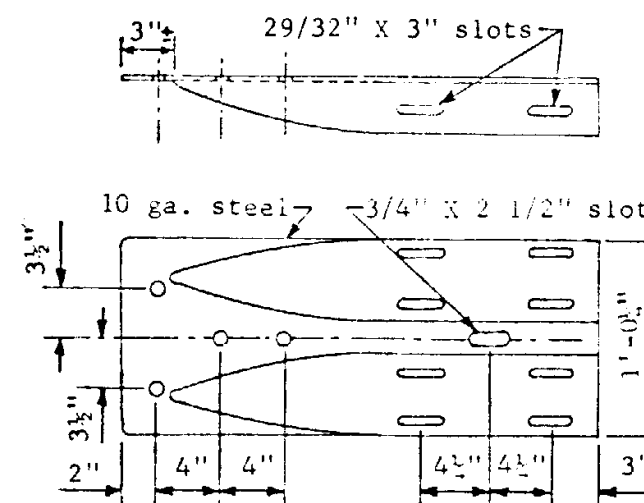


DETAIL A

Guard rail end shoe and connection bolts. See Detail C and General Notes.



DETAIL B



DETAIL C

**GENERAL NOTES**  
Where necessary, dimension F may be increased to provide better alignment and grade.

Connect end shoe to dado with 7/8" high strength bolts set in internally threaded tubular expansion anchors having an externally slit expansion element and a single cone expander. Tensile proof test load in 2500 p.s.i. concrete shall be 6500 lbs.

The guard rail end shoe shall be galvanized after fabrication in accordance with A.S.T.M. specification A123.

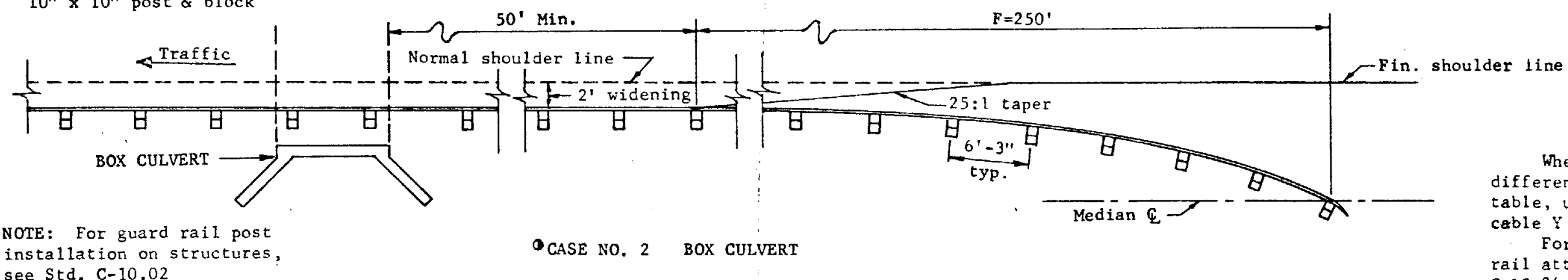
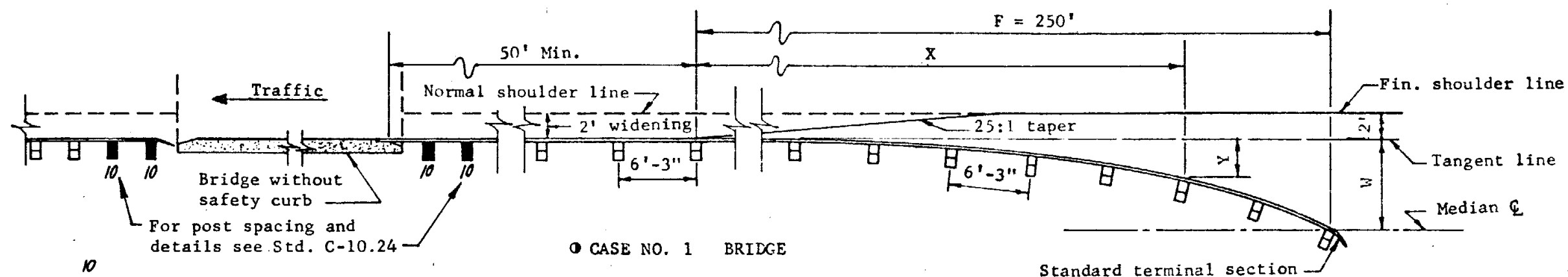
For other construction details of guard rail attachment to bridge, see Plans.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

# GUARD RAIL-STEEL BRIDGE APPROACH DETAILS

Drawn	D.G.	Drawing No. <b>C-10.24</b>
Traced	S.L.T., D.G. 12-69	
Checked	J.P.O.	
Approved Engr. Plans		

Rev



GENERAL NOTES

When the value of W and/or F is different than values shown in the table, use the formula to compute applicable Y values.

For construction details of guard rail attachment to bridge, see Std. C-10.24 and Plans.

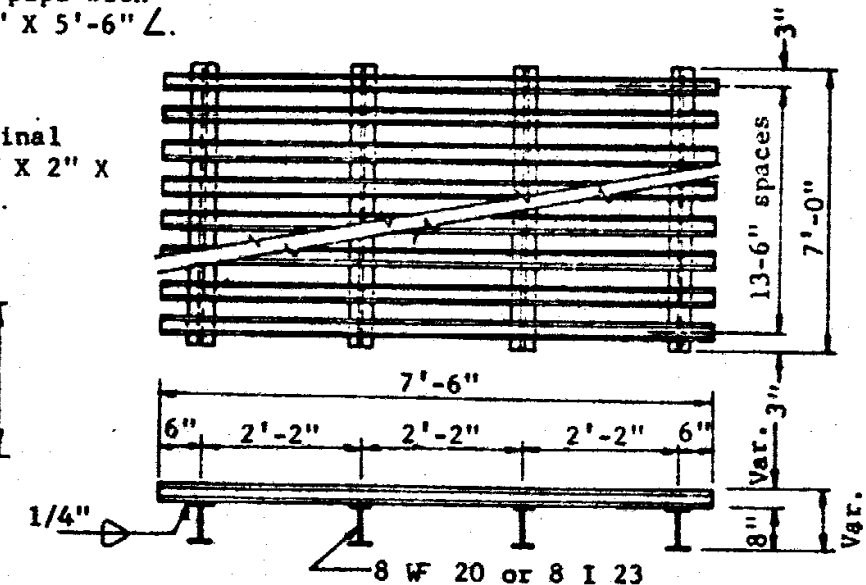
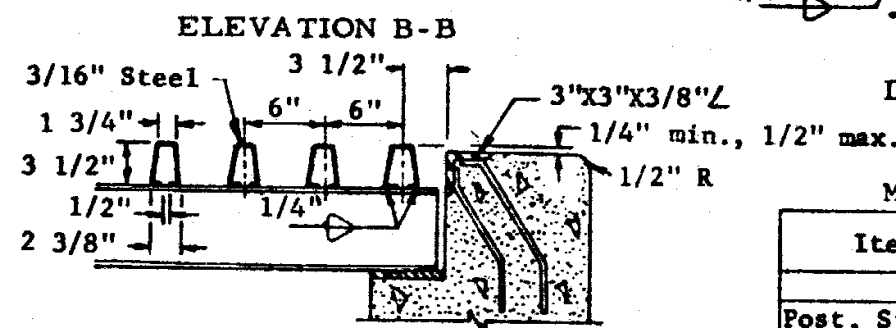
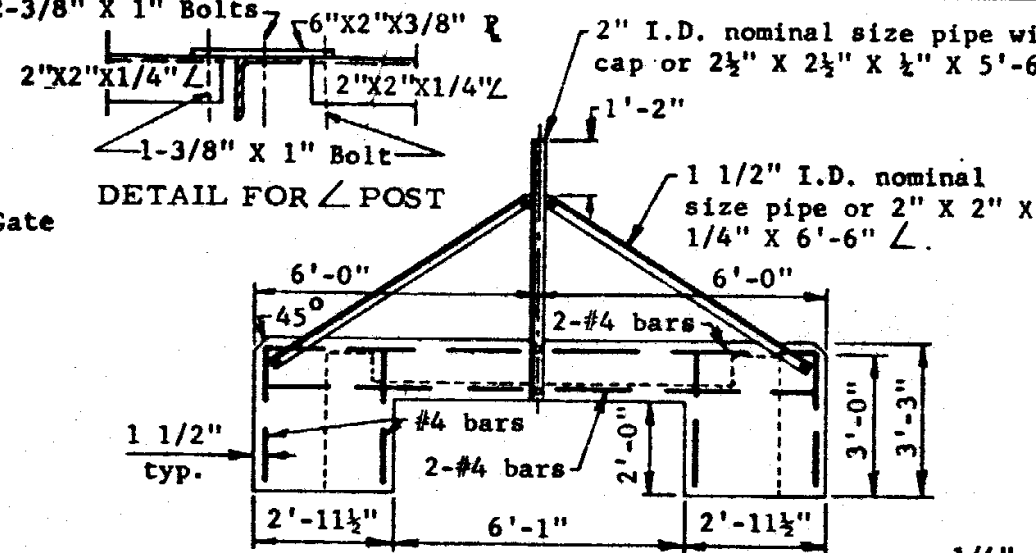
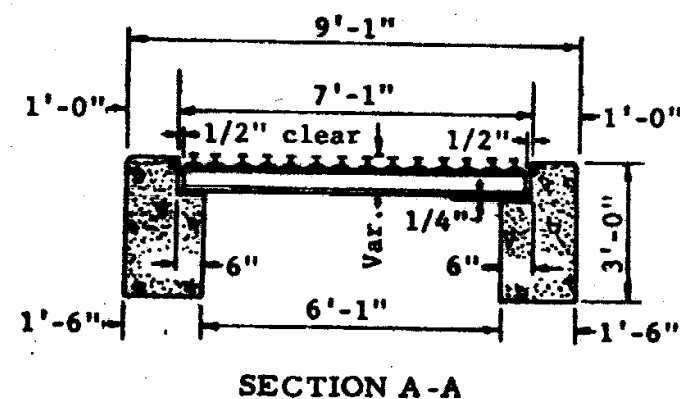
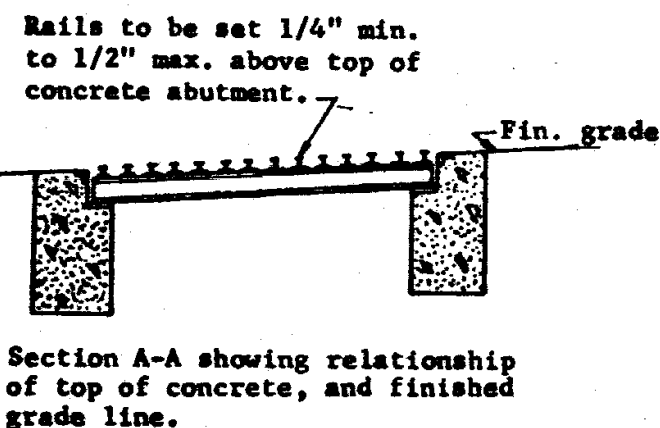
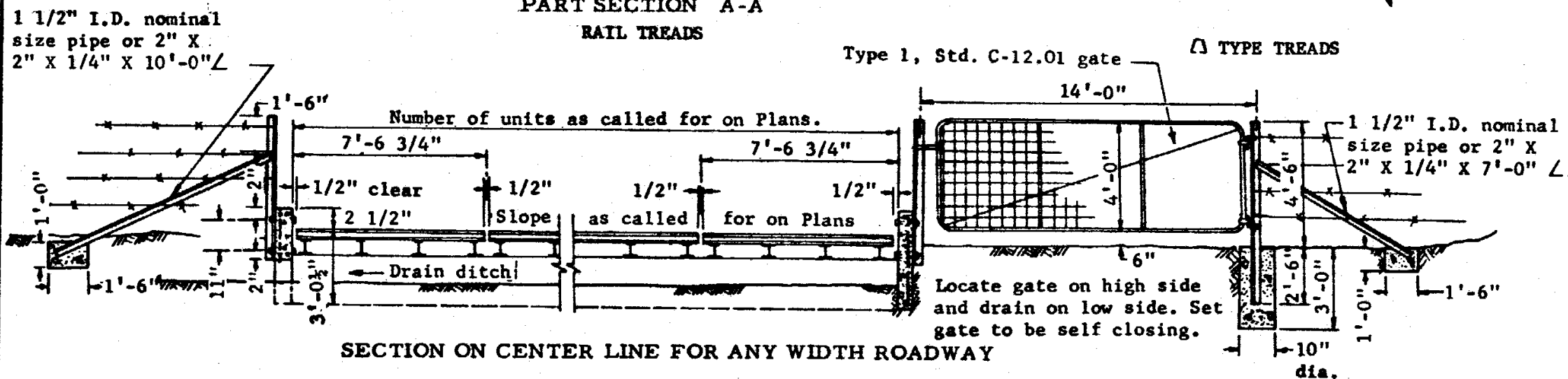
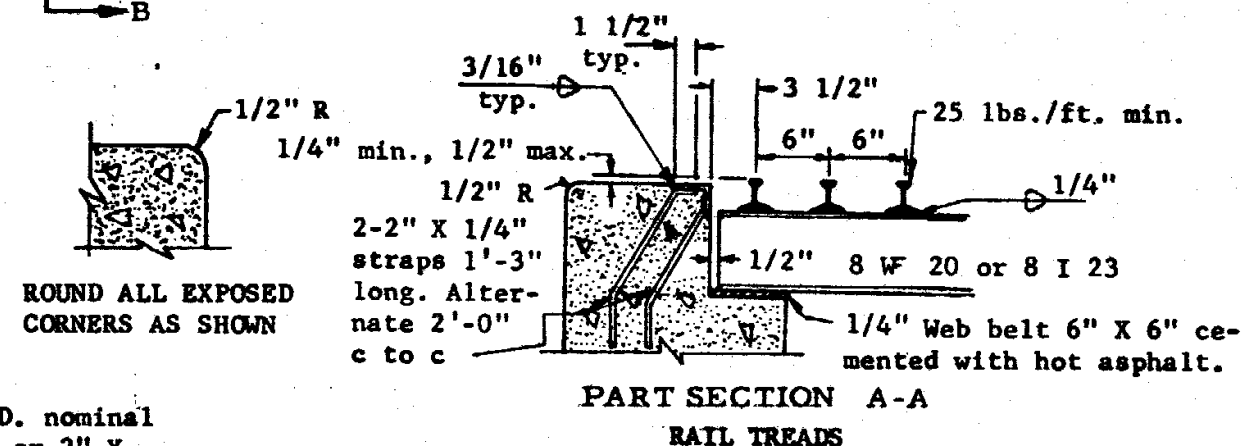
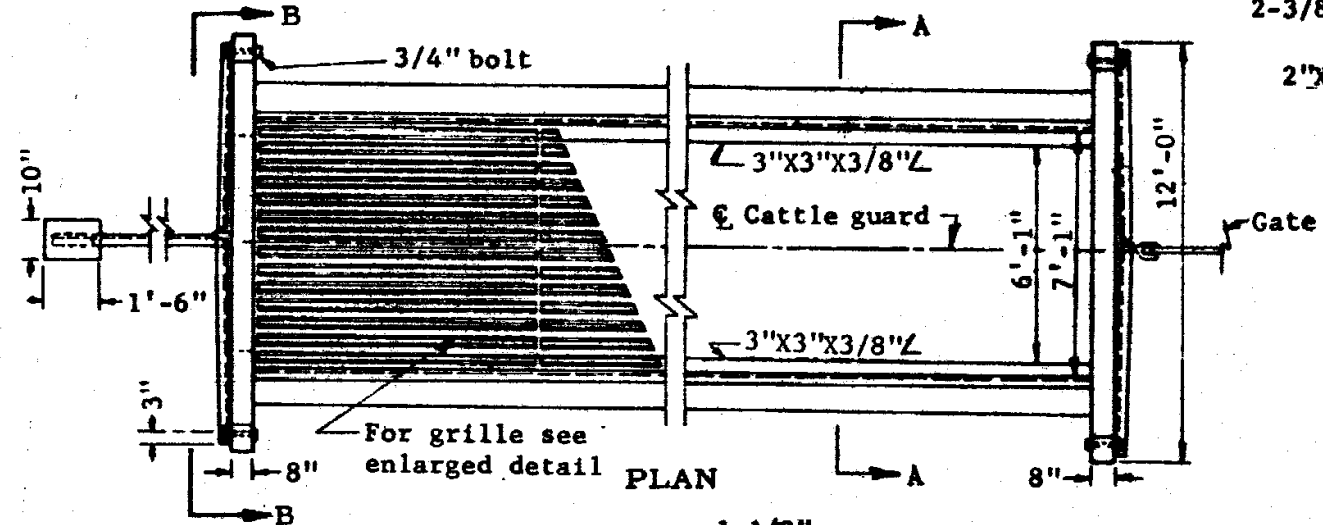
Where necessary, dimension F may be increased to provide better alignment and grade.

● One way roadway shown. For two way roadway, use symm. guard rail flare and fixed dado attachment at trailing end of bridge.

X	Y(Feet)				
	W				
	26'	30'	34'	38'	42'
12'-6"	.065	.075	.085	.095	.105
25'-0"	.260	.300	.340	.38	.42
37'-6"	.585	.675	.765	.86	.95
50'-0"	1.040	1.200	1.360	1.52	1.68
62'-6"	1.625	1.875	2.125	2.38	2.63
75'-0"	2.340	2.700	3.060	3.42	3.78
87'-6"	3.185	3.675	4.165	4.66	5.15
100'-0"	4.16	4.800	5.440	6.08	6.72
112'-6"	5.265	6.075	6.885	7.70	8.51
125'-0"	6.500	7.500	8.500	9.50	10.50
137'-6"	7.865	9.075	10.285	11.50	12.71
150'-0"	9.360	10.800	12.240	13.68	15.12
162'-6"	10.985	12.675	14.365	16.06	17.75
175'-0"	12.740	14.700	16.660	18.62	20.58
187'-6"	14.625	16.875	19.125	21.38	23.63
200'-0"	16.640	19.200	21.760	24.32	26.88
212'-6"	18.785	21.675	24.565	27.46	30.35
225'-0"	21.060	24.300	27.540	30.78	34.02
237'-6"	23.465	27.075	30.685	34.28	37.88
250'-0"	26.00	30.00	34.00	38.00	42.00

$Y = (W)X^2/F^2$  = Offset from Tangent line to guard rail.  
W = Distance between Tangent line and median center line.  
F = Length of flared portion of guard rail.  
X = Distance from beginning of parabolic flare to any 12'-6" multiple of parabolic flare.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
GUARD RAIL-STEEL FLARE TO MEDIAN		
Drawn	D.G.	Drawing No.
Traced	S.L.T., D.G. 12-69	
Checked	J.P.O.	
Approved Eng. Plans		C-10.25



MATERIAL LIST - CATTLE GUARD WITH GATE					
Item	Pcs.	Size	Length	Steel#	Conc. C.Y.
Common to all guard lengths					
Post, Steel	3	See Std. C-12.01			
Braces, Steel	6	See Std. C-12.01			
Conc. for setting Post & Braces					0.17
Reinf. Bars	8	#4	11'-6"	61.50	
Reinf. Bars	8	#4	2'-9"	14.70	
7 Unit - 40' ROADWAY					17.42
Fabricated $\angle$	2	3"X3"X3/8"X52'-10"			
Web Belting	56	6"X6"X $\frac{1}{2}$ "			
6 Unit - 34' ROADWAY					15.16
Fabricated $\angle$	2	3"X3"X3/8"X45'-3 $\frac{1}{2}$ "			
Web Belting	48	6"X6"X $\frac{1}{2}$ "			
5 Unit - 26' ROADWAY					12.90
Fabricated $\angle$	2	3"X3"X3/8"X37'-9"			
Web Belting	40	6"X6"X $\frac{1}{2}$ "			
4 Unit - 20' ROADWAY					10.64
Fabricated $\angle$	2	3"X3"X3/8"X30'-2 $\frac{1}{2}$ "			
Web Belting	32	6"X6"X $\frac{1}{2}$ "			

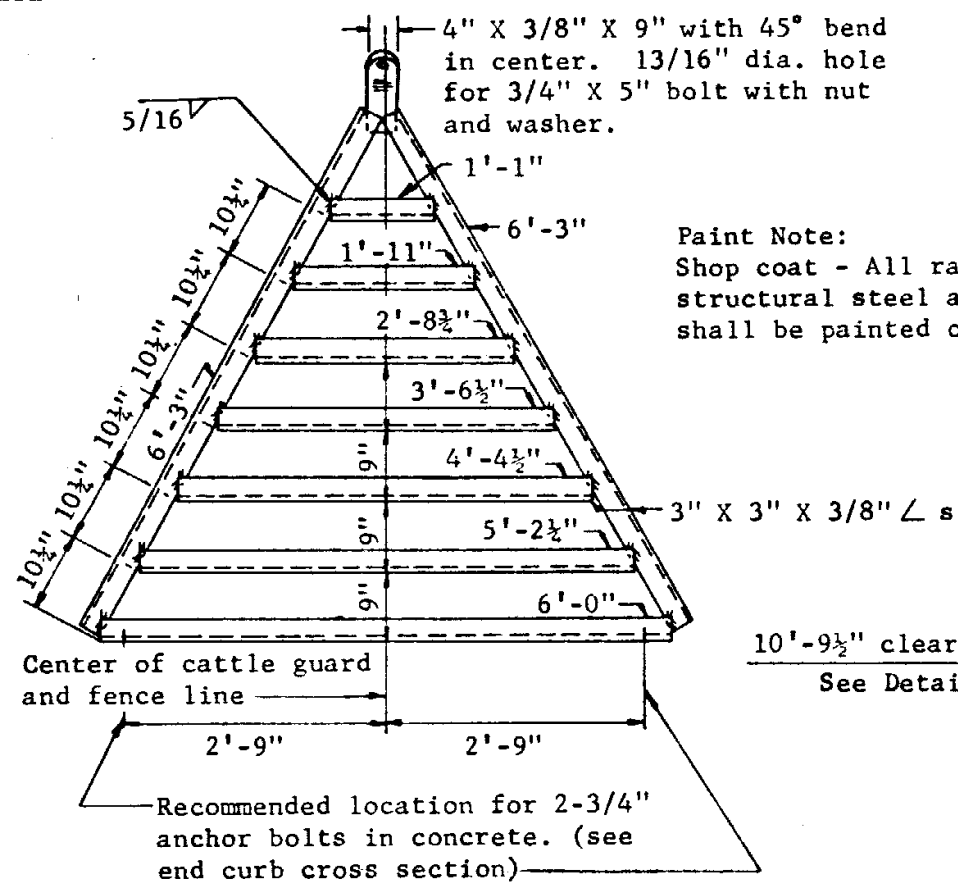
**GENERAL NOTES**

All concrete shall be Class A.

Used rails may be used providing they are clean, free from rust, of uniform cross section and weigh 25 lbs./ft. min.

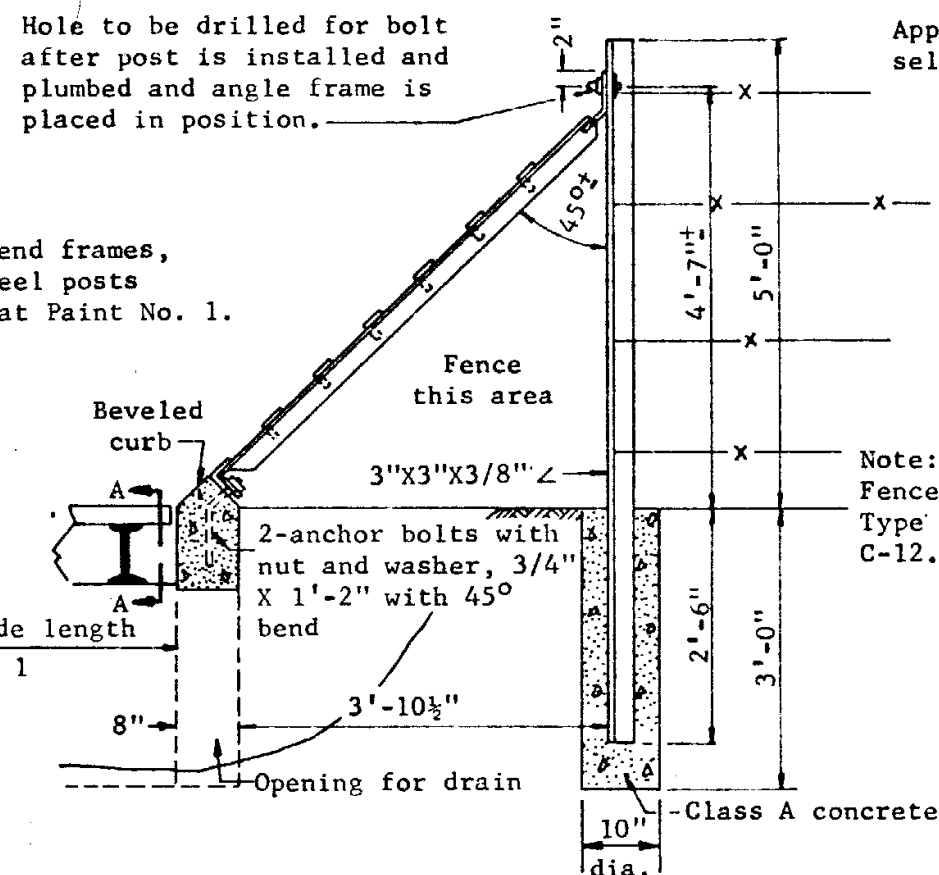
All rails, structural steel, steel posts and braces shall be given one shop coat of No. 1 paint.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev 12-5-68
CATTLE GUARD		
Drawn	12-58	Drawing No.  C-II.OI
Traced	S.L.T. 5-67	
Checked	J.P.O. 800 5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

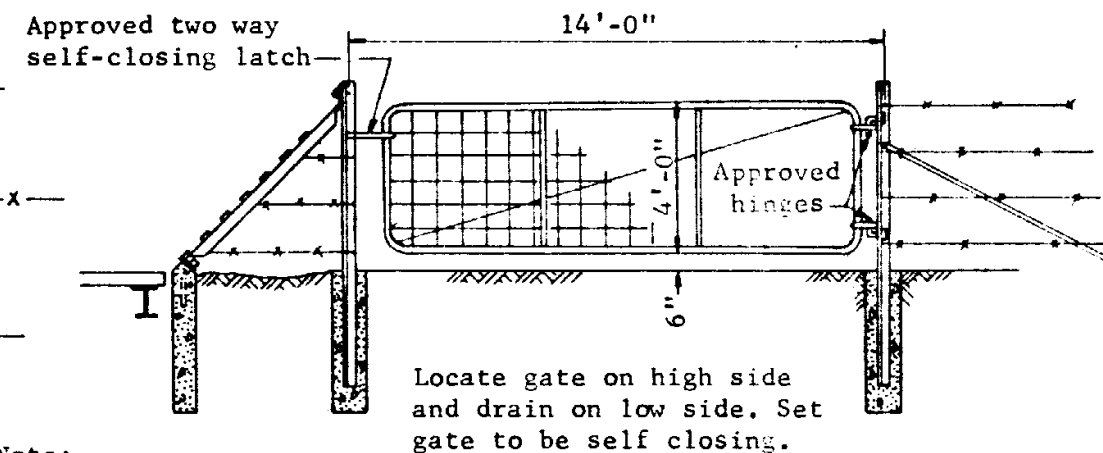


WELDED ANGLE END FRAME  
2-required (one at each end)

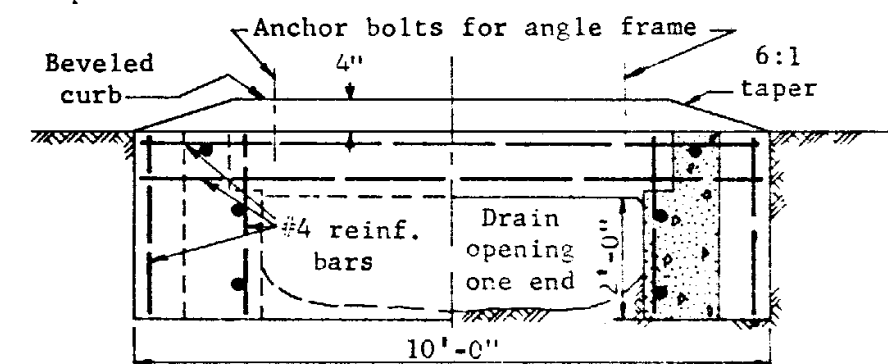
Paint Note:  
Shop coat - All rails, end frames, structural steel and steel posts shall be painted one coat Paint No. 1.



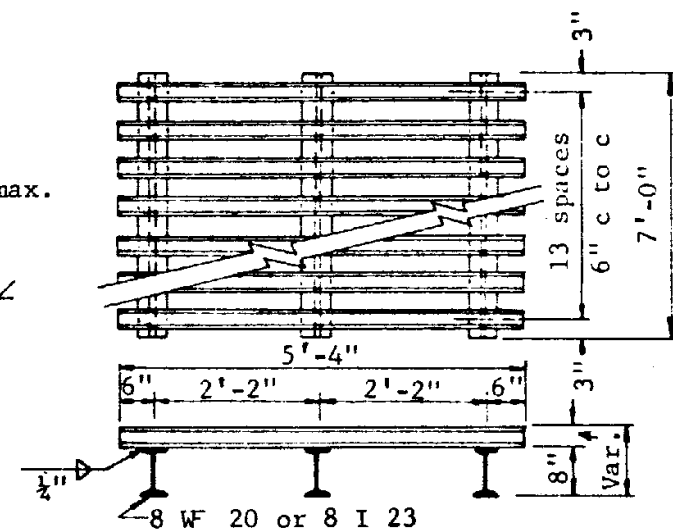
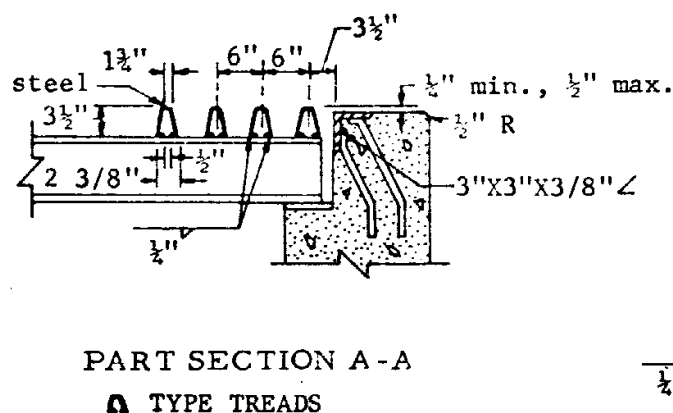
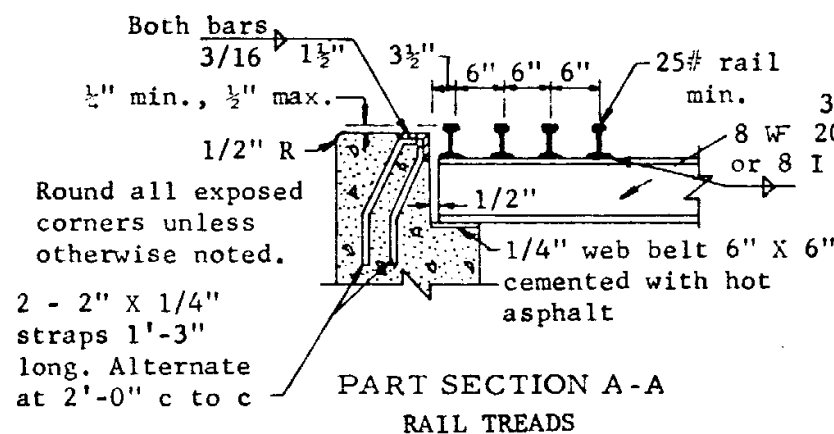
END CURB CROSS SECTION



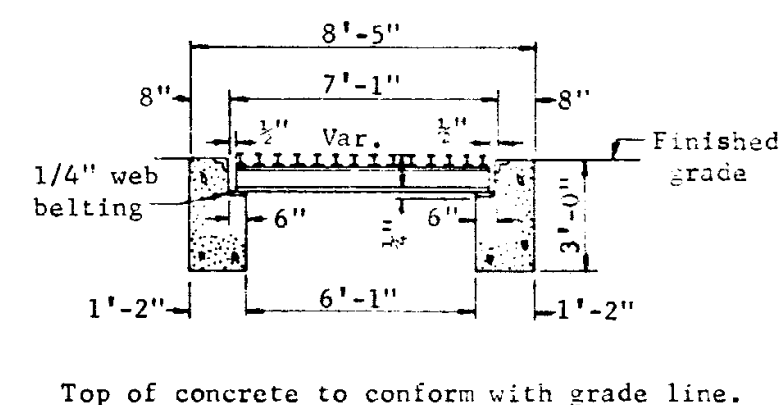
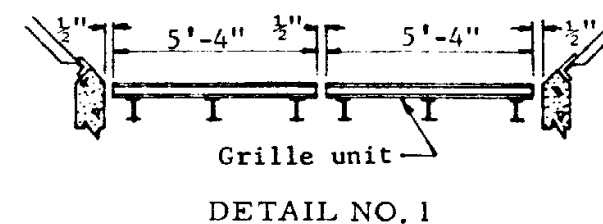
Note:  
Fence posts, braces and Type 1 Gate as per Std. C-12.01.



HALF END VIEW HALF END SECTION  
(Closed end) (Looking toward open end)

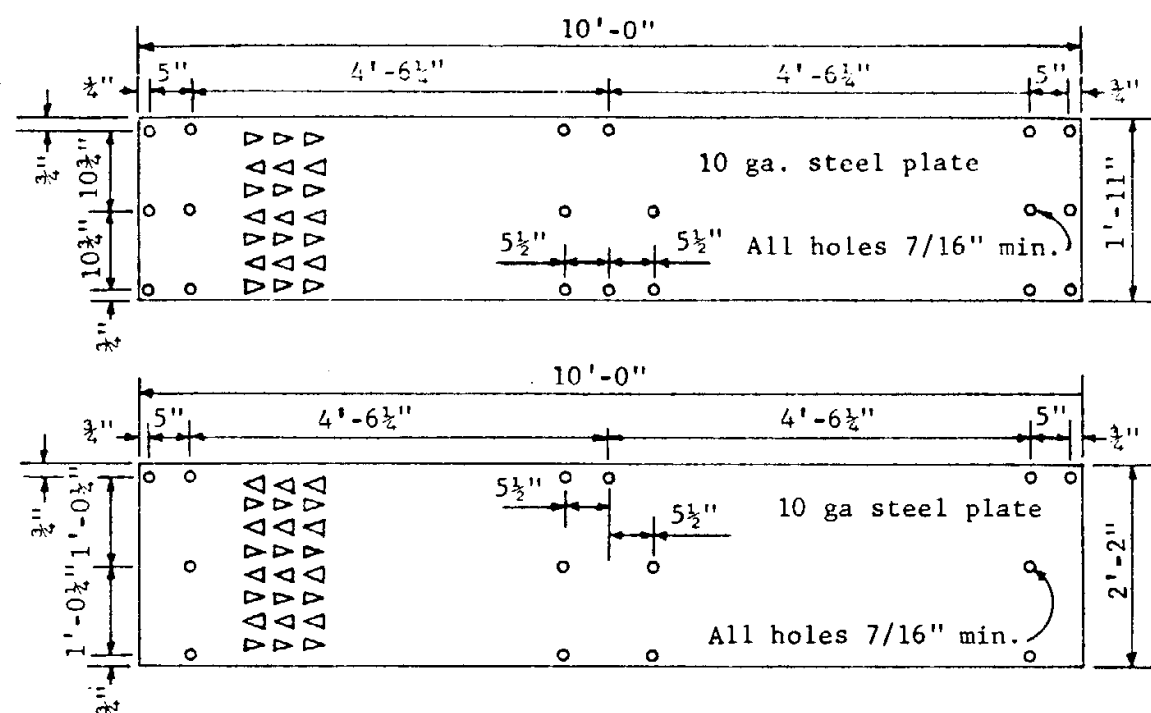


DETAIL OF WELDED GRILLE UNIT

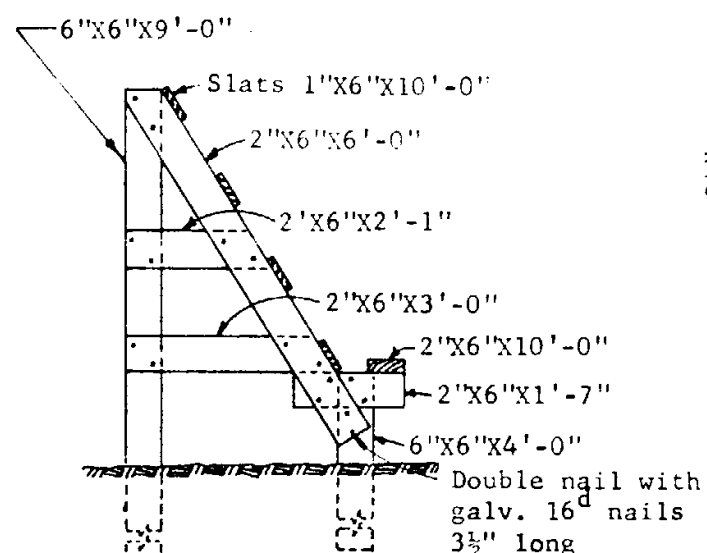


MATERIAL LIST	Req'd.	
Fabricated L	2	3" X 3" X 3/8" X 10'-9 1/2"
Posts, for fence or gate	3	Same as Std. C-12.01 except as noted.
Bolts, with nut & washers	2	3/4" X 5" straight
Bolts, with nut & washers	4	3/4" X 1'-2", 45° bend mid point (anchor bolts)
Gate, with hinges & latch	1	Type 1 Gate for 14' opening, see Detail
Reinforcing bars	4	#4 bars X 8'-2" straight, aggregate weight, 22 lbs.
Reinforcing bars	8	#4 bars X 2'-10" straight, aggregate weight, 15 lbs.
Reinforcing bars	6	#4 bars X 11'-9" straight, aggregate weight, 47 lbs.
Std. welded grille unit	2	Approximate weight 2200 lbs.
Welded angle end frame	2	Approximate weight 560 lbs.
Web belting, grille shims	12	6" X 6" X 1/4"
Concrete	-	Class A. Total cubic yards 3.96 incl's setting 3 posts.

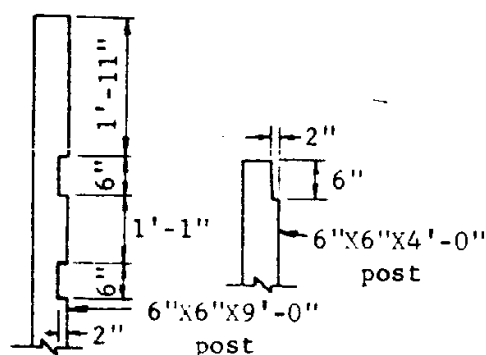
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CATTLE GUARD - RANCH FOR SIDEROAD ONLY			
Drawn	L.D. 5-54	Drawing No.  <b>C-11.02</b>	
Traced	S.L.T. 8-67		
Checked	J.P.O. <i>990 5-68</i>		
Approved Engr. Plans	<i>W.H.H. 5-68</i>		



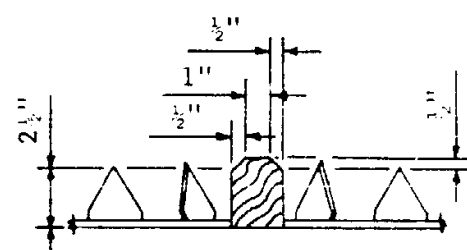
PLAN - 23" & 26" CATTLE GUARD PLATE



END FRAME TIMBER SIZES



END FRAME POST NOTCH DETAIL



DETAIL-2" X 3" TIMBER BETWEEN ADJACENT PLATES

Fasten down with 3 - 3/8" X 7" lag screws each piece

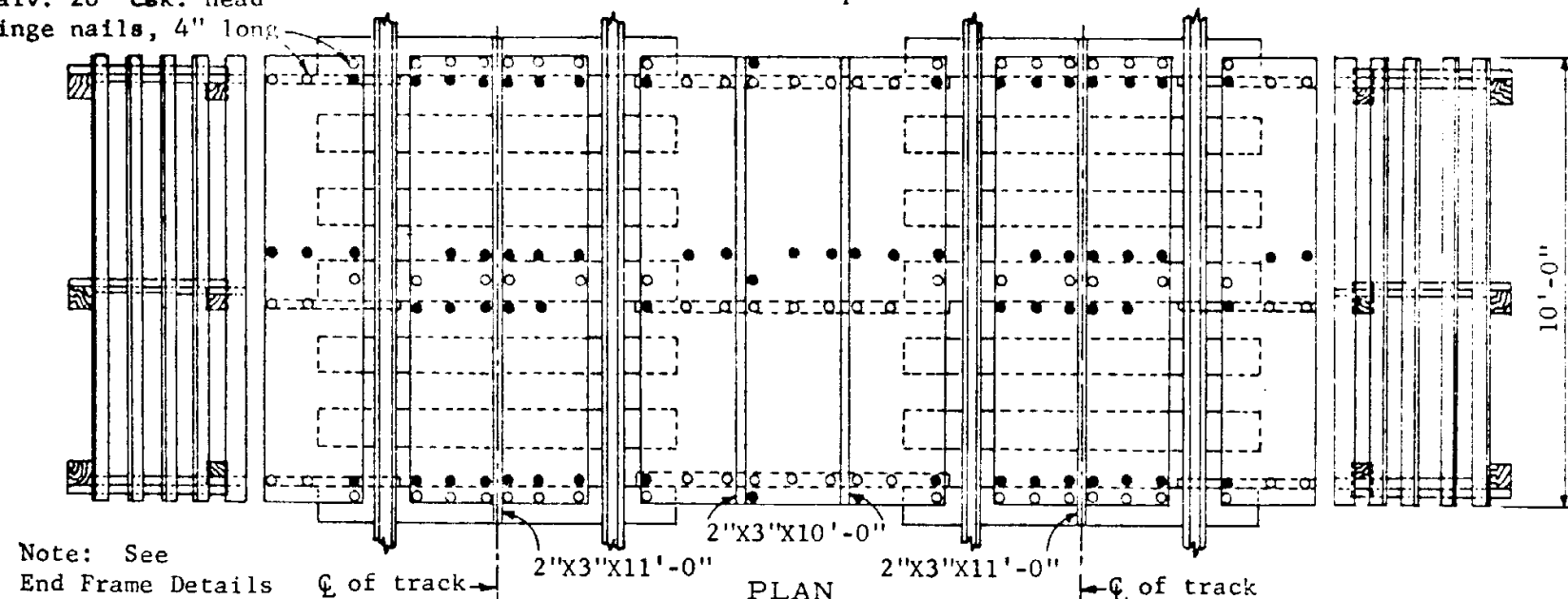
#### GENERAL NOTES

The 2" X 6" & 3" X 6" timbers that are fastened to the ties and the 6" X 6" posts shall be pressure treated, rough and unpainted. The remaining timber shall be given one coat of No. 7 and one coat of No. 8 paint.

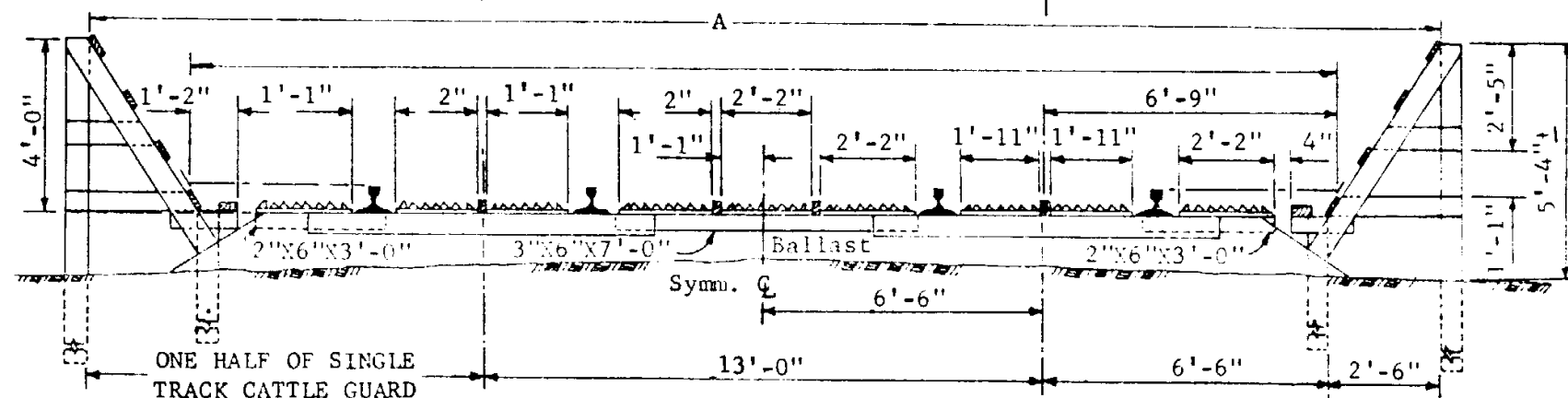
The metal plates shall be furnished with the manufacturer's shop coat of paint or shall be given one coat of No. 1 paint.

Galv. 20<sup>d</sup> csk. head hinge nails, 4" long

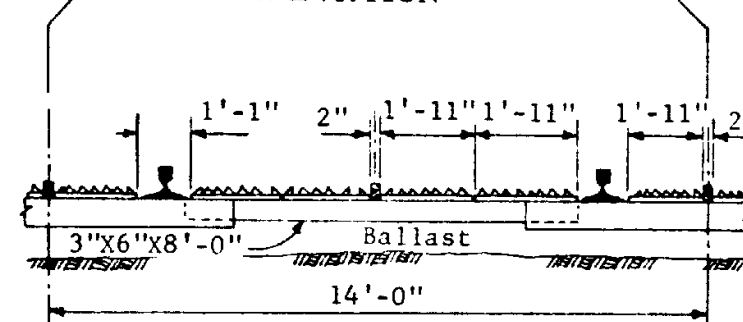
Nails not required in holes thus: •



Note: See End Frame Details



ELEVATION



ELEVATION

DIMENSIONS	A	B
Single Track	18'-0"	13'-6"
13' Track Centers	31'-0"	26'-6"
14' Track Centers	32'-0"	27'-6"

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

CATTLE GUARD  
RAILROAD

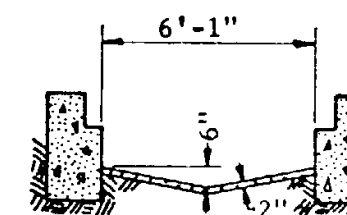
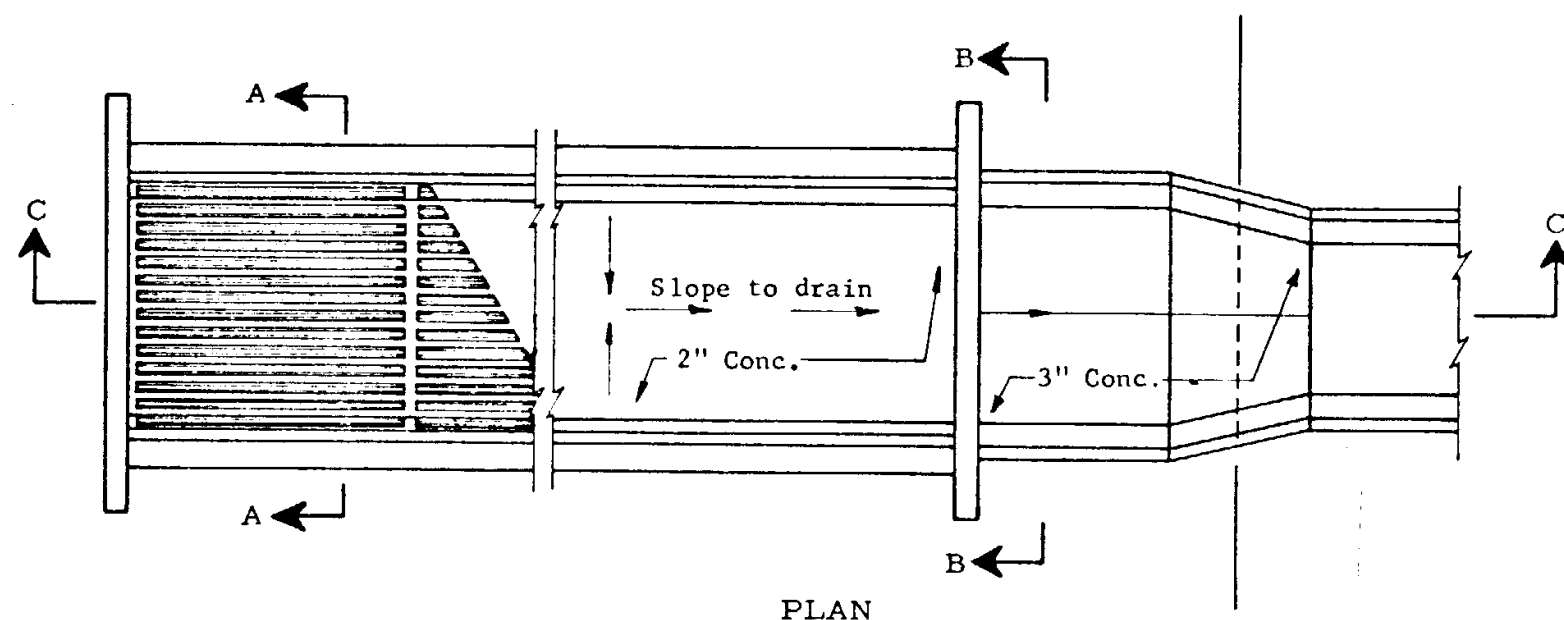
Drawn D.G. 3-67  
Traced S.L.T. 4-67  
Checked J.P.O. JPD 5-68  
Approved Engr. Plans Y. H. H. 5-68

Drawing No.

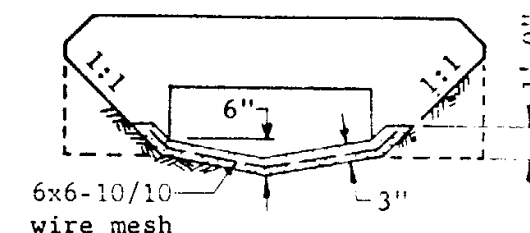
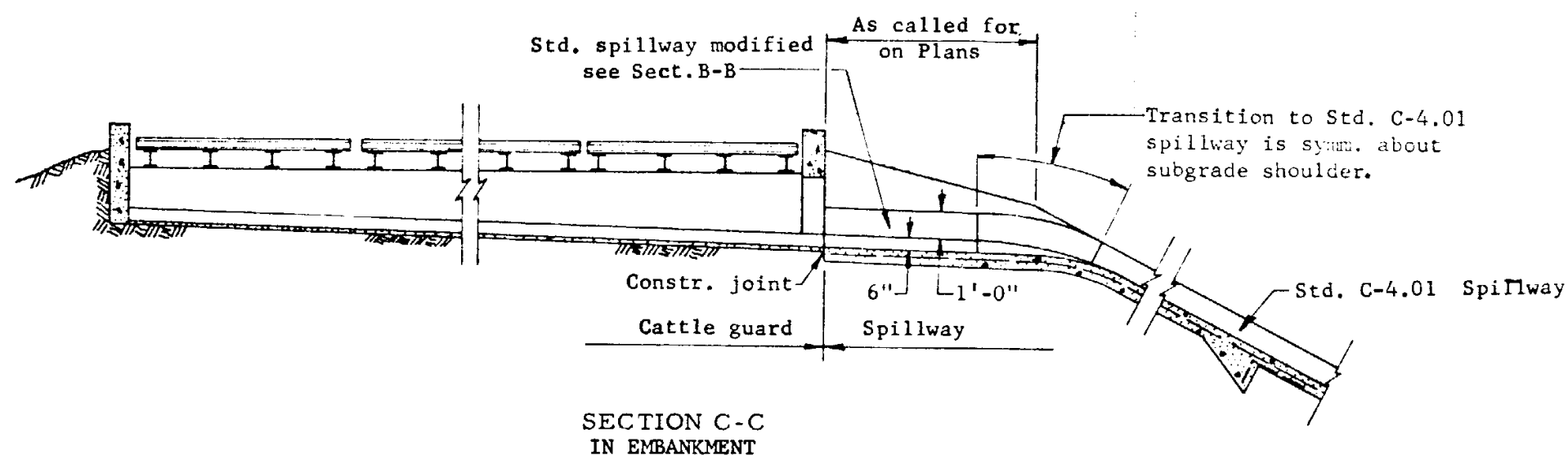
C-II.03

Rev





SECTION A-A



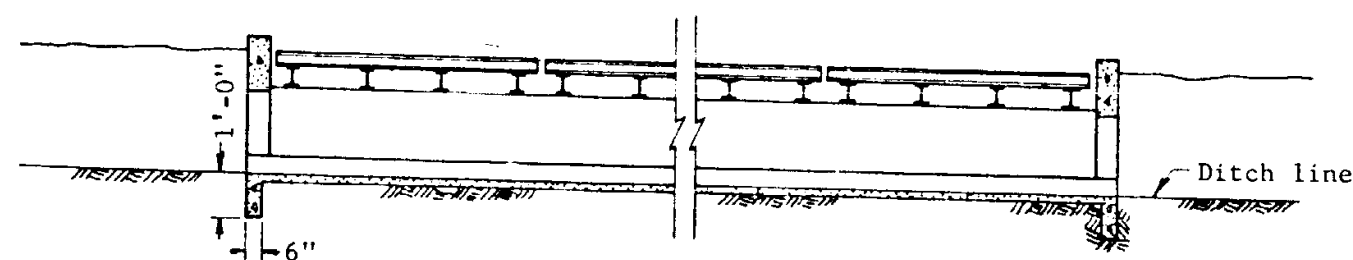
SECTION B-B

GENERAL NOTES

For all other cattle guard details, see Std. C-11.01.

This standard shall be used in embankment or where highly erodable soil is found.

All concrete shall be Class A..



