COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF TRANSPORTATION

BUREAU OF DESIGN
BRIDGE DIVISION

STANDARDS FOR OLD BRIDGES

FROM 1965 TO 1972

VOLUME 5

NOVEMBER 1989

INDEX OF STANDARDS FOR OLD BRIDGES

(VOLUME 5) (FROM YEAR 1965 TO 1972)

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ST-133	(1)	DEC. 17, 1969	STANDARD R.C. ARCH CULVERTS DETAILS
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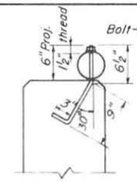
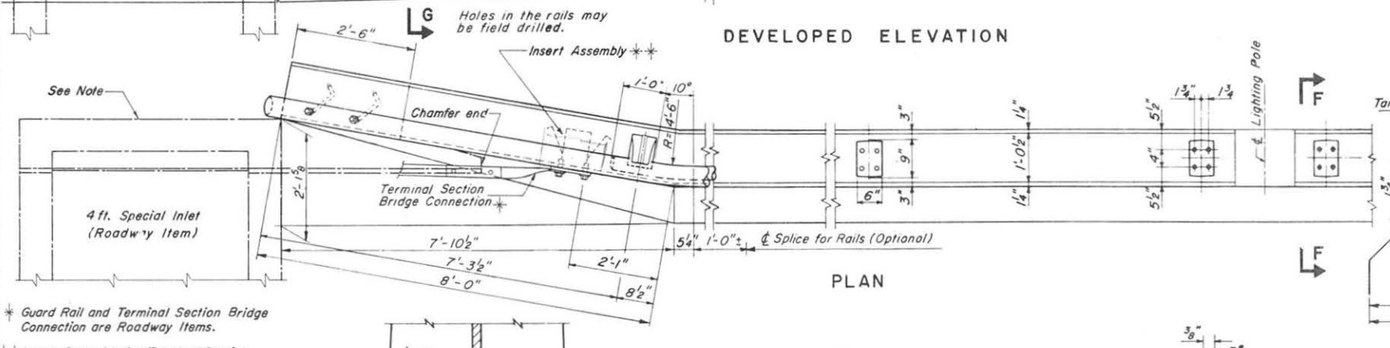
S-3916	(1)	AUG. 28, 1968	PRESTRESSED CONCRETE BRIDGE SUPERSTRUCTURE WITH 16" APPROACH SLAB NOTCH

BRSTOVE.DGN
(55,10)



SECTION E-E

DEVELOPED ELEVATION



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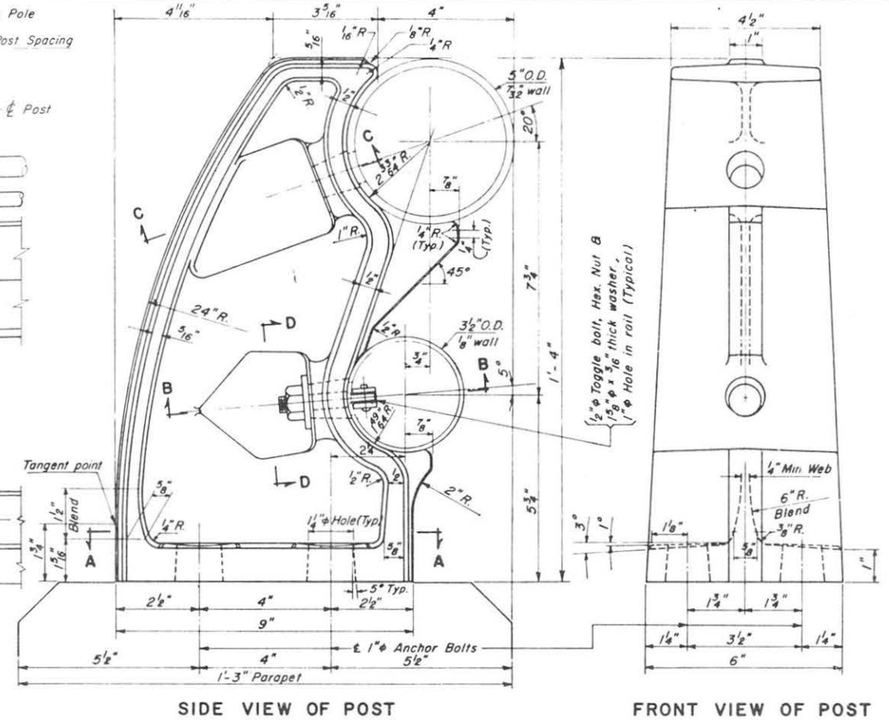
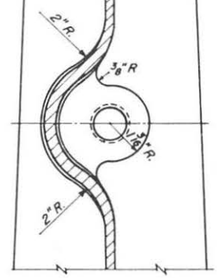


SIDE VIEW OF POST

FRONT VIEW OF POST



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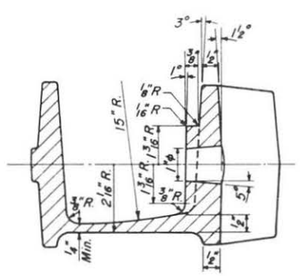
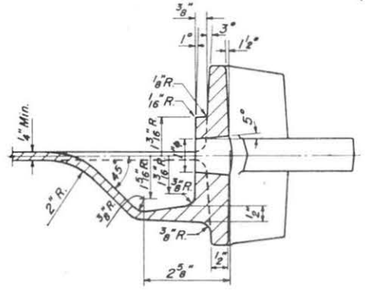
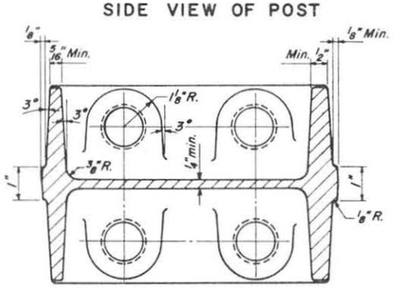


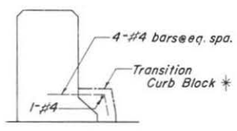
SECTION C-C



SECTION B-B

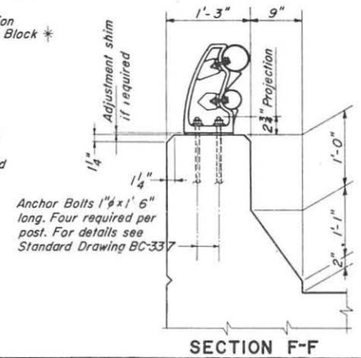


SECTION A-A



SECTION G-G

✳ Transition Curb Block detail to be shown on the design drawings when inlet is required at the end of the structure



Anchor Bolts 1"ϕ x 1'-6" long. Four required per post. For details see Standard Drawing BC-337

SECTION F-F

✳ Guard Rail and Terminal Section Bridge Connection are Roadway Items.

✳✳ Insert Assembly for Terminal Section Bridge Connection shall be Type A (Cap Screw = ⅞"ϕ, a=6", b=7") as shown on Standard Drawing BC-334, and is incidental to Bridge Railing

NOTE:
Inlet placement at the end of structure and the modifications required to the safety parapet are shown thus ————

NOTES

Materials, workmanship and method of payment shall be in accordance with Specifications Forms 408 and 409

Design Specifications: Design Division of 1969 - AASHO "Standard Specifications for Highway Bridges.

Shims and end caps shall be of approved aluminum alloy. Shims shall be flush with base of post and end caps shall be flush with rails.

Anchor materials shall be galvanized conforming to the requirements of Form 409. Toggle bolts may be cadmium plated to conform to ASTM A165. Type TS, in lieu of galvanizing.

Materials shall not be painted.

Posts and post anchor bolts shall be normal to grade and rails, except curved rails, shall be parallel to grade.

Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rails shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion. ℄ Rail splices shall be located 1'-0" minimum from ℄ posts except as specified.

REFERENCE DRAWINGS	
RAILING ANCHOR SYSTEMS	BC-337
THREADED INSERT ANCHOR ASSEMBLY	BC-334
LIGHTING POLE ANCHORAGE	BC-322
ELECTRICAL DETAILS	BC-32.
LOCATION OF POSTS AND EXPANSION JOINTS	DES. DWG.

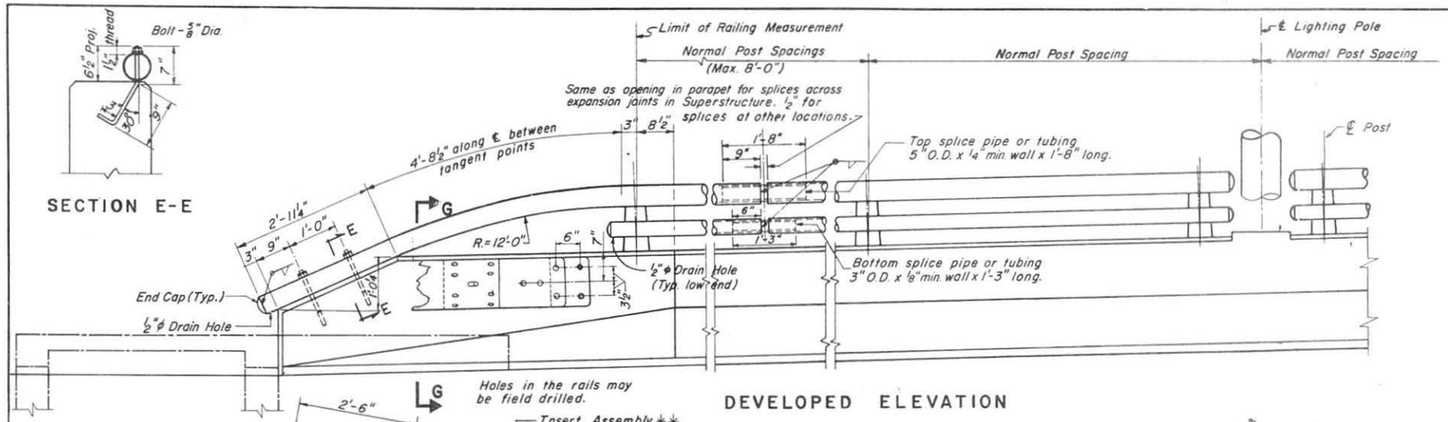
Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

STANDARD
ALUMINUM BRIDGE RAILING
&
GUARD RAIL CONNECTION

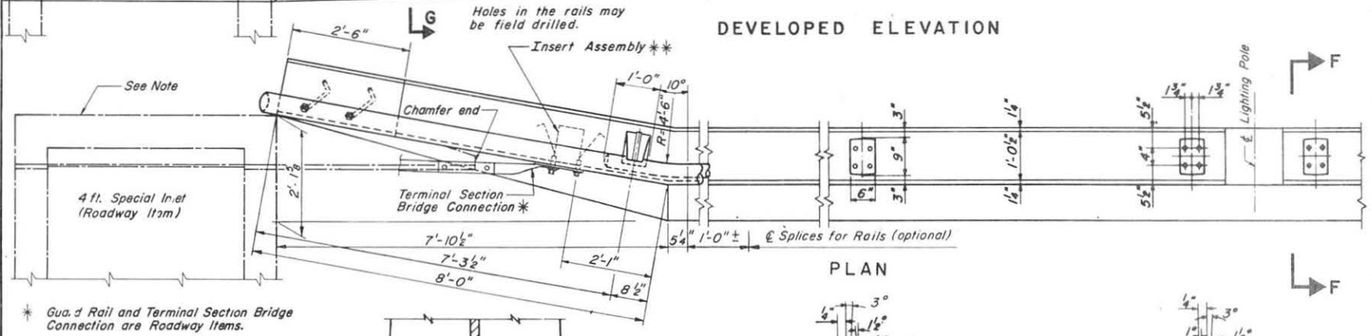
Recommended January 10, 1972
B. L. Kotala
Chief Bridge Engineer

Approved January 10, 1972
W. S. Moore
Deputy Chief Highway Engineer

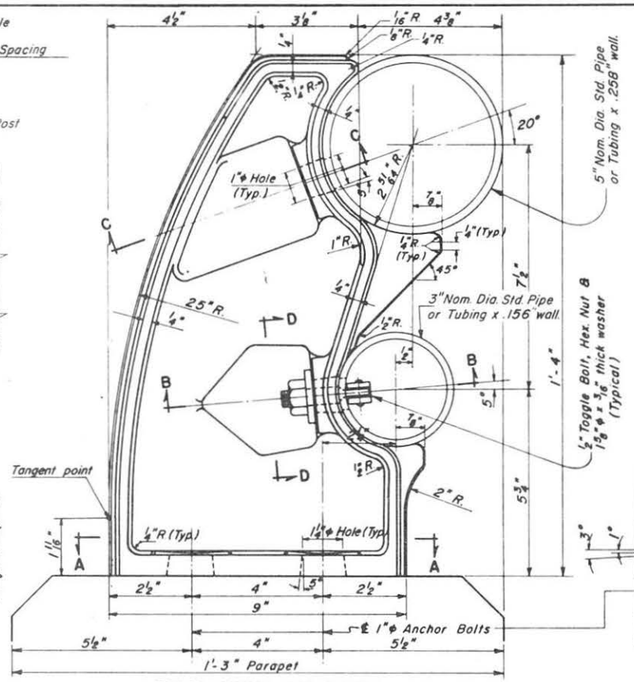
Sht. 1 Of 1
BC-312



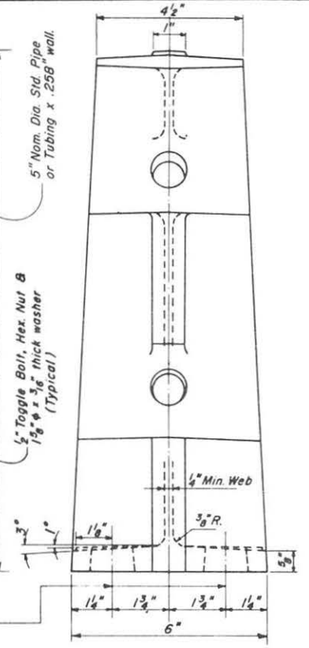
DEVELOPED ELEVATION



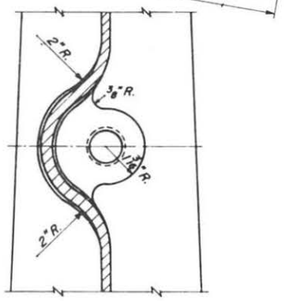
PLAN



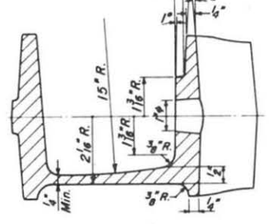
SIDE VIEW OF POST



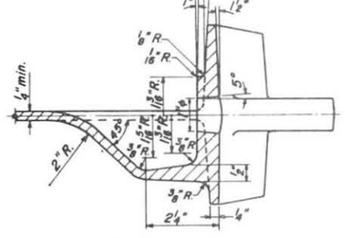
FRONT VIEW OF POST



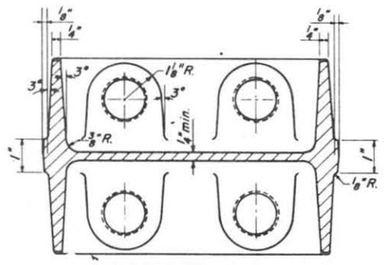
SECTION D-D



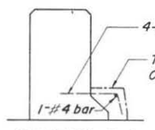
SECTION C-C



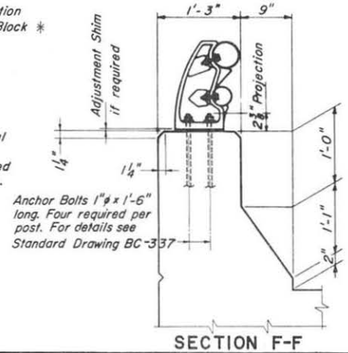
SECTION B-B



SECTION A-A



SECTION G-G



SECTION F-F

* Guard Rail and Terminal Section Bridge Connection are Roadway Items.

** Insert Assembly for Terminal Section Bridge Connection shall be Type B (Cap Screw = ⅞"ϕ, a=6", b=7") as shown on Standard Drawing BC-334, and is incidental to Bridge Railing.

* Transition Curb Block detail to be shown on the design drawings when inlet required at the end of the structure.

NOTE
Inlet placement at the end of structure and the modifications required to the safety parapet are shown thus ——·——·——

NOTES

Materials, workmanship and method of payment shall be in accordance with Specifications Forms 408 and 409.

Design Specifications Design Division of 1969 - AASHO "Standard Specifications for Highway Bridges"

Steel shall be galvanized conforming to the requirements of Form 409. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.

Materials shall not be painted.

Posts and post anchor bolts shall be normal to grade and rails, except curved rails, shall be parallel to grade.

Shims and end caps shall be of approved steel. Shims shall be flush with base of post and end caps shall be flush with rails

Rail splices shall be located between posts or expansion joints and at other locations where necessary. Rails shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion ℄ Rail splices shall be located 1'-0" minimum from ℄ Posts except as specified.

REFERENCE DRAWINGS	
RAILING ANCHOR SYSTEMS	BC-337
THREADED INSERT ANCHOR ASSEMBLY	BC-334
LIGHTING POLE ANCHORAGE	BC-322
ELECTRICAL DETAILS	BC-321
LOCATION OF POSTS AND EXPANSION JOINTS	DES. DWG.

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

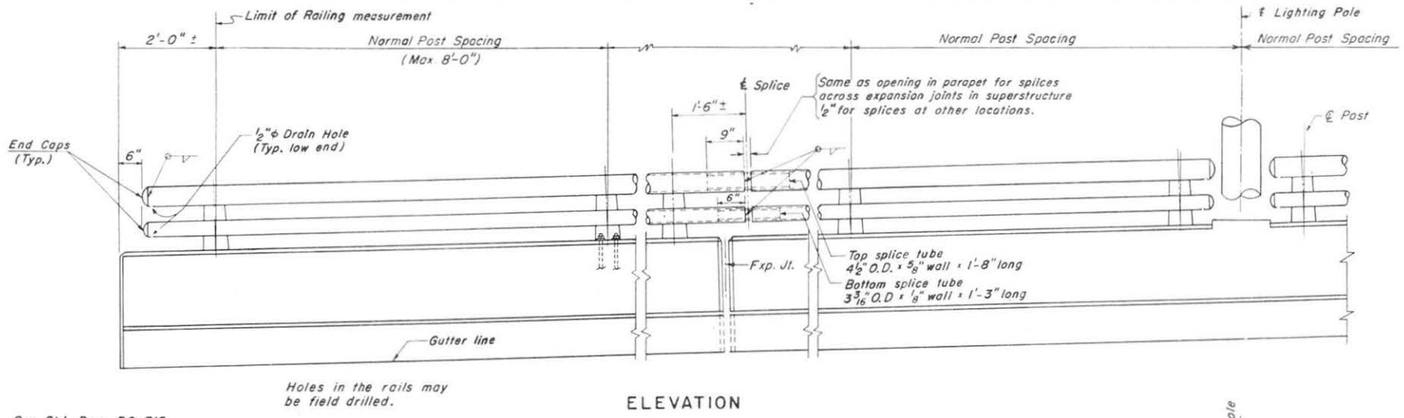
STANDARD
STEEL BRIDGE RAILING
&
GUARD RAIL CONNECTION

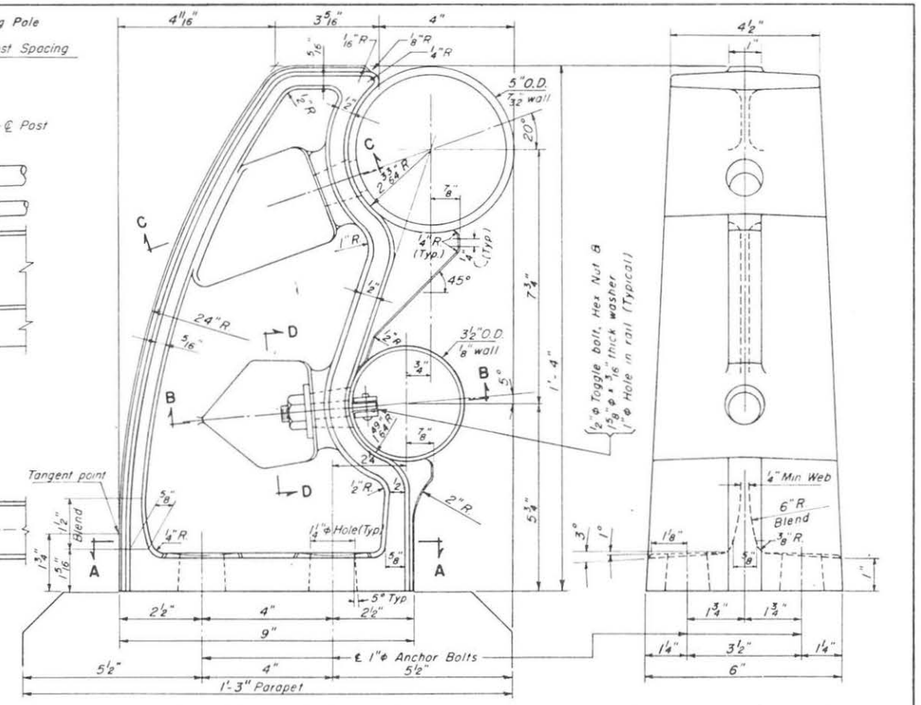
Recommended January 10, 1972
B. F. Kotalik
Chief Bridge Engineer

Approved January 10, 1972
Deputy Chief Highway Engineer

Sht. 1 Of 1
BC-313

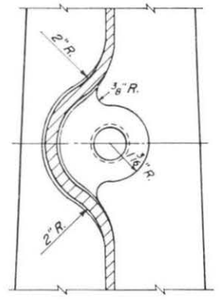
41288 PEL X



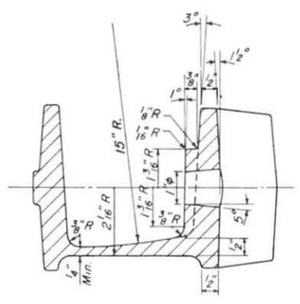


SIDE VIEW OF POST

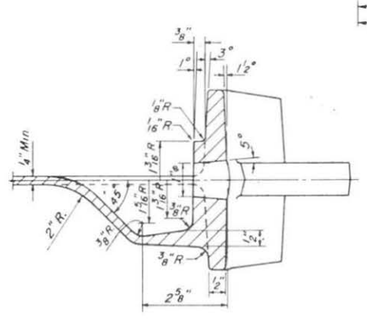
FRONT VIEW OF POST



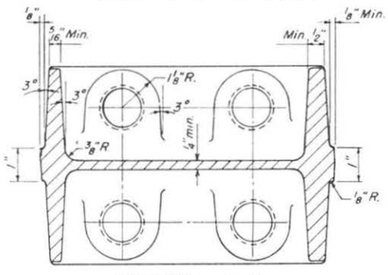
SECTION D-D



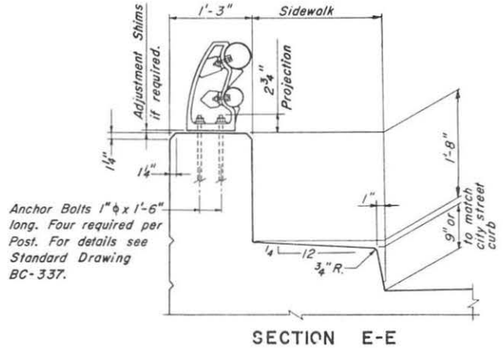
SECTION C-C



SECTION B-B



SECTION A-A



SECTION E-E

NOTES

Materials, workmanship, and method of payment shall be in accordance with Specifications Form 408 & 409.

Design Specifications: Design Division of 1969 - AASHO "Standard Specifications for Highway Bridges."

Shim and end caps shall be of approved aluminum alloy. Shims shall be flush with base of post and end caps shall be flush with rails.

Anchor materials shall be galvanized conforming to the requirements of Form 409. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.

Materials shall not be painted.

Posts and post anchor bolts shall be normal to grade and rails shall be parallel to grade.

Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rails shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion. ℄ Rail splice shall be located 1'-6" (±) from ℄ posts.

REFERENCE DRAWINGS	
RAILING ANCHOR SYSTEMS	BC-337
THREADED INSERT ANCHOR ASSEMBLY	BC-334
LIGHTING POLE ANCHORAGE	BC-322
ELECTRICAL DETAILS	BC-321
GUARD RAIL CONN TO PARAPET W/SIDEWALK	BC-31E
LOCATION OF POSTS AND EXPANSION JOINTS	DES. DWG.

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

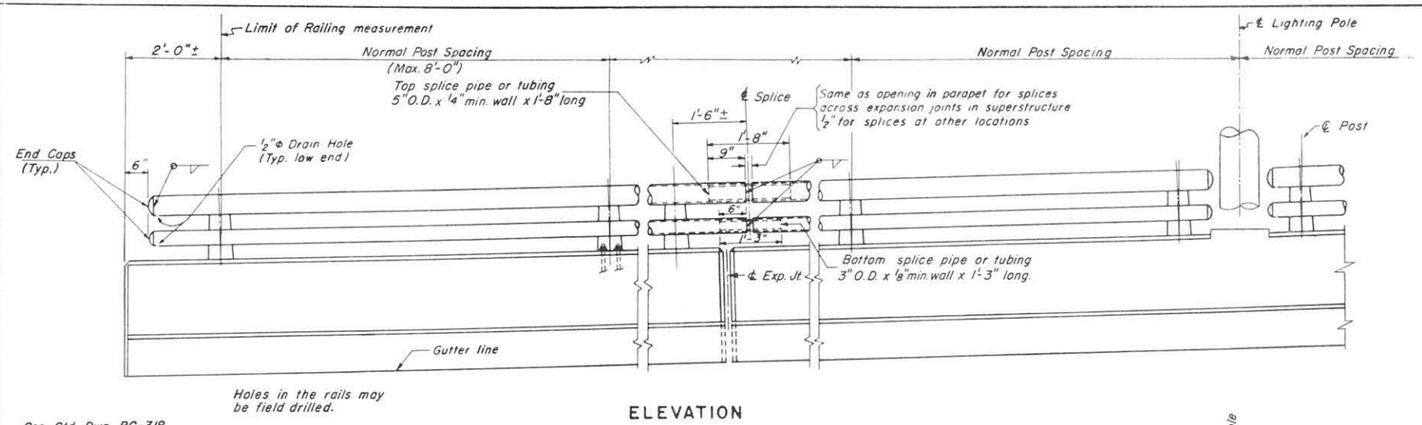
STANDARD
ALUMINUM BRIDGE RAILING

Recommended June 1, 1972
B. D. Katalb
Chief Bridge Engineer

Approved June 1, 1972
R. R. Thacker
Deputy Chief Highway Engineer

Sht. 1 Of 1

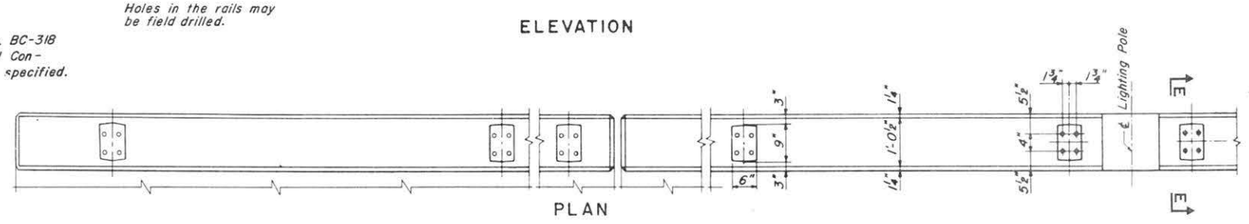
BC-314



Holes in the rails may be field drilled.

ELEVATION

See Std Dwg. BC-318 for Guard Rail Connection when specified.



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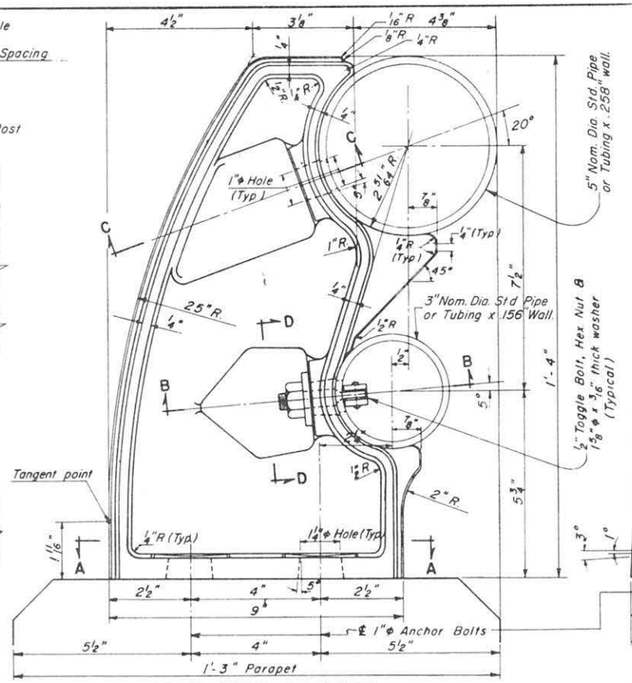
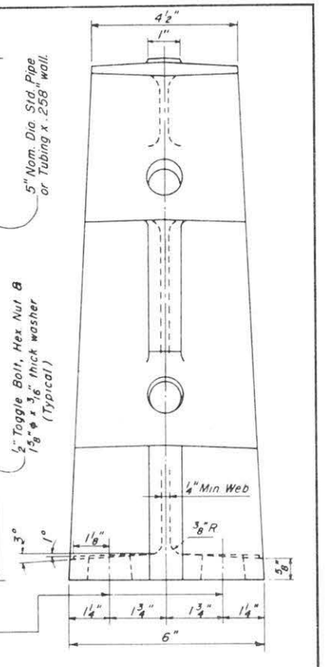
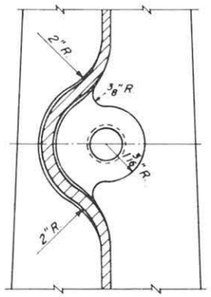


SIDE VIEW OF POST



FRONT VIEW OF POST



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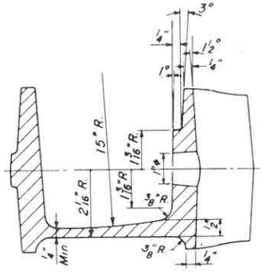

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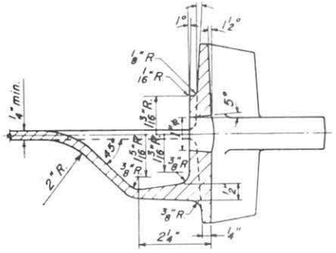
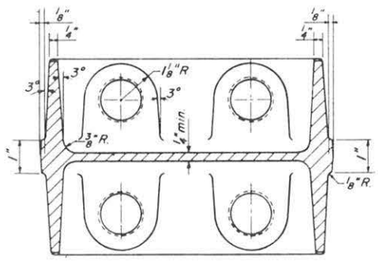
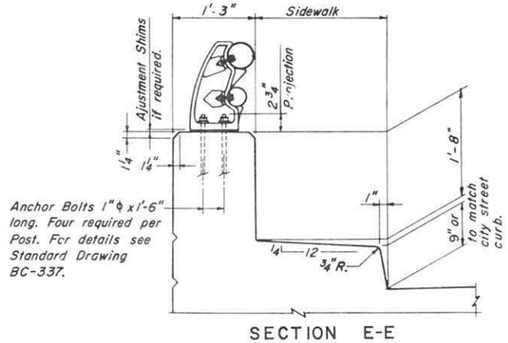


SECTION B-B



SECTION A-A



SECTION E-E

NOTES

Materials, workmanship, and method of payment shall be in accordance with Specifications Forms 408 & 408

Design Specifications: Design Division of 1969 - AASHO "Standard Specifications for Highway Bridges"

Shims and end caps shall be of approved steel. Shims shall be flush with base of post and end caps shall be flush with rails.

Steel shall be galvanized conforming to the requirements of Form 409. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.

Materials shall not be painted

Posts and post anchor bolts shall be normal to grade and rails shall be parallel to grade.

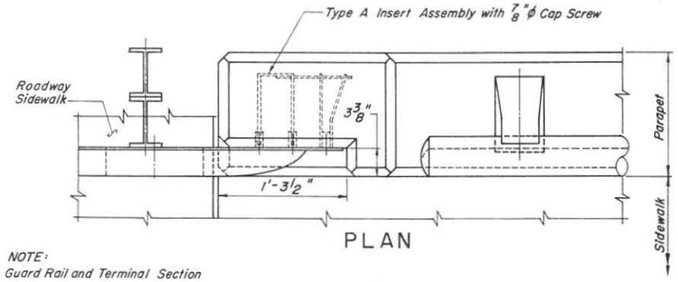
Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rails shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion. ℄ Rail splice shall be located 1'-6" (±) from ℄ posts.

REFERENCE DRAWINGS	
RAILING ANCHOR SYSTEMS	BC-337
THREADED INSERT ANCHOR ASSEMBLY	BC-334
LIGHTING POLE ANCHORAGE	BC-321
ELECTRICAL DETAILS	BC-321
GUARD RAIL CONN. TO PARAPET W/SIDEWALK	BC-318
LOCATION OF POSTS AND EXPANSION JOINTS	DES. DWG.

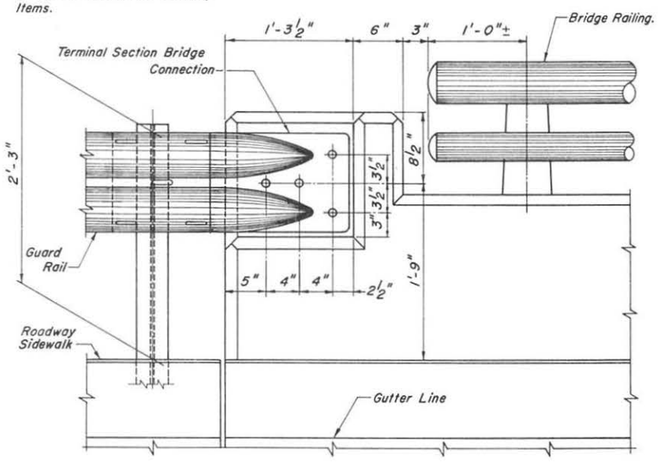
Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

STANDARD
STEEL BRIDGE RAILING

Recommended June 1, 1972	Approved June 1, 1972	Sht. 1 Of 1
B. F. Ketahl, Chief Bridge Engineer	R. R. Musser, Deputy Chief Highway Engineer	BC-315

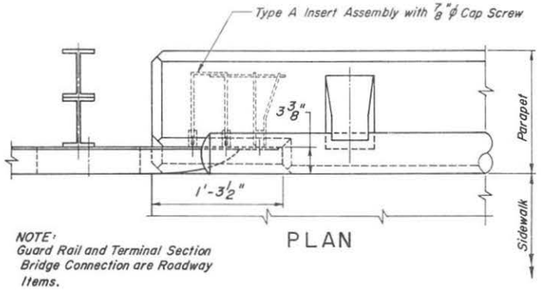


NOTE:
Guard Rail and Terminal Section Bridge Connection are Roadway Items.

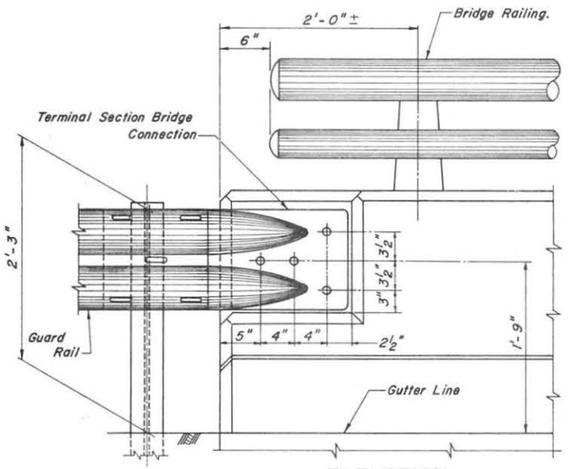


ELEVATION

DETAIL A
(With Roadway Sidewalk)

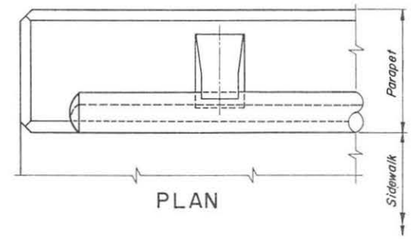


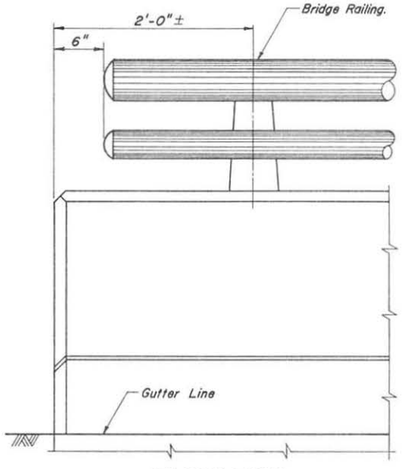
NOTE:
Guard Rail and Terminal Section Bridge Connection are Roadway Items.



ELEVATION

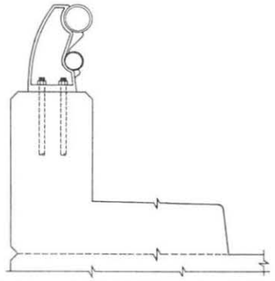
DETAIL B
(Without Roadway Sidewalk)





ELEVATION

DETAIL C
(Without Terminal Section Bridge Connection)



TYPICAL SIDEWALK SECTION

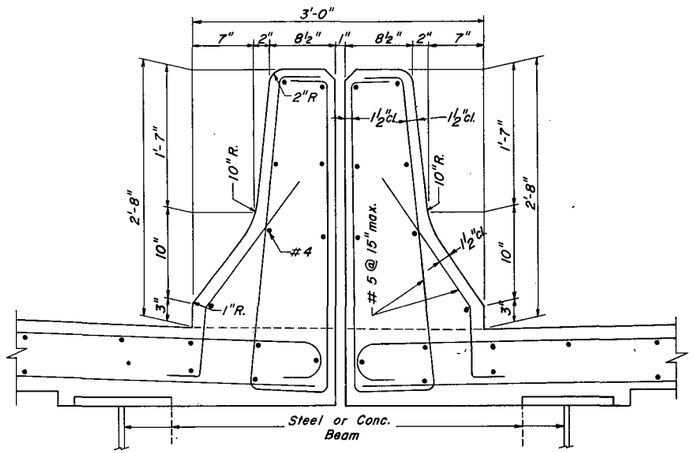
REFERENCE DRAWINGS	
THREADED INSERT ANCHOR ASSEMBLY	BC-334
PEDESTRIAN TRAFFIC BARRIER	BC-317
STEEL BRIDGE RAILING	BC-315
ALUMINUM BRIDGE RAILING	BC-314

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

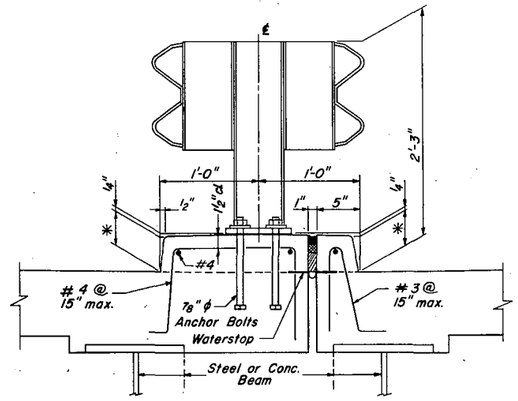
STANDARD

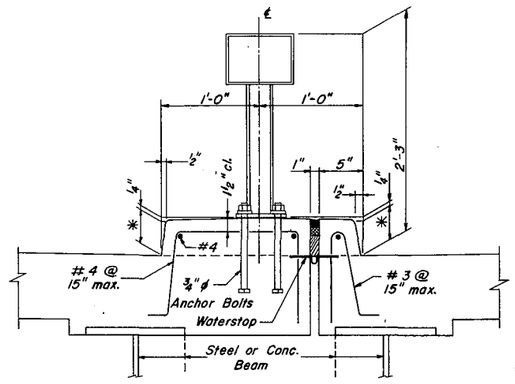
GUARD RAIL CONNECTIONS TO PARAPETS WITH SIDEWALKS

Recommended June 1, 1972	Approved June 1, 1972	Sht. 1 Of 1
B Z Kotalik, Chief Bridge Engineer	R M Mura, Deputy Chief Highway Engineer	BC-318



CONCRETE BARRIER





METAL BARRIERS

* As shown on the Design Drawings.

NOTES

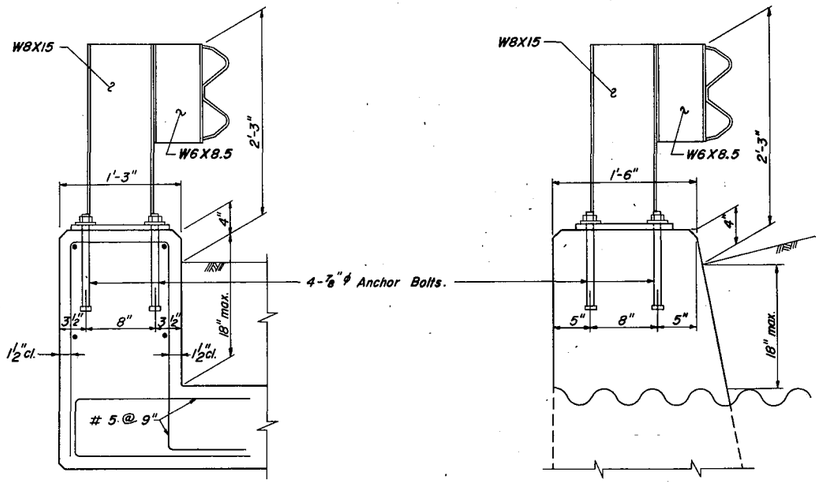
- MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPECIFICATIONS FORM 408 & 409.
- THIS STANDARD DRAWING SHALL BE USED IN CONJUNCTION WITH THE APPLICABLE STANDARD ROADWAY DRAWINGS FOR GUARD RAIL AND MEDIAN BARRIERS.
- CONCRETE BARRIER—
  CONCRETE SHALL BE CLASS AA CEMENT CONCRETE.
- METAL RAIL OR BARRIER—
  ANCHOR BOLTS SHALL BE ACCURATELY SET BY TEMPLATE TO THE CORRECT ELEVATION AND ALIGNMENT AND SHALL BE SECURELY BRACED AGAINST DISPLACEMENT BEFORE THE SURROUNDING CONCRETE IS PLACED.

  ONE LAYER OF 12 OUNCE DUCK, SWABBED WITH RED LEAD PASTE, SHALL BE PLACED BETWEEN THE BASE PLATE AND CONCRETE.

  ANCHOR MATERIAL SHALL CONFORM TO ASTM DESIGNATION A36, AND SHALL BE GALVANIZED CONFORMING TO SECTION 1052.16, FORM 409.

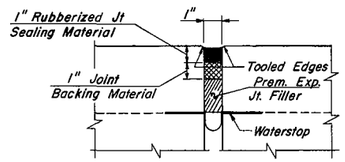
  FOR DETAILS OF ANCHOR SYSTEMS, REFER TO STD. DWG. BC-337.

- FOR SPACING OF POSTS, REFER TO DESIGN DRAWINGS.
- REINFORCEMENT DETAILS SHOWN ON THIS STANDARD ARE FOR DESIGNERS' USE IN THE PREPARATION OF DESIGN DRAWINGS.

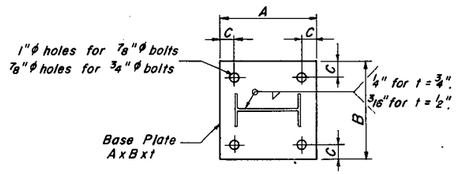


TYPICAL SECTION
(Box Culverts, Slab Bridges & Like Structures)

TYPICAL SECTION
(Metal Culverts)

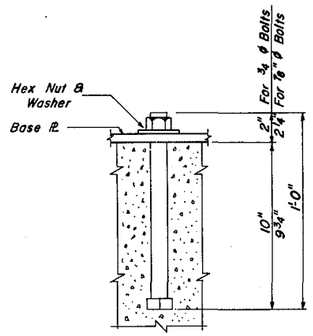


JOINT DETAIL



BASE PLATE DETAIL

Type of Rail	DIMENSIONS			
	A	B	t	C
	8"	11"	¾"	1¾"
	7"	7"	½"	1¼"
	12"	12"	¾"	2"



ANCHOR BOLT DETAIL

For alternate details of anchor systems, refer to Std. Dwg. BC-337.

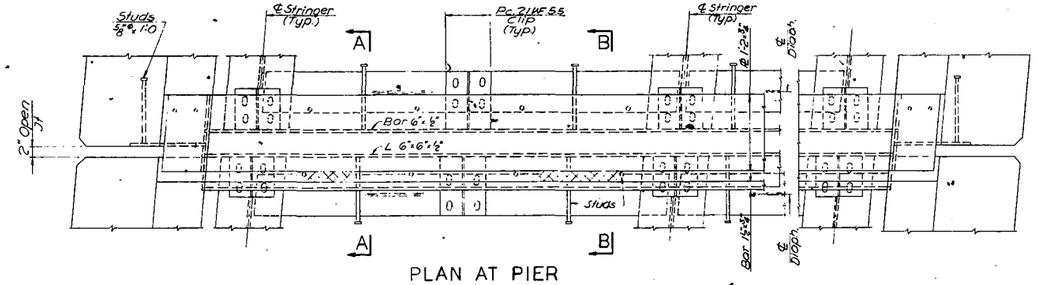
Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

STANDARD
STRUCTURE MOUNTED GUARD RAIL & BARRIERS

Recommended April 1, 1971
Chief Bridge Engineer

Approved April 1, 1971
By Deputy Chief Highway Engineer

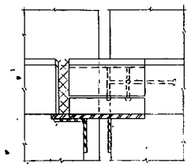
Sht. 1 of 1
BC-333

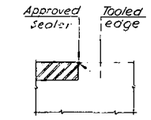


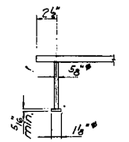
PLAN AT PIER

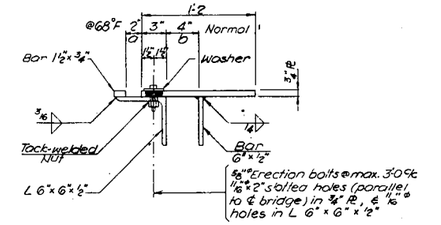
SKEW ANGLES ≥ 75°

Plan at Abutment similar; see Section at Abutment for details.









DETAIL OF TEMPORARY ATTACHMENT

FOR SHIPPING AND ERECTION OF DAM

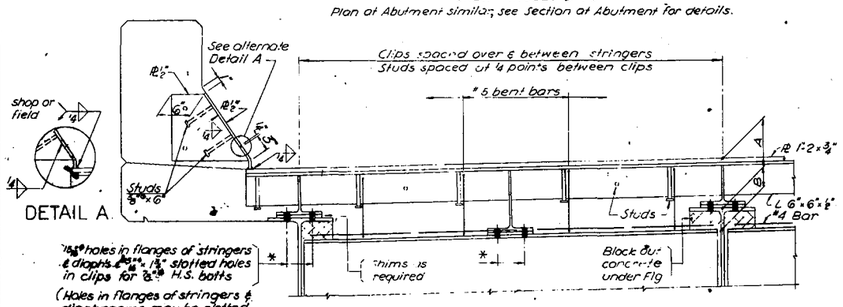
The dimensions "a" & "b" as shown are for a normal temperature of 68°F. for other temperature "T" at time of dam erection, these dimensions shall be adjusted as follows:

a (inches) = 2.00 -12 ε (T-68) L Str. @
b (inches) = 4.00-12 ε (T-68) L Str. @

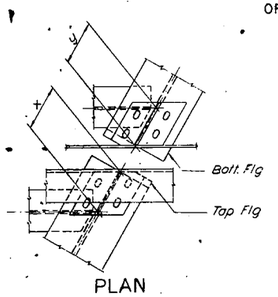
ε = thermal coefficient = 0.0000065
L = total expanded length in feet.