SECTION C-C

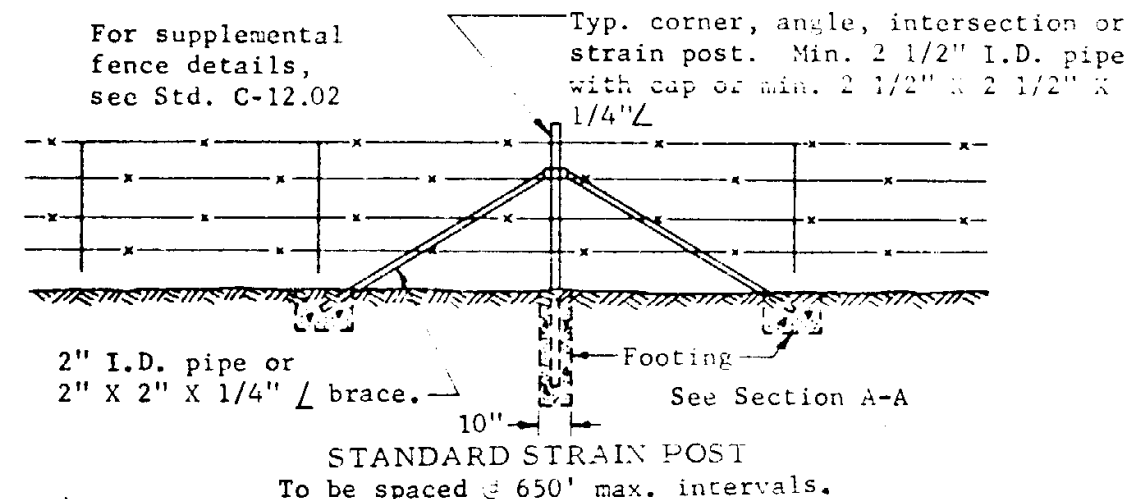
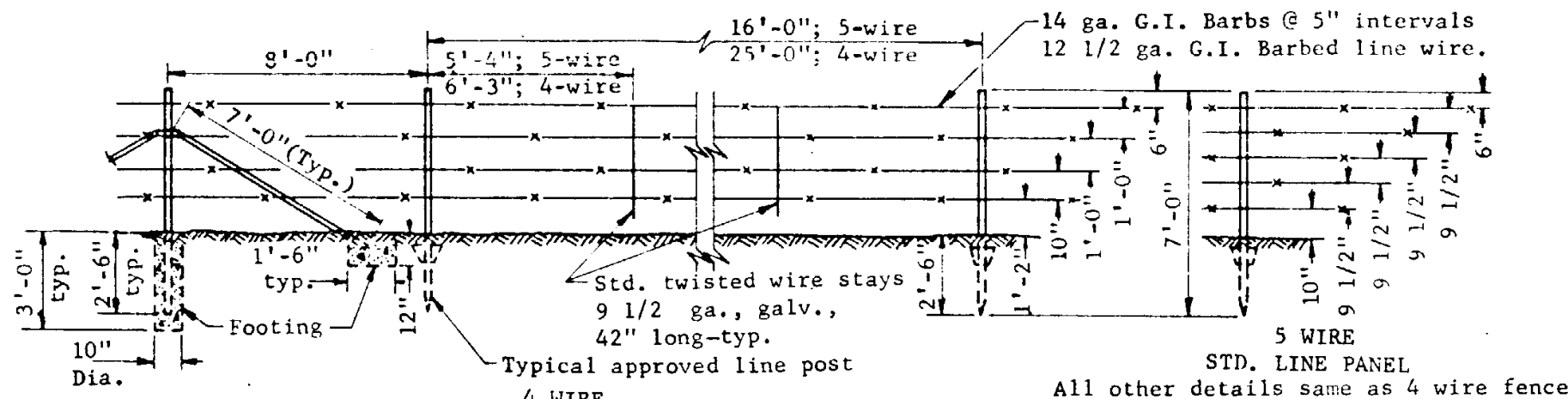
WHERE USED FOR THRU DRAINAGE-  
CATTLE GUARD OPEN BOTH ENDS

ARIZONA HIGHWAY DEPARTMENT  
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12-2-68

CATTLE GUARD  
DRAINAGE

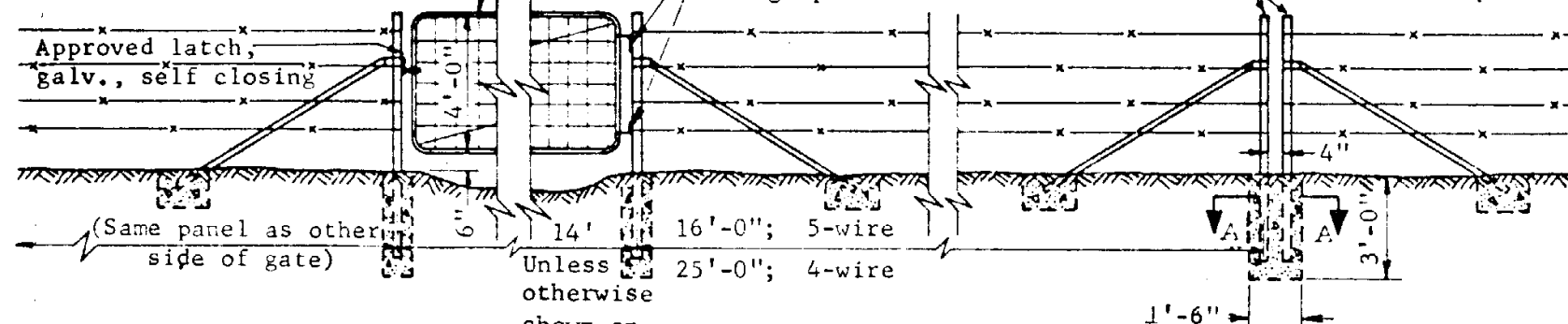
Drawn	M.C.T. 6-15-65	Drawing No.  <b>C-11.04</b>
Traced	R.A.F. 5-5-67	
Checked	J.P.O. 8/10 5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	



STD. CORNER, ANGLE, END  
OR \*INTERSECTION PANEL

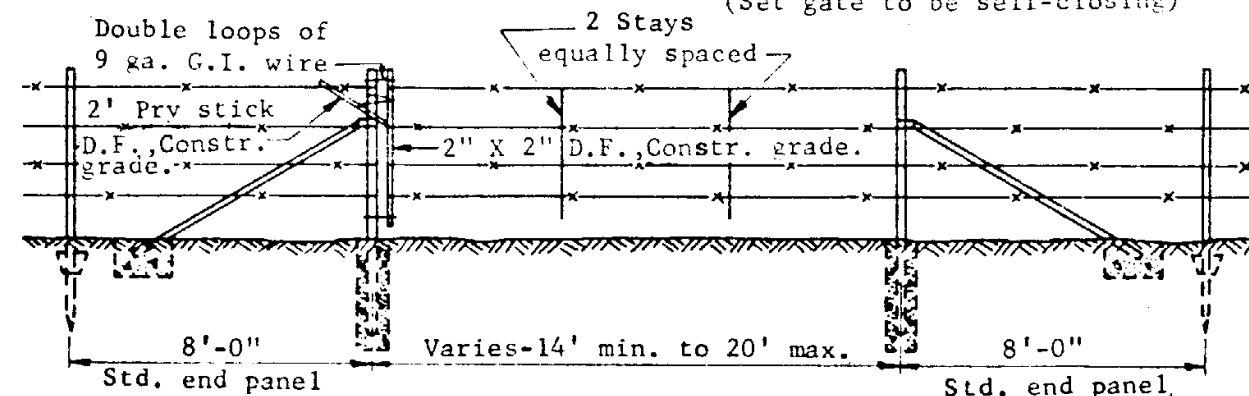
4 WIRE  
STD. LINE PANEL

Approved galv.  
hinges, top  
hinge pin down.



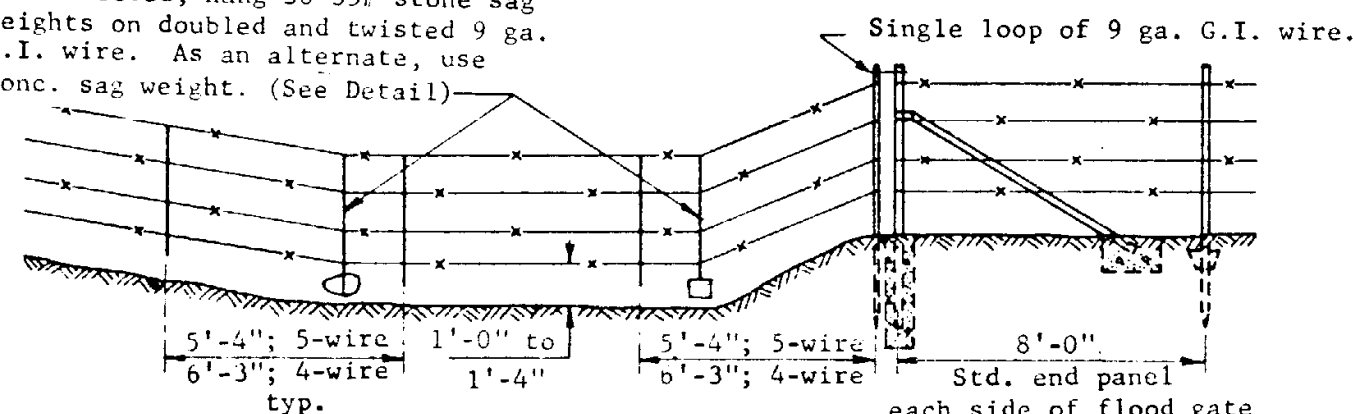
\*Third brace, in line with cross  
fence, required at intersection.

STANDARD TYPE 1 GATE  
(Set gate to be self-closing)

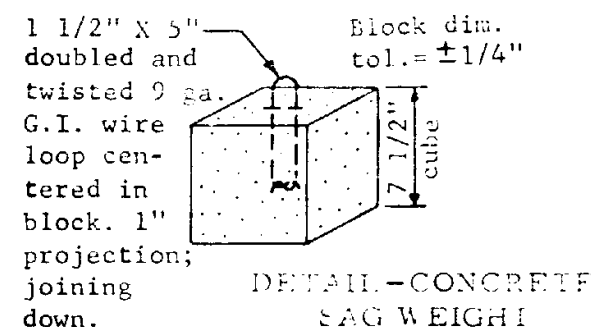


STANDARD TYPE 2 GATE

Where needed, hang 30-35# stone sag  
weights on doubled and twisted 9 ga.  
G.I. wire. As an alternate, use  
conc. sag weight. (See Detail)



STANDARD FLOOD GATE  
Length is Variable

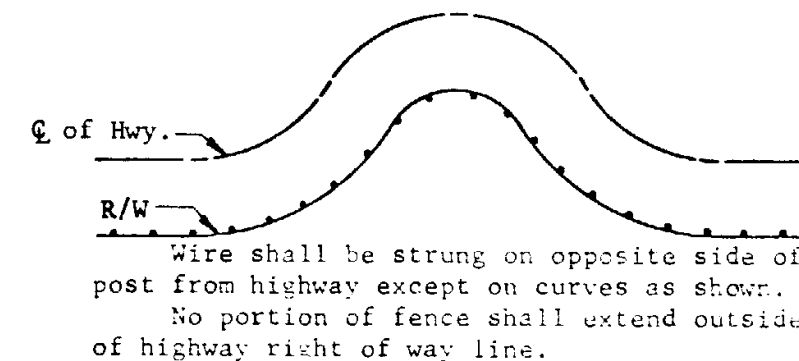


Note:

When tubular post hangers and/or  
latches are used, hangers and/or  
latches shall be drilled for a  
single 3/32" Ø min. drive pin to  
prevent rotation of the hangers  
and latches.

TYPICAL STEEL LINE  
POST SECTIONS

1 3/8" Ø tubing - 2 vert. braces.  
Mesh □, Δ, ◇ - 11 ga. line wires  
- 12 1/2 ga. crosswires. 1 - ad-  
justable diagonal guy. Fully  
galvanized.



GENERAL NOTES

Posts and braces shall be brown in color. Posts  
may have white top. Wood parts of type 2 gate shall  
be unpainted.

Line posts shall be "T", "U", "Rail", "Hat", or  
similar production sections except "Ells" or "Angles";  
shall weigh, exclusive of anchor, a min. of 1.3 #/ft.  
and shall be punched, knobbed or corrugated to hold  
wire firmly in position. Clamps of min. 11 ga. galv.  
wire shall be used to attach fence. Punched, lug type  
fasteners are not permitted.

Where anchor is omitted or post hole is drilled,  
posts must be set in concrete.

There may be a max. of two splices between strain  
posts but not on the same wire and no splice shall be  
placed within 100' of a strain, corner or gate post.

Post spacing shall be measured along top wire.

Angle is any deflection greater than 15°

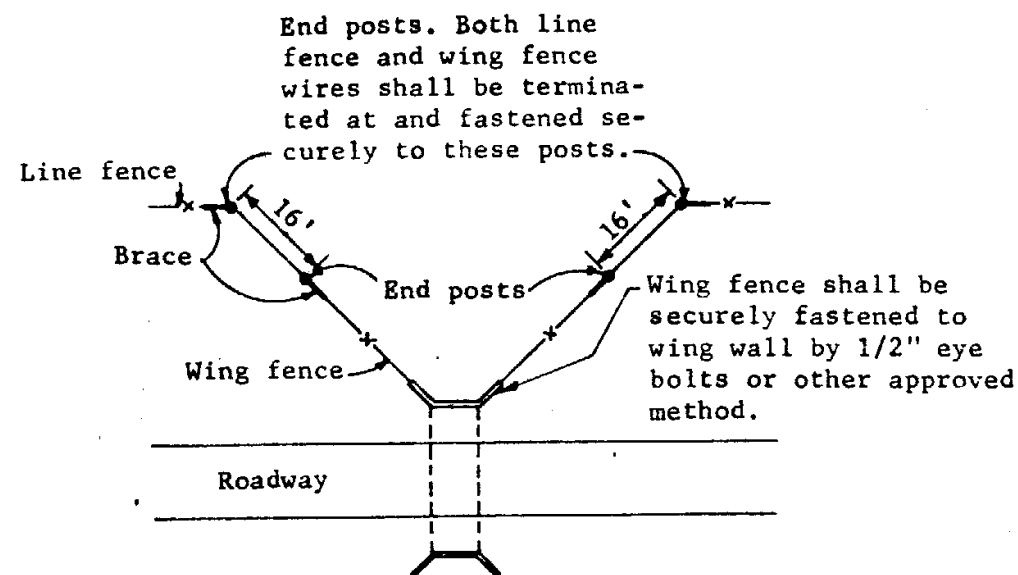
All concrete shall be Class A.

ARIZONA HIGHWAY DEPARTMENT  
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LINE FENCE AND GATES  
STEEL POSTS

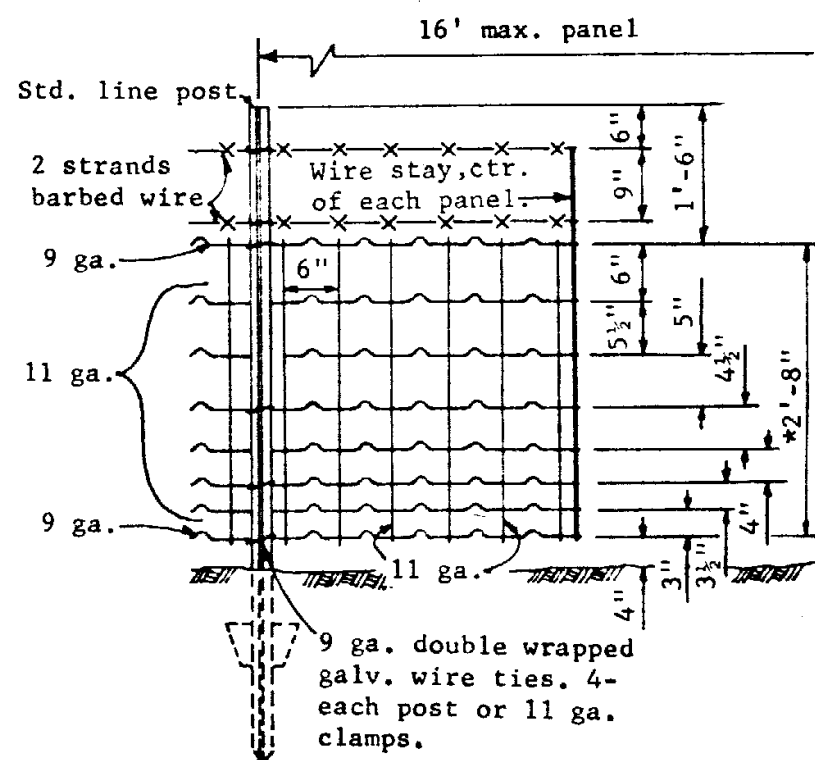
Drawn	K. S. 6-1938	Drawing No.  <b>C-12.01</b>
Traced	R.A.F 3-7-67	
Checked	J.P.O. 890 5-68	
Approved Engr. Plans	W. H. H. 5-68	

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12-5-68



### WING FENCE DETAIL

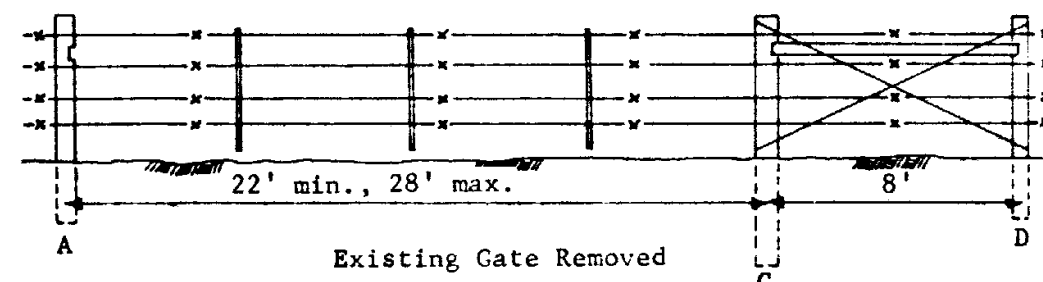
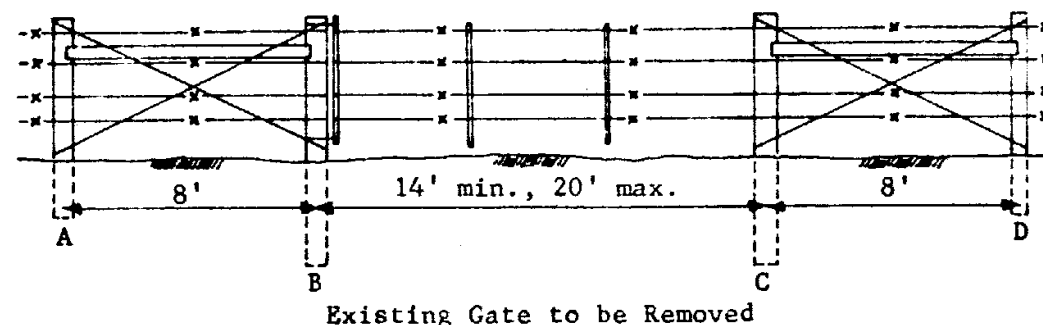
This detail shall be used where wing fences are called for on plans.



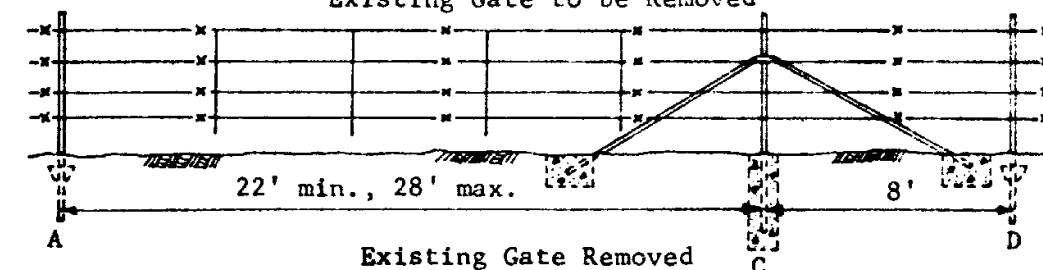
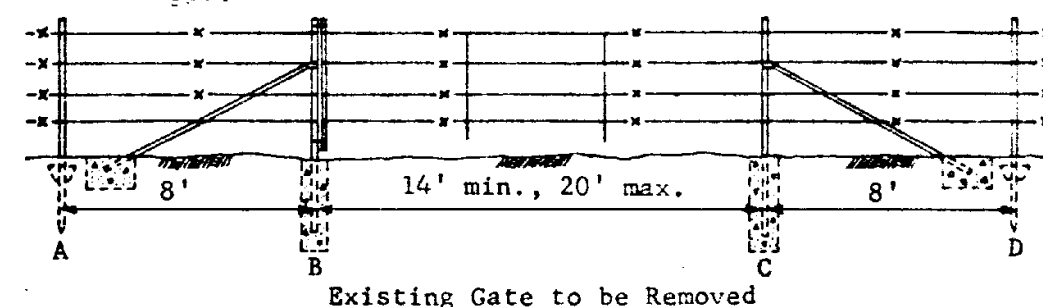
### STOCK FENCE

\*Rectangular mesh galv. stock fence.

### WOOD POST FENCE-TYPE 1 or 2 GATE-4 or 5 WIRE



### STD. C-12.01 FENCE-TYPE 1 or 2 GATE-4 or 5 WIRE

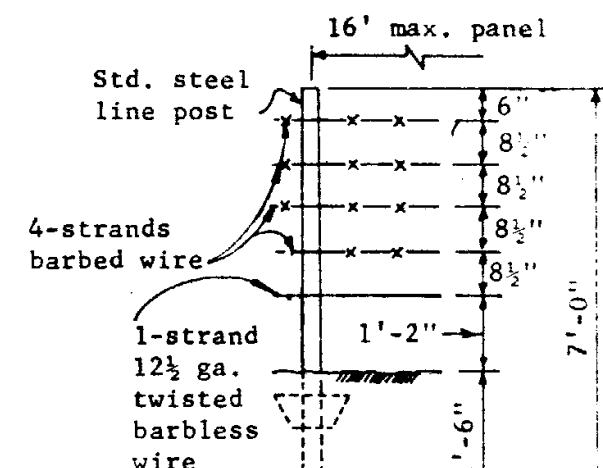


### DETAIL FOR REMOVING EXISTING LINE GATES

Procedure: Remove gate and hardware and wire between posts A and C. Install new second brace at post C (Std. C-12.01 fence only). Stretch new wire between posts A and C. Remove post B and brace.

(Approved salvaged wire may be used.)

Staples for wood posts shall be 1 1/2" galvanized and fabricated from 9 gauge wire.



Drawn for 5-wire

### GAME FENCE

4-wire game fence shall be constructed using standard 4-wire line fence post spacing and substituting 12 1/2 ga. twisted barless wire for the bottom strand.

### GENERAL NOTES

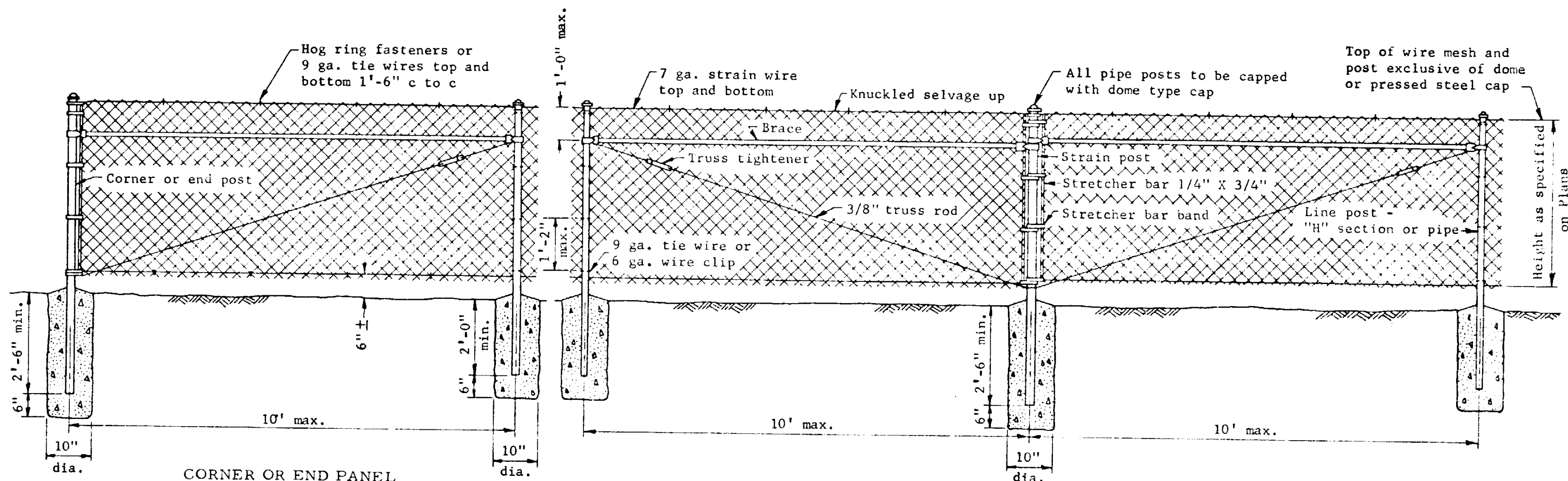
For any details not shown on this sheet, refer to Std. C-12.01

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## SUPPLEMENTAL FENCE DETAILS

Drawn	LOM, KS, EC-1-1-1	Drawing No.
Traced	D.G. 3-1-1	
Checked	J.P.O. 890 5-63	
Approved	Engr. Plans	
	5-63	C-12.02

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11-14-68



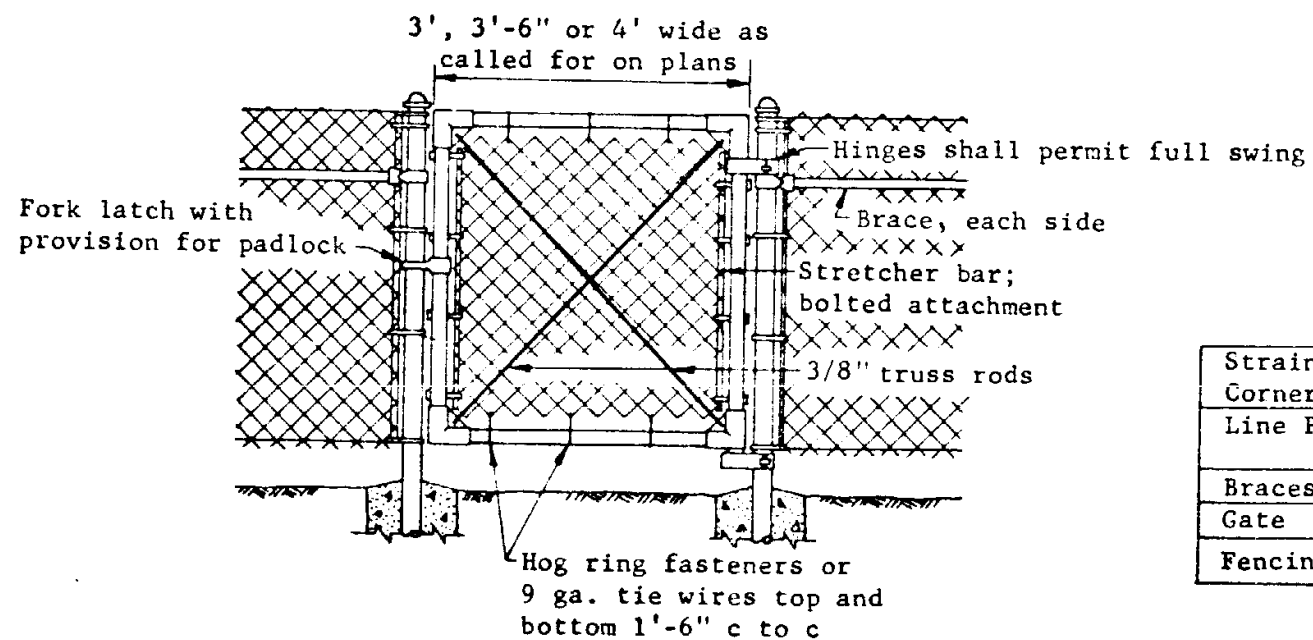
CORNER OR END PANEL

STRAIN PANEL

To be spaced at 500' maximum intervals

#### GENERAL NOTES

- All concrete shall be Class A.
- Gates shall be of welded or malleable cast or pressed steel fitting construction.
- Fittings not specifically detailed shall be of approved heavy duty design.
- "H" Section posts shall be capped with pressed steel top.



WALK GATE

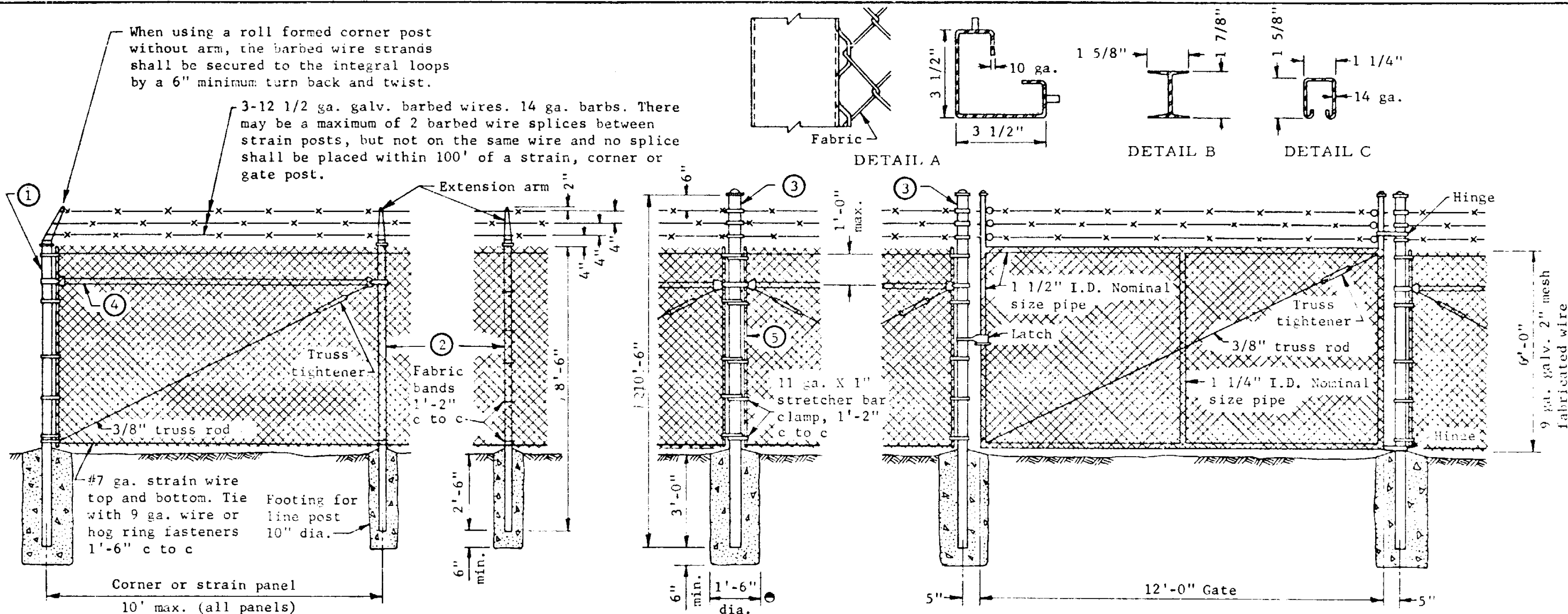
Strain, End & Corner Posts	2" I.D. Nominal size pipe
Line Posts	1 1/2" I.D. Nominal size pipe "H" Sec. 1 7/8" X 1 5/8" Nominal size
Braces	1 1/4" I.D. Nominal size pipe
Gate	1 1/2" I.D. Nominal size pipe
Fencing	9 ga., 2" mesh fabricated wire

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## FENCE CHAIN LINK

Drawn	L.O.M. 2-58	Drawing No.  <b>C-12.03</b>
Traced	R.A.F. 11-67	
Checked	J.P.O. 870 5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	



● Footing for Strain, End, Corner and Gate Posts

Note: For Walk Gate, see Std. C-12.03.

Fencing shall be 9 ga., 2" mesh, fabricated wire.

Fence Using Pipe Members		
Member	Size	Lgth.
① Corner post	3 1/2" I.D. nominal pipe size	9'-0"
② Line post	1 1/2" I.D. nominal pipe size	8'-6"
③ Strain or gate post	3 1/2" I.D. nominal pipe size	10'-6"
④ Brace	1 1/4" I.D. nominal pipe size	as req'd.
⑤ Stretcher bar	1/4" x 3/4" flat	6'-2"
Fence Using Roll Formed Members		
① Corner post	5.14# /ft. section with integral fabric loops per Detail A or equal	9'-0"
② Line post	2.72# /ft. section per Detail B or equal	8'-6"
③ Strain or gate post	3 1/2" I.D. nominal pipe size	10'-6"
④ Brace	1.35# /ft. section per Detail C or equal	as req'd.
⑤ *Stretcher bar	1/4" X 3/4" flat	6'-2"

\* Not used with corner post having integral fabric loops. (See Detail A)

**GENERAL NOTES**

All concrete shall be Class A.

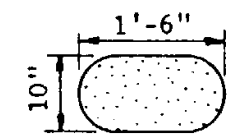
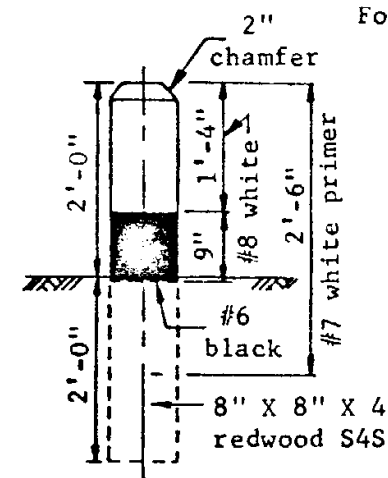
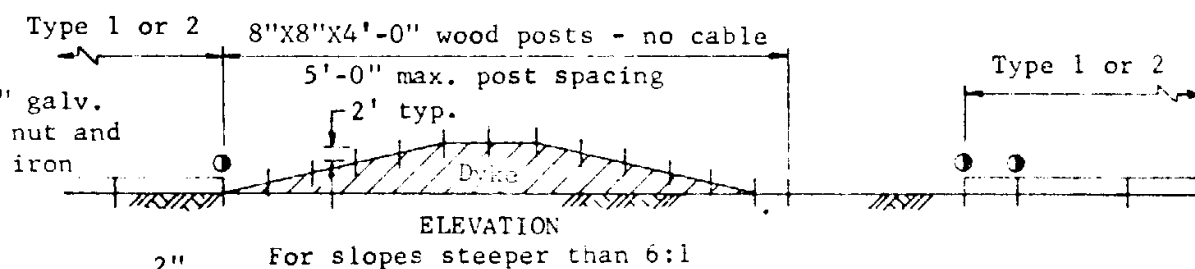
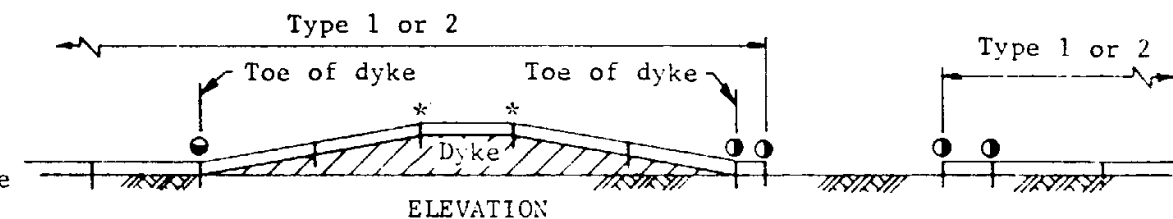
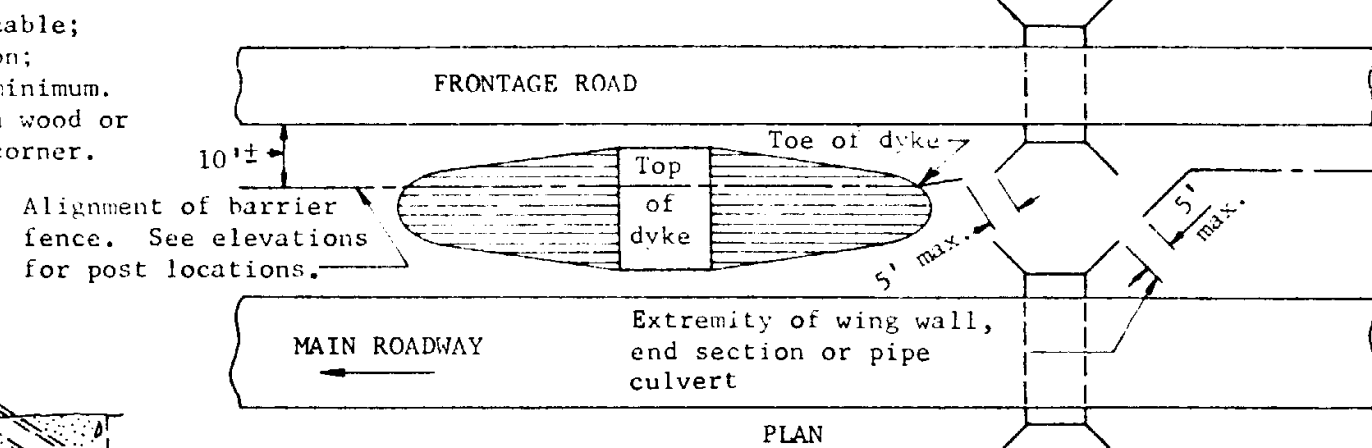
Gates shall be of welded or malleable cast or pressed steel fitting construction.

Fittings not specifically detailed shall be of approved heavy duty design.

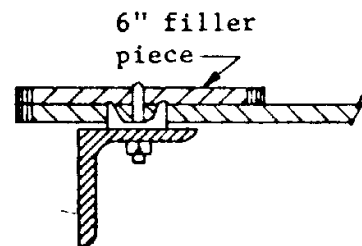
Strain posts shall be spaced at 500' maximum intervals and both corner and strain posts shall have strain panels each side.

All pipe posts shall be capped.

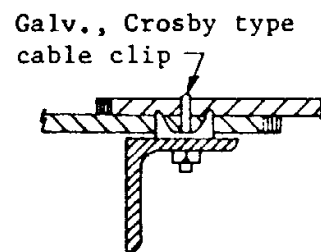
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
FENCE-INDUSTRIAL TYPE, FABRICATED WIRE			
Drawn	L.O.M. 3-65	Drawing No.  C-12.04	
Traced	R.A.F. 1-68		
Checked	J.P.O. JPC 5-68		
Approved Engr. Plans	W.H. Miller 5-68		



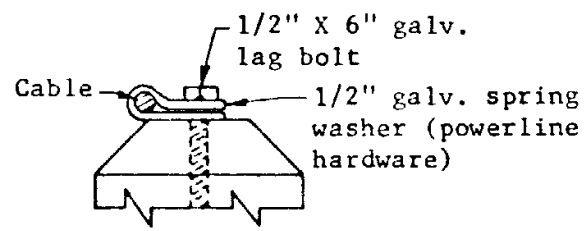
SECTION A-A



SECTION C-C



SECTION B-B



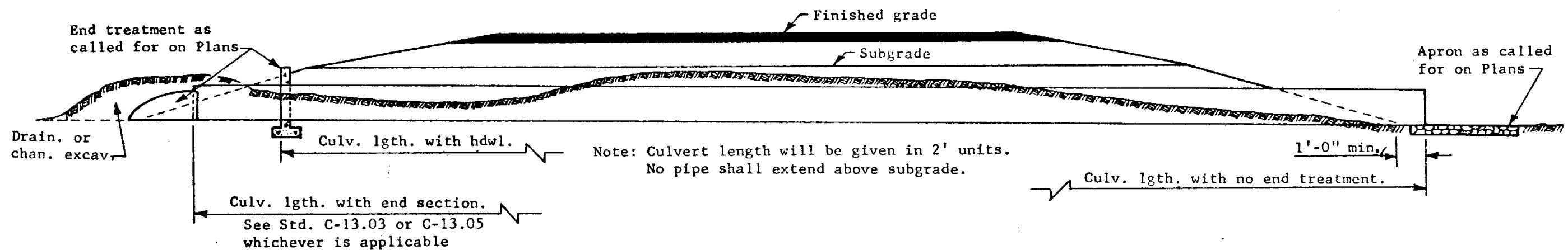
SECTION D-D

\*\*\*Maximum distance between end post and cable splices. Place turnbuckle approximately mid-way between end posts.

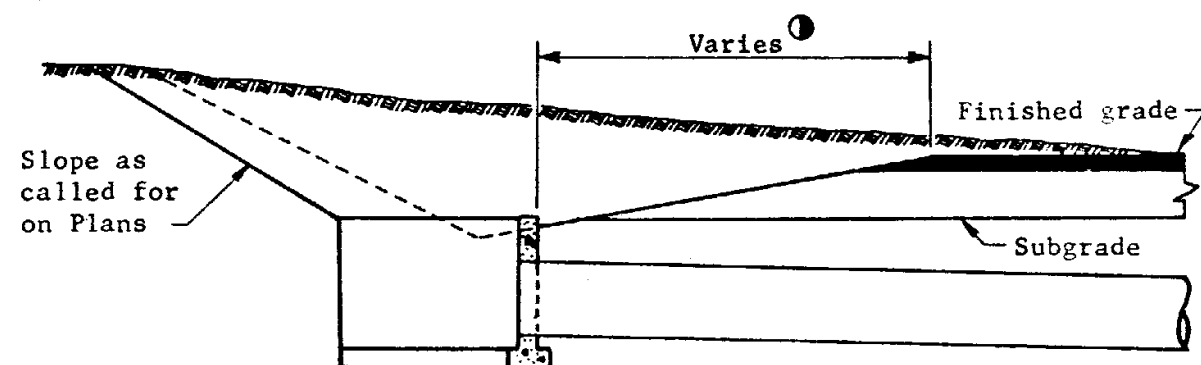
### GENERAL NOTES

All concrete shall be Class A.  
Wood posts for barrier fence shall be rough, pressure treated.  
Steel posts for barrier fence shall be painted green with white tops.  
Barrier posts shall be S4S redwood, untreated.  
All cable ends shall be wrapped with galvanized tie wire in accordance with the cable manufacturer's recommendations.  
Barrier fence shall be used only to prevent crossings between roadways and shall not be used where guard rail is required or where physical barriers are present.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
BARRIER FENCE AND BARRIER POST		
Drawn	D.G. 10-66	Drawing No.  <b>C-12.05</b>
Traced	S.L.T. 10-67	
Checked	J.P.O. <i>90 5-68</i>	
Approved Engr. Plans	<i>W. H. H. 5-68</i>	



EMBANKMENT INSTALLATION



CUT INSTALLATION

① Width of cut ditch minus 1'-0".

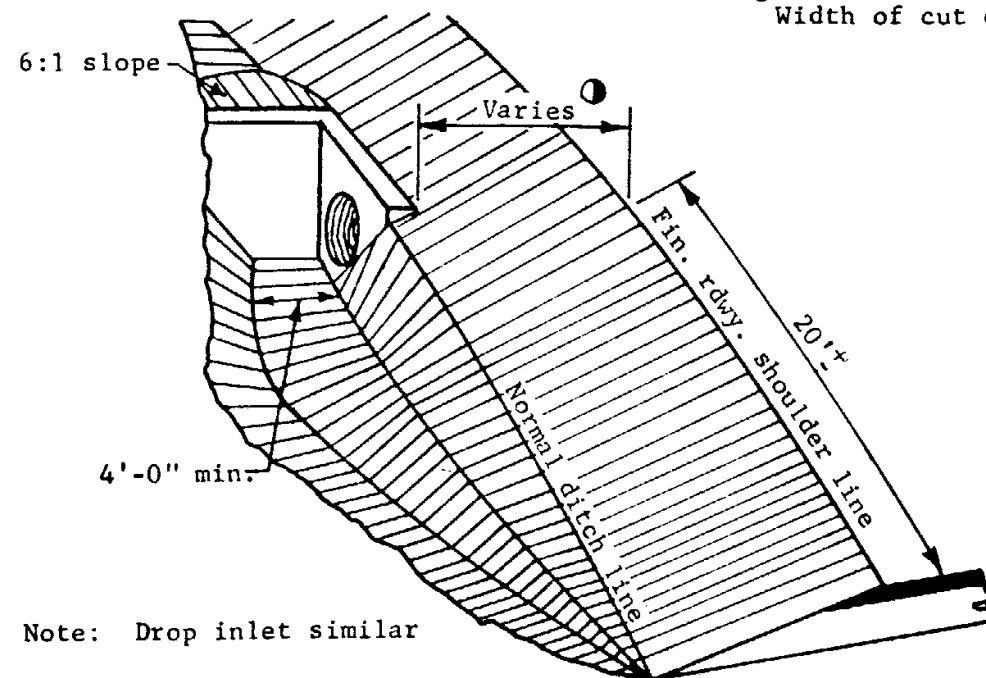
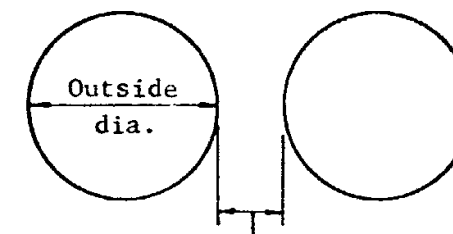
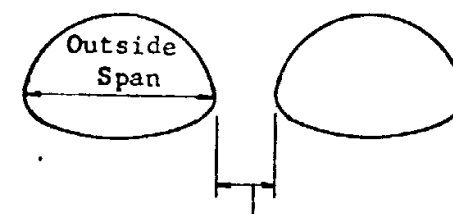


FIGURE A



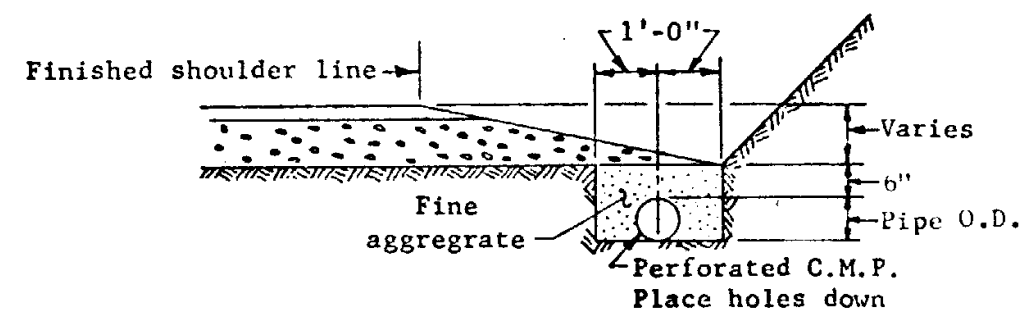
Diameter	*Minimum space between pipes
12" to 24"	1'-0"
30" to 66"	One-half diameter of pipe
72" to 84"	3'-0"

\*When headwalls are used, space as per headwall standard.

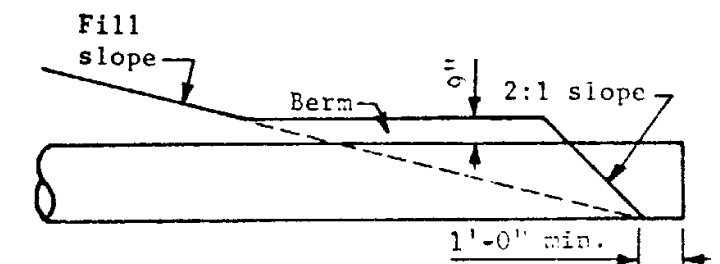


Span	Minimum space between pipe arches
18" to 36"	1'-0"
43" to 72"	One-third span of pipe arch

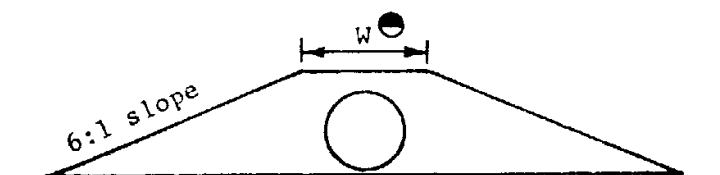
SPACING FOR MULTIPLE INSTALLATIONS



PERFORATED C.M.P. INSTALLATION



Side Elevation



End Elevation

● W for outlet end = 4' + pipe dia.

Berm shall be constructed as noted on plans.

#### GENERAL NOTES

Additional excavation shall be required, as shown in Figure A, when headwalls are located in a cut ditch.

Headwall shall not extend more than 3" above the embankment slope and in no case above the shoulder elevation.

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## PIPE CULVERT INSTALLATION

Drawn D.G. 3-68

Traced D.G. 3-68

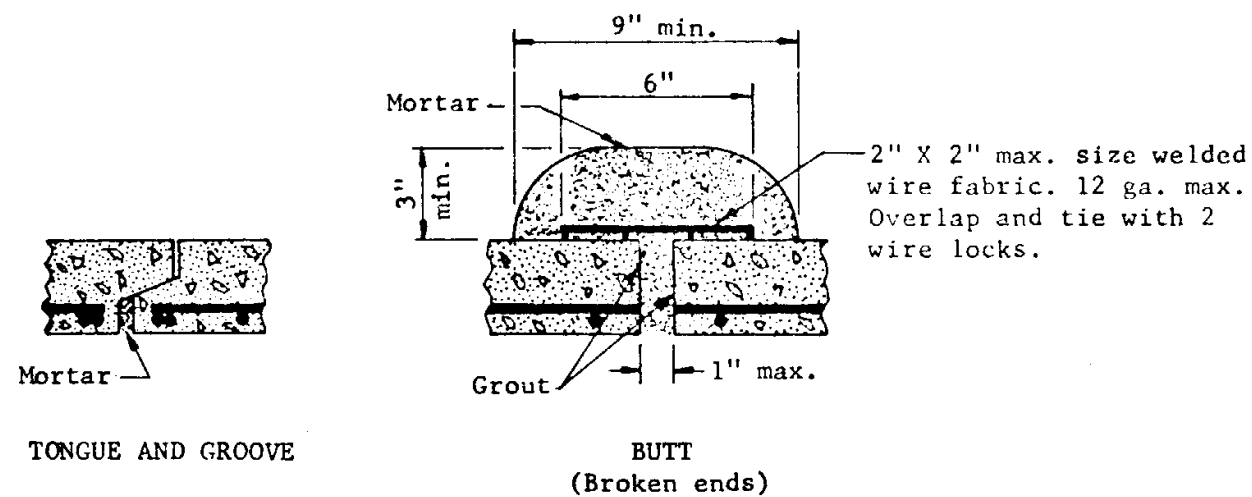
Checked J.P.O. 8-5-68

Approved  
Engr. Plans *Heidrich 5-68*

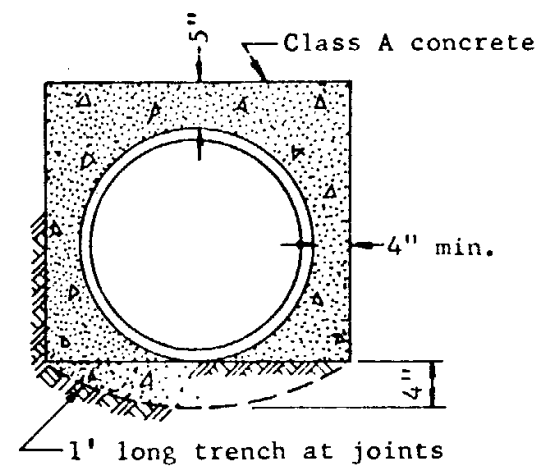
Drawing No.

C-13.01





MORTAR JOINTS

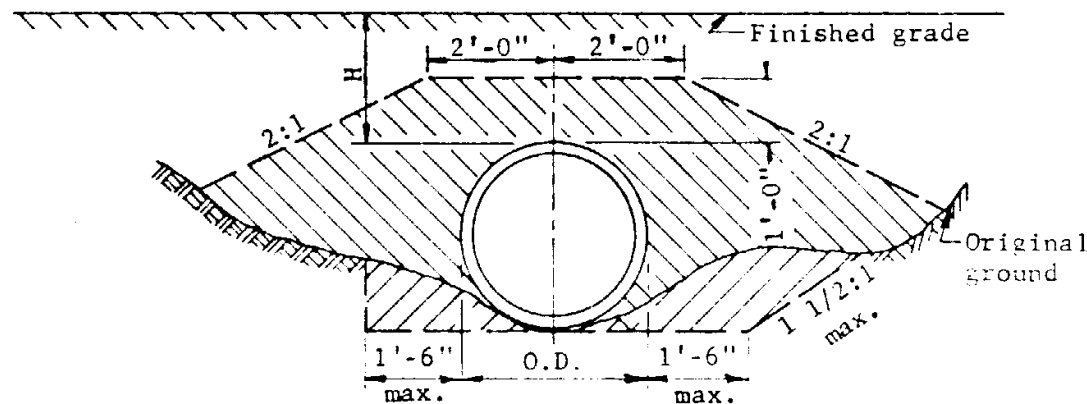


CONCRETE ENCASEMENT

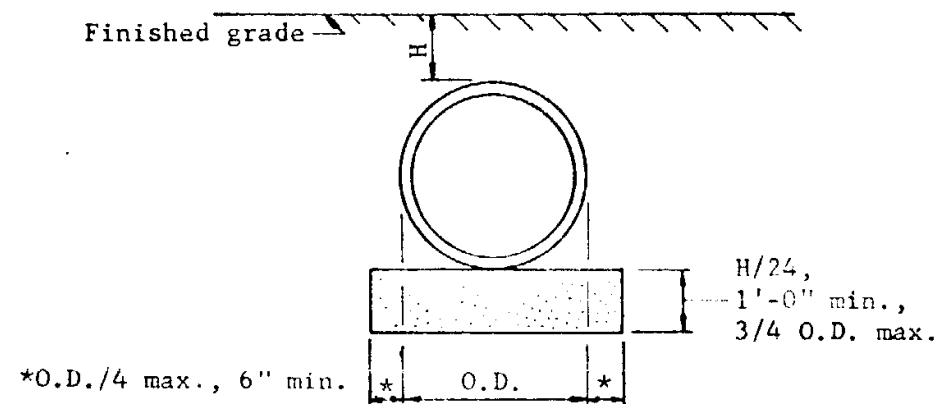
**GENERAL NOTES**  
 Rubber gasketed joints shall be used on irrigation and storm sewer lines unless mortar joints are specified.

Cross drains with tongue and groove joints will not require external mortar bands.

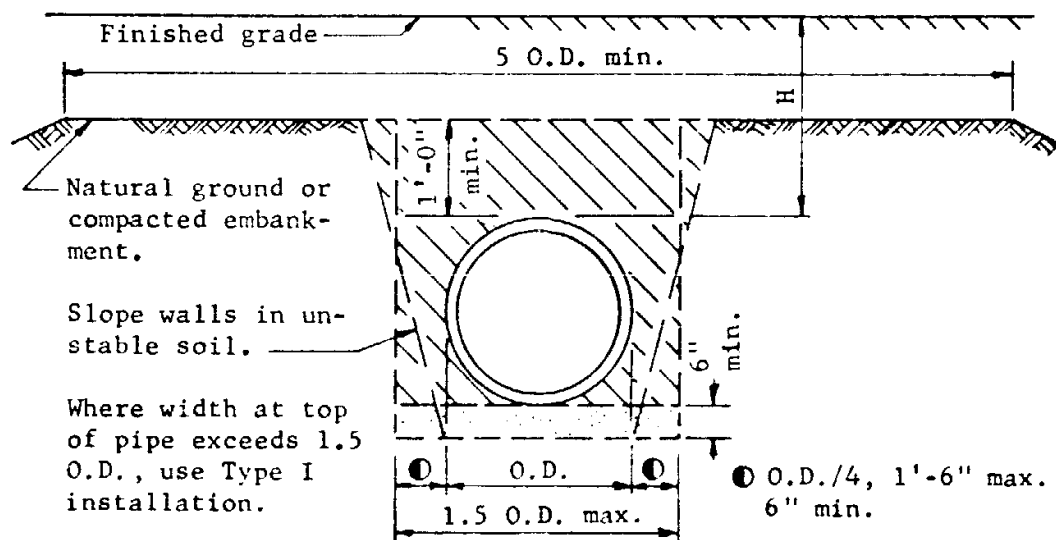
For minimum cover and maximum fill heights on concrete pipes, refer to Std. C-13.03.



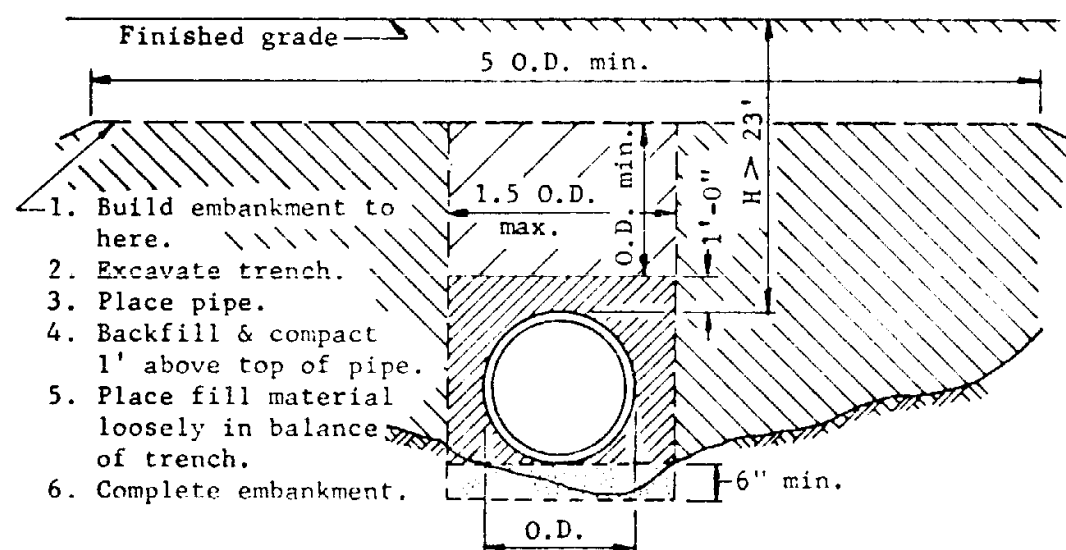
TYPE 1 - POSITIVE PROJECTING



SOLID ROCK OR OTHER UNYIELDING MATERIAL



TYPE 2 - NEGATIVE PROJECTING



TYPE 3 - IMPERFECT TRENCH

1. Build embankment to here.
2. Excavate trench.
3. Place pipe.
4. Backfill & compact 1' above top of pipe.
5. Place fill material loosely in balance of trench.
6. Complete embankment.

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# REINFORCED CONCRETE PIPE PLACEMENT

Drawn	R.E.W.	3-58	Drawing No.  <b>C-13.02</b>
Traced	S.L.T.	7-67	
Checked	J.P.O.	900 5-68	
Approved Engr. Plans	4/11/68 5-68		



HORIZONTAL ELLIPTICAL PIPE											VERTICAL ELLIPTICAL PIPE																				
Size	Area of Open'g	HE II			HE III			HE IV			Size	Area of Open'g	VE II			VE III			VE IV			VE V			VI						
		Crack D Load 1000			Crack D Load 1350			Crack D Load 2000					Crack D Load 1000			Crack D Load 1350			Crack D Load 2000			Crack D Load 3000			Crack D Load 4000						
		Min.	Type		Min.	Type		Min.	Type				Min.	Type		Min.	Type		Min.	Type		Min.	Type		Min.	Type					
			(1)	(2)		(1)	(2)		(1)	(2)				(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)		(1)	(2)	(1)	(2)	(1)	(2)
14 x 23	1.8				2	13	20	1	20	NL	45 x 29	7.4	2	15	15	2	23	40	88	1	35	NL	NL	1	NL	NL	NL	1	NL	NL	NL
19 x 30	3.3				2	13	15	1	20	NL	49 x 32	8.8	2	15	15	2	18	30	78	1	28	NL	NL	1	NL	NL	NL	1	NL	NL	NL
22 x 34	4.1				2	13	15	1	20	40	53 x 34	10.2	2	15	15	2	18	25	70	1	27	NL	85	1	NL	NL	NL	1	NL	NL	NL
24 x 38	5.1	2	10	10	2	13	15	1	20	30	60 x 38	12.9	2	15	15	2	18	20	70	1	27	55	80	1	65	NL	NL	1	75	NL	NL
27 x 42	6.3	2	10	10	2	13	13	1	20	25	68 x 43	16.6	2	15	15	2	18	20	70	1	27	40	80	1	50	NL	NL	1	55	NL	NL
29 x 45	7.4	2	10	10	2	13	13	1	20	25	76 x 48	20.5	2	15	15	2	18	18	70	1	27	35	77	1	40	NL	NL				
32 x 49	8.8	2	10	10	1	13	13	1	20	22	83 x 53	24.8	2	15	15	2	18	18	70	1	27	30	77	1	35	NL	NL				
34 x 53	10.2	2	10	10	1	13	13	1	20	22	91 x 58	29.5	2	15	15	2	18	18	70	1	27	30	74								
38 x 60	12.9	2	10	10	1	13	13	1	20	22	98 x 63	34.6	2	15	15	2	18	18	70	1	27	30	74								
43 x 68	16.6	1	10	10	1	13	13	1	20	22	106 x 68	40.1	2	15	15	2	18	18	70	1	27	30	74								
48 x 76	20.5	1	10	10	1	13	13	1	20	22																					
53 x 83	24.8	1	10	10	1	13	13	1	20	22																					
58 x 91	29.5	1	10	10	1	13	13	1	20	22																					
63 x 98	34.6	1	10	10	1	13	13	1	20	22																					
68 x106	40.1	1	10	10	1	13	13	1	20	22																					

NOTE: NL indicates no limit.

ROUND PIPE																			
Size	Area of Open'g	CLASS I			CLASS II			CLASS III				CLASS IV				CLASS V			
		Crack D Load 800			Crack D Load 1000			Crack D Load 1350				Crack D Load 2000				Crack D Load 3000			
		Min.	Type		Min.	Type		Min.	Type			Min.	Type			Min.	Type		
			(1)	(2)		(1)	(2)		(1)	(2)	(3)		(1)	(2)	(3)		(1)	(2)	(3)
12	0.8	3	8	9	3	11	14	3	40	NL	NL	2	NL	NL	NL	1	NL	NL	NL
15	1.2	3	8	9	3	11	14	3	30	NL	NL	2	60	NL	NL	1	NL	NL	NL
18	1.8	3	8	9	3	11	14	3	25	NL	NL	2	40	NL	NL	1	NL	NL	NL
21	2.4	3	8	9	3	11	14	2	20	30	44	1	30	NL	NL	1	NL	NL	NL
24	3.1	3	8	9	3	11	11	2	15	20	39	1	25	NL	NL	1	NL	NL	NL
30	4.9	3	8	9	3	11	11	2	15	20	35	1	23	NL	65	1	60	NL	NL
36	7.1	3	8	9	3	11	11	2	15	15	35	1	23	40	62	1	45	NL	NL
42	9.6	3	8	9	2	11	11	2	15	15	35	1	23	30	62	1	35	NL	NL
48	12.6	3	8	9	2	11	11	2	15	15	35	1	23	26	59	1	32	NL	100
54	15.9	3	8	9	2	11	11	2	15	15	35	1	23	24	59	1	32	60	95
60	19.6	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	48	90
66	23.8	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	47	85
72	28.3	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	43	85
78	33.2	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	43	85
84	38.5	3	8	9	2	11	11	2	15	15	35	1	23	23	57	1	32	43	85
90	44.2	3	8	9	2	11	11	2	15	15	34	1	23	23	56	1	32	43	85
96	50.3	3	8	9	2	11	11	2	15	15	33	1	23	23	54	1	32	43	80
102	56.7	3	8	9	2	11	11	2	15	15	31	1	23	23	52	1	32	43	80
108	63.6	3	8	9	2	11	11	2	15	15	30	1	23	23	50	1	32	43	80

#### GENERAL NOTES

All fill heights are measured in feet from finished grade to top of pipe.  
Minimum fill heights shall be as noted except no pipe shall extend above subgrade.

For cases not covered hereon, special designs may be prepared.

Type refers to type of placement.

For other details see Std. C-13.02.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev	
FILL HEIGHTS FOR REINFORCED CONCRETE PIPE			
Drawn	J.P.O. 7-65		
Traced	S.L.T. 8-67		
Checked	J.P.O. 9-68		
Approved	Eng. Plans	Drawing No. <b>C-13.03</b>	
5-68			

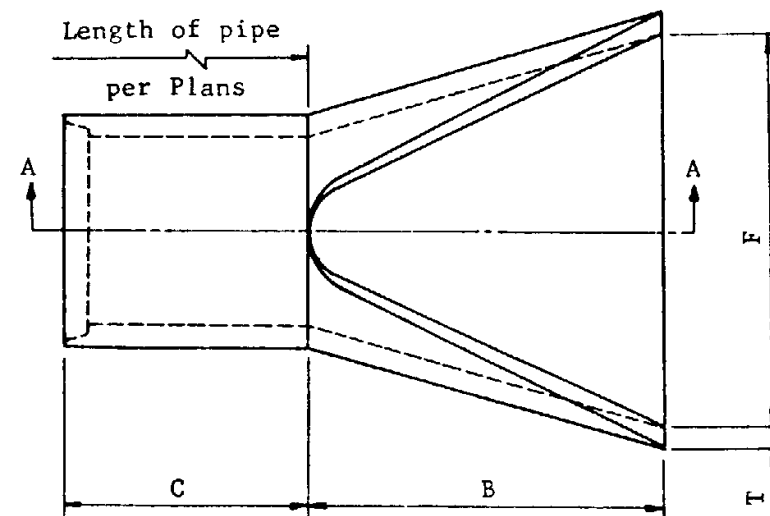
PIPE DIA.	APPROX. WEIGHT	DIMENSIONS - INCHES						APPROX. SLOPE
		T	A	B	C	E	F	
24	1520#	3	9 $\frac{1}{2}$	43 $\frac{1}{2}$	30	73 $\frac{1}{2}$	48	3
27	1930#	3 $\frac{1}{2}$	10 $\frac{1}{2}$	49 $\frac{1}{2}$	24	73 $\frac{1}{2}$	54	3
30	2190#	3 $\frac{1}{2}$	12	54	19 $\frac{1}{2}$	73 $\frac{1}{2}$	60	3
36	4100#	4	15	63	34 $\frac{1}{2}$	97 $\frac{1}{2}$	72	3
42	5380#	4 $\frac{1}{2}$	21	63	35	98	78	3
48	6550#	5	24	72	26	98	84	3
54	8240#	5 $\frac{1}{2}$	27	65	33 $\frac{1}{4}$	98 $\frac{1}{2}$	90	2 $\frac{1}{2}$

# GENERAL NOTES

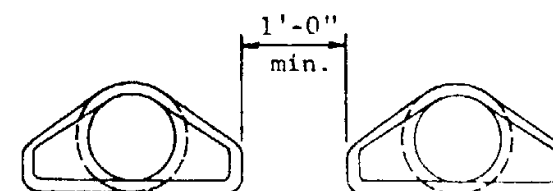
Design of end section shall conform to standards for reinforced concrete pipe.

End section joint conformation shall match the pipe joints.

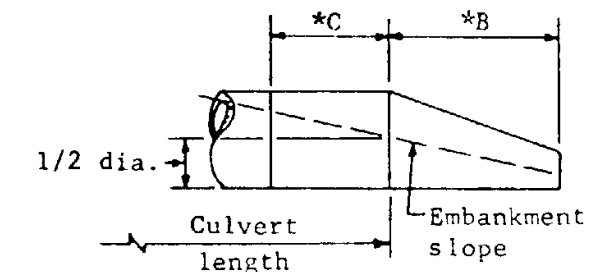
Embankment slope shall be warped to match slope of end section.



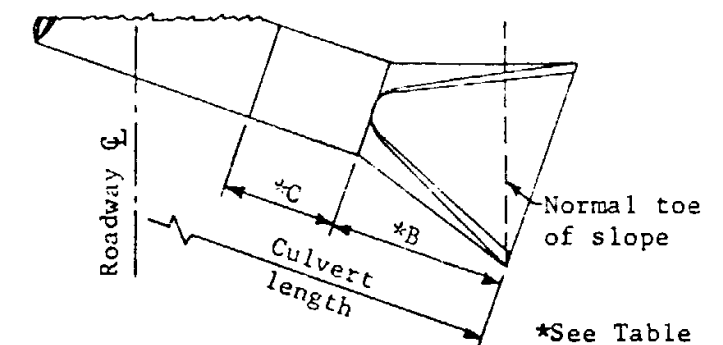
PLAN



SPACING FOR MULTIPLE INSTALLATION

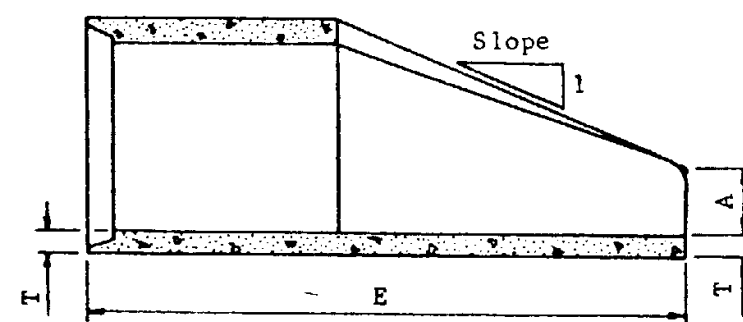


Right Angle Culvert

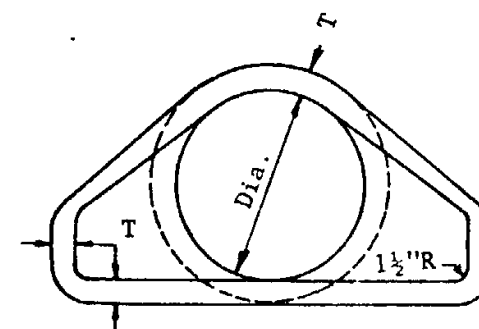


Skewed Culvert

CULVERT LENGTH AS SHOWN ON PLANS



SECTION A-A



FRONT ELEVATION

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## END SECTION REINFORCED CONCRETE PIPE

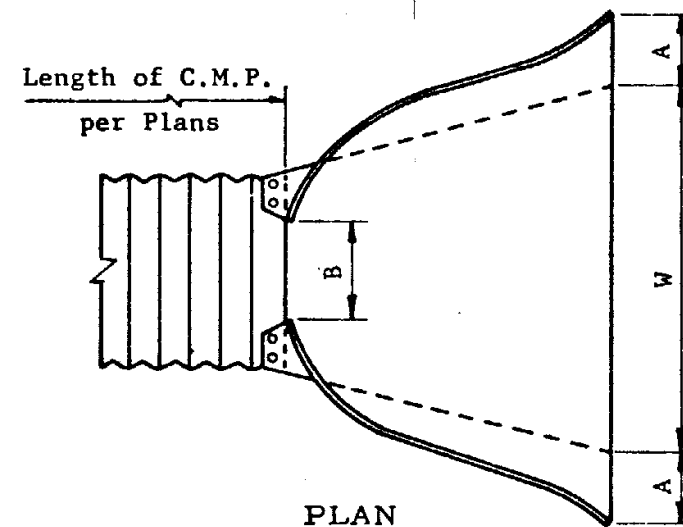
Drawn D.G. - 4-67  
Traced S.L.T. - 5-67  
Checked J.P.O. 8/20 5-68  
Approved  
Engr. Plans *[Signature]* 5-68

Drawing No.

C-13.04

Rev

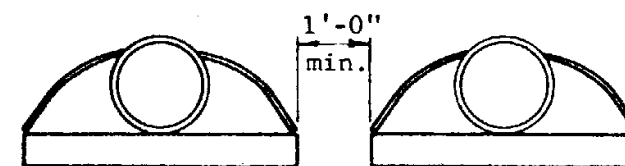




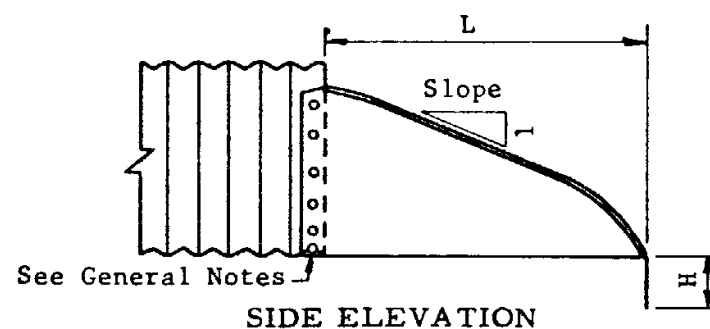
PLAN

PIPE DIA.	GA.	DIMENSIONS - INCHES					APPROX. SLOPE
		A $\pm 1$	B Max.	H $\pm 1$	L $\pm 1\frac{1}{2}$	W $\pm 2$	
24	16	10	13	6	41	48	2 1/2
30	14	12	16	8	51	60	2 1/2
36	14	14	19	9	60	72	2 1/2
42	12	16	22	11	69	84	2 1/2
48	12	18	27	12	78	90	2 1/4
54	12	18	30	12	84	102	2

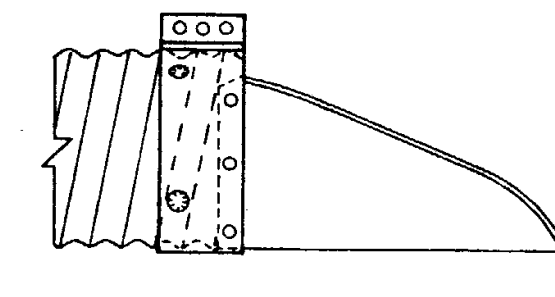
PIPE ARCH		GA.	DIMENSIONS - INCHES					APPROX. SLOPE
SPAN	RISE		A $\pm 1$	B Max.	H $\pm 1$	L $\pm 1\frac{1}{2}$	W $\pm 2$	
29	18	16	9	14	6	32	48	2 1/2
36	22	14	10	16	6	39	60	2 1/2
43	27	14	12	18	8	46	75	2 1/2
50	31	12	13	21	9	53	85	2 1/2
58	36	12	18	26	12	63	90	2 1/2
65	40	12	18	30	12	70	102	2 1/2
72	44	12	18	33	12	77	114	2 1/4



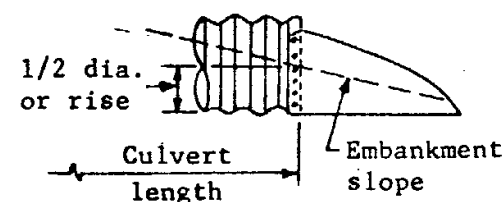
SPACING FOR MULTIPLE INSTALLATION



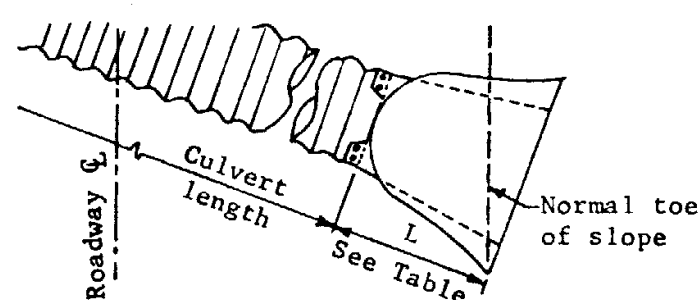
SIDE ELEVATION



SIDE ELEVATION OF INSTALLATION USING ADAPTOR



Right Angle Culvert



Skewed Culvert

CULVERT LENGTH AS SHOWN ON PLANS

#### GENERAL NOTES

The end section shall be joined to the pipe, arch, connector or adaptor by welding, 3/8" bolts or rivets. The maximum allowable spacing of the bolts or rivets shall be 1'-0" but in no case shall there be less than 8 bolts or rivets per joint.

When an adaptor is used, the adaptor shall meet the requirements for a standard coupling band.

End sections comprised of two or more pieces may be field assembled using 3/8" bolts or rivets.

End sections may be joined directly to pipe or pipe arch without use of 24" connectors.

All components of the end section shall be galvanized.

Embankment slope shall be warped to match slope of end section.

When pipe is exposed beyond normal embankment slope, a covering berm shall be added see Std. C-13.01.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

Rev  
12-17-68

END SECTION  
CORRUGATED METAL  
PIPE AND PIPE ARCH

Drawn D.G. 4-67  
Traced R.A.F. 6-67  
Checked J.P.O. 9/20 5-68  
Approved Engr. Plans 4/11/68 5-68

Drawing No.

C-13.05

TABLE I CORRUGATED, CIRCULAR, STEEL PIPE - 2 2/3" X 1/2" ANNULAR OR HELICAL CORRUGATIONS RIVETED, WELDED OR LOCK SEAM FABRICATION H-20 LOADING										
Dia.	16 Ga.--.064"		14 Ga.--.079"		12 Ga.--.109"		10 Ga.--.138"		8 Ga.--.168"	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
12	2	76	2	83						
15	2	60	2	66						
18	3	51	2	56	1	71				
24	3	37	2	41	1	48				
30	3	31	2	33	1	37				
36	3	26	2	28	1	32	1	34		
42	2	26	2	28	2	29	2	31	2	32
48	2	26	2	27	2	28	2	29	2	30
54			2	26	2	27	2	28	2	28
60					2	26	2	27	2	28
66					2	26	2	26	2	27
72							2	26	2	26
78									3	26
84									3	26

TABLE II CORRUGATED, CIRCULAR, STEEL PIPE - 3" X 1" ANNULAR OR HELICAL CORRUGATIONS RIVETED, WELDED, LOCK SEAM H-20 LOADING										
Dia.	16 Ga.--.064"		14 Ga.--.079"		12 Ga.--.109"		10 Ga.--.138"		8 Ga.--.168"	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
36	2	29	2	41	1	56	1	65	1	70
42	2	24	2	35	1	44	1	50	1	60
48	3	21	2	30	1	38	1	42	1	49
54	3	19	2	27	1	34	1	37	1	42
60	3	18	2	24	2	31	2	34	1	37
66	3	16	3	22	2	30	2	32	2	34
72	3	15	3	20	2	29	2	30	2	32
78	3	13	3	18	2	28	2	29	2	31
84			3	18	2	27	2	28	2	29
90			3	17	3	26	3	27	3	28
96					3	24	3	25	3	26
102					3	22	3	24	3	25
108					3	21	3	22	3	23
114							3	21	3	22
120							3	20	3	21

TABLE III STRUCTURAL PLATE PIPE - 6" X 2" CORRUGATIONS BOLTED FABRICATION (4 - 3/4", A-325 bolts per foot of seam) * H-20 LOADING																
Dia.	12 Ga.		10 Ga.		8 Ga.		7 Ga.		5 Ga.		3 Ga.		1 Ga.			
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
60	1	39	1	57	1	66	75	1	71	86	1	79	158	1	88	176
72	1	32	1	46	1	49	63	1	52	72	1	56	87	1	61	122
84	1	28	1	38	1	40	54	1	42	62	1	45	74	1	48	88
96	2	24	2	34	2	35	47	2	36	54	2	38	65	2	40	77
108	2	21	2	31	2	32	42	2	33	48	2	34	58	2	36	67
120	2	19	2	29	2	30	37	2	31	42	2	32	52	2	33	60
132	3	18	3	26	3	29	33	3	29	39	3	30	46	3	31	55
144	3	16	3	23	3	28	31	3	28	36	3	29	42	3	29	51
156	3	15	3	21	3	27	29	3	27	33	3	28	40	3	28	47
168	3	14	3	19	3	26		3	27	30	3	27	37	3	28	43
180	3	13	3	18	3	24		3	27	29	3	27	34	3	27	41
192			3	18	3	23		3	27	32	3	27	38	3	27	38
204			4	17	4	22		4	26	30	4	26	36	4	27	36
216					4	20		4	26	29	4	26	34	4	26	34
228					4	20		4	26		4	26	32	4	26	32
240								4	26		4	26	30	4	26	30
252								4	25		4	26	30	4	26	30

NOTE: (1) indicates circular pipe.  
(2) indicates 5" vertically elongated pipe.  
When sizes below heavy line are used, design calculations shall be prepared and submitted for checking.

\* Bolts shall be torqued to not less than 200 ft. lbs. nor greater than 300 ft. lbs.

#### GENERAL NOTES

All fill heights are measured, in feet, from finished grade to top of pipe.

Minimum fill heights shall be as noted except no pipe shall extend above the subgrade.

Fill heights over 100' shall be used only after a thorough investigation of the foundation material.

All corrugated metal pipe and appurtenant parts shall be galvanized.

For installation details, see Std. C-13.01.

For fill height design data, see Std. C-13.07.

*Gauge change C*

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
CORRUGATED METAL PIPE DESIGN FILL HEIGHTS		
Drawn	D.G.	Drawing No.
Traced	S.L.T. 9-67	
Checked	J.P.O. 770 5-68	
Approved		
Engr. Plans	J. Heisler 5-68	
		<b>C-13.06</b>

2 2/3" X 1/2" Corrugations						3" X 1" Corrugations						6" X 2" Corrugations					
Gage	A <sub>s</sub>	I	r	C <sub>u</sub>		A <sub>s</sub>	I	r	C <sub>u</sub>			A <sub>s</sub>	I	r	C <sub>u</sub>		
				1 rivet	2 rivet				2-5/16 rivets	2-3/8 rivets	2-7/16 rivets				4-bolts ft.	6-bolts ft.	8-bolts ft.
16	.0646	.001892	.1726	16750	21500	.0742	.008658	.3452	19200	25800							
14	.0808	.002392	.1726	18200	29800	.0927	.010833	.3452	26500	34300							
12	.1130	.003425	.1726	23400	46800	.130	.015458	.3452		41600	53000	.1297	.060416	.688	42000		
10	.1454	.004533	.1726	24500	49000	.1674	.020175	.3452		43500	61000	.1669	.078166	.688	62000		
8	.17775	.005725	.1726	25600	51300	.2048	.025083	.3452		45600	64000	.2041	.096166	.688	81000		
7												.2283	.1078	.688	93000		
5												.2666	.126916	.688	112000		
3												.3048	.146166	.688	132000		
1												.3432	.165833	.688	144000	184000	220000
3/8"												.4680	.232	.688			270000

7/8" bolts. All other 6" X 2" C<sub>u</sub> values are for 3/4" bolts.

#### Criterion 1. DEFLECTION OF PIPE

$$\text{Formula 1(a) } I(\text{for circular pipe}) = \frac{2.31 R^3 h - 57.3 R^3}{26,800,000}$$

Formula 1(b) I(for 5% vertically elongated pipe)=Substitute h/2 for h in 1a. Solve 1a for I and determine required gauge and corrugation from table. If 6" X 2" corrugation is indicated, solve for I in 1(b) to determine gauge required for elongated pipe. If I is negative, metal thickness required is less than the minimum tabular value.

#### Criterion 2. LONGITUDINAL SEAM STRENGTH

$$\text{Formula 2(a) } C_a = \frac{Dh}{0.0046}$$

Solve for C<sub>a</sub> and determine gauge and corrugation from table of C<sub>u</sub> values.

#### Criterion 3. BUCKLING OF PIPE WALL

$$\text{Formula 3(a) } f_u = 45,000 - 1.4547 \left[ \frac{0.64 R}{r} \right]^2$$

Use r for the corrugation corresponding to the heaviest gauge determined by formulae 1a, 1b and 2a. Solve for f<sub>u</sub> to determine the maximum allowable buckling stress.

$$\text{Formula 3(b) } A_s = \frac{1.805 R h}{f_u}$$

Solve for A<sub>s</sub>, using f<sub>u</sub> value determined in 3a, and select gauge and corrugation from table.

\* When Deflection or Buckling is the control, an increase in the maximum h may be realized by backfilling to 95% Proctor density. This revises the applicable formulae to:

$$\text{Formula 1(a) } I = \frac{2.08 R^3 h - 57.3 R^3}{26,800,000}$$

$$\text{Formula 3(a) } f_u = 45,000 - 1.4547 \left[ \frac{0.44 R}{r} \right]^2$$

#### EXAMPLE

Given: h = 27; D = 15; R = 90  
Find: Gauge and corrugation required.

Solution:  
Deflection of pipe

$$\text{Formula 1(a) } I = \frac{(2.31)(729,000)(27) - (57.3)(729,000)}{26,800,000} = 0.138$$

I values in table indicate a gauge requirement, for circular pipe, of 5 in 6" X 2" corr.

$$\text{Formula 1(b) } I = \frac{(1.155)(729,000)(27) - (57.3)(729,000)}{26,800,000} = -0.711$$

The result being negative indicates a gauge requirement lighter than 12 gauge when pipe is elongated 5% vertically.

#### Longitudinal Seam Strength

$$\text{Formula 2(a) } C_a = \frac{(15)(27)}{0.0046} = 88,000$$

Referring to table, 7 gauge, 6" X 2" corr. is required.

#### Buckling of Pipe Wall

$$\text{Formula 3(a) } f_u = 45,000 - 1.4547 \left[ \frac{(0.64)(90)}{.688} \right]^2 = 34820$$

Note that since a 6" X 2" corr. is indicated by the preceding results, the 6" X 2" value for r is used.

The result (allowable buckling stress) is used in the following formula 3(b) to determine gauge requirement.

$$\text{Formula 3(b) } A_s = \frac{(1.805)(90)(27)}{34820} = 0.126$$

The table indicates a gauge requirement of 12 gauge in 6" X 2" corr.

#### Analysis:

Using vertically elongated pipe, the lightest gauge and corr. that will satisfy all requirements is 7 gauge, 6" X 2" corr. Similarly, with circular pipe the lightest gauge is 5. Since cost-wise the two are comparable, 7 ga., 6" X 2" 5% vertically elongated pipe is selected.

Criteria 1, 2 and 3 embody the factors to be investigated in the design of corrugated metal pipe culverts.

Appurtenant formulae are developed from data supplied by the B.P.R. 1966 publication titled "Corrugated Metal Pipe Culverts - Structural Design Criteria and Recommended Installation Practices." These formulae provide safety factors as follows: Criteria 1 = 3.33; Criteria 2 = 3.33 and Criteria 3 = 2.00.

Constants used are:

Embankment weight/cu. ft. = 130 lbs.  
Embankment density = 90% Proctor.  
Modulus of passive earth resistance = 1000 p.s.i.  
Soil stiffness coefficient = 0.32.  
Deflection lag factor = 1.39.  
Modulus of elasticity = 29,000,000 p.s.i.

Explanation of symbols used:

A<sub>s</sub> = Area/lin. inch of pipe in sq. inches.  
C<sub>a</sub> = Actual ring compression in lb./ft.  
C<sub>u</sub> = Allowable ring compression in lb./ft.  
D = Pipe diameter in ft.  
f<sub>a</sub> = Actual buckling stress in p.s.i.  
f<sub>u</sub> = Allowable buckling stress in p.s.i.  
h = Fill height; fin. grade to top of pipe in ft.  
I = Moment of inertia of pipe wall in inches<sup>4</sup>/inch.  
R = Radius of pipe in inches.  
r = Radius of gyration of pipe wall in inches.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 12.5.68
CORRUGATED METAL PIPE FILL HEIGHT DESIGN DATA			
Drawn	D.G. 9-67	Drawing No.	
Traced	S.L.T. 10-67		
Checked	J.P.O. 800 5-68		
Approved			
Engr. Plans	M. H. H. 5-68	C-13.07	

TABLE 1-A CORRUGATED, STEEL PIPE ARCH. 2 2/3" X 1/2" CORRUGATIONS. RIVETED, WELDED OR LOCK SEAM FABRICATION. H-20 LOADING												
Size - In. Span X Rise	Opening Area Sq. Ft.	Corner Radius In.	Fill Heights - Ft.									
			Maximum Corner Pressure = 4000 Lb./Sq. Ft.									
			16 Ga. -.064"		14 Ga. -.079"		12 Ga. -.109"		10 Ga. -.138"		8 Ga. -.168"	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
18 X 11	1.1	3.5	1 1/2	12	1 1/2	12	1 1/2	12	1 1/2	12	1 1/2	12
22 X 13	1.6	4.0	1 1/2	11	1 1/2	11	1 1/2	11	1 1/2	11	1 1/2	11
25 X 16	2.2	4.0	2	10	2	10	2	10	2	10	2	10
29 X 18	2.8	4.5	2	10	2	10	2	10	2	10	2	10
36 X 22	4.4	5.0	2	9	2	9	2	9	2	9	2	9
43 X 27	6.4	5.5	2	8	2	8	2	8	2	8	2	8
50 X 31	8.7	6.0	3	7	3	7	3	7	3	7	3	7
58 X 36	11.4	7.0			3	7	3	7	3	7	3	7
65 X 40	14.3	8.0					3	8	3	8	3	8
72 X 44	17.6	9.0							4	8	4	8

#### GENERAL NOTES

All fill heights are measured from finished grade to top of pipe arch.

Minimum fill heights shall be as noted except no pipe arch shall extend above the subgrade.

To determine fill heights for sizes other than those shown in the tables, use Std. C-13.09 Pipe Arch Design Data.

TABLE 2-A STRUCTURAL PLATE PIPE ARCH. 6" X 2" Corrugations. BOLTED FABRICATION, 4-BOLTS/FT. * H-20 LOADING										
Size Span & Rise	Opening Area Sq. Ft.	Corner Radius In.	Fill Heights - Ft.							
			Max. Corner Pressure = 4000 Lb./Sq. Ft.							
			12 Ga.		10 Ga.		8 Ga.		7 Ga.	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
6'-1" X 4'-7"	22	18	1	15	1	15	1	15	1	15
7'-0" X 5'-1"	28	18	1 1/2	13	1 1/2	13	1 1/2	13	1 1/2	13
7'-11" X 5'-7"	35	18	1 1/2	12	1 1/2	12	1 1/2	12	1 1/2	12
8'-10" X 6'-1"	43	18	1 1/2	10	1 1/2	10	1 1/2	10	1 1/2	10
9'-9" X 6'-7"	52	18	2	9	2	9	2	9	2	9
10'-11" X 7'-1"	61	18	2	8	2	8	2	8	2	8
11'-10" X 7'-7"	71	18			2	7	2	7	2	7
12'-8" X 8'-1"	81	18			3	6	3	6	3	6

\* Bolts shall be torqued to not less than 200 ft. lbs. nor greater than 300 ft. lbs.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION		Rev
CORRUGATED METAL PIPE ARCH DESIGN FILL HEIGHTS		
Drawn	D.G. 10-67	Drawing No.
Traced	S.L.T. 10-67	
Checked	J.P.O. 8PD 5-68	
Approved	<i>Heider</i> 5-68	
Engr. Plans		<b>C-13.08</b>

TABLE I											
2 2/3" X 1/2" Corrugations						6" X 2" Corrugations					
Gage	A <sub>s</sub>	I	r	C <sub>u</sub>		A <sub>s</sub>	I	r	C <sub>u</sub>		
				1 rivet	2 rivet				4-bolts ft.	6-bolts ft.	8-bolts ft.
16	.0646	.001892	.1726	16750	21500						
14	.0808	.002392	.1726	18200	29800						
12	.1130	.003425	.1726	23400	46800	.1297	.060416	.688	42000		
10	.1454	.004533	.1726	24500	49000	.1669	.078166	.688	62000		
8	.1775	.005725	.1726	25600	51300	.2041	.096166	.688	81000		
7						.2283	.1078	.688	93000		
5						.2666	.126916	.688	112000		
3						.3048	.146166	.688	132000		
1						.3432	.165833	.688	144000	184000 220000	

TABLE II			
h or h'	L <sub>L</sub>	L <sub>D</sub>	L <sub>L</sub> +L <sub>D</sub>
1'	1800	130	1930
2'	800	260	1060
3'	600	390	990
4'	400	520	920
5'	250	650	900
6'	200	780	980
7'	175	910	1085
8'	100	1040	1140

For h=9' and over, L<sub>L</sub> is eliminated so total load then becomes h X 130.

#### Criterion I CORNER PRESSURE

Formula 1 (a)  $P = \frac{6S(L_L + L_D)}{R_c}$

Using h, take (L<sub>L</sub> + L<sub>D</sub>) from Table II and solve for P.  
Note: If P>4000, consideration shall be given toward possible special back fill design.

Formula 1 (b)  $(L_L + L_D) = \frac{667R_c}{S}$

Solve for L<sub>L</sub> + L<sub>D</sub>. Use Table II to determine h'.

#### Criterion 2 LONGITUDINAL SEAM STRENGTH.

Formula 2  $C_a = 1.67S (L_L + L_D)$   
Using h, take (L<sub>L</sub> + L<sub>D</sub>) from Table II and solve for C<sub>a</sub>.  
Determine gauge and corr. by comparing C<sub>a</sub> with C<sub>u</sub> values in Table I.

#### Criterion 3 BUCKLING OF PIPE ARCH WALL

Formula 3 (a)  $f_u = 22500 - 0.72735 (3.84S/r)^2$

Formula 3 (b)  $f_u = \frac{S(L_L + L_D)}{24A_s}$

Use r for corrugation indicated by Formula 2  
Equate f<sub>u</sub> from 3(a) in 3(b) and solve for A<sub>s</sub>  
Determine gauge and corrugation from Table I.

#### Criterion 4 DEFLECTION

Formula 4(a)  $\Delta_u = 0.6H$

Formula 4(b)  $\Delta_a = \frac{1.507hSR^3}{29,000,000 I + 61R^3}$

Use value I of heaviest gauge and corrugation required by Criteria 2 and 3. If  $\Delta_u > \Delta_a$ , deflection is satisfactory.

#### EXAMPLE:

Given: 72" X 44" Pipe Arch, h = 15, R<sub>c</sub> = 9.

Find: Gauge, corrugation, h'

Formula 1(a)  $P = \frac{6 \times 6 \times 1950}{9}$

= 7800

Since P>4000 investigation of special backfill and/or corner support design is mandatory.

Formula 1(b)  $(L_L + L_D) = \frac{667 \times 9}{6}$

= 1000

From Table II, h' = 3

Formula 2  $C_a = 1.67 \times 6 \times 1950$   
= 19550

Referring to Table I, 12 ga., 1-rivet, 2 2/3" X 1/2" is satisfactory with respect to seam strength

Formula 3(a)  $f_u = 22500 - 0.72735 \times (3.84 \times 6 / .1726)^2$   
= 9620

Formula 3(b)  $9620 = \frac{6 \times 1950}{24A_s}$

A<sub>s</sub> = 0.0507

Referring to Table I, value of A<sub>s</sub> indicates a lighter gauge than that called for in Formula 2 so 12 ga., 1-rivet, 2 2/3" X 1/2" is safe from buckling.

Formula 4 (a)  $\Delta_u = 0.6 \times 3.67$   
= 2.202

$\Delta_a = \frac{1.507 \times 15 \times 6 \times (3 \times 6 + 3 \times 3.67)^3}{29,000,000 \times 0.003425 + 61 \times (3 \times 6 + 3 \times 3.67)^3}$   
= 2.08

$\Delta_u > \Delta_a$  so deflection is satisfactory.

Criteria 1, 2, 3 and 4 embody the factors to be investigated in the design of corrugated metal pipe arch culverts.

Appurtenant formulae are condensed from data supplied by the 1967 edition of American Iron and Steel Institute's publication titled "Handbook of Steel Drainage and Highway Construction Products" and the B. P. R. 1966 publication titled "Corrugated Metal Pipe Culverts - Structural Design Criteria and Recommended Installation Practices." These formulae provide safety factors of 1, 3.33, 2 and 3.33 respectively for Criteria 1, 2, 3 and 4.

Constants used are the same as for Std. C-13.07, "Corrugated Metal Pipe Fill Height Design Data."

#### Explanation of variable symbols used:

A<sub>s</sub> = Area per lin. inch of pipe arch in sq. in.

C<sub>a</sub> = Actual ring compression in lbs./ft.

C<sub>u</sub> = Allowable ring compression in lbs./ft.

f<sub>u</sub> = Allowable buckling stress in p.s.i.

h = Max. fill height; fin. grade to top of pipe arch.

h' = Min. fill height; fin. grade to top of pipe arch.

I = Moment of inertia of pipe arch wall in inches<sup>4</sup>/inch

R = 3H+3S in inches

r = Radius of gyration of pipe wall in inches.

Δ<sub>u</sub> = Allowable deflection in inches.

Δ<sub>a</sub> = Actual deflection in inches

S = Span in ft.

H = Rise in ft.

R<sub>c</sub> = Corner radius in inches

P = Corner pressure in lbs./sq.ft.

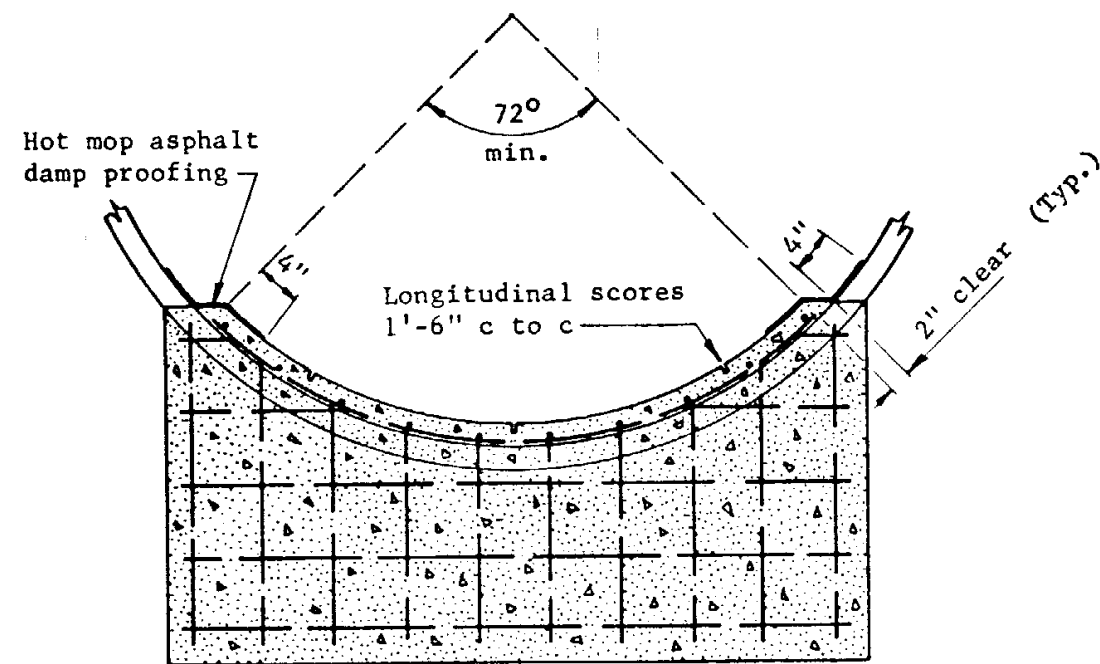
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

Rev  
12-5-68

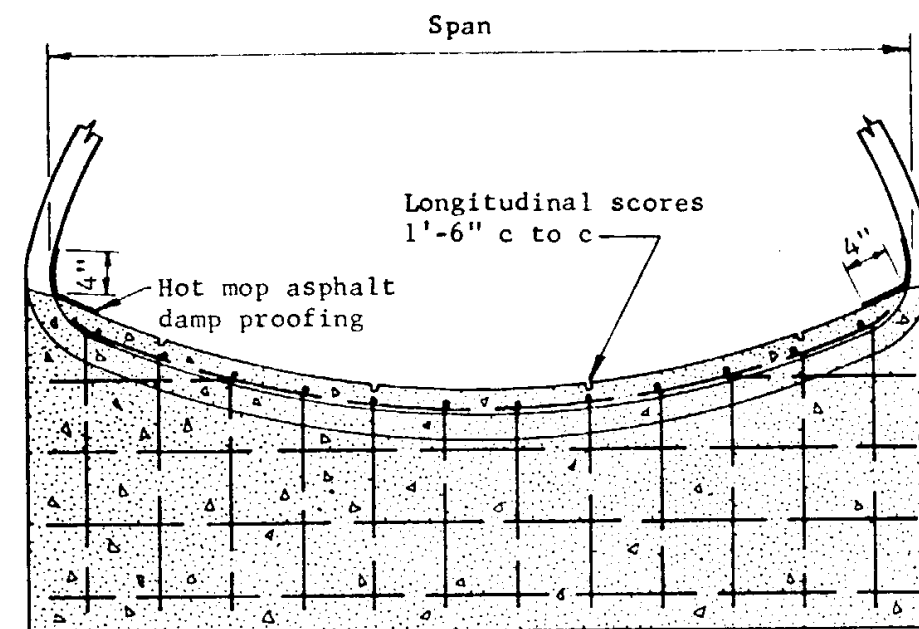
CORR. METAL PIPE ARCH  
FILL HEIGHT  
DESIGN DATA

Drawn	D.G. 10-67	Drawing No.  <b>C-13.09</b>
Traced	R.A.F. 11-67	
Checked	J.P.O. 990 5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	



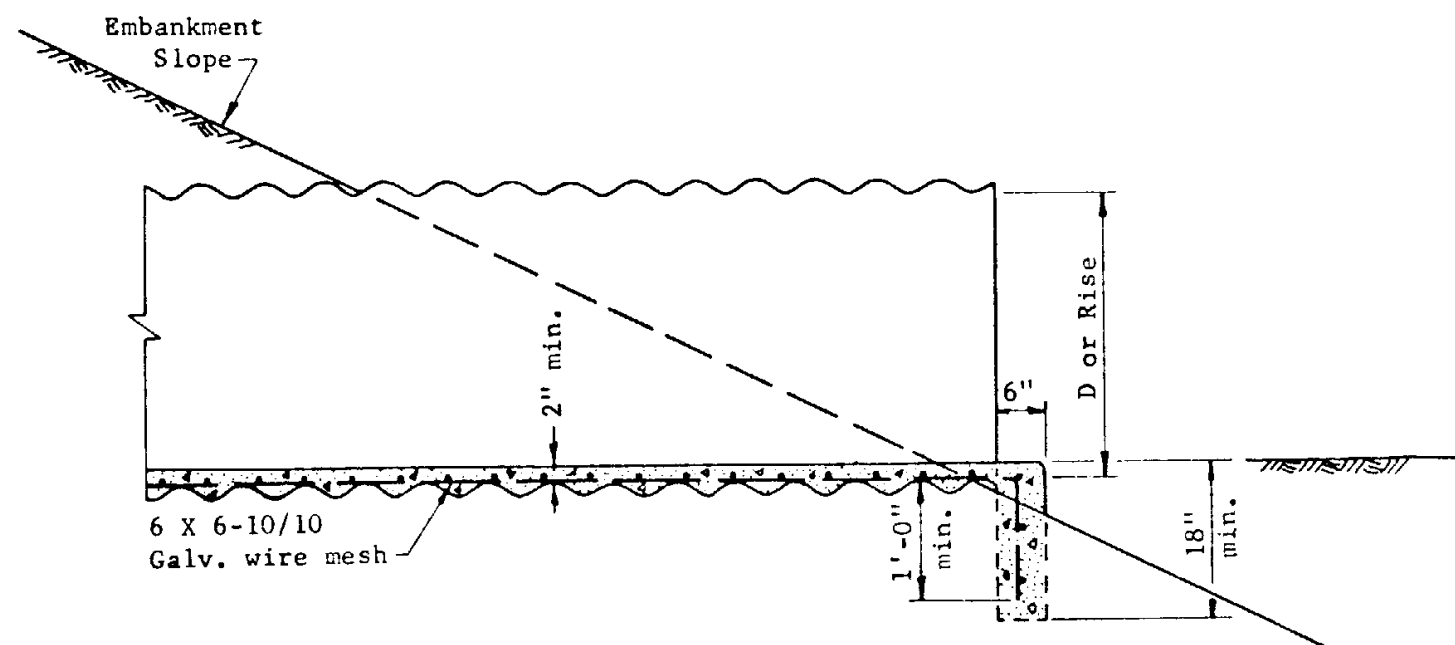


FULL CIRCULAR PIPE,  
C. M. P. OR STRUCTURAL PLATE PIPE



PIPE ARCH OR  
STRUCTURAL PLATE ARCH

# END ELEVATIONS



PIPE & PIPE ARCH  
LONGITUDINAL SECTION

## GENERAL NOTES

The wire mesh shall be fastened or welded in an approved manner to the corrugation crests.

All laps shall be 6" minimum.

Invert paving shall not be placed until fill over pipe is completed.

Concrete shall be Class A or pneumatic mortar.

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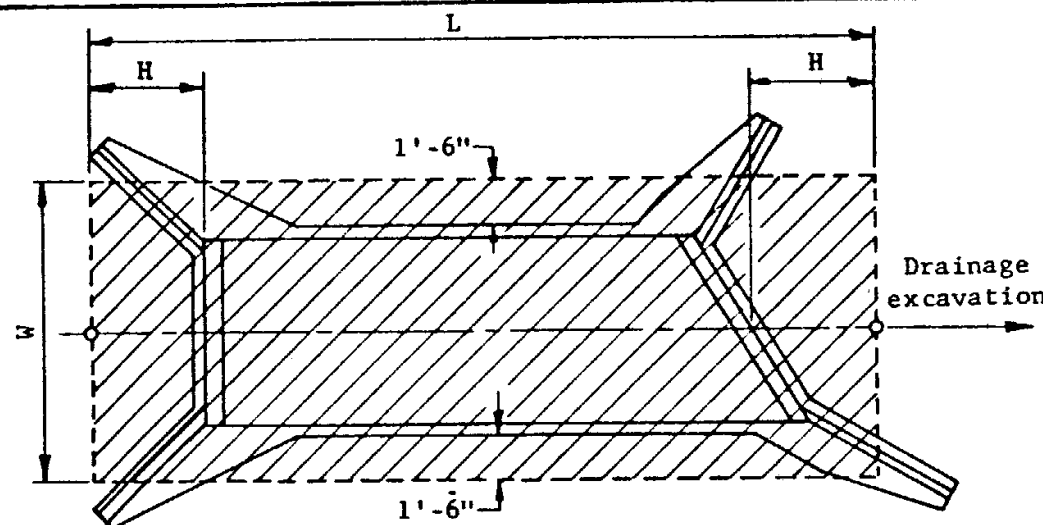
CORRUGATED METAL PIPE  
CONCRETE INVERT  
PAVEMENT

Drawn D.G.  
Traced R.A.F. 5-17-67  
Checked J.P.O. 8PD 5-68  
Approved Engr. Plans *8/6/68*

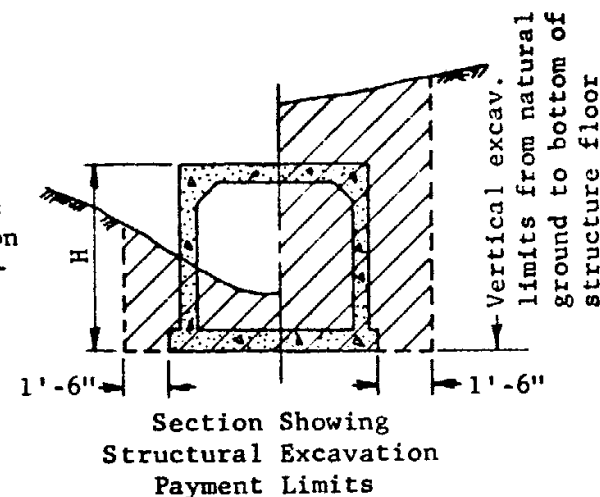
Drawing No.

C-13.10

Rev  
11-14-68

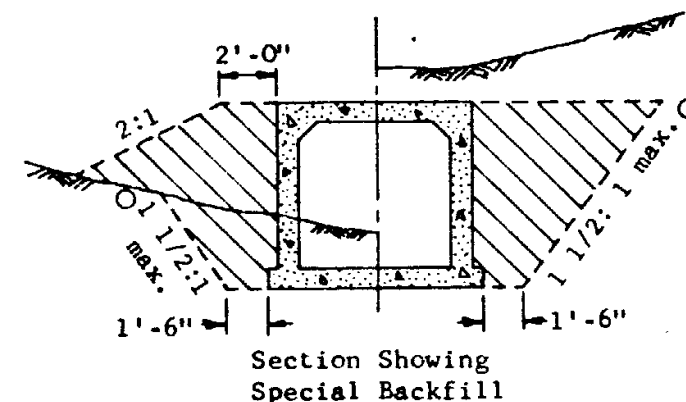


Plan View Showing Structural Excavation Length, L, and Width, W, for Payment Limits

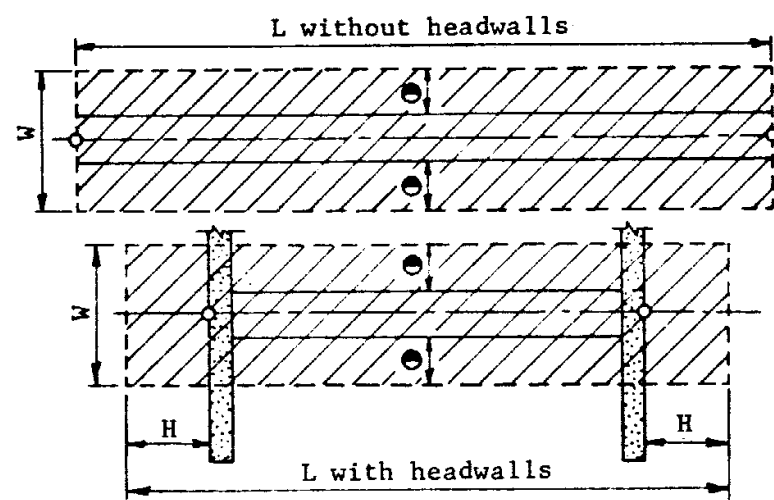
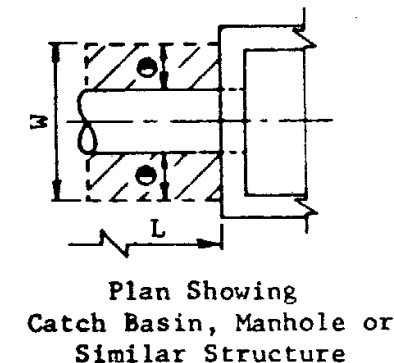


### CONCRETE BOX CULVERTS

H = Height of barrel or headwall excluding cutoff wall.  
 Ⓞ = 1'-6" max.