Example 1:
T = 30° L = 100 feet @ = 90°
a = 2.00 -12 (0.0000065) (30-68) 100
= 2.00 -12 (-.0247)
= 2.30" - Say 2⅜"

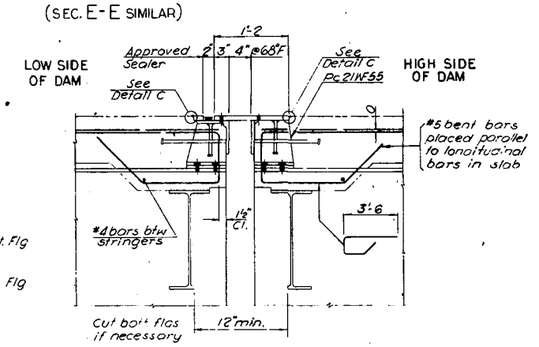
Example 2:
T = 106°, L = 100 feet @ = 90°
a = 2.00 - 12 (0.0000065) (106 - 68) 100
= 2.00 - .30
= 1.70" - Say 1¾"



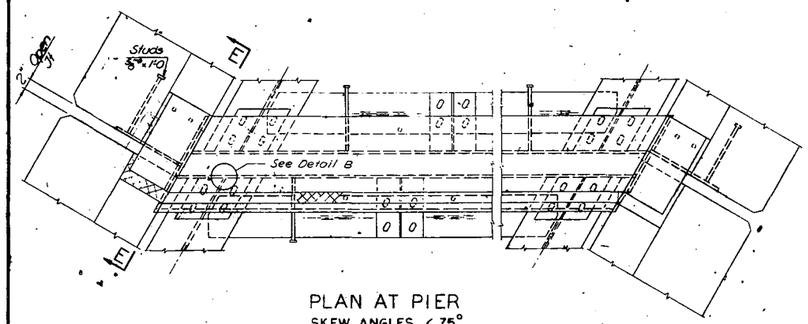
TYP. SECTION



PLAN
TOP & BOTT. FLG



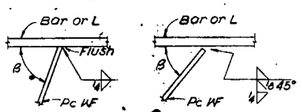
SECTION A-A



PLAN AT PIER

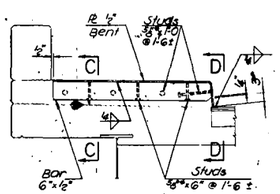
SKEW ANGLES < 75°

Plan at Abutment similar, see Section at Abutment for details.

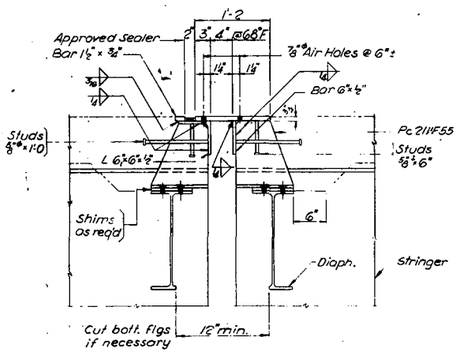


FOR SKEW ANGLES < 45°, β = 45° MIN.

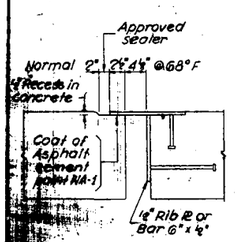
DETAIL B



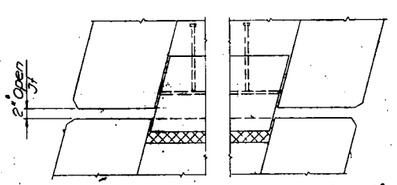
SECTION AT SIDEWALK



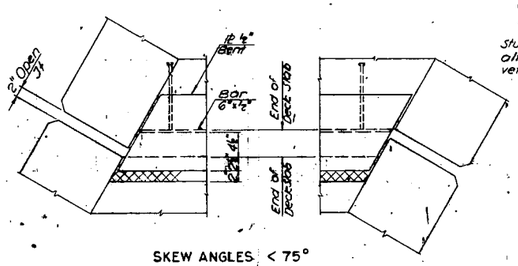
SECTION B-B



SECTION C-C

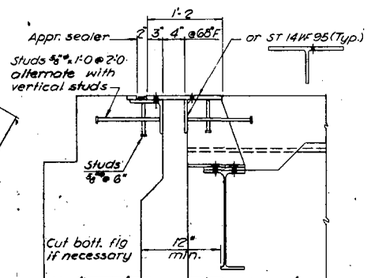


SKEW ANGLES ≥ 75°



SKEW ANGLES < 75°

PLANS AT SIDEWALK



SECTION AT ABUTMENT

NOTES

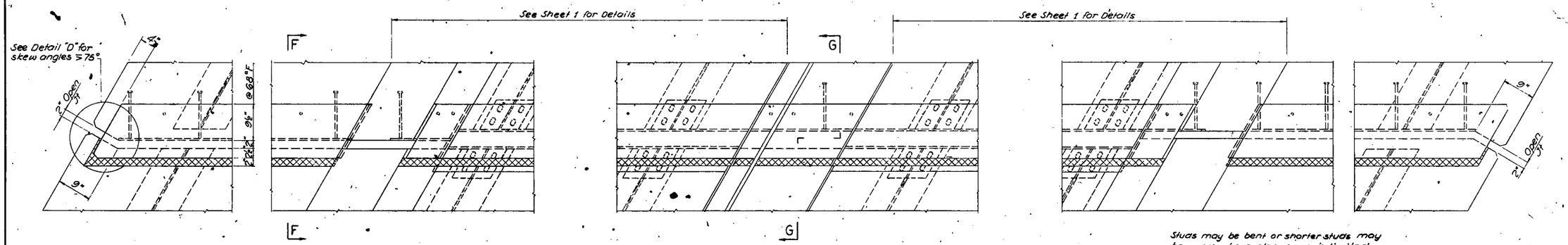
- *Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.*
- *Structural steel shall conform to ASTM A36 Designation.*
- *Provisions shall be made to fasten both elements of the dam together with bolts for shipping and erection purposes. After erection, and after opening is adjusted for erection temperature, bolts shall be removed. Holes shall be filled with approved sealer.*
- *Expansion dam shall be erected to follow roadway grade and crown.*
- *Concrete shall be placed under the dam and vibrated until the concrete is forced through the ⅞" holes. Strike off excess concrete. After concrete has cured, inspect the holes and remove unsound concrete. Clean the holes with an air jet and fill with an approved sealer.*
- *Steel surfaces in contact with concrete shall not be painted.*
- *One coat of asphalt cement paint MA-1 shall be applied to steel surfaces sliding on concrete.*
- *The WF Clips shall be placed equally between stringers at maximum spacing of 4'-0.*
- *Dimensions and details shown in section or plan are typical.*
- *For dimensions A, B, x and y, refer to Design Drawings. A = distance from top of deck slab to top of stringer at ℄ Brgs, and B = distance from top of diaphragm to top of stringer.*

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

STANDARD
PLATE EXPANSION DAM

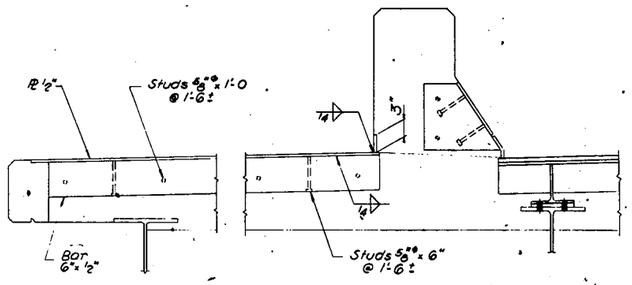
FOR STEEL I-BM. BRIDGES

Recommended July 1, 1970	Approved July 1, 1970	Sht. 1 of 2 Sh.
Chief Bridge Engineer	Chief Engr. For Highway Adm.	BC-361

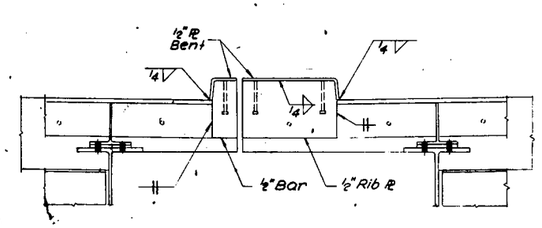


Studs may be bent or shorter studs may be used where clearance is limited.

PLAN

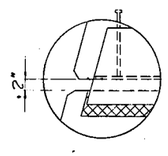


AT SIDEWALK

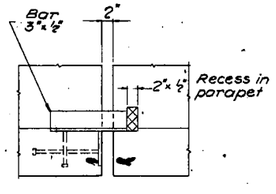


AT DIVISOR

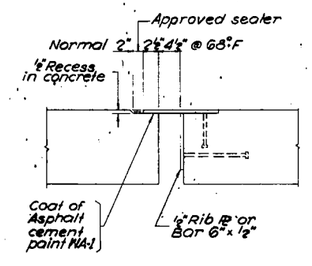
TYPICAL SECTIONS



DETAIL "D"
SKEW ANGLES ≥ 75°



SECTION F-F



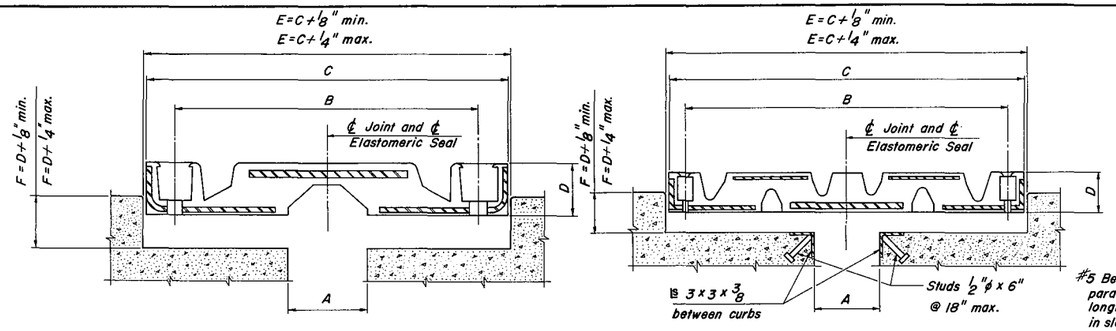
SECTION G-G

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

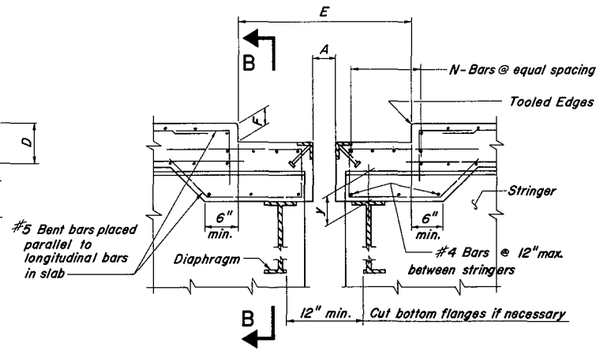
STANDARD
PLATE EXPANSION DAM

FOR STEEL I-BM. BRIDGES

Recommended July 1, 1970	Approved July 1, 1970	Sht. 2 of 2
B. F. Kotala, Chief Bridge Engineer	Chief Engr. For Highway Adm.	BC-361



TYPES OF ELASTOMERIC EXPANSION DAMS



TYPICAL SECTION AT PIER

OMIT L FOR TYPE I DAM
(See Table 1 For A, y And N)

NOTES

This Standard Drawing shall be used as a guide in the preparation of shop detail drawings.

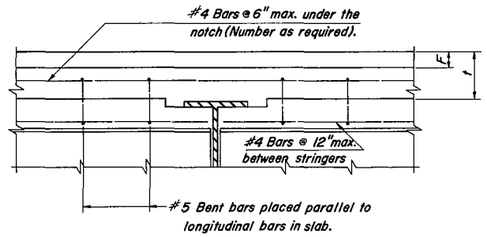
All materials and workmanship shall be in accordance with Specifications Forms 408, 409 and the Special Provisions.

Elastomeric Expansion Seal shall be of a movement classification not less than the movement classification specified on the Design Drawings.

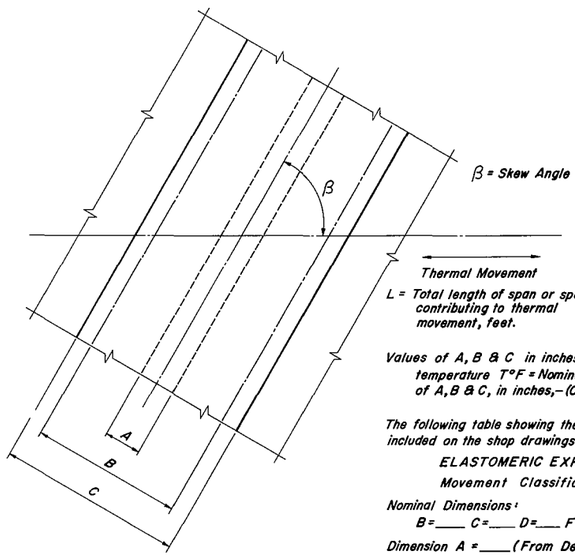
Dimensions B, C, D, E and F shall be shown on the Shop Drawings for the elastomeric expansion seal meeting the movement classification requirement.

Elastomeric Expansion Seal shall be designed for a live load =100 lbs./sq. in. plus 60% impact = 160 lbs./sq. in. The design span shall be assumed as A+(1/2)(Movement Classification). The live load deflection shall not exceed 1/1000 of the design span for elastomeric expansion dam.

TYPICAL SECTION A-A



SECTION B-B



PLAN

ELASTOMERIC EXPANSION DAM

L = Total length of span or spans contributing to thermal movement, feet.

Values of A, B & C in inches, at temperature T°F = Nominal values of A, B & C, in inches, − (0.000318)(L)(T−50)(Sin β)

The following table showing the necessary dimensions shall be included on the shop drawings.

ELASTOMERIC EXPANSION SEAL

Movement Classification = _____

Nominal Dimensions:

B=____ C=____ D=____ F=____ min., _____ max.

Dimension A =____ (From Design Drawings)

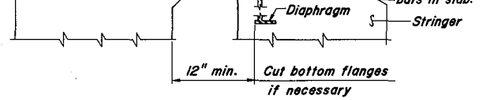
TEMPERATURE DEGREES F	A	B	C	E Min.	E Max.
−10					
0					
10					
20					
30					
40					
50 *					
60					
70					
80					
90					
100					
110					

* Nominal Dimension

TABLE 1

Δ (inches)	A (inches)	y (inches)	N (No. of Bars)
2	2	3	2
2 1/2	2 1/2	4	2
4	4	4	3
6 1/2	4	5	3
9	5 1/2	6	4
13	7 1/2	7	5

Δ = Movement Classification



TYPICAL SECTION AT ABUTMENT

OMIT L FOR TYPE I DAM
(See Table 1 For A, y And N)

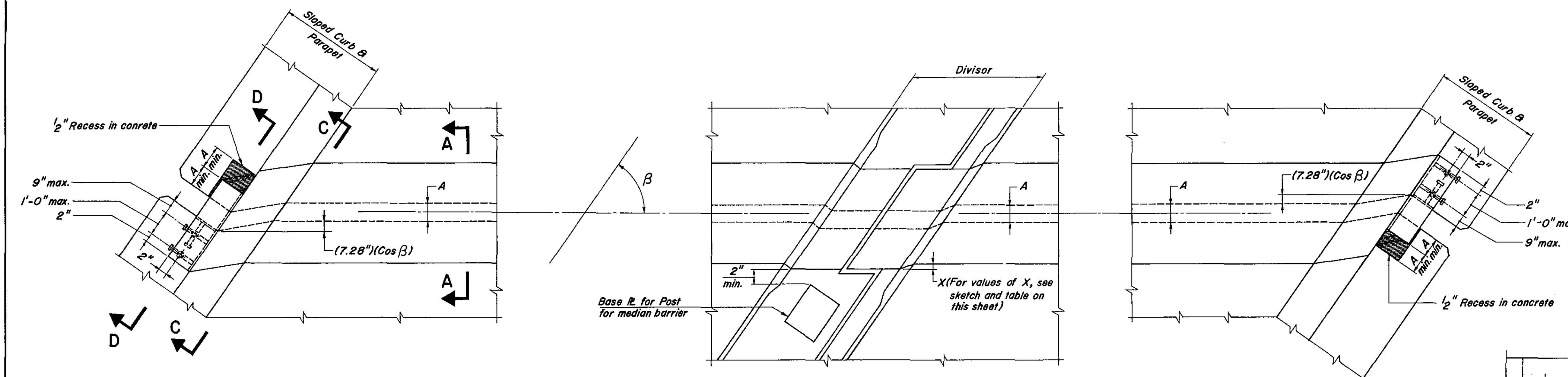
Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

STANDARD

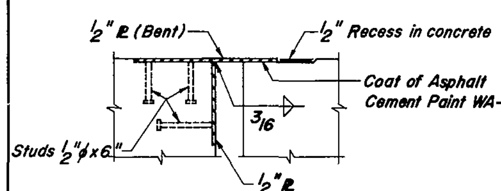
REINFORCED ELASTOMERIC EXPANSION DAM

FOR STEEL I-BM. BRIDGES

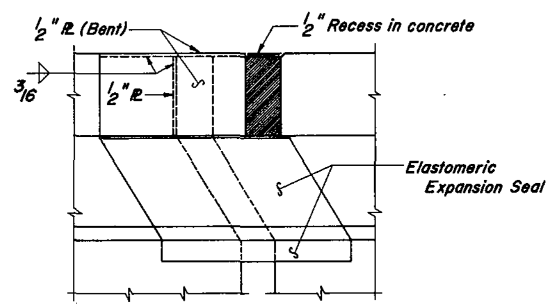
Recommended SEPT. 18, 1970	Approved SEPT. 18, 1970	Sht. 1 Of 3
D. F. Katalla	David C. Sims	BC-364
Chief Bridge Engineer	Chief Highway Engineer	



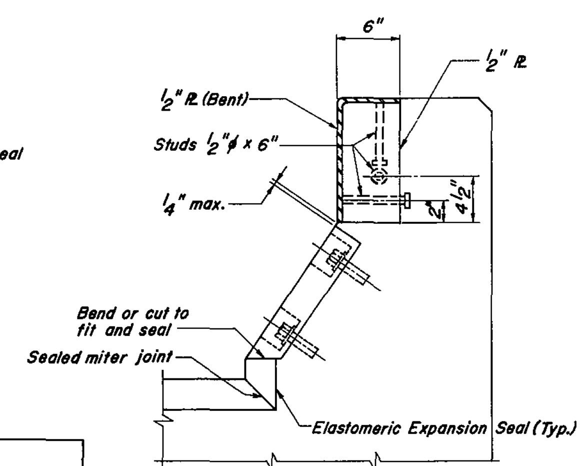
PLAN AT PIER
(Plan At Abutment Similar)



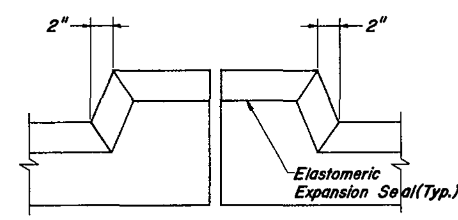
SECTION D-D



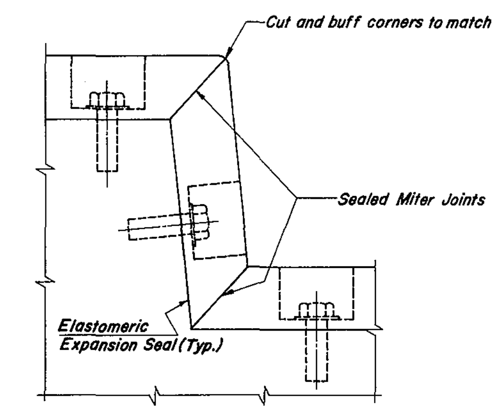
SECTION C-C
(Studs Not Shown)



DETAIL AT SLOPED CURB & PARAPET



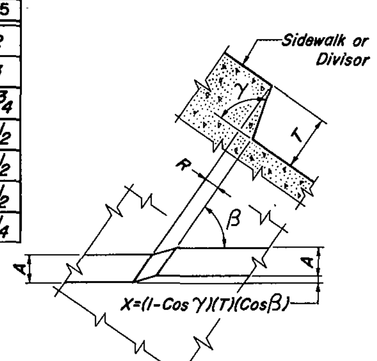
DETAIL AT DIVISOR



DETAIL AT CURBS
(Sidewalk & Divisor)

VALUES OF X, INCHES, WHEN R = 2"

T	SKEW ANGLES β													
	90	85	80	75	70	65	60	55	50	45	40	35	30	25
4"	0	0	0	0	¾	1	1	1¼	1½	1½	1¾	1¾	2	2
5"	0	0	0	¾	1	1¼	1½	1¾	2	2¼	2½	2½	2¾	3
6"	0	0	¾	1	1½	1¾	2	2¼	2½	3	3¼	3¼	3½	3¾
7"	0	0	1	1¼	1¾	2¼	2½	3	3¼	3½	4	4¼	4½	4½
8"	0	0	1	1½	2	2½	3	3½	4	4¼	4¾	5	5¼	6½
9"	0	0	1¼	2	2½	3	3½	4	4½	5	5½	5¾	6	6½
10"	0	0	1½	2	2¾	3½	4	4½	5¼	5½	6¼	6½	7	7¼



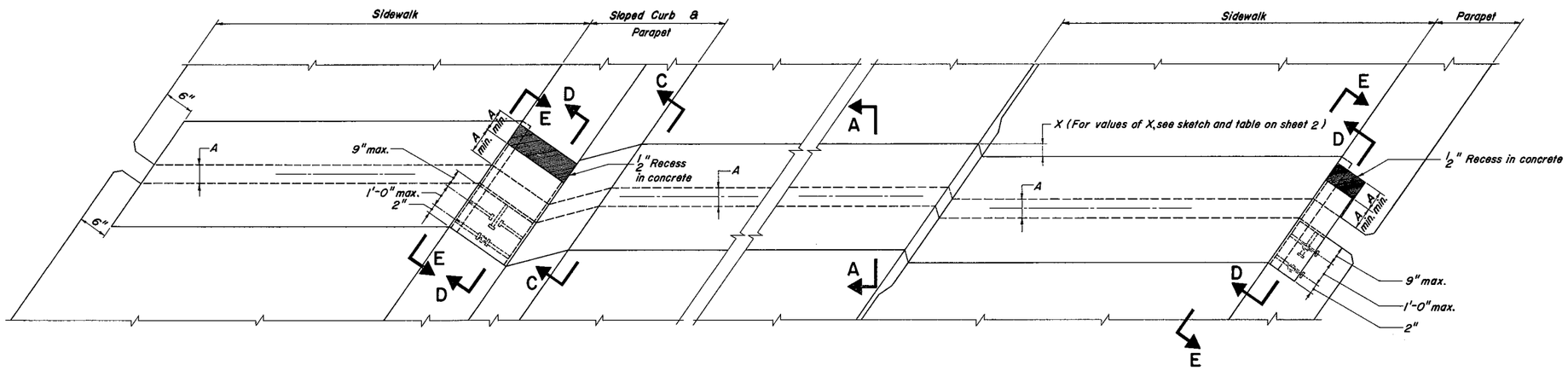
Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

STANDARD

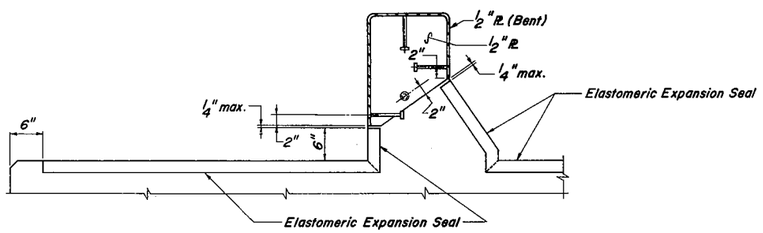
REINFORCED ELASTOMERIC EXPANSION DAM

FOR STEEL I-BM. BRIDGES

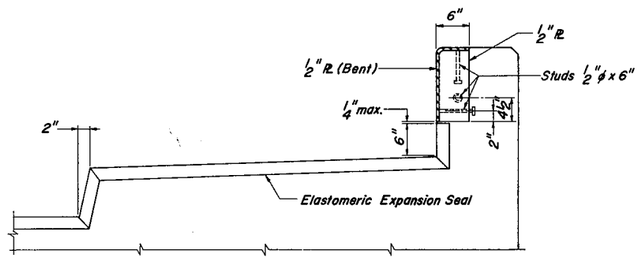
Recommended SEPT. 18, 1970	Approved SEPT. 18, 1970	Sht. 2 Of 3
Chief Bridge Engineer	Chief Highway Engineer	BC-364



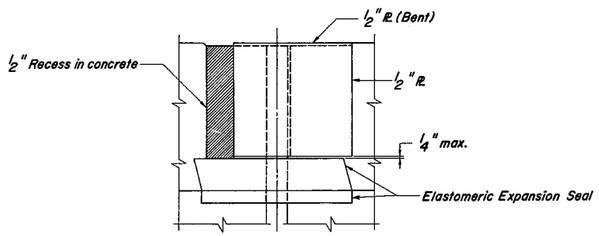
PLAN WITH SIDEWALKS AT PIER
(Plan Similar At Abutments)



DETAIL AT SIDEWALK



DETAIL AT SIDEWALK



SECTION E-E
(Studs Not Shown)

For dimensions and details not shown, see sheets 1&2.

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

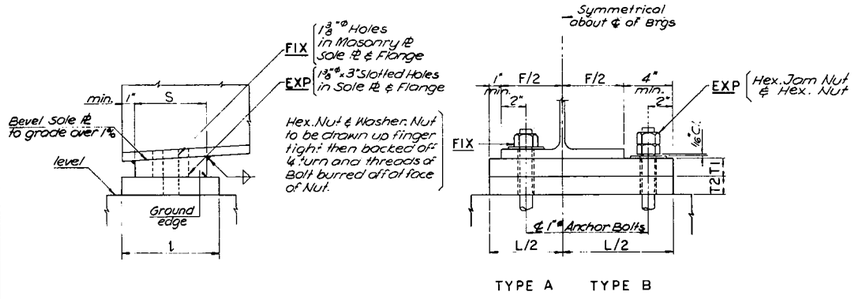
STANDARD

REINFORCED ELASTOMERIC EXPANSION DAM

FOR STEEL I-BM. BRIDGES

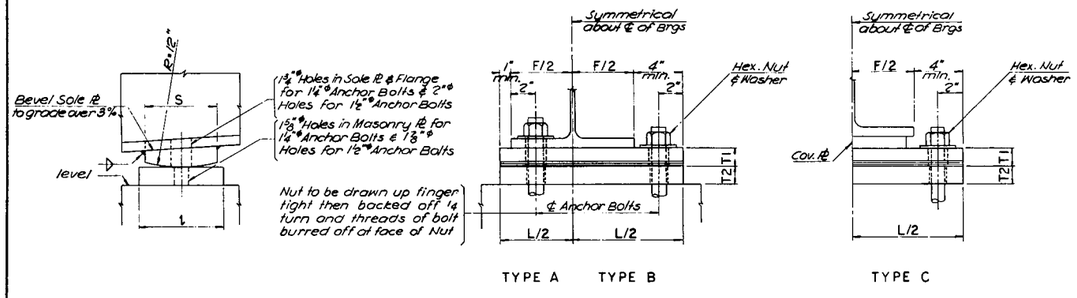
Recommended SEPT. 18, 1970	Approved SEPT. 18, 1970	Sht. 3 Of 3
B. E. Ketah Chief Bridge Engineer	David A. Lima Chief Highway Engineer	BC-364

9128 8 PEL-X R. K. ELLIOTT CO.
STANPAT PRODUCTS INC. PORT WASHINGTON, N.Y.



FIXED BEARINGS I F & EXPANSION BEARINGS I E

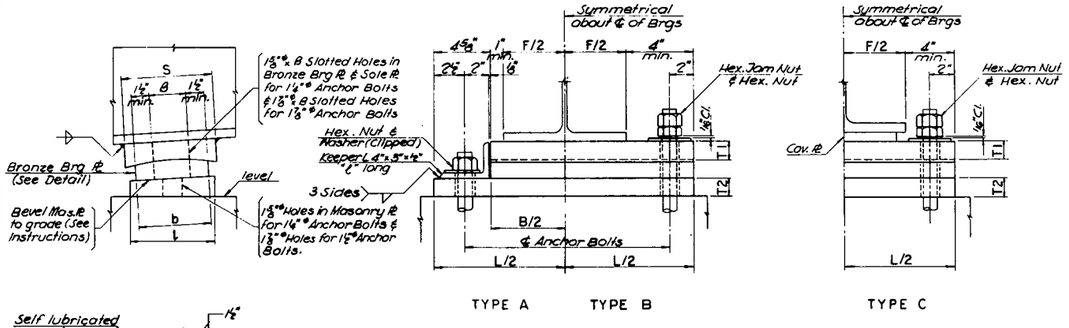
For simple spans up to 50 ft.

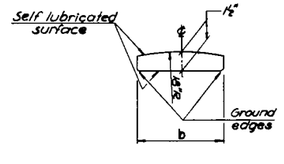


FIXED BEARINGS I F & EXPANSION BEARINGS I E

React. Kips	Mark	TYPE A & B					
		S	t	L	T1	T2	wt. lbs
50	R 50	6	8	12	1½	1½	83
60	R 60	6	8	14	1½	1½	95
70	R 70	6	8	16	1½	1½	107
80	R 80	6	8	18	1½	1½	119
90	R 90	6	8	20	1½	1½	131
100	R100	6	8	22	1½	1½	143

FIXED BEARINGS II F





BRONZE BRG ℄ DETAIL

- *The dimension B shall be computed using the equation: B = (Bolt Dia + 1/16" + 1/8" per 10 ft of expanded length) but not less than 3" and shall be specified on the design drawings.*
- *Minimum value of ℓ shall be (b+2) or (b + 1/8" per 10 ft of expanded length) whichever is greater.*
- *Minimum value of b shall be (B + 3")*
- *Minimum value of S shall be (b + 1½")*

EXPANSION BEARINGS III E

FIXED BEARINGS II F

React. Kips	Mark	Dimensions						React. Kips	Mark	Dimensions					
		S	t	L	T1	T2	wt.lbs			S	t	L	T1 · T2		wt.lbs
TYPE A															
60	R 60	5	6	12	1½	1½	66	90	R 90	6	8	14	1½	1½	92
70	R 70	6	7	12	1½	1½	75	100	R 100	6	8	14	1½	1½	92
80	R 80	6	7	14	1½	1½	83	120	R 120	6	8	16	1½	1½	103
TYPE B															
60	R 60	5	6	18	1½	1½	94	220	R 220	10	11	20	2½	2½	260
70	R 70	6	7	18	1½	1½	108	240	R 240	10	12	20	2½	2½	272
80	R 80	6	7	20	1½	1½	125	260	R 260	10	12	22	2½	2½	340
90	R 90	6	7	20	1½	1½	125	280	R 280	10	12	24	2½	2½	370
100	R100	6	7	20	1½	1½	125	300	R 300	10	12	26	2½	2½	395
120	R120	6	7	20	1½	1½	125	320	R 320	11	13	26	2½	2½	450
140	R140	8	9	20	1½	1½	147	340	R 340	11	13	27	2½	2½	470
160	R160	8	9	20	1½	1½	147	360	R 360	11	13	28	2½	2½	485
180	R180	8	9	20	1¾	1¾	162	380	R 380	11	13	30	3	3	530
200	R200	8	10	20	2	2	178	400	R 400	11	14	30	3	3	555

EXPANSION BEARINGS III E *

React. Kips	Mark	TYPE A								TYPE B & C						
		b	B	t	L	S	T1	T2	wt.lbs	b	t	L	S	T1	T2	wt.lbs
50	R 50	6	12	8	21¼	7½	1½	1½	112	6	8	18	7½	1½	1½	128
60	R 60	6	12	8	21¼	7½	1½	1½	120	6	8	18	7½	1½	1½	128
70	R 70	6	12	8	21¼	7½	1½	1½	135	6	8	18	7½	1½	1½	165
80	R 80	6	14	8	23¼	7½	1½	1½	150	6	8	20	7½	1½	1½	178
90	R 90	6½	14	8½	23¼	8½	1½	1½	166	6½	8½	20	8½	1½	1½	197
100	R100	7½	14	9½	23¼	9½	1½	1½	193	7½	9½	20	9½	1½	1½	221
120	R120	7½	16	9½	25¼	9½	1½	1½	211	7½	10	21	9½	1½	1½	237
140	R140	8	18	10	27¼	10	1½	1½	242	8	10½	22	10	1½	1½	256
160	R160	8	20	10	29¼	10	1½	1½	307	8	11	23	10	1¾	1¾	310
180	R180	8½	21	10½	30¼	10½	1¾	1¾	332	8½	11½	24	10½	2	2	336
200	R200	9	22	11	31¼	11	2	2	403	9	12	25	11	2	2	345
220	R220	9½	23	11½	32¼	11½	2¼	2¼	480	9½	12½	26	11½	2¼	2¼	490
240	R240	10	24	12	33¼	12	2¼	2¼	534	10	13	27	12	2¼	2¼	533

* *Bearings are designed for a maximum eccentricity of 1½ inches. For larger eccentricity special design is required. Eccentricity = .00437 L for temp. rise and .00813 for temp. fall, where L = Expanded length in feet.*

NOTES

- *All materials and workmanship shall be in accordance with P.D.H. Forms 408 and 409, and 1966 - AWS "Specifications for Welded Highway and Railway Bridges."*
- *Design Specifications: Design Division of 1965 AASHO "Standard Specifications for Higway Bridges".*
- *All Steel shall conform to ASTM A36 Designation, except as noted.*
- *The Bronze Alloy self lubricated Bearing Plates shall meet the ASTM Specifications B22 - Alloy D except that a maximum of up to 2½% lead will be allowed. The lubricated area shall comprise approximately 25% of the bearing surface. Plates shall be provided with holes drilled in or with trepponed recesses on the top and bottom faces, filled with a lubricating compound suitable for long life service.*
- *Rockers shall be shop assembled and match marked to insure free movement of rockers with pintles in place.*
- *Finish of contact surface shall conform to AASHO Art 2.10.25.*
- *℄ of all Bearings shall be truly vertical at a temperature of 68°F under full dead load.*
- *Anchor Bolts may be set by template or other suitable means before concrete is placed, or may be set in preformed holes and grouted with non-shrink mortar.*
- *Holes in masonry plates shall be filled with bituminous sealing material Class BF-1, except as noted on the plans.*
- *At each bearing, an area extending 1" beyond masonry plate shall be poured at least 4" high and after curing ground to a true plane and elevation. This area shall be thoroughly swobbed with red lead paint, and three layers of 12 oz. duck shall be placed thereon, each layer's top surface having been thoroughly swobbed with red lead paint. The shoes shall be set while the paint is wet.*
- *Anchor Bolts shall be swedge or approved type and to be set in the masonry as specified on the plans.*

DESIGN INFORMATION

Allowable Design Stresses

Tension and compression due to bending	*20,000 psi*
Bearing on flat parts in contact	*29,000 psi*
Bearing on rocker plate (lbs per linear inch)	*1,380 R (for R ≤ 12½")*
Bearing on rocker plate (lbs per linear inch)	*4,880√R (for R > 12½")*
Bearing on self lubricated plate	*1,000 psi*
Bearing on Concrete Masonry	
Bearing I	*700 psi*
Bearings II, III & IV	*1,000 psi*

SIZE OF FILLET WELD

Thickness of thicker part joined	Min. size of fillet weld
To ½" inclusive	3/16"
Over ½" to ¾"	¼"
Over ¾" to 1½"	5/16"
Over 1½" to 2¼"	3/8"
Over 2¼" to 6"	½"

Commonwealth of Pennsylvania

DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

APPROVED: JAN - 2 1968
Chief Engineer

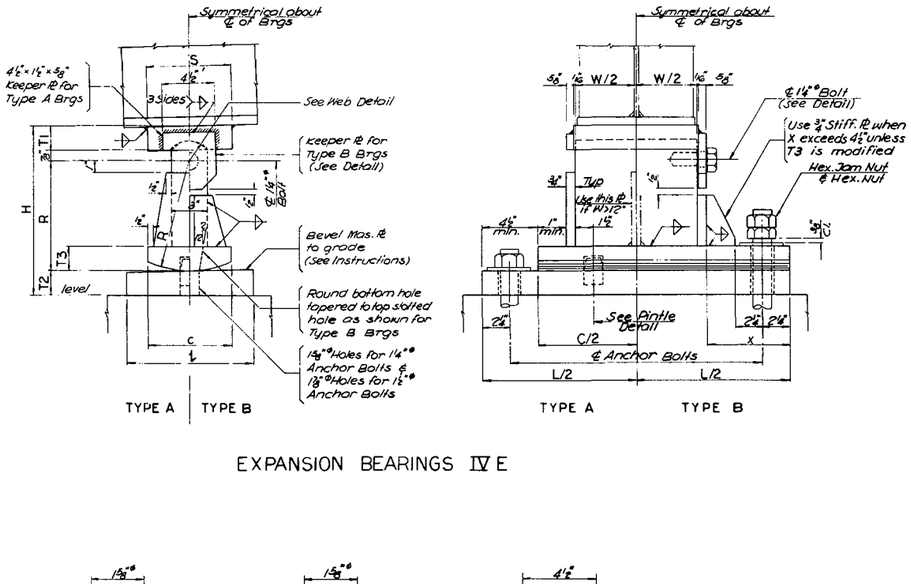
APPROVED: JAN - 2 1968
Bridge Engineer

STANDARD STEEL I-BEAM BRIDGES BEARINGS

SHEET 1 OF 2

ST-111

01200 PEN-E D. E. HARRITT CO.

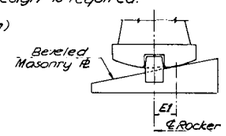


EXPANSION BEARINGS IV E

EXPANSION BEARINGS IV E *

React. Kips	Mark	S	W	c	C	L	ℓ	R	T1	T2	T3	H	Wt. Lbs.
						TYPE A							
75	R 75	6	10	6	13½	22½	8	8	2	2	2	12⅛	245
100	R100	6	10	6	13½	22½	9	8	2	2	2	12⅜	285
150	R150	7	10	7	16	25	10½	9	2	2	2	13⅜	335
200	R200	7	11	7	18	27	12	10	2¼	2¼	2	15⅜	410
250	R250	8	12	8	20	29	13½	11	2¼	2½	2¼	16⅛	535
300	R300	8	13	8	22	31	14	12	2¼	2½	2¼	18⅛	660
350	R350	9	14	9	24	33	15	13	2½	3	2⅜	19⅞	830
400	R400	9	16	9	26	35	16	14	2½	3¼	2⅜	21⅛	990
						TYPE B							
75	R 75	6	10	6	—	20½	8	8	2	2	2	12⅜	275
100	R100	6	11½	6	—	22	9	8	2	2	2	12⅞	310
150	R150	7	10	7	—	25	10½	9	2	2	2	13⅜	380
200	R200	7	11	7	—	27	12	10	2¼	2¼	2	15⅜	455
250	R250	8	12	8	—	29	13½	11	2¼	2½	2¼	16⅜	595
300	R300	8	13	8	—	31	14	12	2¼	2½	2¼	17⅜	720
350	R350	9	14	9	—	33	15	13	2½	3	2¼	19⅜	905
400	R400	9	16	9	—	35	16	14	2½	3¼	2¼	20¾	1075

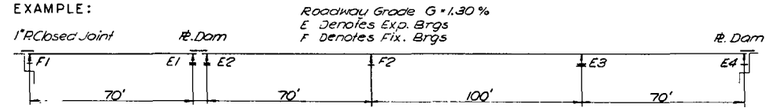
* Bearings are designed for a maximum total Eccentricity E of 2".
For larger Eccentricities, special design is required.
Total Eccentricity E = E1 + E2
E1 = Eccentricity at 68°F (see Sketch)
E2 = .00437 L for temperature rise
and .00813 L for temperature fall,
where L = Expanded length in feet.



INSTRUCTIONS

- Weights shown in tables are approximate and include all materials such as anchor bolts, nuts, washers or bronze brg plate.
- Where uplift exists, Type E or C (Brgs III E) and Type B (Brgs IV E) shall be used only for outside stringers and for the stringers adjacent to the divided median.
- Fixed bearings shall be placed at low end of span whenever it is possible.
- Thicknesses shown are at ℄ bearings.
- Dimensions given in tables are in inches except as noted.
- Dimensions shown in the tables are the minimum required. They shall be redesigned to suit the beam flange and must be shown on the design drawings.
- Beveled masonry plate shall be used only with plate expansion dam, when roadway grade G exceeds the value K, where K = (2.68 - .008L)%, in which L = total (left + right) expanded length, feet.

EXAMPLE:

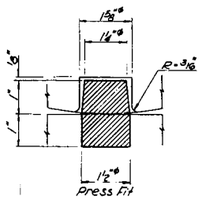


Total Expanded Length L = 70 + 70 = 140
From Equation K = (2.68 - .008 × 140)% = 1.48%
Since G > K Do not bevel masonry plates of bearings E1 & E2

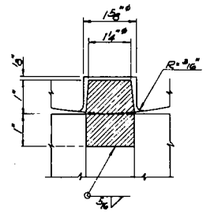
Total Expanded Length L = 100 + 70 = 170
From Equation K = (2.68 - .008 × 170)% = 1.16%
Since G > K Bevel masonry plates of bearings E3 & E4

- To determine the longitudinal force due to friction, the following coefficient of friction may be assumed:

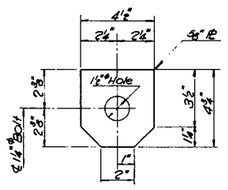
Type of brgs	Coefficient of friction
I E	0.30
III E	0.12
IV E	0.30 R/R



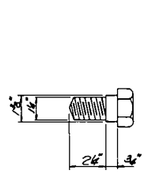
PINTLE DETAIL



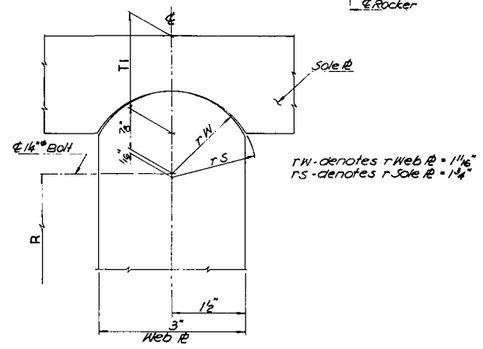
ALTERNATE PINTLE DETAIL



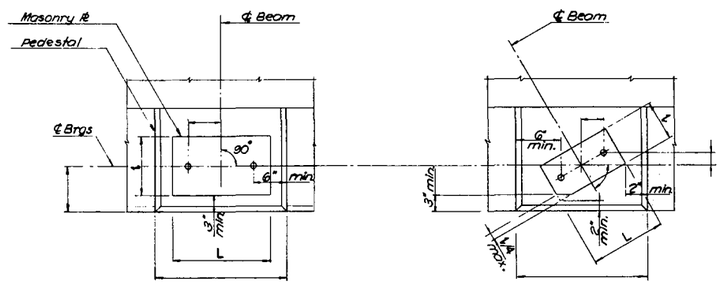
KEEPER ℞ DETAIL FOR TYPE B BEARINGS



BOLT DETAIL



WEB DETAIL



BRIDGE SEAT PLAN

APPROVED: JAN - 2 1968
M Auchaster
Chief Engineer

APPROVED: JAN - 2 1968
B F Kotaks
Bridge Engineer

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

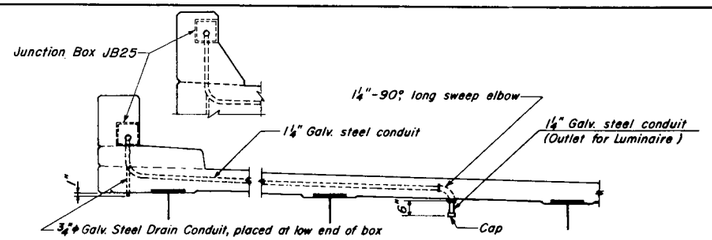
STANDARD STEEL I-BEAM BRIDGES

BEARINGS

SHEET 2 OF 2

ST-111

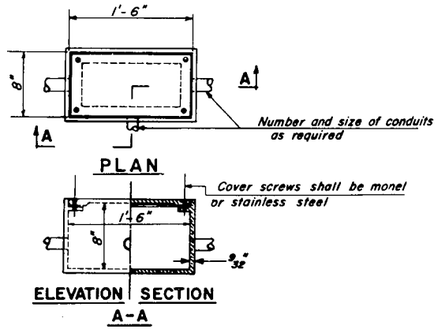
81300 PRL-2 E. K. BLIZETT CO.



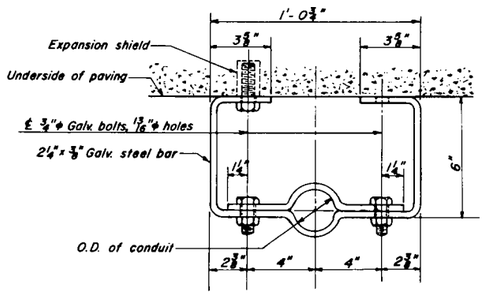
TYPICAL INSTALLATION OF JUNCTION BOX JB25

CONDUITS & FITTINGS FOR UNDERBRIDGE LIGHTING

• Refer to design drawings for location of outlets for future Luminaires.



JUNCTION BOX JB25 *



CONDUIT HANGER

* { O-Z Electrical Mfg. Co., Inc. — O-Z Cat. No. YU180808 / Hope Electrical Products Co. — Type H6200 / Spring City Electrical Mfg. Co. — Type IR } OR APPROVED EQUAL

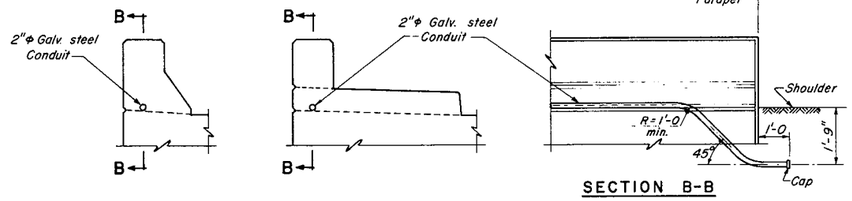
** { O-Z Electrical Mfg. Co., Inc. — Types AX and DX in tandem / Appleton Electric Co. / Spring City Electrical Mfg. Co. } OR APPROVED EQUAL

NOTES:

(1.) Provide opening in concrete. Distance "F" all around from edge of fitting to inside of opening to be at least 1" to provide for ¾" maximum deflection.

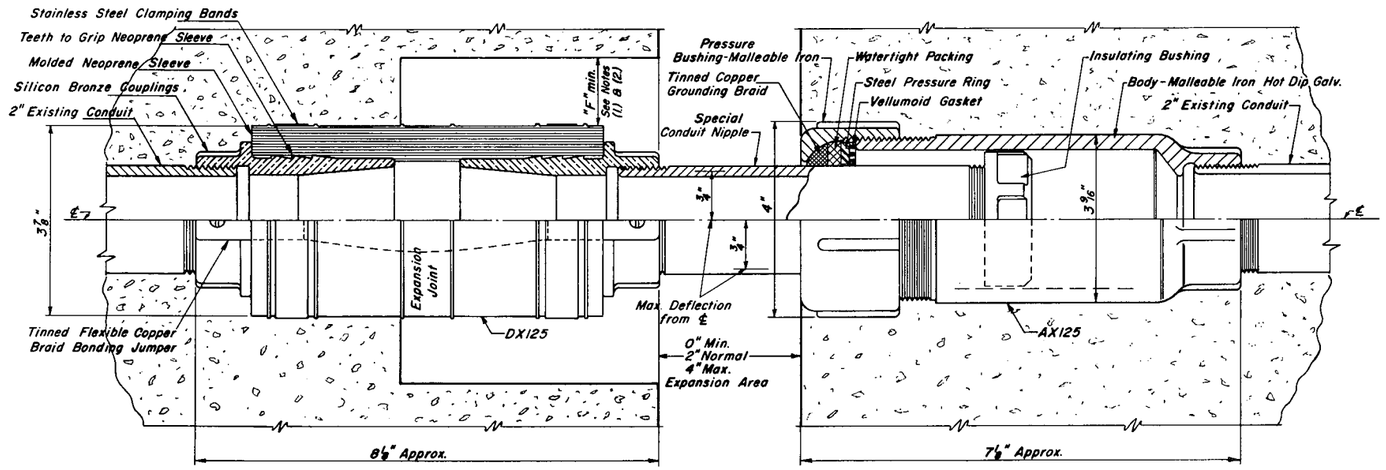
(2.) If the deflection which must be provided for is less than ¾" the size of the opening in the concrete may be reduced. Dimension "F" should equal deflection required + ¼".