○ Plans show max. quantities



Pipe line in trench and pipe culvert with or without one or more headwalls.

Plan View Showing Length, L, and Width, W, for Payment Limits

Concrete or corrugated metal pipe

Pipe with normal wingwall, flared end sect. or U headwall

Pipe with skewed wingwall

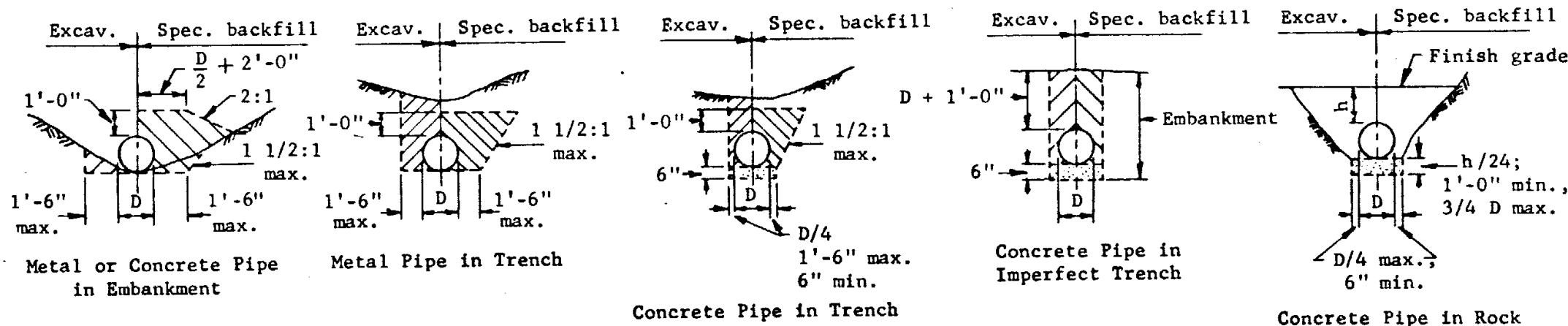
Pipe with L headwall

**GENERAL NOTES**  
 Payment limits shown include structural excavation for headwalls, cutoff walls, wingwalls, end sections etc.

Placement of special backfill around headwalls and wingwalls shall be the same as that for structures.

Payment limits shown shall be applied to multiple installations by discounting the overlap in width limits.

D indicates the O.D. and maximum outside width of circular and arch type structures respectively.



Sections Showing Structural Excavation Width Limits and Special Backfill Placement

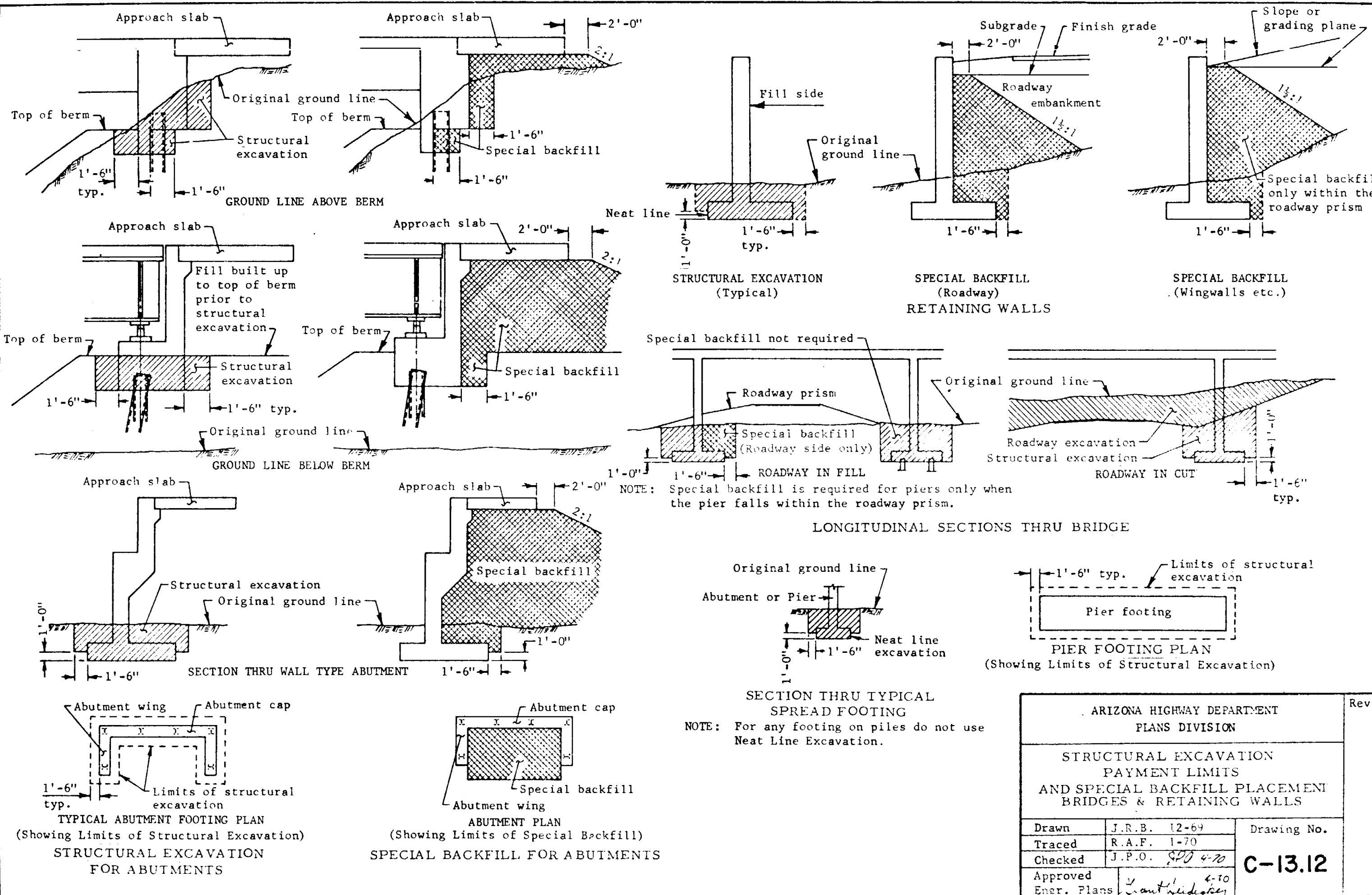
PIPE LINES AND PIPE CULVERTS

ARIZONA HIGHWAY DEPARTMENT  
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 12-5-68

STRUCTURAL EXCAVATION  
 PAYMENT LIMITS  
 AND SPECIAL BACKFILL PLACEMENT

Drawn	D.G.	12-66	Drawing No.  <b>C-13.11</b>
Traced	R.A.F.	2-68	
Checked	J.P.O.	8PO 5-68	
Approved Engr. Plans	E. Heidrich 5-68		



ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
STRUCTURAL EXCAVATION PAYMENT LIMITS AND SPECIAL BACKFILL PLACEMENT BRIDGES & RETAINING WALLS			
Drawn	J.R.B. 12-69	Drawing No.  <b>C-13.12</b>	
Traced	R.A.F. 1-70		
Checked	J.P.O. 8-70		
Approved Engr. Plans	L. Ant. 4-70		

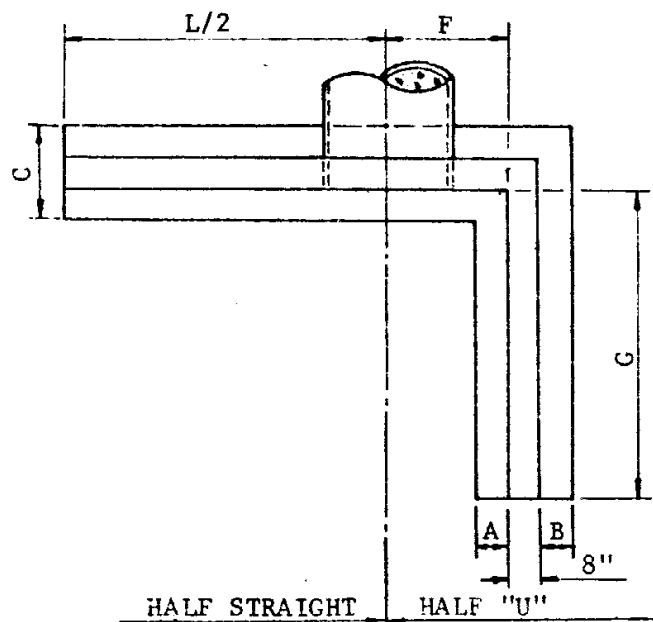
DIMENSIONS									
I.D.	A	B	C	D	E	L	L+E	F	G
18"	6"	6"	1'-8"	4'-2"	2'-8"	9'-6"	12'-2"	1'-7"	4'-6"
24"	8"	8"	2'-0"	4'-8"	3'-6"	11'-6"	15'-0"	2'-1"	5'-6"
30"	8"	8"	2'-0"	5'-2"	4'-4"	13'-6"	17'-10"	2'-7"	6'-6"
36"	1'-0"	8"	2'-4"	5'-8"	5'-2"	15'-6"	20'-8"	3'-1"	7'-6"
42"	1'-1"	10"	2'-7"	6'-2"	6'-0"	17'-6"	23'-6"	3'-7"	8'-6"
48"	1'-2"	1'-0"	2'-10"	6'-8"	6'-10"	19'-6"	26'-4"	4'-1"	9'-6"

"U" HEADWALL									
I.D.	Conc. C.Y.		Reinf. Steel #4 Bars						
	For C.M.P.	For Conc. Pipe	a		b		b <sub>1</sub>		lbs.
			No.	Lgth	No.	Lgth	No.	Lgth	
18"	1.68	1.65	12	4'-8"	6	4'-3"	10	5'-8"	90
24"	2.37	2.33	14	5'-4"	6	5'-3"	12	6'-8"	121
30"	3.01	2.96	18	5'-10"	6	6'-3"	12	7'-8"	152
36"	3.90	3.83	20	6'-8"	6	7'-3"	14	8'-8"	194
42"	4.72	4.63	24	7'-1"	6	8'-3"	14	9'-8"	263
48"	5.91	4.79	28	7'-8"	6	9'-3"	16	10'-8"	289

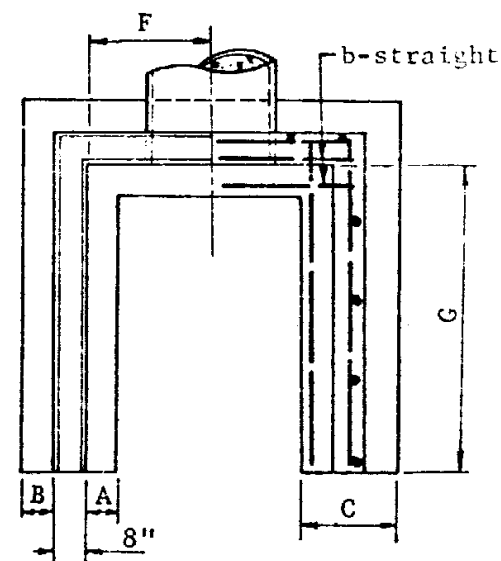
"L" HEADWALL									
I.D.	Conc. C.Y.		Reinf. Steel #4 Bars						lbs.
	For C.M.P.	For Conc. Pipe	a		b		b <sub>1</sub>		
			No.	Lgth.	No.	Lgth.	No.	Lgth.	
18"	1.42	1.39	10	4'-8"	6	6'-9"	5	5'-8"	73
24"	2.00	1.96	12	5'-4"	6	8'-3"	5	6'-8"	97
30"	2.53	2.48	14	5'-10"	6	9'-9"	6	7'-8"	118
36"	3.27	3.20	16	6'-8"	6	11'-3"	7	8'-8"	149
42"	4.04	3.95	18	7'-2"	6	12'-9"	7	9'-8"	194
48"	4.94	4.82	20	7'-8"	6	14'-3"	8	10'-8"	215

SINGLE PIPE HEADWALL							
I.D.	Conc. C.Y.		Reinf. Steel #4 Bars				lbs.
	For C.M.P.	For Conç. Pipe	a		b		
			No.	Lgth.	No.	Lgth.	
18"	1.17	1.14	8	4'-8½"	5	9'-3"	56
24"	1.64	1.60	10	5'-4½"	5	11'-3"	74
30"	2.05	2.00	10	5'-10½"	5	13'-3"	83
36"	2.63	2.56	12	6'-8½"	5	15'-3"	105
42"	3.24	3.15	14	7'-2½"	5	17'-3"	125
48"	3.96	3.84	16	7'-8½"	5	19'-3"	147

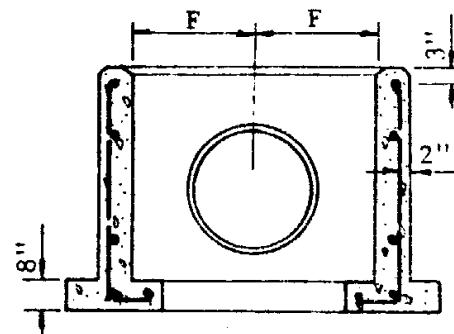
DOUBLE PIPE HEADWALL							
I.D.	C.Y. Conc.		Reinf. Steel #4 Bars				lbs.
	For C.M.P.	For Conc. Pipe	a		b		
			No.	Lgth.	No.	Lgth.	
18"	1.47	1.42	9	4'-8"	5	11'-11"	68
24"	2.07	2.00	11	5'-4"	5	14'-9"	88
30"	2.62	2.52	12	5'-10"	5	17'-7"	105
36"	3.40	3.27	14	6'-8"	5	20'-5"	131
42"	4.19	4.01	16	7'-2"	5	23'-3"	154
48"	5.15	4.92	17	7'-8"	5	26'-1"	175



"L" HEADWALL

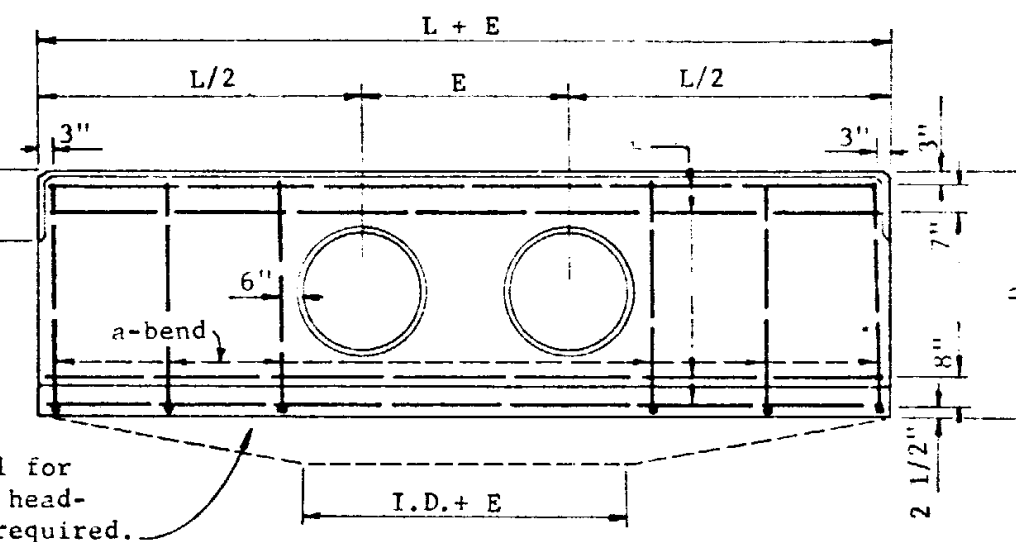
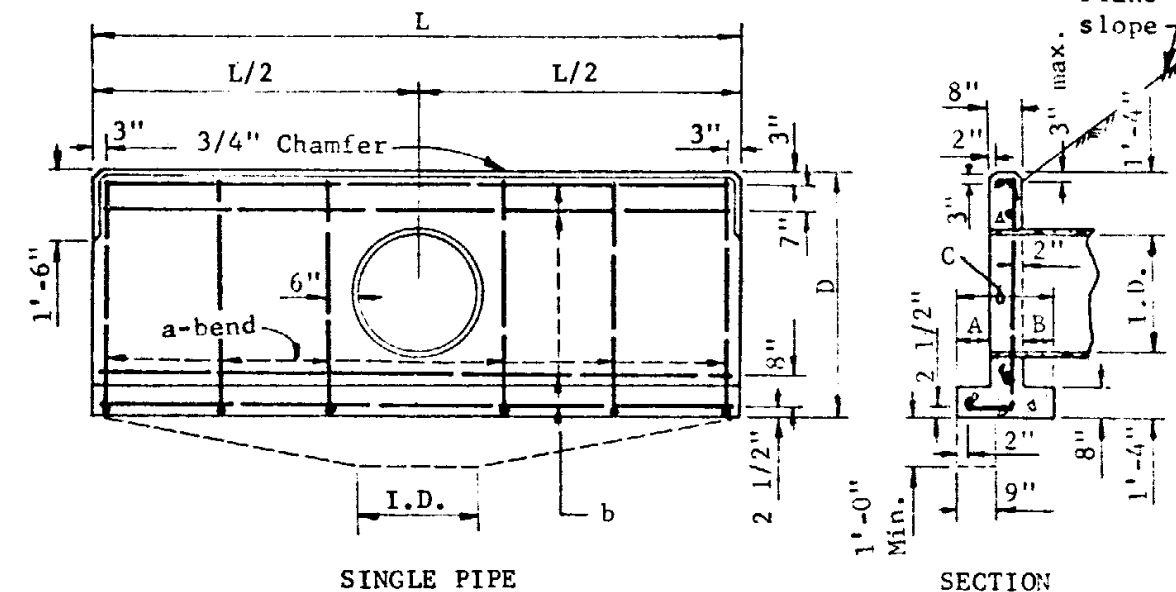


PLAN



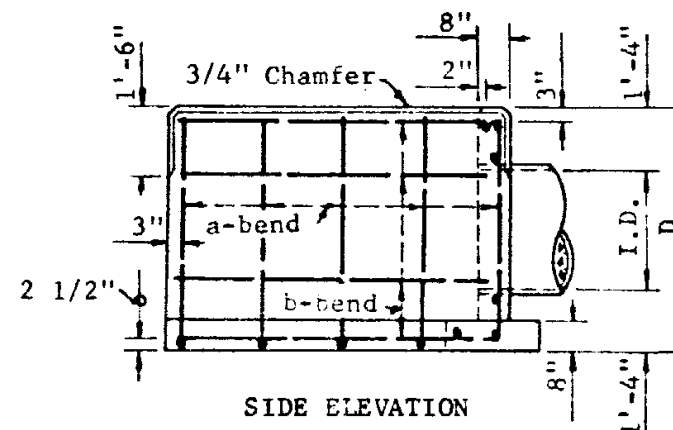
SECTION

"U" HEADWALL



DOUBLE PIPE  
STRAIGHT HEADWALLS

GENERAL NOTES  
All concrete shall be Class A.  
High point of headwall shall not project more than 3" above slope.



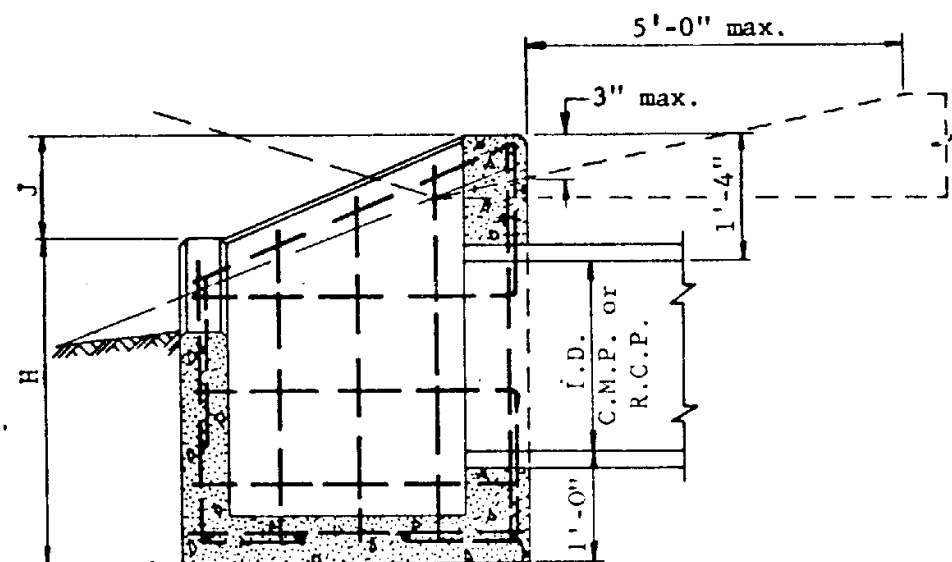
SIDE ELEVATION

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

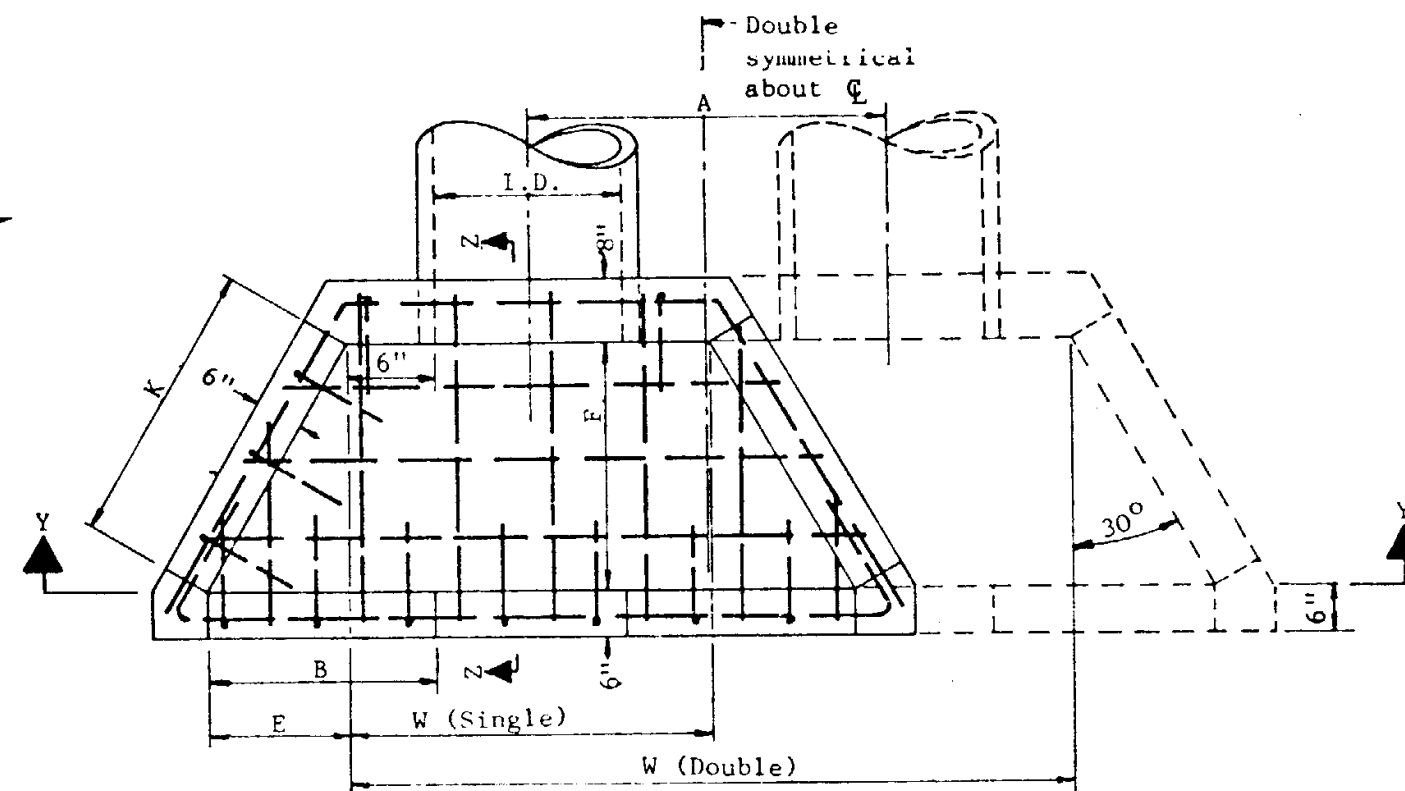
PIPE HEADWALL  
STRAIGHT, "L" & "U" TYPE

Drawn	L.O.M. 3-23-65	Drawing No. <b>C-14.01</b>
Traced	S.L.T. 5-5-67	
Checked	J.P.O. 8PO 5-68	
Approved Engr. Plans	<i>Whidaker 5-68</i>	



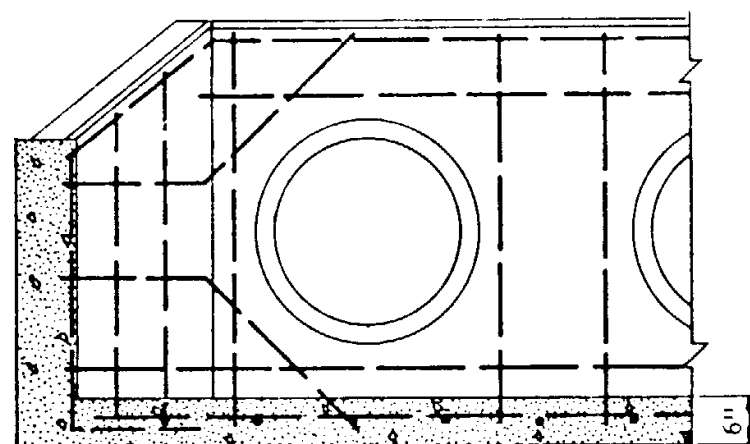


SECTION Z-Z

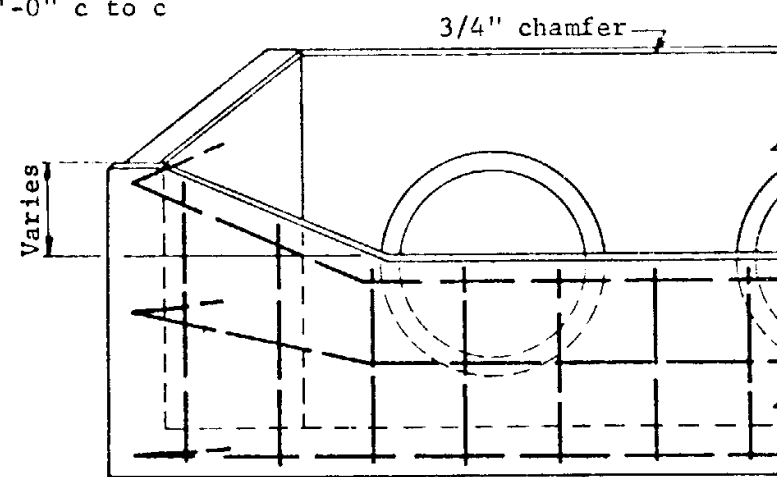


PLAN

All reinforcing shall be  
#4 bars 1'-0" c to c



SECTION Y-Y



ELEVATION

GENERAL NOTES  
Reference Std. C-13.01.  
High point of headwall shall not  
project more than 3" above slope.  
All concrete shall be Class A.

PIPE	DIMENSIONS									QUANTITIES					
I.D.	W		A	B	E	F	H	J	K	CONC. C.Y.				REINF. STEEL	
	Single	Double								Single		Double		LBS.	
										C.M.P.	For Conc. Pipe Deduct	C.M.P.	For Conc. Pipe Deduct	Single	Double
18"	2'-6"	5'-2"	2'-8"	1'-3"	9"	1'-3 5/8"	3'-1"	9"	1'-6"	0.76	0.03	1.12	0.06	75	107
24"	3'-0"	6'-6"	3'-6"	1'-7 1/2"	1'-1 1/2"	1'-11 3/8"	3'-5"	11"	2'-3"	1.00	0.04	1.55	0.09	92	136
30"	3'-6"	7'-10"	4'-4"	2'-0"	1'-6"	2'-7 1/4"	3'-9"	1'-1"	3'-0"	1.50	0.06	2.29	0.13	112	166
36"	4'-0"	9'-2"	5'-2"	2'-4 1/2"	1'-10 1/2"	3'-3"	4'-0"	1'-4"	3'-9"	1.96	0.09	3.01	0.17	145	214
42"	4'-6"	10'-6"	6'-0"	2'-9"	2'-3"	3'-10 3/4"	4'-4"	1'-6"	4'-6"	2.49	0.11	3.85	0.23	189	279

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PLANS DIVISION

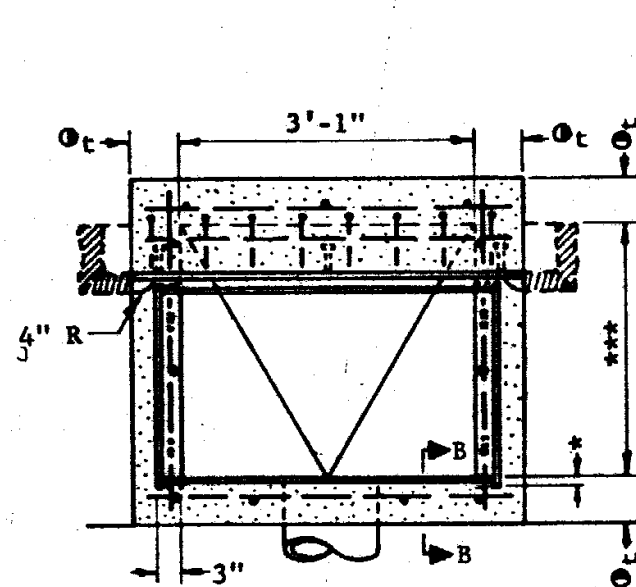
DROP INLET HEADWALLS

Drawn K.S. 10-39  
Traced S.L.T. 8-67  
Checked J.P.O. 890 5-68  
Approved  
Engr. Plans

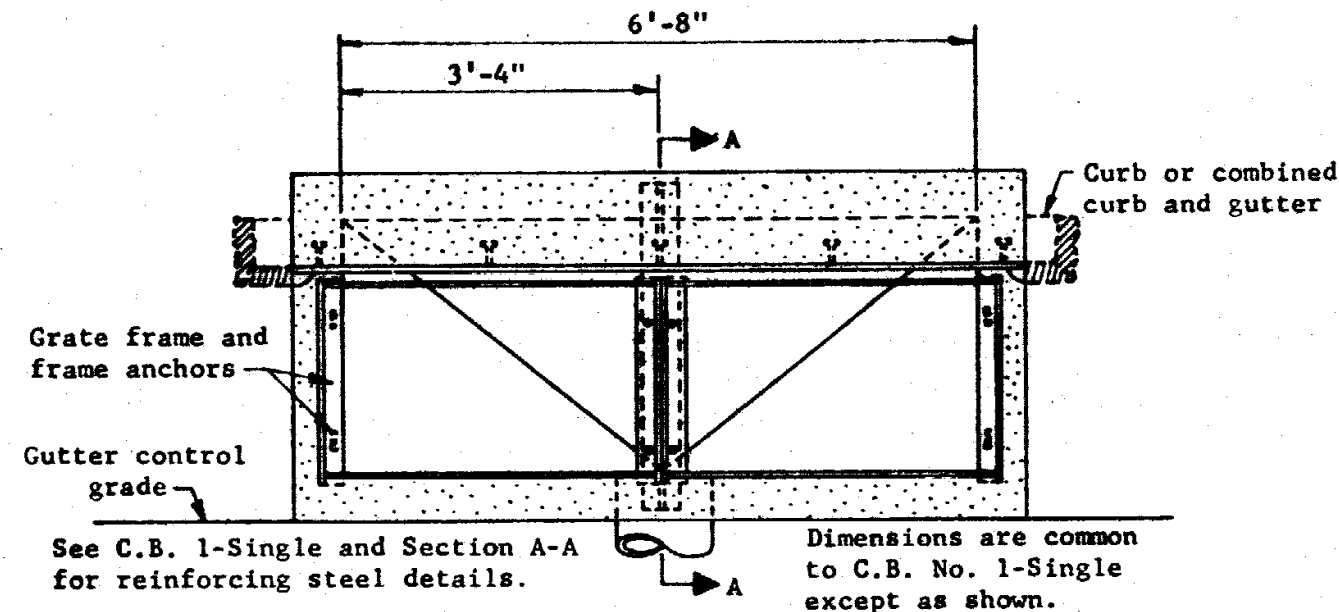
Drawing No.

C-14.03

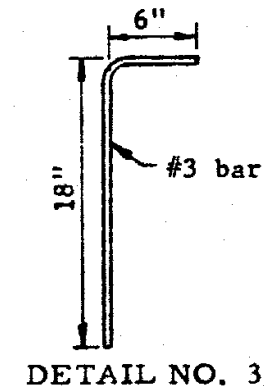
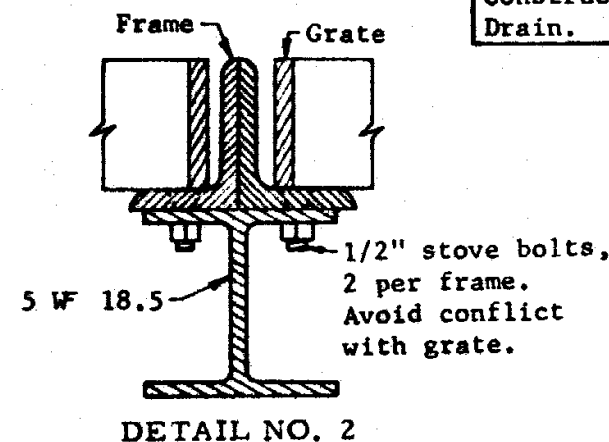
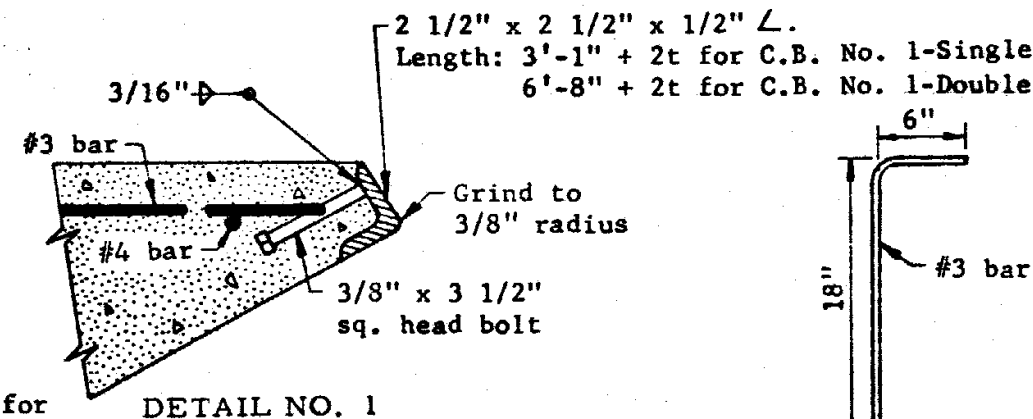
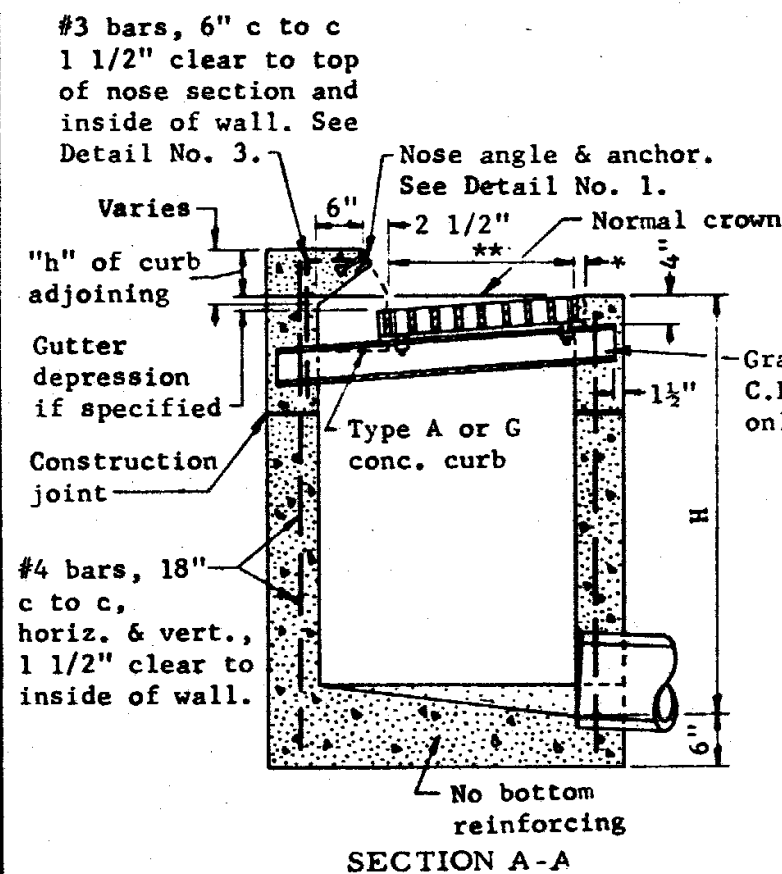
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11-14-68



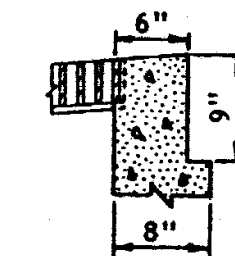
PLAN-CATCH BASIN NO. 1 - SINGLE



PLAN - CATCH BASIN NO. 1 -DOUBLE



NOTE: Provide Std. C-15.08 Construction Drain.



SECTION B-B

Use this section when t = 8"

# GENERAL NOTES

Pipes can be placed in any wall.

Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.

Welding shall be in accordance with A.H.D. Welding Specifications.

For grates LW-1, TW-2, etc., and frame details and opening areas, see Stds. C-15.06 and C-15.07.

Any specified gutter depression shall be warped to opening according to Std. C-15.08.

All structural steel shall be ASTM A 36.

Grate support and nose angle shall be given one shop coat of No. 1 paint.

All concrete shall be Class A.

Curb opening areas (Sq.Ft.) for Catch Basin No. 1-Single and Catch Basin No. 1-Double equal 0.26 and 0.55, respectively, for each inch of curb "h" + gutter depression - 2.1"

\* 3/4" for longitudinal and 3" for transverse grates.

\*\* 2'-0" for LW-1, LB-1, TW-1 and TB-1 grates. 1'-6" for LW-2, LB-2, TW-2 and TB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.

\*\*\* 2'-8 1/2" for LW-1, LB-1, TW-1 and TB-1 grates. 2'-2 1/2" for LW-2, LB-2, TW-2 and TB-2 grates.

● t = 6" when H is 8' or less; 8" when H is over 8'. (See Section B-B)

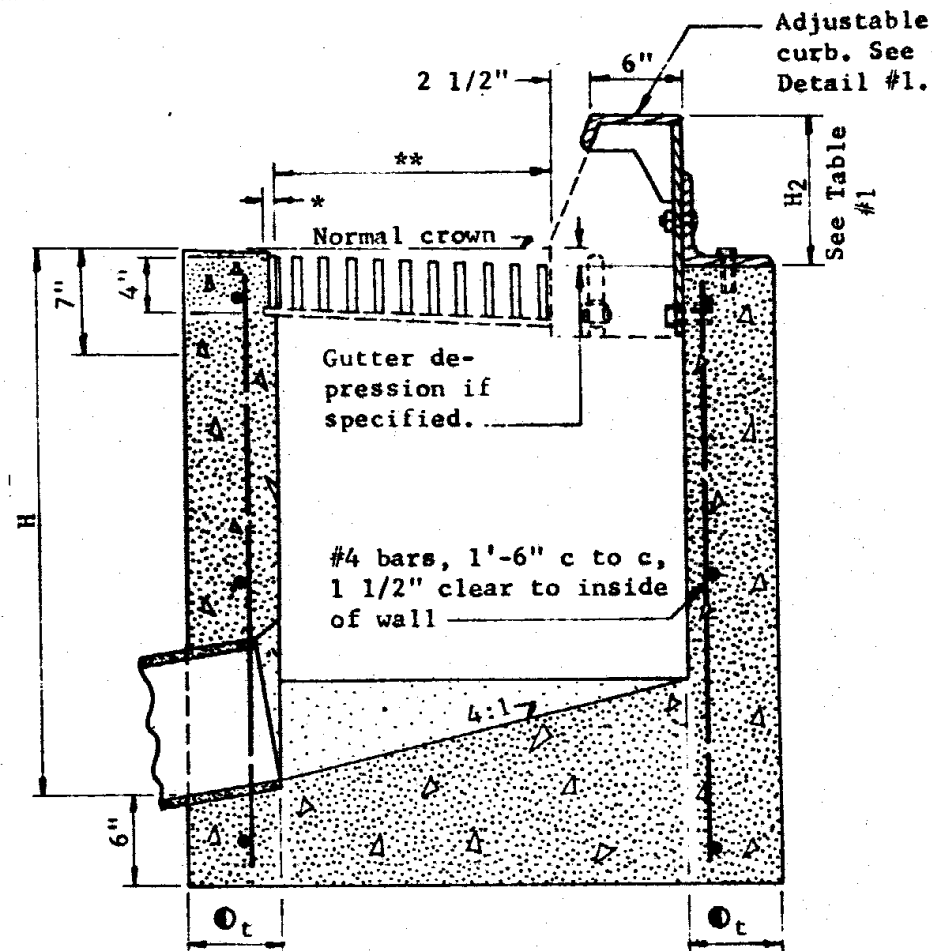
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## TYPE 1 CATCH BASIN

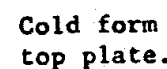
Drawn	D.G. 7-67	Drawing No.  <b>C-15.01</b>
Traced	R.A.F. 7-67	
Checked	J.P.O. 9PO 5-68	
Approved Engr. Plans	G. Heidrich 5-68	

Rev  
12-5-68

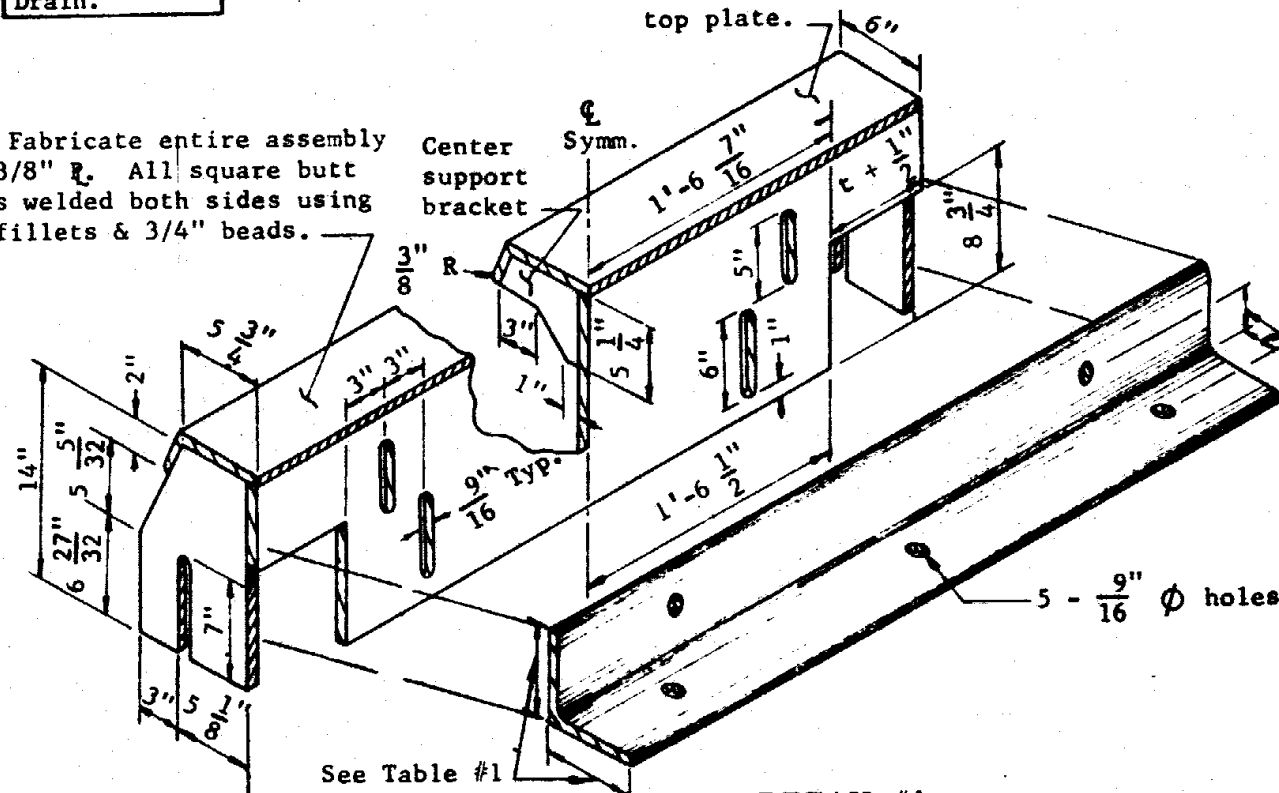




\* 3/4" for LW or LB grates.  
3" for TW or TB grates.  
\*\* 2'-0" for LW-1, LB-1, TW-1 or TB-1  
grates. 1'-6" for LW-2, LB-2, TW-2 or  
TB-2 grates. Use 1'-6" dimension when  
catch basin is used with combined curb and  
gutter.  
    ○ t = 6" when H is 8' or less; 8"  
when H is over 8'. (See Sect. B-B)



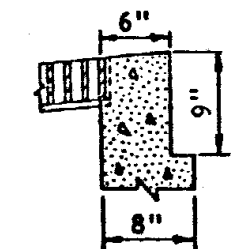
Center  
support  
bracket



DETAIL #1  
ADJUSTABLE CURB ASSEMBLY

H <sub>2</sub>	Support Angle size
4 1/16" to 8 3/16"	4"x4"x3/8"
8 1/4" to 9 3/16"	5"x5"x3/8"
9 1/4" to 10 1/16"	6"x6"x3/8"

3"(Applicable to  
all support angle  
sizes.)



**SECTION B-B**

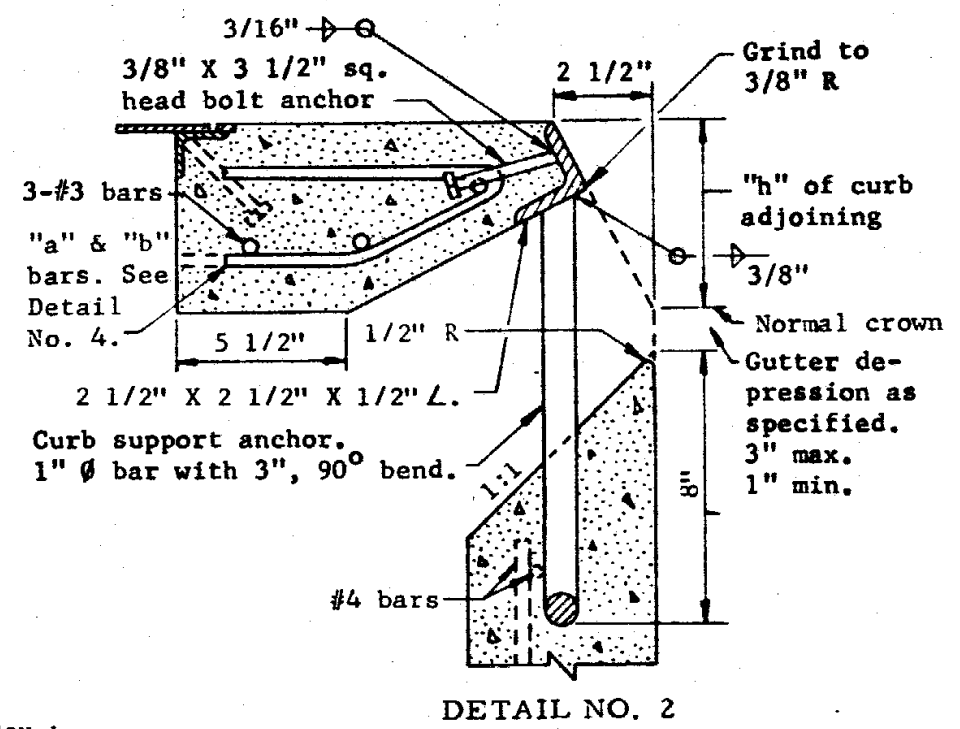
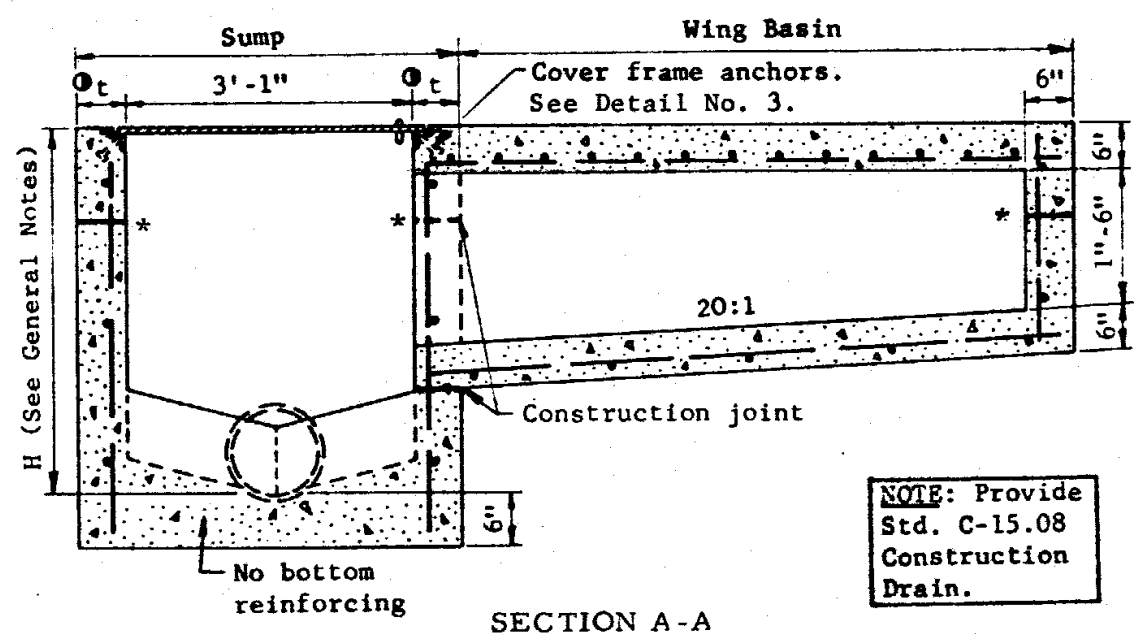
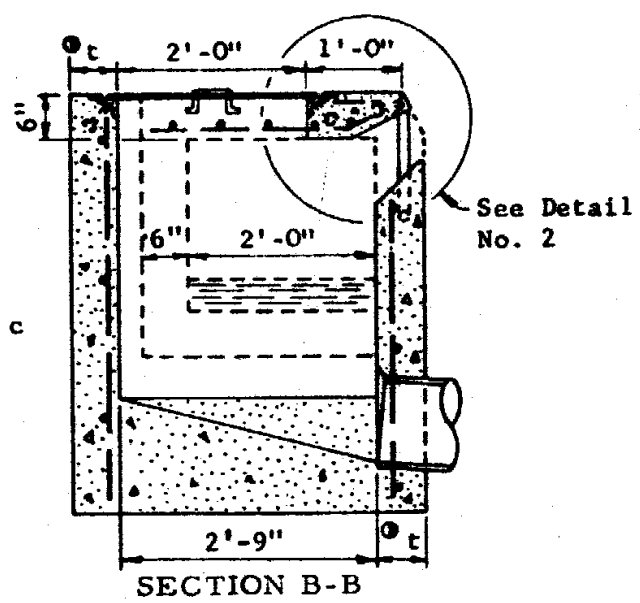
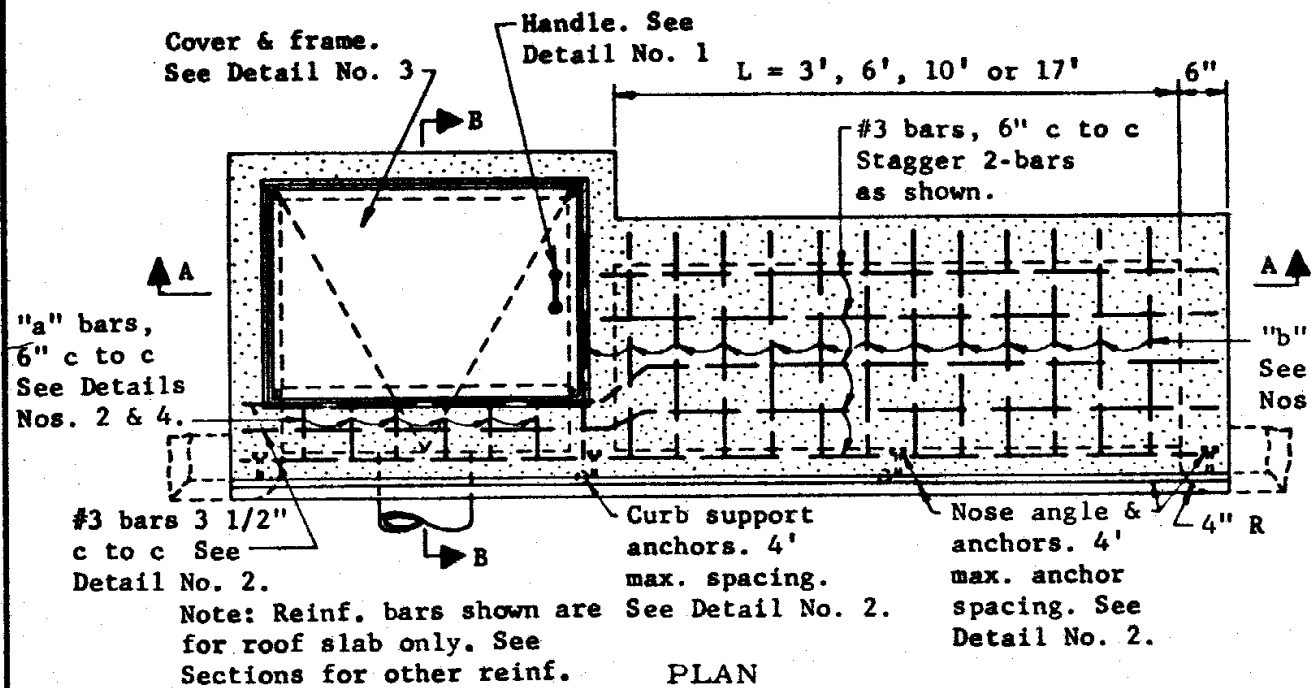
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

lev  
2-5-68

## TYPE 2 CATCH BASIN

Drawn	D.C.	11-66	Drawing No.  <b>C-15.02</b>
Traced	S.L.T.	6-67	
Checked	J.P.O.	<i>JPO 5-68</i>	
Approved Engr. Plans	<i>4/11/68 5-68</i>		





**GENERAL NOTES**

C.B. 3 sump only.