(3.) The "AX" portion of this complete assembly has been approved by "Underwriters' Laboratories Inc." for use with rigid conduit without external bonding jumpers per section 250-77 of the 1965 National Electric Code.



CONDUIT DETAILS AT ENDS OF BRIDGE

Conduit beyond concrete shall be coated in accordance with the Lighting Specifications.



CONDUIT EXPANSION AND DEFLECTION JOINT FITTINGS **

APPROVED: JAN - 2 1968
Chief Engineer

APPROVED: JAN - 2 1968
Bridge Engineer

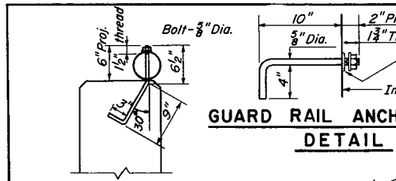
APPROVED: JAN - 2 1968
Electrical Engineer

Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

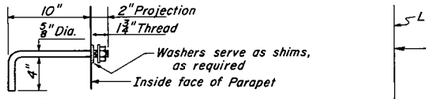
STANDARD
ELECTRICAL DETAILS
FOR STRUCTURES

SHEET 1 OF 1

ST-149



SECTION E-E



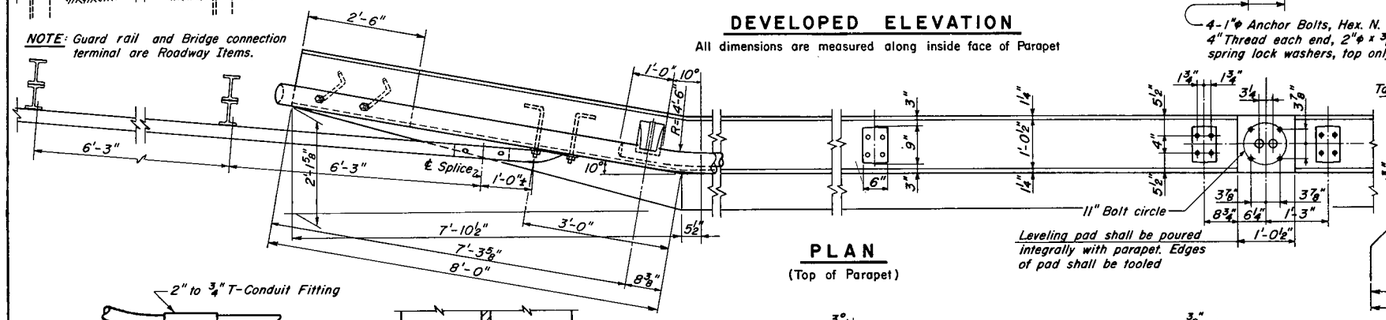
GUARD RAIL ANCHOR BOLT DETAIL

DEVELOPED ELEVATION

All dimensions are measured along inside face of Parapet

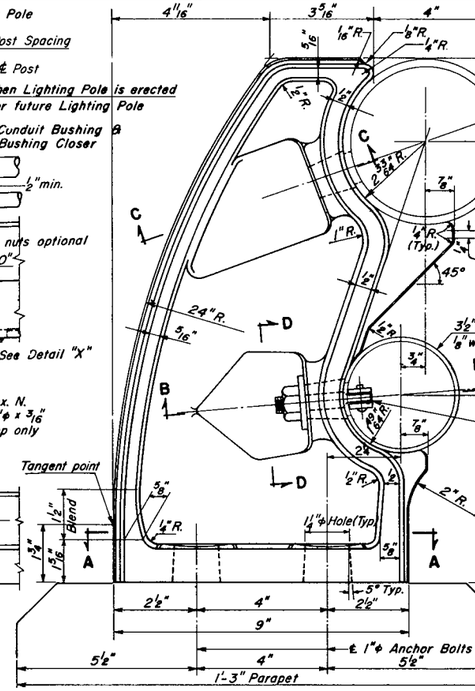
4-1"ϕ Anchor Bolts, Hex. N. 4" Thread each end, 2"ϕ x 3/16" spring lock washers, top only

NOTE: Guard rail and Bridge connection terminal are Roadway Items.

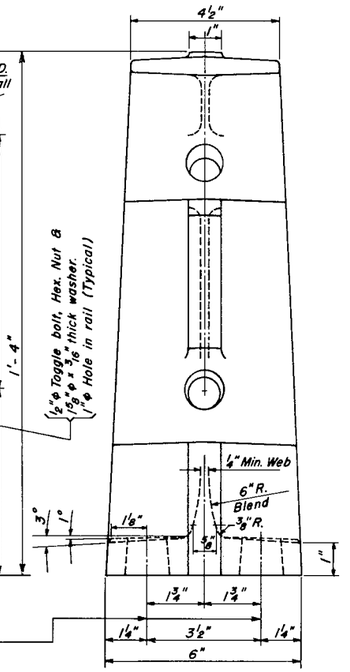


PLAN

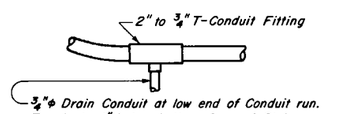
(Top of Parapet)



SIDE VIEW OF POST

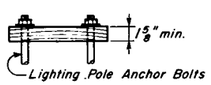


FRONT VIEW OF POST



¾"ϕ Drain Conduit at low end of Conduit run. Terminate 1" below bottom face of Slab.

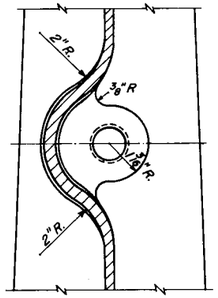
DETAIL "X"



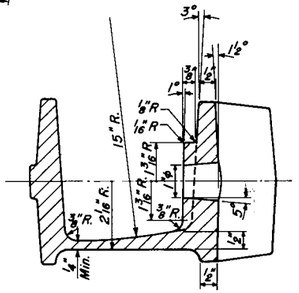
PROTECTIVE WOOD BLOCK

Hardwood 11⅝" square

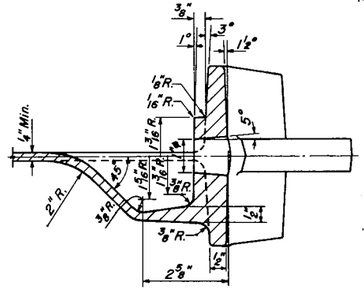
Protective wood blocks, with holes bored to fit bolt spacing and conduit, shall be painted with two coats of Aluminum paint before installation. Wood blocks must be in place before rails are installed.



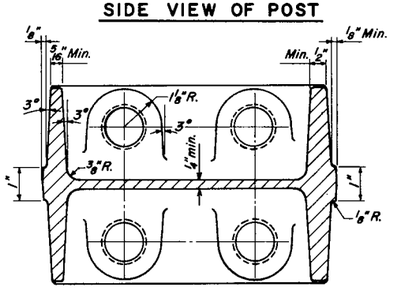
SECTION D-D



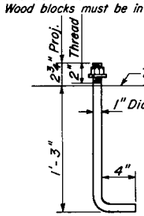
SECTION C-C



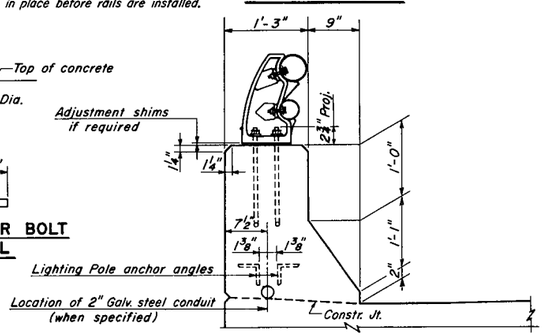
SECTION B-B



SECTION A-A



POST ANCHOR BOLT DETAIL



SECTION THRU PARAPET & RAILING

Des.	K.L.F.
Trc.	F.F.F.
Ckd.	JS/BFK

4128B PEL-X

NOTES

- All materials and workmanship shall be in accordance with PDH Forms 408 and 409.
- Design Specifications: Design Division of 1965-AASHO "Standard Specifications for Highway Bridges."
- Rails and splice tubes shall be Aluminum Alloy 6061-T6 or 6062-T6.
- Posts shall be Aluminum Alloy A344-T4.
- Shims and end caps shall be an approved aluminum alloy. Shims shall be flush with base of post and end caps shall be flush with rails.
- Guard rail, railing and railing post anchor materials and lighting pole anchor materials shall conform to ASTM A36.
- Toggle bolts shall be an approved type capable of supporting a 9,000 pound load in tension, before rupture, when tested through a 1"ϕ hole.
- All steel shall be galvanized conforming to ASTM A123 or A153 as applicable, except anchor angles shall not be galvanized. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.
- Surfaces of post in contact with concrete or steel, and surfaces of guard rail connection in contact with concrete shall be thoroughly coated with Caulking Compound conforming to Federal Specifications TT-C598(2). After erection and alignment, openings between metal surfaces and concrete shall be sealed with this compound.
- Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rail tubes shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion.
- Posts and post anchor bolts shall be normal to grade and rails except curved rails, shall be parallel to grade.
- Lighting pole anchorages shall be used only when lighting poles or future lighting poles are specified. Poles shall be truly vertical with bases level.
- Railing shall be measured continuously between centers of end posts and shall include all railing posts, rails, end caps, toggle bolts, anchor bolts with washers and nuts for rails, posts, guard rail end section connections and lighting poles, lighting pole anchor angles and protective wood blocks.
- Materials shall not be painted, except protective wood blocks.
- For future lighting: Conduit, lighting pole anchor bolts, nuts and washers above concrete shall be heavily coated with an approved bitumastic compound and protective wood blocks placed and firmly secured.
- For Electrical Details not shown, refer to Standard Drawing ST-149.
- For spacing of posts and location of expansion joints, refer to Design drawings.

APPROVED: JAN - 2 1968
M. Sweeney
Chief Engineer

APPROVED: JAN - 2 1968
B J Kotalik
Bridge Engineer

APPROVED: JAN - 2 1968
K. T. Law
Electrical Engineer

Commonwealth of Pennsylvania

DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
PARAPET WITH
ALUMINUM BRIDGE RAILING
AND
GUARD RAIL CONNECTION

SHEET 1 OF 1

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SUPERSTRUCTURE

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION	
ST-101*	1	12-17-69	STEEL I-BEAM BRIDGES	DECK SLAB DETAILS
ST-102	1	10-1-68	COMPOSITE A36 STEEL I-BEAM BRIDGES	DESIGN GRAPHS
ST-102	2	10-1-68		DESIGN GRAPHS
ST-102	3	10-1-68		DESIGN GRAPHS
ST-102	4	10-1-68		SHEAR CONNECTORS
ST-102	5	10-1-68		MOMENT OF INERTIA GRAPHS
ST-103	1	10-1-68	COMPOSITE A441 STEEL I-BEAM BRIDGES	DESIGN GRAPHS
ST-103	2	10-1-68		DESIGN GRAPHS
ST-103	3	10-1-68		DESIGN GRAPHS
ST-103	4	10-1-68		SHEAR CONNECTORS

SUPERSTRUCTURE DETAILS

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION	
ST-111*	1	12-17-69	STEEL I-BEAN BRIDGES	STEEL DIAPHRAGMS
ST-111	2	12-17-69		CONCRETE DIAPHRAGMS
ST-112*	1	12-17-69		BEARINGS
ST-112*	2	12-17-69		BEARINGS
ST-113	1	10-1-68		CLOSED JOINT DETAILS
ST-114*	1	12-17-69		PLATE EXPANSION DAM
ST-114*	2	12-17-69		PLATE EXPANSION DAM
ST-115*	1	12-17-69		TOOTH EXPANSION DAM
ST-115*	2	12-17-69		TOOTH EXPANSION DAM
ST-115*	3	12-17-69		TOOTH EXPANSION DAM
ST-116*	1	10-1-68		BRIDGE DRAINAGE
ST-116*	2	10-1-68		BRIDGE DRAINAGE

SUBSTRUCTURE

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION	
ST-121	1	10-1-68	R.C. ABUTMENTS WITH BACKWALL	REINFORCEMENT & DETAILS
ST-121	2	6-12-69		LAYOUT & DETAILS
ST-122	1	10-1-68	R.C. ABUTMENTS WITHOUT BACKWALL	REINFORCEMENT & DETAILS
ST-122	2	6-12-69		LAYOUT & DETAILS
ST-123	1	10-1-68	R.C. ABUTMENTS	MISCELLANEOUS DETAILS
ST-124	1	10-1-68	R.C. RETAINING WALLS	

CULVERTS

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION	
ST-131	1	3-24-69	METAL CULVERTS	ENDWALL DETAILS
ST-132	1	12-17-69	R.C. BOX CULVERTS	DETAILS
ST-132	2	12-17-69		DESIGN
ST-132	3	12-17-69		DESIGN
ST-132	4	12-17-69		DESIGN
ST-132	5	12-17-69		DESIGN
ST-133	1	12-17-69	R.C. ARCH CULVERTS	DETAILS

MISCELLANEOUS

DWG NO.	SHT. NO.	APPD. DATE	DESCRIPTION
ST-141*	1	3-18-69	WATERSTOP DETAILS

NOTES

THESE STANDARDS SHALL BE USED AS A GUIDE IN THE PREPARATION OF STRUCTURE PLANS.

DESIGN COMPUTATIONS ARE NOT REQUIRED FOR ANY PORTION OF A STRUCTURE FOR WHICH THE INFORMATION IS TAKEN VERBATIM FROM A STANDARD; E.G. A STEEL BEAN SECTION AS SHOWN ON A STANDARD MAY BE USED IF THE CORRESPONDING DINENSIONS AND DESIGN DATA OF THE STRUCTURE BEING DESIGNED ARE IDENTICAL TO THOSE SHOWN ON THE STANDARD.

REASONABLE MODIFICATIONS OF THE DETAILS SHOWN ON STANDARDS MAY BE REQUIRED IF CONDITIONS WARRANT.

STANDARDS MARKED THUS * MAY BE REFERRED TO ON THE PLANS IN LIEU OF SHOWING SPECIFIC DETAILS, PROVIDED COORDINATING INFORMATION IS SHOWN ON THE PLANS.

APPROVED: DEC. 17, 1969
H.W. Buchanan
CHIEF ENGINEER

APPROVED: DEC. 17, 1969
B.J. Kotalik
BRIDGE ENGINEER

Commonwealth of Pennsylvania

DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARDS FOR R.C. & STEEL STRUCTURES

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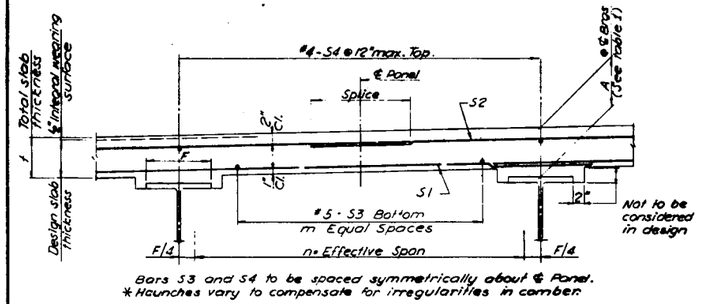
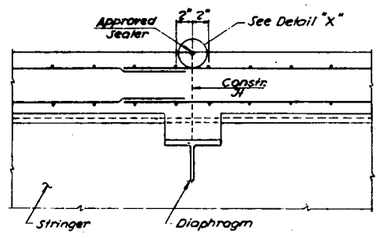
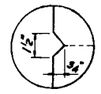


Bars S3 and S4 to be spaced symmetrically about ℄ Panel.
* Haunches vary to compensate for irregularities in camber.

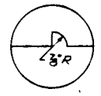
TYPICAL SLAB PANEL



TRANSVERSE CONSTR. JT DETAIL



V-NOTCH DETAIL



DRIP NOTCH DETAIL

NOTES

MATERIALS & WORKMANSHIP

- Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.
- Class AA Cement Concrete shall be used in deck slab, curbs, sidewalks and parapets.
- Reinforcement Bars shall conform to the requirements of Specifications Form 408 except that structural grade bars shall not be used. Bars shall be detailed in accordance with the current ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures. 2" concrete cover shall be provided on reinforcement bars except where noted otherwise.

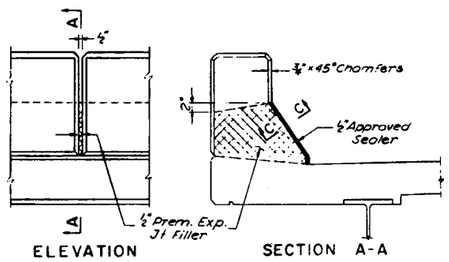
DESIGN

- Design Specifications: Design Division of 1969 AASHO, "Standard Specifications for Highway Bridges", and as supplemented by the current Design Manual, Part 4, Structures.
- Live Load: HS20-44
- Dead Load includes 30 lbs per sq. ft for future wearing surface on the deck slab.
- Dead Load of 15 lbs per sq. ft of deck area shall be considered in the design of beams when the use of Permanent Metal Deck forms is specified.

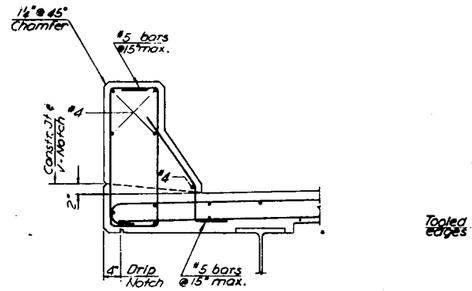
n	t	Bars S1 & S2	Bars S3	
			m	Spacing
4'-7	7½"	#5 @ 5" = 0.47"	3	11"
4'-11	7½"	#5 @ 7½" = 0.50"	4	11"
5'-3	7½"	#5 @ 7" = 0.53"	4	10"
5'-5	7½"	#5 @ 6½" = 0.57"	5	9"
5'-7	7½"	#5 @ 6" = 0.62"	5	9"
5'-10	8"	#5 @ 7" = 0.53"	5	10"
6'-4	8"	#5 @ 6½" = 0.57"	6	9"
6'-7	8"	#5 @ 6" = 0.62"	7	9"
6'-10	8"	#5 @ 5½" = 0.68"	8	8"
7'-0	8½"	#5 @ 6½" = 0.57"	7	9"
7'-7	8½"	#5 @ 6" = 0.62"	8	9"
7'-11	8½"	#5 @ 5½" = 0.68"	9	8½"

n = max. normal effective span permitted for given reinforcement bars S1 and S2

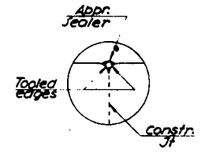
SLAB REINFORCEMENT



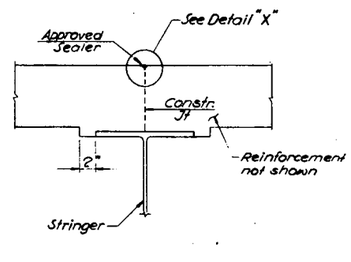
OPEN JOINT DETAIL



SLOPED CURB DETAIL



DETAIL "X"



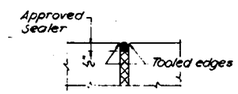
LONGITUDINAL CONSTR. JT DETAIL

INSTRUCTIONS

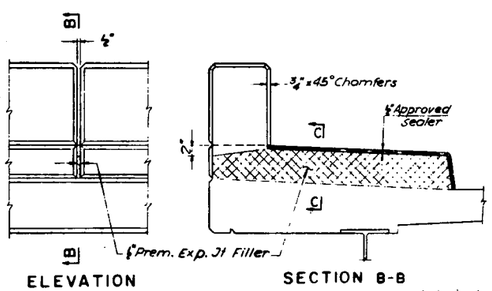
- Place transverse reinforcement in deck slab parallel to ℄ Brgs for skew angles 75° and more. For skew angles less than 75° the bars shall be placed normal to ℄ of bridge and length cut to fit.
- To determine the required area of bars S1 & S2:
  a. For values of skew angles β, less than 75°, use area of bars shown in table.
  b. For values of skew angles β, 75° and greater, increase area of bars by Cosec. β.
  c. Spacing of bars shall be measured along ℄ of bridge.
- On skew angles under 75°, a minimum of 3 - #5 bars @ 6" t shall be placed in top and bottom of the deck slab parallel to abutment or pier joint over the end supports.

TABLE 1		
CAMBER	A	
Up to 1½"	1 + ½"	
Over 1½" to 3"	1 + ¾"	
Over 3"	1 + 1"	

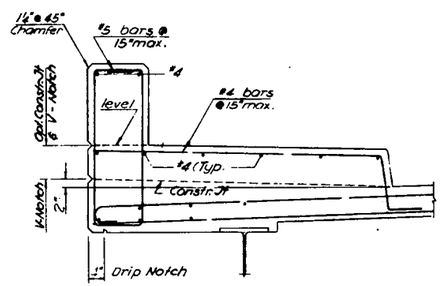
Variation in flange thickness is not included in "A".
"A" shall be modified for a concave (sag) vertical curve.



SECTION C-C



OPEN JOINT DETAIL



SIDEWALK DETAIL

APPROVED: DEC. 17, 1969
W. Anderson
Chief Engineer

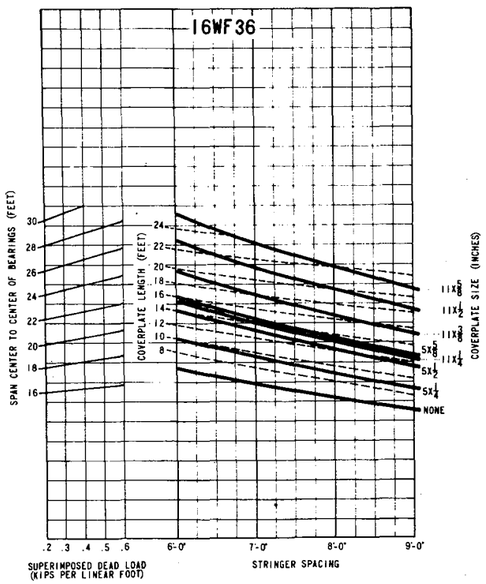
APPROVED: DEC. 17, 1969
B J Ketels
Bridge Engineer

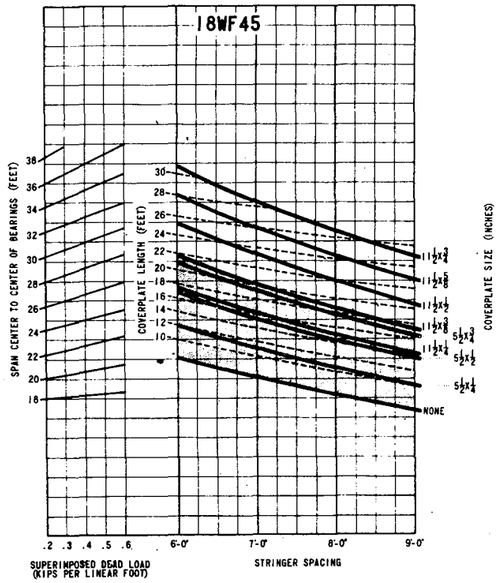
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

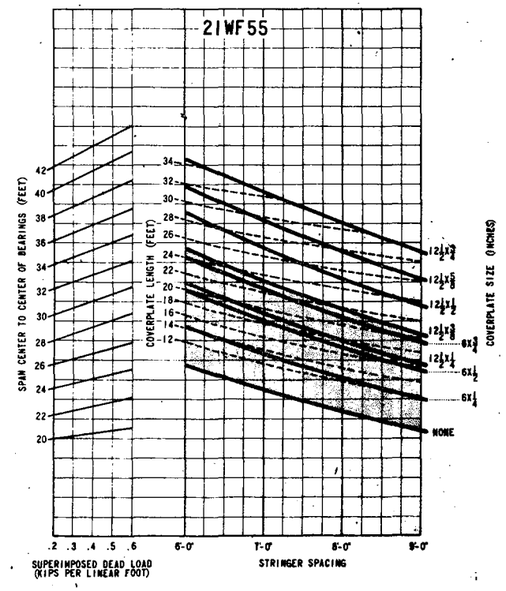
STANDARD STEEL I-BEAM BRIDGES DECK SLAB DETAILS

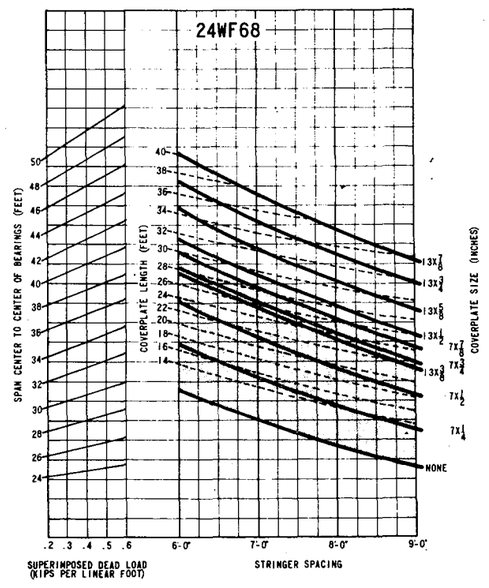
SHEET 1 OF 1

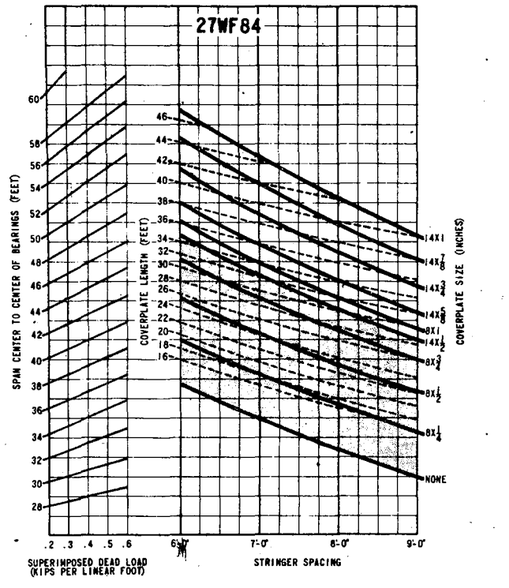
ST-101

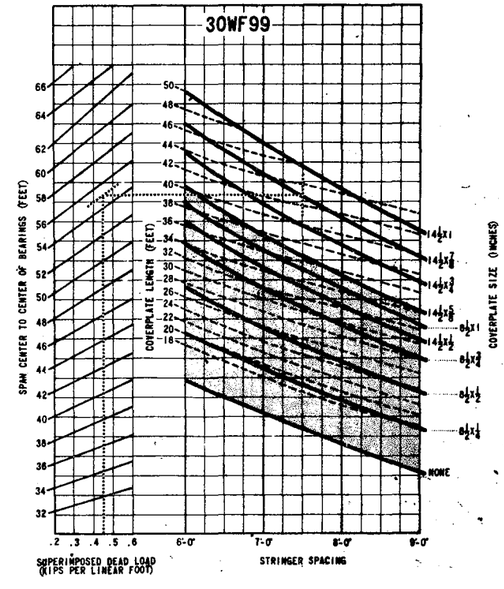












NOTE: SHADED AREAS INDICATE THAT LIGHTER BEAM AND COVERPLATE COMBINATIONS ARE AVAILABLE ELSEWHERE IN THE CHARTS.

NOTES

- *For specifications, notes, and other details, refer to Std. Dwg. ST-101.*
- *For selection of the most apparent economical beam, refer to Sheet #4*
- *Superimposed dead load includes: Future wearing surface. (Not applicable if deck slab is designed with bituminous wearing surface on to structures under fill.) Weight of railings, parapets, curbs or sidewalks, and any other dead load applied after deck slab has been cured, distributed equally to all stringers, in kips per lin. ft.*

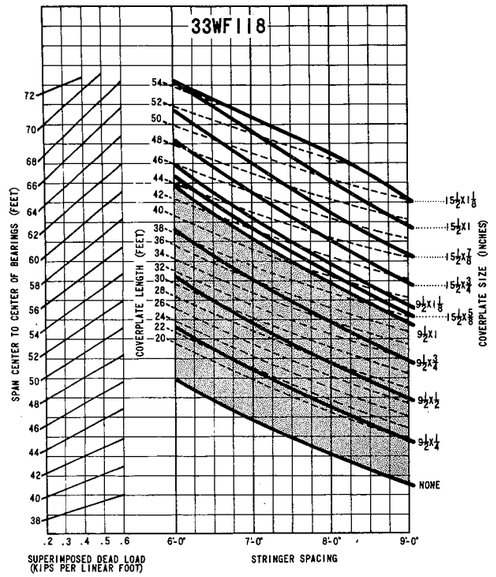
APPROVED: OCT. 1, 1968
CHIEF ENGINEER

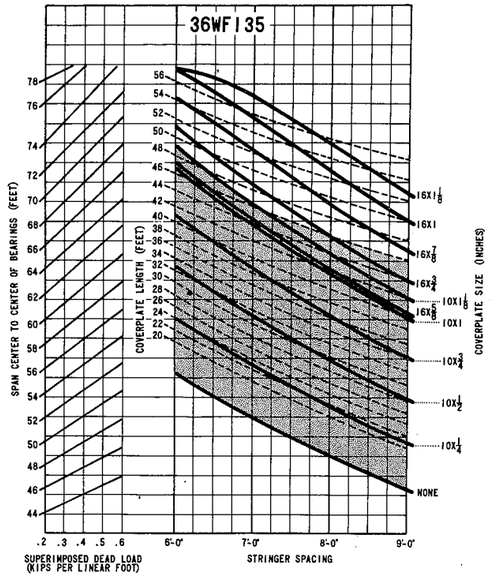
APPROVED: OCT. 1, 1968
BRIDGE ENGINEER

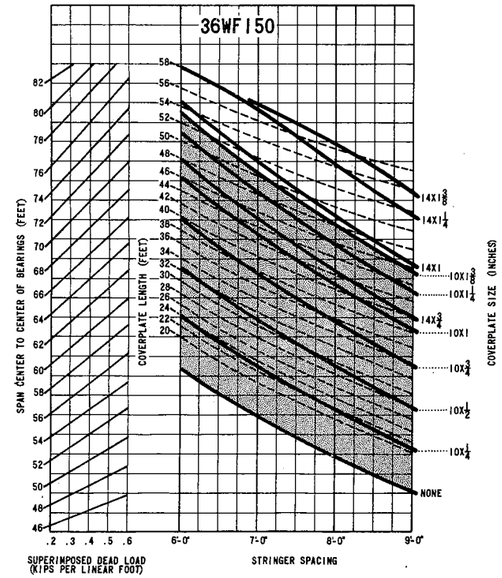
Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

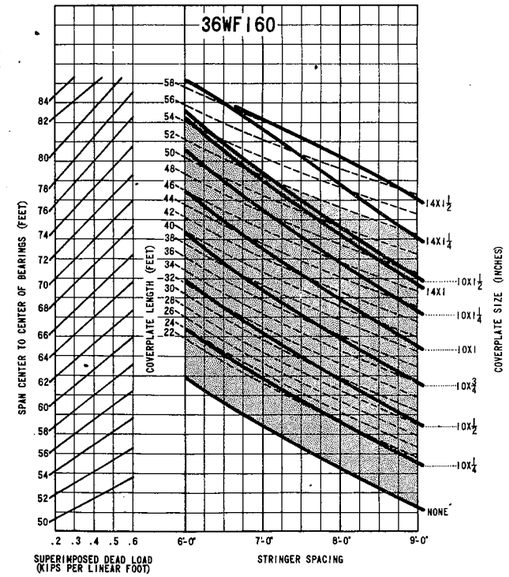
STANDARD
COMPOSITE A36 STEEL I-BEAM BRIDGES

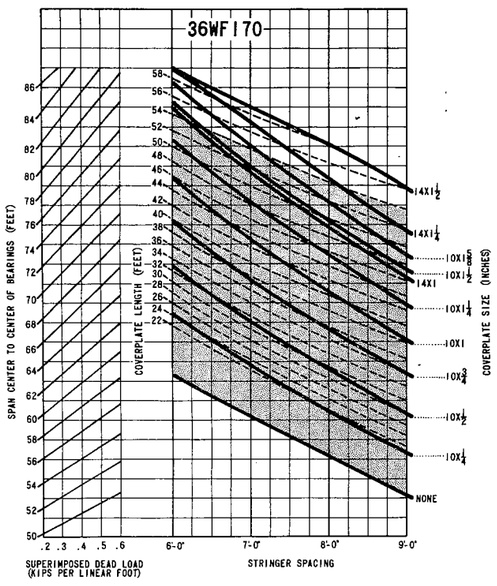
DESIGN GRAPHS

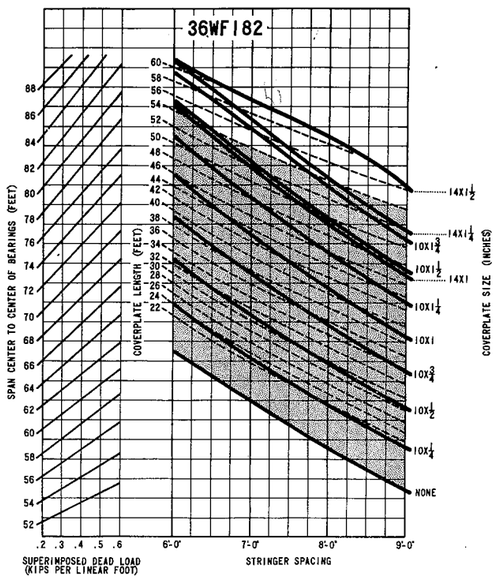


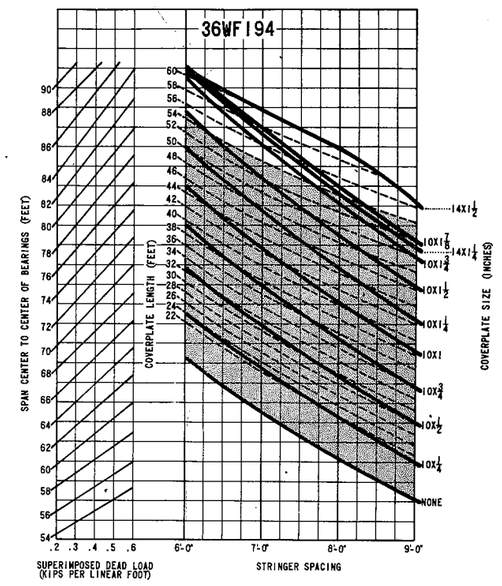












NOTE: SHADED AREAS INDICATE THAT LIGHTER BEAM AND COVERPLATE COMBINATIONS ARE AVAILABLE ELSEWHERE IN THE CHARTS.

APPROVED: OCT. 1, 1968
CHIEF ENGINEER

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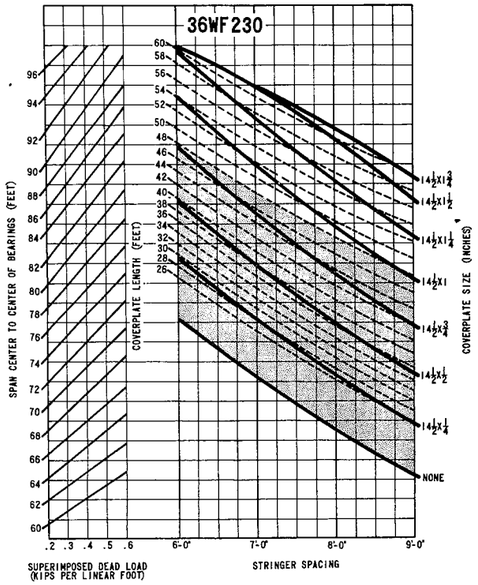
B.Z. Kotalik
BRIDGE ENGINEER

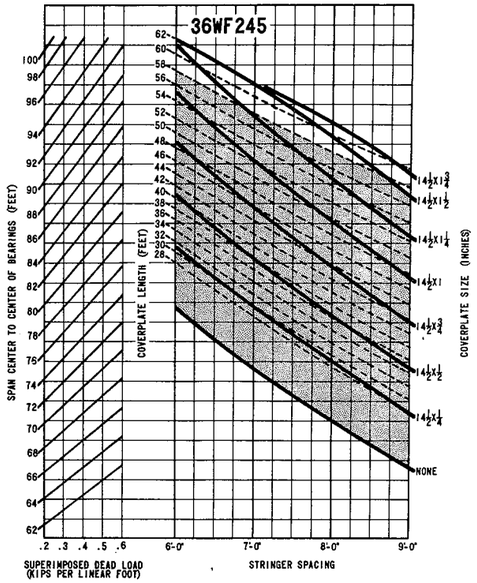
Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

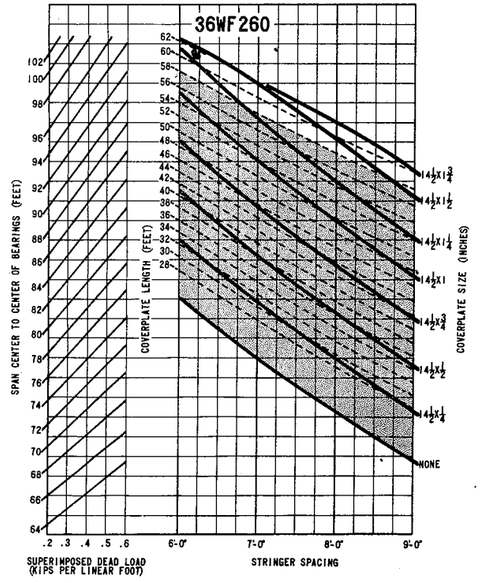
STANDARD
COMPOSITE A36 STEEL I-BEAM BRIDGES

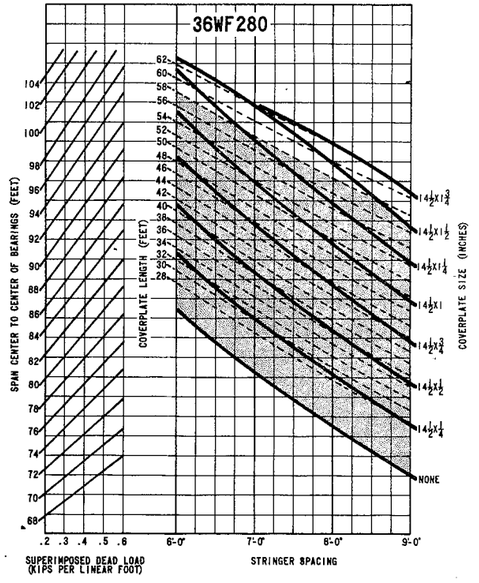
DESIGN GRAPHS

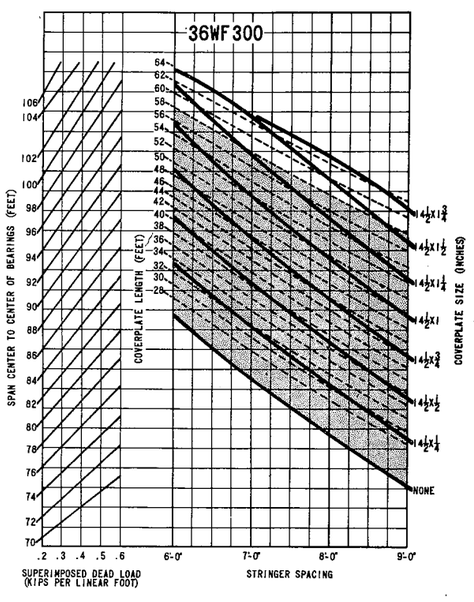
PREPARED BY BETHLEHEM STEEL CORPORATION IN COOPERATION WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION FOR THE PENNSYLVANIA DEPARTMENT OF HIGHWAYS.











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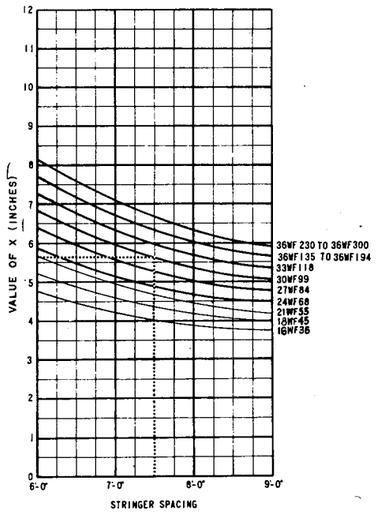
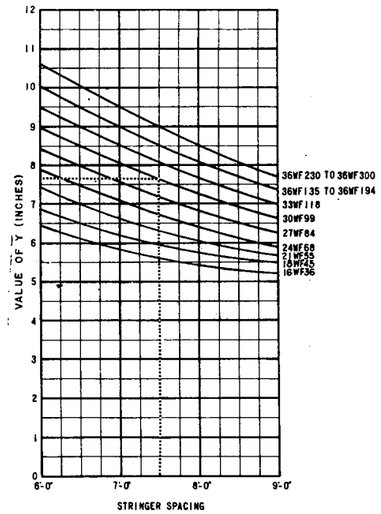
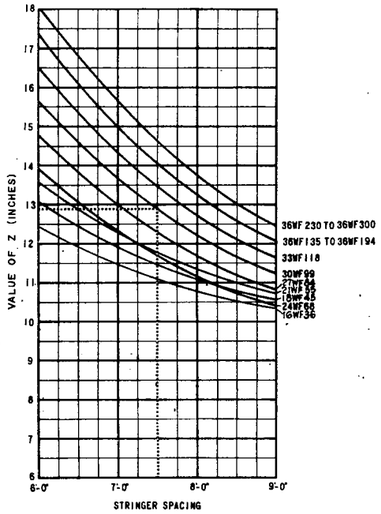
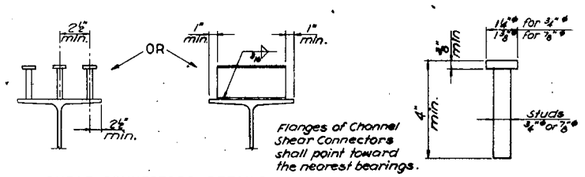


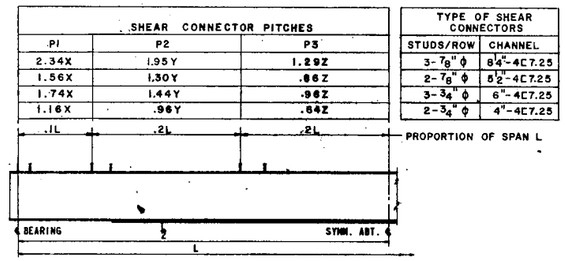




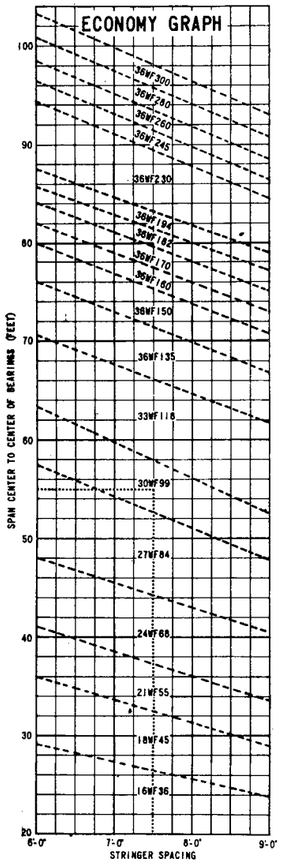


SHEAR CONNECTOR PITCHES		
P1	P2	P3
2.34X	1.95Y	1.29Z
1.56X	1.30Y	.86Z
1.74X	1.44Y	.96Z
1.16X	.96Y	.64Z

TYPE OF SHEAR CONNECTORS	
STUDS/ROW	CHANNEL
3-⅞" ø	8¼"-4C7.25
2-⅞" ø	5½"-4C7.25
3-¾" ø	6"-4C7.25
2-¾" ø	4"-4C7.25



NOTE: THE NUMBER OF SHEAR CONNECTORS BETWEEN POINT OF MAXIMUM POSITIVE MOMENT AND ADJACENT SUPPORTS SHALL NOT BE LESS THAN THAT REQUIRED BY THE FORMULA $N = Hi/\phi\, Qu$. (SEE 1966-67 INTERIM SPECIFICATIONS)



SAMPLE DESIGN PROBLEM

1. THE FOLLOWING INFORMATION IS KNOWN:
   A. SPAN CENTER TO CENTER OF BEARINGS=55 FEET.
   B. STRINGER SPACING=7'-6".
   C. SUPERIMPOSED DEAD LOAD=0.45 KIPS PER LINEAR FOOT OF BEAM.
2. REFERRING TO THE ECONOMY GRAPH, IT IS FOUND THAT THE 30WF99 GRAPH WILL PROBABLY YIELD THE MOST ECONOMICAL DESIGN.
3. ENTER THE 30WF99 GRAPH AT 0.45 KIPS PER LINEAR FOOT OF BEAM AND MOVE VERTICALLY TO THE 55-FOOT SPAN. MOVING FROM THIS POINT HORIZONTALLY TO THE 7'-6" STRINGER SPACING, IT IS SEEN THAT THE COVERPLATE IS $14\frac{1}{2}'' \times \frac{7}{8}''$ X 43'-0" LONG. NOTE THAT IF THE SPAN HAD BEEN 48 FEET THE DESIGN WOULD HAVE BEEN IN THE SHADED UNECONOMICAL PORTION OF THE GRAPH, INDICATING THAT A LIGHTER BEAM AND COVERPLATE COULD HAVE BEEN USED.
4. FROM GRAPHS, X=5.7, Y=7.7 AND Z=12.8 ARE FOUND FOR A 30WF99 AT A 7'-6 STRINGER SPACING. USING 2-¾" ø STUDS PER ROW OR 4"-4C 7.25

   $P1 = 1.16X = 6.6$, USE $6\frac{1}{2}''$, $\frac{1 \times 55 \times 12}{6.5}$ = 10 SPACES @ $6\frac{1}{2}'' = 65''$

   $P2 = .96Y = 7.4$, USE $7\frac{1}{2}''$, $\frac{2 \times 55 \times 12}{7.5}$ = 18 SPACES @ $7\frac{1}{2}'' = 135''$

   $P3 = .64Z = 8.2$, USE 8 , $\frac{2 \times 55 \times 12}{8}$ = 16 SPACES @ 8 = $128''$

   TOTAL $328''$

   $\frac{55 \times 12}{2} = 330''$ SAY O.K.

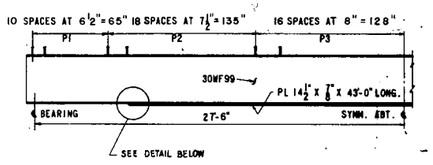
   $N = \frac{Hi}{\phi\, Qu}$ = 62 STUDS, 33 CHANNELS
5. MOMENT OF INERTIA OF THE BEAM AND COVERPLATE SECTION (I_1) IS FOUND BY ENTERING THE 30WF99 MOMENT OF INERTIA GRAPH WITH A COVERPLATE AREA OF 14.5 X .875 = 12.7 SQUARE INCHES. MOVE UP TO $\frac{A}{n}$ = 0 LINE (ZERO SLAB AREA). I_1=6000 IN.^{4}
6. MOMENT OF INERTIA OF THE COMPOSITE SECTION (I_2) IS FOUND BY MOVING UP TO $\frac{A}{n}$ = 24 WHERE:
   A = AREA OF STRUCTURAL PORTION OF SLAB
   = 8" X 7.5' X 12"/' = 720 IN.^{2}
   N = 30 FOR SUPERIMPOSED DEAD LOADS
   $\frac{A}{n} = \frac{720}{30} = 24$
   I_2 = 14300 IN.^{4}
7. DEAD LOAD DEFLECTIONS ARE CALCULATED USING THESE MOMENTS OF INERTIA AND COMPUTED DEAD LOADS* PER FOOT OF BEAM IN THE EQUATION

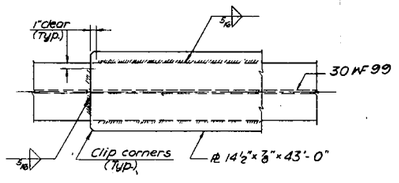
   $\Delta = .000775 L^4 \left(\frac{W_1}{I_1} + \frac{W_2}{I_2} \right)$

   WHERE:
   Δ = TOTAL DEAD LOAD DEFLECTION AT ℄ OF BEAM (INCHES)
   W_1 = COMPUTED WEIGHT OF SLAB AND STEEL (KIPS PER LINEAR FOOT OF BEAM)
   = $\frac{8.5'' \times 7.5'}{12}$ X .150 KIPS/FT.^{3} (SLAB) + .025 KIPS/FT. (HAUNCH) + .099 KIPS/FT. (BEAM) + .043 KIPS/FT. (COVERPLATE)
   = .962 KIPS/FT.
   W_2 = SUPERIMPOSED DEAD LOAD (KIPS PER LINEAR FOOT OF BEAM)
   = .450 KIPS/FT.
   I_1 AND I_2 = MOMENTS OF INERTIA AS FOUND IN STEPS 5 AND 6.

   $\Delta = .000775 \times 55^4 \left(\frac{.962}{6000} + \frac{.450}{14300} \right) = 1.35''$

   SAY: $1\frac{3}{8}''$
8. LIVE LOAD DEFLECTIONS DO NOT GOVERN ANY OF THESE DESIGNS AND NEED NOT BE CALCULATED.
9. FINAL DESIGN:





COVER PLATE DETAIL

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STANDARD

COMPOSITE A36 STEEL I-BEAM BRIDGES

SHEAR CONNECTORS AND SAMPLE DESIGN PROBLEM

KEJ

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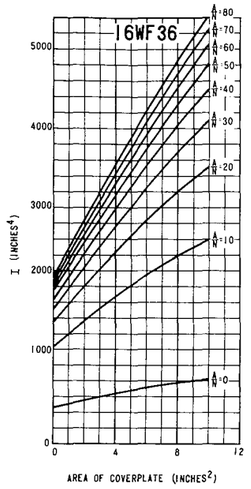

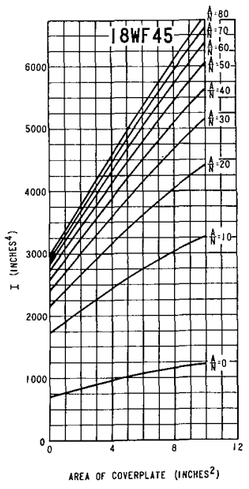

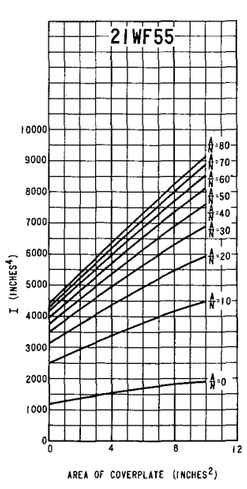

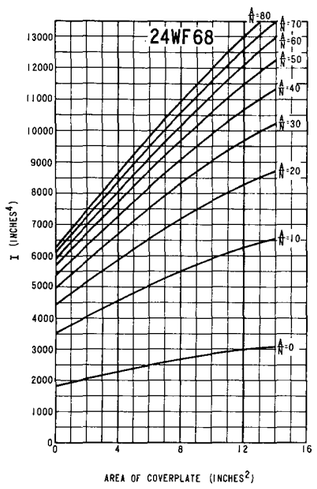

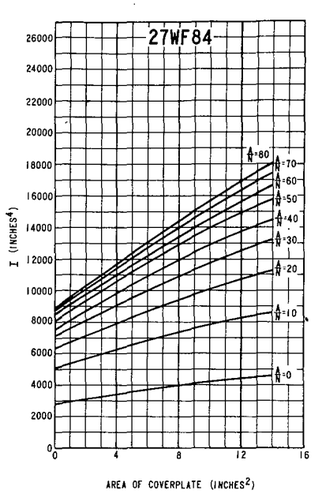

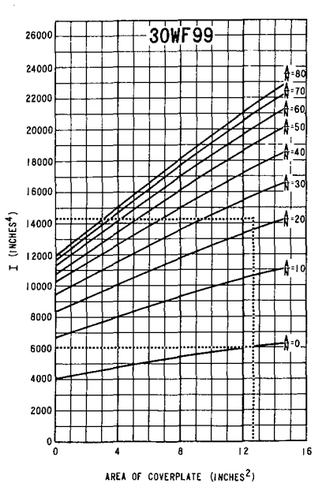

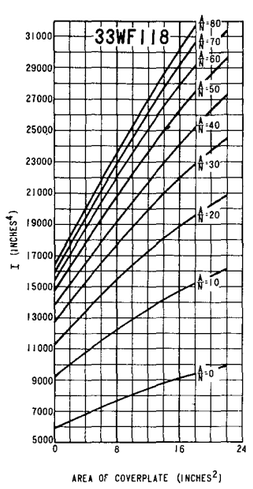

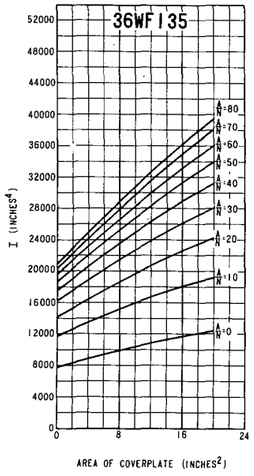

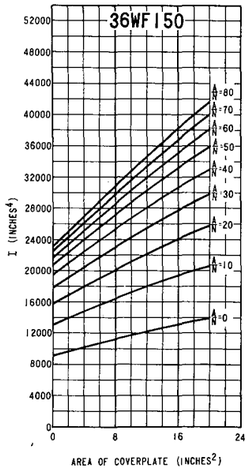

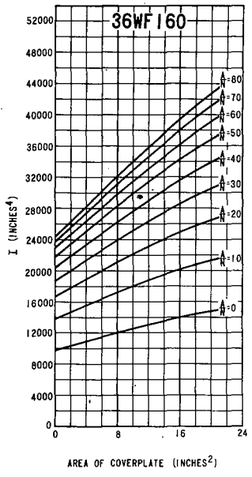

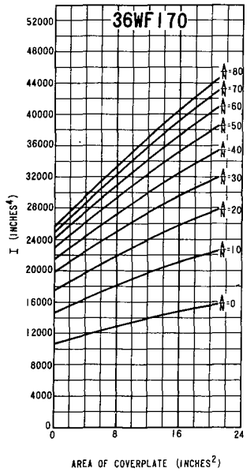

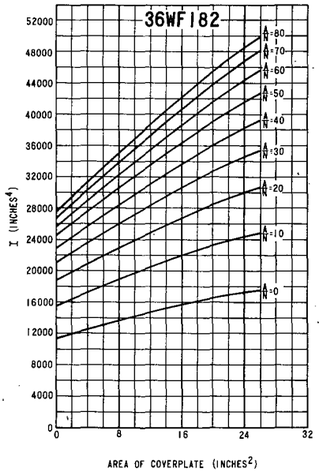

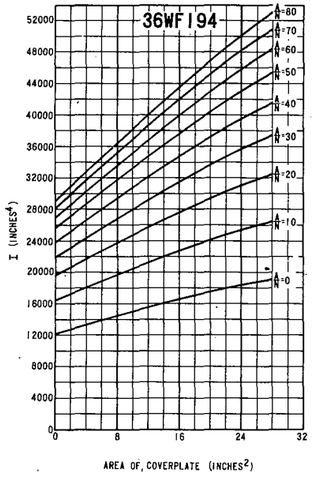

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CHIEF ENGINEER

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STANDARD

COMPOSITE STEEL I BEAM BRIDGES

MOMENT OF INERTIA GRAPHS

NOTE: A = AREA OF STRUCTURAL PORTION OF SLAB

N = $\frac{\text{MODULUS OF ELASTICITY FOR STEEL}}{\text{MODULUS OF ELASTICITY FOR CONCRETE}}$

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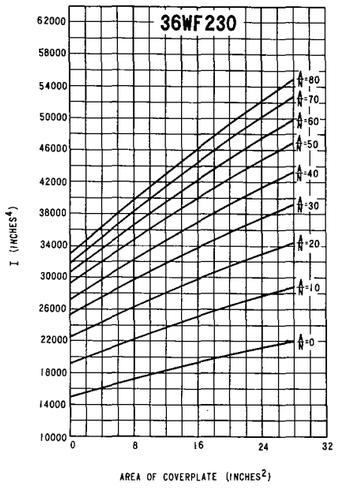

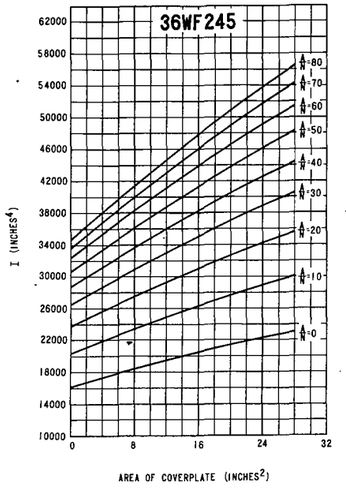

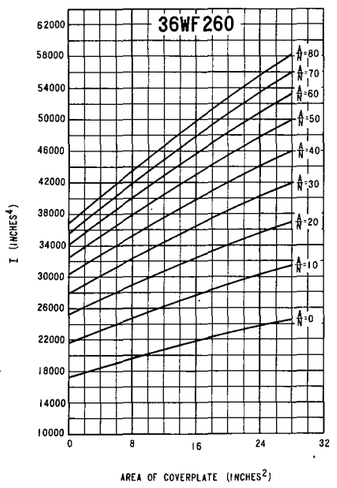

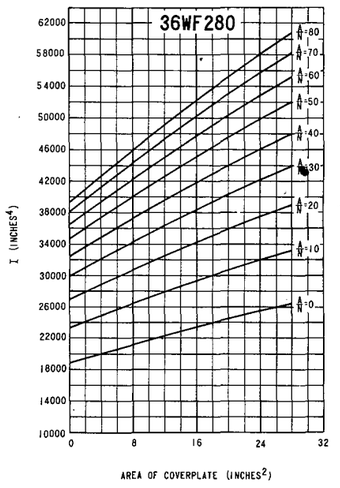

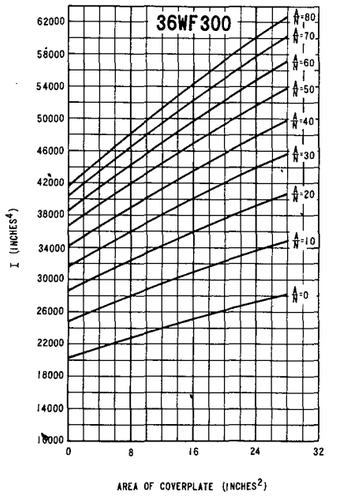

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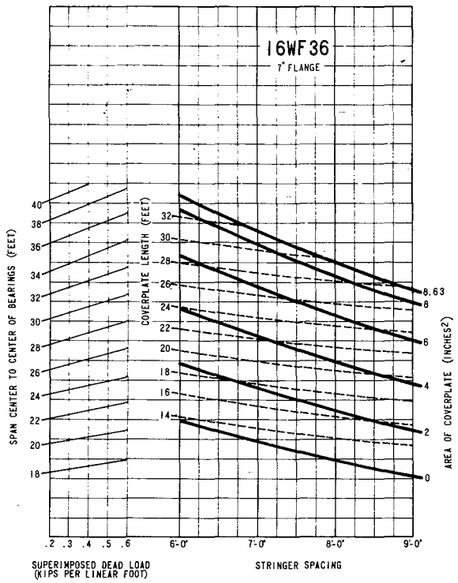

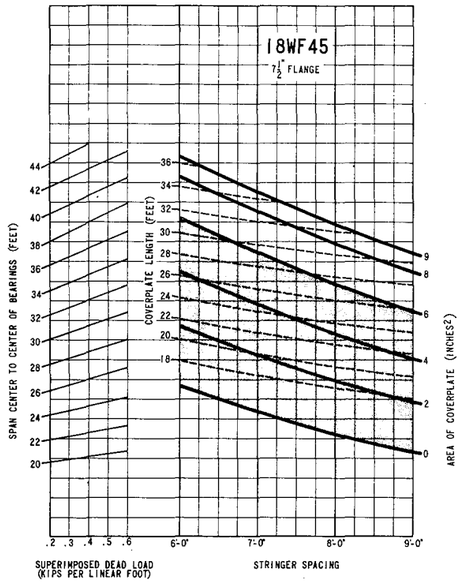

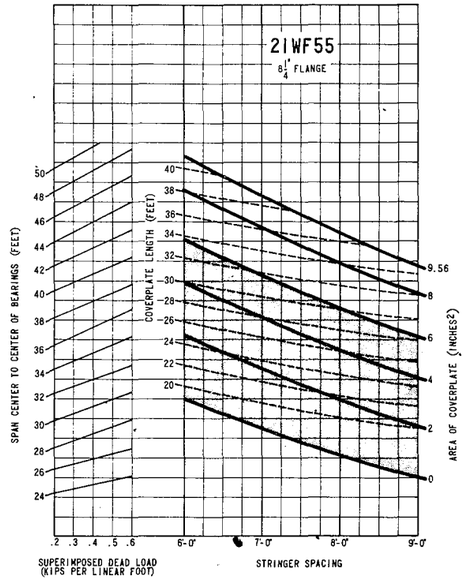

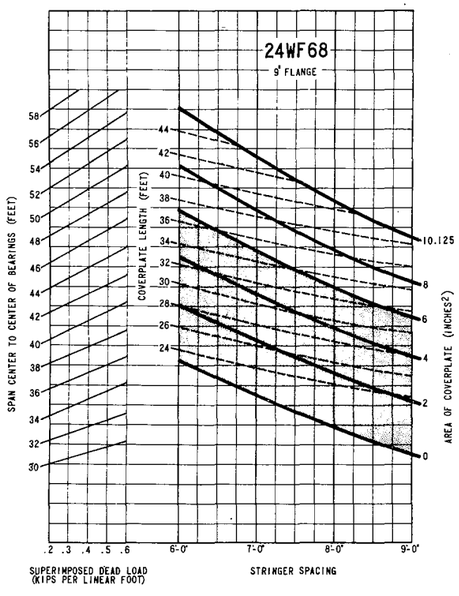

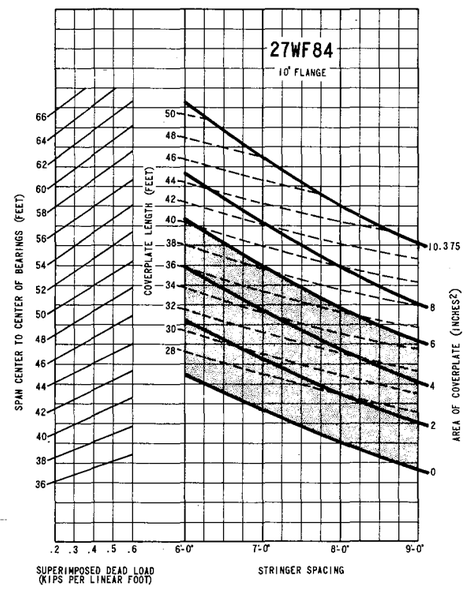

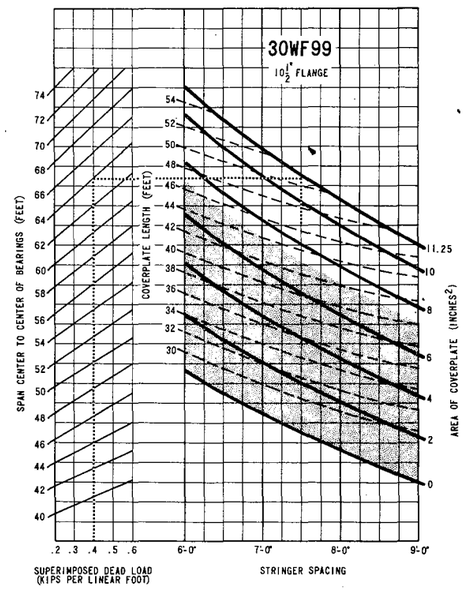

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NOTES

- FOR SPECIFICATIONS, NOTES, AND OTHER DETAILS, REFER TO STANDARD DRAWING ST-101.
- FOR SELECTION OF THE APPARENT MOST ECONOMICAL BEAM, REFER TO SHEET 4.
- SUPERIMPOSED DEAD LOAD INCLUDES:
  FUTURE WEARING SURFACE (NOT APPLICABLE IF DECK SLAB IS DESIGNED WITH BITUMINOUS WEARING SURFACE OR TO STRUCTURES UNDER FILL), WEIGHT OF RAILINGS, PARAPETS, CURBS OR SIDEWALKS AND ANY OTHER DEAD LOAD APPLIED AFTER DECK SLAB HAS BEEN CURED, DISTRIBUTED EQUALLY TO ALL STRINGERS IN KIPS PER LINEAL FOOT.
- THE MINIMUM THICKNESS OF COVERPLATE SHALL BE $\frac{3}{16}$". THE MAXIMUM THICKNESS SHALL BE ONE AND ONE-HALF TIMES THE THICKNESS OF THE FLANGE TO WHICH IT IS ATTACHED, EXCEPT AS LIMITED BY THE FOLLOWING STRESS RESTRICTIONS:
  16WF36 TO 33WF118 INCLUSIVE: DESIGN STRESS IS 27 KSI, AND THE COVERPLATE THICKNESS MAY NOT EXCEED $\frac{3}{4}$".
  36WF135 TO 36WF194 INCLUSIVE: DESIGN STRESS IS 27 KSI FOR COVERPLATE AREAS DENOTED BY SOLID LINES (——), AND THE COVERPLATE THICKNESS MAY NOT EXCEED $\frac{3}{4}$". DESIGN STRESS IN THE COVERPLATES WITH AREAS DENOTED BY DOT-DASH (—·—) LINES IS 25 KSI, AND THE COVERPLATE THICKNESS MAY NOT EXCEED 1 $\frac{1}{2}$".
  36WF230 TO 36WF300 INCLUSIVE: DESIGN STRESS IS 25 KSI, AND THE COVERPLATE THICKNESS MAY NOT EXCEED 1 $\frac{1}{2}$".
- THE WIDTHS OF COVERPLATE SHALL BE EITHER MINIMUM 2" NARROWER OR MINIMUM 2" WIDER THAN THE BEAM FLANGE, BUT IN NO CASE THE OVERHANG SHALL EXCEED 3 TIMES THE THICKNESS OF COVERPLATE AND NOT MORE THAN 3".
- DISTANCE BETWEEN THE LINES OF FILLET WELDS CONNECTING COVERPLATES TO STRINGER FLANGES, IN A DIRECTION TRANSVERSE TO THE LONGITUDINAL AXIS OF THE STRINGER, SHALL NOT EXCEED 24 TIMES THE THICKNESS OF COVERPLATE.

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CHIEF ENGINEER

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BRIDGE ENGINEER

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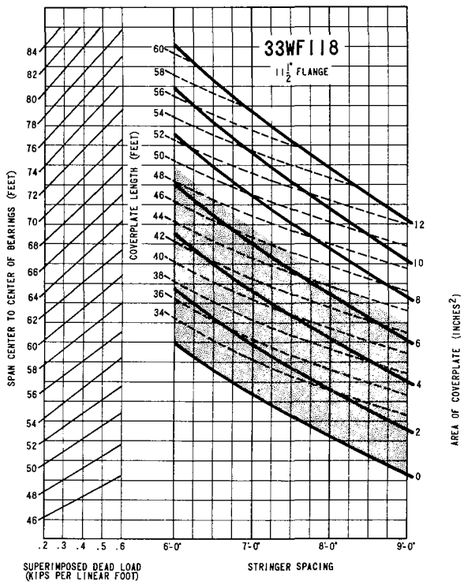
BRIDGE DIVISION

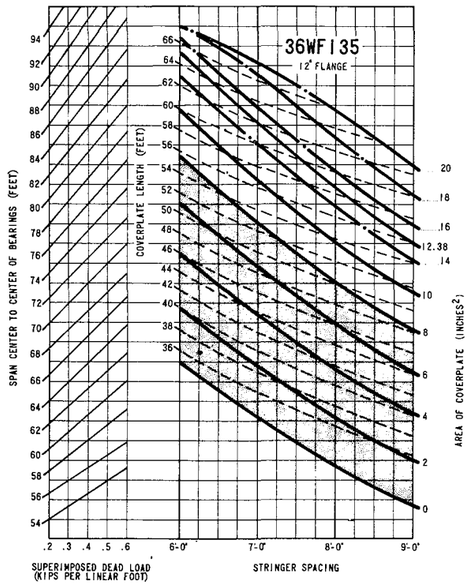
STANDARD
COMPOSITE A441 STEEL I-BEAM BRIDGES

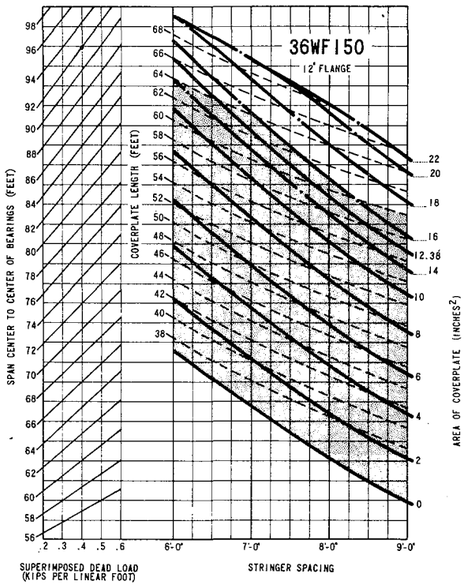
DESIGN GRAPHS

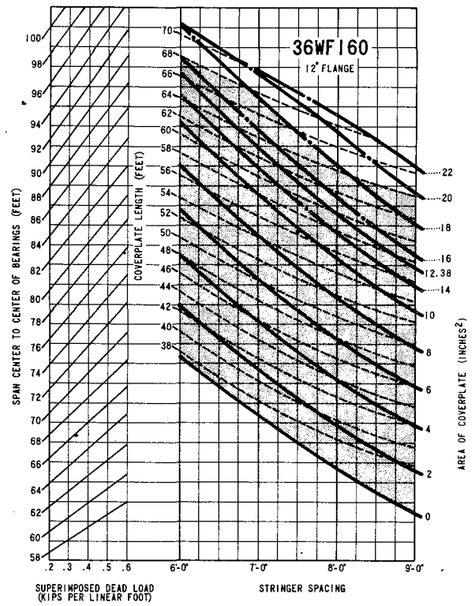
ST-103

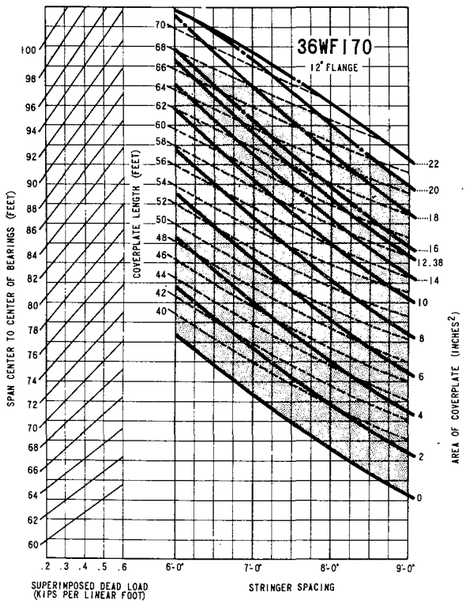
PREPARED BY BETHLEHEM STEEL CORPORATION IN COOPERATION WITH THE AMERICAN [illegible]

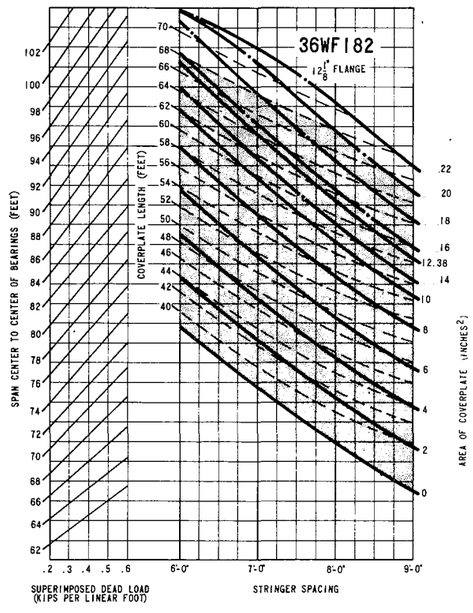


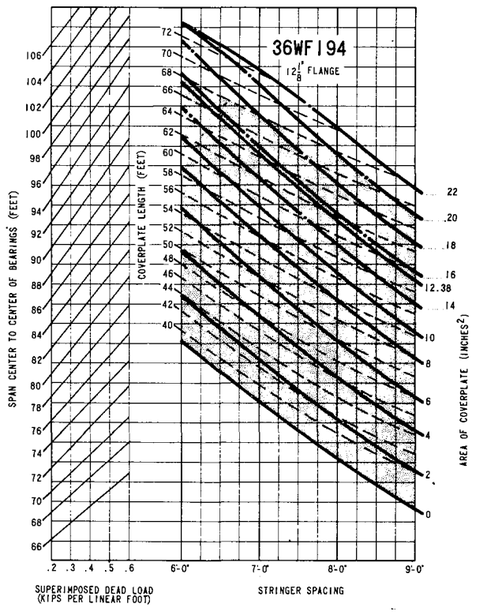












NOTE: SHADED AREAS INDICATE THAT LIGHTER BEAM AND COVERPLATE COMBINATIONS ARE AVAILABLE ELSEWHERE IN THE CHARTS.

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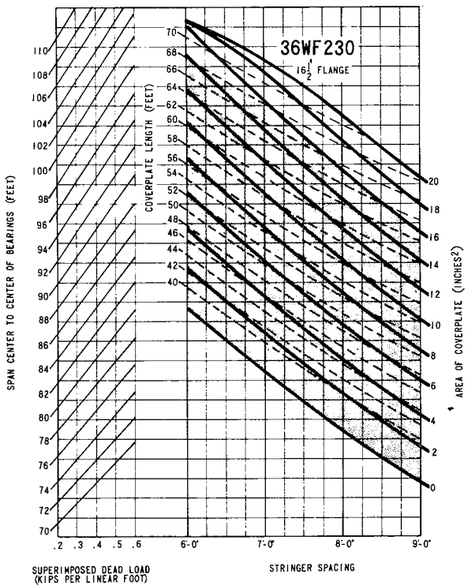
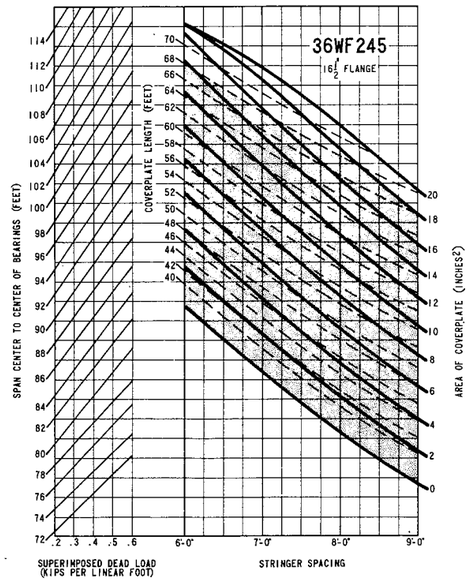
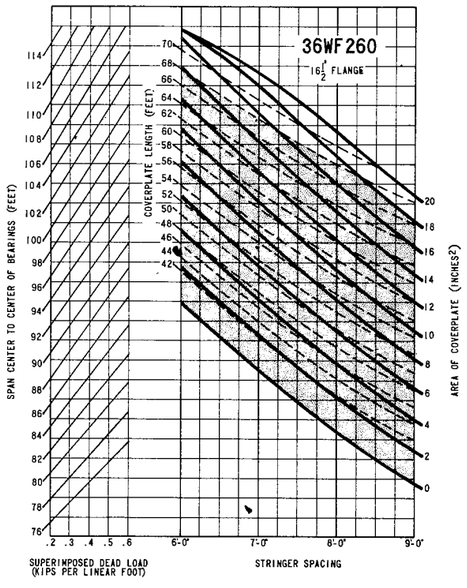
DESIGN GRAPHS

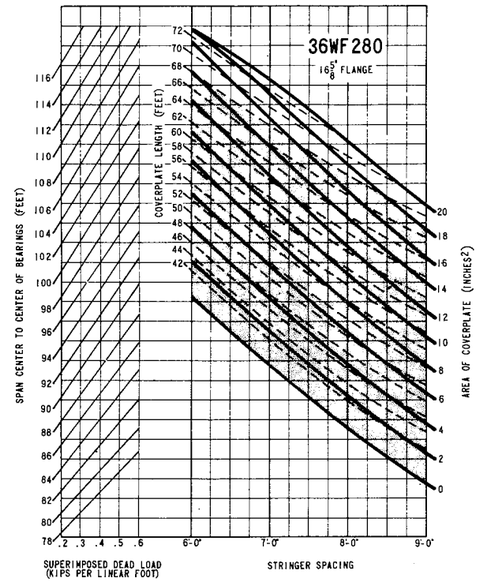
ST-103

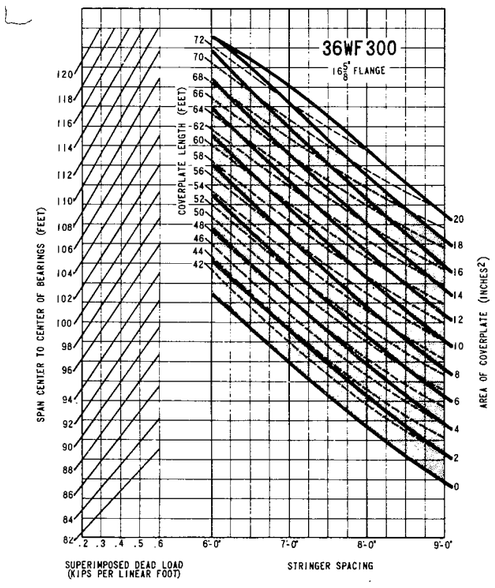
PREPARED BY BETHLEHEM STEEL CORPORATION IN COOPERATION WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION FOR THE PENNSYLVANIA DEPARTMENT OF HIGHWAYS.

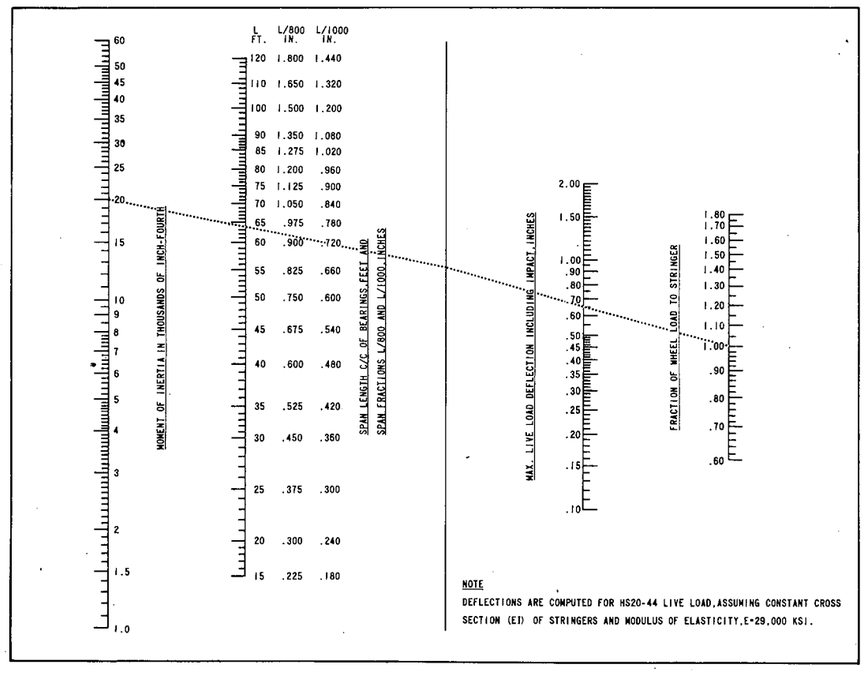












NOTE

DEFLECTIONS ARE COMPUTED FOR HS20-44 LIVE LOAD, ASSUMING CONSTANT CROSS SECTION (EI) OF STRINGERS AND MODULUS OF ELASTICITY, E=29,000 KSI.

NOTE: SHADED AREAS INDICATE THAT LIGHTER BEAM AND COVERPLATE COMBINATIONS ARE AVAILABLE ELSEWHERE IN THE CHARTS.

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CHIEF ENGINEER

APPROVED: OCT. 1, 1968

BRIDGE ENGINEER

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BRIDGE DIVISION

STANDARD

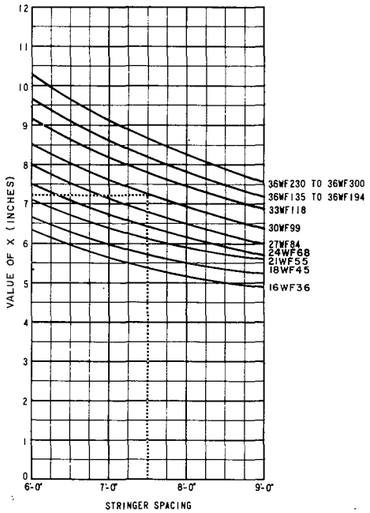
COMPOSITE A441 STEEL I-BEAM BRIDGES

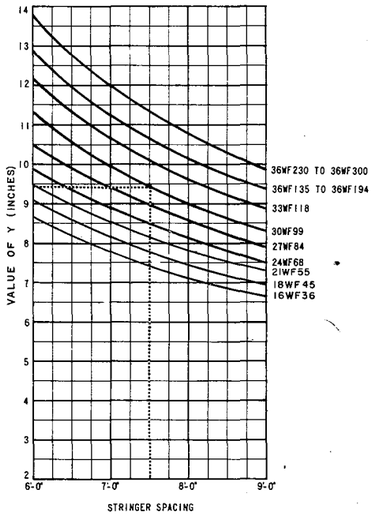
DESIGN GRAPHS AND LIVE LOAD DEFLECTION GRAPH

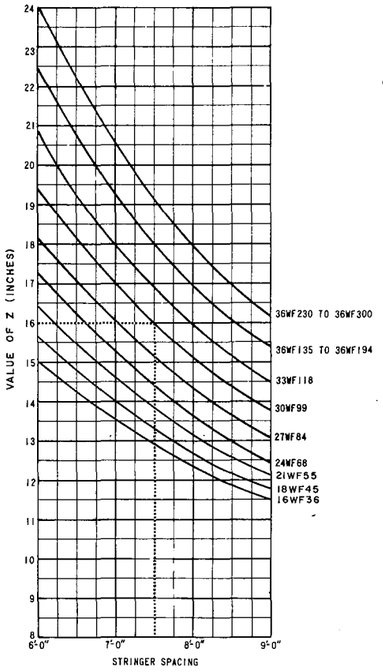
SHEET 3 OF 4

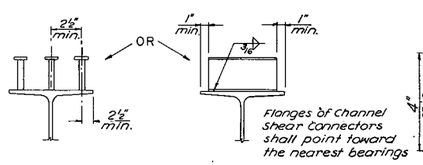
ST-103

PREPARED BY BETHLEHEM STEEL CORPORATION IN COOPERATION WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION FOR THE PENNSYLVANIA DEPARTMENT OF HIGHWAYS.

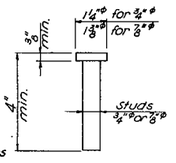








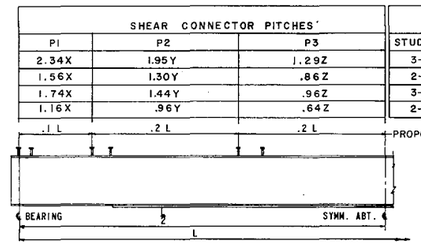
SHEAR CONNECTORS DETAILS



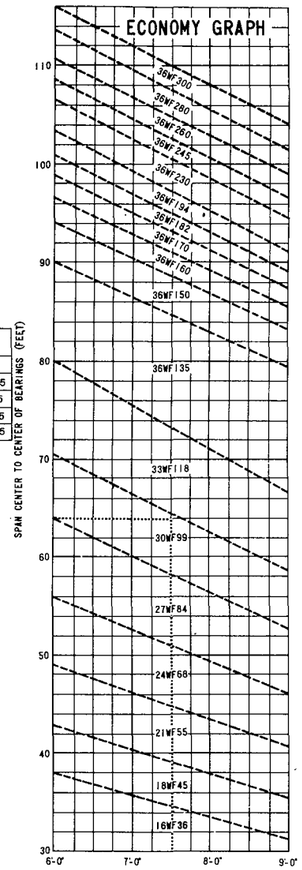
STUD DETAIL

SHEAR CONNECTOR PITCHES		
P1	P2	P3
2.34X	1.95Y	1.29Z
1.56X	1.30Y	.86Z
1.74X	1.44Y	.96Z
1.16X	.96Y	.64Z
.1 L	.2 L	.2 L

TYPE OF SHEAR CONNECTORS	
STUDS/ROW	CHANNEL
3-7/8" ϕ	8¼"-4C7.25
2-7/8" ϕ	5½"-4C7.25
3-¾" ϕ	6"-4C7.25
2-¾" ϕ	4"-4C7.25



NOTE: THE NUMBER OF SHEAR CONNECTORS BETWEEN POINT OF MAXIMUM POSITIVE MOMENT AND ADJACENT SUPPORTS SHALL NOT BE LESS THAN THAT REQUIRED BY THE FORMULA $N = Hi/\phi Qu$. (SEE 1966-67 INTERIM SPECIFICATIONS)



SAMPLE DESIGN PROBLEM

1. THE FOLLOWING INFORMATION IS KNOWN:
   - A. SPAN CENTER TO CENTER OF BEARINGS = 64 FEET.
   - B. STRINGER SPACING = 7'-6".
   - C. SUPERIMPOSED DEAD LOAD = 0.40 KIPS PER LINEAR FOOT OF BEAM.
   - D. TWO (2) TRAFFIC LANES SUPPORTED BY FOUR (4) STRINGERS.
2. REFERRING TO THE ECONOMY GRAPH, IT IS FOUND THAT THE 30WF99 GRAPH WILL PROBABLY YIELD THE MOST ECONOMICAL DESIGN.
3. ENTER THE 30WF99 GRAPH AT 0.40 KIPS PER LINEAR FOOT OF BEAM AND MOVE VERTICALLY TO THE 64-FOOT SPAN. MOVING FROM THIS POINT HORIZONTALLY TO THE 7'-6" STRINGER SPACING, IT IS SEEN THAT THE AREA OF COVERPLATE IS 11 SQUARE INCHES X 50'-6". USE PLATE 15" X 3/4" X 50'-6":
   AREA = 11.25 SQUARE INCHES
   MAXIMUM ALLOWABLE OVERHANG = 3 (PLATE THICKNESS) = $3(\frac{3}{4}") = 2\frac{1}{4}"$
   FLANGE WIDTH = $10\frac{1}{2}"$
   ALLOWABLE COVERPLATE WIDTH = $10\frac{1}{2}" + 2(2\frac{1}{4}") = 15"$ OK.
   NOTE THAT IF THE SPAN HAD BEEN 52 FEET THE DESIGN WOULD HAVE BEEN IN THE SHADED PORTION OF THE GRAPH, INDICATING THAT A LIGHTER BEAM AND COVERPLATE COULD HAVE BEEN USED.
4. FROM GRAPHS, X = 7.2, Y = 9.4 AND Z = 16.0 ARE FOUND FOR A 30WF99 AT A 7'-6 STRINGER SPACING. USING 2-¾" ϕ STUDS PER OR 4"-4C7.25

   P1 = 1.16X = 8.4, USE $8\frac{1}{2}"$, $\frac{.1 \times 64 \times 12}{8\frac{1}{2}} = 9$ SPACES @ $8\frac{1}{2}" = 76.5$

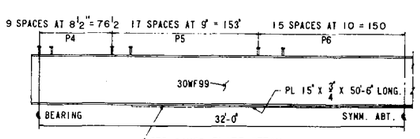
   P2 = .96Y = 9.0, USE 9", $\frac{.2 \times 64 \times 12}{9} = 17$ SPACES @ 9 = 153

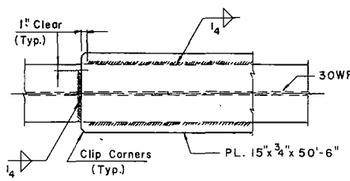
   P3 = .64Z = 10.2, USE 10", $\frac{.2 \times 64 \times 12}{10} = 15$ SPACES @ 10 = 150
   TOTAL 379.5"

   $\frac{64 \times 12}{2} = 384"$ SAY O.K.

   $N = \frac{Hi}{\phi Qu} = 75$ STUDS, 40 CHANNELS

5. FOR MOMENTS OF INERTIA, REFER TO STANDARD DRAWING ST-102 SHEET NO. 5.
   MOMENT OF INERTIA OF THE BEAM AND COVERPLATE SECTION (I_1), IS FOUND BY ENTERING THE 30WF99 MOMENT OF INERTIA GRAPH WITH A COVERPLATE AREA OF 11.25 SQUARE INCHES. MOVE UP TO $\frac{A}{N} = 0$ LINE (ZERO SLAB AREA). $I_1 = 5900$ IN.^{4}
6. MOMENT OF INERTIA OF THE COMPOSITE SECTION (I_2) IS FOUND BY MOVING UP TO $\frac{A}{N} = 24$ WHERE:
   A = AREA OF STRUCTURAL PORTION OF SLAB
   $= 8" \times 7.5' \times 12" = 720$ IN.^{2}
   N = 30 FOR SUPERIMPOSED DEAD LOADS
   $\frac{A}{N} = \frac{720}{30} = 24$
   $I_2 = 13,800$ IN.^{4}
7. DEAD LOAD DEFLECTIONS ARE CALCULATED USING THESE MOMENTS OF INERTIA AND COMPUTED DEAD LOADS PER FOOT OF BEAM IN THE EQUATION.
   $\Delta = .000775 L^4 \left(\frac{W_1}{I_1} + \frac{W_2}{I_2}\right)$
   WHERE:
   Δ = TOTAL DEAD LOAD DEFLECTION AT ℄ OF BEAM (INCHES)
   L = SPAN CENTER TO CENTER OF BEARINGS (FEET)
   W_1 = COMPUTED WEIGHT OF SLAB AND STEEL (KIPS PER LINEAR FOOT OF BEAM)
   $= \frac{8.5" \times 7.5'}{12} \times .150$ KIPS/FT^3 (SLAB)
   + .025 KIPS/FT. (HAUNCH) + .099 KIPS/FT. (BEAM)
   + .038 KIPS/FT. (COVERPLATE) = .957 KIPS/FT.
   W_2 = SUPERIMPOSED DEAD LOAD (KIPS PER LINEAR FOOT OF BEAM) = .40 KIPS/FT.
   I_1 AND I_2 MOMENTS OF INERTIA AS FOUND IN STEPS 5 AND 6.
   $\Delta = .000775 (64^4)\left(\frac{.957}{5900} + \frac{.400}{13,800}\right) = 2.48"$
   SAY: $2\frac{1}{2}"$
8. CHECK LIVE LOAD DEFLECTION.
   - A. MAXIMUM ALLOWABLE DEFLECTION = $\frac{SPAN}{1000}$
   - B. WHEEL LOAD DISTRIBUTION FACTOR FOR LIVE LOAD DEFLECTION ASSUMING UNIFORM PARTICIPATION OF ALL STRINGERS
     $= \frac{4 \text{ WHEELS}}{4 \text{ BEAMS}} = 1.0$
   - C. FIND MOMENT OF INERTIA FOR LIVE LOAD BY ENTERING THE 30WF99 MOMENT OF INERTIA GRAPH WITH A COVERPLATE AREA OF 11.25 SQUARE INCHES AND MOVING VERTICALLY TO $\frac{A}{N} = 72$
     WHERE:
     A = 8" X 7.5' X 12" = 720 IN.^{2}
     N = 10 FOR LIVE LOADS
     I = 20,000 IN.^{4}
   - D. USING THE LIVE LOAD DEFLECTION NOMOGRAPH, IT IS FOUND THAT THE LIVE LOAD DEFLECTION IS .65 INCHES.
   - E. ENTERING THE NOMOGRAPH AT 64 FOOT SPAN, IT IS FOUND THAT THE ALLOWABLE DEFLECTION OF $\frac{SPAN}{1000}$ IS GREATER THAN .65 INCHES. THEREFORE THE DESIGN IS ACCEPTABLE.
9. FINAL DESIGN:





COVER PLATE DETAIL

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CHIEF ENGINEER

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BRIDGE DIVISION

STANDARD

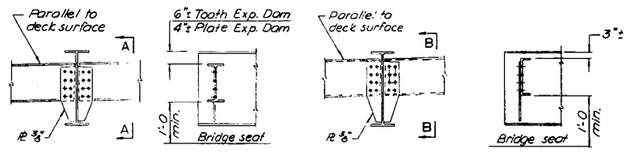
COMPOSITE A441 STEEL I-BEAM BRIDGES

SHEAR CONNECTORS AND SAMPLE DESIGN PROBLEM

SHEET 4 OF 4

ST-103

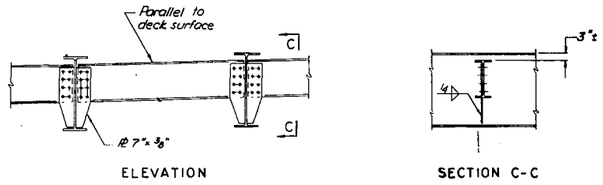
PREPARED BY BETHLEHEM STEEL CORPORATION IN COOPERATION WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION FOR THE PENNSYLVANIA DEPARTMENT OF HIGHWAYS



ELEVATION — SECTION A-A — ELEVATION — SECTION B-B

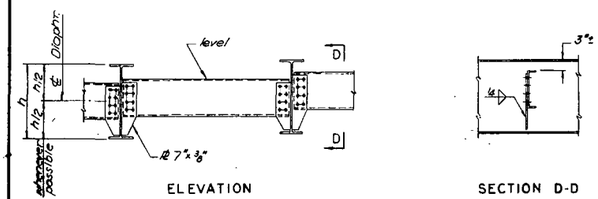
DETAILS AT ℄/T EXP. DAM — DETAILS AT CLOSED DECK JOINT

END DIAPHRAGMS



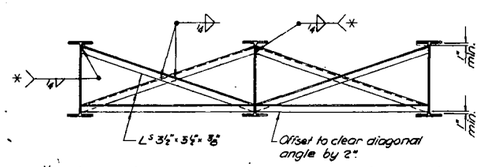
ELEVATION — SECTION C-C

DIAPHRAGMS AT DECK CONSTRUCTION JOINT



ELEVATION — SECTION D-D

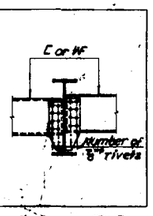
INTERMEDIATE DIAPHRAGMS



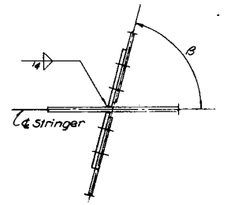
* Weld both sides of vertical leg and one side of horizontal leg to stringer web.

ALTERNATE INTERMEDIATE DIAPHRAGMS

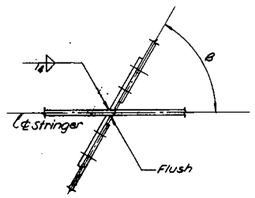
SIZE OF STRINGERS	END DIAPHRAGMS AT PLATE EXPANSION DAM SIZE	NO OF RIVETS	END DIAPHRAGMS AT CLOSED DECK JOINT SIZE	NO OF RIVETS	DIAPHRAGMS AT DECK CONSTR. JOINT SIZE	NO OF RIVETS	INTERMEDIATE DIAPHRAGMS SIZE	NO OF RIVETS
24 WF	12 WF 40	6	15 C 40	6	12 WF 40	6	12 C 25	6
27 WF	14 WF 43	6	15 C 40	6	14 WF 43	6	15 C 33.9	6
30 WF	14 WF 43	6	18 C 42.7	8	14 WF 43	6	15 C 33.9	6
33 WF	18 WF 45	8	18 C 42.7	8	18 WF 45	8	18 C 42.7	8
36 WF	18 WF 45	8	18 C 42.7	8	18 WF 45	8	18 C 42.7	8



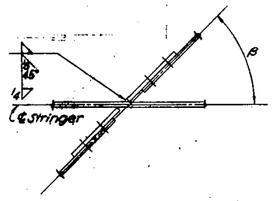
DIAPHRAGM DETAILS FOR WF STRINGERS



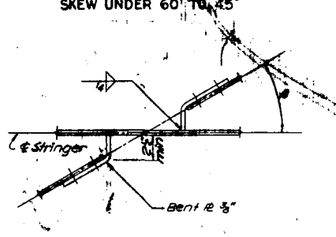
SKEW 90° TO 75°



SKEW UNDER 75° TO 60°



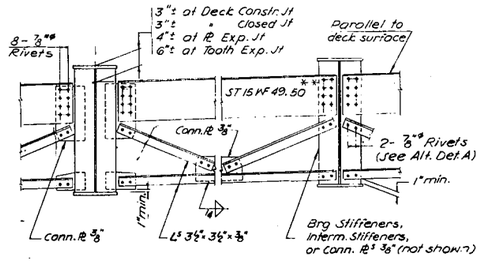
SKEW UNDER 60° TO 45°



SKEW UNDER 45°

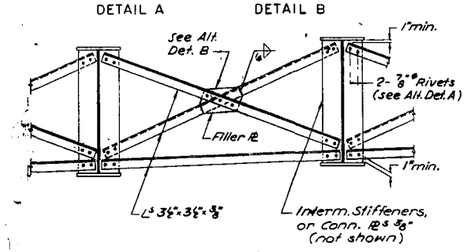
DIAPHRAGM TO WF STRINGER CONNECTION DETAILS

- See "Diaphragm to ℄ Girder Stringer Connection Details" when Stiffeners are used.
- Use pedestals to provide a minimum 1'-0 clearance between bottom flange of end diaphragms and bridge seat.