C.B. 3-Wing (illustrated), sump with wing basin upstream.

C.B. 3-Double Wing, sump with symmetrical wing basins each side.

Pipes can be placed in any wall except wall adjacent to a wing basin.

Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.

Gutter depression shall be warped to opening according to Std. C-15.08.

All structural steel shall be ASTM A 36.

Nose angle shall be given one shop coat of No. 1 paint.

All concrete shall be class A.

All reinforcing bars shall be #4, 1'-6" c to c both ways and 1 1/2" clear to inside of walls and outside of wing basin floor except as shown.

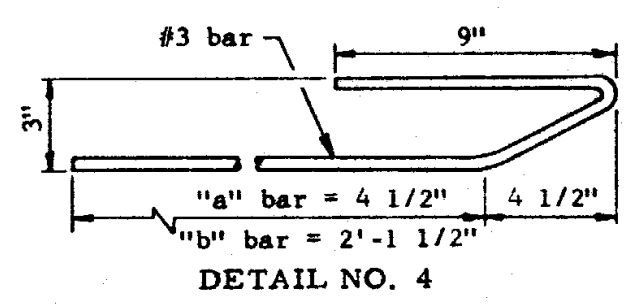
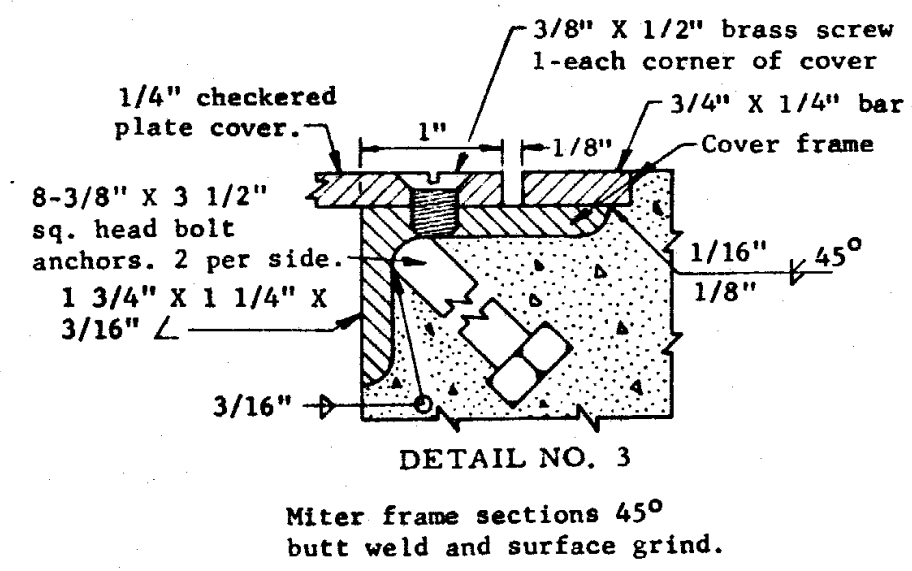
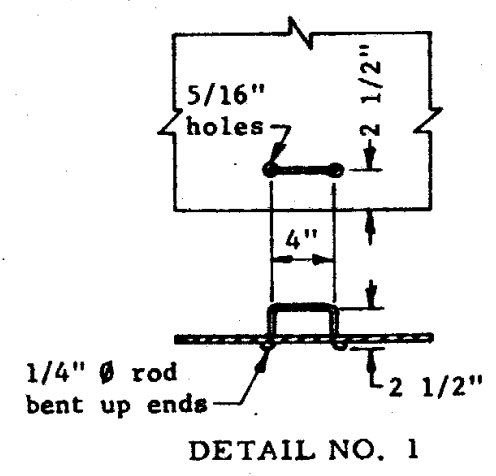
Curb opening area (Sq. Ft.) per inch of curb "h" + gutter depression = curb opening length (ft.) x 0.0834.

Welding shall be in accordance with A.H.D. Welding Specifications.

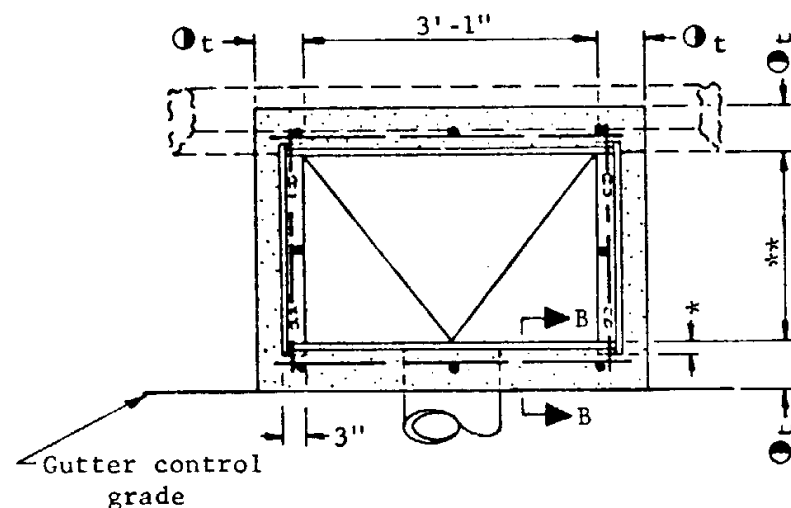
\* Construction joints at bottom of curb line.

Ø t = 6" when H = 8' or less  
8" when H is greater than 8'.

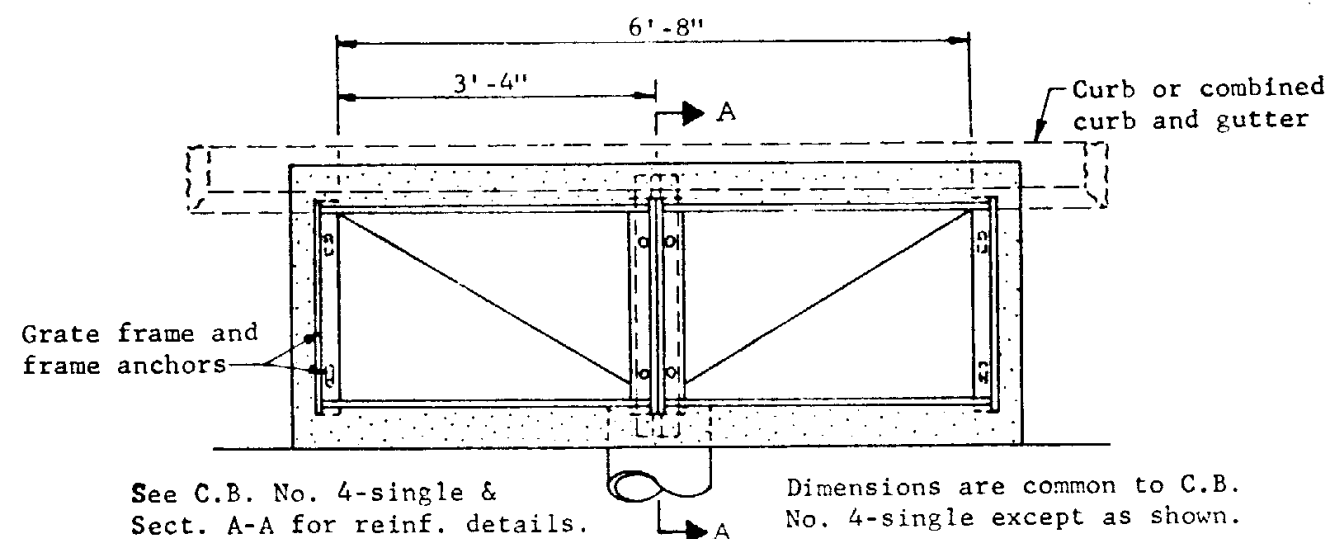
H = 2'-10" min. when L = 3'  
3'-0" min. when L = 6'  
3'-2" min. when L = 10'  
3'-7" min. when L = 17'



ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 122-68
TYPE 3 CATCH BASIN			
Drawn	D.G. 7-67	Drawing No.  C-15.03	
Traced	R.A.F. 7-67		
Checked	J.P.O. 9PO 5-68		
Approved Engr. Plans	W.H. 5-68		

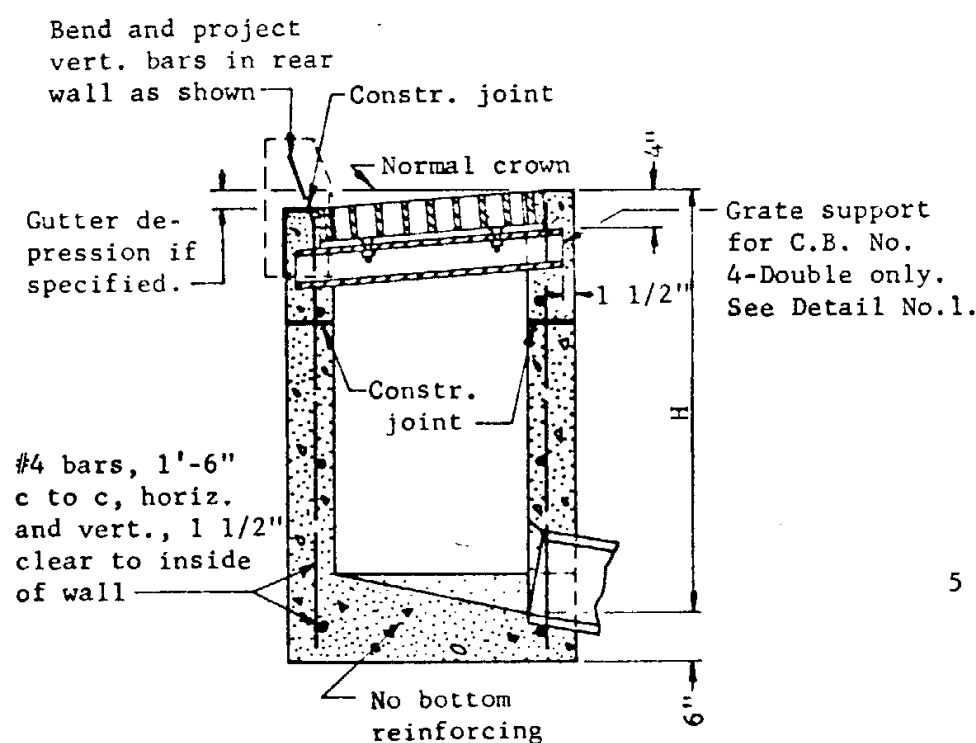


PLAN, CATCH BASIN NO. 4-SINGLE

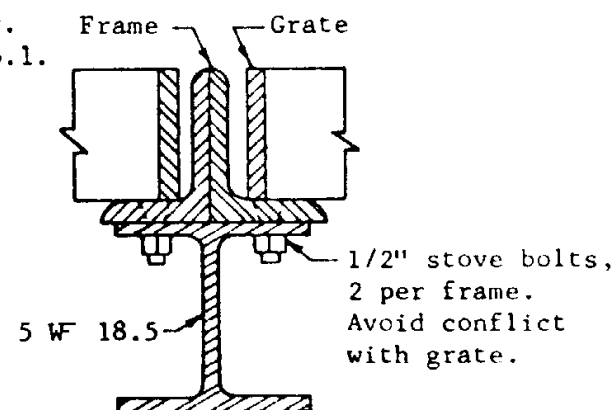


PLAN, CATCH BASIN NO. 4-DOUBLE

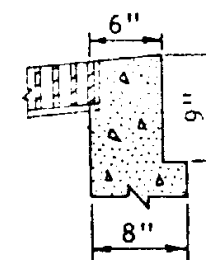
NOTE: Provide  
Std. C-15.08  
Construction  
Drain.



SECTION A-A



DETAIL NO. 1



SECTION B-B  
Use this section  
when t = 8"

#### GENERAL NOTES

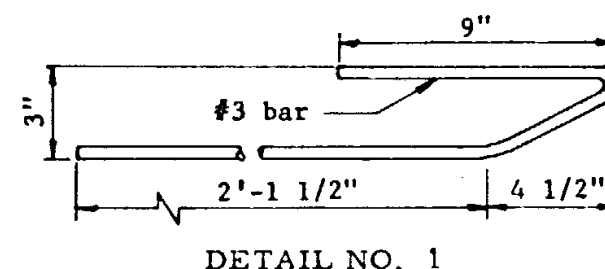
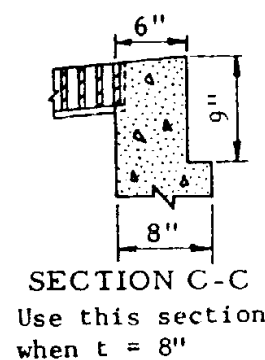
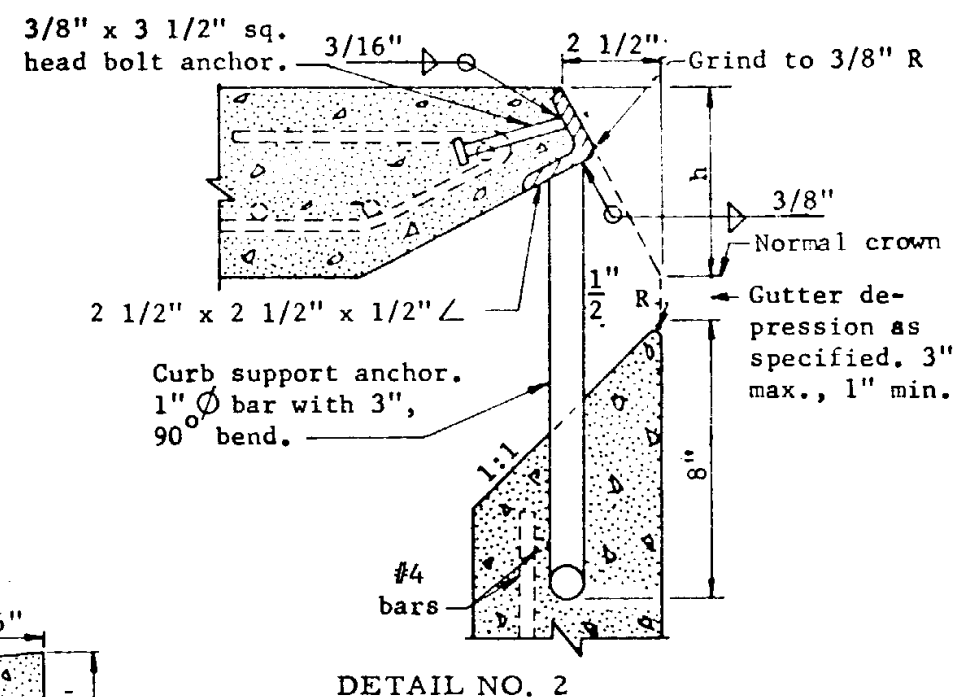
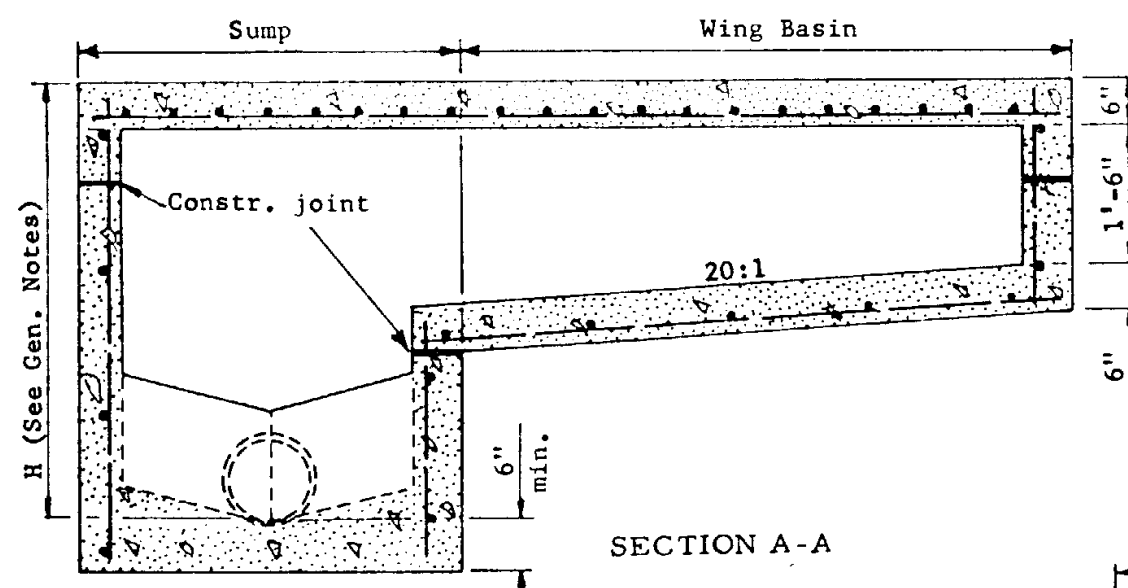
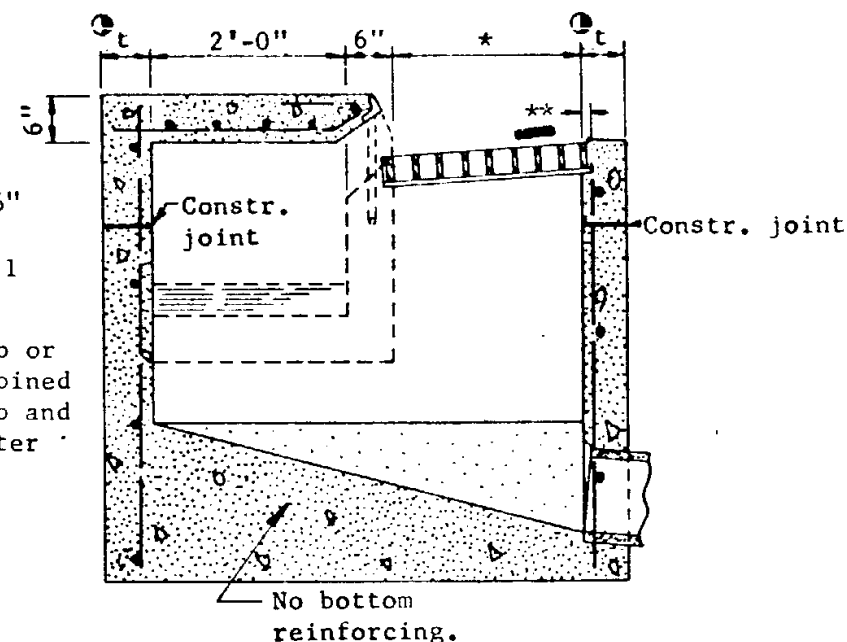
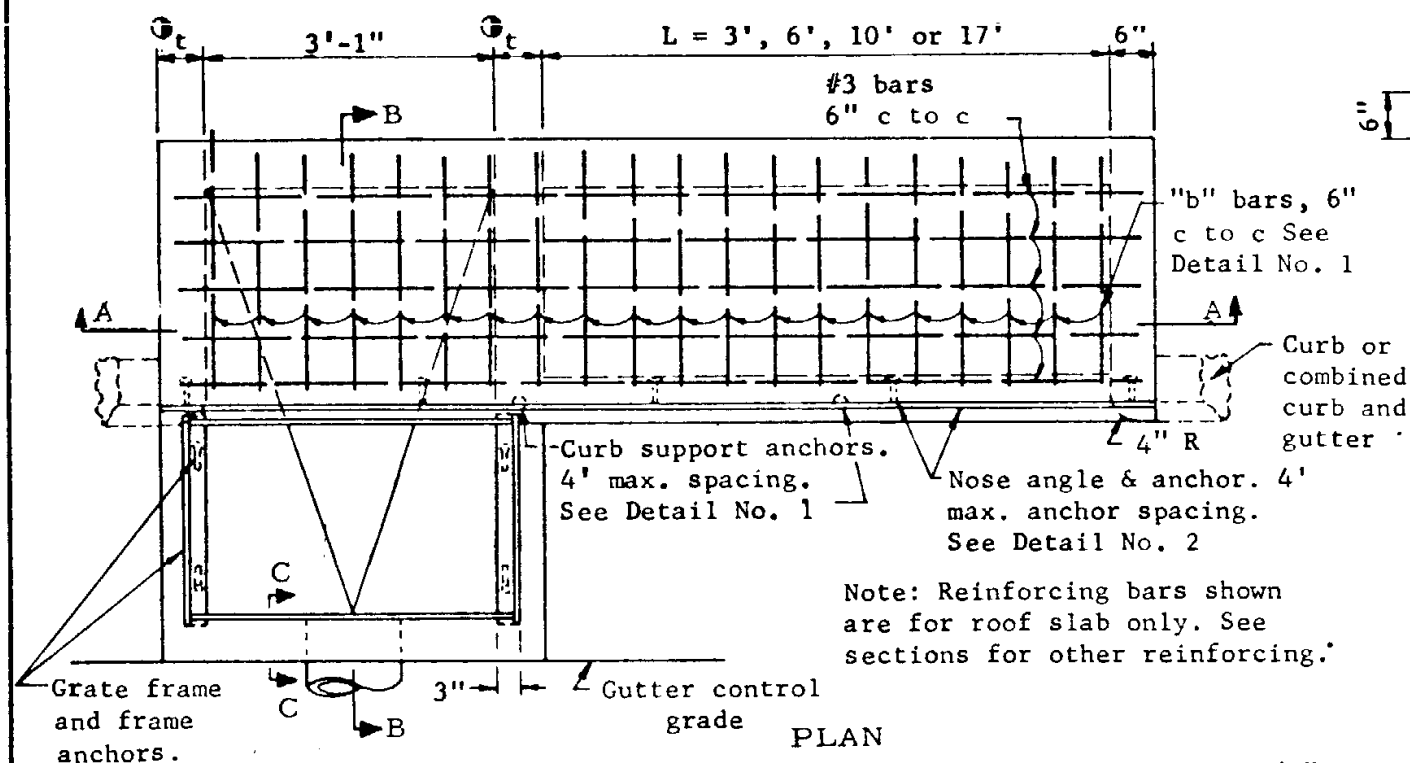
- Pipes can be placed in any wall.
- Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.
- Curb over catch basin shall not be constructed until catch basin concrete has set for a minimum of 24 hours.
- For grate and frame details and opening areas, see Stds. C-15.06 and C-15.07.
- Any specified gutter depression shall be warped to opening according to Std. C-15.08.
- All structural steel shall be ASTM A 36.
- Grate support shall be given one shop coat of No. 1 paint.
- All concrete shall be Class A.

- \* 3/4" for LW or LB grates.
- 3" for TW or TB grates.

- \*\* 2'-0" for LW-1, LB-1, TW-1 and TB-1 grates. 1'-6" for LW-2, LB-2, TW-2 and TB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.

- t = 6" when H = 8' or less
- 8" when H is greater than 8'. (See Section B-B)

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
TYPE 4 CATCH BASIN			
Drawn	D.G. 6-67	Drawing No.  <b>C-15.04</b>	
Traced	S.L.T. 7-67		
Checked	J.P.O. 8PD 5-68		
Approved Engr. Plans	<i>W. J. J. 5-68</i>		



# GENERAL NOTES

C.B. 5, sump only.

C.B. 5 Single, (illustrated), sump with wing basin upstream.

C.B. 5 Double, sump with symmetrical wing basins each side.

Pipes can be placed in any wall except wall adjacent to a wing basin.

Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.

Welding shall be in accordance with A.H.D. Welding Specifications.

Gutter depression shall be warped to opening according to Std. C-15.08.

All structural steel shall be in accordance with ASTM A 36.

Nose angle shall be painted with one No. 1 shop coat.

All concrete shall be Class A.

All reinforcing bars shall be #4, 18" c to c both ways and 1 1/2" clear to inside of walls and outside of wing basin floor except as shown.

Curb opening area (Sq. Ft.) per inch of curb "h" + gutter depression = curb opening length (Ft.) X 0.0834.

For grate and frame details and opening areas, see Stds. C-15.06 and C-15.07.

$t = 6"$  when  $H = 8'$  or less; 8" when  $H$  is greater than 8'. (See Section C-C)

\*2'-0" for LW-1 and LB-1 grates; 1'-6" for LW-2 and LB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.

\*\* 3/4" for longitudinal and 3" for transverse grates.

$H = 3'-3"$  min. when  $L = 3'$

3'-5" min. when  $L = 6'$

3'-7" min. when  $L = 10'$

4'-0" min. when  $L = 17'$

NOTE: Provide Std. C-15.08 Construction Drain.

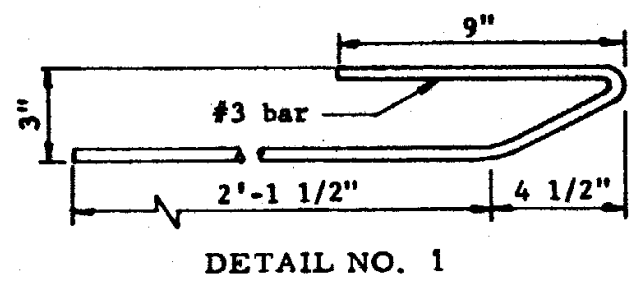
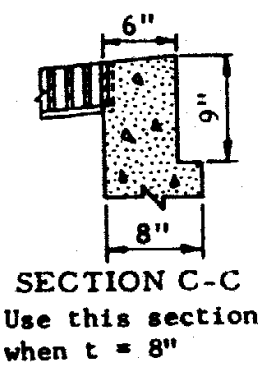
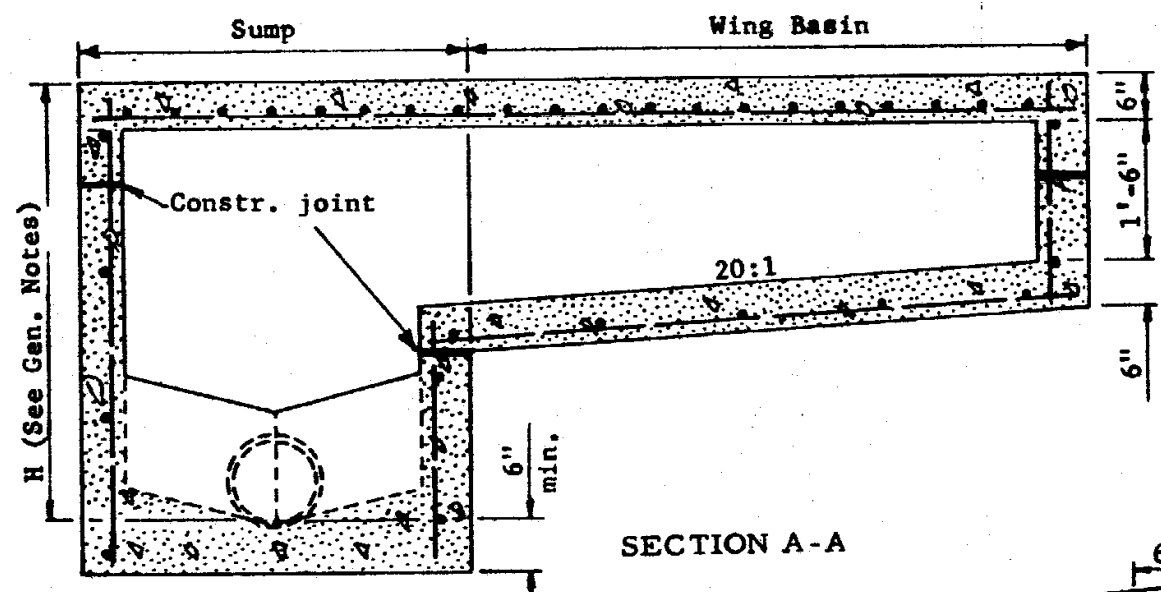
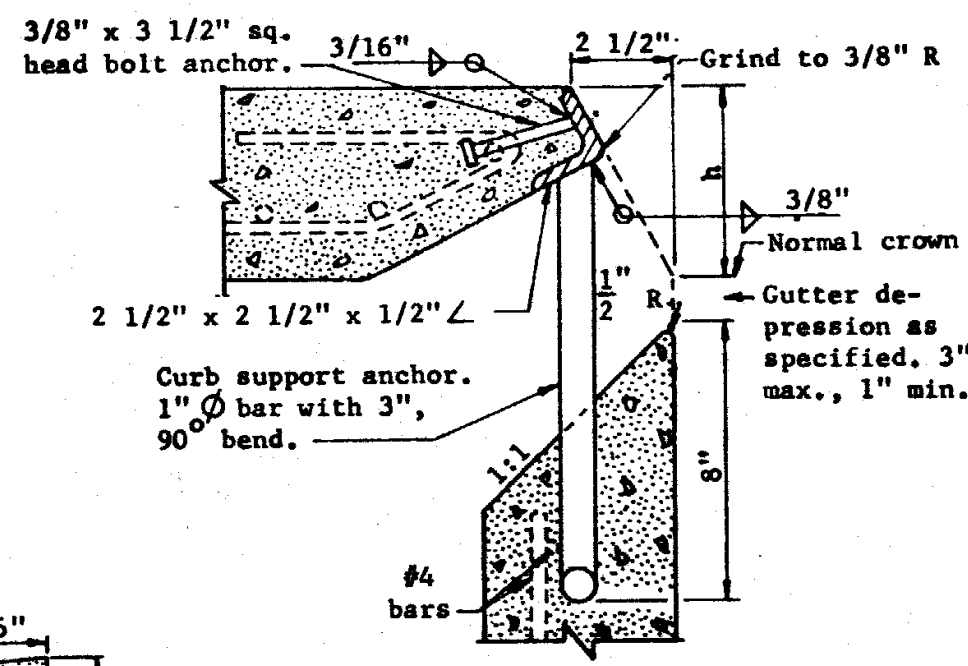
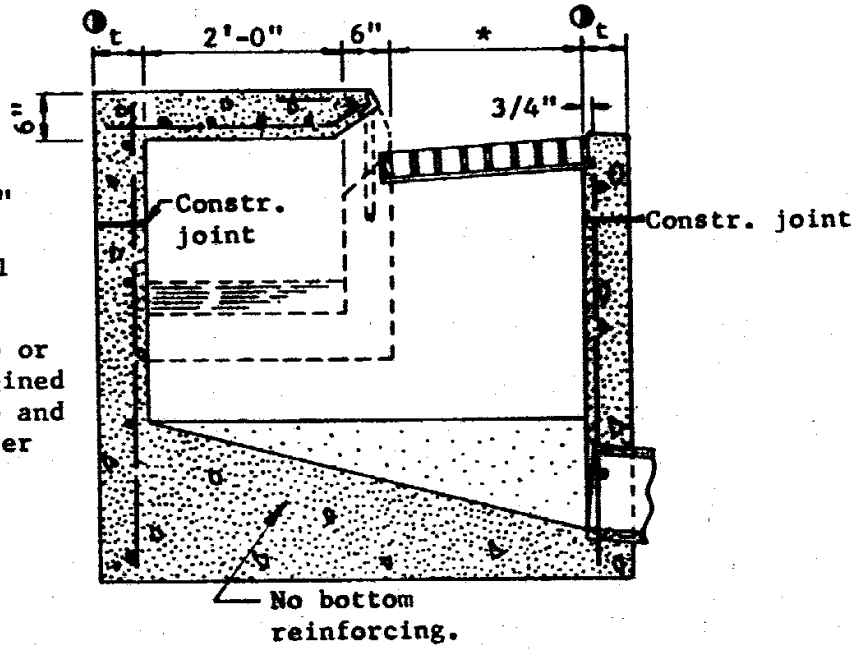
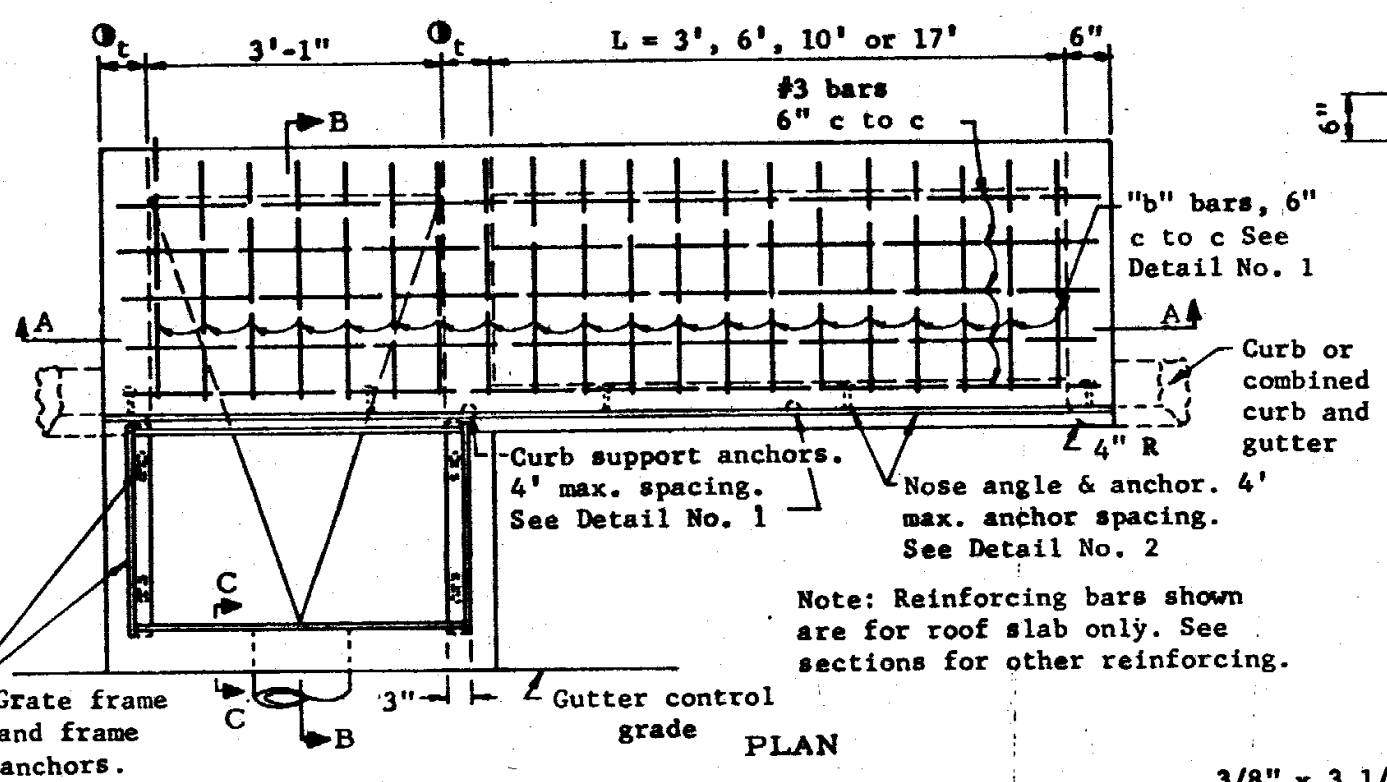
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## TYPE 5 CATCH BASIN

Drawn	D.G. 7-67	Drawing No.
Traced	S.L.T. 7-67	
Checked	J.P.O. 8PO 5-68	
Approved	J. Kleider 5-68	
Eng. Plans		

C-15.05

Rev  
12-5-68  
9-29-70



**GENERAL NOTES**

C.B. 5, sump only.

C.B. 5 Single, (illustrated), sump with wing basin upstream.

C.B. 5 Double, sump with symmetrical wing basins each side.

Pipes can be placed in any wall except wall adjacent to a wing basin.

Sump floor shall have a wood trowel finish and a minimum slope of 4:1 in all directions toward outlet pipe.

Welding shall be in accordance with A.H.D. Welding Specifications.

Gutter depression shall be warped to opening according to Std. C-15.08.

All structural steel shall be in accordance with ASTM A 36.

Nose angle shall be painted with one No. 1 shop coat.

All concrete shall be Class A.

All reinforcing bars shall be #4, 18" c to c both ways and 1 1/2" clear to inside of walls and outside of wing basin floor except as shown.

Curb opening area (Sq. Ft.) per inch of curb "h" + gutter depression = curb opening length (Ft.) X 0.0834.

For grate and frame details and opening areas, see Stds. C-15.06 and C-15.07.

Øt = 6" when H = 8' or less; 8" when H is greater than 8'. (See Section C-C)

\*2'-0" for LW-1 and LB-1 grates; 1'-6" for LW-2 and LB-2 grates. Use 1'-6" dimension when catch basin is used with combined curb and gutter.

H = 3'-3" min. when L = 3'

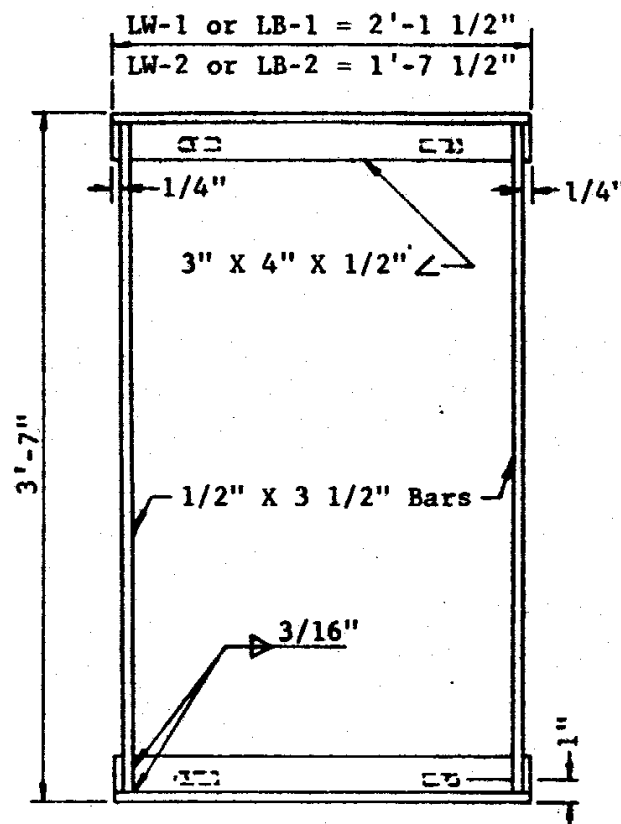
3'-5" min. when L = 6'

3'-7" min. when L = 10'

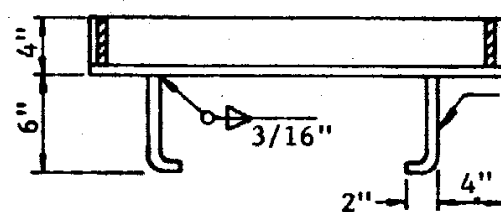
4'-0" min. when L = 17'

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 12-5-68
TYPE 5 CATCH BASIN			
Drawn	D.G.	7-67	Drawing No.  <b>C-15.05</b>
Traced	S.L.T.	7-67	
Checked	J.P.O.	8-68 5-68	
Approved Ingr. Plans	9/6/68 5-68		

NOTE: Provide Std. C-15.08 Construction Drain.

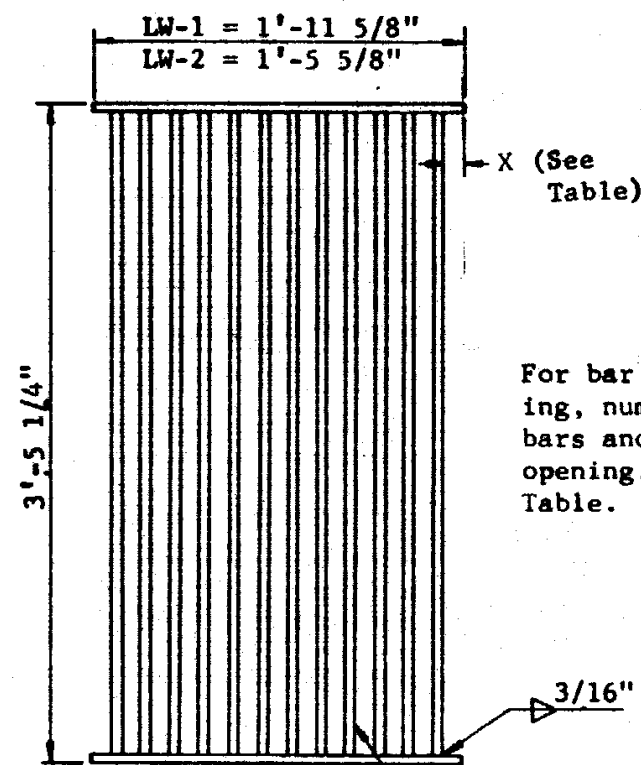


PLAN

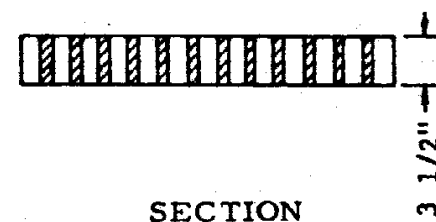


SECTION

FRAME



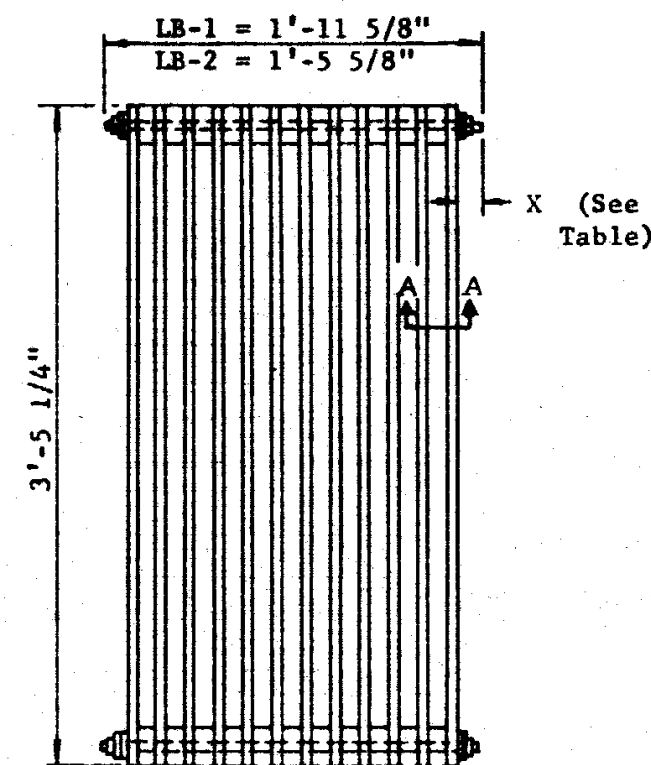
PLAN



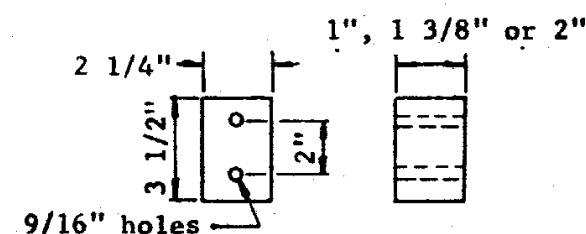
SECTION

GRATE TYPES LW-1 & LW-2

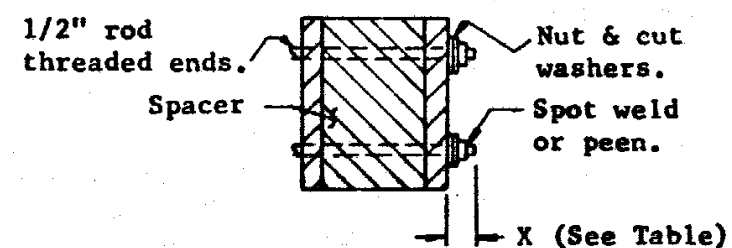
Restricted to use on longitudinal grades of 3% and less.



PLAN



BAR SPACER DETAIL  
Cast iron, cast steel or  
steel bar stock.



SECTION A-A

GRATE TYPES LB-1 & LB-2

For use on longitudinal grades in excess of 3% or as an alternate to Type LW on grades of 3% or less.

# GENERAL NOTES

Grating units and frames shall be fabricated from structural steel except as noted. Structural steel shall be in accordance with ASTM A 36.

Welding shall be in accordance with A.H.D. Welding Specifications.

The completed assembly shall be given one shop coat of No. 1 paint.

LW indicates longitudinal welded.  
LB indicates longitudinal bolted.

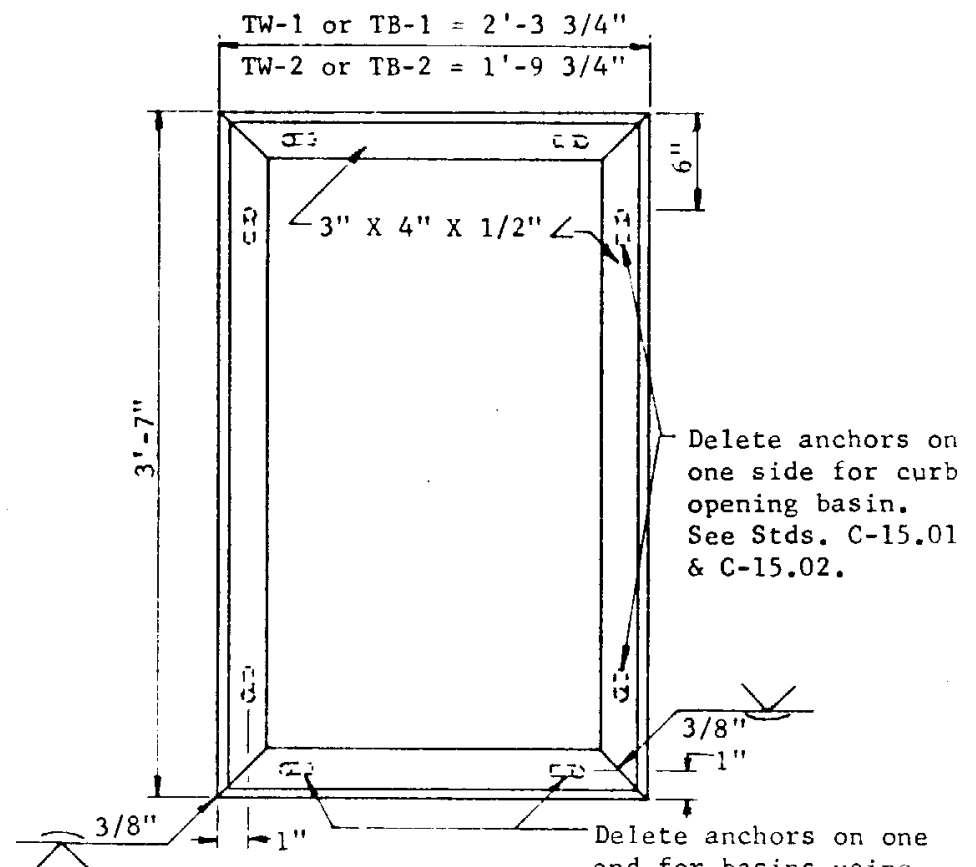
Type	Clear Spacing	No. Bars	X	Grate Opening Sq. Ft.
LW or LB-1.0	1"	16	5/16"	4.58
LW or LB-1.1	1 3/8"	12	1 1/4"	4.99
LW or LB-1.2	2"	9	1 9/16"	5.41
LW or LB-2.0	1"	12	5/16"	3.47
LW or LB-2.1	1 3/8"	9	1 1/16"	3.75
LW or LB-2.2	2"	7	1 1/16"	4.03

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

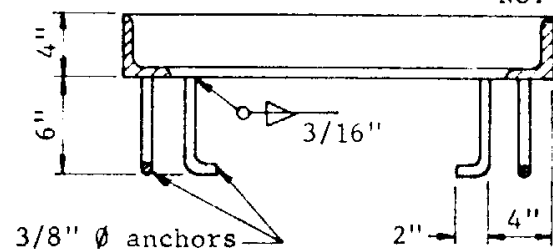
## CATCH BASIN GRATE LB AND LW GRATES

Drawn	D.G. 7-66	Drawing No.
Traced	S.L.T. 7-67	
Checked	J.P.O. 8/10 5-68	
Approved	Eng. Plans	
C-15.06		

Rev  
12-5-68



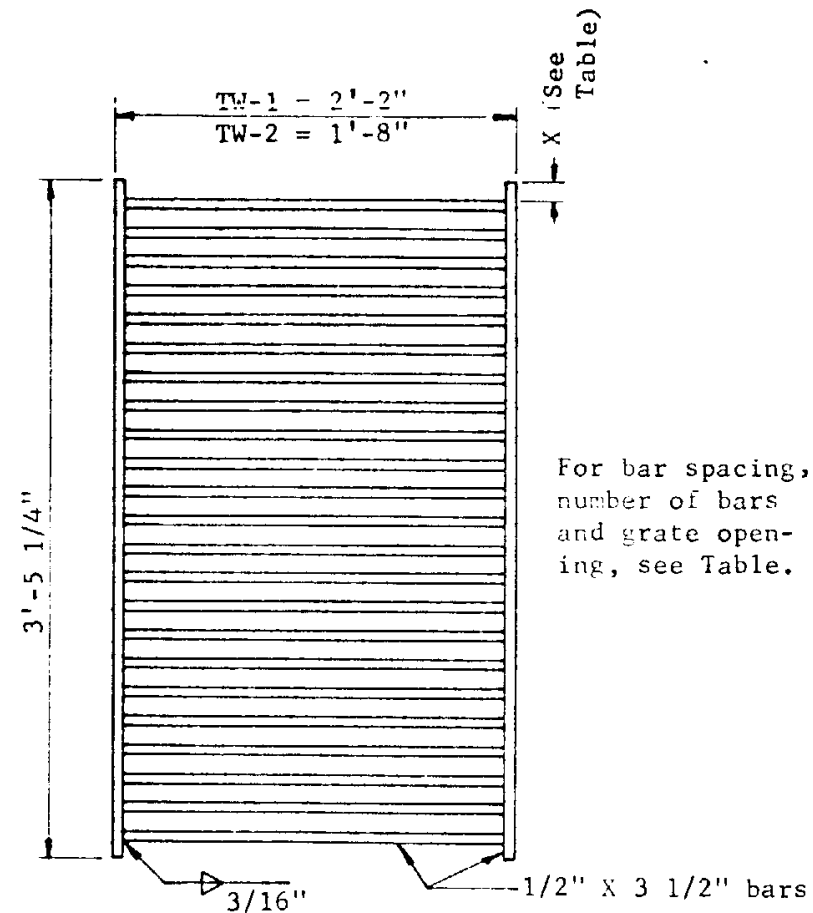
PLAN



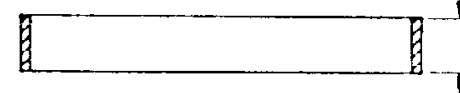
SECTION

FRAME

Type	Clear Spacing	No. Bars	X	Grate Opening Sq. Ft.
TW or TB-1.0	1"	28	7/8"	3.47
TW or TB-1.1	1 3/8"	22	11/16"	3.93
TW or TB-1.2	2"	16	1 5/8"	4.31
TW or TB-2.0	1"	28	7/8"	2.51
TW or TB-2.1	1 3/8"	22	11/16"	2.83
TW or TB-2.2	2"	16	1 5/8"	3.11

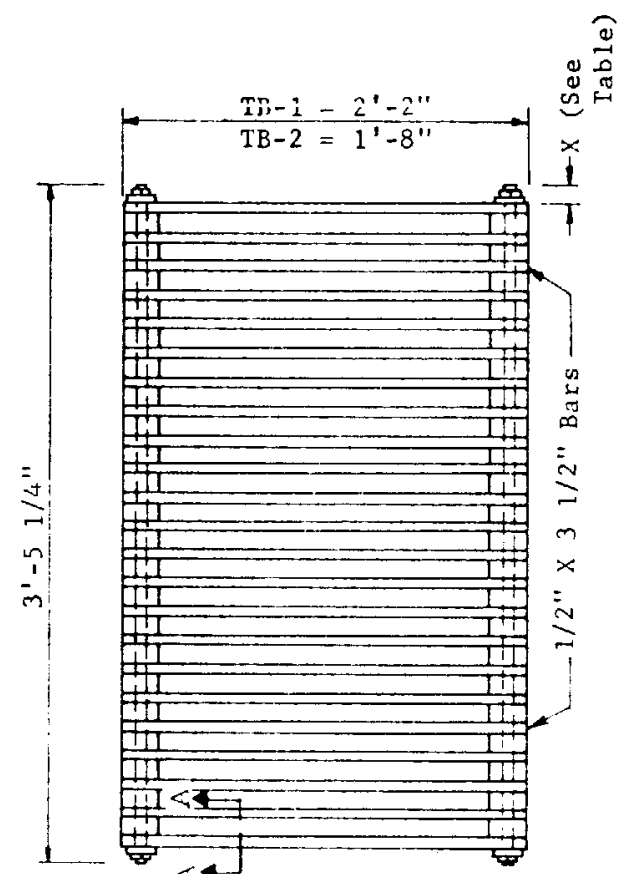


PLAN



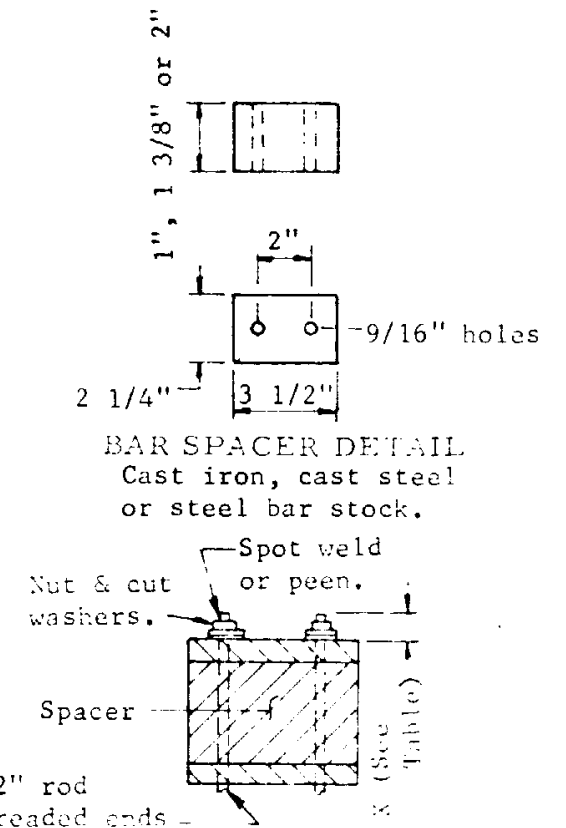
SECTION

GRATE TYPES TW-1 & TW-2



PLAN

GRATE TYPES TB-1 & TB-2



SECTION A-A

#### GENERAL NOTES

Grating units and frames shall be fabricated from structural steel except as noted. Structural steel shall be in accordance with ASTM A 36.