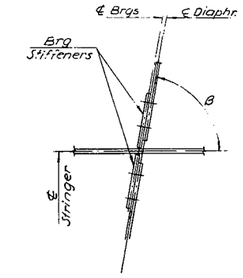


** Use 15 C 40 at deck closed Jt

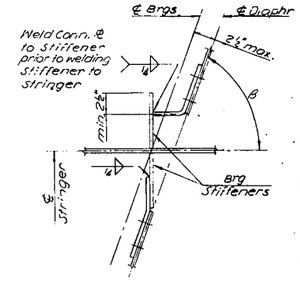
END DIAPHRAGMS & DIAPHRAGMS AT DECK CONSTR. JOINT



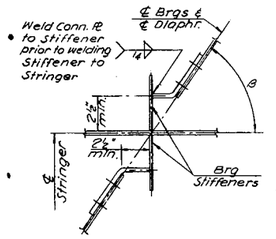
INTERMEDIATE DIAPHRAGMS



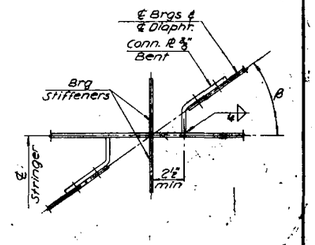
SKEW 90° TO 75°



SKEW UNDER 75° TO 60°



SKEW UNDER 60° TO 45°



SKEW UNDER 45°

DIAPHRAGM TO ℄ GIRDER STRINGER CONNECTION DETAILS

DIAPHRAGM DETAILS FOR ℄ GIRDER STRINGERS

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INSTRUCTIONS

- Diaphragm spacing shall not exceed 25 ft.
- For skew angles 75° and more, intermediate diaphragms may be placed parallel to ℄ Brgs. For skew angles under 75°, intermediate diaphragms shall be placed normal to stringers and staggered where practical.

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BRIDGE DIVISION

STANDARD
STEEL I-BEAM BRIDGES
STEEL DIAPHRAGMS

SHEET 1 OF 2

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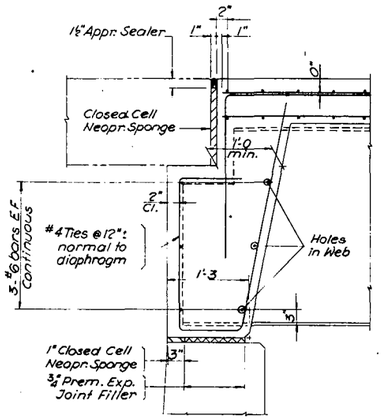
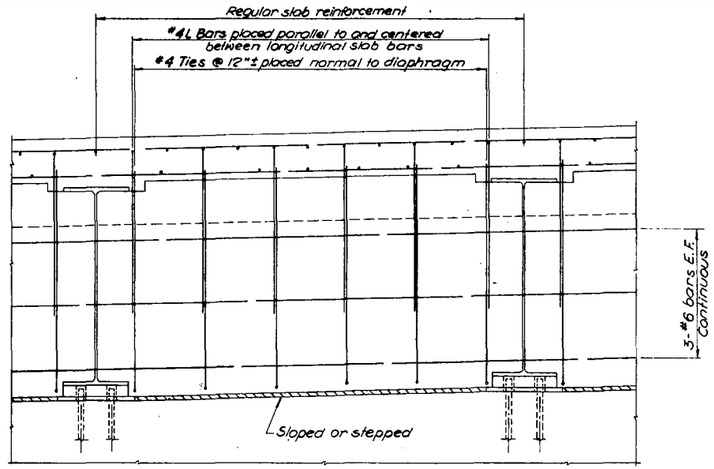


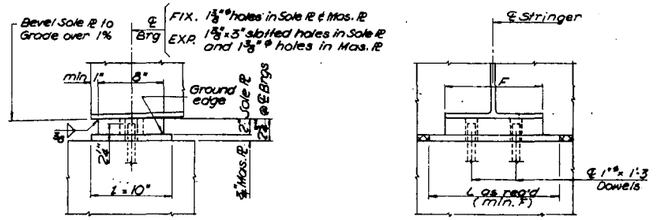
TYP. SECTION



TYP. ELEVATION

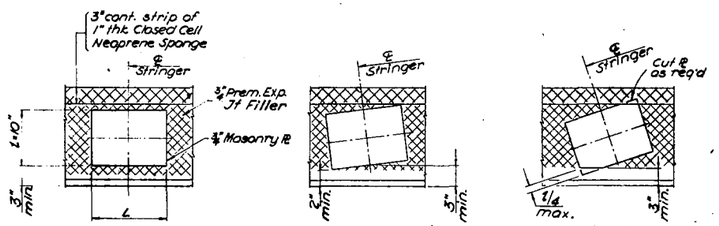
TYPE A DIAPHRAGM

FOR SPANS OR EXPANSION LENGTH UP TO 50 FT



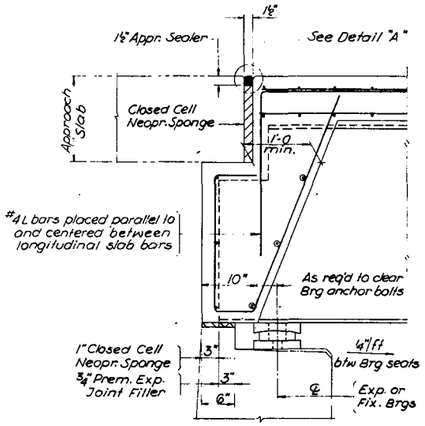
BEARING DETAILS

TYPE A DIAPHRAGMS

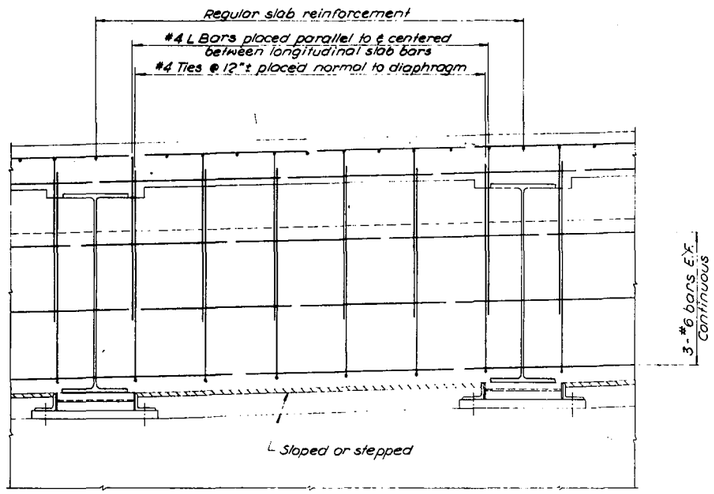


MASONRY Pl DETAILS

TYPE A DIAPHRAGMS



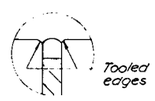
TYP. SECTION



TYP. ELEVATION

TYPE B DIAPHRAGM

FOR SPANS OR EXPANSION LENGTH UP TO 70 FT



DETAIL "A"

NOTES

- Details shown on either section are typical for both Diaphragms except where noted otherwise.

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DEPARTMENT OF HIGHWAYS
DIVISION OF BRIDGE ENGINEERING

STANDARD
STEEL I-BEAM BRIDGES
CONCRETE DIAPHRAGMS

SHEET 2 OF 2

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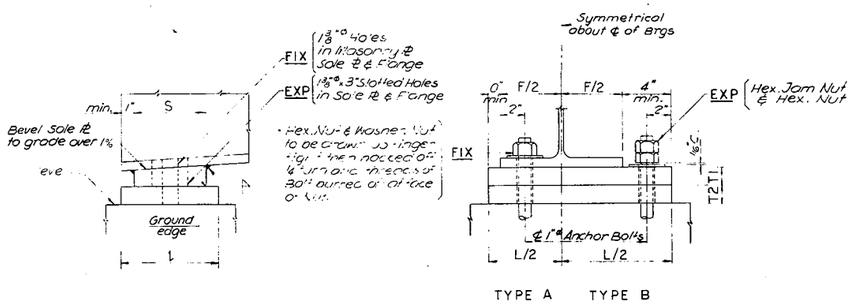
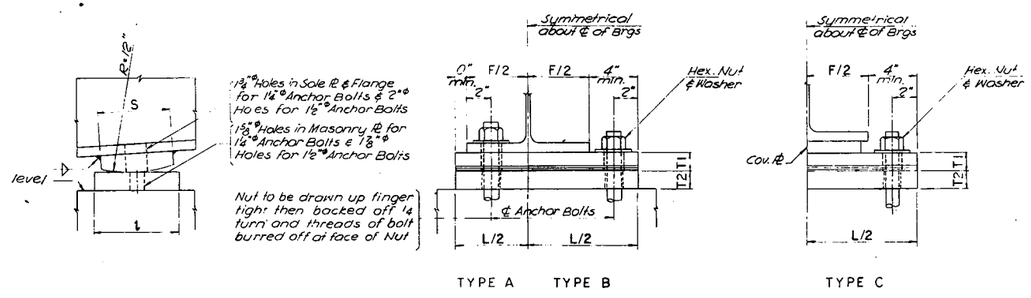
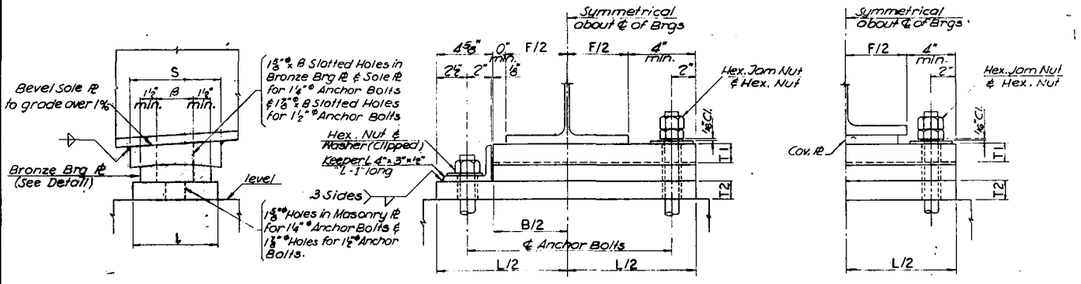


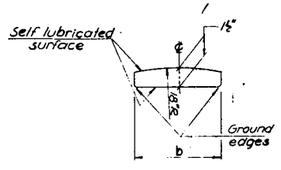
FIXED BEARINGS I F & EXPANSION BEARINGS I E

For simple spans up to 50 Ft.



FIXED BEARINGS II F





BRONZE BRG PL DETAIL

- *The dimension B shall be computed using the equation: B = (Bolt Dia + ⅝" + ⅛" per 10 ft of expanded length) but not less than 3" and shall be specified on the design drawings.*
- *Minimum value of ℄ shall be (b + 2) or (b + ⅛" per 10 ft of expanded length) whichever is greater.*
- *Minimum value of b shall be (B + 3")*
- *Minimum value of S shall be (b + 1¼")*

EXPANSION BEARINGS III E

FIXED BEARINGS I F & EXPANSION BEARINGS I E

React. Kips	Mark	TYPE A & B S	t	L	T1	T2	wt. lbs
50	R 50	6	8	11	1½	1½	75
60	R 60	6	8	12	1½	1½	80
70	R 70	6	8	13	1½	1½	85
80	R 80	6	8	15	1½	1½	98
90	R 90	6	8	16	1½	1½	105
100	R100	6	8	18	1½	1½	115

FIXED BEARINGS II F

React. Kips	Mark	Dimensions S	t	L	T1	T2	wt.lbs	React. Kips	Mark	Dimensions S	t	L	T1	T2	wt.lbs
TYPE A															
60	R 60	5	6	12	1½	1½	66	90	R 90	6	8	14	1½	1½	92
70	R 70	6	7	12	1½	1½	75	100	R 100	6	8	14	1½	1½	92
80	R 80	6	7	14	1½	1½	89	120	R 120	6	8	16	1½	1½	108
TYPE B															
60	R 60	5	6	18	1½	1½	94	220	R 220	10	11	20	2¼	2¼	260
70	R 70	6	7	18	1½	1½	108	240	R 240	10	12	20	2¼	2¼	272
80	R 80	6	7	20	1½	1½	125	260	R 260	10	12	22	2¼	2¼	340
90	R 80	6	7	20	1½	1½	125	280	R 280	10	12	24	2¼	2¼	370
100	R 100	6	7	20	1½	1½	125	300	R 300	10	12	26	2¾	2¾	440
120	R 120	6	7	20	1½	1½	125	320	R 320	11	13	26	2¾	2¾	475
140	R 140	8	9	20	1½	1½	147	340	R 340	11	13	27	2¾	2¾	495
160	R 160	8	9	20	1½	1½	147	360	R 360	11	13	28	2¾	2¾	505
180	R 180	8	9	20	1¾	1¾	162	380	R 380	11	13	30	3	3	600
200	R 200	8	10	20	2	2	190	400	R 400	14	14	30	3	3	680

EXPANSION BEARINGS III E *

React Kips	Mark	TYPE A b	B	t	L	S	T1	T2	wt.lbs	TYPE B & C b	t	L	S	T1	T2	wt.lbs
50	R 50	6	12	8	21¼	7½	1½	1½	155	6	8	18	7½	1½	1½	174
60	R 60	6	12	8	21¼	7½	1½	1½	155	6	8	18	7½	1½	1½	174
70	R 70	6	12	8	21¼	7½	1½	1½	155	6	8	18	7½	1½	1½	174
80	R 80	6	14	8	23¼	7½	1½	1½	174	6	8	20	7½	1½	1½	197
90	R 90	6½	14	8½	23¼	8½	1½	1½	197	6½	8½	20	8½	1½	1½	209
100	R 100	7½	14	9½	23¼	9½	1½	1½	207	7½	9½	20	9½	1½	1½	234
120	R 120	7½	16	9½	25¼	9½	1½	1½	230	7½	10	21	9½	1½	1½	250
140	R 140	8	18	10	27¼	10	1½	1½	267	8	10½	22	10	1½	1½	276
160	R 160	8	20	10	29¼	10	1½	1½	292	8	11	23	10	1¾	1¾	328
180	R 180	8½	21	10½	30¼	10½	1¾	1¾	357	8½	11½	24	10½	2	2	396
200	R 200	9	22	11	31¼	11	2	2	430	9	12	25	11	2	2	428
220	R 220	9½	23	11½	32¼	11½	2¼	2¼	512	9½	12½	26	11½	2¼	2¼	510
240	R 240	10	24	12	33¼	12	2¼	2¼	553	10	13	27	12	2¼	2¼	555

* *Bearings are designed for a maximum eccentricity of 1½ inches. For larger eccentricity special design is required.*

NOTES

- *Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.*
- *Design Specifications: Design Division of 1965 AASHO "Standard Specifications for Highway Bridges."*
- *All steel shall conform to ASTM A36 Designation.*
- *Bronze bearing plate shall conform to Section 1052.09, Form 408.*
- *Rockers shall be shop assembled and match marked to insure free movement of rockers with pintles in place.*
- *Facing of bearing surfaces shall conform to Section 1053.24, Form 409.*
- *Setting of bearings shall conform to Section 1054.04(d), Form 408.*
- *Setting of anchor bolts shall conform to Section 1054.04(b), Form 408.*
- *Holes in masonry plates shall be filled with bituminous sealing material Class BF-1, except as noted on the drawings.*
- *Bearing areas shall be prepared as specified in section 1054.04, Form 209.*
- *Anchor bolts shall be sweage or approved type and shall be set in the masonry as specified on the drawings.*

DESIGN INFORMATION

Allowable Design Stresses

Tension and compression due to bending	*20,000 psi*
Bearing on flat parts in contact	*29,000 psi*
Bearing on rocker plate (Lbs per linear inch)	*1,380 R (for R ≥ 12")*
Bearing on rocker plate (Lbs per linear inch)	*4,880√R (for R > 12")*
Bearing on Bronze Bearing plate	*1,000 psi*
Bearing on Concrete Masonry	
Bearing I	*700 psi (Average)*
Bearings II, III & IV	*1,000 psi*

SIZE OF FILLET WELD

Thickness of thicker part joined	Min. size of fillet weld
To ½" inclusive	3/16"
Over ½" to ¾"	¼"
Over ¾" to 1½"	5/16"
Over 1½" to 2¼"	3/8"
Over 2¼" to 6"	½"

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Chief Engineer

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Bridge Engineer

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD STEEL I-BEAM BRIDGES BEARINGS

SHEET 1 OF 2

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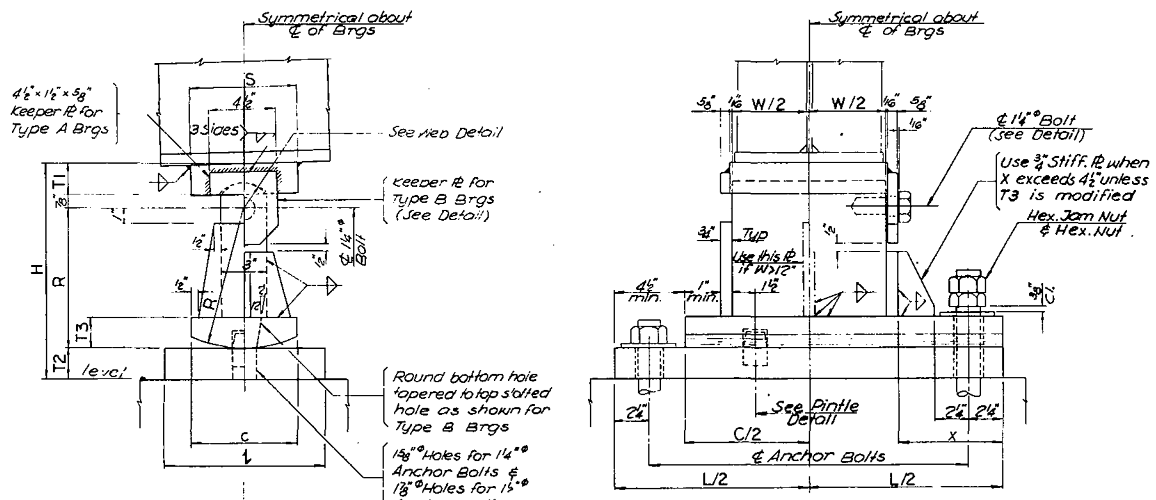


TYPE A | TYPE B   TYPE A   TYPE B

EXPANSION BEARINGS IV E

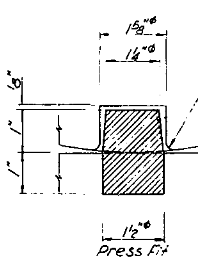
React. Kips	Mark	S	W	c	C	L	ℓ	R	T1	T2	T3	H	Wt. Lbs
TYPE A													
75	R 75	6	10	6	13½	22½	8	8	2	2	2	12⅞	265
100	R100	6	10	6	13½	22½	9	8	2	2	2	12⅞	285
150	R150	7	10	7	16	25	10½	9	2	2	2	13⅞	335
200	R200	7	11	7	18	27	12	10	2¼	2¼	2	15⅜	430
250	R250	8	12	8	20	29	13½	11	2¼	2½	2¼	16⅝	535
300	R300	8	13	8	22	31	14	12	2¼	2¾	2½	17⅞	660
350	R350	9	14	9	24	33	15	13	2½	3	2¾	19⅜	830
400	R400	9	16	9	26	35	16	14	2½	3¼	2¾	20⅝	990
TYPE B													
75	R 75	6	10	6	—	20½	8	8	2	2	2	12⅞	275
100	R100	6	11½	6	—	22	9	8	2	2	2	12⅞	295
150	R150	7	10	7	—	25	10½	9	2	2	2	13⅞	380
200	R200	7	11	7	—	27	12	10	2¼	2¼	2	15⅜	470
250	R250	8	12	8	—	29	13½	11	2¼	2½	2¼	16⅝	570
300	R300	8	13	8	—	31	14	12	2¼	2¾	2¼	17⅞	700
350	R350	9	14	9	—	33	15	13	2½	3	2¼	19⅜	900
400	R400	9	16	9	—	35	16	14	2½	3¼	2¼	20⅝	1030

*Bearings are designed for a maximum Eccentricity E = 2". For larger Eccentricities, special design is required.

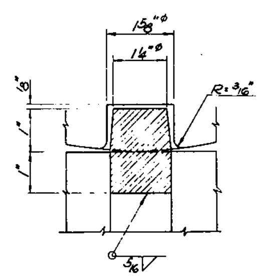
INSTRUCTIONS

- Weights shown in tables are approximate and include all materials such as anchor bolts, nuts, washers or bronze brg plate.
- Where uplift exists, Type B or C (Brgs III E) and Type B (Brgs IV) shall be used only for outside stringers
- Fixed bearings shall be placed at low end of span whenever it is possible.
- Thicknesses shown are at ℄ bearings.
- Dimensions shown in tables are in inches except as noted.
- Dimensions shown in tables are the minimum required. They shall be redesigned to suit the beam flange and must be shown on the design drawings.
- To determine longitudinal force due to friction, the following coefficient of friction may be assumed:

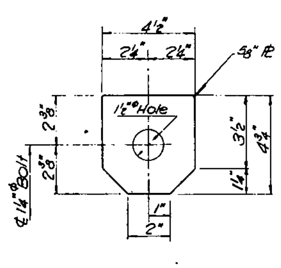
Type of brgs.	Coefficien of friction
I E	0.30
III E	0.10
IV E	0.30 r/R



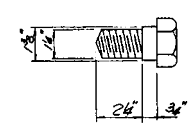
PINTLE DETAIL



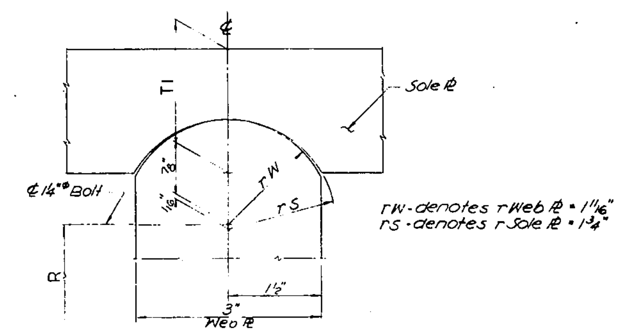
ALTERNATE PINTLE DETAIL



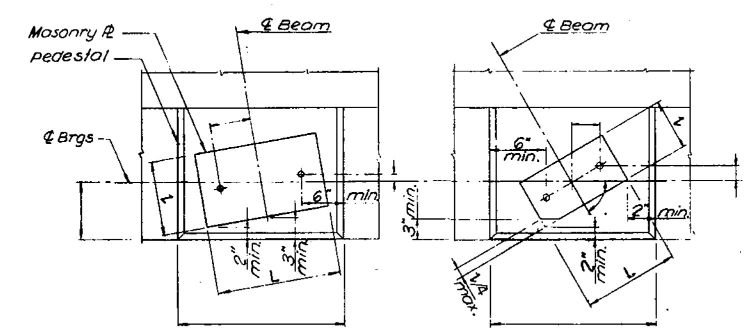
KEEPER ℘ DETAIL FOR TYPE B BEARINGS



BOLT DETAIL

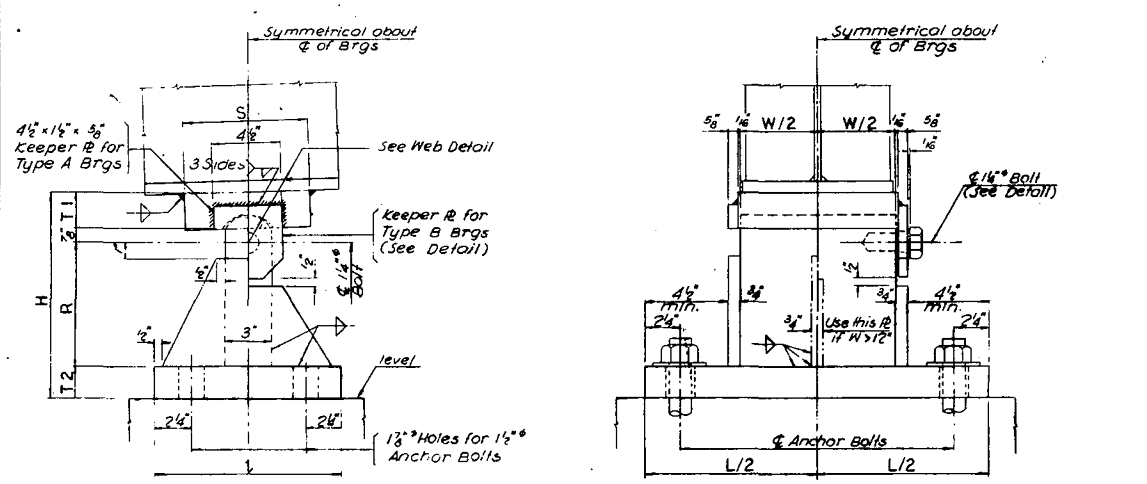


WEB DETAIL



BRIDGE SEAT PLAN

NOMINAL WASHER DIMENSIONS			
SIZE OF BOLT	OUTSIDE DIA	SIZE OF HOLE	APPROX THICKNESS
1"	2½"	1 1/16"	11/64"
1¼"	3"	1⅜"	11/64"
1½"	3½"	1⅝"	3/16"



TYPE A | TYPE B   TYPE A   TYPE B

FIXED BEARINGS IV F

For spans greater than 150 feet

FIXED BEARINGS IV F TYPE A & B										
React. Keeps	Mark	S	W	L	ℓ	T1	T2	R	H	Wt. Lbs TYPE A	Wt. Lbs TYPE B
75	R 75	6	8	18	8	2	2	6	10⅞	190	193
100	R100	6	8	18	9	2	2	6	10⅞	200	203
150	R150	7	9	19	10	2	2	7	11⅞	240	243
200	R200	7	9	20	11	2¼	2	7	12⅛	260	263
250	R250	8	10	22	12	2¼	2	8	13⅛	320	323
300	R300	8	11	24	13	2¼	2¼	8	13⅜	390	393
350	R350	9	12	26	14	2½	2½	9	14⅞	490	493
400	R400	9	13	28	15	2½	2¾	9	15⅛	570	573

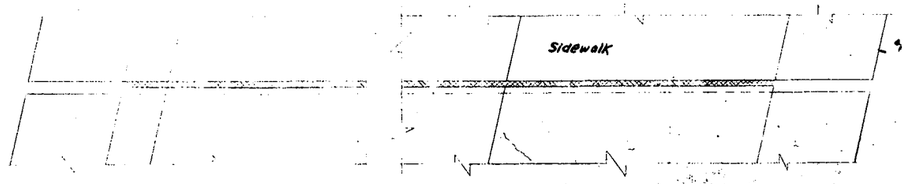
APPROVED: DEC 17, 1969
[signature]
Chief Engineer

APPROVED: DEC 17, 1969
B. F. Kotalik
Bridge Engineer

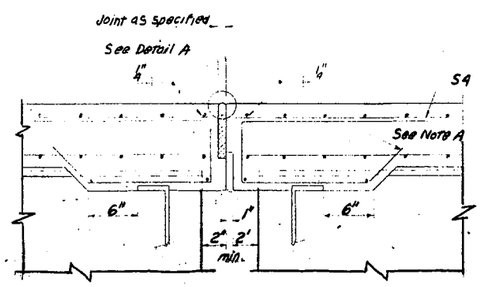
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
STEEL I-BEAM BRIDGES
BEARINGS

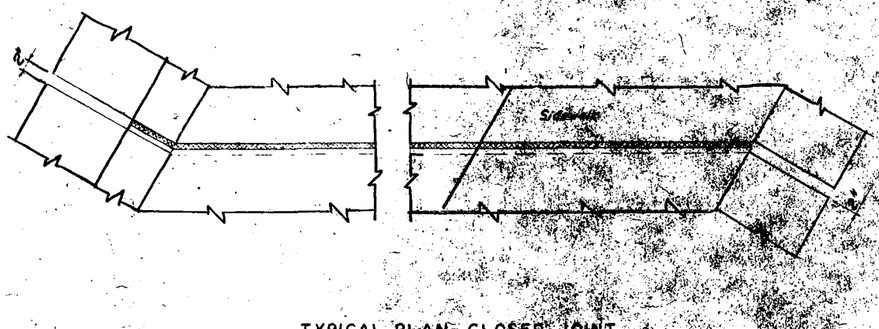
SHEET 2 OF 2   ST-112



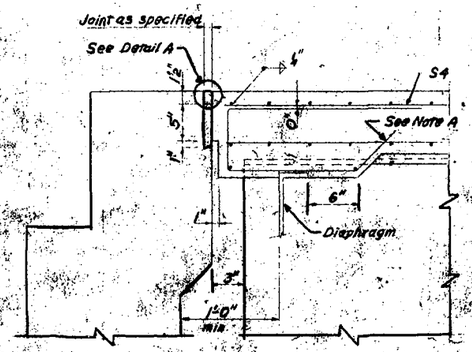
TYPICAL PLAN- CLOSED JOINT
SKEW ANGLES ≠ 75°



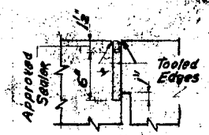
TYPICAL SECTION
CLOSED JOINT AT PIER



TYPICAL PLAN- CLOSED JOINT
SKEW ANGLES ≠ 75°



TYPICAL SECTION
CLOSED JOINT AT ABUTMENT



DETAIL A

#4 bars placed parallel.
10 longitudinal top bars.
54 between beams.

NOTE A

SPAN LENGTH	JOINT	
	FIXED END	EXP. END
Max. 55'	1"-P	1"-N
Over 55' to 70'	1"-P	1½" N
Over 70' to 90'	1"-P	1½"-N *
Over 90' to 125'	1"-N	Pl. Dam
Over 125'	Pl. Dam	Pl. Dam

* Pl. Dam shall be used if overall height of Abutment exceeds 16'-0

END SPAN OR TOTAL EXP. LENGTH	JOINT	
	FIXED END	EXP. END
Max. 55'	1"-P	1"-N
Over 55' to 90'	1"-P	1½"-N
Over 90' to 125'	1"-N	Pl. Dam
Over 125' to 250'	Pl. Dam	Pl. Dam
Over 250	Pl. Dam	T-Dam

SIMPLE SPAN CONTINUOUS SPAN

JOINT AT ABUTMENT

℄ PIER

TOTAL EXP. LENGTH (LEFT)	TYPE OF BRGS.	JOINT	TYPE OF BRGS	TOTAL EXP. LENGTH (RIGHT)
Max. 55'	Exp.	1"-N.	Fix.	Max 90'
Over 55 to 90'	Exp.	1½"-N	Fix	Max 90'
Max 90'	Fix	1"-P	Fix	Max 90'
Over 90'	Fix	Pl. Dam	Fix	Any
Max. 125"	Exp.	Pl. Dam ⊠	Exp.	Max 125
Max. 90'	Exp	Pl. Dam	Fix	Over 90'
Over 90' to 250'	Exp	Pl. Dam	Fix	Any
Any	Exp.	T Dam	Exp	Over 125'
Over 250'	Exp.	T Dam	Fix	Any

⊠ (a) 1"-N shall be used for a total exp. length (left + right) of max 55'.
(b) 1½" N shall be used for a total exp. length (left + right) of over 55' to max. 90'.

SIMPLE AND/OR CONTINUOUS SPANS

JOINT AT PIER

JOINT ARRANGEMENTS

P= Premolded Expansion Joint Filler,
N= Closed Cell Neoprene Sponge.

Pl. Dam = Plate Expansion Dam.
T Dam = Tooth Expansion Dam.

APPROVED: OCT. 1, 1968
Chief Engineer

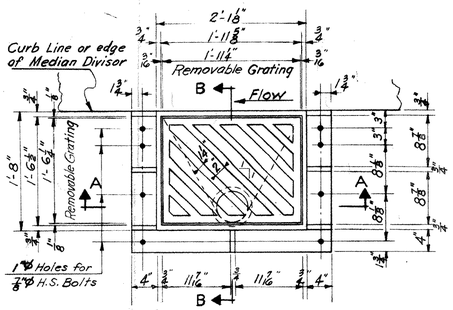
APPROVED: OCT 1, 1968
Bridge Engineer

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
STEEL I-BEAM BRIDGES
CLOSED JOINT DETAILS & JOINT ARRANGEMENT

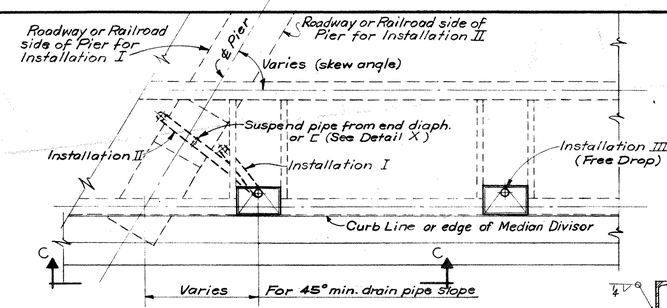
SHEET 1 OF 1

ST-113



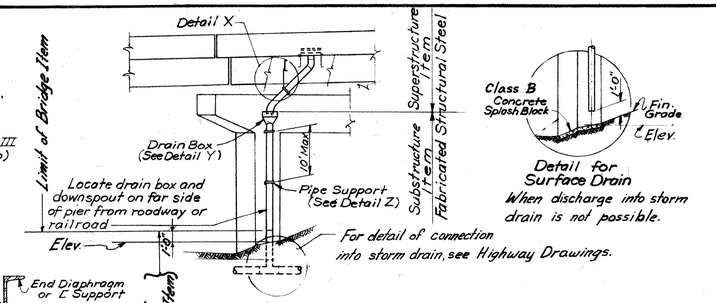
PLAN - TYPE A SCUPPER

Note: Openings in grating must point downgrade toward curb.



TYPICAL LOCATION PLAN OF TYPE A, D OR E SCUPPER

For choice of installation - See Instruction Note 1.



ELEVATION C - C

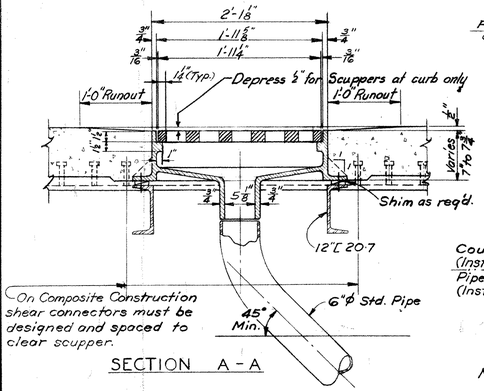
Installation I shown.
Installation II similar except downspout is on opposite side of pier column.

Detail for Surface Drain

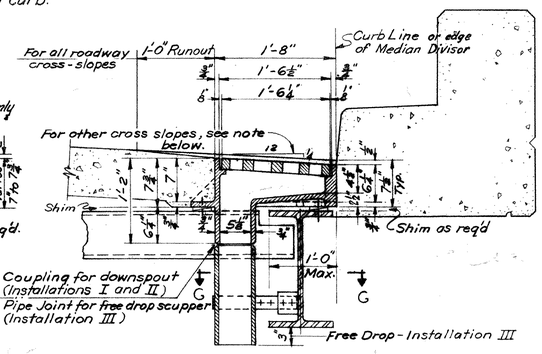
When discharge into storm drain is not possible.

NOTES:

- All materials and workmanship shall comply with PDH Form 409/49 and the current A.W.S. Standard Specifications for Welded Highway and Railway Bridges.
- All pipes shall be standard 6" ϕ steel pipes. All pipe fittings shall be screwed malleable iron (ASTM A338) or steel welding fittings (ASTM A234) except at field connection, shown on Sect. B-B, where victaulic coupling, (or approved equal), is specified. Scupper, drain box, and grating material shall be malleable iron, cast steel, or ductile iron (ASTM A339 Grade 60-45-10) unless welded construction is used, in which case, structural steel (ASTM A36) shall be used. All materials shall be galvanized. Areas upon which the galvanizing has been damaged shall be cleaned and painted with an approved aluminum paint.
- Weight of scuppers, pipe, fittings, couplings, and pipe supports above drain box shall be included in the Fabricated Structural Steel Item for Superstructure quantities. Weight of drain boxes, pipe, fittings, couplings, and pipe supports below drain box shall be included in the Fabricated Structural Steel item for the various units of the substructures.

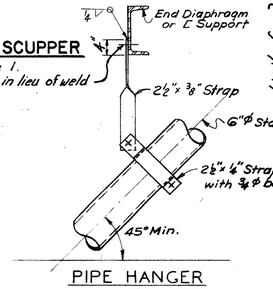


SECTION A - A

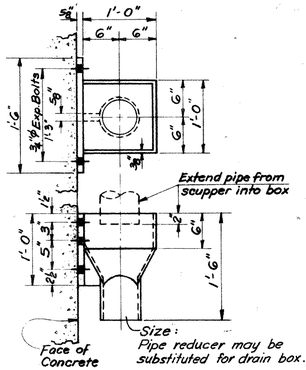


SECTION B - B

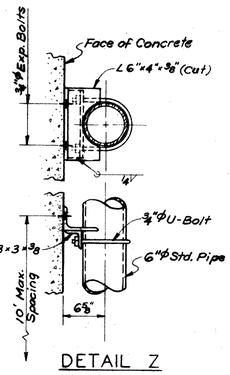
Note: For cross-slopes other than ½ in 12 raise or lower roadway side of scupper to align with cross-slope of roadway and adjust supporting channels and shims.



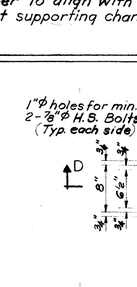
PIPE HANGER DETAIL X



DETAIL Y DRAIN BOX



DETAIL Z PIPE SUPPORTS



SECTION G-G

INSTRUCTIONS:

1. Type A, D and E Scuppers:
   Use on all steel framed superstructures in accordance with requirements shown on Scupper Spacing Chart and use on steel framed superstructure alternate to Prestressed Concrete superstructure in lieu of Scupper-Type Drain shown on P.D.H. Prestressed Concrete Bridge Standards.

   Installation I of scupper and downspout should be located on far side of pier column from roadway or railroad, except that Installation II must be used where the far side is downgrade from a toothed expansion dam.

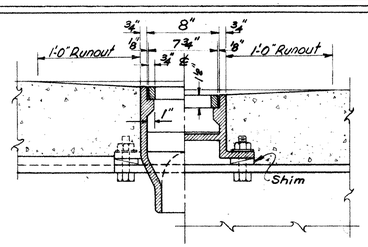
   Installation II may be used in lieu of Installation I if slope of pipe between scupper and downspout can be held to 45° or more and the far side is downgrade from a sliding plate dam.

   Installation III (free drop) may be used in spans over water ways and over any ground where discharge would not be objectionable.

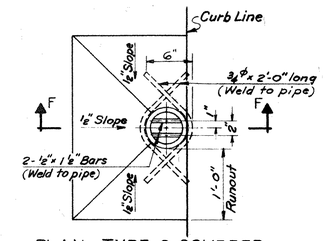
2. Type B and C Scuppers:
   Use on steel framed superstructure alternate to Prestressed Concrete superstructure in lieu of aluminum or steel drains shown on P.D.H. Prestressed Concrete Bridge Standards. Type B Scupper must be used where the beam flange would obstruct Type C or where Type C would be exposed on the outside of the fascia beam.

   Type C may be modified for use on Reinforced Concrete Slab and Reinforced Concrete T-Beam Bridges where required. Type B may be used adjacent to a divisor, to drain a narrow water table, where Type A or D would not be economical.
3. For larger dimensions, scupper shall be modified to fit.
4. For Installations I and II, downspout may be connected to Storm Drain, if practical, and details of the connection shall be included on Highway Drawings. If connection to storm drain is impractical, downspout shall discharge onto Splash Block
5. Roadway inlets should be placed off the bridge at the low end, in lieu of scuppers in end span(s). These inlets shall be shown on bridge plans as well as on roadway plans.
6. For Details of Type D and E Scuppers, See Sheet 2.

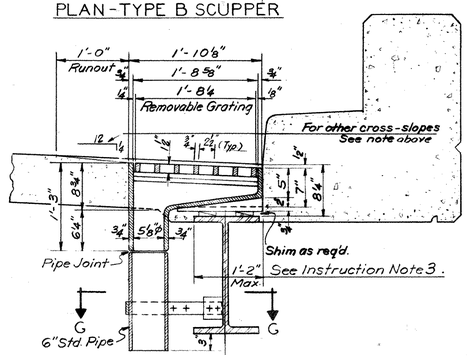
PLAN - TYPE B SCUPPER



SECTION E - E



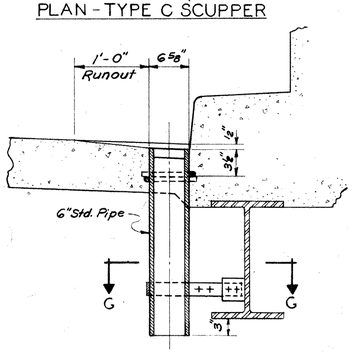
PLAN - TYPE C SCUPPER



SECTION D - D

SCUPPER TYPE "B" & TYPE "C"

To be used on steel alternates to original prestressed concrete design. (See Instruction Note 2.)



SECTION F - F

Approved: FEB. 25, 1965

T. H. Jensen
Bridge Engineer

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

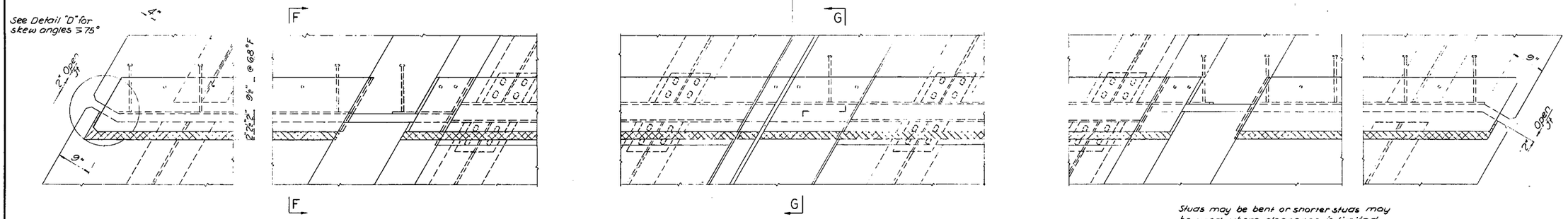
STANDARD STEEL I-BEAM BRIDGES

BRIDGE DRAINAGE

Des.	S.S.S.
Trc.	D.A.S.
Ckd.	B.F.K.

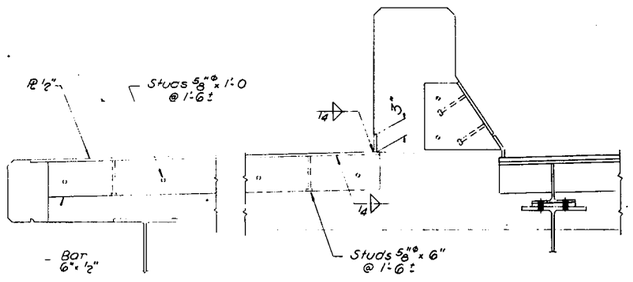
J. K. WELL CO., CRONAFLEX

ST-114

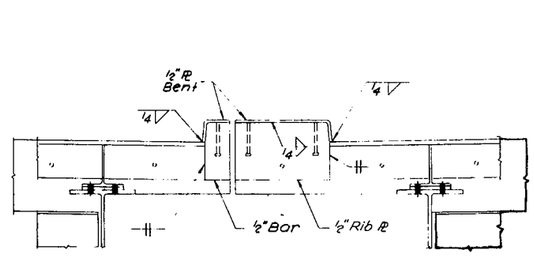


Studs may be bent or shorter studs may be used where clearance is limited.

PLAN

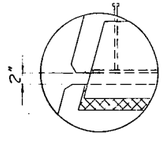


AT SIDEWALK

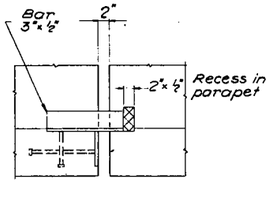


AT DIVISOR

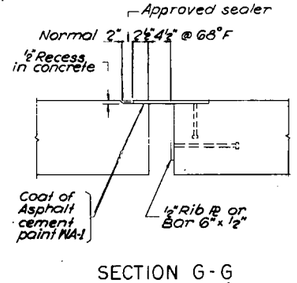
TYPICAL SECTIONS



DETAIL "D"
SKEW ANGLES ≥ 75°



SECTION F-F



SECTION G-G

APPROVED: DEC. 17, 1969
CHIEF ENGINEER

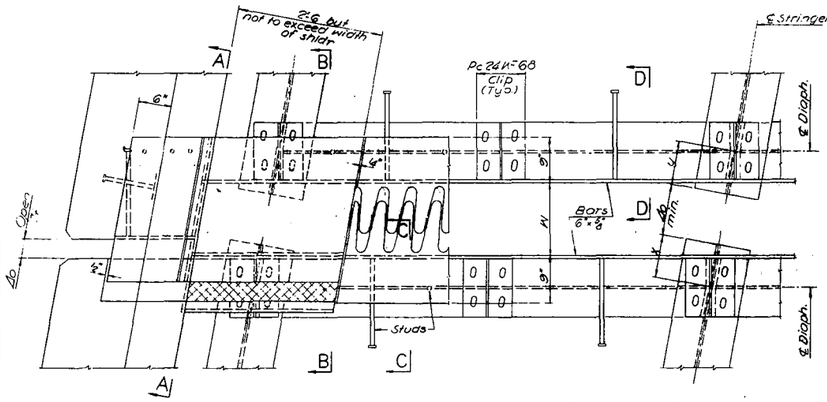
APPROVED: DEC. 17, 1969
BRIDGE ENGINEER

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
DIVISION OF BRIDGE ENGINEERING

STANDARD
STEEL I-BEAM BRIDGES
PLATE EXPANSION DAM

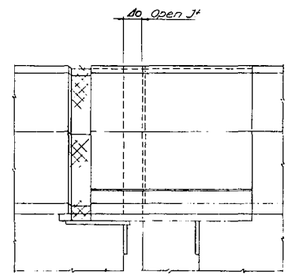
SHEET 2 OF 2

ST-114

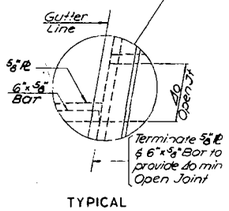


PLAN AT PIER
SKEW ANGLES ≥ 75°

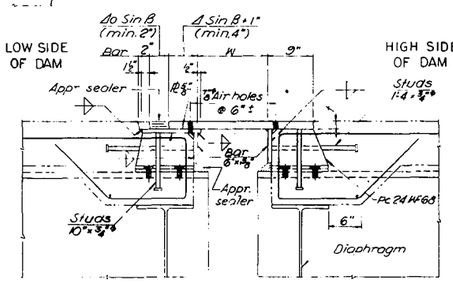
Plan at Abutment similar, see Section at Abutment for details.