Welding shall be in accordance with A.H.D. Welding Specifications.

The completed assembly shall be given one shop coat of No. 1 paint.

TW indicates transverse welded.  
TB indicates transverse bolted.

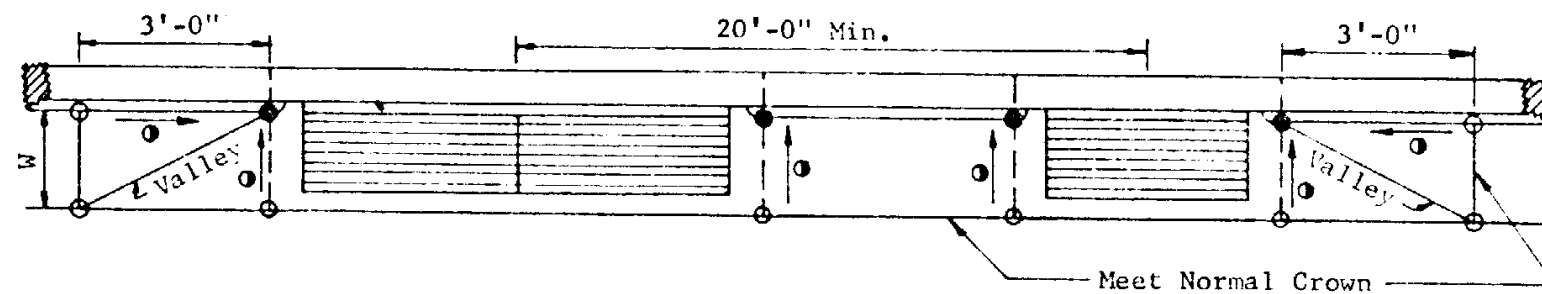
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

Rev  
2-5-68

CATCH BASIN GRATE  
TB AND TW GRATES

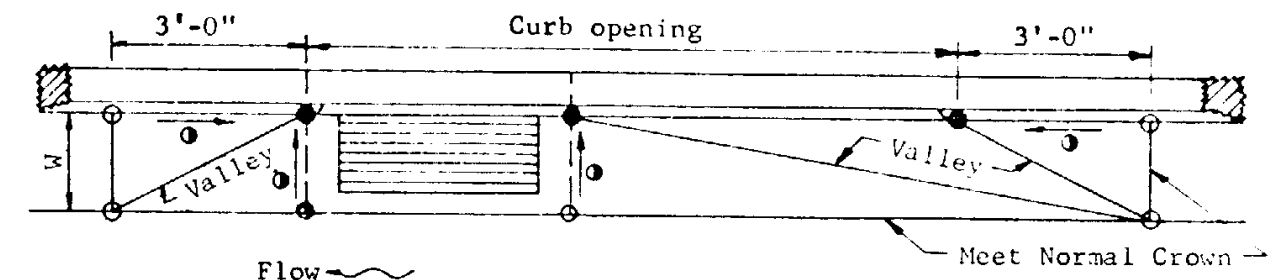
Drawn	D.G. 6-67	Drawing No.
Traced	S.L.T. 7-67	
Checked	J.P.O. JPO 5-68	
Approved		
Engr. Plans	Shindler 5-68	

C-15.07

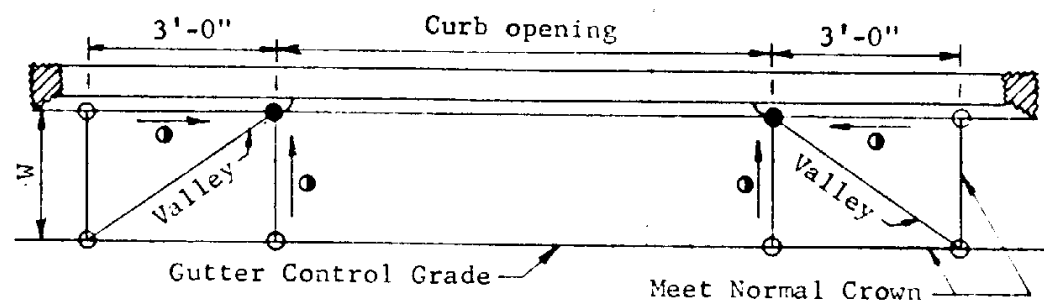


CATCH BASIN TYPES 1, 2, 4-SINGLE, 4-DOUBLE & 5-SINGLE

(Grate opening only or combination; showing minimum spacing for Catch Basins in series.)

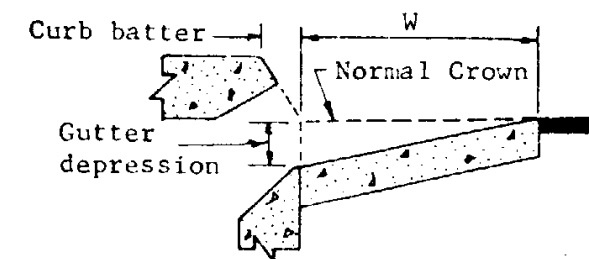


CATCH BASIN TYPES 5-SINGLE & 5-DOUBLE



CATCH BASIN TYPE 3

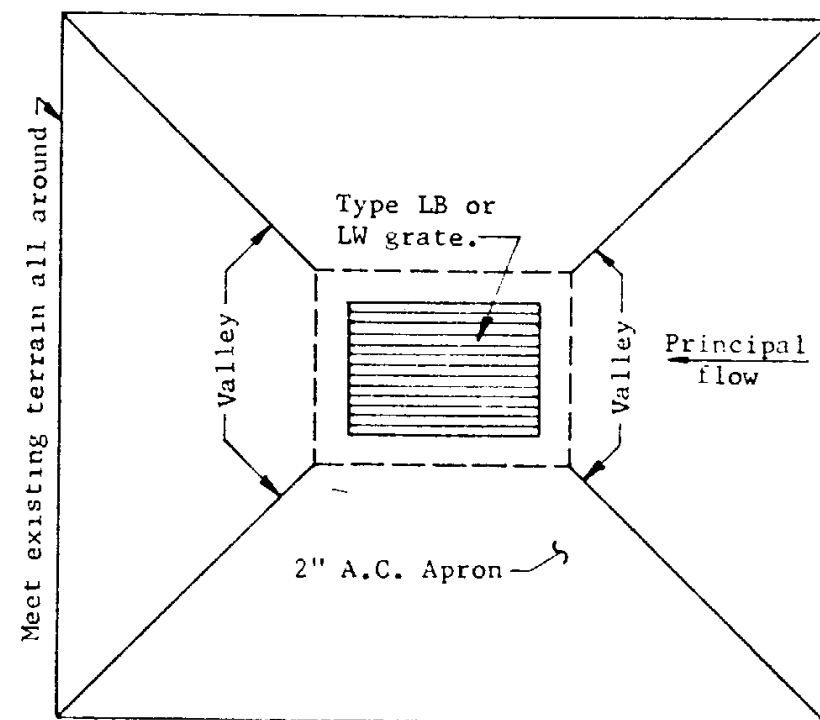
(Curb opening only.)



DETAIL NO. 1

#### LEGEND

- Gutter depression: 3" max. (See Detail No. 1)
- O = Normal crown or gutter flow line elevation.
- = Depressed elevation.
- = Straight grade with downward slope.
- W = Normal gutter width per Std. C-5.01

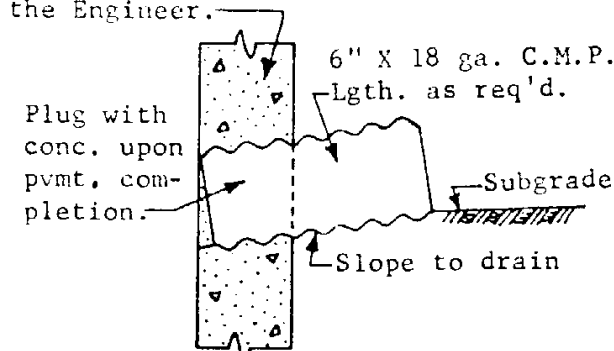


CATCH BASIN TYPE 4

(Off roadway location)

Apron shall be shaped to suit local conditions and shall extend a minimum of 4'-0" from edge of grate in all directions. Grate shall be depressed a minimum of 4" below surrounding terrain and bars shall parallel direction of principal flow.

\*Catch basin wall as specified by the Engineer.

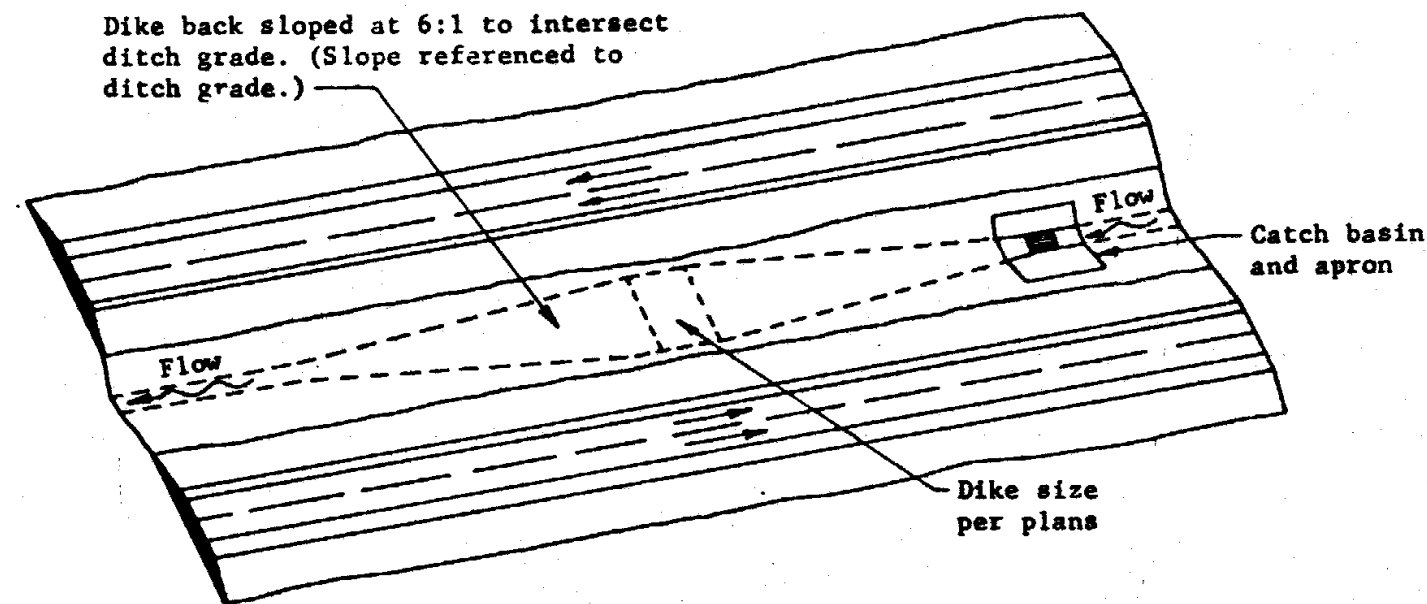


CATCH BASIN CONSTRUCTION DRAIN

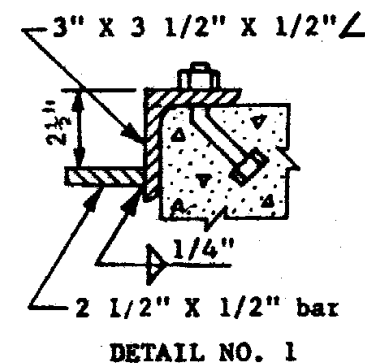
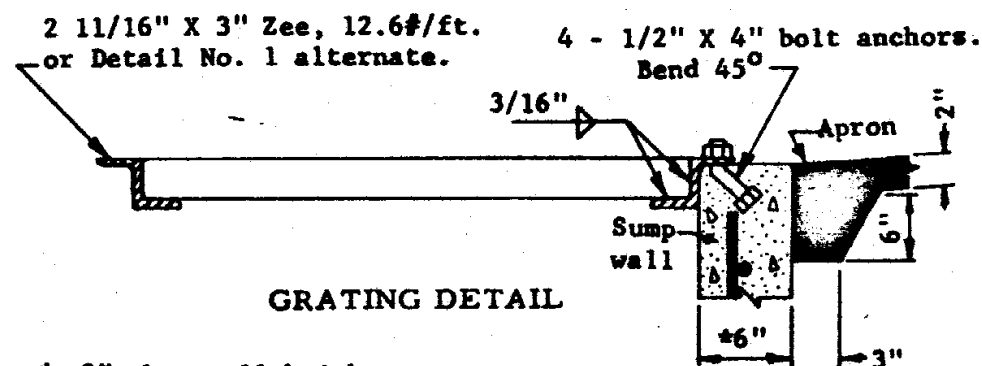
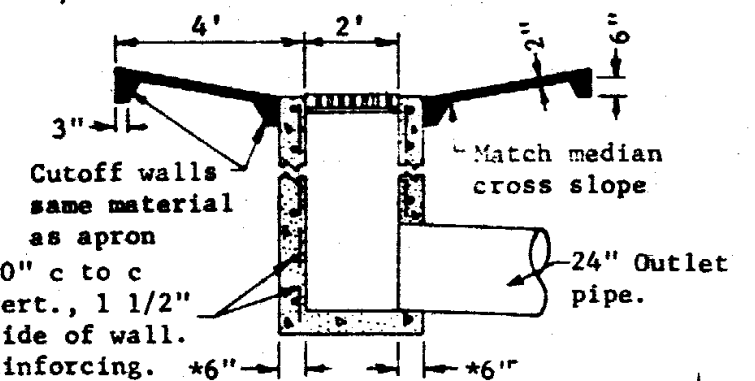
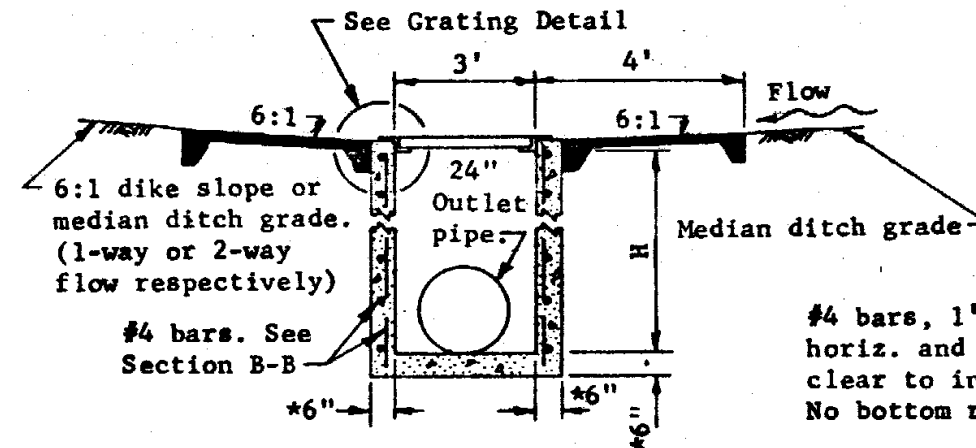
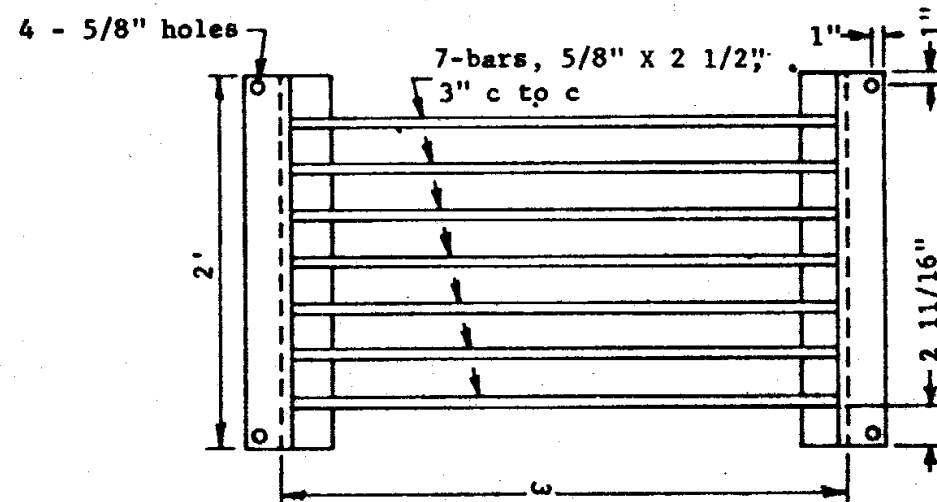
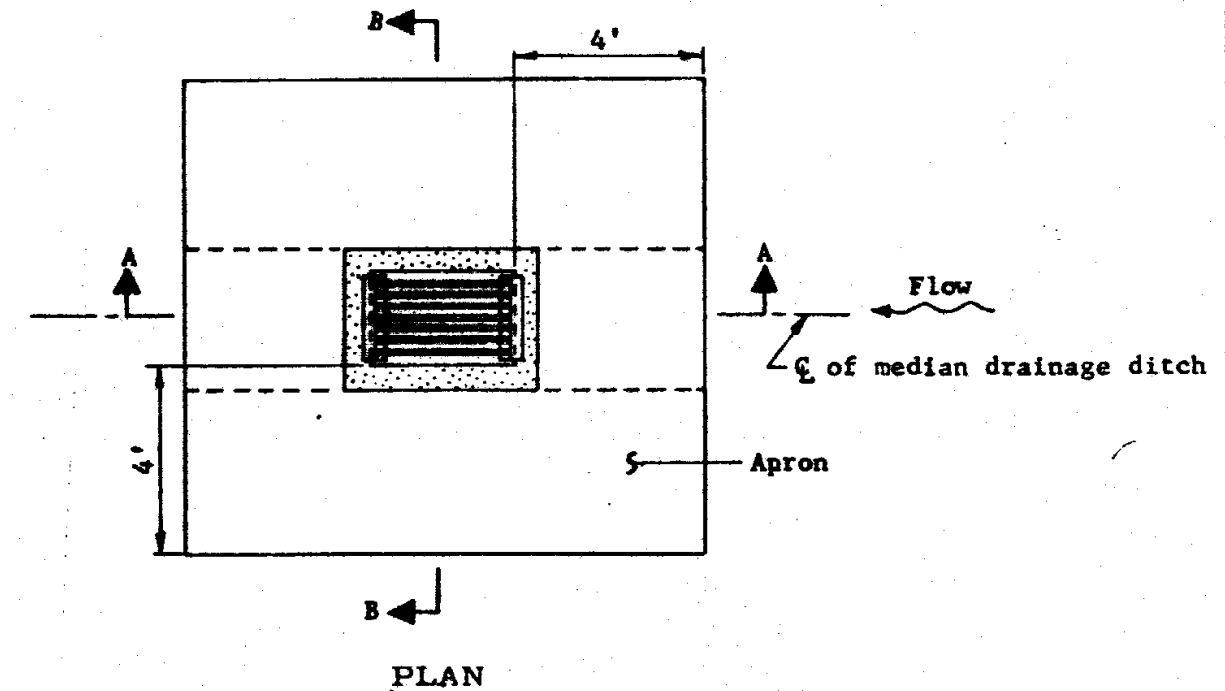
\*Drain may be deleted at option of Engineer

GENERAL NOTES  
No gutter depression shall be used adjacent to median.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
CATCH BASIN DEPRESSED APRON & CONSTRUCTION DRAIN			
Drawn	S.I.T.	10-67	Drawing No.  <b>C-15.08</b>
Traced	S.L.T.	10-67	
Checked	J.P.O.	9/20 5-68	
Approved	Eng. Plans	4/1/21 11.1.15-68	



PLAN PERSPECTIVE  
ILLUSTRATING 1-WAY FLOW WITH DYKE



**GENERAL NOTES**

Apron shall be A.C. or P.C. concrete as specified on Plans.

Concrete shall be Class A.

Grating shall be fabricated of structural steel.

Structural steel shall be in accordance with ASTM A 36.

Welding shall be in accordance with A.H.D. Welding Specifications.

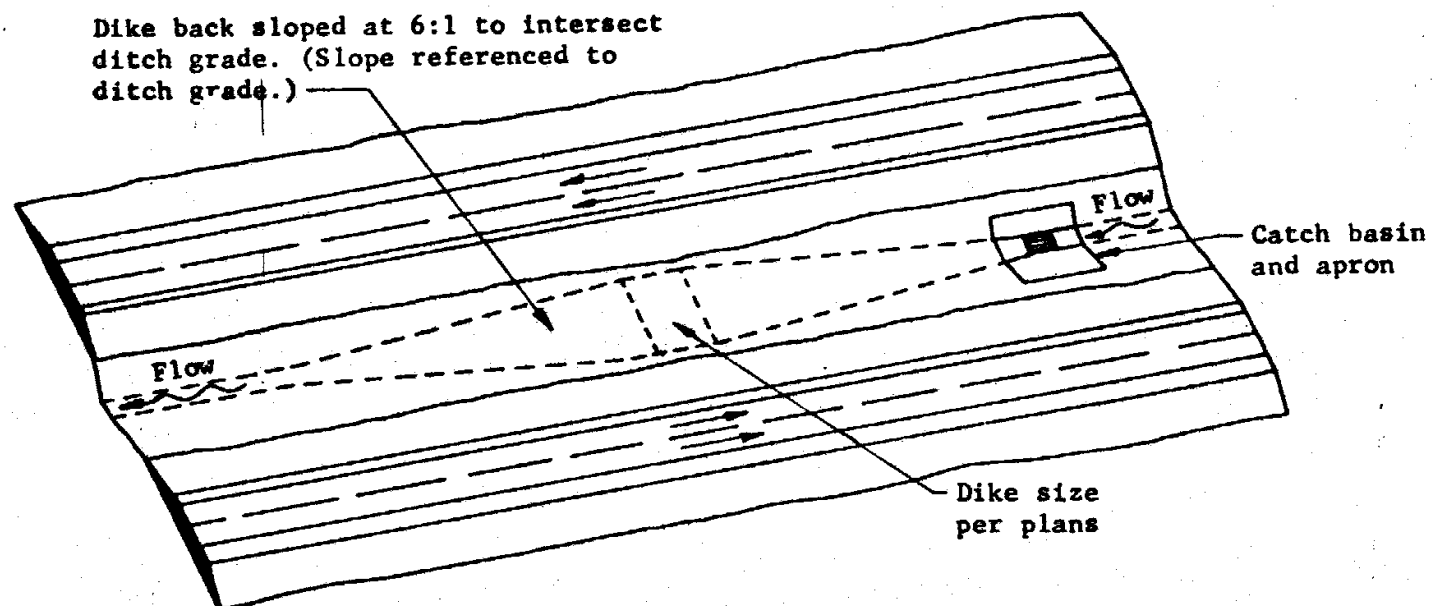
Grating assembly shall be given one shop coat of No. 1 paint.

"H" indicated on project Plans.

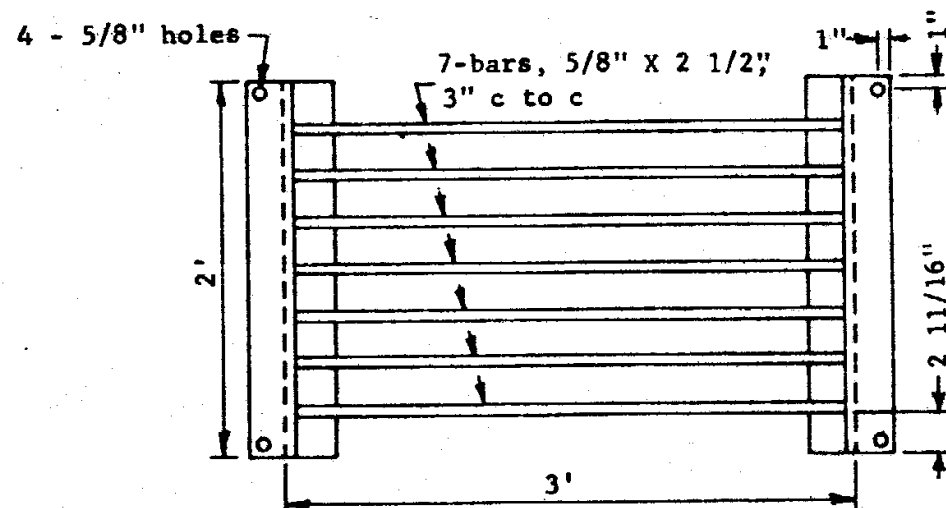
ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 11-21-68 10-6-70
MEDIAN CATCH BASIN			
Drawn	D.G.	3-68	Drawing No.  C-15.09
Traced	R.A.F.	3-68	
Checked	J.P.O.	SPD 5-68	
Approved	[Signature]		



Dike back sloped at 6:1 to intersect ditch grade. (Slope referenced to ditch grade.)



PLAN PERSPECTIVE  
ILLUSTRATING 1-WAY FLOW WITH DYKE

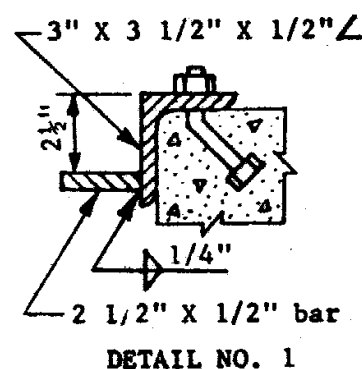
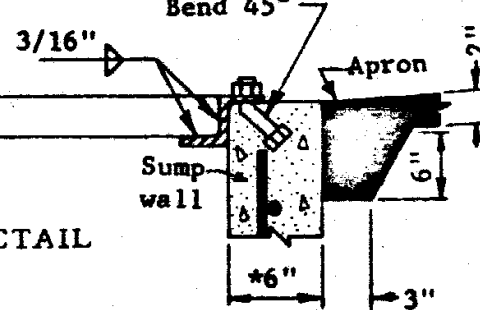


2 11/16" X 3" Zee, 12.6#/ft.  
or Detail No. 1 alternate.

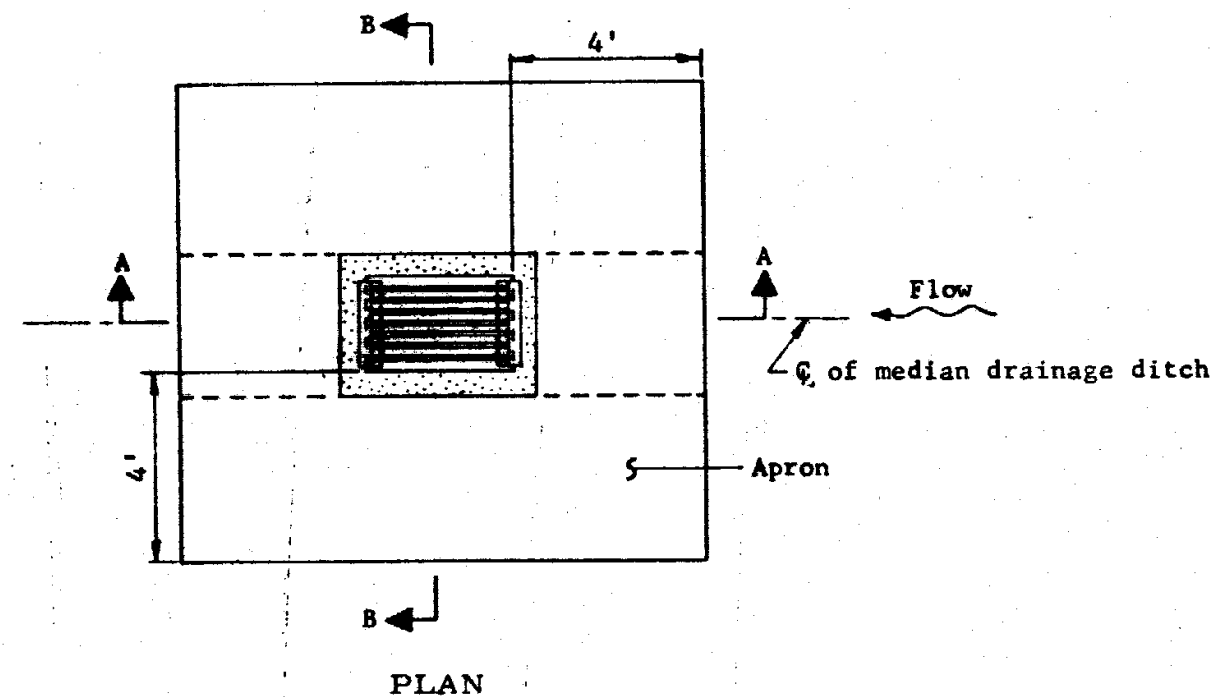
4 - 1/2" X 4" bolt anchors.  
Bend 45°

GRATING DETAIL

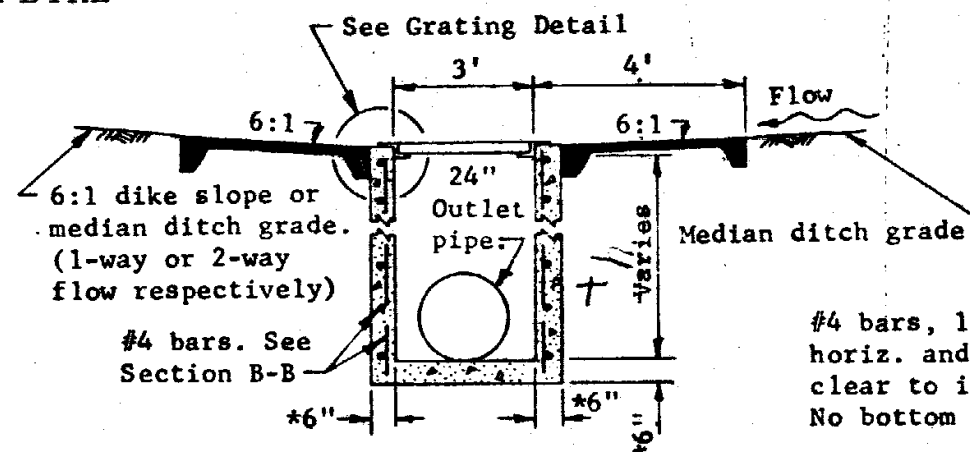
\* 8" when wall height  
exceeds 8'.



DETAIL NO. 1

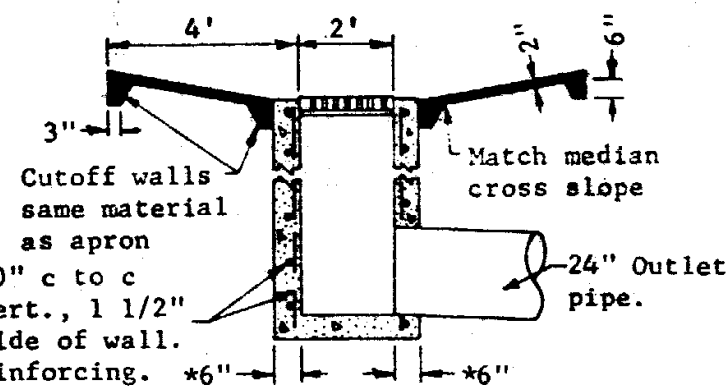


PLAN



SECTION A-A  
+ min 4'  
max 9'

*h = to be shown on notes*



SECTION B-B

#### GENERAL NOTES

Apron shall be A.C. or P.C. concrete as specified on Plans.  
Concrete shall be Class A.  
Grating shall be fabricated of structural steel.  
Structural steel shall be in accordance with ASTM A 36.  
Welding shall be in accordance with A.H.D. Welding Specifications.  
Grating assembly shall be given one shop coat of No. 1 paint.

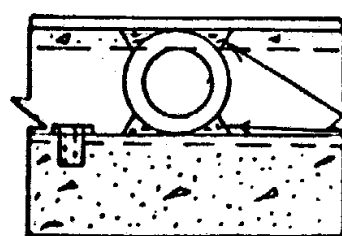
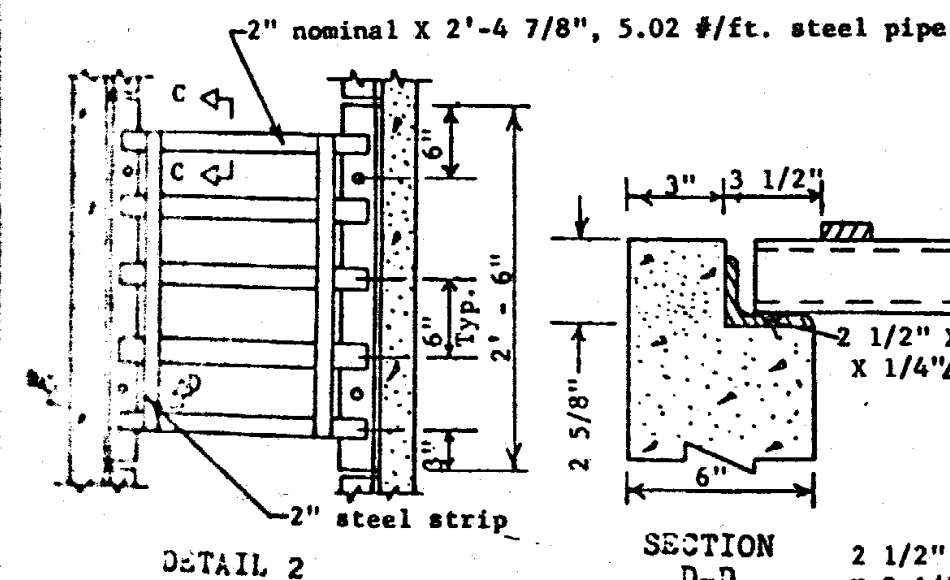
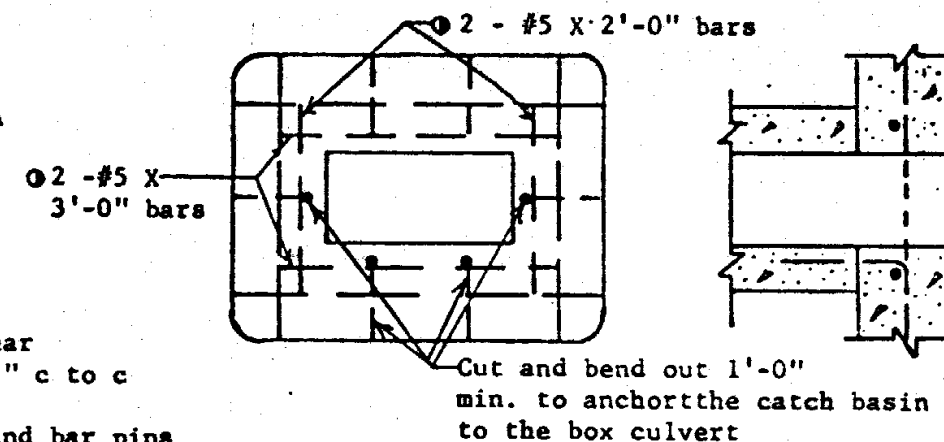
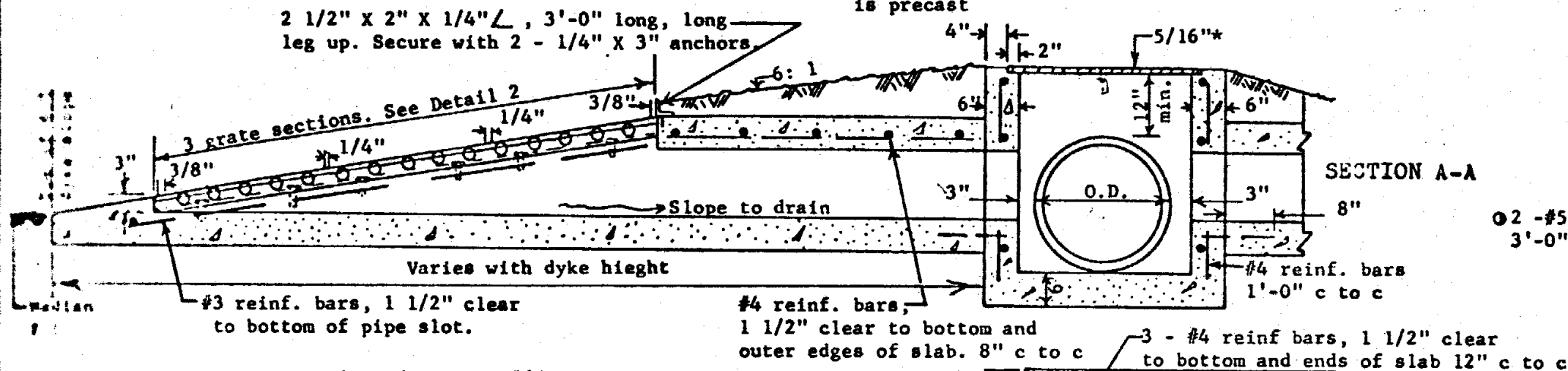
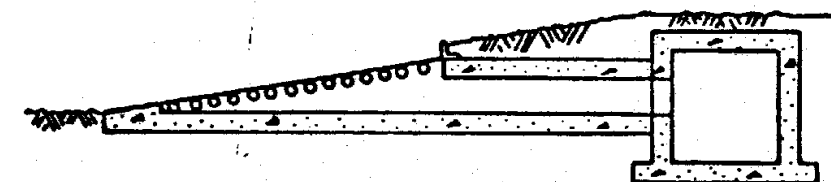
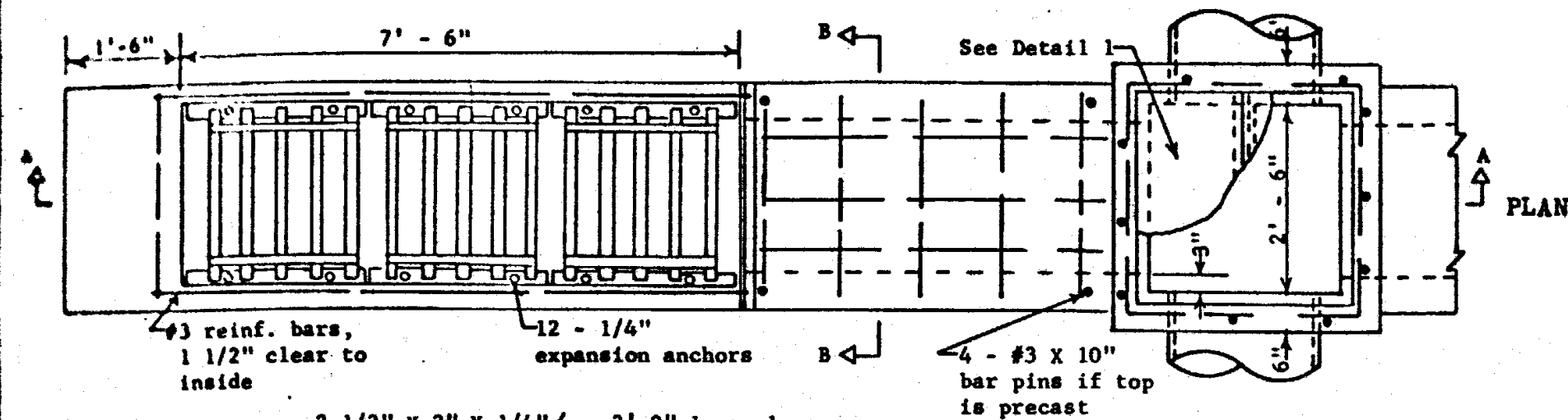
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

### MEDIAN CATCH BASIN

Drawn	D.G.	3-68
Traced	R.A.F.	3-68
Checked	J.P.O.	8PO 5-68
Approved	Engr. Plans	

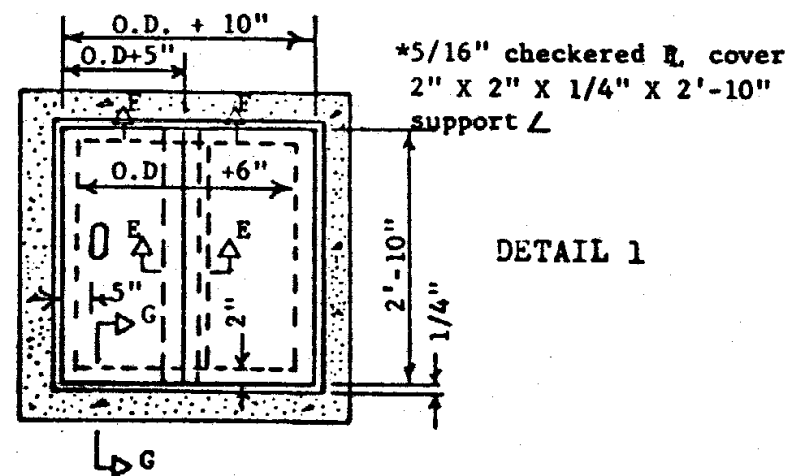
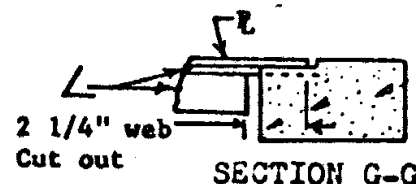
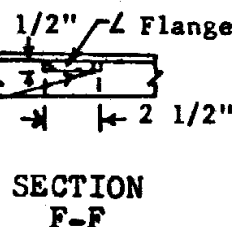
Drawing No.  
**C-15.09**

Rev  
11-21-68

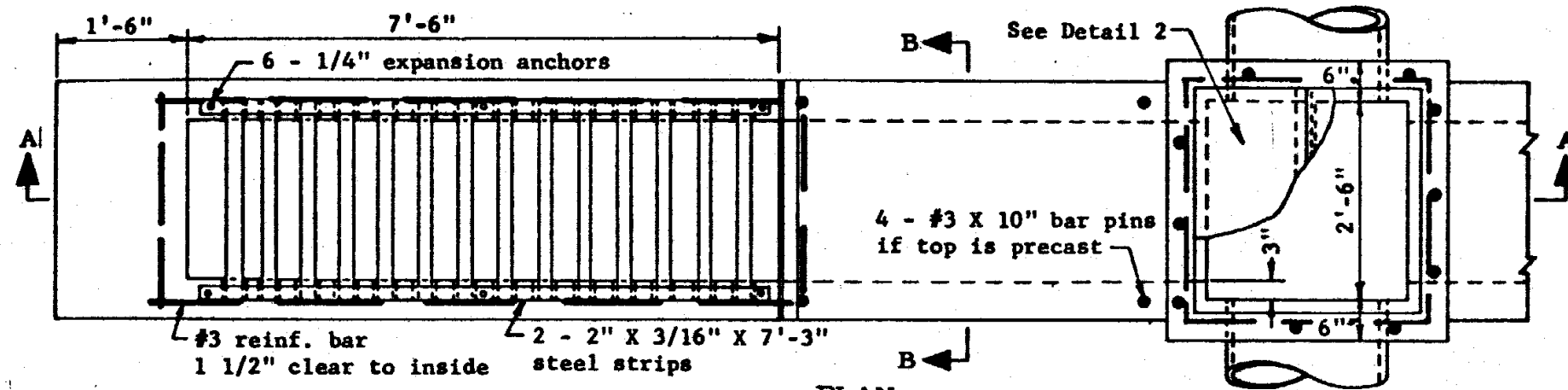


SECTION D-D

2 1/2" X 1/2" X 2 1/4" slot in wall to receive L flange

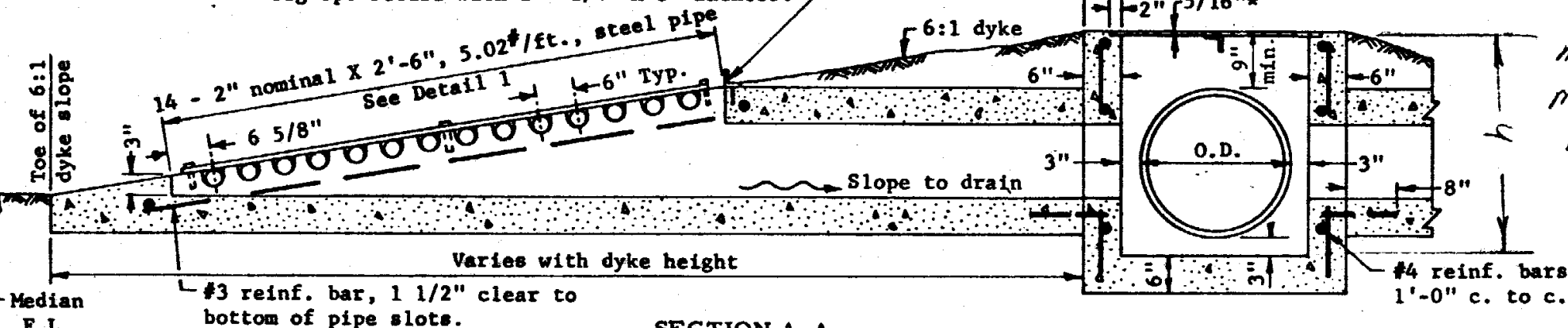


ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev 12-5-68 4-28-70 10-6-70
MEDIAN DYKE CATCH BASIN			
Drawn	D.G. 3 - 68	Drawing No. <b>C-15.10</b>	
Traced	R.A.F. 4 - 68		
Checked	J.P.O.		
Approved	<i>[Signature]</i>		



PLAN

2 1/2" X 2" X 1/4" L, 3'-0" long, long leg up. Secure with 2 - 1/4" X 3" anchors.

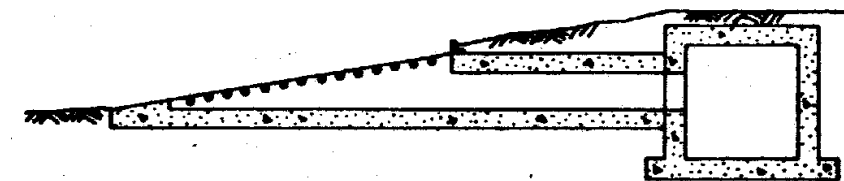


SECTION A-A

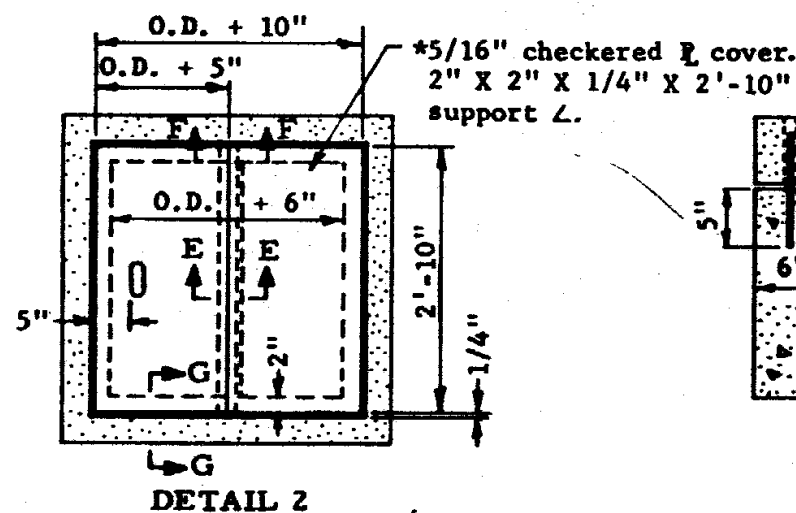
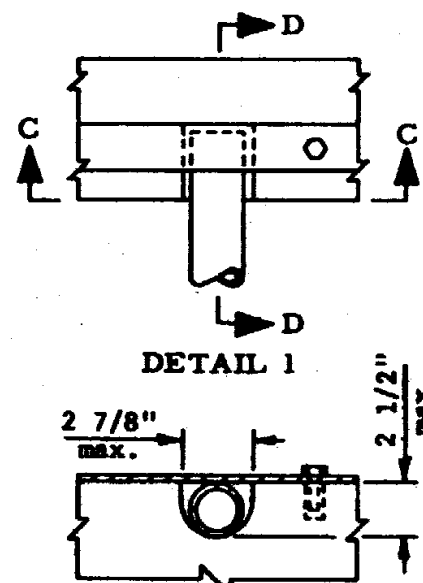
min - 24" - 4'

max - 9'

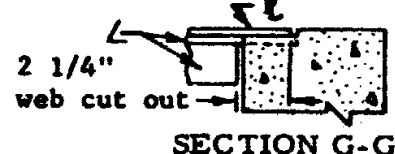
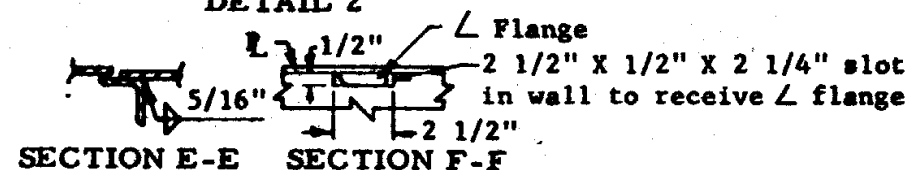
h - to be shown on plan



INLET TO BOX CULVERT  
(See Bridge sheets for details)



SECTION B-B



# GENERAL NOTES

All concrete shall be Class A.  
Steel pipe, plate and strip shall be in accordance with ASTM A 36.  
Exposed steel shall be given one shop coat of No. 1 paint.

\*When O.D. + 5" exceeds 1'-11", use 3/8" plate.