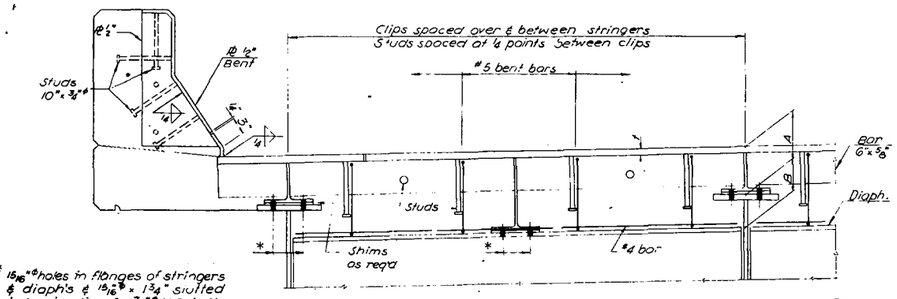
SECTION A-A



TYPICAL

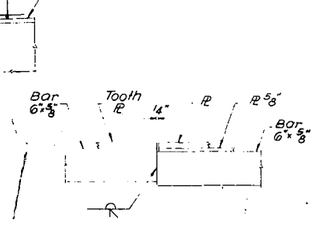


SECTION B-B

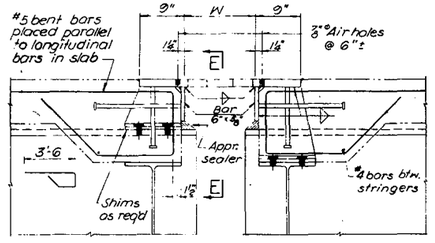


* 15/16"ø holes in flanges of stringers & diaph's & 15/16"ø x 1¾" slotted holes in clips for ⅞"ø H.S. bolts
(Holes in flanges of stringers & diaphragms may be slotted 15/16"ø x 1⅜" for lateral adjustment)

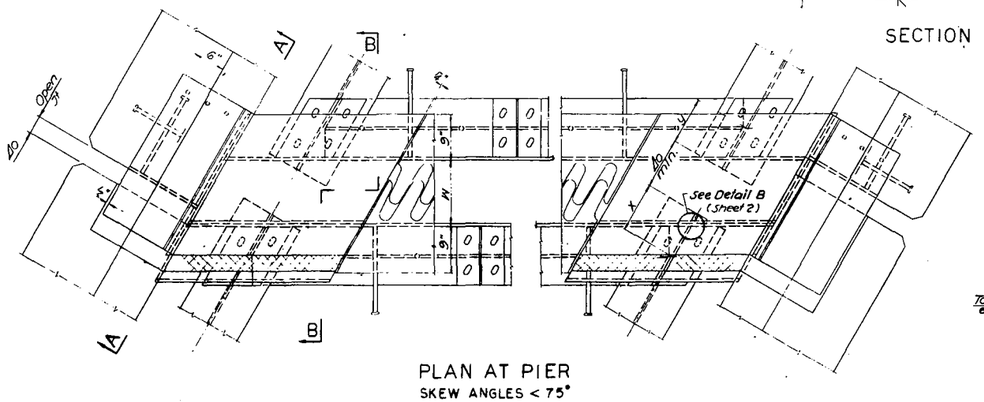
TYPICAL SECTION



SECTION E-E

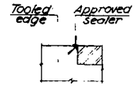


SECTION C-C SECTION D-D

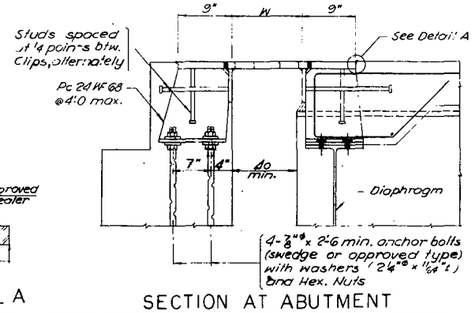


PLAN AT PIER
SKEW ANGLES < 75°

Plan at Abutment similar, see Section at Abutment for details.



DETAIL A



SECTION AT ABUTMENT

NOTES

- Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.
- Structural steel shall conform to ASTM A36 Designation.
- Steel surfaces in contact with concrete shall not be painted.
- One coat of asphalt cement paint WA-1 shall be applied to steel surfaces sliding on concrete.
- For shipping and erection purposes temporary L's 4"x3"x ½" at maximum 5'-0 c/c shall be bolted and welded in shop as shown in Detail of Temporary Attachment. After concrete has set, angles shall be removed by chipping connection welds and grinding surfaces smooth.
- Expansion dam shall be erected to follow roadway grade and crown.
- Concrete shall be placed under the dam and vibrated until the concrete is forced through the ⅞"ø holes. Strike off excess concrete. After concrete has cured inspect the holes and remove unsound concrete. Clean the holes with an air jet and fill with an approved sealer.

DESIGN INFORMATION

Expansion: Min. Ø (inch) = δ + 12 ε T_c L = δ + 0.00328L See table below

Contraction: Min. Δ (inch) = δ + 12 ε T_c L = δ + 0.00608L

L = Expanded length in ft
δ = L/250 inches, but not less than 1"
Normal temperature = 68°F
Temperature range = -10°F to +110°F
T_c = Temperature change, 42°F Rise and 78°F Fall
ε = Thermal coefficient = 0.0000065 /°F
Design Live Load = 100 psi + 60% impact = 160 psi
Deflection of tooth shall not exceed L/300 where L = cantilever span of tooth.

INSTRUCTIONS

- The WF Clips shall be placed equally between stringers at max. spacing of 4'-0.
- Dimensions and details shown in section or plan are typical.
- For dimensions Δ, Ø, t', A, B, x and y, refer to design drawings. A = distance from top of deck slab to top of stringer at ℄ bearings and B = distance from top of diaphragm to top of stringer.

L'	25'	30'	35'	40'	45'	50'	55'	60'	65'	70'	75'	80'	85'	90'	95'	100'
Ø"	1¾	2¼	2½	2⅞	3¼	3⅝	4	4⅜	4¾	5	5½	5⅞	6¼	6½	6⅞	7¼
Δ"	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
t"	¾	¾	⅞	1	1	1	1	1⅛	1⅛	1¼	1⅜	1⅜	1½	1⅝	1¾	1⅜

SIZE OF FILLET WELD	
THICKNESS OF THICKER PART JOINED	MIN. FILLET WELD
To ½" inclusive	3/16"
Over ½" to ¾"	¼"
Over ¾" to 1½"	5/16"
Over 1½" to 2¼"	⅜"
Over 2¼" to 6"	½"

APPROVED: DEC. 17, 1969
CHIEF ENGINEER

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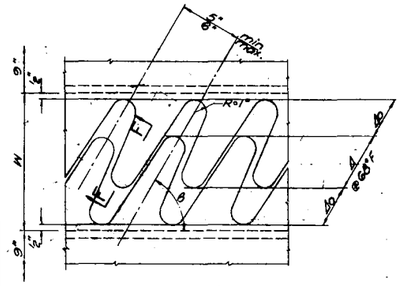
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

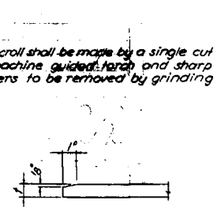
STANDARD
STEEL I-BEAM BRIDGES
TOOTH EXPANSION DAM

SHEET 1 OF 3

ST-115

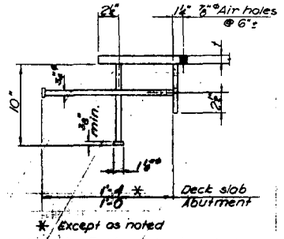


PLAN



SECTION F-F

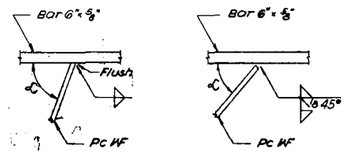
TOOTH PLATE DETAIL



* Except as noted

Studs may be 6cm or shorter studs may be used where clearance is limited.

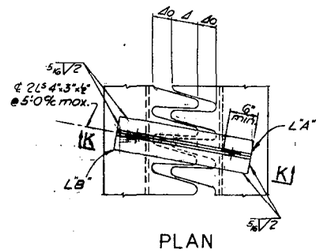
STUD DETAIL



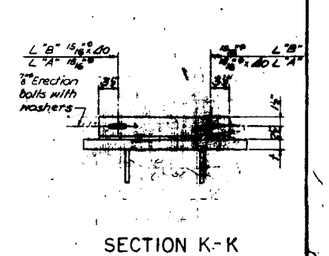
60° ≥ ∝ < 75° 45° ≥ ∝ < 60°

FOR SKEW ANGLES < 45°, ∝ = 45° MIN.

DETAIL B



PLAN



SECTION K-K

The value of Δo for temperature at time of dam erection other than 68°F is:

Δo (T) (inches) = Δo (68) − 12 ε (T − 68) L

Δo (T) (inches) = Δo for T°F temperature at time of dam erection

Δo (68) (Inches) = Δo for 68°F normal temperature as shown on plan

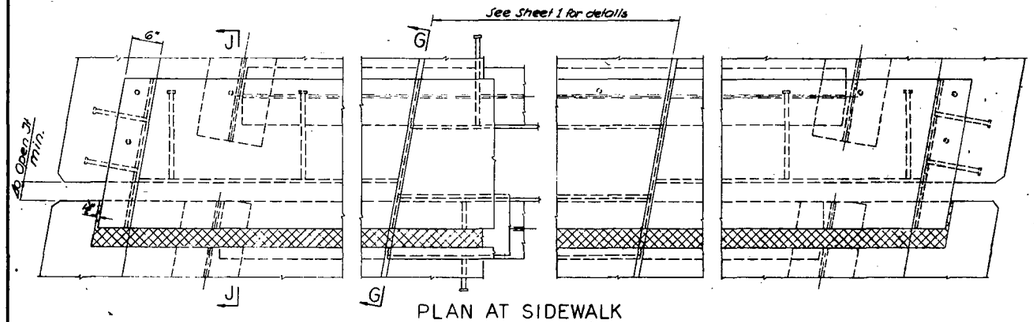
ε = thermal coefficient = 0.0000065/F°

L = total expanded length in feet

Example: L = 300 ft., T = 30°F and Δo = 3" (shown on plan), the required Δo for 30°F temperature at time of dam erection will be 3⅜" approx.

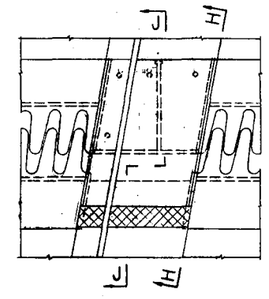
DETAIL OF TEMPORARY ATTACHMENT

FOR SHIPPING AND ERECTION OF DAM



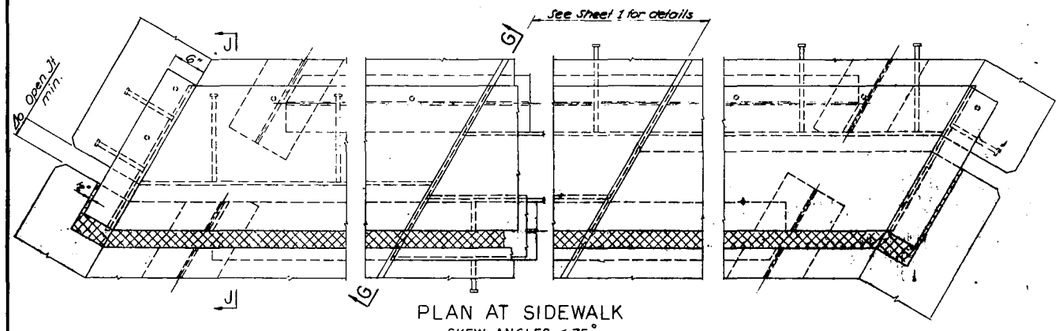
PLAN AT SIDEWALK

SKEW ANGLES ≥ 75°



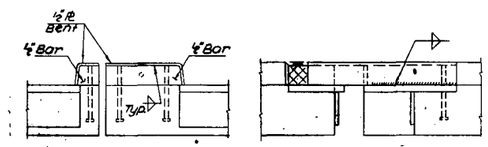
PLAN AT DIVISOR

ALL SKEW ANGLES

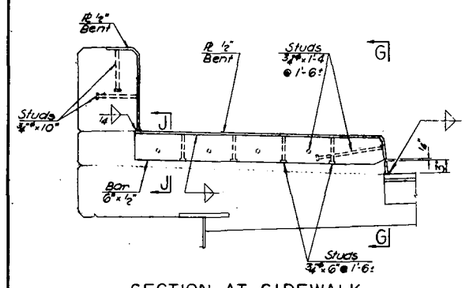


PLAN AT SIDEWALK

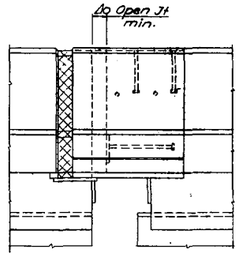
SKEW ANGLES < 75°



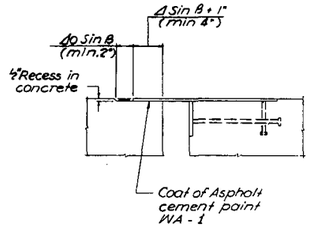
SECTION AT DIVISOR SECTION H-H



SECTION AT SIDEWALK



SECTION G-G



SECTION J-J

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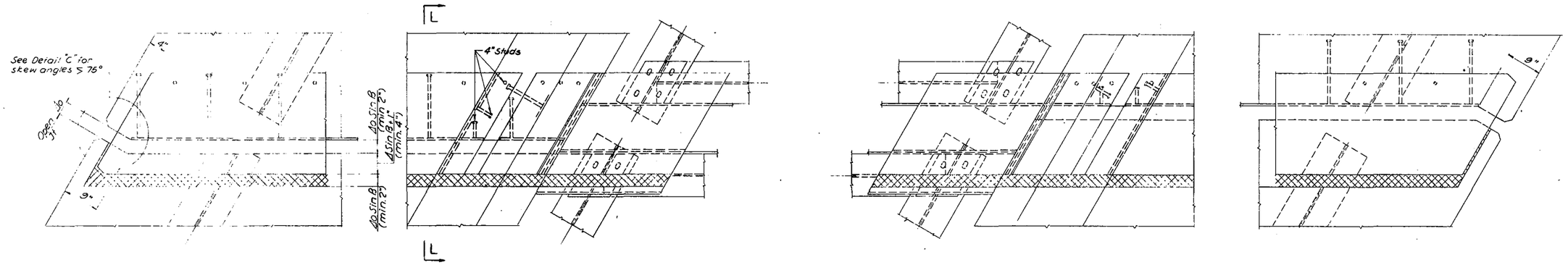
BRIDGE DIVISION

STANDARD
STEEL I-BEAM BRIDGES
TOOTH EXPANSION DAM

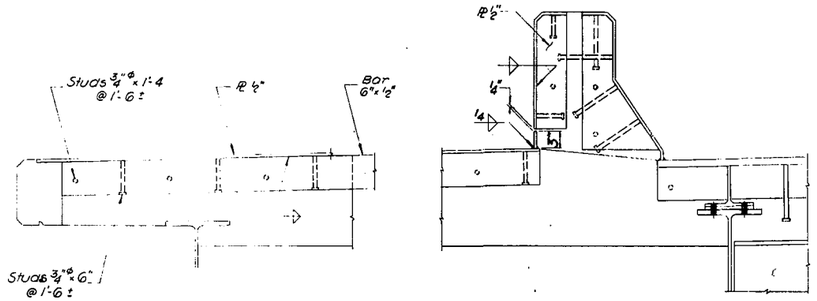
SHEET 2 OF 3

ST-115

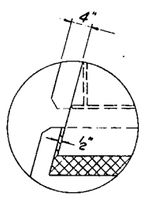
See Sheet 1 for Details



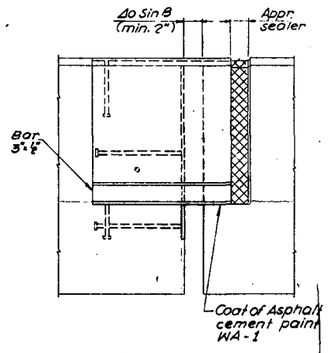
PLAN



TYP. SECTION AT SIDEWALK



DETAIL "C"
SKEW ANGLES ≤ 75°



SECTION L-L

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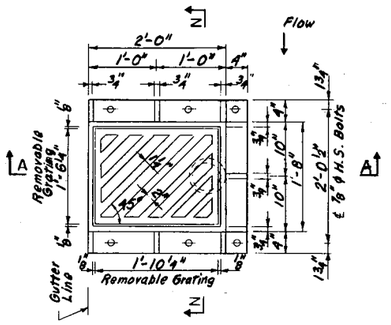
STANDARD
STEEL I-BEAM BRIDGES
TOOTH EXPANSION DAM

SHEET 3 OF 3

ST-115



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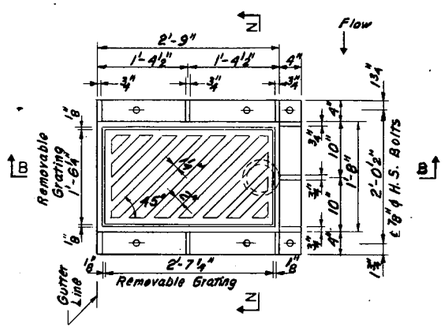

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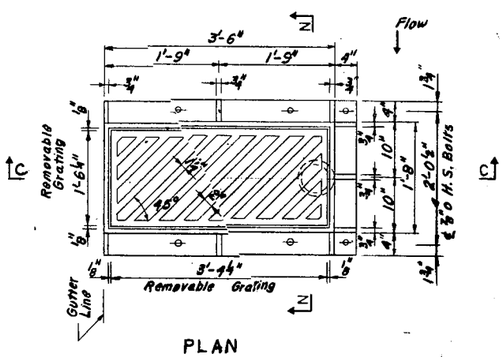

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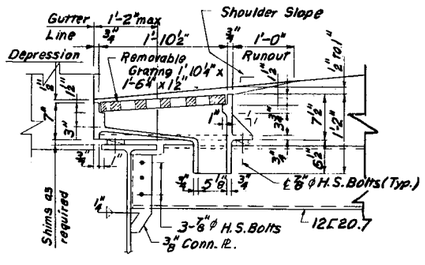
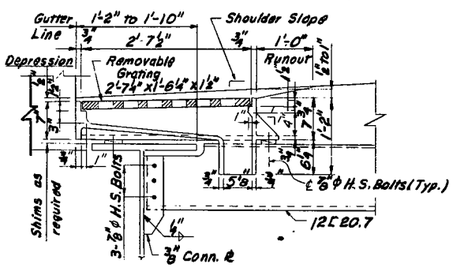


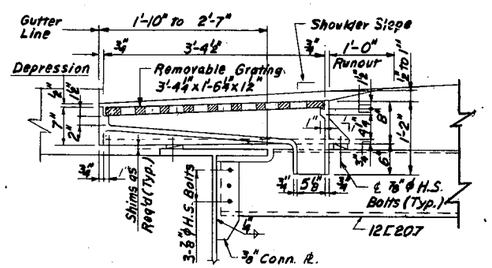
SECTION A-A

TYPE A SCUPPER



SECTION B-B

TYPE B SCUPPER

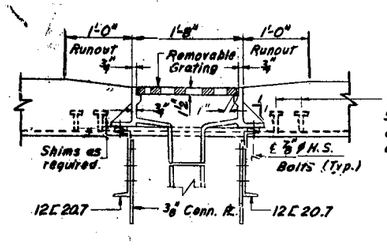


SECTION C-C

TYPE C SCUPPER

NOTES

- Materials and workmanship shall be in accordance with Specifications Form 409.
- All pipes shall be standard 6" ø steel pipe (ASTM A53). Pipe joints shall be screwed malleable iron (ASTM A338) or steel welding fittings (ASTM A234) for use with steel pipe, except as noted.
- Scupper, drain box and grating material shall be malleable iron (ASTM A47 Grade 35018), cast steel (ASTM A27 Grade 65-35) or ductile iron (ASTM A536 Grade 60-40-18) unless welded construction is used, in which case structural steel (ASTM A36) shall be used.
- Welding of cast material will not be permitted.
- All materials shall be galvanized. After erection, areas upon which the galvanizing has been damaged shall be cleaned, then coated with a galvanizing repair compound conforming to Federal Specification O-G-93.
- If scupper, drain box and grating are welded, welding shall precede galvanizing.



On Composite Construction Shear Connectors must be designed and spaced to clear Scupper.

SECTION N-N

TYP. FOR ALL SCUPPERS

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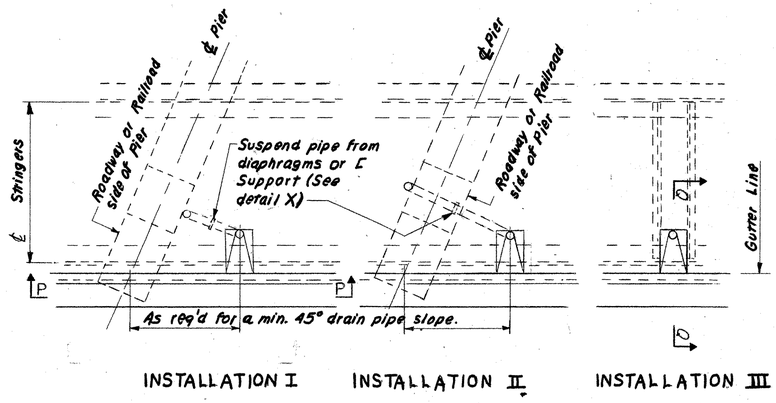
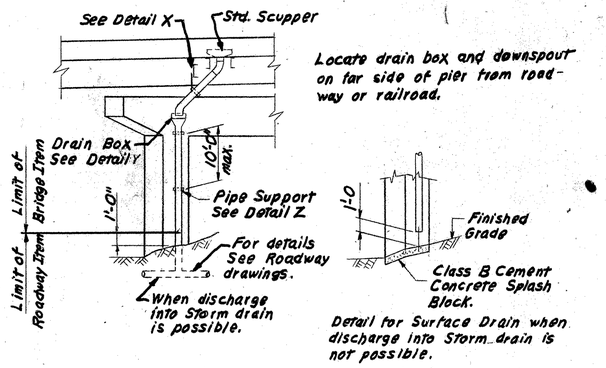
STANDARD
STEEL I-BEAM BRIDGES
BRIDGE DRAINAGE
SCUPPER DETAILS

SHEET 1 OF 2

ST-116

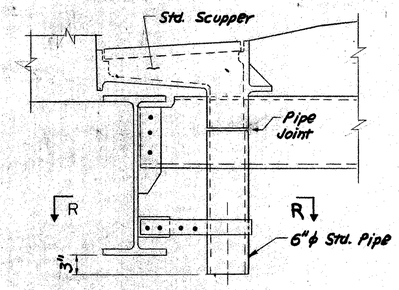


PLAN SHOWING TYPICAL INSTALLATION OF SCUPPERS

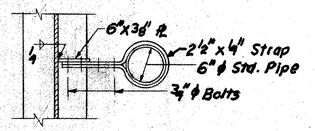


ELEVATION P-P

For Installations I and II, downspout may be connected to Storm Drain, if practical, and details of the connection shall be included on Roadway Drawings. If connection to storm drain is impractical, downspout shall discharge onto Splash Block.

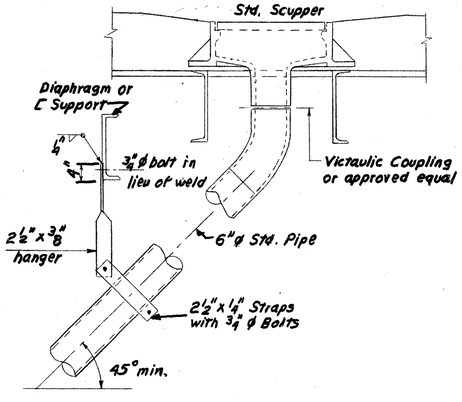


SECTION Q-Q

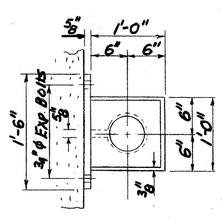


SECTION R-R

Installation III shall be used in spans over streams and over ground where discharge would not be objectionable,



ELEVATION
DETAIL X



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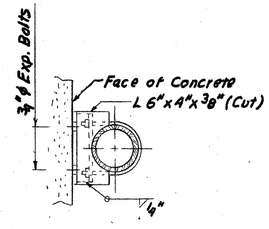

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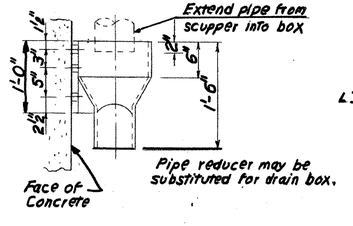
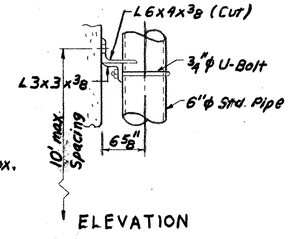


ELEVATION
DETAIL Y



ELEVATION
DETAIL Z

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DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
STEEL I-BEAM BRIDGES
BRIDGE DRAINAGE
DOWNSPOUTING DETAILS

SHEET 2 OF 2

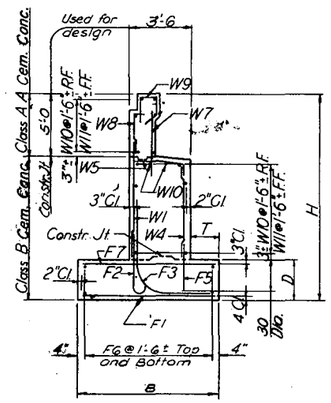
ST-116

REINFORCED CONCRETE ABUTMENTS WITH BACKWALL

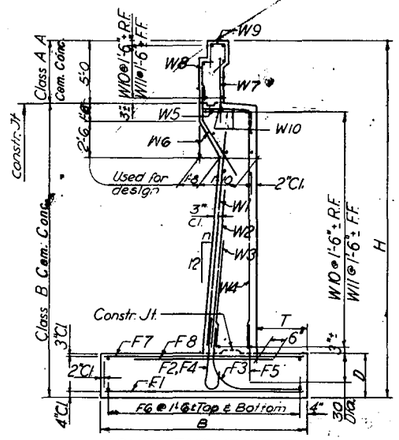
Abutment Type	Height, H, Ft.	Batter n	Base B Ft.	Toe T Ft.	Footing Thickness D Ft.	Maximum Design Foundation Pressure Tons Per Sq. Ft. — Total Superstructure Load (DL+LL) Kips/Ft. 50	70	90	110	REINFORCEMENT BARS F1 Size	F1 Spacing c/c	F1 Length	F2 Size	F2 Spacing c/c	F2 Length	F2 K	F3 Size	F3 Spacing c/c	F3 Length	F3 K	F3 M	F4 Size	F4 Spacing c/c	F4 Length	F4 K	F5 Size	F5 Spacing c/c	F5 Length	F6 Size	F6 No. of Bars	F7 Size	F7 Spacing c/c	F7 Length	F8 Size	F8 Spacing c/c	F8 Length	W1 Size	W1 Spacing c/c	W1 Length	W2 Size	W2 Spacing c/c	W2 Length	W3 Size	W3 Spacing c/c	W3 Length	W4 Size	W4 Spacing c/c	W4 Length	W5 Size	W5 Spacing c/c	W5 Length	W6 Size	W6 Spacing c/c	W6 Approx. Length	W10 Size	W10 No. of Bars	W11 Size	W11 No. of Bars	Approximate Quantities per Ft. Length Class B Cem. Conc. Cu. Yds.	Reinforcement Bars Lbs
I	10	—	6'-0	1'-0	2'-0	1.76	2.10	2.42	2.76	#5	18"	5'-8	#5	18"	6'-9	6'-2	—	—	—	—	—	—	—	—	#5	18"	4'-6	#5	10	#5	18"	5'-8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	#5	18"	6'-0	—	—	—	#4	5	#5	3	0.83	38
	12	—	7'-0	1'-3	2'-0	1.89	2.18	2.48	2.78	↓	↓	6'-8	#5	18"	8'-9	8'-2	—	—	—	—	—	—	—	—	↓	↓	6'-6	↓	10	#5	↓	6'-8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	↓	↓	↓	—	—	—	—	6	—	4	1.17	44
	14	—	8'-0	1'-6	2'-0	2.03	2.29	2.55	2.82	↓	↓	7'-8	#6	18"	11'-0	10'-4	—	—	—	—	—	—	—	—	↓	↓	8'-6	↓	12	#6	↓	7'-8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	↓	↓	↓	—	—	—	—	7	↓	5	1.50	53
	16	—	9'-0	1'-9	2'-0	2.16	2.40	2.64	2.90	#5	18"	8'-8	#5	18"	3'-10	3'-3	#5	18"	11'-3	4'-3	6'-2	—	—	—	—	#5	18"	3'-3	#5	14	#7	18"	8'-8	—	—	—	#5	18"	10'-6	—	—	—	—	—	—	—	—	—	#5	18"	8'-9	#5	18"	6'-0	—	—	—	#4	9	#5	7	1.83	75
II	18	1	10'-0	2'-0	2'-3	2.33	2.55	2.78	3.00	#6	24"	9'-8	#6	24"	4'-6	3'-10	#6	24"	8'-6	3'-0	3'-10	#7	12"	9'-6	8'-8	#6	24"	4'-0	#5	14	#5	12"	9'-8	#5	12"	6'-0	#6	24"	10'-0	#5	24"	8'-6	—	—	—	#6	24"	10'-6	#6	24"	6'-0	#6	24"	6'-0	#4	10	#5	8	1.73	113
	20		11'-3	2'-3	2'-3	2.46	2.68	2.85	3.05	↓	↓	10'-11	#6		4'-6	3'-10	#7		9'-0	3'-5	3'-11	#8		5'-4	4'-5			4'-0		16	#5		10'-11	#7		7'-9	#6		12'-0	#5		10'-5	#8	12"	8'-9			12'-6								11		9	2.00	154
	22		12'-9	2'-3	2'-6	2.56	2.75	2.92	3.10	#6		12'-5	#6		4'-9	4'-1	#8		10'-0	3'-9	4'-7	#9		6'-3	5'-0			4'-0		18	#5		12'-5	#8		8'-6	#6		13'-9	#6		12'-3	#9		9'-6			14'-3								12		10	2.40	193
	24		14'-0	2'-6	2'-6	2.64	2.78	2.93	3.12	#6		13'-8	#7		5'-3	4'-5	#8		10'-3	3'-6	4'-3	#9		6'-3	5'-0			4'-0		20	#6		13'-8	#9		8'-9	#7		15'-9	#7		13'-3	#9		10'-0			16'-3								14		12	2.71	229
	26		15'-3	3'-0	2'-9	2.70	2.81	2.94	3.13	#7		14'-11	#7		5'-6	4'-8	#9		11'-6	4'-2	4'-10	#10		7'-0	5'-7			4'-0		22	#7		14'-11	#9		9'-0	#7		17'-6	#7		15'-0	#10		12'-0			18'-0								15		13	3.15	287
	28	↑	16'-9	3'-6	2'-9	2.74	2.85	3.01	3.15	#7	↑	16'-5	#8	↑	5'-10	4'-11	#10	↑	12'-9	4'-10	5'-5	#10	↑	7'-0	5'-7	↑	↑	4'-0	↑	24	#7	↑	16'-5	#10	↑	9'-9	#8	↑	19'-6	#9	↑	16'-6	#10	↑	11'-3	↑	↑	20'-0	↑	↑	↑	↑	↑	↑	↑	16	↑	14	3.79	337
	30	1	18'-0	4'-0	3'-0	2.78	2.90	3.04	3.17	#8	24"	17'-8	#9	24"	6'-6	5'-3	#10	24"	14'-0	5'-6	6'-0	#11	12"	7'-9	6'-2	#6	24"	4'-0	#5	24	#8	12"	17'-8	#10	12"	10'-6	#9	24"	21'-3	#10	24"	18'-6	#11	12"	11'-9	#6	24"	21'-9	#6	24"	6'-0	#6	24"	6'-0	#4	17	#5	15	4.31	406

BACKWALL (5'-0")

Abutment Type	REINFORCEMENT BARS W7 Size	W7 Spacing c/c	W7 Length	W8 Size	W8 Spacing c/c	W8 Length	W9 Size	W9 Spacing c/c	W9 Length	W10 Size	W10 No. of Bars	W11 Size	W11 No. of Bars	Approximate Quantities per Ft. Length Class A.A Cem. Conc. Cu. Yds.	Reinforcement Bars Lbs.
I	#5	18"	6'-0	#5	18"	4'-10	#5	18"	6'-6	#4	5	#5	5	0.28	19
II	#6	24"	6'-0	#6	24"	4'-10	#6	24"	6'-6	#4	5	#5	5	0.28	20



ABUTMENT TYPE I



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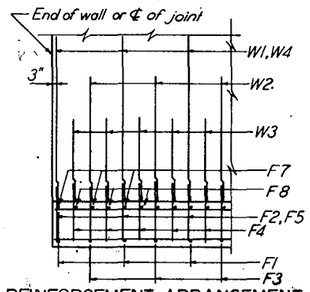
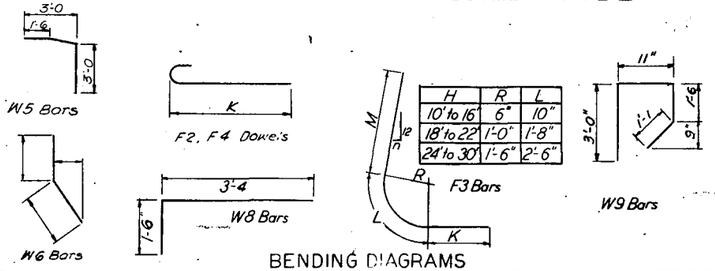
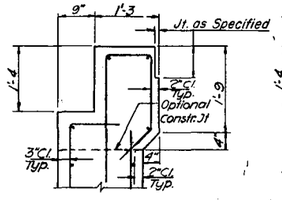


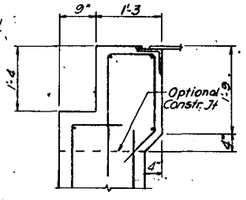
REINFORCEMENT ARRANGEMENT



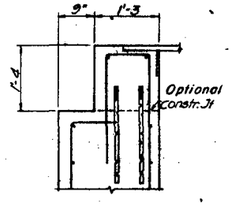
BENDING DIAGRAMS



DETAIL AT CLOSED JT



DETAIL AT R.E.P. DAM



DETAIL AT TOOTH EXP. DAM

INSTRUCTIONS

- Maximum Design Foundation Pressure shall be shown on the plan.
- Special design is required for footing on rock, piles or pedestals or for design data other than shown.
- F.F. = Front Face. R.F. = Rear Face. E.F. = Each Face

DESIGN DATA

- Coefficient of friction between soil and base = 0.45
- Factor of safety against sliding = 1.50 min.
- Factor of safety against overturning = 2.00 min.
- Weight of backfill material = 120 lbs./cu.ft.
- Weight of concrete = 150 lbs./cu.ft.
- Equivalent fluid earth pressure = 35 lbs./sq.ft. per ft. of depth
- Liveload Surcharge = 2'-0" equivalent fill height.
- Height of Backwall = 5'-0".
- Total longitudinal force = 2.25 k./Linear ft applied at the bridge seat elevation, which is the force assumed equivalent to the effect of traction, wind, friction etc. forces applied in accordance with AASHO specifications.

NOTES

- Materials and workmanship shall be in accordance with Specifications Form 408.
- Design Specifications: Design Division of 1965 - AASHO "Standard Specifications For Highway Bridges", and as supplemented by the Current Design Manual, Part 4, Structures.
- Reinforcement bars shall conform to Rail Steel, Billet steel (intermediate or hard grade), or Axle steel (intermediate or hard grade), and are detailed in accordance with Current ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures. Minimum lap shall be 30 diameters and minimum cover shall be 2" except as noted.
- Class AA Cement Concrete shall be used in backwalls. All other concrete shall be Class B Cement Concrete.
- Exposed concrete edges shall be chamfered 1" x 1".

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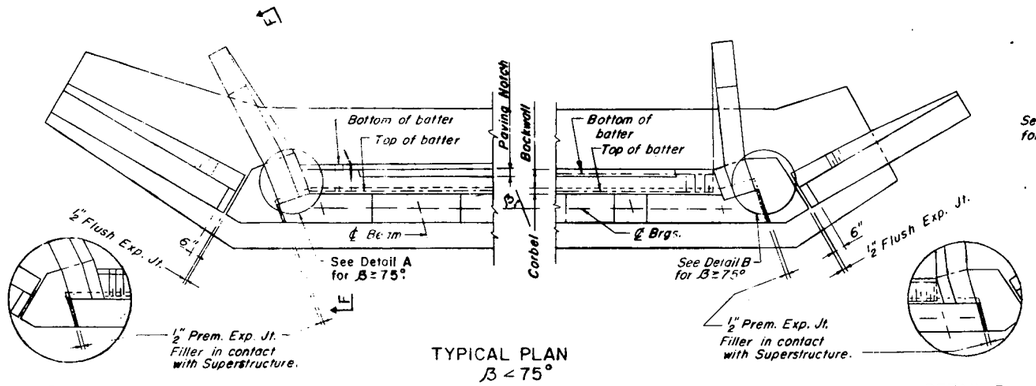
Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

STANDARD
R.C. ABUTMENTS
WITH BACKWALL

REINFORCEMENT AND DETAI

SHEET 1 OF 2

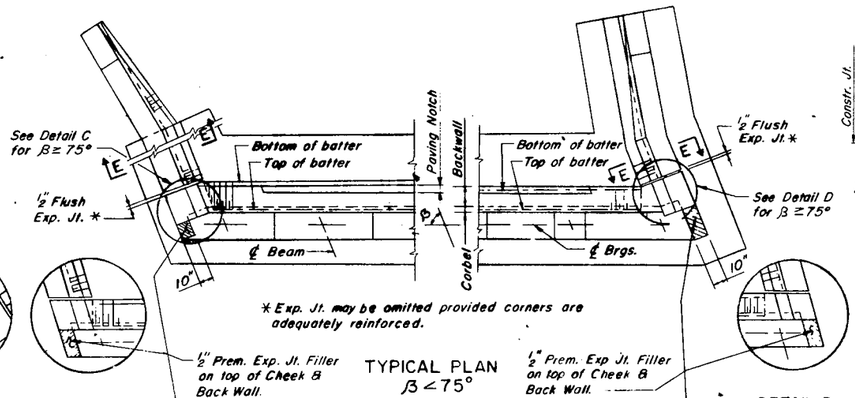
ST-121



TYPICAL PLAN
β < 75°

DETAIL A

DETAIL B

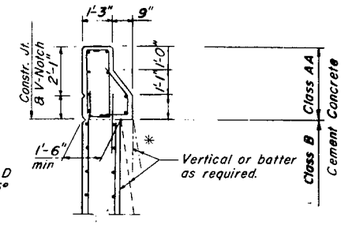


* Exp. Jt. may be omitted provided corners are adequately reinforced.

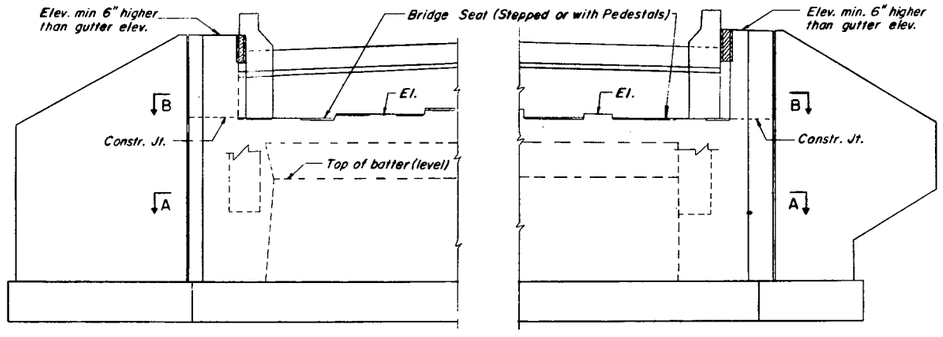
TYPICAL PLAN
β < 75°

DETAIL C

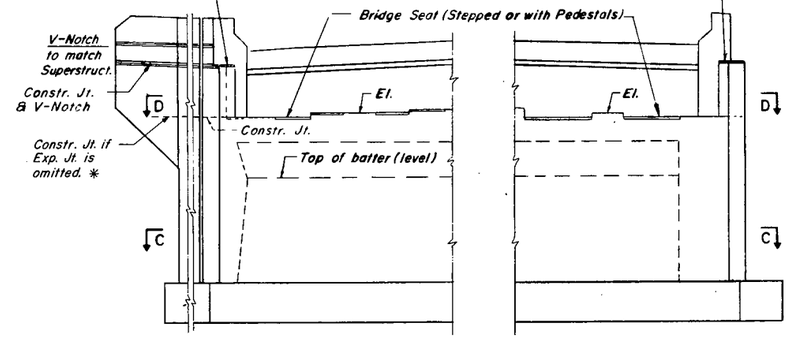
DETAIL D



SECTION E-E



TYPICAL ELEVATION



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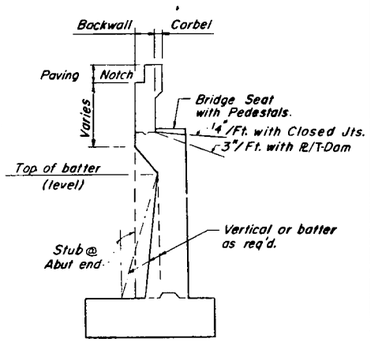
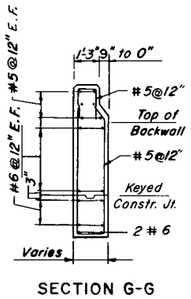
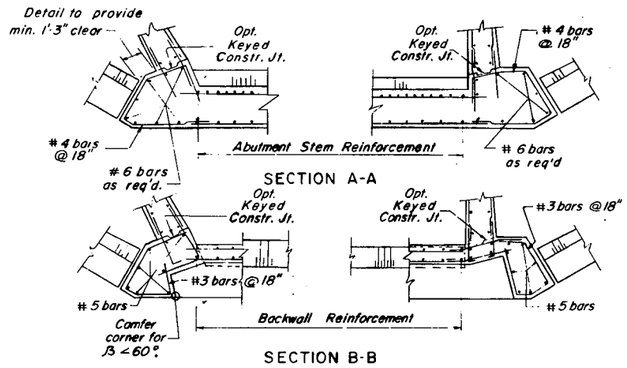


ABUT. SECTION



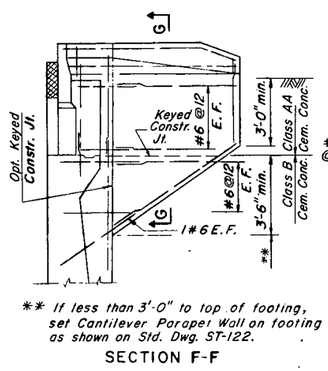
SECTION G-G



SECTION A-A

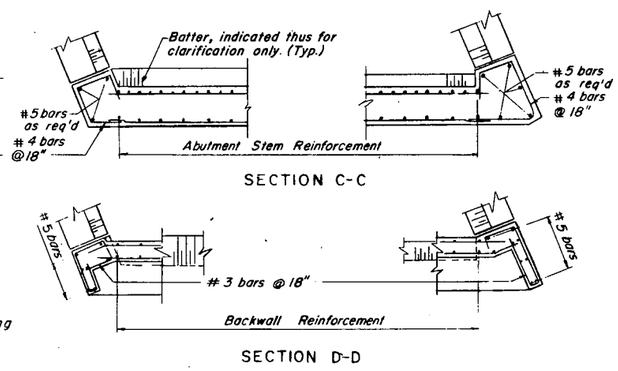
SECTION B-B

ABUTMENTS WITH FLARED WINGS



** If less than 3'-0" to top of footing, set Cantilever Parapet Wall on footing as shown on Std. Dwg. ST-122.

SECTION F-F



SECTION C-C

SECTION D-D

ABUTMENTS WITH U-WINGS

APPROVED: JUNE 12, 1969
CHIEF ENGINEER

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BRIDGE ENGINEER

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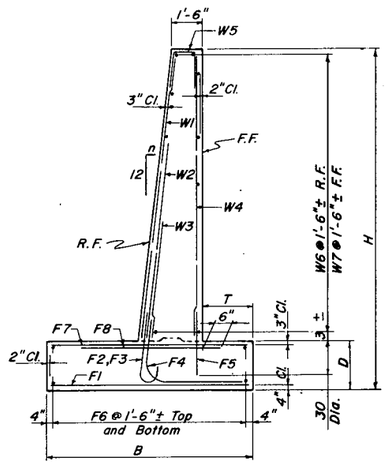
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
R.C. ABUTMENTS WITH BACKWALL
LAYOUT & DETAILS

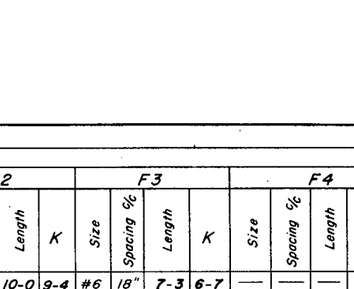
SHEET 2 OF 2

ST-121

Height H, Ft.	Batter n	Base B, Ft.	Toe T, Ft.	Footing Thickness D, Ft.	Maximum Design Foundation Pressure Tons per Sq. Ft. Total Superstructure load (D.L.+ L.L.) Kips/Ft. 5.0	7.0	9.0	11.0	REINFORCEMENT BARS F1 Size	Spacing	Length	F2 Size	Spacing	Length	K	F3 Size	Spacing	Length	K	F4 Size	Spacing	Length	K	M	F5 Size	Spacing	Length	F6 No. of Bars	F7 Size	Spacing	Length	F8 Size	Spacing	Length	W1 Size	Spacing	Length	W2 Size	Spacing	Length	W3 Size	Spacing	Length	W4 Size	Spacing	Length	W5 Size	Spacing	Length	W6 No. of Bars	W7 No. of Bars	Approximate Quantities per Ft. Length Class B Conc. Cu. Yds.	Reinforcement bars, lbs.
10	1	7-9	1-9	2-0	1.68	1.95	2.22	2.48	#5	18"	7-5	#6	18"	10-0	9-4	#6	18"	7-3	6-7	—	—	—	—	—	#5	18"	9-6	#5	12	#5	18"	7-5	—	—	—	—	—	—	#6	18"	9-9	—	—	—	—	—	—	—	—	—	#5	18"	7-1	#4	6	#5	6	1.12	62
12		8-9	2-0	2-0	1.90	2.15	2.40	2.72	#6	18"	8-5	#6	18"	4-3	3-7	#7	18"	9-6	8-8	—	—	—	—	—	#5	18"	3-3		12	#6	18"	8-5	—	—	—	—	—	—	#5	18"	9-9	—	—	—	—	—	—	#5	18"	9-9		18"			7		7	1.36	82
14		9-6	2-0	2-0	2.12	2.34	2.59	2.83	#7	18"	9-2	#7	18"	4-9	3-11	#8	18"	9-9	8-10	—	—	—	—	—	#5	18"	3-3		14	#5	18"	9-2	#6	18"	6-0	#7	18"	11-9	—	—	—	—	—	—	#5	18"	11-9		18"			9		9	1.59	110
16		10-3	2-3	2-0	2.42	2.65	2.88	3.10	#7	18"	9-11	#7	18"	5-0	4-2	#9	18"	5-9	4-6	—	—	—	—	—	#5	18"	3-3		14	#6	18"	9-11	#6	18"	6-3	#7	18"	13-9	#9	18"	9-3	—	—	—	#5	18"	13-9	#5	18"			10		10	1.84	132
18		11-6	2-6	2-3	2.43	2.63	2.33	3.03	#5	12"	11-2	#9	24"	6-9	5-6	#9	24"	6-0	4-9	#5	12"	11-3	3-9	5-10	#6	24"	4-0		16	#6	12"	11-2	#6	12"	6-9	#8	24"	15-6	#9	24"	11-3	—	—	—	#6	24"	15-6	#6	24"			11		11	2.21	167
20		12-9	3-0	2-3	2.65	2.84	3.00	3.15			12-5	#9		6-9	5-6	#10		7-0	5-7	#6		13-3	4-5	7-2			4-0		18	#6		12-5	#7		7-3			17-6	#10		13-6	—	—	—			17-6					12		12	2.53	205
22		13-9	3-6	2-6	2.85	3.00	3.16	3.31			13-5	#10		8-0	6-7	#10		7-3	5-10	#7		16-0	5-1	9-3			4-0		20	#6		13-5	#7		8-0			19-3	#10		15-3	—	—	—			19-3					14		14	2.94	241
24		15-3	4-0	2-6	2.83	2.96	3.10	3.25			14-11	#10		8-0	6-7	#10		7-3	5-10	#8		11-0	5-3	3-3			4-0		22	#8		14-11	#8		8-3			21-3	#10		17-3	#8	12"	10-0			21-3					15		15	3.32	303
26		16-6	4-6	2-9	2.80	2.92	3.05	3.18			16-2	#10		8-3	6-10	#10		7-6	6-1	#9		12-3	5-11	3-10			4-0		22	#8		16-2	#9		8-9			23-0	#10		19-0	#9		12-0			23-0					16		16	3.80	353
28		17-9	5-0	2-9	2.75	2.87	2.98	3.10			17-5	#10		8-3	6-10	#10		7-6	6-1	#10		13-6	6-7	4-5			4-0		24	#9		17-5	#10		8-9			25-0	#10		21-0	#10		14-3			25-0					17		17	4.19	427
30	1	19-0	5-6	3-0	2.70	2.81	2.91	3.02	#5	12"	18-8	#10	24"	8-6	7-1	#11	24"	8-0	6-5	#11	12"	14-6	7-3	4-9	#6	24"	4-0	#5	26	#10	12"	18-8	#10	12"	9-0	#8	24"	26-9	#11	24"	22-9	#11	12"	14-6	#6	24"	26'-9	#6	24"	7-1	#4	19	#5	19	4.73	510



TYPICAL SECTION



REINFORCEMENT ARRANGEMENT

DESIGN DATA

- Coefficient of friction between soil and base = 0.45.
- Factor of safety against sliding = 1.50 minimum.
- Factor of safety against overturning = 2.00 minimum.
- Weight of backfill material = 120 lbs./cu. ft.
- Weight of concrete = 150 lbs./cu. ft.
- Equivalent fluid earth pressure = 35 lbs./sq. ft. per foot of depth.
- Depth of Surcharge = 5'-0" (3 ft. Superstructure and 2 ft. live load Surcharge).
- Total longitudinal force = 2.25 k./Linear ft applied at the bridge seat elevation, which is the force assumed equivalent to the effect of traction, wind, friction etc. forces applied in accordance with AASHO Specifications.