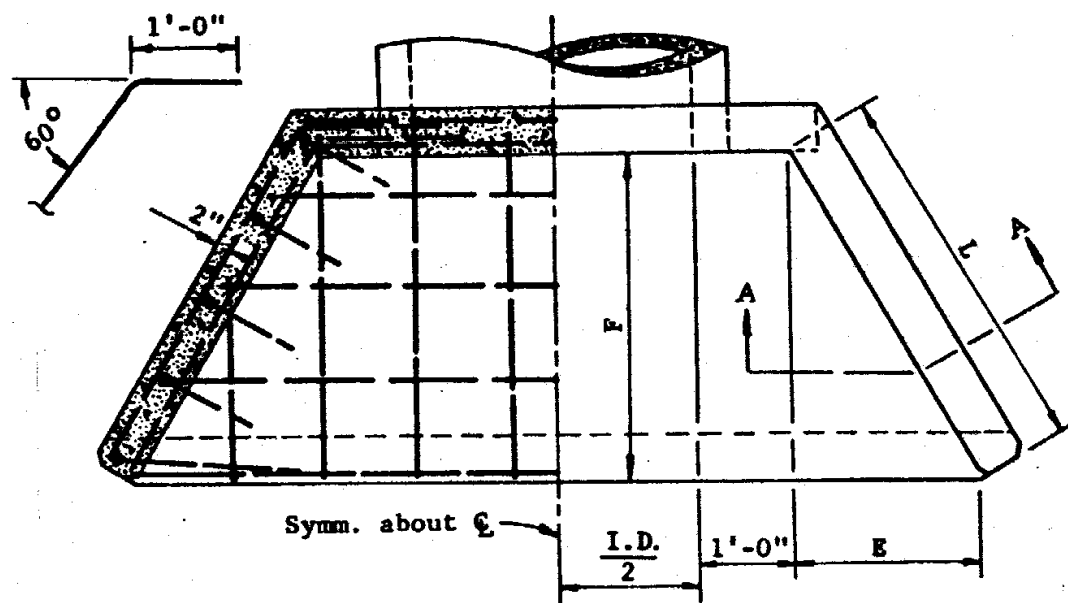
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## MEDIAN DYKE CATCH BASIN

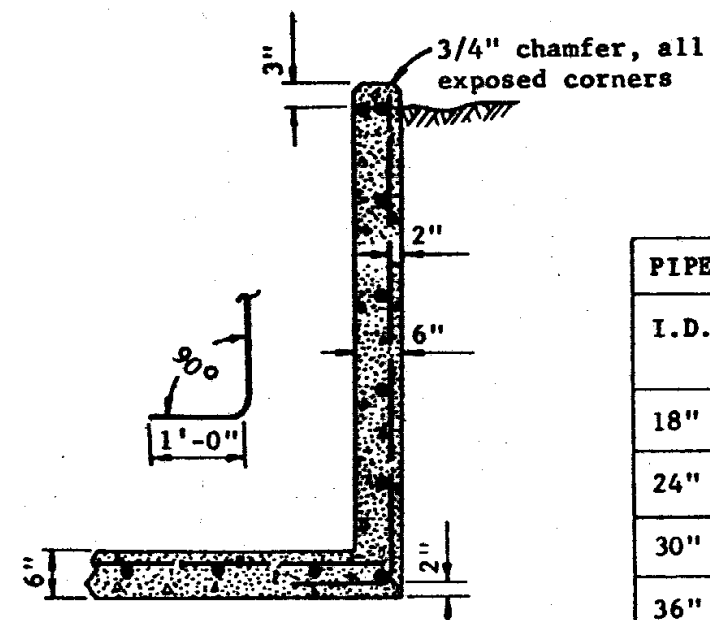
Drawn D.G. 3-68  
Traced R.A.F. 4-68  
Checked J.P.O. 5-68  
Approved  
Engr. Plans

Drawing No.  
**C-15.10**

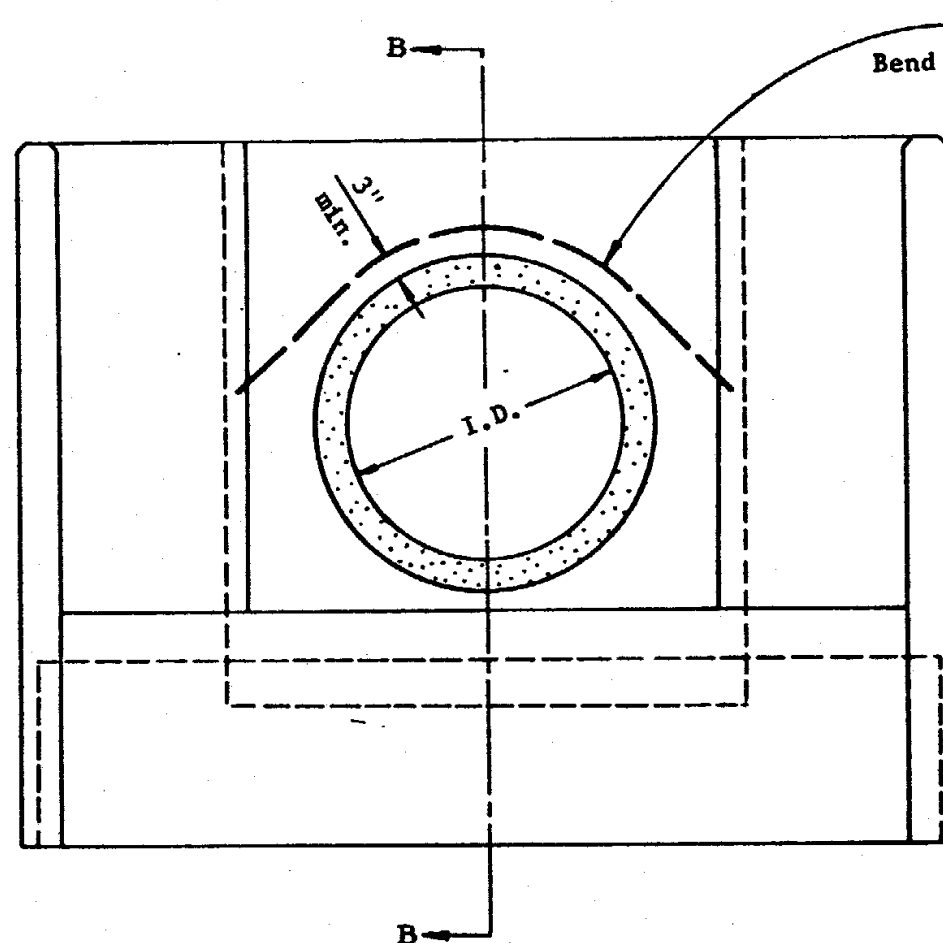
Rev  
12-68



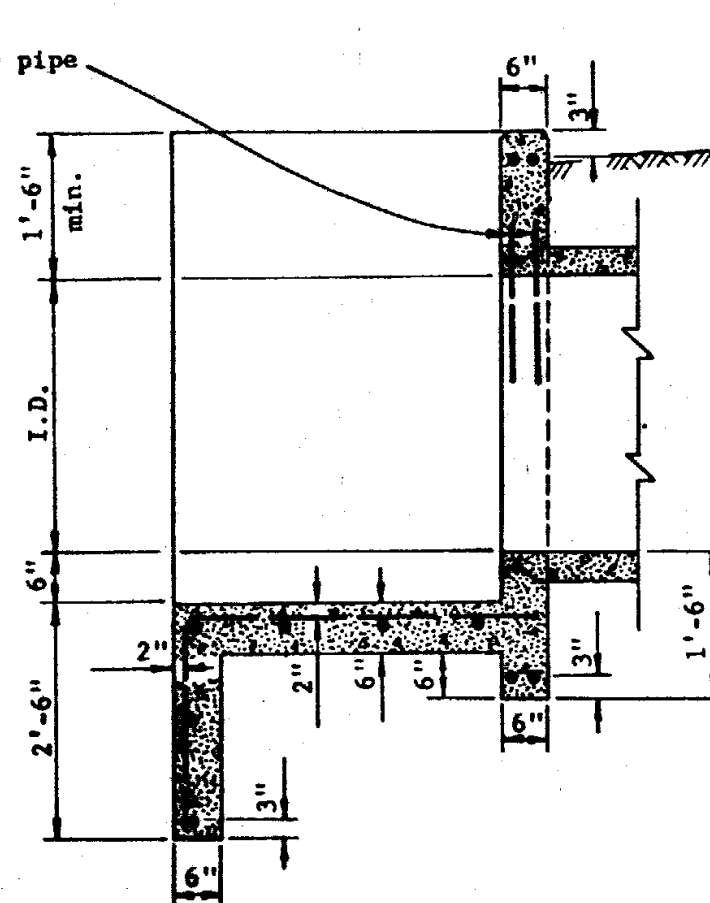
PLAN



SECTION A-A



ELEVATION



SECTION B-B

PIPE I.D.	DIMENSIONS			QUANTITIES		
	L	E	F (Approx)	C.Y. Conc. C.M.P.	C.Y. Conc. R.C.P.	Reinf. Steel Lbs.
18"	2'-0"	1'-0"	1'-9"	0.97	0.96	65
24"	2'-0"	1'-0"	1'-9"	1.11	1.07	78
30"	3'-0"	1'-6"	2'-7"	1.50	1.44	108
36"	4'-0"	2'-0"	3'-6"	2.08	2.01	150
42"	5'-0"	2'-6"	4'-4"	2.71	2.63	205
48"	6'-0"	3'-0"	5'-2"	3.39	3.30	270
54"	7'-0"	3'-6"	6'-1"	4.14	4.02	335
60"	8'-0"	4'-0"	6'-11"	4.96	4.80	410

GENERAL NOTES

All concrete shall be Class A.

All reinforcing bars shall be #4 except two #6 bars over pipe. Bar spacing approximately 1'-0" c to c unless otherwise noted.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

IRRIGATION HEADWALLS  
18" TO 60"  
DIAMETER PIPES

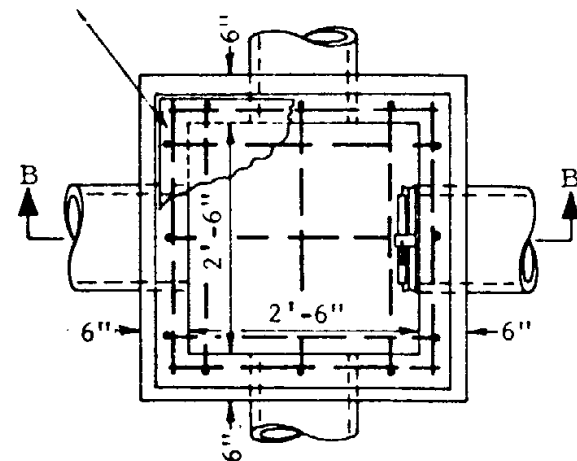
Drawn R.J.J. 3-10-58  
Traced S.L.T. 5-4-67  
Checked J.P.O. 990 5-68  
Approved  
Engr. Plans *W. Heidecker 5-68*

Drawing No.

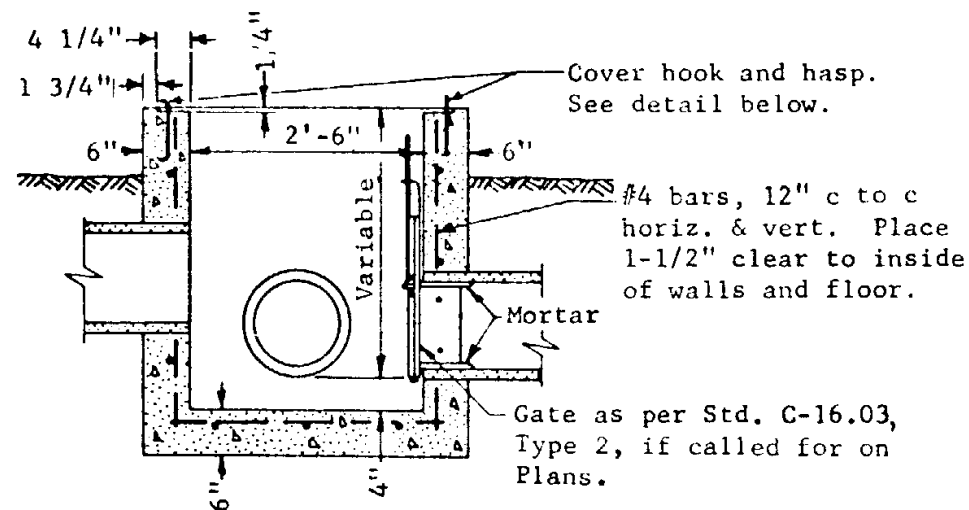
C-16.01

Rev

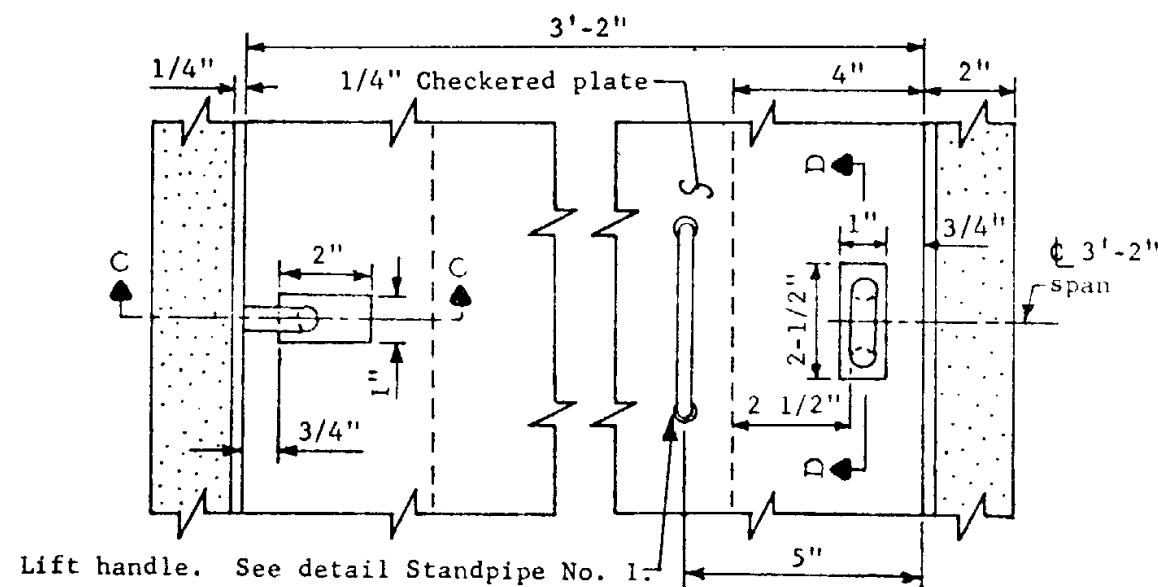
Cover. See detail below.



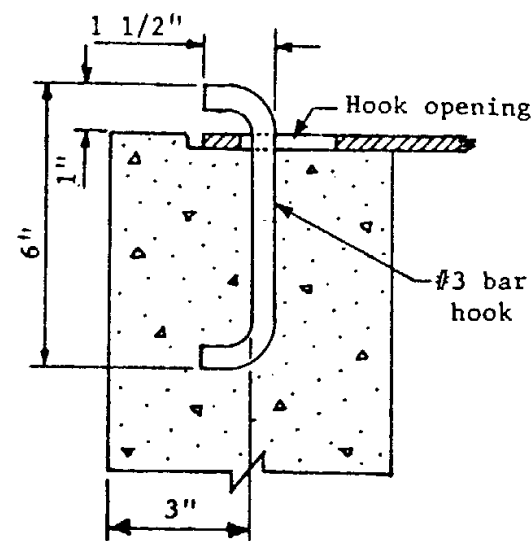
PLAN



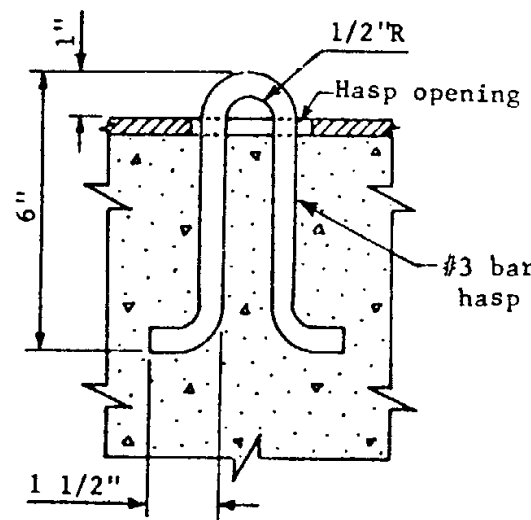
SECTION B-B



PLAN-LOCKING COVER



SECTION C-C



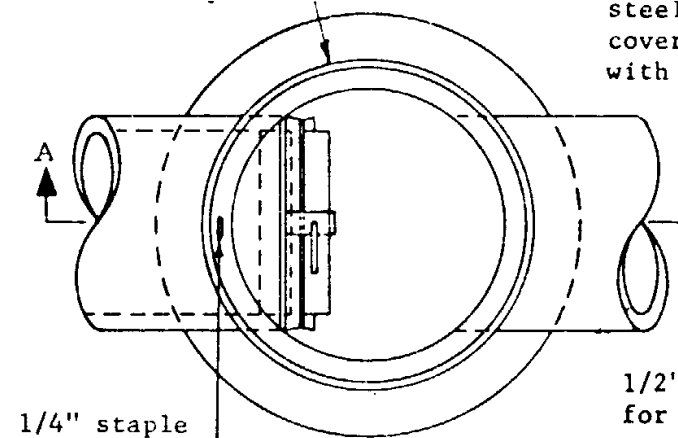
SECTION D-D

IRRIGATION STANDPIPE NO. 2

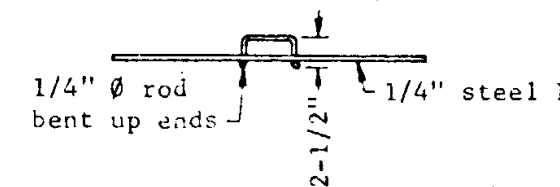
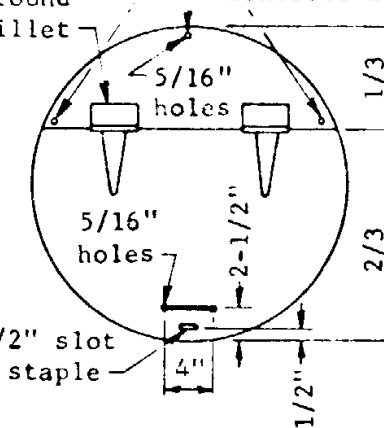
R.C. Pipe; size as shown on plans

Tee hinges, 1/4" steel, welded to cover all around with 1/4" fillet

3 - 1/4" bolt size self drilling type concrete anchors.

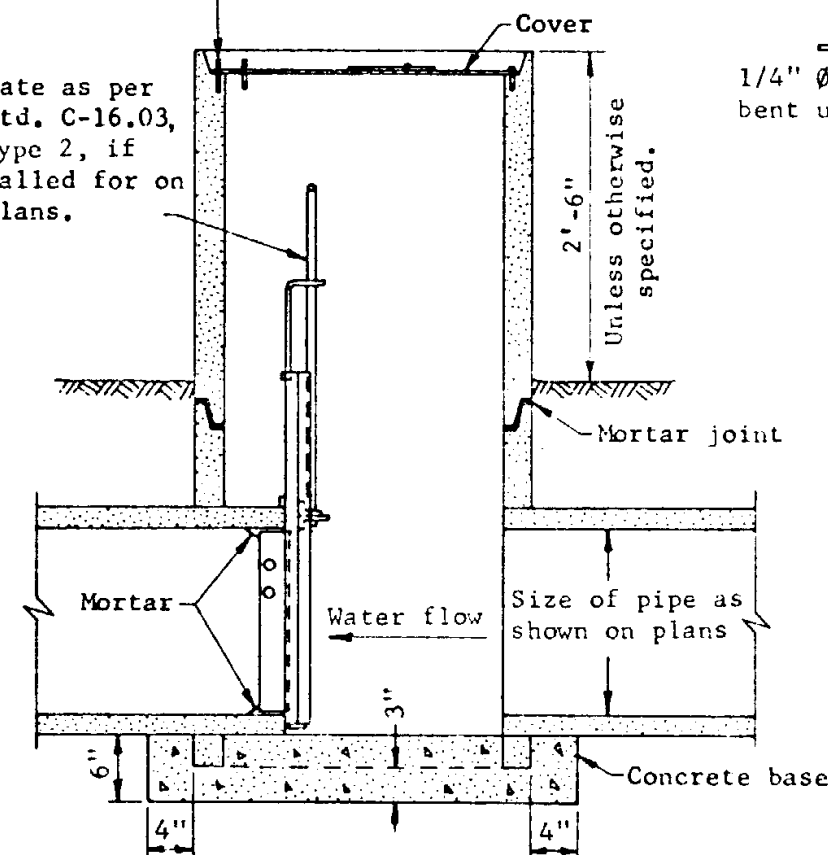


PLAN



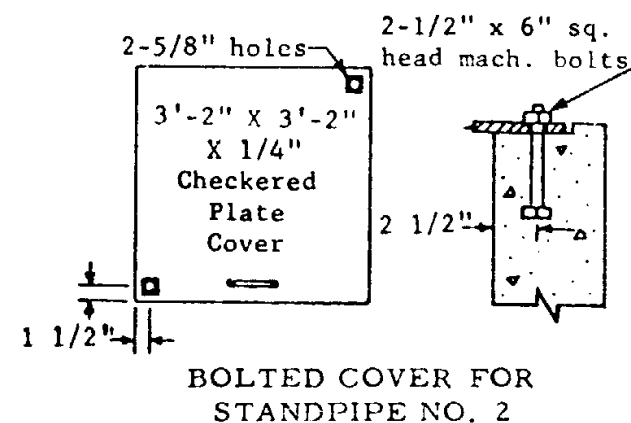
COVER FOR NO. 1 STANDPIPE

Gate as per Std. C-16.03, Type 2, if called for on plans.



SECTION A-A  
IRRIGATION STANDPIPE NO. 1

**GENERAL NOTES**  
All concrete shall be Class A.  
Structural steel shall be in accordance with ASTM A 36.  
All cover steel and exposed appurtenances shall be given one shop coat of No. 1 paint.  
Plans shall specify locked or bolted cover for Standpipe No. 2



BOLTED COVER FOR  
STANDPIPE NO. 2

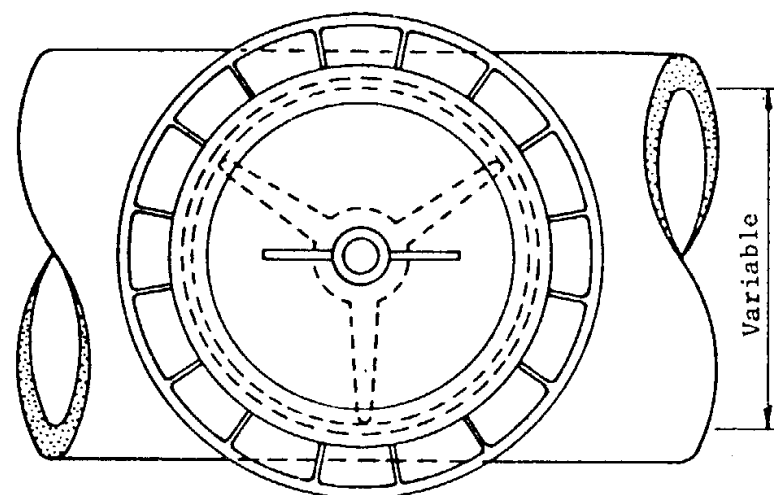
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

# IRRIGATION STANDPIPE NO. 1 AND NO. 2

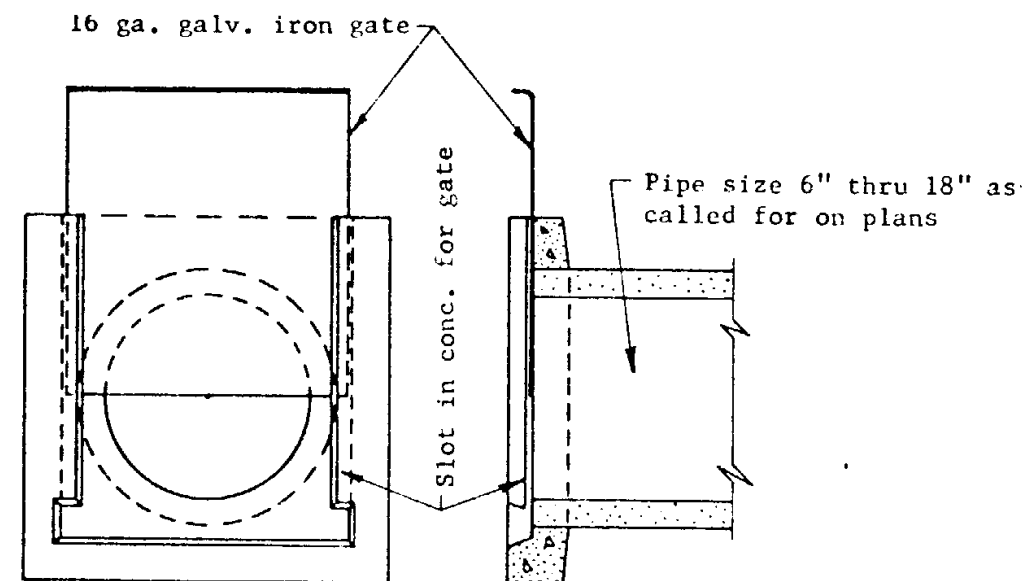
Drawn	S.G.
Traced	R.A.F. 10-67
Checked	J.P.O. 9/10 5-68
Approved	H. H. H. 5-68

Drawing No.  
**C-16.02**

Rev



PLAN



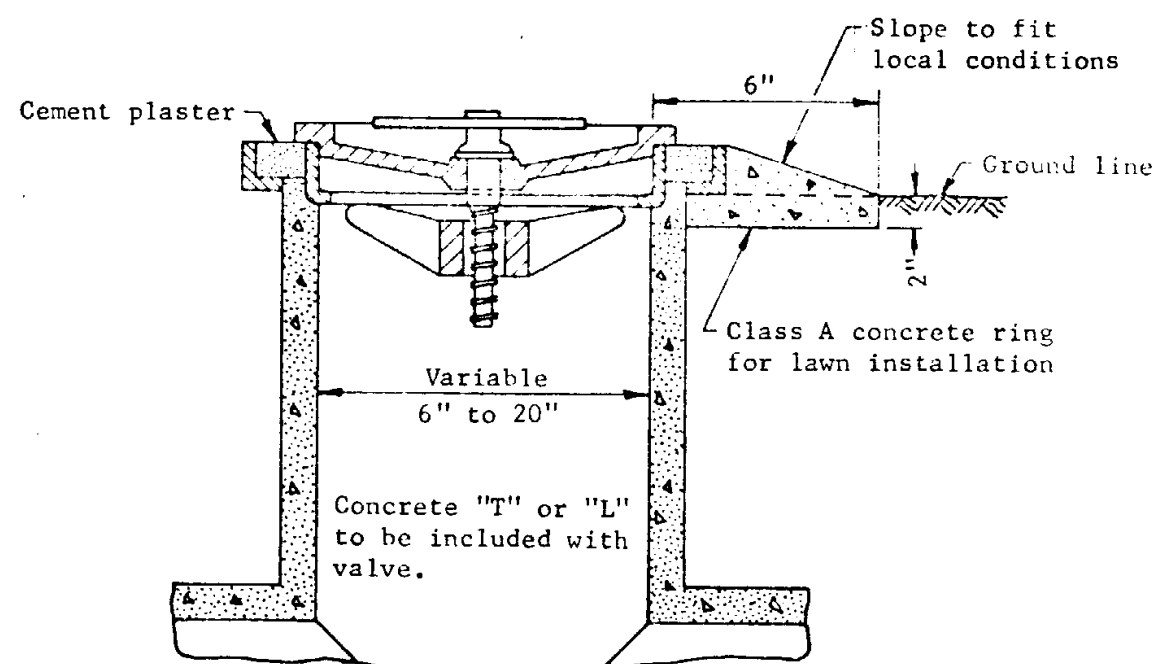
ELEVATION

SECTION

PRECAST IRRIGATION GATE

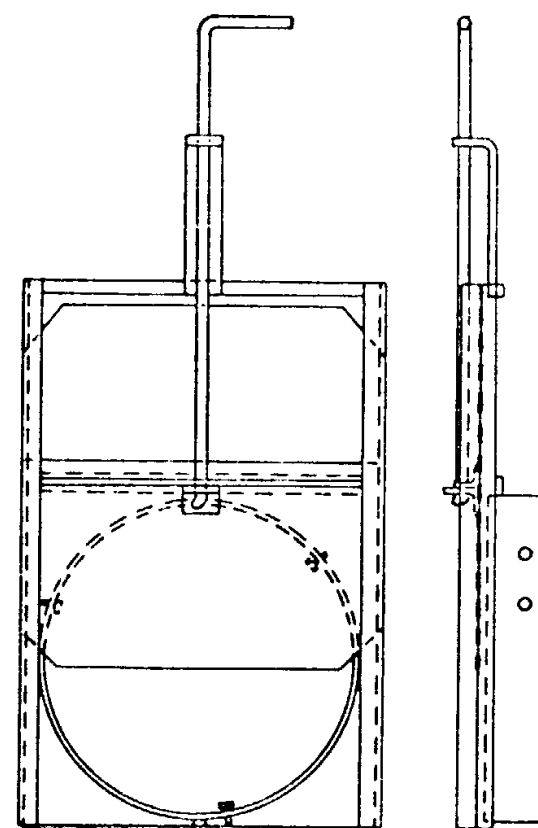
For open ditch installation

TYPE 1



Irrigation Valve Number of valve shall correspond to the size of the pipe in inches. No. 6 to No. 20.

PART SECTION  
FLUSH IRRIGATION VALVE,



ELEVATION

SECTION

IRRIGATION GATE  
For standpipe installation

TYPE 2

TYPE 2

For pipes 6" through 24". Gate and frame shall be galvanized iron. Type shown is for concrete pipe. For C.M.P., external steel adjustable band shall be used in place of internal steel ring.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

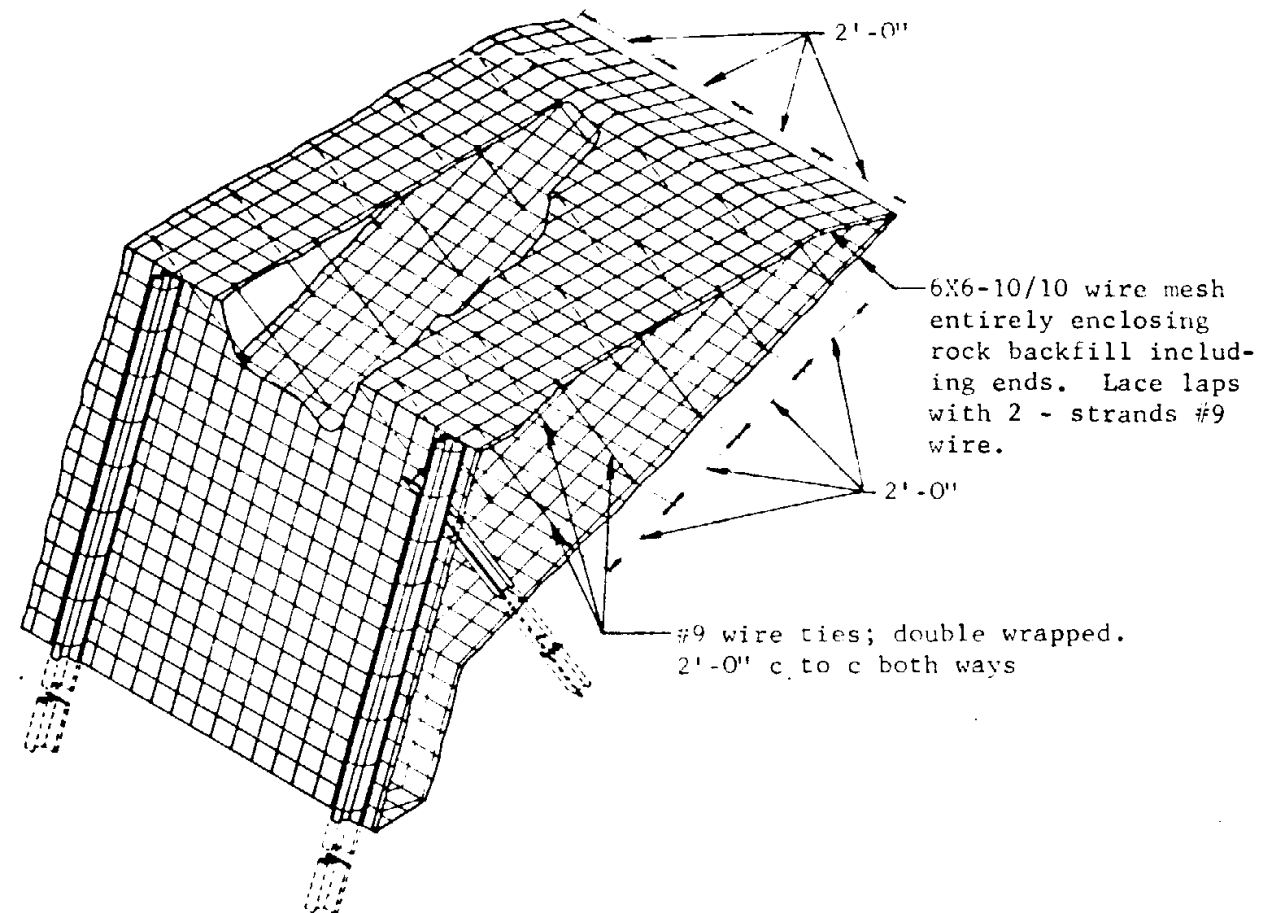
Rev

# IRRIGATION VALVE IRRIGATION GATES

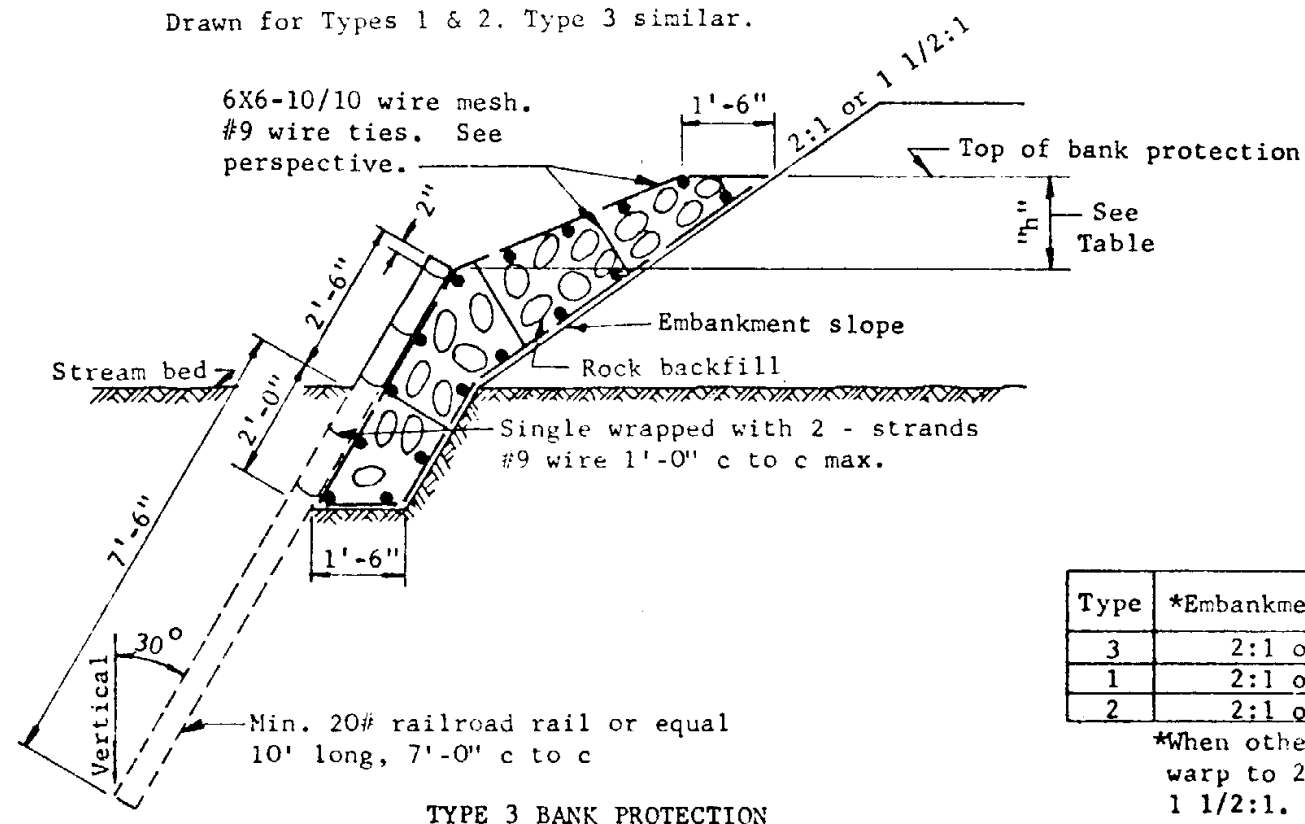
Drawn	O.K. 12/35
Traced	R.A.F. 10/66
Checked	J.P.O. 9/0 5-68
Approved	
Engr. Plans	5/15/68

Drawing No.

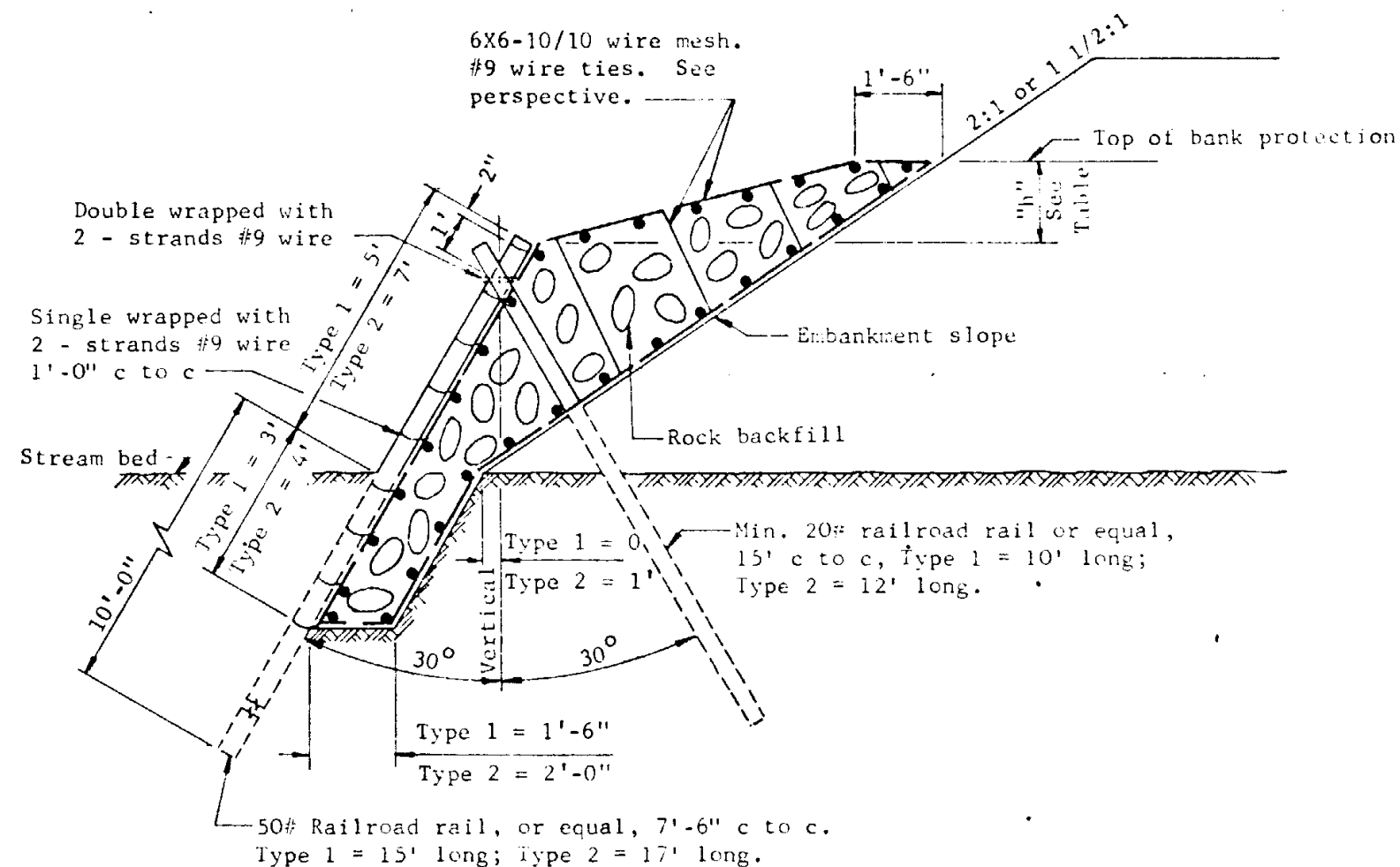
C-16.03



PERSPECTIVE  
Drawn for Types 1 & 2. Type 3 similar.



TYPE 3 BANK PROTECTION



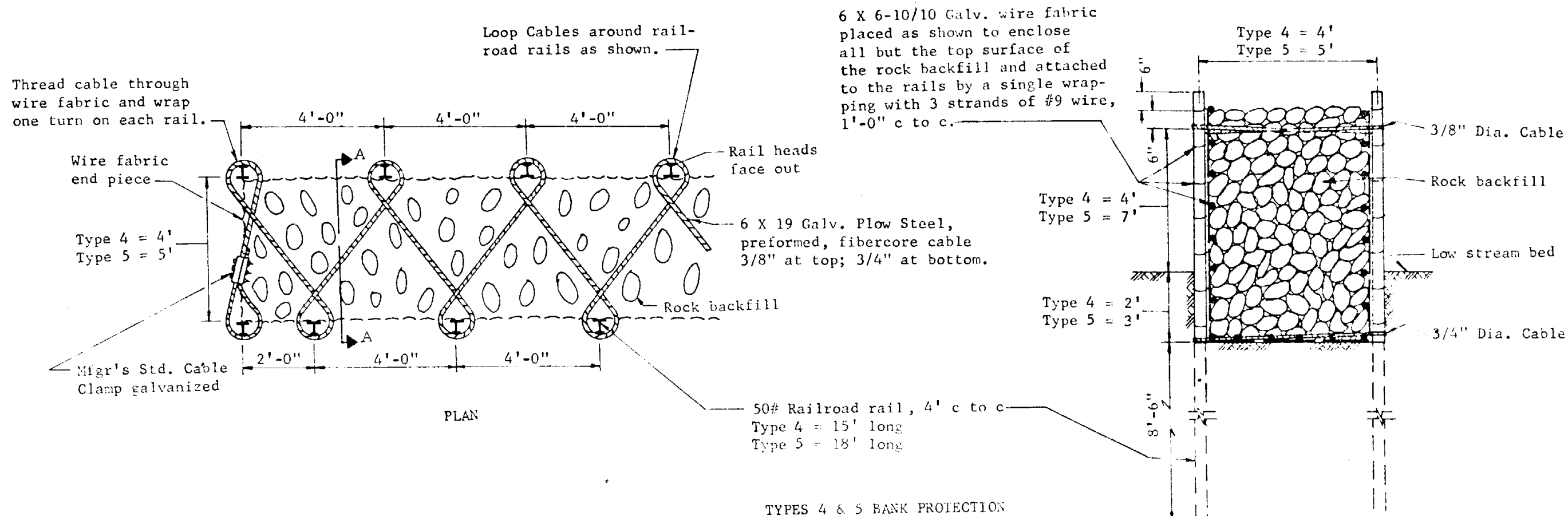
TYPE: TYPE 1 & 2 BANK PROTECTION

GENERAL NOTES  
Rock for backfill shall not pass a 6" square opening.

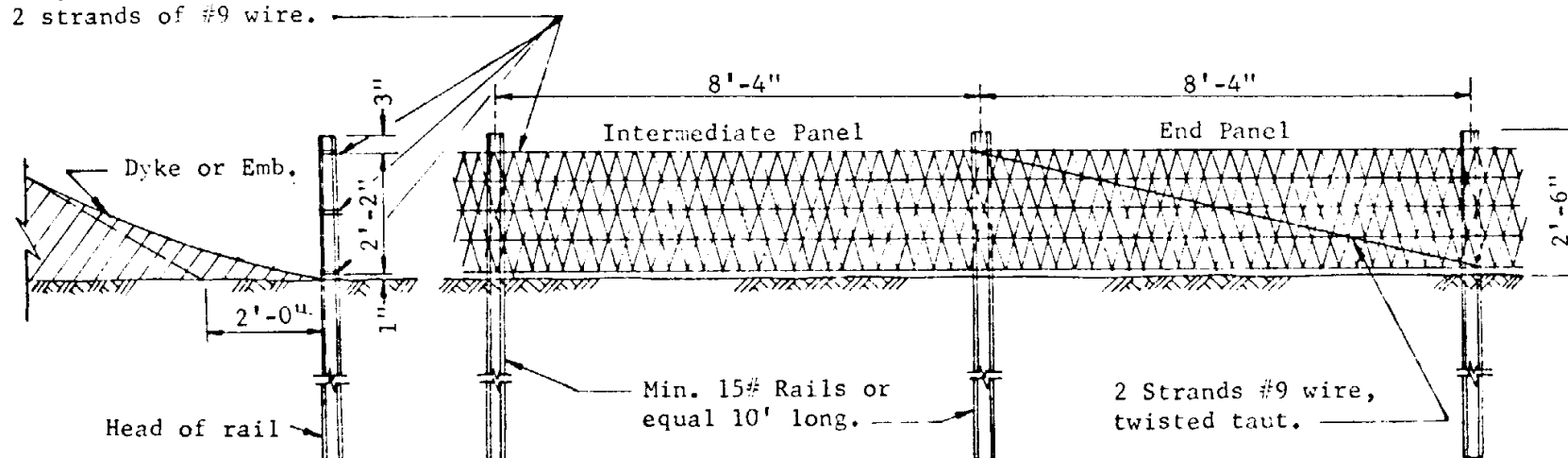
Type	*Embankment slope rate	"h"	Top of bank protection above stream bed
3	2:1 or 1 1/2:1	0' to 2'	2' to 4'
1	2:1 or 1 1/2:1	0' to 3'	4' to 7'
2	2:1 or 1 1/2:1	0' to 6'	6' to 12'

\*When other embankment slope rates are encountered, warp to 2:1 or 1 1/2:1; that is, warp 1:1 slope to 1 1/2:1.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
BANK PROTECTION TYPES 1, 2, & 3			
Drawn	H.A.K.	6-33	Drawing No.  C-17.01
Traced	SLT & RAF	7-67	
Checked	J.P.O.	980-568	
Approved			
Engr. Plans	Schneider 5-68		



2" X 4"  $\Delta$  galv. woven wire fabric; horizontal wires shall be 2 strands, twisted, min. 12 1/2 ga; diagonal wires min. 14 ga. Attach to rails as shown by single wrapping with 2 strands of #9 wire.



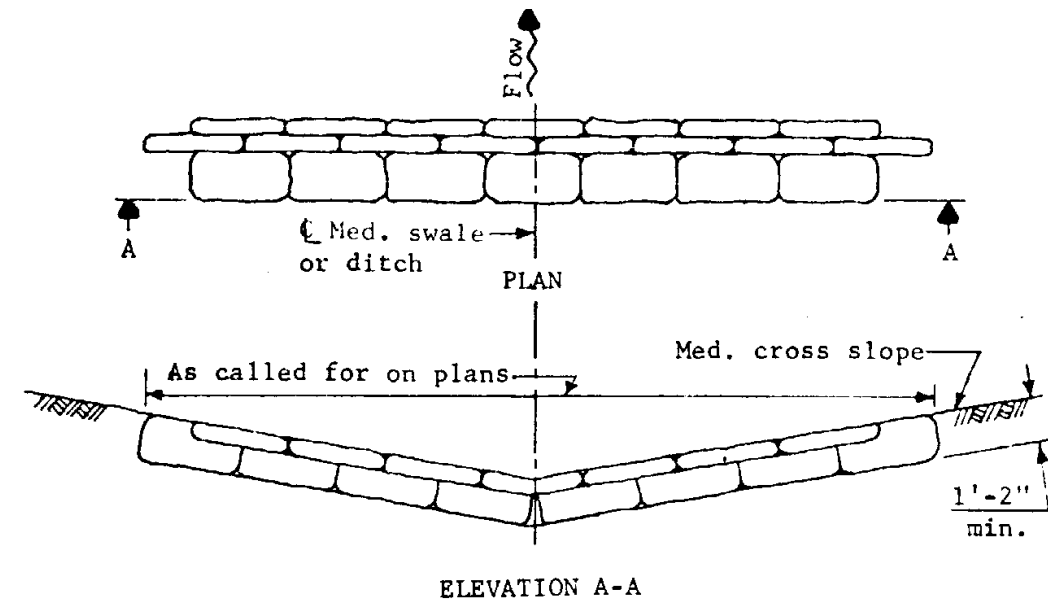
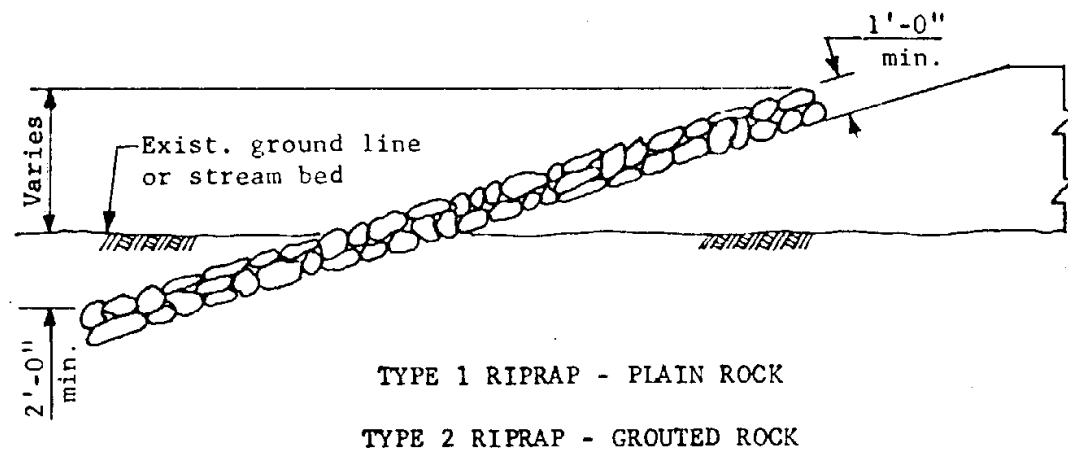
TYPE 6 BANK PROTECTION

SECTION A-A

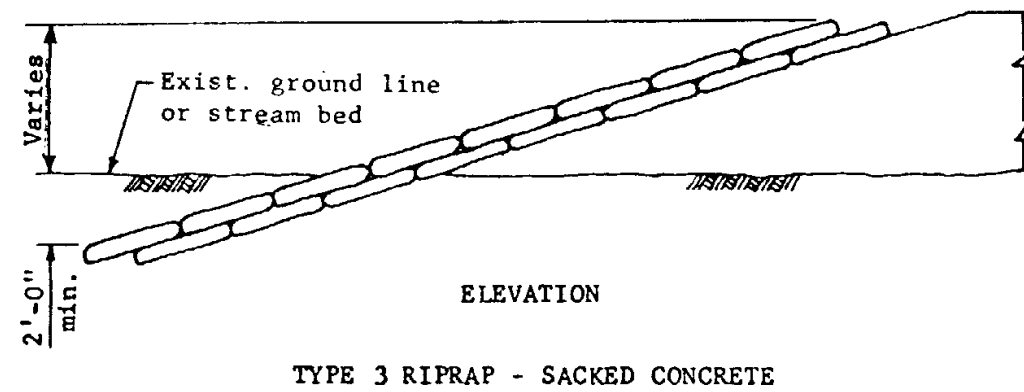
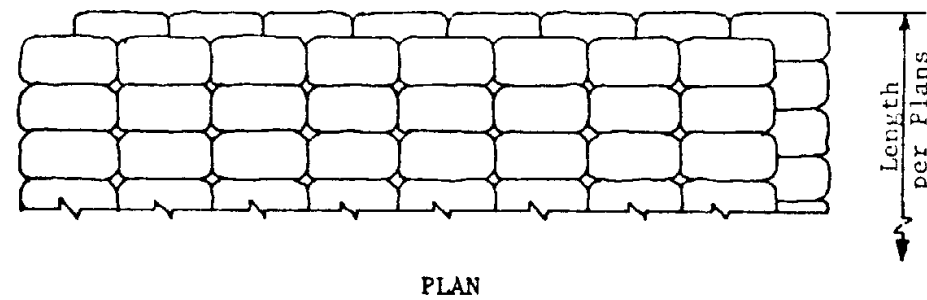
GENERAL NOTES  
Rock for backfill shall not pass a 6" square opening.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
BANK PROTECTION RAIL AND WIRE TYPES 4, 5, & 6			
Drawn	H.A.K. 6-35	Drawing No.  <b>C-17.02</b>	
Traced	S.L.T. 6-67		
Checked	J.P.O. 9PD 5-68		
Approved Engr. Plans	<i>El Hinder 5-68</i>		





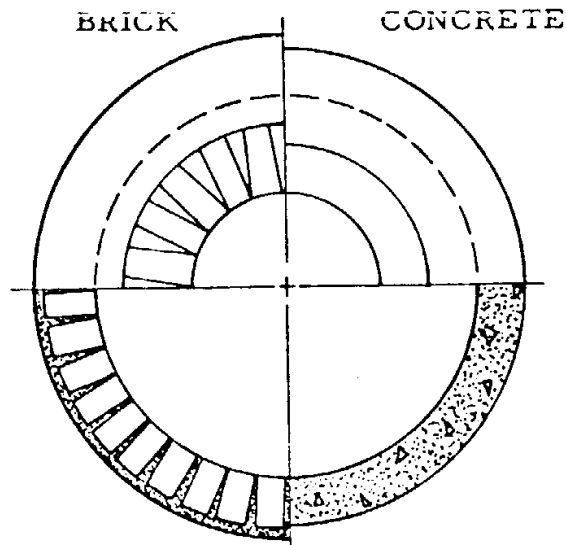
TYPE 4 RIPRAP - SACKED CONCRETE EROSION CHECK



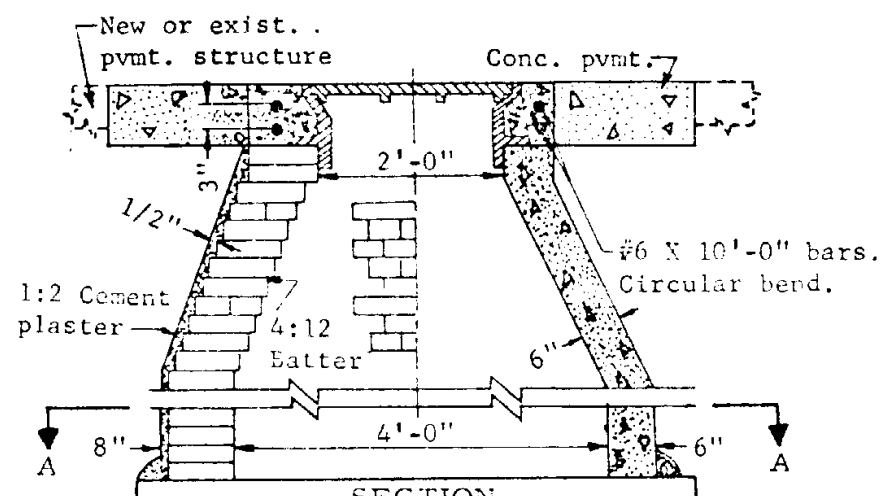
GENERAL NOTES  
Grout for riprap may be pneumatically placed mortar.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
RIPRAP			
Drawn	D.G. 5-68	Drawing No.  C-17.03	
Traced	D.G. 5-68		
Checked	J.P.O. <i>JPO</i> 5-68		
Approved Engr. Plans	<i>M. Heidrich</i> 5-68		

HALF PLAN

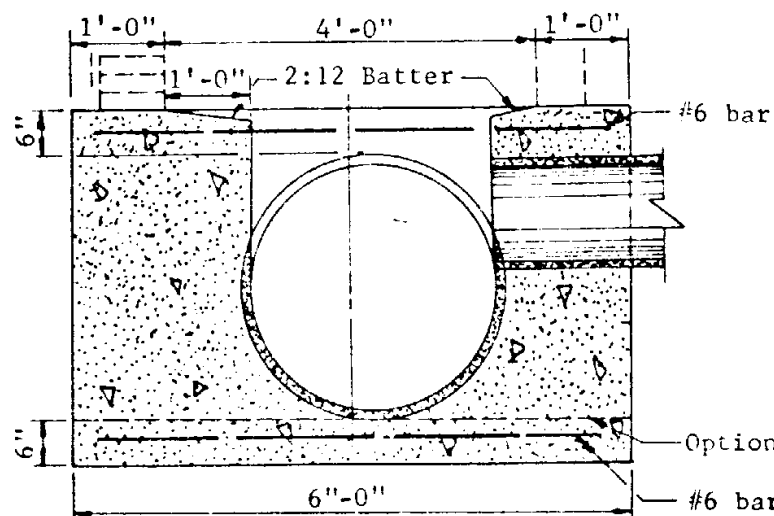


SECTION A-A



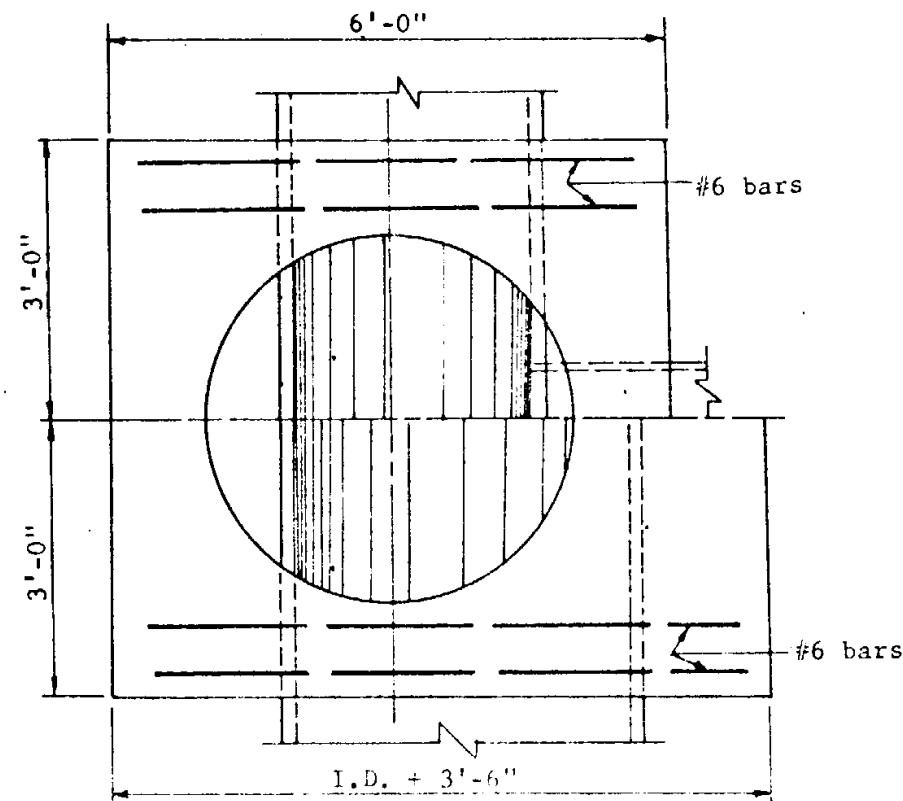
BRICK  
MANHOLE NO. 1

CONCRETE  
MANHOLE NO. 2

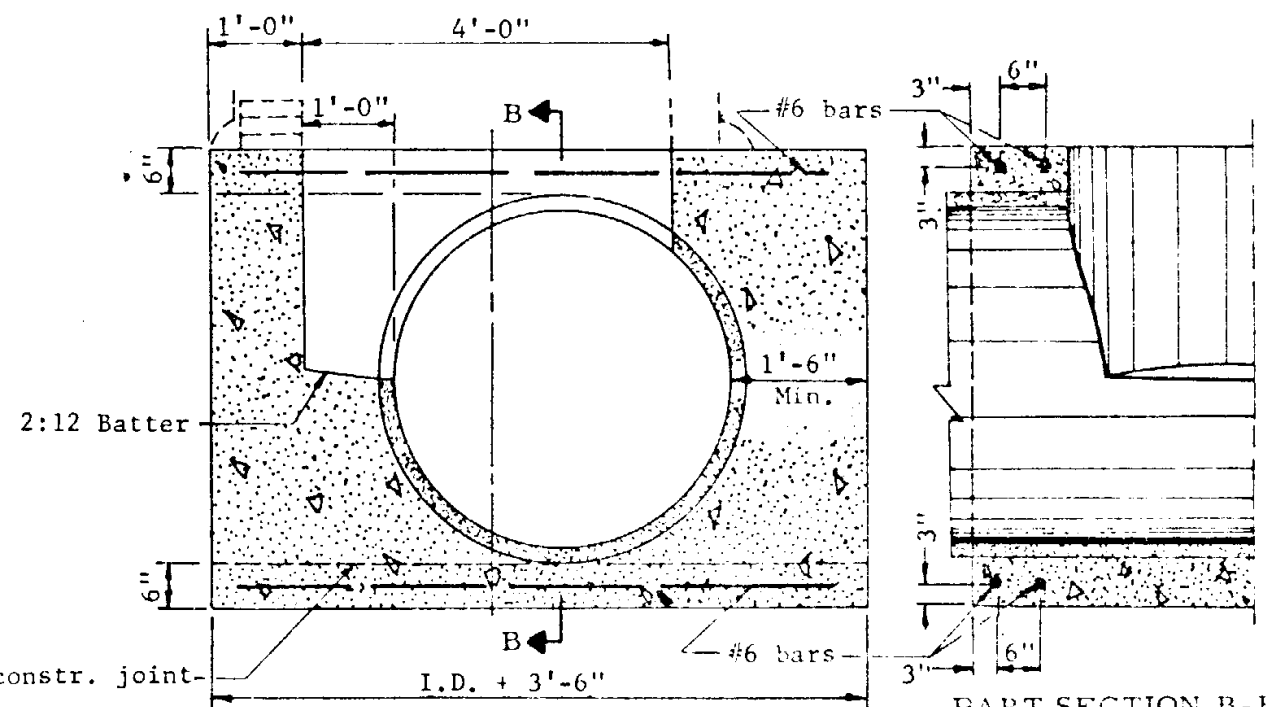


SECTION  
STANDARD BASE STRUCTURE  
FOR PIPES 6" TO 36" I. D.