INSTRUCTIONS

- Maximum Design Foundation Pressure shall be shown on the plan.
- Special design is required for footing on rock, piles or pedestals or for design data other than shown.
- F.F. = Front Face, R.F. = Rear Face, E.F. = Each Face.

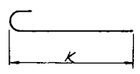
NOTES

- Materials and workmanship shall be in accordance with Specifications Form 408.
- Design Specifications: Design Division of 1965- AASHO "Standard Specification For Highway Bridges," and as supplemented by the Current Design Manual, Part 4, Structures.
- **Reinforcement bars shall conform to Rail steel, Billet steel (intermediate or hard grade), or Axle steel (intermediate or hard grade),** and are detailed in accordance with Current ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures. Minimum lap shall be 30 diameters and minimum cover shall be 2" except as noted.
- All Concrete shall be Class B Cement Concrete.
- Exposed concrete edges shall be chamfered 1"x 1".

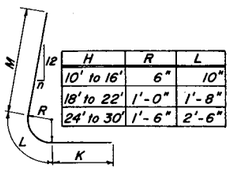
APPROVED: OCT. 1, 1968
CHIEF ENGINEER

APPROVED: OCT. 1, 1968
BRIDGE ENGINEER

BENDING DIAGRAMS

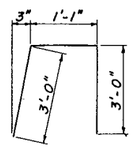


F2, F3 DOWELS



H	R	L
10' to 16'	6"	10"
18' to 22'	1'-0"	1'-8"
24' to 30'	1'-6"	2'-6"

F4 BARS



W5 BARS

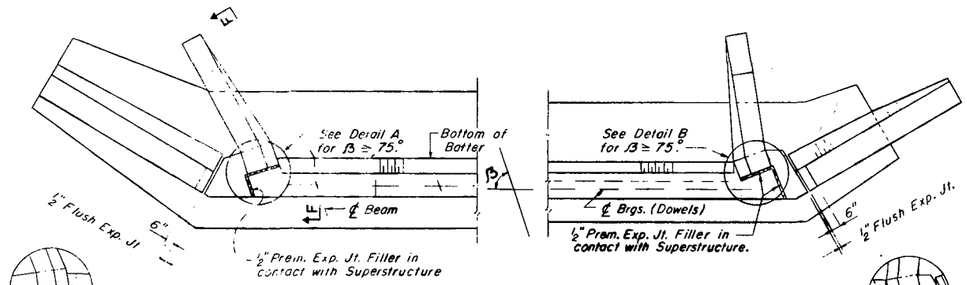
Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

STANDARD

R.C. ABUTMENTS
WITHOUT BACKWALL
REINFORCEMENT AND DETAILS

SHEET 1 OF 2

ST-122



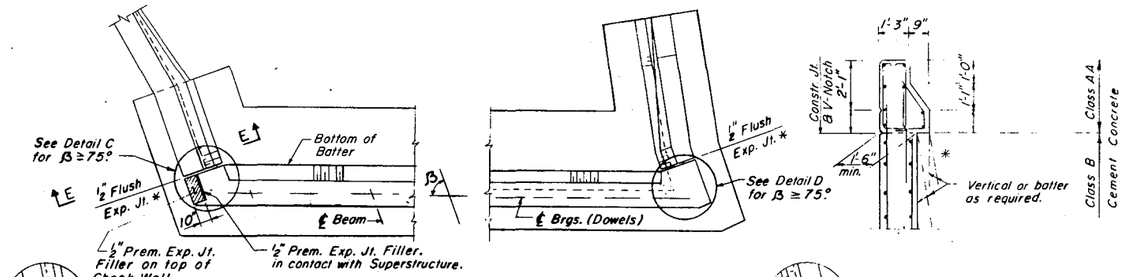
Beam Bridge With Conc. End Diaphragm

R. C. Slab Bridge

DETAIL A

DETAIL B

TYPICAL PLAN
β < 75°



Beam Bridge With Conc. End Diaphragm

R. C. Slab Bridge

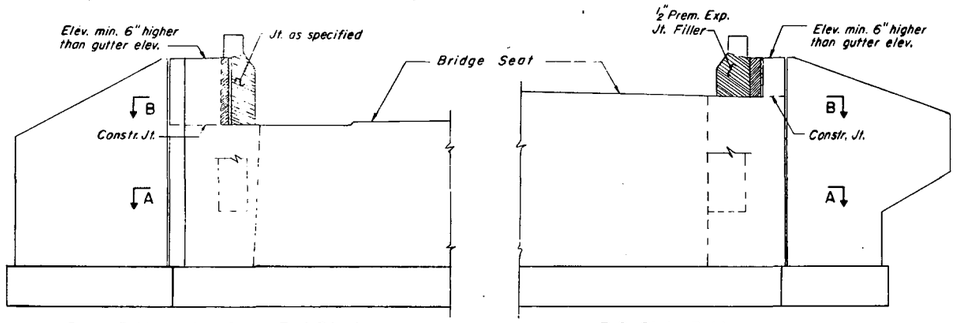
SECTION E-E

*Exp. Jt. may be omitted provided corners are adequately reinforced.

DETAIL C

DETAIL D

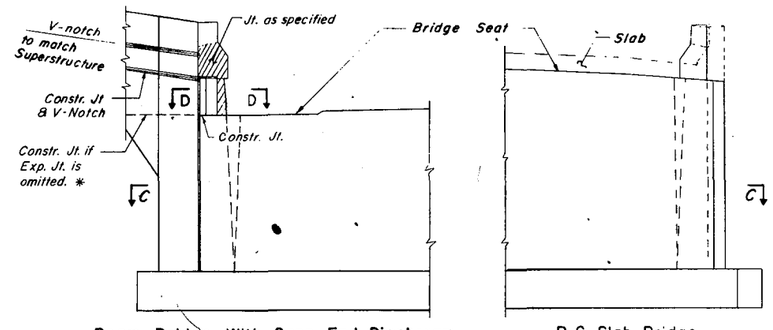
TYPICAL PLAN
β < 75°



Beam Bridge With Conc. End Diaphragm

R.C. Slab Bridge

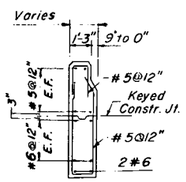
TYPICAL ELEVATION



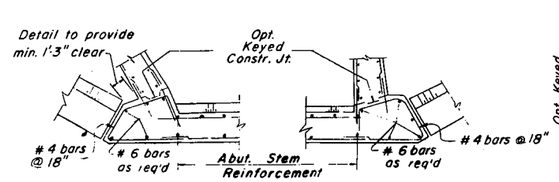
Beam Bridge With Conc. End Diaphragm

R.C. Slab Bridge

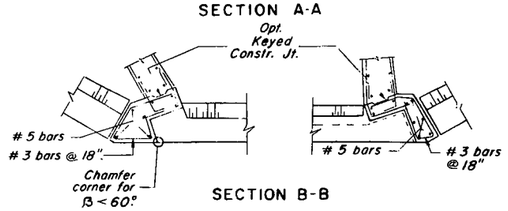
TYPICAL ELEVATION



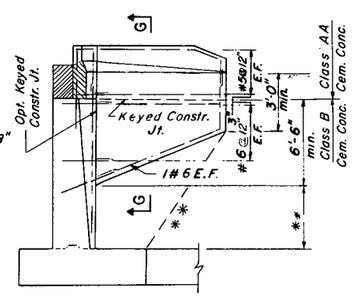
SECTION G-G



SECTION A-A



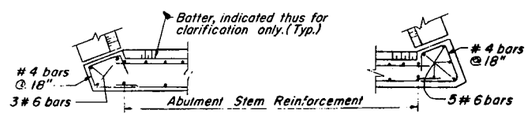
SECTION B-B



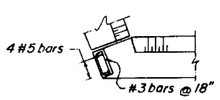
SECTION F-F

** If less than 3'-0" to top of footing, set Cantilever Parapet Wall on footing as shown in dashed line.

ABUTMENTS WITH FLARED WINGS



SECTION C-C



SECTION D-D

ABUTMENTS WITH U-WINGS

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CHIEF ENGINEER

APPROVED: JUNE 12, 1969
B. J. Kotalik
BRIDGE ENGINEER

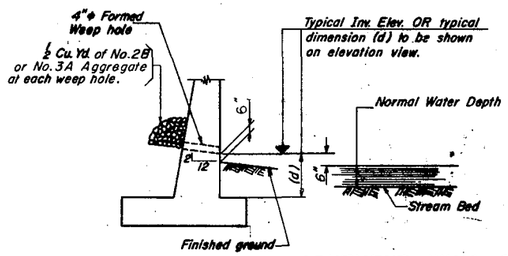
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
R. C. ABUTMENTS
WITHOUT BACKWALL
LAYOUT & DETAILS

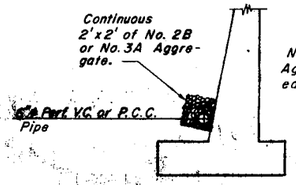
SHEET 2 OF 2

ST-122

SCHEME A

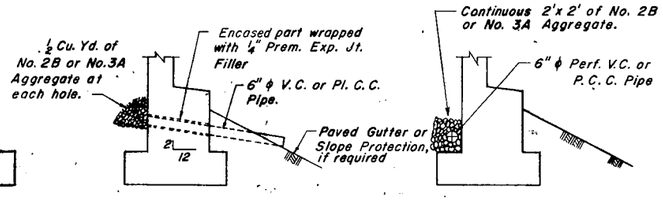


SCHEME B



ABUTMENT, WING & RETAINING WALLS

SCHEME A



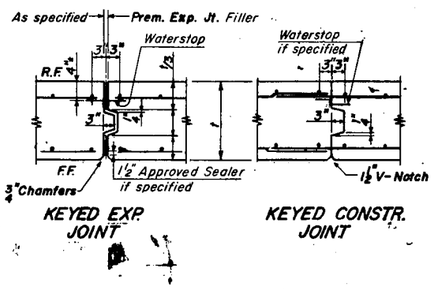
SCHEME B

STUB ABUTMENT IN CUT

SUBSTRUCTURE DRAINAGE

INSTRUCTIONS

- Scheme A shall be used if discharge at front of wall is not objectionable, otherwise Scheme B shall be used.
- Spacing of weep holes shall not exceed fifteen (15) feet.
- Pipe shall be sloped minimum ⅛" per foot.
- When Pipes are used to collect water at the rear of abutments, wing walls and retaining walls, they shall be shown on a plan view of the bridge drawings, and the quantity shall appear in the Estimated Bridge Quantities.
  Pipe Underdrain Outlets carrying drainage collected from the rear of abutments, wing walls and retaining walls to highway drainage system, shall be shown on a plan view of the bridge drawings and also on the roadway plans. These pipes shall be identified on the bridge drawings as a Roadway Pay Item. For details see Sketch "X" below. However, pipes encased in concrete walls or extending beyond the front face of stub abutments and discharging into a ditch or onto a paved slope shall be included in the Estimated Bridge Quantities.
- 6"ϕ Perf. V.C. or P.C.C. Pipe = 6"ϕ Perforated Vitrified Clay or Porous Cement Concrete Pipe.
- 6"ϕ V.C. or Pl. C.C. Pipe = 6"ϕ Vitrified Clay or Plain Cement Concrete Pipe.

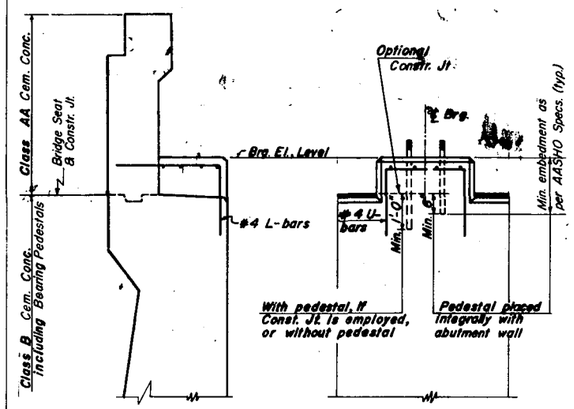


KEYED EXP. JOINT

KEYED CONSTR. JOINT

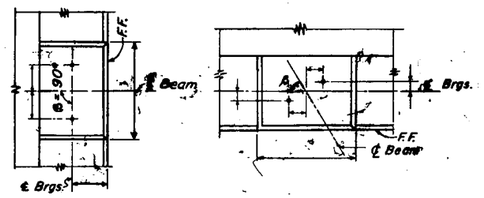
INSTRUCTIONS

- Keyed joints in top of exposed wall shall be flush to a depth of one foot.
- Provide Construction Joints at approx. 30 ft.
- Provide Expansion Joints at approx. 90 ft.
- Flush Expansion Joint similar to Keyed Expansion Joint except omit key.
- Waterstop shall be stopped one foot from top of wall.



SECTION ELEVATION

ABUTMENT WITH BACKWALL



ANCHOR BOLT PLAN

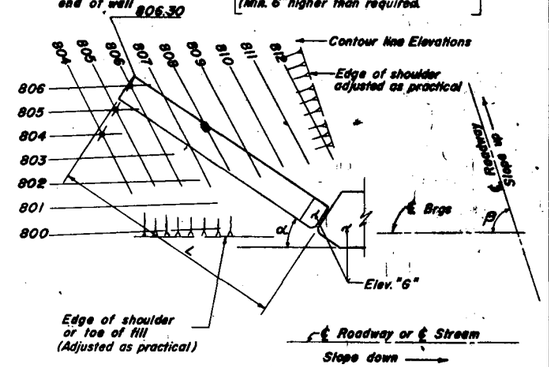
INSTRUCTIONS

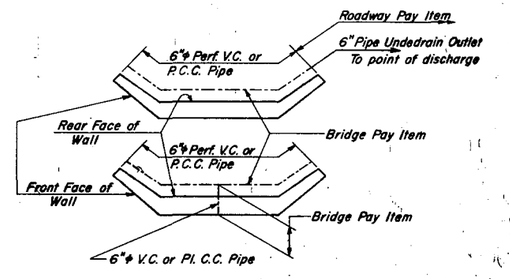
- Skew angle β and the dimensions required for location of the anchor bolts shall be shown on the plans.
- Concrete in Bearing Pedestals may be Class AA, but will be paid for as Class B.
- Reinforcement may be omitted in pedestals of depths 4" and less.
- Bearing area shall be prepared as specified in Section 1054.04 (a) of Form 409, and setting of anchor bolts shall conform to Section 1054.04 (b) of Form 409.

LENGTH OF WING WALLS

In general, wing walls shall be of sufficient length to retain the roadway embankment to the required extent and to furnish protection against erosion. Wing wall lengths shall be computed using the actual condition at the site. The following method is proposed here to compute the required lengths.

Highest elevation at end of wall 806.30 — Use 806.80 as top of wing wall Elev. (Min. 6" higher than required.





SKETCH "X"

APPROVED: OCT. 1, 1968
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BRIDGE ENGINEER

Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

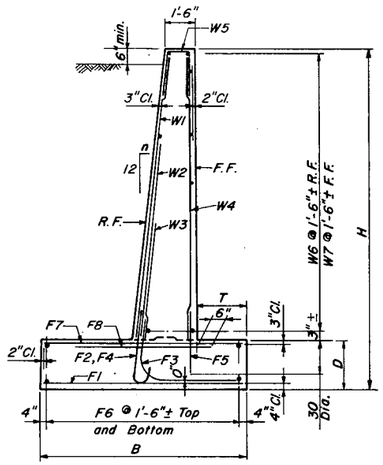
STANDARD
R.C. ABUTMENTS
MISCELLANEOUS DETAILS

SHEET 1 OF 1

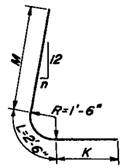
ST-123

REINFORCED CONCRETE RETAINING WALLS

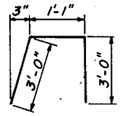
Height H, Ft.	Batter n	Base B, Ft.	Toe T, Ft.	Footing Thickness D, Ft.	Maximum Design Foundation Pressure, T/sf.	REINFORCEMENT BARS																																						Approximate Quantities per Lin. Ft. of Wall	
						F1			F2				F3					F4				F5			F6	F7			F8			W1			W2			W3			W4			W5			W6		W7		Class B Cem. Conc. Cu. Yds.	Reinforcement bars lbs.
						Size	Spacing c/c	Length	Size	Spacing c/c	Length	K	Size	Spacing c/c	Length	K	M	Size	Spacing c/c	Length	K	Size	Spacing c/c	Length	No. of Bars	Size	Spacing c/c	Length	Size	Spacing c/c	Length	Size	Spacing c/c	Length	Size	Spacing c/c	Length	Size	Spacing c/c	Length	Size	Spacing c/c	Length	Size	Spacing c/c	Length	Size	No. of Bars	Size	No. of Bars		
TYPE I RETAINING WALLS FOR LEVEL FILL																																															
10	1	5-3	1-0	2-0	1.03	#5	18"	4-11	#5	18"	10-0	9-5	—	—	—	—	—	—	—	—	—	#5	18"	9-5	#5	8	#5	18"	4-11	—	—	—	—	—	—	—	—	—	#5	18"	7-1	#4	6	#5	6	0.93	44
12		6-6	1-3	2-0	1.20			6-2	#5		3-10	3-3	—	—	—	—	—	—	—	—				3-3		10	#5		6-2	—	—	—	#5	18"	9-9	—	—	—	—	—	—	#5	18"	9-9			7		7	1.19	54
14		7-6	1-3	2-0	1.38			7-2	#5		3-10	3-3	—	—	—	—	—	—	—	—				3-3		12	#5		7-2	#5	18"	4-6			11-9	—	—	—	—	—	—			11-9			9		9	1.44	67
16		8-6	1-6	2-0	1.59			8-2	#6		5-3	4-7	—	—	—	—	—	—	—	—				3-3		12	#5		8-2	#5		5-6			13-9	—	—	—	—	—	—			13-9			10		10	1.71	75
18		9-6	1-6	2-3	1.80			9-2	#5		4-1	3-6	—	—	—	—	—	#5	18"	6-10	6-3			3-3		14	#5		9-2	#6		6-6			15-6	—	—	—	—	—	—			15-6			11		11	2.05	92
20		10-3	1-6	2-3	2.07			9-11	#5		4-1	3-6	—	—	—	—	—	#7		9-6	8-8			3-3		14	#6		9-11	#7		7-6			17-6	—	—	—	—	—	—			17-6			12		12	2.23	110
22		11-3	1-9	2-6	2.35			10-11	#5		4-4	3-9	—	—	—	—	—	#8		11-4	10-5			3-3		16	#6		10-11	#8		8-3			19-3	—	—	—	—	—	—			19-3			14		14	2.71	132
24		12-3	1-9	2-6	2.61	#5	18"	11-11	#5	18"	4-4	3-9	—	—	—	—	—	#9	18"	6-3	5-0	#5	18"	3-3		18	#8	18"	11-11	#9	18"	8-9	#5	18"	21-3	#9	18"	10-6	—	—	—	#5	18"	21-3	#5	18"			15		15	3.04	172
26		13-6	2-0	2-9	2.78	#6	24"	13-2	#6	24"	5-2	4-6	#5	24"	8-6	3-6	2-6	#8	12"	6-0	5-1	#6	24"	4-0		18	#6	12"	13-2	#8	12"	9-3	#6	24"	23-0	#5	24"	12-3	#8	12"	9-0	#6	24"	23-0	#5	24"			16		16	3.50	198
28		14-9	2-3	2-9	2.92	#6	24"	14-5	#6	24"	5-2	4-6	#5	24"	9-0	4-0	2-6	#9	12"	6-6	5-3	#6	24"	4-0		20	#8	12"	14-5	#9	12"	9-9	#6	24"	25-0	#5	24"	14-3	#9	12"	11-3	#6	24"	25-0	#5	24"			17		17	3.88	255
30	1	16-0	2-6	3-0	2.98	#6	24"	15-8	#6	24"	5-5	4-9	#5	24"	9-6	4-3	2-9	#10	12"	7-6	6-1	#6	24"	4-0	#5	22	#8	12"	15-8	#10	12"	10-6	#6	24"	26-9	#5	24"	16-0	#10	12"	13-3	#6	24"	26-9	#5	24"	7-1	#4	19	#5	19	4.40	310
TYPE II RETAINING WALLS FOR LEVEL FILL WITH 2 FOOT SURCHARGE																																															
10	1	6-3	1-0	2-0	1.13	#5	18"	5-11	#5	18"	10-0	9-5	—	—	—	—	—	—	—	—	—	#5	18"	9-5	#5	10	#5	18"	5-11	—	—	—	—	—	—	—	—	—	#5	18"	7-1	#4	6	#5	6	1.00	47
12		7-3	1-3	2-0	1.26			6-11	#5		3-10	3-3	—	—	—	—	—	—	—	—	—			3-3		12	#5		6-11	—	—	—	#5	18"	9-9	—	—	—	—	—	—	#5	18"	9-9			7		7	1.25	57
14		8-6	1-3	2-0	1.45			8-2	#6		5-3	4-7	—	—	—	—	—	—	—	—	—			3-3		12	#5		8-2	#5	18"	5-3			11-9	—	—	—	—	—	—			11-9			9		9	1.52	70
16		9-6	1-6	2-0	1.70			9-2	#5		3-10	3-3	—	—	—	—	—	#6	18"	6-9	6-1			3-3		14	#5		9-2	#7		6-3			13-9	—	—	—	—	—	—			13-9			10		10	1.78	89
18		10-6	1-6	2-3	2.05			10-2	#5		4-1	3-6	—	—	—	—	—	#7		9-3	8-5			3-3		16	#5		10-2	#8		7-0			15-6	—	—	—	—	—	—			15-6			11		11	2.13	107
20		11-6	1-6	2-3	2.33			11-2	#6		4-8	4-0	—	—	—	—	—	#8		11-4	10-5			3-3		16	#7		11-2	#9		7-9	#5		17-6	—	—	—	—	—	—			17-6			12		12	2.43	135
22		12-6	1-9	2-6	2.55			12-2	#6		4-11	4-3	—	—	—	—	—	#9		6-3	5-0			3-3		18	#7		12-2	#10		8-6	#6		19-3	#9	18"	10-3	—	—	—			19-3			14		14	2.82	174
24		13-6	1-9	2-6	2.70	#5	18"	13-2	#7	18"	6-3	5-5	—	—	—	—	—	#10	18"	7-0	5-7	#5	18"	3-3		18	#9	18"	13-2	#11	18"	9-0	#6	18"	21-3	#10	18"	12-9	—	—	—	#5	18"	21-3	#5	18"			15		15	3.16	223
26		14-9	2-0	2-9	2.83	#6	24"	14-5	#6	24"	5-2	4-6	#6	24"	9-0	3-6	3-0	#9	12"	6-6	5-3	#6	24"	4-0		20	#8	12"	14-5	#9	12"	9-9	#6	24"	23-0	#6	24"	13-9	#9	12"	11-3	#6	24"	23-0	#5	24"			16		16	3.62	272
28		16-0	2-6	2-9	2.90	#6	24"	15-8	#6	24"	5-2	4-6	#6	24"	9-9	4-3	3-0	#10	12"	7-3	5-10	#6	24"	4-0		22	#9	12"	15-8	#10	12"	10-3	#6	24"	25-0	#6	24"	15-9	#10	12"	13-3	#6	24"	25-0	#5	24"			17		17	4.01	318
30	1	17-6	2-9	3-0	2.97	#6	24"	17-2	#6	24"	5-5	4-9	#7	24"	10-6	4-6	3-6	#11	12"	8-0	6-5	#6	24"	4-0	#5	24	#9	12"	17-2	#11	12"	11-0	#6	24"	26-9	#7	24"	17-9	#11	12"	13-9	#6	24"	26-9	#5	24"	7-1	#4	19	#5	19	4.56	384



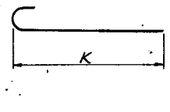
TYPICAL SECTION



F3 Bars

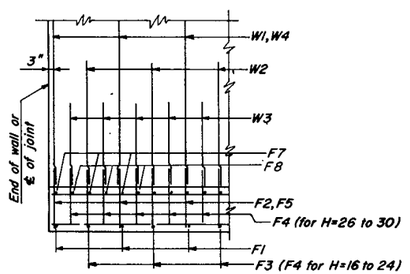


W5 Bars



F2, F4 Dowels

BENDING DIAGRAMS



REINFORCEMENT ARRANGEMENT

DESIGN DATA

- Coefficient of friction between soil and base = 0.45
- Factor of safety against sliding = 1.50 min.
- Factor of safety against overturning = 2.00 min.
- Weight of backfill material = 120 lbs./cu. ft.
- Weight of concrete = 150 lbs./cu. ft.
- Equivalent fluid earth pressure = 35 lbs./sq. ft. per foot of depth.

NOTES

- Materials and workmanship shall be in accordance with Specifications Form 408.
- Design Specifications: Design Division of 1965 AASHO "Standard Specification For Highway Bridges," and as supplemented by the Current Design Manual, Part 4, Structures.
- Reinforcement bars shall conform to Rail steel, Billet steel (intermediate or hard grade), or Axle steel (intermediate or hard grade), and are detailed in accordance with Current ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures. Minimum lap shall be 30 diameters and minimum cover shall be 2" except as noted.
- All concrete shall be Class B Cement Concrete.
- Exposed concrete edges shall be chamfered 1"x1".

INSTRUCTIONS

- Maximum Design Foundation Pressure shall be shown on the plan.
- Special design is required for footing on rock, piles or pedestals or for design data other than shown.
- Type II wall may be used for wing walls if conditions are similar.
- F.F. = Front Face, R.F. = Rear Face, E.F. = Each Face.

APPROVED: OCT. 1, 1968
CHIEF ENGINEER

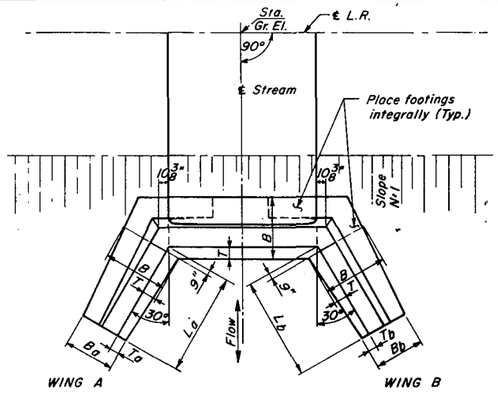
APPROVED: OCT. 1, 1968
BRIDGE ENGINEER

Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

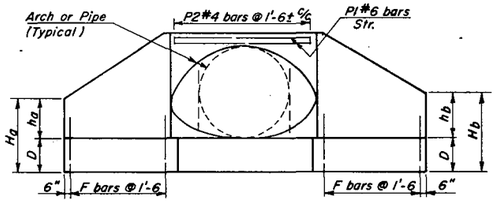
STANDARD
R.C. RETAINING WALLS

SHEET 1 OF 1

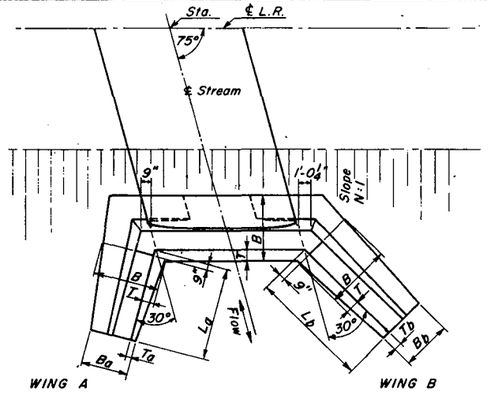
ST-124



PLAN



DEVELOPED ELEVATION



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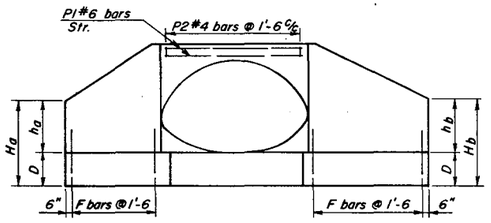

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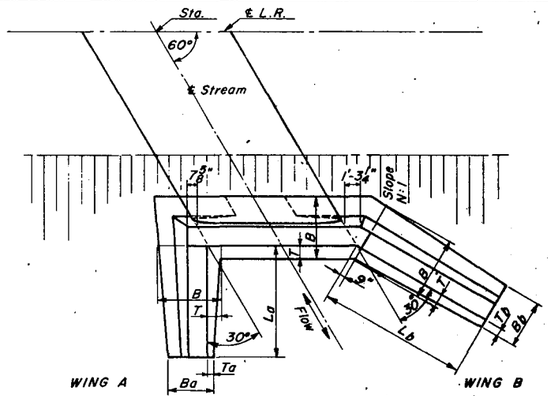
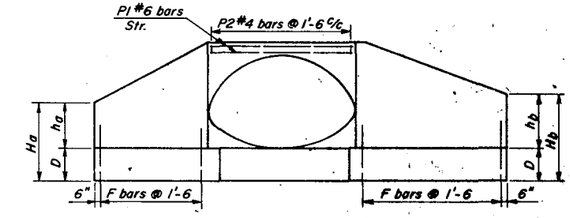


PLAN



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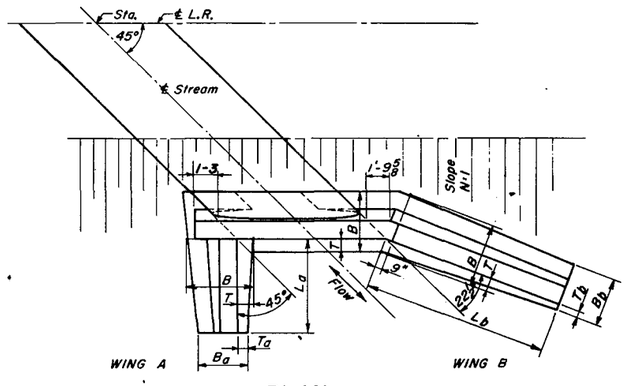
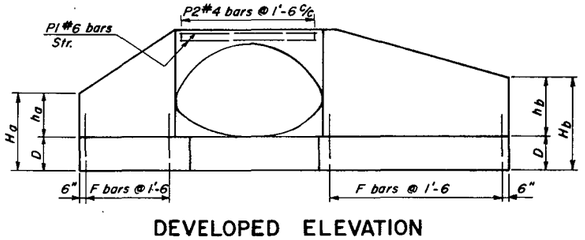


PLAN



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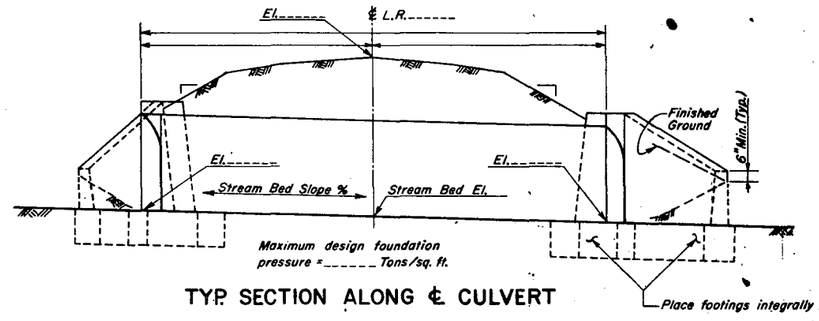
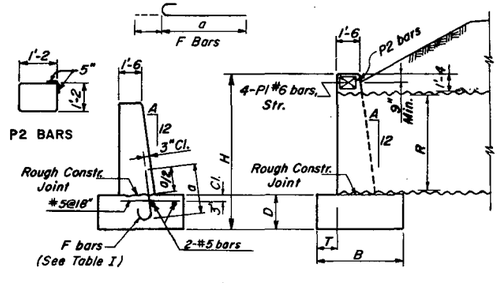


TYP. SECTION ALONG ℄ CULVERT



TYP. WING WALL SECTION

TYP. HEAD WALL SECTION

TABLE I

H Ha Hb	A	D	T Ta Tb	B Ba Bb	F - bars Size	 Spc.c/c	 Lg'th."a"	Maximum Design Found. Pressure
4'	0	2'-0	6"	3'-3	#5	1'-6	3'-6	.55 T/□'
5'			6"	3'-9				.65
6'			6"	4'-3				.75
7'			9"	4'-9				.85
8'			9"	5'-3				.95
9'	0		1'-0	5'-9				1.05
10'	1	2'-0	1'-0	6'-3			3'-6	1.15
11'	1	2'-6	1'-3	6'-9			4'-6	1.20
12'	1		1'-3	7'-3	#5			1.26
13'	2		1'-3	7'-6	#6			1.35
14'	2		1'-3	8'-6				1.45
15'	2	2'-6	1'-6	9'-0			4'-6	1.60
16'	3	3'-0	1'-6	9'-6			5'-0	1.70
17'			1'-6	10'-0				1.90
18'			1'-6	10'-6				2.00
19'			1'-6	11'-0				2.15
20'	3	3'-0	1'-6	11'-6	#6	1'-6	5'-0	2.30 T/□'

TABLE II

Normal Roadway Fill Slope N:1		Skew Angle	WING A La	 ha	WING B Lb	 hb
	½:1	90°	1.10 R - .55	.37 R + .82	1.10 R - .55	.37 R + .82
		75°	1.02 R - .51	.34 R + .58	1.24 R - .62	.41 R + 1.00
		60°	R - .50	.33 R + .33	1.50 R - .75	.50 R + 1.12
		45°	.88 R - .44	.41 R + .29	1.96 R - .98	.50 R + 1.17
	2:1	90°	1.46 R - .37	.37 R + .78	1.46 R - .37	.37 R + .78
		75°	1.36 R - .34	.34 R + .61	1.66 R - .41	.41 R + .93
		60°	1.33 R - .33	.33 R + .42	2.00 R - .50	.50 R + 1.02
		45°	1.17 R - .29	.41 R + .40	2.61 R - .65	.50 R + 1.07

NOTES

- Materials and workmanship shall be in accordance with Specifications Form 408.
- Design Specifications: Design Division of 1965- AASHO, "Standard Specifications for Highway Bridges," and as supplemented by the Current Design Manual, Part 4, Structures.
- Live Load: HS20-44
- Reinforcement bars shall conform to the requirements of Specifications Form 408, except that structural grade bars shall not be used. Bars shall be detailed in accordance with the current ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures. 2" concrete cover shall be provided on reinforcement bars except where noted otherwise.
- All concrete shall be Class B Cement Concrete.
- Exposed Concrete edges shall be chamfered 1"x 1".

INSTRUCTIONS

1. Establish H and determine A, B, D and T from table I.
2. Establish La, ha, Lb, hb from table II.
3. Make Ha = ha + D, Hb = hb + D and determine Ba, Bb, Ta and Tb from table I.
4. For Wing Walls, D & A to be provided as determined for Head Wall "H."
5. If bearing capacity of foundation is less than maximum design foundation pressure shown in table I, revise footing as required and check stability of wall.

APPROVED: MARCH 24, 1969
CHIEF ENGINEER

APPROVED: MARCH 24, 1969
BRIDGE ENGINEER

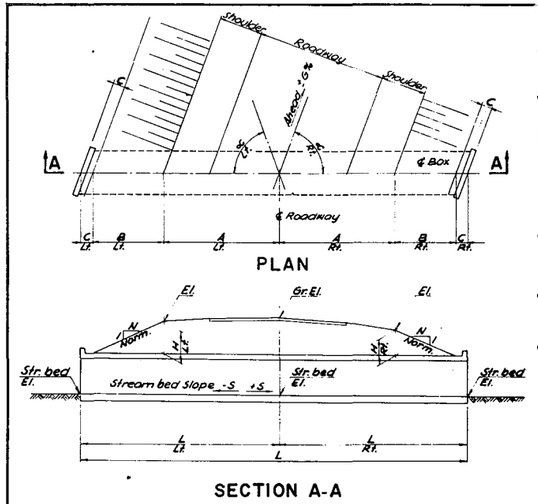
Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

STANDARD METAL CULVERTS

END WALL DETAILS

ST-131

SHEET 1 OF 1

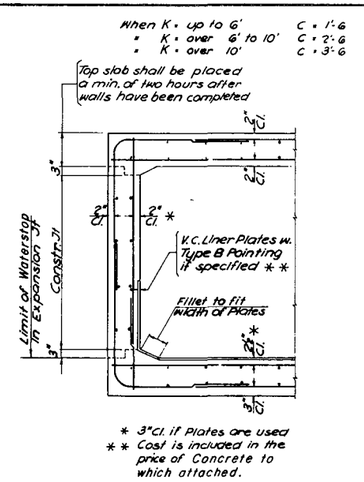


- To compute the length L it is necessary to find the dimensions B Lt and B Rt. All other dimensions can be easily obtained.
- ∠ = Skew angle N:1 = Normal slope of fill
  θ = Grade slope of roadway S = Stream bed slope
- Use value of G or S with the proper sign :
  +G = Grade slope up-ahead
  -G = " " down-ahead
  +S = Stream bed slope down-toward the right
  -S = " " " -toward the left
  Example : G = ± 0.05% = ± 0.0005
  S = ± 2.75% = ± 0.0275
- For ∠ Lt : B Lt. = $\frac{N \cdot H \cdot Lt.}{\sin \angle Lt. - G \cdot N \cdot \cos \angle Lt. + S \cdot N}$

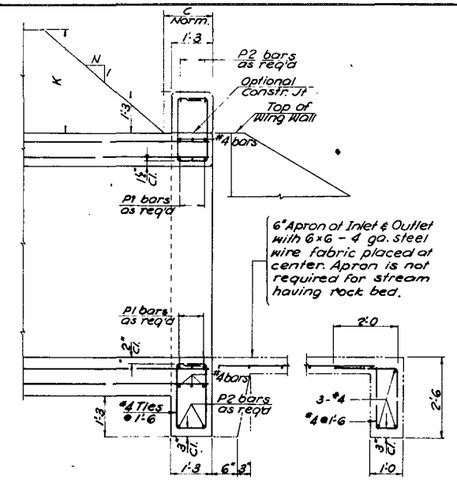
  B Rt. = $\frac{N \cdot H \cdot Rt.}{\sin \angle Lt. + G \cdot N \cdot \cos \angle Lt. - S \cdot N}$
- For ∠ Rt : B Lt. = $\frac{N \cdot H \cdot Lt.}{\sin \angle Rt. + G \cdot N \cdot \cos \angle Rt. + S \cdot N}$

  B Rt. = $\frac{N \cdot H \cdot Rt.}{\sin \angle Rt. - G \cdot N \cdot \cos \angle Rt. - S \cdot N}$
- The above equations for length are not applicable for culvert under roadway on horizontal or vertical curve.

LENGTH OF CULVERT



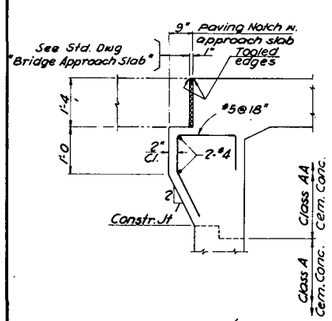
* 3" Cl. if Plates are used
** Cost is included in the price of Concrete to which attached.



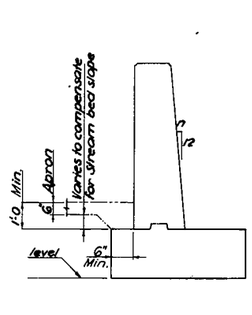
TYPICAL SECTIONS

NOTES

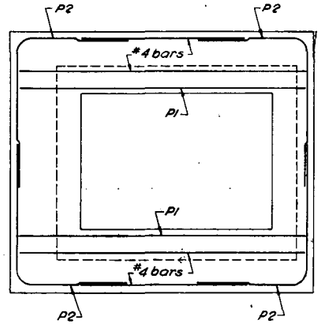
- Materials and workmanship shall be in accordance with Specifications Form 408.
- Design specifications : Design Division of 1969 AASHO "Standard Specifications for Highway Bridges", and as supplemented by the Design Manual, Part 4, Structures.
- Live Load : HS20-44
- Dead Load includes 30 lbs per sq. ft for future wearing surface on the top slab of boxes at grade.
- Class A Cem. Conc. shall be used in entire box and parapets, except Class AA Cem. Conc. shall be used in top slab (for boxes at grade). Class B Cem. Conc. shall be used in wingwalls and aprons.
- Reinforcement Bars shall conform to the requirements of Specifications Form 408 except that structural grade bars shall not be used. Bars shall be detailed in accordance with current ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures. 2" concrete cover shall be provided on reinforcement bars except where noted otherwise.
- At any time during placement of the backfill, the difference in fill elevations on the sides shall not exceed 2 feet. During compaction of the backfill, the wheels of rollers shall not come closer than one foot to the face of the structure.
- Exposed concrete edges shall be chamfered 1" × 1".