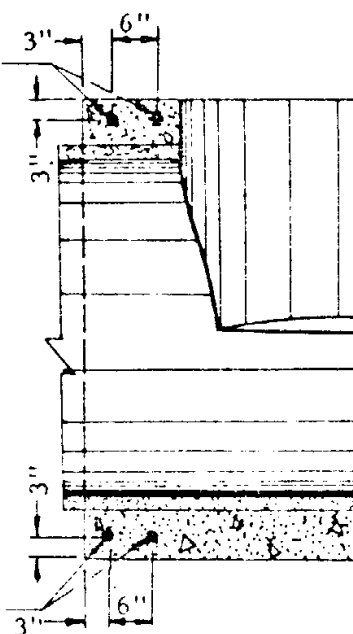
HALF PLAN  
PIPES 36" I. D. & SMALLER



HALF PLAN  
PIPES OVER 36" I. D.



SECTION  
STANDARD BASE STRUCTURE  
FOR PIPES OVER 36" I. D.

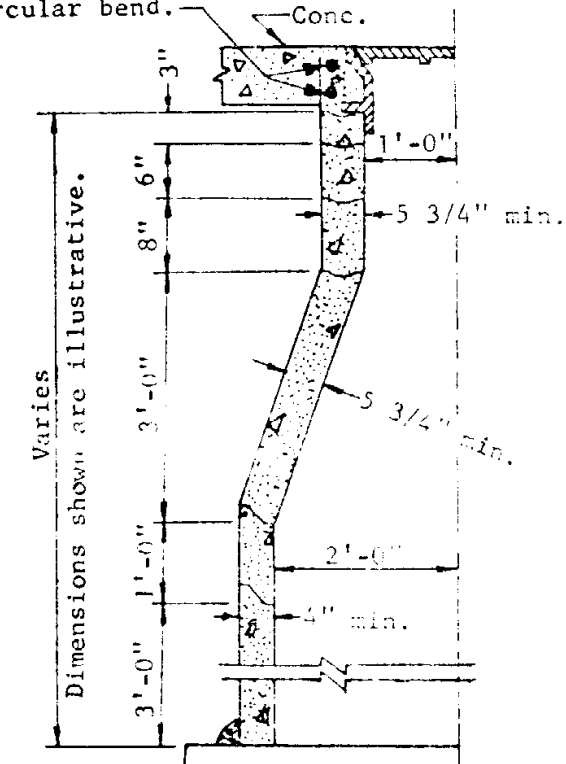


PART SECTION B-B

GENERAL NOTES

All concrete shall be Class A.  
Every fifth course of bricks shall be laid as stretchers.  
Manhole frame and cover, Std. C-18.02, is shown. Other types may be substituted if noted on Plans.  
For manhole cut replacement in bituminous or concrete pavement, see Std. C-7.03.

#6 X 10'-0" bars.  
Circular bend.



HALF SECTION  
MANHOLE NO. 3  
PRECAST REINFORCED CONCRETE

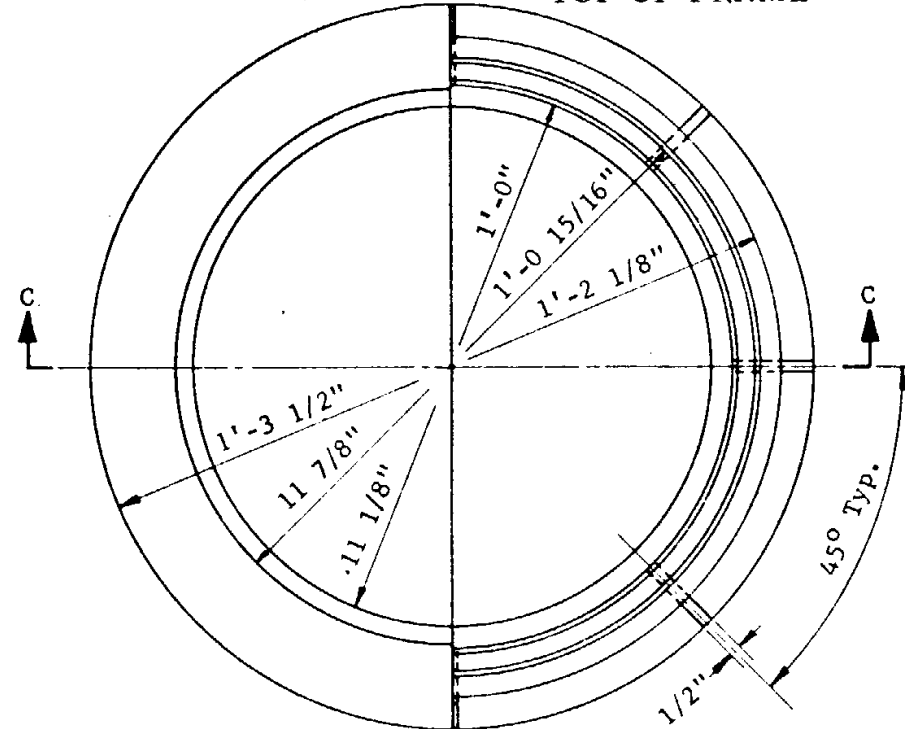
ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

MANHOLE DETAILS

Drawn	R.E.W. - 3-58	Drawing No.
Traced	S.L.T. - 5-57	
Checked	J.P.O. 980 5-68	
Approved		
Engr. Plans	W. J. J. 5-68	

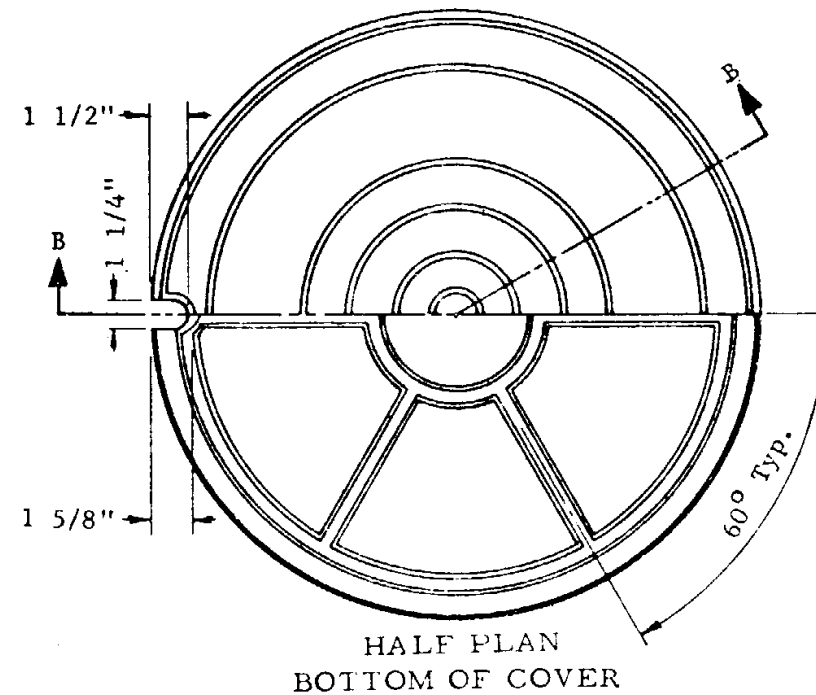
C-18.01

HALF PLAN  
BOTTOM OF FRAME



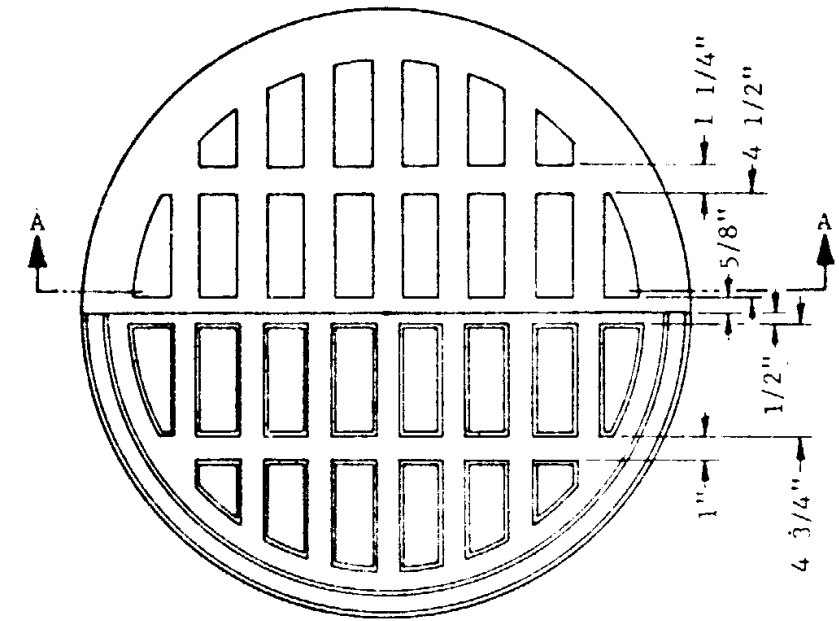
HALF PLAN  
TOP OF FRAME

HALF PLAN  
TOP OF COVER

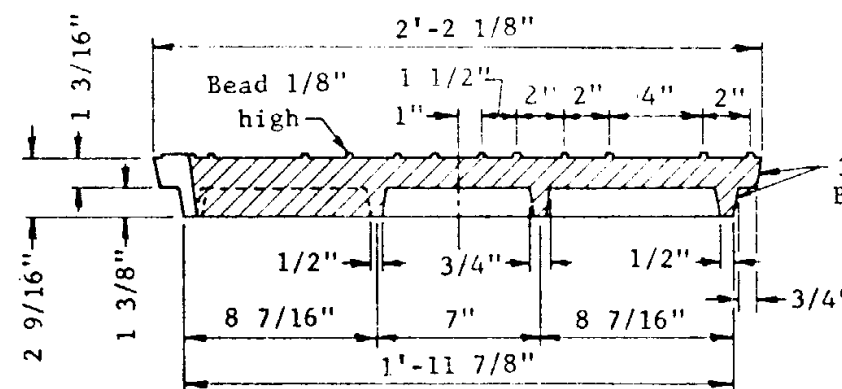


HALF PLAN  
BOTTOM OF COVER

HALF PLAN  
TOP OF COVER

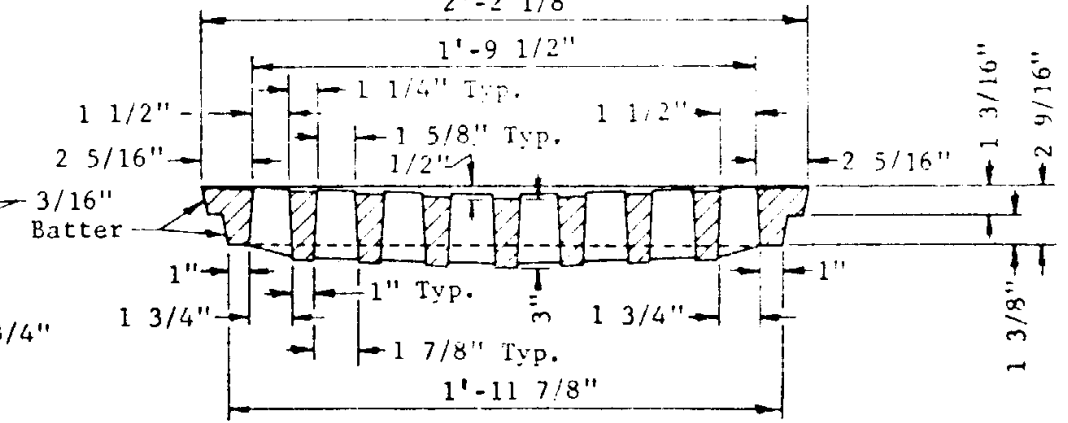


HALF PLAN  
BOTTOM OF COVER  
2'-2 1/8"



SECTION B-B OF COVER

TYPE A COVER  
Approx. weight 190 lbs.



SECTION A-A OF COVER

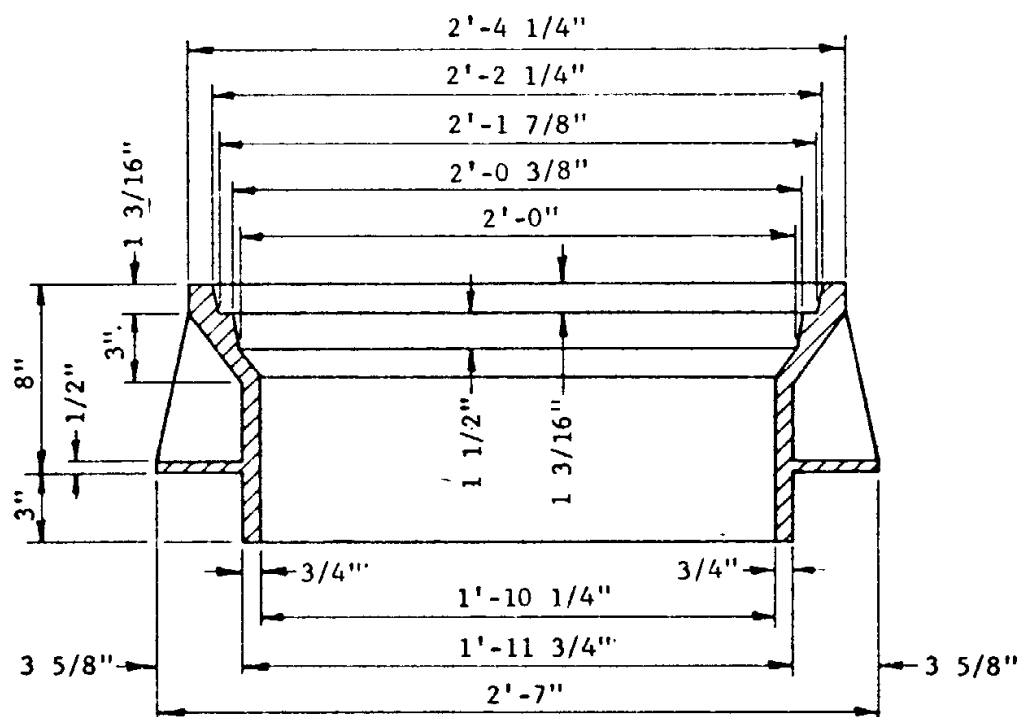
TYPE B COVER  
Approx. weight 280 lbs.

#### GENERAL NOTES

Type C cover shall be the same as Type A except that the cover shall be vented with at least six one inch holes, equally spaced in a circle 8 1/2" from the center of the cover.

Type A cover shall be used unless otherwise specified.

The bearing faces shall be machined so that the cover will have a uniform bearing in any position in the frame.



SECTION C-C OF FRAME

Approx. weight 260 lbs.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

## MANHOLE-CAST IRON FRAME & COVER DETAILS

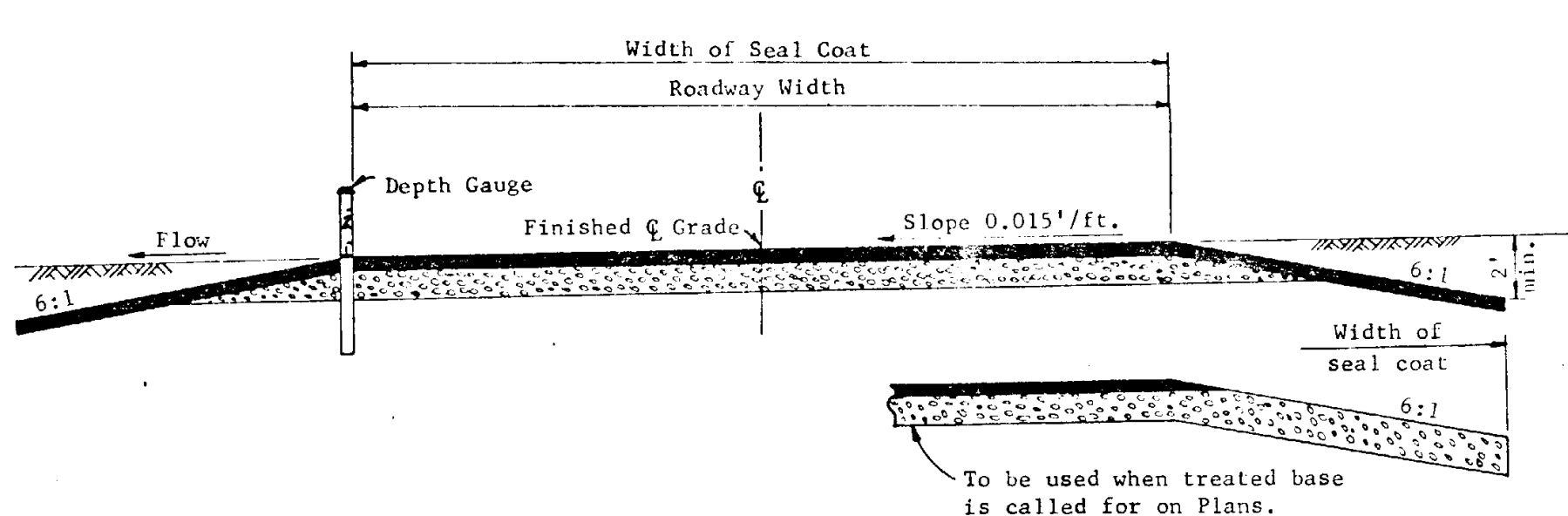
Drawn	O.K.	10-35
Traced	R.A.F.	6-67
Checked	J.P.O.	890 5-68
Approved	Engr. Plans <i>W. H. H. 5-68</i>	

Drawing No.

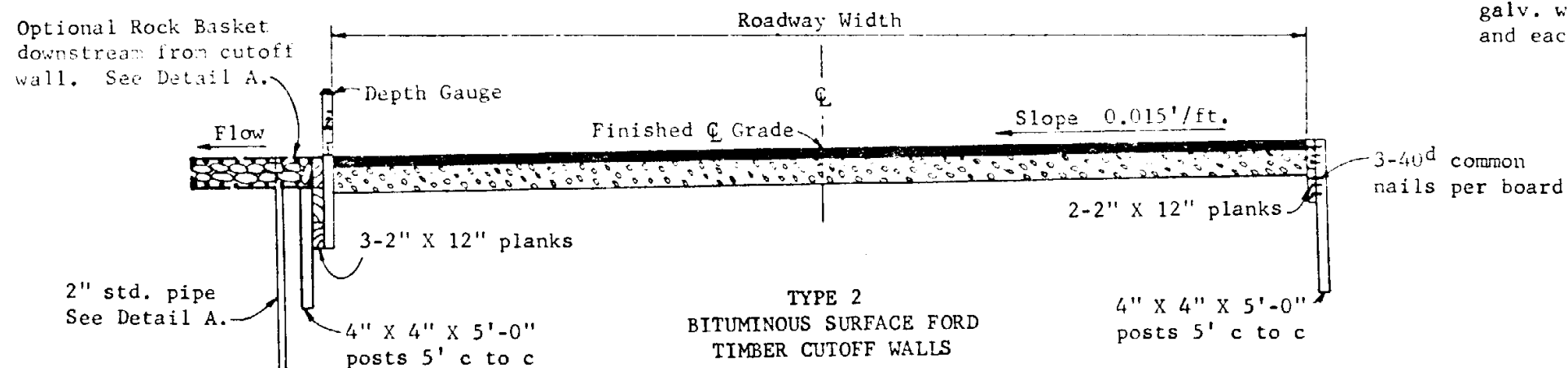
C-18.02

Rev

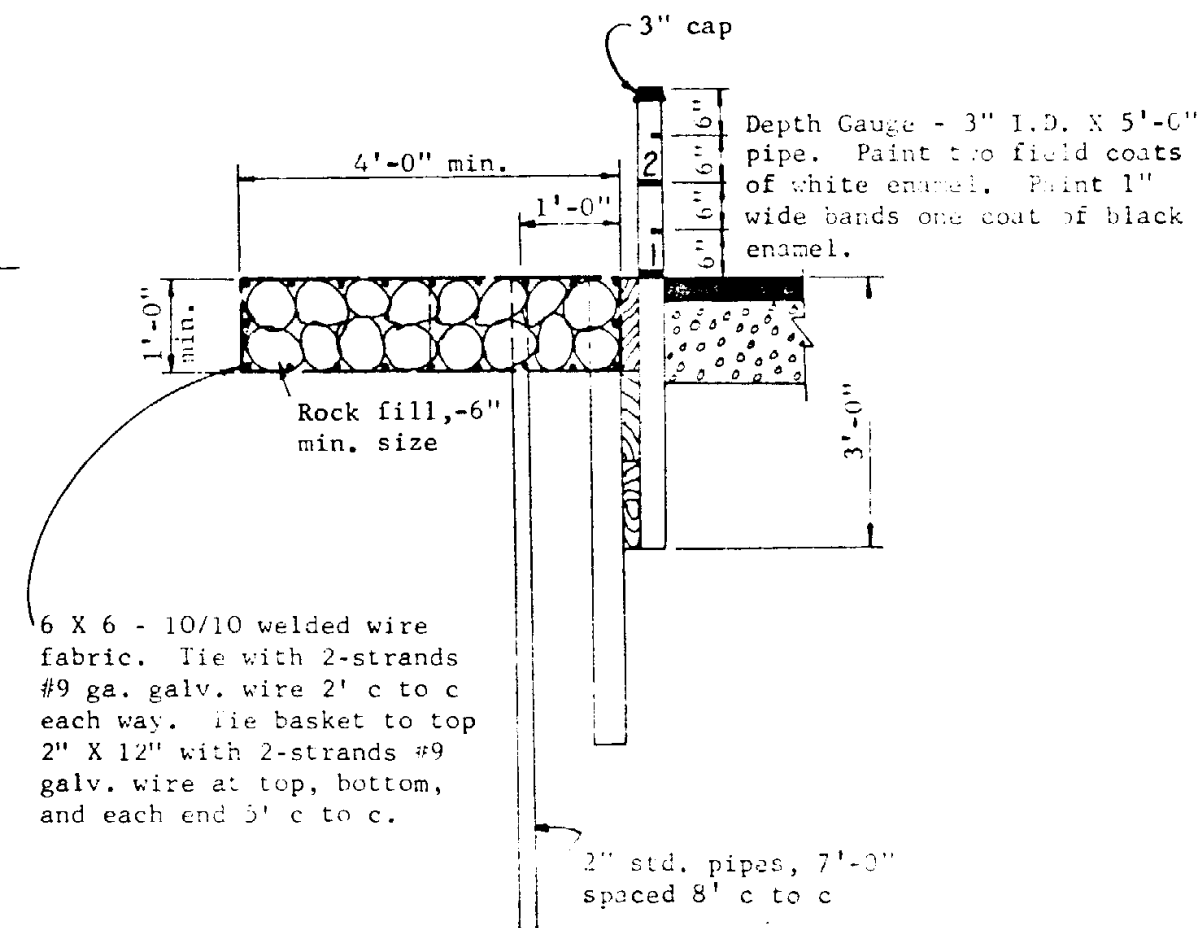




TYPE 1  
BITUMINOUS SURFACE FORD



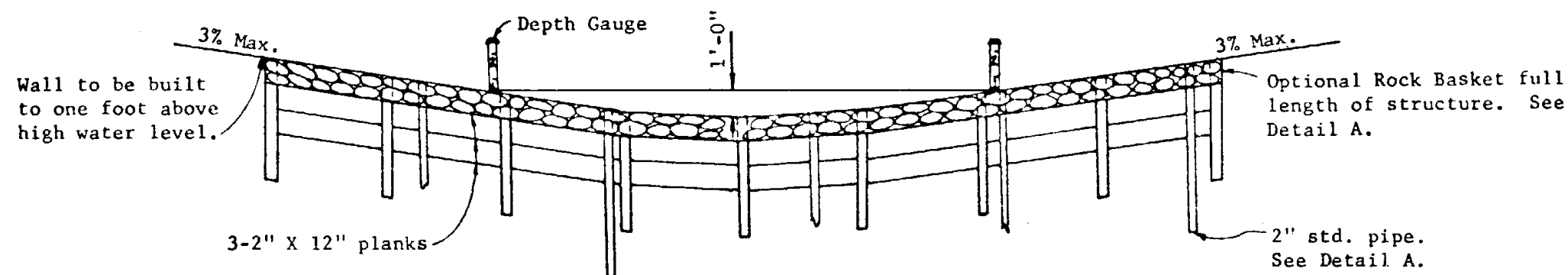
TYPE 2  
BITUMINOUS SURFACE FORD  
TIMBER CUTOFF WALLS



DETAIL A

#### GENERAL NOTES

- All timber shall be rough, pressure treated and unpainted.
- Rock basket, full length of structure shall be included only when called for on Plans.
- See Plans for bituminous surface and base material details.
- Galvanize pipes in accordance with ASTM A123.



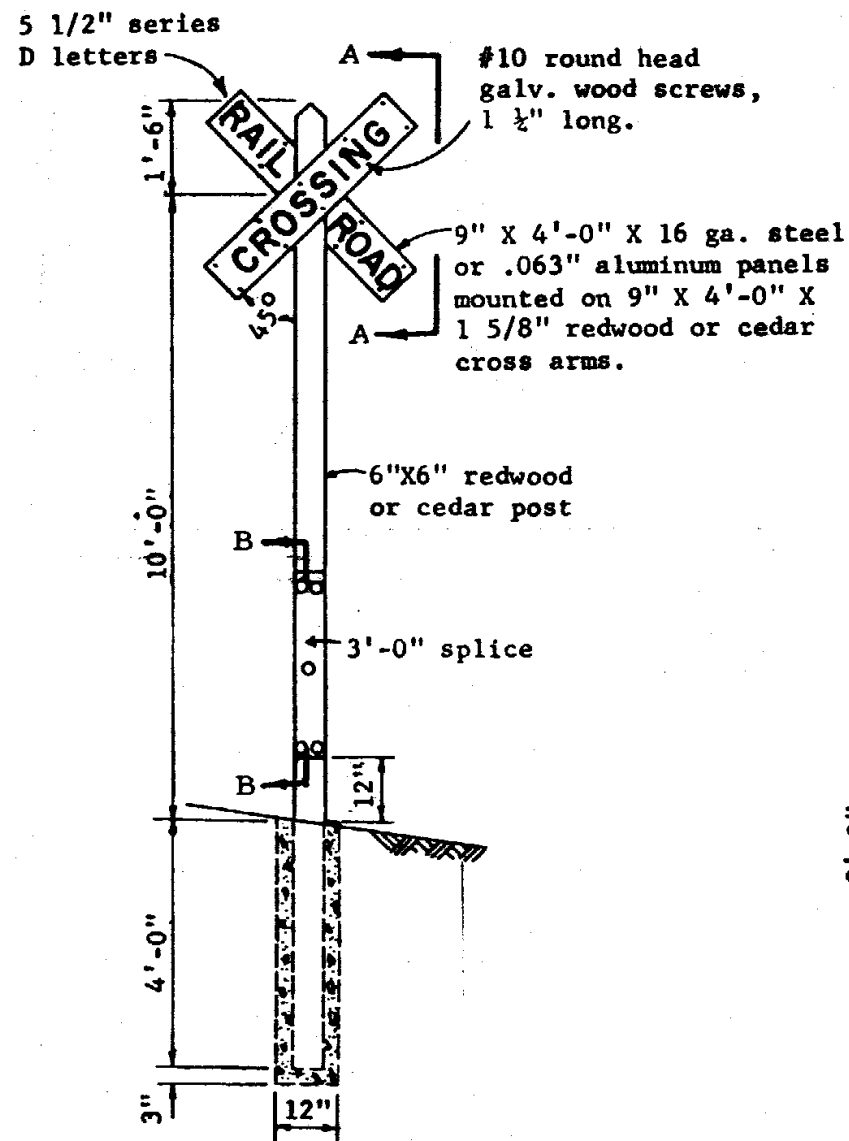
ELEVATION - TYPE 2

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PLANS DIVISION

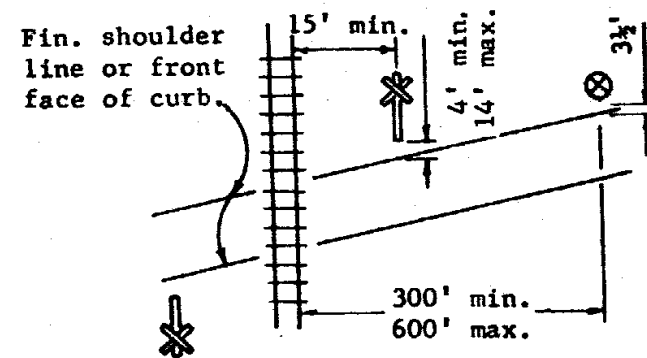
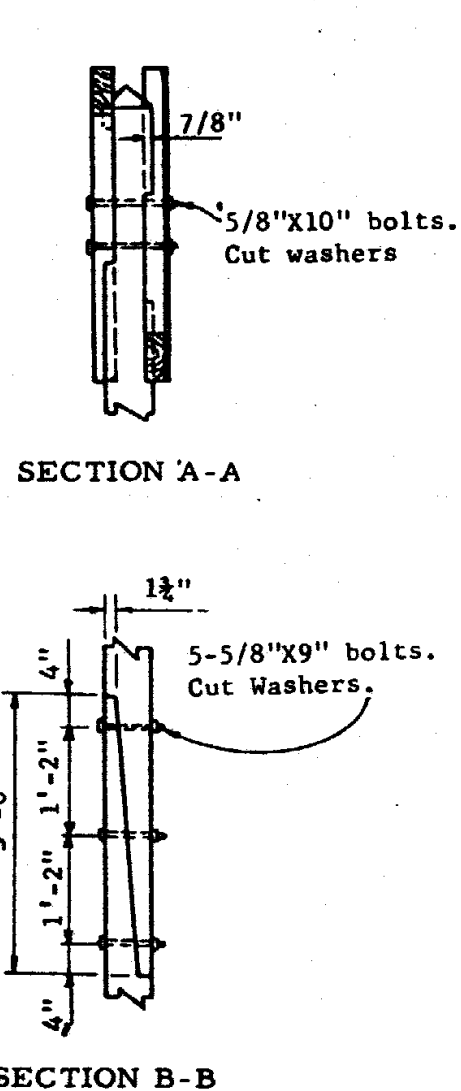
Rev  
12-5-68

FORDS

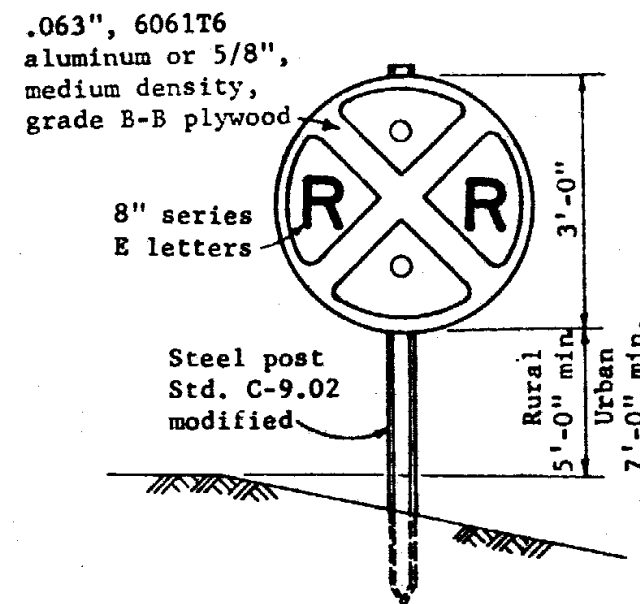
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Traced	S.L.T. 5-57	
Checked	J.P.O. 9-5-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	



RAILROAD CROSSING SIGN



LOCATION PLAN



RAILROAD ADVANCE WARNING SIGN

# GENERAL NOTES

All wood shall be redwood or cedar, S4S and untreated.

When a single railroad crossing sign is used for a crossing, both sides of cross arms shall carry sheet steel or aluminum message panels. When two railroad crossing signs are used for a crossing, lettered message panels shall be mounted only on the side of cross arms facing traffic.

Railroad Crossing Sign message panel background shall be silver-white flat top reflective sheeting with black, opaque letters.

Advance Warning Sign traffic face background shall be highway yellow flat top reflective sheeting with black, opaque letters, border and symbol.

All wood and metal surfaces, except those covered with reflective sheeting shall be primed and finished with two coats of No. 11 white enamel.

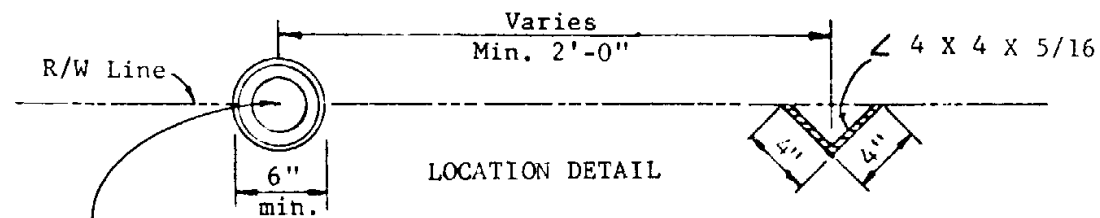
Reflective sheeting shall be applied in accordance with the manufacturer's specifications.

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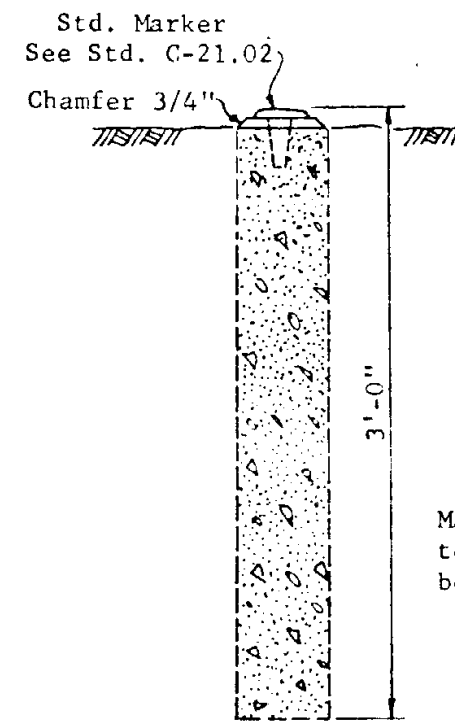
## RAILROAD CROSSING SIGNS

Drawn	D.G. 12-66	Drawing No. <b>C-20.01</b>
Traced	S.L.T. 3-67	
Checked	J.P.O. 8PO 5-68	
Approved Engr. Plans	<i>M. J. J. 5-68</i>	

Rev

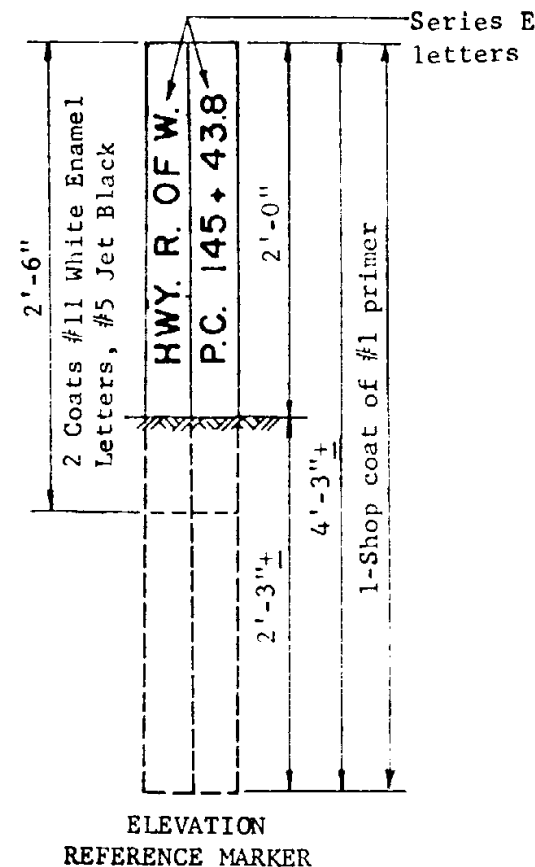


Std. Marker. Transit point shall be punched by Engineer.



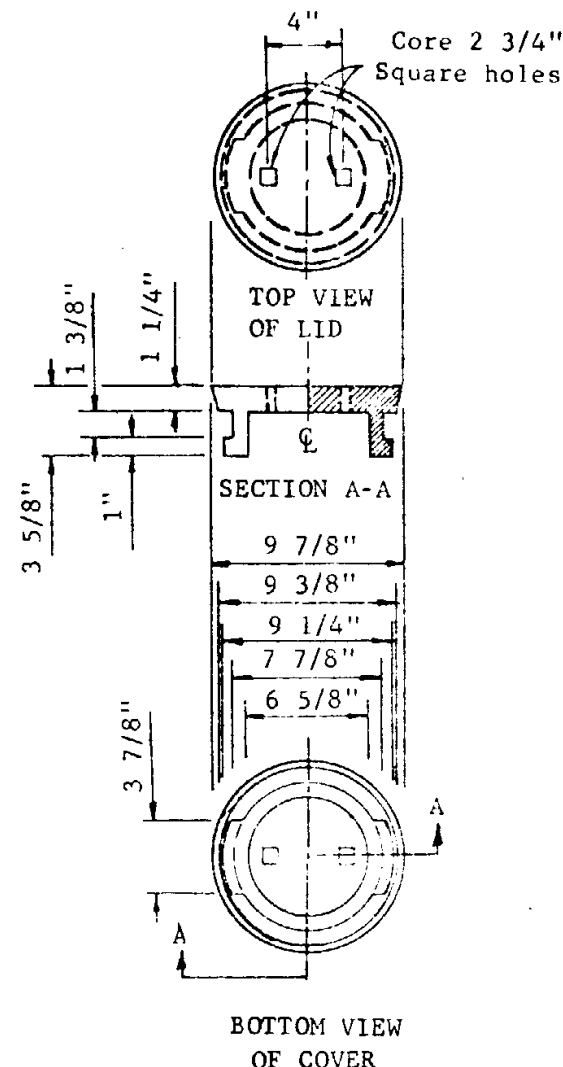
ELEVATION SURVEY MONUMENT

RIGHT OF WAY MARKER



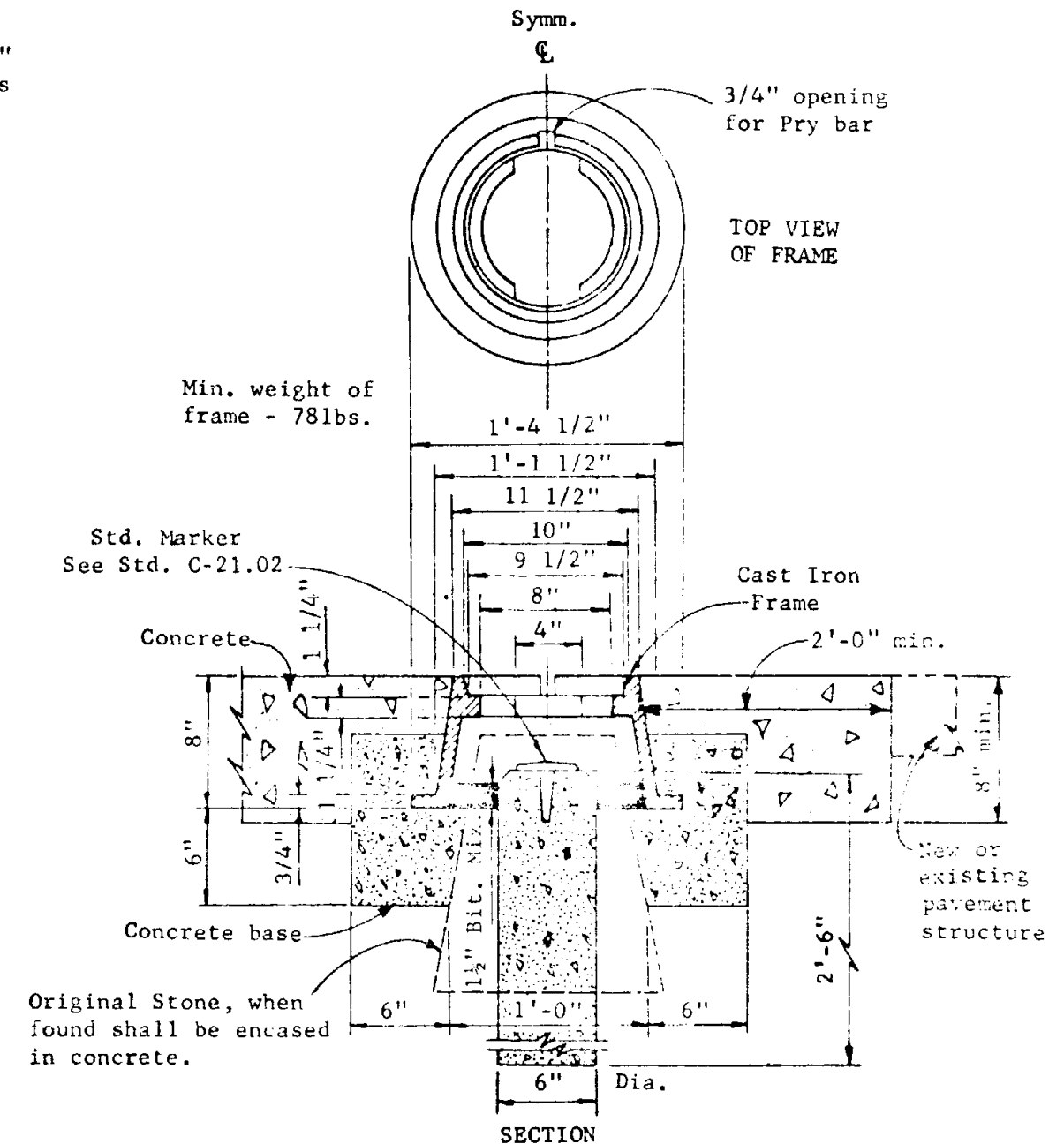
May be poured to neat lines below grade.

ELEVATION REFERENCE MARKER



Min. weight of cover - 31 lbs.

SURVEY MONUMENT, FRAME AND COVER



Min. weight of frame - 78 lbs.

Original Stone, when found shall be encased in concrete.

#### GENERAL NOTES

A Survey Monument, Frame and Cover, complete and in place, shall be considered as a unit. In bituminous pavement, frame and cover shall be set after A. C. is placed.

A Right of Way Marker, consisting of Survey Monument and Reference Marker, complete and in place, shall be considered as a unit. Right of Way Markers shall be placed as shown on Plans or as directed by the Engineer.

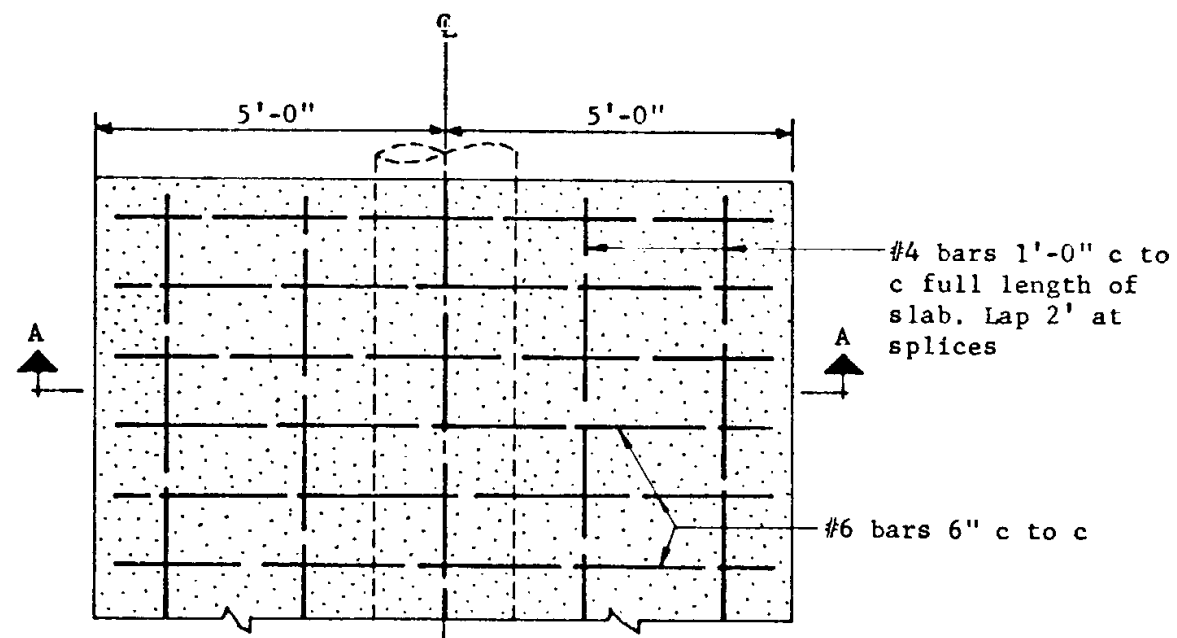
All concrete shall be Class A.

ARIZONA HIGHWAY DEPARTMENT  
PLANS DIVISION

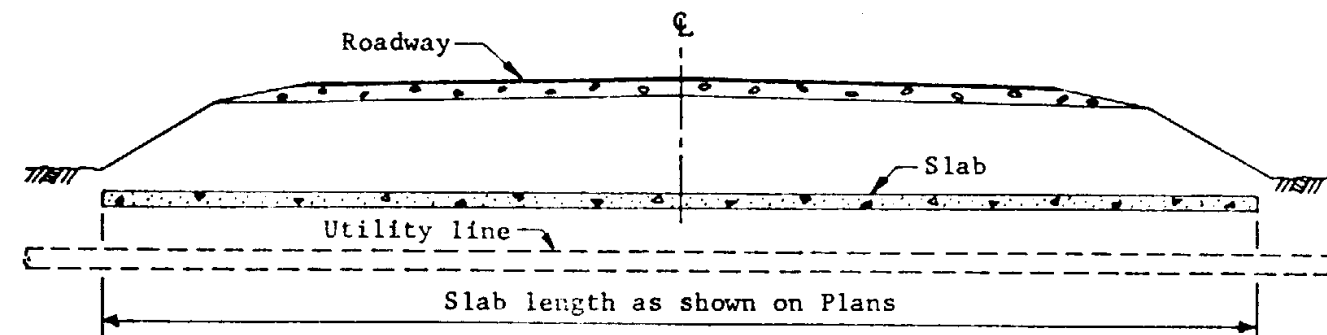
## SURVEY MONUMENT, FRAME AND COVER RIGHT OF WAY MARKER

Drawn	11-45	Drawing No.  <b>C-21.01</b>
Traced	S.L.T. 3-67	
Checked	J.P.G. 8-68	
Approved Engr. Plans	<i>[Signature]</i> 5-68	

Rev

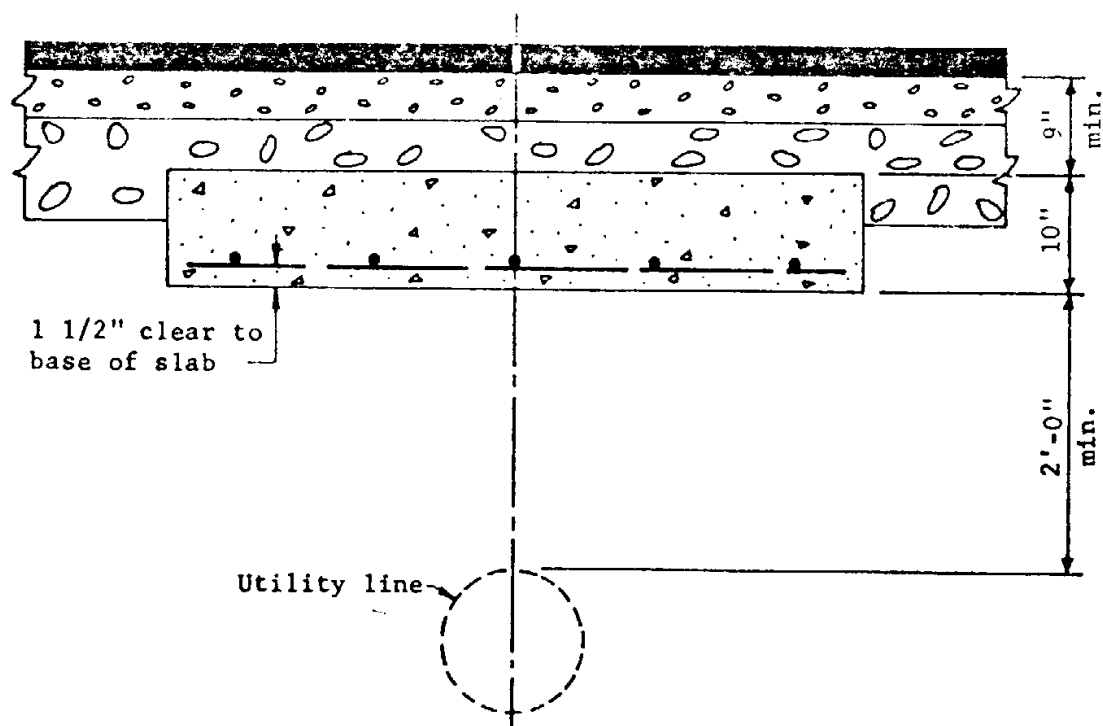


PLAN



CROSS SECTION

FOR SINGLE INSTALLATION	
Quantities per ft. of slab length	
Concrete	Reinforcing Steel
0.31 C.Y.	35.22 lbs.



SECTION A-A

GENERAL NOTES  
Concrete shall be Class A.

ARIZONA HIGHWAY DEPARTMENT PLANS DIVISION			Rev
SLAB OVER UTILITY LINE			
Drawn	L.O.M. 5-65	Drawing No.  C-22.01	
Traced	D.G. 3-67		
Checked	J.P.O. 8-68		
Approved Engr. Plans	<i>[Signature]</i> 5-68		