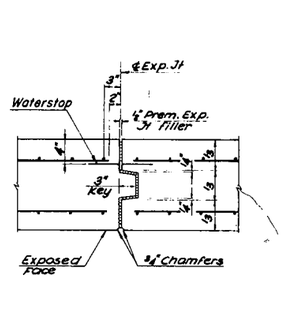
DETAIL OF BOX AT GRADE



SECTION B-B

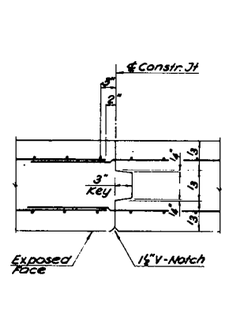


SECTION C-C

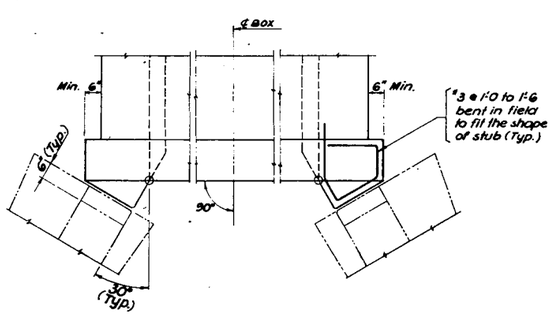


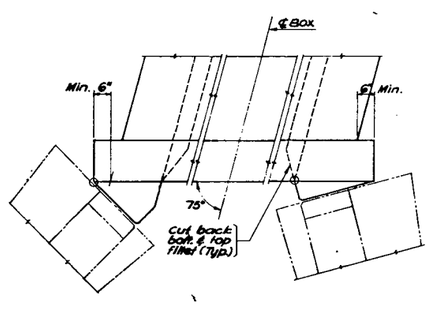
KEYED EXPANSION JT DETAIL

Flush Exp. Jt similar except omit Key

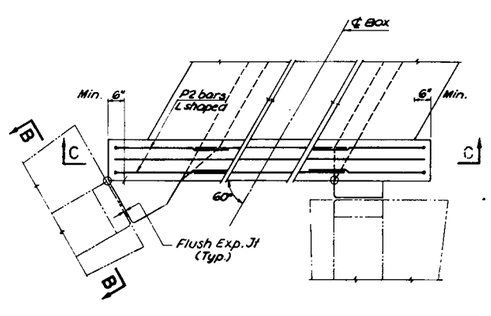


KEYED CONSTR. JT DETAIL





TYPICAL LAYOUT OF WING WALLS



APPROVED: DEC. 17, 1969
CHIEF ENGINEER

APPROVED: DEC. 17, 1969
BRIDGE ENGINEER

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD R. C. BOX CULVERTS DETAILS

SHEET 1 OF 5

ST-132

REINFORCED CONCRETE SINGLE CELL BOX CULVERTS

Box Size L x H	Design Depth of Fill, Feet	T1 *	T2	W	a	b	Type of Cross Section	B1 Size	B1 Spacing	B2 Size	B2 Spacing	B3 Size	B3 Spacing	B4 Size	B4 Spacing	B5 Size	B5 Spacing	B6 Size	B6 Spacing	B7 Size	B7 Spacing	B8 Size	B8 Spacing	B9 Size	B9 Spacing	B10 Size	B10 Spacing	Transverse Bars	Cement Concrete Cu. Yds.	Reinf. Bars Lbs.
6 x 4	0	10	10½	10	3	3	I	#4	19	#4	9½	#6	9½	–	–	#4	19			#6	9½	–	–	#4	9½	#4	19		.74	80
	2	10	10½	10	3	3	I	#4	19	#4	9½	#6	9½	–	–	#4	19			#6	9½	–	–	#4	9½	#4	19		.74	80
	4	10	10½	10	3	3	I	#4	17	#4	8½	#5	8½	–	–	#4	17			#4	8½	–	–	#4	8½	#4	17		.74	73
	6	10	10½	10	3	3	I	#4	17	#4	8½	#5	8½	–	–	#4	17			#4	8½	–	–	#4	8½	#4	17		.74	73
	8	10	10½	10	3	3	I	#4	20	#4	10	#6	10	–	–	#4	20			#5	10	–	–	#4	10	#4	20		.74	72
	12	10	10½	10	3	3	I	#4	20	#4	10	#6	10	–	–	#4	20			#5	10	–	–	#4	10	#4	20		.74	72
	16	10	10½	10	3	3	I	#4	16	#4	8	#6	8	–	–	#4	16			#5	8	–	–	#4	8	#4	16		.74	86
	20	10	10½	10	3	3	I	#4	18	#4	9	#7	9	–	–	#4	18			#6	9	–	–	#4	9	#4	18		.74	89
	24	10	10½	10	3	3	I	#4	16	#5	8	#7	16	#6	16	#4	16			#7	16	#5	16	#5	8	#4	16		.74	110
	28	10	11	10	3	3	I	#4	14	#5	7	#7	14	#6	14	#4	14			#7	14	#5	14	#5	7	#4	14		.75	125
	32	10	11½	10	3	3	I	#4	14	#5	7	#7	14	#7	14	#4	14			#7	14	#6	14	#5	7	#4	14		.76	131
	36	10	12	10	3	3	I	#4	14	#5	7	#7	14	#7	14	#4	14			#7	14	#7	14	#5	7	#4	14		.77	135
	40	10½	12½	10½	3	3	I	#4	13	#5	6½	#7	13	#7	13	#4	13			#7	13	#7	13	#5	6½	#4	13		.81	145
6 x 6	0	10	10½	12	3	3	I	#4	19	#4	9½	#6	9½	–	–	#4	19			#6	9½	–	–	#4	9½	#4	19		.96	91
	2	10	10½	12	3	3	I	#4	19	#4	9½	#6	9½	–	–	#4	19			#6	9½	–	–	#4	9½	#4	19		.96	91
	4	10	10½	12	3	3	I	#4	16	#4	8	#5	8	–	–	#4	16			#4	8	–	–	#4	8	#4	16		.96	92
	6	10	10½	12	3	3	I	#4	16	#4	8	#5	8	–	–	#4	16			#4	8	–	–	#4	8	#4	16		.96	92
	8	10	10½	12	3	3	I	#4	20	#4	10	#6	10	–	–	#4	20			#5	10	–	–	#4	10	#4	20		.96	83
	12	10	10½	12	3	3	I	#4	19	#4	9½	#6	9½	–	–	#4	19			#5	9½	–	–	#4	9½	#4	19		.96	86
	16	10	10½	12	3	3	I	#4	16	#4	8	#6	8	–	–	#4	16			#5	8	–	–	#4	8	#4	16		.96	98
	20	10	10½	12	3	3	I	#4	19	#5	9½	#7	9½	–	–	#4	19			#6	9½	–	–	#5	9½	#4	19		.96	111
	24	10	10½	12	3	3	I	#4	17	#5	8½	#7	17	#7	17	#4	17			#7	17	#5	17	#5	8½	#4	17		.96	122
	28	10	11	12	3	3	I	#4	14	#5	7	#7	14	#6	14	#4	14			#6	14	#6	14	#5	7	#4	14		.97	139
	32	10	11½	12	3	3	I	#4	14	#5	7	#7	14	#7	14	#4	14			#7	14	#6	14	#5	7	#4	14		.98	146
	36	10	12	12	3	3	I	#4	14	#5	7	#7	14	#7	14	#4	14			#7	14	#7	14	#6	7	#4	14		[illegible]	162
	40	10½	12½	12	3	3	I	#4	13	#5	6½	#7	13	#7	13	#4	13			#7	13	#7	13	#6	6½	#4	13		1.02	174
8 x 4	0	10	10½	10	3	3	I	#4	10½	#4	10½	#6	10½	–	–	#4	10½			#7	10½	–	–	#5	10½	#4	10½		.86	107
	2	10	10½	10	3	3	I	#4	10½	#4	10½	#6	10½	–	–	#4	10½			#7	10½	–	–	#4	10½	#4	10½		.86	107
	4	10	10½	10	3	3	I	#4	18	#4	9	#6	9	–	–	#4	18			#5	18	–	–	#4	9	#4	18		.86	87
	6	10	10½	10	3	3	I	#4	17	#4	8½	#6	8½	–	–	#4	17			#5	8½	–	–	#4	8½	#4	17		.86	92
	8	10	10½	10	3	3	I	#4	16	#4	8	#6	8	–	–	#4	16			#5	8	–	–	#4	8	#4	16		.86	97
	12	10	11	10	3	3	I	#4	19	#5	9½	#7	9½	–	–	#4	19			#6	9½	–	–	#5	9½	#4	19		.88	114
	16	10	11	10	3	3	I	#4	17	#5	8½	#7	8½	–	–	#4	17			#7	8½	–	–	#5	8½	#4	17		.88	131
	20	10	11½	10	3	3	I	#4	14	#5	7	#7	14	#7	14	#4	14			#7	14	#6	14	#5	7	#4	14		.89	148
	24	10½	12½	10½	3	3	I	#4	16	#5	8	#8	16	#8	16	#4	16			#8	16	#7	16	#5	8	#4	16		.96	155
	28	11	13	11	3	3	I	#4	15	#5	7½	#8	15	#8	15	#4	15			#8	15	#7	15	#6	7½	#4	15		1.00	163
	32	11½	13½	12	3	3	I	#4	14	#6	7	#8	14	#8	14	#4	14			#8	14	#7	14	#6	7	#4	14		1.07	208
	36	12	14	12½	3	3	II	#4	15	#5	15	#8	15	#9	15	#4	15			#8	15	#8	15	#5	15	#4	15		1.12	150
	40	12½	15	13½	3	3	II	#4	14	#5	14	#8	14	#8	14	#4	14			#8	14	#8	14	#5	14	#4	14		1.21	183
8 x 6	0	10	10½	12	3	3	I	#4	10½	#5	10½	#7	10½	–	–	#4	10½			#7	10½	–	–	#5	10½	#4	10½		1.08	135
	2	10	10½	12	3	3	I	#4	10½	#5	10½	#7	10½	–	–	#4	10½			#7	10½	–	–	#5	10½	#4	10½		1.08	135
	4	10	10½	12	3	3	I	#4	11½	#5	11½	#7	11½	–	–	#4	11½			#7	11½	–	–	#5	11½	#4	11½		1.08	105
	6	10	10½	12	3	3	I	#4	11	#5	11	#7	11	–	–	#4	11			#6	11	–	–	#5	11	#4	11		1.08	118
	8	10	10½	12	3	3	I	#4	11	#5	11	#7	11	–	–	#4	11			#6	11	–	–	#5	11	#4	11		1.08	125
	12	10	10½	12	3	3	I	#4	17	#5	8½	#7	8½	–	–	#4	17			#6	8½	–	–	#5	8½	#4	17		1.08	136
	16	10	11	12	3	3	I	#4	15	#5	7½	#7	7½	–	–	#4	15			#6	7½	–	–	#5	7½	#4	15		1.10	140
	20	10	12	12	3	3	I	#4	16	#5	8	#8	16	#7	16	#4	16			#7	16	#7	16	#6	8	#4	16		1.13	176
	24	10	12½	12	3	3	I	#4	14	#5	7	#8	14	#7	14	#4	14			#7	14	#7	14	#6	7	#4	14		1.14	182
	28	11	13½	12	3	3	I	#4	15	#5	7½	#8	5	#8	18	#4	15			#8	15	#7	15	#6	7½	#4	15		1.20	191
	32	11½	14	12½	3	3	I	#4	14	#5	7	#8	14	#8	14	#4	14			#8	14	#7	14	#6	7	#4	14		1.26	216
	36	12½	15	12½	3	3	II	#4	16	#5	16	#9	16	#9	16	#4	16			#9	16	#8	16	#5	16	#4	16		1.32	185
	40	13	15½	13½	3	3	II	#4	14	#5	14	#8	14	#9	14	#4	14			#8	14	#8	14	#5	14	#4	14		1.40	225
8 x 8	0	10	10½	12	3	3	I	#4	10	#4	10	#7	10	–	–	#4	10	#4	10	#7	10	–	–	#5	10	#4	10		1.23	144
	2	10	10½	12	3	3	I	#4	10	#4	10	#7	10	–	–	#4	10	#4	10	#7	10	–	–	#5	10	#4	10		1.23	144
	4	10	10½	12	3	3	I	#4	13	#5	13	#8	13	–	–	#4	13	#4	13	#7	13	–	–	#5	13	#4	13		1.23	132
	6	10	10½	12	3	3	I	#4	13	#5	13	#8	13	–	–	#4	13	#4	13	#7	13	–	–	#5	13	#4	13		1.23	132
	8	10	10½	12	3	3	I	#4	19	#5	9½	#7	9½	–	–	#4	19	#4	19	#6	9½	–	–	#5	9½	#4	19		1.23	137
	12	10	10½	12	3	3	I	#4	18	#5	9	#8	18	#7	18	#4	18	#4	18	#6	18	#6	18	#5	9	#4	18		1.23	157
	16	10	11½	12	3	3	I	#4	15	#5	7½	#7	15	#7	15	#4	15	#4	15	#7	15	#5	15	#5	7½	#4	15		1.26	176
	20	10	12	12	3	3	I	#4	17	#6	8½	#8	17	#8	17	#4	17	#4	17	#8	17	#6	17	#6	8½	#4	17		1.27	190
	24	10½	13	12	3	3	I	#4	16	#5	8	#8	16	#8	16	#4	16	#4	16	#8	16	#7	16	#6	8	#4	16		1.32	197
	28	11	14	12	3	3	I	#4	15	#5	7½	#8	15	#8	15	#4	15	#4	15	#8	15	#7	15	#6	7½	#4	15		1.37	200
	32	12	14½	12½	3	3	I	#4	16	#5	7½	#9	15	#8	15	#4	15	#4	15	#9	15	#7	16	#6	7½	#4	15		1.45	225
	36	12½	15	12½	3	3	II	#4	14	#5	14	#8	14	#9	14	#4	14	#4	14	#9	14	#7	14	#5	14	#4	14		1.48	220
	40	13	15½	13½	3	3	II	#4	15	#5	15	#9	16	#9	15	#4	15	#4	15	#9	16	#8	16	#5	15	#4	15		1.57	262

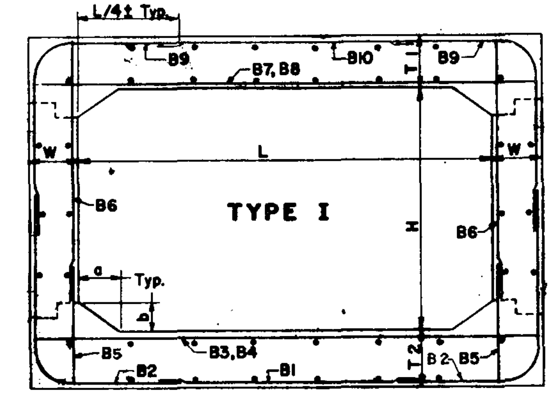
Box Size L x H	Design Depth of Fill, Feet	T1 *	T2	W	a	b	Type of Cross Section	B1 Size	B1 Spacing	B2 Size	B2 Spacing	B3 Size	B3 Spacing	B4 Size	B4 Spacing	B5 Size	B5 Spacing	B6 Size	B6 Spacing	B7 Size	B7 Spacing	B8 Size	B8 Spacing	B9 Size	B9 Spacing	B10 Size	B10 Spacing	Transverse Bars	Cement Concrete Cu. Yds.	Reinf. Bars Lbs.
10 x 4	0	10	10½	10	3	3	I	#4	14	#4	7	#6	14	#5	14	#4	14			#7	14	#6	14	#5	7	#4	14		1.00	116
	2	10	10½	10	3	3	I	#4	14	#4	7	#6	14	#6	14	#4	14			#7	14	#6	14	#5	7	#4	14		1.00	134
	4	10	10½	10	3	3	I	#4	15	#4	7½	#7	15	#5	15	#4	15			#6	15	#5	15	#5	7½	#4	16		1.00	115
	6	10	10½	10	3	3	I	#4	16	#5	8	#7	16	#6	16	#4	16			#6	16	#6	16	#5	8	#4	16		1.00	132
	8	10	10½	10	3	3	I	#4	15	#5	7½	#7	15	#6	15	#4	15			#6	15	#6	15	#5	7½	#4	15		1.00	139
	12	10	11½	10	3	3	I	#4	13	#5	6½	#6	13	#6	13	#4	13			#6	13	#6	13	#5	6½	#4	13		1.03	145
	16	10½	12½	10½	3	3	I	#4	15	#6	7½	#8	15	#7	15	#4	15			#8	15	#6	15	#6	7½	#4	15		[illegible]	196
	20	11	13	11½	3	3	I	#4	15	#6	7½	#8	15	#8	15	#4	15			#8	15	#7	15	#7	7½	#4	15		[illegible]	210
	24	12	14	12½	3	3	I	#4	14	#6	7	#8	14	#8	14	#4	14			#8	14	#7	14	#7	7	#4	14		[illegible]	233
	28	12½	15	14	3	3	II	#4	13	#5	13	#8	13	#8	13	#4	13			#8	13	#7	13	#7	13	#4	13		[illegible]	218
	32	13½	15½	14½	3	3	II	#4	12	#5	12	#8	12	#8	12	#4	12			#8	12	#7	12	#7	12	#4	12		1.48	221
	36	14	16	16	3	3	II	#4	12	#6	12	#7	12	#9	12	#4	12			#9	12	#7	12	#7	12	#4	12		1.57	234
	40	14½	17	17	3	3	II	#4	11½	#6	11½	#7	11½	#9	11½	#4	11½			#9	11½	#7	11½	#7	11½	#4	11½		1.67	245
10 x 6	0	10	10½	12	3	3	I	#4	17	#4	8½	#7	17	#6	17	#4	17			#7	17	#7	17	#5	8½	#4	17		[illegible]	140
	2	10	10½	12	3	3	I	#4	15	#5	7½	#7	15	#6	15	#4	15			#7	15	#6	15	#5	7½	#4	15		[illegible]	162
	4	10	10½	12	3	3	I	#4	18	#5	9	#7	18	#7	18	#4	18			#6	18	#6	18	#5	9	#4	18		[illegible]	139
	6	10	10½	12	3	3	I	#4	15	#5	7½	#7	15	#7	15	#4	15			#6	15	#5	15	#5	7½	#4	15		1.21	160
	8	10	11	12	3	3	I	#4	14	#5	7	#7	14	#6	14	#4	14			#6	14	#5	14	#5	7	#4	14		1.23	171
	12	10	11½	12	3	3	I	#4	17	#6	8½	#8	17	#7	17	#4	17			#7	17	#7	17	#6	8½	#4	17		1.25	175
	16	10	12½	12	3	3	I	#4	13	#5	6½	#8	13	#6	13	#4	13			#7	13	#7	13	#6	6½	#4	13		1.28	227
	20	11½	14	12	3	3	I	#4	14	#5	7	#8	14	#8	14	#4	14			#8	14	#7	14	#6	7	#4	14		1.40	251
	24	12½	14½	12½	3	3	I	#4	14	#6	7	#8	14	#8	14	#4	14			#8	14	#8	14	#6	7	#4	14		1.47	267
	28	13½	15	13½	3	3	II	#4	13	#5	13	#7	13	#9	13	#4	13			#9	13	#7	13	#5	13	#4	13		1.56	243
	32	14	16	14½	3	3	II	#4	12	#5	12	#7	12	#9	12	#4	12			#9	12	#7	12	#5	12	#4	12		1.69	252
	36	15	16½	15½	3	3	II	#4	12	#5	12	#8	12	#9	12	#4	12			#9	12	#7	12	#5	12	#4	12		1.80	267
	40	15½	17½	16½	3	3	II	#4	12	#5	12	#8	12	#9	12	#4	12			#9	12	#8	12	#5	12	#4	12		1.92	281
10 x 8	0	10	10½	12	3	3	I	#4	16	#4	8	#7	16	#6	16	#4	16	#4	16	#7	16	#6	16	#5	8	#4	16		1.36	146
	2	10	10½	12	3	3	I	#4	16	#5	8	#7	16	#7	16	#4	16	#4	16	#7	16	#7	16	#5	8	#4	16		1.36	190
	4	10	11	12	3	3	I	#4	17	#5	8½	#7	17	#7	17	#4	17	#4	17	#6	17	#6	17	#5	8½	#4	17		1.38	181
	6	10	11	12	3	3	I	#4	16	#5	8	#8	16	#6	16	#4	16	#4	16	#6	16	#6	16	#5	8	#4	16		1.38	196
	8	10	11½	12	3	3	I	#4	15	#5	7½	#8	15	#6	15	#4	15	#4	15	#6	15	#6	15	#5	7½	#4	15		1.39	200
	12	10	12	12	3	3	I	#4	15	#5	7½	#8	15	#7	15	#4	15	#4	15	#7	15	#6	15	#6	7½	#4	15		1.41	210
	16	10½	13	12	3	3	I	#4	15	#5	7½	#8	15	#8	15	#4	15	#4	15	#8	15	#7	15	#6	7½	#4	15		1.47	230
	20	11½	14½	12	3	3	I	#4	14	#5	7	#8	14	#8	14	#4	14	#4	14	#8	14	#7	14	#6	7	#4	14		1.56	262
	24	13	15	12	3	3	I	#4	15	#6	7½	#9	15	#8	15	#4	15	#4	15	#9	15	#8	15	#6	7½	#4	15		1.63	280
	28	14	16	13	3	3	II	#4	14	#5	14	#8	14	#9	14	#4	14	#4	14	#9	14	#8	14	#5	14	#4	14		1.78	276
	32	14½	16½	14	3	3	II	#4	13	#5	13	#8	13	#9	13	#4	13	#4	13	#9	13	#8	13	#5	13	#4	13		1.87	287
	36	15½	17½	15	3	3	II	#4	12	#5	12	#8	12	#9	12	#4	12	#4	12	#9	12	#8	12	#5	12	#4	12		2.02	290
	40	16	18	16	3	3	II	#4	11½	#5	11½	#8	11½	#9	11½	#4	11½	#4	11½	#9	11½	#8	11½	#5	11½	#4	11½		2.12	310
10 x 10	0	10	10½	12	3	3	I	#4	16	#4	8	#7	16	#7	16	#4	16	#4	16	#7	16	#7	16	#5	8	#4	16		1.51	185
	2	10	11	12	3	3	I	#4	15	#4	7½	#7	15	#7	15	#4	15	#4	15	#7	15	#7	15	#5	7½	#4	15		1.52	194
	4	10	11	12	3	3	I	#4	17	#5	8½	#8	17	#7	17	#4	17	#4	17	#6	17	#6	17	#5	8½	#4	17		1.52	184
	6	10	11½	12	3	3	I	#4	16	#5	8	#8	16	#7	16	#4	16	#4	16	#6	16	#6	16	#5	8	#4	16		1.54	192
	8	10	12	12	3	3	I	#4	18	#5	9	#8	18	#8	18	#4	18	#4	18	#7	18	#6	18	#6	9	#4	18		1.56	202
	12	10	12½	12	3	3	I	#4	17	#5	8½	#8	17	#8	17	#4	17	#4	17	#7	17	#7	17	#6	8½	#4	17		1.58	212
	16	10½	13½	12	3	3	I	#4	14	#5	7	#8	14	#8	14	#4	14	#4	14	#7	14	#7	14	#6	7	#4	14		1.64	257
	20	11½	14½	12	3	3	I	#4	14	#5	7	#9	14	#8	14	#4	14	#4	14	#8	14	#7	14	#6	7	#4	14		1.71	279
	24	13	15½	12½	3	3	I	#4	15	#6	7½	#9	15	#9	15	#4	15	#4	15	#9	15	#8	15	#6	7½	#4	15		1.83	302
	28	14	16½	13	3	3	I	#4	15	#6	7½	#9	15	#9	15	#4	15	#4	15	#9	15	#9	15	#6	7½	#4	15		2.10	365
	32	14½	17	14½	3	3	II	#4	13	#5	13	#8	13	#9	13	#4	13	#4	13	#9	13	#8	13	#5	13	#4	13		[illegible]	347
	36	15½	18	15	3	3	II	#4	12	#5	12	#8	12	#9	12	#4	12	#4	12	#9	12	#8	12	#5	12	#4	12		2.22	384
	40	16	18½	16	3	3	II	#4	12	#5	12	#9	12	#9	12	#4	12	#4	12	#9	12	#8	12	#5	12	#4	12		[illegible]	393
12 x 6	0	10	10½	12	3	3	I	#4	18	#5	9	#7	18	#7	18	#4	18			#8	18	#8	18	#6	9	#4	18		1.34	186
	2	10	11	12	3	3	I	#4	16	#5	8	#7	16	#7	16	#4	16			#8	16	#7	16	#6	8	#4	16		1.36	210
	4	10	11	12	3	3	I	#4	17	#6	8½	#8	17	#7	17	#4	17			#7	17	#6	17	#6	8½	#4	17		1.36	185
	6	10	11½	12	3	3	I	#4	15	#6	7½	#8	18	#7	15	#4	15			#7	15	#6	15	#6	7½	#4	15		1.38	201
	8	10	12	12	3	3	I	#4	17	#6	8½	#8	17	#8	17	#4	17			#8	17	#6	17	#7	8½	#4	17		1.40	225
	12	10½	13½	12	3	3	I	#4	16	#6	8	#9	16	#8	16	#4	16			#8	16	#7	16	#7	8	#4	16		1.49	259
	16	12	14	12	3	3	I	#4	17	#7	8½	#10	17	#7	17	#4	17			#9	17	#8	17	#7	8½	#4	17		1.58	266
	20	13	15½	13½	3	3	I	#4	15	#7	7½	#9	15	#8	15	#4	15			#9	15	#8	15	#7	7½	#4	15		1.75	304
	24	14½	16½	14½	3	3	II	#4	13	#5	13	#8	13	#9	13	#4	13			#9	13	#8	13	#5	13	#4	13		1.92	272
	28	15	17	16	3	3	II	#4	12	#5	12	#8	12	#9	12	#4	12			#9	12	#8	12	#5	12	#4	12		2.05	302
	32	16	18	17½	3	3	II	#4	15	#6	15	#9	15	#10	15	#4	15			#10	15	#9	15	#6	15	#4	15		2.21	315
	36	16½	19	18½	3	3	II	#4	13	#7	13	#8	13	#10	13	#4	13			#10	13	#8	13	#7	13	#4	13		2.34	356
	40	17½	19½	20	3	3	II	#4	12	#7	12	#8	12	#10	12	#4	12			#10	12	#8	12	#7	12	#4	12		2.49	387

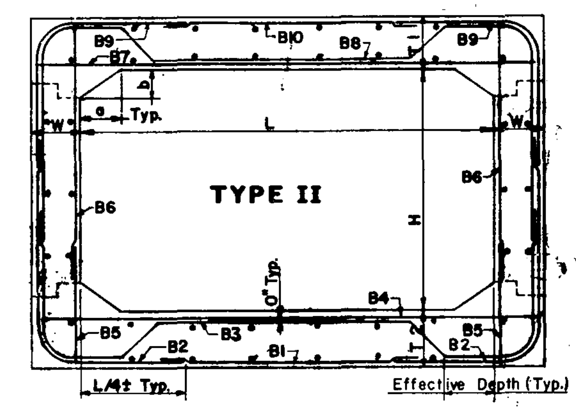
Extend dowel B5

Transverse Bars: Transverse (parallel to Centerline Culverts) reinforcement bars shall be provided as specified in Design Manual, Part 4, Structures.

* For boxes at grade (i.e. 0' fill) with ½" integral wearing surface (i.e. without bituminous wearing surface course), the values of T1 = tabulated values +½"

TYPICAL CROSS SECTIONS





APPROVED: DEC. 17, 1969
CHIEF ENGINEER

APPROVED: DEC. 17, 1969
BRIDGE ENGINEER

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
R.C. BOX CULVERTS
DESIGN

SHEET 2 OF 5

ST-132

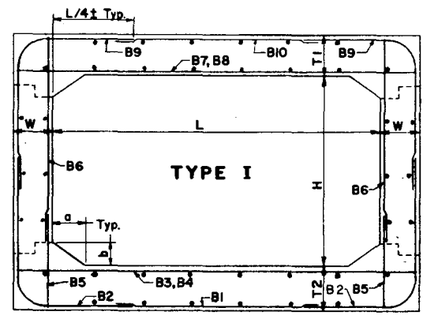
REINFORCED CONCRETE SINGLE CELL BOX CULVERTS

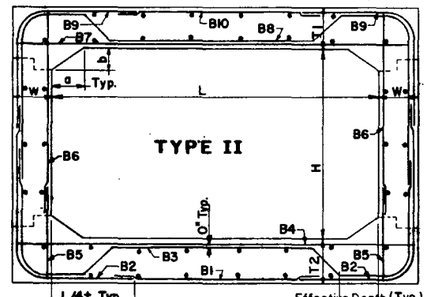
Box Size L x H	Design Depth of fill, Feet	Dimensions in Inches T1 *	T2	W	a	b	Type of Cross Section	REINFORCEMENT BARS B1 Size	B1 Spacing	B2 Size	B2 Spacing	B3 Size	B3 Spacing	B4 Size	B4 Spacing	B5 Size	B5 Spacing	B6 Size	B6 Spacing	B7 Size	B7 Spacing	B8 Size	B8 Spacing	B9 Size	B9 Spacing	B10 Size	B10 Spacing	Transverse Bars	Approx. Quantities per lin. ft. Cement Concrete Cu. Yds.	Reinf. Bars Lbs.
12 x 8	0	10½	1'	1'2	3	3	I	#4	13	#4	6	#3	3	#5	3	#4	3	#4	13	#7	13	#6	13	#5	6½	#4	13		1.51	210
	2	10	11½	1'	3	3	I	#4	16	#5	8	#3	3	#7	16	#4	16	#4	16	#8	16	#7	16	#6	8	#4	16		1.53	236
	4	10	11½	1'2	3	3	I	#4	16	#5	8	#8	16	#7	16	#4	16	#4	16	#7	16	#5	16	#6	8	#4	16		1.53	219
	6	10	12½	1'2	3	3	I	#4	15	#5	7½	#5	7½	#5	15	#4	15	#4	15	#7	15	#6	15	#6	7½	#4	15		1.56	225
	8	10	13	1'2	3	3	I	#4	14	#5	7	#5	14	#7	14	#4	14	#4	14	#7	14	#7	14	#6	7	#4	14		1.59	236
	12	11	14	1'2	3	3	I	#4	13	#6	8½	#8	13	#9	18	#4	18	#4	18	#9	18	#8	18	#7	9	#4	18		1.67	290
	16	12	15	1'2½	3	3	I	#4	17	#6	8½	#9	17	#9	17	#4	17	#4	17	#9	17	#8	17	#7	8½	#4	17		1.80	303
	20	14	16	1'3	3	3	I	#4	15	#6	7½	#9	15	#9	15	#4	15	#9	15	#8	15	#7	7½	#4	15	#5	15		1.96	340
	24	14½	17	1'4½	3	3	II	#5	14	#5	14	#9	14	#9	14	#5	14	#5	14	#8	14	#5	14	#5	14	#4	14		2.13	301
	28	15½	18	1'5½	3	3	II	#5	15	#5	15	#9	15	#10	15	#5	15	#4	15	#10	15	#9	15	#5	15	#4	15		2.28	336
	32	16½	19	1'6½	3	3	II	#5	15	#5	15	#10	15	#10	15	#5	15	#4	15	#10	15	#9	15	#5	15	#4	15		2.44	347
	36	17½	20	1'7½	3	3	II	#5	14	#5	14	#10	14	#10	14	#5	14	#4	14	#10	14	#9	14	#5	14	#4	14		2.60	385
	40	18	20½	1'8	3	3	II	#5	13	#5	13	#10	13	#10	13	#5	13	#4	13	#10	13	#10	13	#5	13	#4	13		2.75	425
12 x 10	0	10	11½	1'2	3	3	I	#4	13	#5	6½	#7	13	#6	13	#4	13	#4	13	#7	13	#6	13	#5	6½	#4	13		1.67	230
	2	10	12	1'2	3	3	I	#4	13	#4	6½	#7	13	#7	13	#4	13	#4	13	#7	13	#5	13	#5	6½	#4	13		1.72	280
	4	10	12	1'2	3	3	I	#4	17	#5	8½	#8	17	#8	17	#4	17	#4	17	#7	17	#7	17	#6	3½	#4	17		1.70	241
	6	10	12½	1'2	3	3	I	#4	15	#5	7½	#8	15	#8	15	#4	15	#4	15	#7	15	#6	15	#6	7½	#4	15		1.72	256
	8	10	13½	1'2	3	3	I	#4	13	#5	6½	#8	13	#7	13	#4	13	#4	13	#7	13	#6	13	#6	6½	#4	13		1.76	278
	12	11	14½	1'2	3	3	I	#4	13	#5	6½	#8	13	#8	13	#4	13	#4	13	#8	13	#6	13	#6	6½	#4	13		1.85	326
	16	12½	15½	1'2	3	3	I	#4	16	#6	8	#8	16	#8	16	#4	16	#4	16	#8	16	#7	8	#5	16	#4	16		1.95	352
	20	14	16½	1'3	3	3	I	#4	6	#6	8	#9	16	#9	16	#4	16	#9	16	#9	16	#7	8	#5	16	#4	16		2.14	378
	24	15	17½	1'4	3	3	II	#4	5	#5	15	#5	15	#10	15	#5	15	#5	15	#10	15	#8	15	#5	15	#4	15		2.31	348
	28	16	18½	1'5	3	3	II	#5	14	#5	14	#9	14	#10	14	#5	14	#4	14	#10	14	#8	13	#5	13	#4	13		2.47	388
	32	17	19½	1'6½	3	3	II	#5	13	#5	13	#9	13	#10	13	#5	13	#4	13	#10	13	#8	13	#5	13	#4	13		2.69	424
	36	18	20½	1'7½	3	3	II	#5	12	#5	12	#9	12	#10	12	#5	12	#4	12	#10	12	#8	12	#5	12	#4	12		2.86	446
	40	18½	21½	1'8½	3	3	II	#5	12	#5	12	#9	12	#10	12	#5	12	#4	12	#10	12	#9	12	#5	12	#4	12		3.01	468
14 x 6	0	10½	12	1'2	3	3	I	#4	14	#6	7	#8	14	#6	14	#4	14	#7	14	#7	14	#5	7	#4	14		1.56	260
	2	11	13	1'2	3	3	I	#4	16	#6	8	#8	16	#4	16	#4	16	#8	16	#8	16	#6	8	#4	16		1.64	284
	4	10	12	1'2	3	3	I	#4	16	#6	8	#8	16	#6	16	#4	16	#8	16	#7	16	#7	8	#4	16		1.53	272
	6	10	13	1'2	3	3	I	#4	16	#6	8	#8	16	#6	16	#4	16	#8	16	#7	16	#7	8	#4	16		1.59	292
	8	11	13½	1'2	3	3	I	#4	15	#6	7½	#9	15	#7	15	#4	15	#4	15	#8	15	#7	15	#7	7½	#4	15		1.66	311
	12	12½	14½	1'3	3	3	I	#4	13	#6	8½	#9	17	#9	17	#4	17	#4	17	#9	17	#8	17	#8	8½	#4	17		1.84	362
	16	13½	15½	1'4	3	3	I	#4	16	#8	8	#9	16	#8	16	#4	16	#4	16	#9	16	#8	8	#4	16	#5	16		1.99	413
	20	14½	17	1'5	3	3	II	#5	16	#5	16	#9	16	#10	16	#4	16	#4	16	#10	16	#9	16	#7	16	#4	16		2.19	403
	24	15½	18	1'6	3	3	II	#4	15	#7	15	#9	14	#10	14	#4	14	#4	14	#10	14	#9	14	#8	14	#4	14		2.40	394
	28	16½	19	1'7	3	3	II	#5	14	#9	14	#9	14	#10	14	#4	14	#4	14	#10	14	#9	14	#8	14	#4	14		2.59	440
	32	17½	20	20½	3	3	II	#4	14	#7	14	#10	14	#10	14	#4	14	#4	14	#10	14	#9	14	#9	14	#4	14		2.79	501
	36	18½	21	21½	3	3	II	#4	13	#6	13	#10	13	#10	13	#4	13	#4	13	#10	13	#9	13	#8	13	#4	13		2.94	507
	40	19½	22	23	3	3	II	#4	13	#7	13	#10	13	#10	13	#4	13	#4	13	#10	13	#10	13	#8	13	#4	13		3.14	511
14 x 8	0	10½	13	1'2	3	3	I	#4	14	#5	7	#8	14	#7	14	#4	14	#4	14	#8	14	#6	14	#5	7	#4	14		1.76	274
	2	11	13½	1'2	3	3	I	#4	13	#6	9	#9	18	#9	18	#4	18	#4	18	#10	18	#6	13	#6	9	#4	18		1.81	291
	4	10	12½	1'2	3	3	I	#4	16	#6	8	#8	16	#8	16	#4	16	#4	16	#8	16	#7	16	#6	8	#4	16		1.70	285
	6	10½	13½	1'2	3	3	I	#4	14	#5	7	#8	14	#8	14	#4	14	#4	14	#7	14	#7	14	#6	7	#4	14		1.78	282
	8	11	14½	1'2	3	3	I	#4	12	#5	6	#8	12	#7	12	#4	12	#4	12	#7	12	#7	12	#6	6	#4	12		1.86	318
	12	12½	15½	1'2½	3	3	I	#4	18	#7	9	#10	18	#9	18	#4	18	#4	18	#9	18	#9	18	#8	9	#4	18		2.01	366
	16	14	16½	1'3½	3	3	I	#4	18	#7	9	#10	18	#10	18	#4	18	#4	18	#10	18	#9	18	#8	9	#4	18		2.23	414
	20	15½	18	1'5	3	3	I	#4	16	#7	8	#10	16	#10	16	#4	16	#4	16	#10	16	#9	16	#8	8	#4	16		2.45	433
	24	16½	19	19½	3	3	II	#4	15	#5	15	#10	15	#10	15	#4	15	#4	15	#10	15	#9	15	#5	15	#4	15		2.66	402
	28	17½	20½	21½	3	3	II	#4	15	#5	15	#11	15	#11	15	#4	15	#4	15	#11	15	#9	15	#6	15	#4	15		2.86	423
	32	18½	21	19½	3	3	II	#4	15	#5	15	#10	15	#11	15	#4	15	#4	15	#11	15	#9	15	#7	15	#4	15		3.07	461
	36	19½	22½	20½	3	3	II	#4	14	#5	14	#10	14	#11	14	#4	14	#4	14	#11	14	#9	14	#7	14	#4	14		3.28	470
	40	20½	23	22	3	3	II	#4	13	#5	13	#10	13	#11	13	#4	13	#4	13	#11	13	#9	13	#7	13	#4	13		3.47	492
14 x 10	0	10½	13½	1'2	3	3	I	#4	16	#5	8	#9	16	#7	16	#4	16	#4	16	#8	16	#7	16	#6	8	#4	16		1.93	283
	2	11½	14	1'2	3	3	I	#4	14	#5	7	#8	14	#8	14	#4	14	#4	14	#7	14	#5	7	#4	14		2.01	298
	4	10	13	1'2	3	3	I	#4	15	#5	7½	#8	15	#8	15	#4	15	#4	15	#8	15	#6	15	#6	7½	#4	15		1.88	289
	6	10½	14	1'2	3	3	I	#4	14	#5	7	#8	14	#8	14	#4	14	#4	14	#8	14	#6	14	#6	7	#4	14		1.96	307
	8	11½	15	1'3	3	3	I	#5	13	#5	6½	#8	13	#8	13	#4	13	#4	13	#8	13	#6	13	#6	6½	#4	13		2.06	325
	12	13	16	1'3½	3	3	I	#4	18	#7	9	#11	18	#8	18	#4	18	#4	18	#10	18	#8	18	#7	9	#4	18		2.22	370
	16	14	17	1'4½	3	3	I	#4	17	#7	8½	#11	17	#9	17	#4	17	#4	17	#10	17	#9	17	#7	8½	#4	17		2.39	416
	20	15½	18½	1'5½	3	3	I	#4	17	#7	8½	#11	17	#10	17	#4	17	#4	17	#11	17	#9	17	#8	8½	#4	17		2.62	460
	24	17	20	20½	3	3	I	#4	16	#7	8	#11	16	#10	16	#4	16	#4	16	#10	16	#8	8	#4	16	#5	16		2.90	507
	28	18	21	21½	3	3	II	#4	15	#5	15	#10	15	#11	15	#4	15	#4	15	#10	15	#10	15	#5	15	#4	15		3.12	406
	32	19	22	22½	3	3	II	#4	14	#5	14	#10	14	#11	14	#4	14	#4	14	#10	14	#10	14	#5	14	#4	14		3.31	422
	36	20	23	20	3	3	II	#4	13	#5	13	#10	13	#11	13	#4	13	#4	13	#10	13	#10	13	#5	13	#4	13		3.54	433
	40	21	24	21½	3	3	II	#4	14	#5	14	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#5	14	#4	14		3.87	473
16 x 8	0	11	13½	1'2	3	3	I	#4	17	#6	8½	#9	17	#8	17	#4	17	#4	17	#9	17	#8	17	#5	8½	#4	17		1.96	313
	2	12	14½	1'2	3	3	I	#4	17	#6	8½	#9	17	#9	17	#4	17	#4	17	#9	17	#8	17	#5	8½	#4	17		2.07	336
	4	11	13½	1'2	3	3	I	#4	17	#6	8½	#9	17	#8	17	#4	17	#4	17	#9	17	#7	8½	#4	17		1.96	332
	6	11½	15	1'2	3	3	I	#4	17	#6	8½	#9	17	#9	17	#4	17	#4	17	#9	17	#8	17	#7	8½	#4	17		2.07	360
	8	12½	16½	1'2½	3	3	I	#4	18	#7	9	#10	18	#9	18	#4	18	#4	18	#9	18	#8	9	#5	18	#4	18		2.18	405
	12	14	17	1'4	3	3	I	#4	16	#7	8	#10	16	#9	16	#4	16	#4	16	#9	16	#8	8	#5	16	#4	16		2.39	470
	16	15½	18½	1'5	3	3	I	#5	14	#7	7	#10	14	#9	14	#4	14	#4	14	#9	14	#8	14	#5	7	#4	14		2.72	540
	20	17	20½	1'6	3	3	I	#4	12	#7	6	#10	12	#8	12	#4	12	#4	12	#8	12	#8	12	#6	6	#4	12		2.96	580
	24	18	21	21½	3	3	II	#4	13	#5	15	#10	15	#8	15	#5	15	#5	15	#10	15	#8	15	#5	15	#4	15		3.25	465
	28	19½	22½	23	3	3	II	#4	14	#5	14	#10	14	#11	14	#4	14	#4	14	#10	14	#9	14	#6	14	#4	14		3.54	500
	32	20½	23½	24	3	3	II	#4	13	#5	13	#10	13	#11	13	#4	13	#4	13	#10	13	#10	13	#6	13	#4	13		3.77	548
	36	21	24½	24	3	3	II	#4	12	#5	12	#10	12	#11	12	#4	12	#4	12	#10	12	#10	12	#7	12	#4	12		4.00	586
	40	22	25½	25½	3	3	II	#4	12	#6	12	#10	12	#11	12	#4	12	#4	12	#10	12	#10	12	#8	12	#4	12		4.24	645
16 x 10	0	11	14	1'2	3	3	I	#4	15	#6	9	#9	18	#9	18	#4	15	#6	9	#9	18	#9	15	#5	18	#4	18		2.13	330
	2	12	15	1'2	3	3	I	#4	18	#6	9	#10	18	#9	15	#4	18	#4	18	#9	18	#9	18	#6	9	#4	18		2.25	361
	4	11	14½	1'2	3	3	I	#4	18	#5	9	#9	18	#9	18	#4	18	#4	18	#9	18	#9	18	#7	9	#4	18		2.17	303
	6	12	15½	1'2	3	3	I	#4	18	#6	9	#10	18	#9	18	#4	18	#4	18	#9	18	#9	18	#7	9	#4	18		2.27	375
	8	13	16	1'2½	3	3	I	#4	17	#7	8½	#10	17	#8	17	#4	17	#4	17	#9	17	#9	17	#7	8½	#4	17		2.40	414
	12	14½	17½	1'4	3	3	I	#4	15	#7	7½	#11	14	#11	14	#4	15	#4	15	#9	15	#7	7½	#4	15		2.84	475
	16	16	19	1'5½	3	3	I	#4	12	#6	6	#9	12	#9	12	#4	12	#4	12	#9	12	#8	12	#7	6	#4	12		2.97	503
	20	17½	20½	1'6½	3	3	I	#4	12	#7	6	#10	12	#9	12	#4	12	#4	12	#9	12	#9	12	#7	6	#4	12		3.23	539
	24	19	22	1'8	3	3	I	#4	13	#7	6½	#11	13	#9	13	#4	13	#4	13	#11	13	#8	13	#7	6½	#4	13		3.52	571
	28	20½	24½	1'9½	3	3	I	#4	13	#7	6½	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#8	13	#4	13		3.76	560
	32	21½	24½	21	3	3	II	#4	13	#5	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#9	13	#4	13		4.07	595
	36	22	25½	22	3	3	II	#4	13	#5	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#6	13	#4	12		4.33	609
	40	23	26½	24½	3	3	II	#4	12	#5	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#6	12	#4	12		4.59	676
16 x 12	0	11	14½	1'2	3	3	I	#4	13	#6	9	#10	13	#8	13	#4	13	#4	13	#8	13	#8	13	#6	8	#4	13		2.31	346
	2	12	15½	1'2	3	3	I	#4	16	#6	8	#10	16	#8	16	#4	16	#4	16	#9	16	#8	16	#6	8	#4	16		2.42	386
	4	11½	15	1'2	3	3	I	#4	13	#5	6½	#9	13	#8	13	#4	13	#4	13	#8	13	#8	13	#6	6½	#4	13		2.37	373
	6	12	16	1'2	3	3	I	#4	13	#5	6½	#9	13	#8	13	#4	13	#4	13	#8	13	#8	13	#7	6½	#4	13		2.45	390
	8	13	16½	1'2½	3	3	I	#4	16	#6	9	#10	16	#9	16	#4	16	#4	16	#9	16	#8	16	#7	9	#4	16		2.58	422
	12	14½	18	1'4½	3	3	I	#4	15	#6	7½	#10	15	#10	15	#5	15	#5	15	#9	15	#9	15	#7	7½	#4	15		2.84	480
	16	16½	20	1'5	3	3	I	#4	14	#6	7	#10	14	#10	14	#4	14	#4	14	#10	14	#9	14	#7	7	#4	14		3.20	546
	20	17½	21	1'6½	3	3	I	#4	12	#6	6	#10	12	#9	12	#4	12	#4	12	#9	12	#9	12	#7	6	#4	12		3.46	610
	24	19	22½	1'8	3	3	I	#4	13	#7	6½	#11	13	#10	13	#4	13	#4	13	#10	13	#10	13	#7	6½	#4	13		3.77	677
	28	20½	24	19½	3	3	II	#4	14	#5	14	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#5	14	#4	14		4.10	620
	32	21½	25½	21	3	3	II	#4	13	#5	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#5	13	#4	13		4.39	643
	36	23	26½	22½	3	3	II	#4	12	#5	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#5	12	#4	12		4.69	670
	40	24	27½	24	3	3	II	#4	12	#5	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#5	12	#4	12		4.96	706
16 x 14	0	11	15	1'2	3	3	I	#4	7	#6	9½	#9	17	#9	17	#4	17	#4	17	#9	17	#9	17	#6	9½	#4	17		2.49	376
	2	12½	16	1'2	3	3	I	#4	13	#5	6½	#9	13	#8	13	#4	13	#4	13	#8	13	#8	13	#6	13	#4	13		2.63	420
	4	11½	15	1'2	3	3	I	#4	13	#5	6½	#9	13	#7	13	#4	13	#4	13	#8	13	#8	13	#6	6½	#4	13		2.52	397
	6	12	16	1'2½	3	3	I	#4	12	#5	6	#9	12	#8	12	#4	12	#4	12	#8	12	#8	12	#6	6	#4	12		2.64	420
	8	13	17	1'3½	3	3	I	#4	12	#6	6	#9	12	#8	12	#4	12	#4	12	#8	12	#7	12	#6	6	#4	12		2.76	450
	12	14½	18½	14	3	3	I	#4	14	#6	7	#10	14	#9	14	#4	14	#4	14	#10	14	#7	14	#7	7	#4	14		3.08	510
	16	16½	20	15½	3	3	I	#4	14	#7	7	#10	14	#10	14	#4	14	#4	14	#10	14	#9	14	#7	7	#4	14		3.44	587
	20	17½	21½	16½	3	3	I	#4	13	#7	6½	#10	13	#10	13	#4	13	#4	13	#10	13	#9	13	#7	6½	#4	13		3.80	670
	24	18½	23	18	3	3	I	#4	14	#7	7	#11	14	#11	14	#4	14	#4	14	#10	14	#10	14	#8	7	#4	14		4.05	730
	28	20½	24½	19½	3	3	I	#4	13	#7	6½	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#9	6½	#4	13		4.36	760
	32	22	26	21	3	3	I	#4	13	#5	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#5	13	#4	13		4.71	690
	36	23	27	22½	3	3	II	#4	12	#5	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#5	12	#4	12		5.00	715
	40	24	29	24	3	3	II	#4	12	#5	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#5	12	#4	12		5.35	761

Transverse (parallel to Centerline Culverts) reinforcement bars shall be provided as specified in Design Manual, Part 4, Structures.

* For boxes at grade (i.e. 0' fill) with ½" integral wearing surface (i.e. without bituminous wearing surface course), the values of T1 = tabulated values + ½"

TYPICAL CROSS SECTIONS





APPROVED: DEC. 17, 1969
CHIEF ENGINEER

APPROVED: DEC. 17, 1969
BRIDGE ENGINEER

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
R.C. BOX CULVERTS
DESIGN

SHEET 3 OF 5

ST-132

81288 PEL-X

REINFORCED CONCRETE SINGLE CELL BOX CULVERTS

Box Size L x H	Design Depth of Fill, Feet	T1 *	T2	W	a	b	Type of Cross Section	B1 Size	B1 Spacing	B2 Size	B2 Spacing	B3 Size	B3 Spacing	B4 Size	B4 Spacing	B5 Size	B5 Spacing	B6 Size	B6 Spacing	B7 Size	B7 Spacing	B8 Size	B8 Spacing	B9 Size	B9 Spacing	B10 Size	B10 Spacing	Transverse Bars	Cement Concrete Cu. Yds.	Reinf. Bars Lbs.
18 x 8	0	11½	14	12	3	3	I	#4	16	#6	8	#9	16	#8	16	#4	16	#4	16	#8	16	#8	16	#6	8	#4	16		2.18	359
	2	12½	15½	12½	3	3	I	#4	14	#6	7	#9	14	#8	14	#4	14	#4	14	#9	14	#7	14	#6	7	#4	14		2.36	410
	4	12	14½	12½	3	3	I	#4	15	#7	7½	#8	15	#7	15	#4	15	#4	15	#7	15	#7	15	#7	7½	#4	15		2.27	388
	6	13	15½	13	3	3	I	#4	15	#7	7½	#10	15	#7	15	#4	15	#4	15	#8	15	#7	15	#7	7½	#4	15		2.41	433
	8	13½	16½	14	3	3	I	#4	16	#8	8	#10	16	#9	16	#4	16	#4	16	#9	16	#9	16	#8	8	#4	16		2.58	521
	12	15	18½	16	3	3	I	#4	14	#7	7	#10	14	#9	14	#4	14	#4	14	#9	14	#9	14	#8	7	#4	14		2.93	588
	16	17	20	18	3	3	I	#4	13	#8	6½	#10	13	#9	13	#4	13	#4	13	#9	13	#9	13	#8	6½	#4	13		3.29	701
	20	18	21½	19½	3	3	I	#4	14	#8	7	#11	14	#10	14	#4	14	#4	14	#10	14	#10	14	#9	7	#4	14		3.56	741
	24	19½	23	21½	3	3	II	#4	15	#6	15	#11	15	#11	15	#4	15	#4	15	#11	15	#10	15	#9	15	#4	15		3.90	620
	28	21	24	23½	3	3	II	#4	14	#6	14	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#9	14	#4	14		4.21	665
	32	22	25½	25½	3	3	II	#4	13	#6	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#9	13	#4	13		4.56	727
	36	23	26½	27½	3	3	II	#4	12	#6	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#9	12	#4	12		4.82	806
	40	24	27½	29	3	3	II	#4	12	#7	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#10	12	#4	12		5.06	851
18 x 10	0	12	15	12	3	3	I	#4	18	#6	9	#10	18	#8	18	#4	18	#4	18	#9	18	#8	18	#6	9	#4	18		2.41	379
	2	13	16	12½	3	3	I	#4	17	#6	8½	#10	17	#9	17	#4	17	#4	17	#9	17	#9	17	#6	8½	#4	17		2.58	418
	4	12½	15	12	3	3	I	#4	17	#7	8½	#10	17	#8	17	#4	17	#4	17	#10	17	#7	17	#7	8½	#4	17		2.44	415
	6	13½	16½	12½	3	3	I	#4	16	#7	8	#10	16	#9	16	#4	16	#4	16	#9	16	#9	16	#7	8	#4	16		2.64	461
	8	14	17½	13½	3	3	I	#4	14	#7	7	#10	14	#8	14	#4	14	#4	14	#9	14	#8	14	#7	7	#4	14		2.81	524
	12	16	19	15½	3	3	I	#4	15	#7	7½	#10	15	#9	15	#4	15	#4	15	#10	15	#10	15	#8	7½	#4	15		3.19	614
	16	17½	21	17	3	3	I	#4	15	#8	7½	#11	15	#10	15	#4	15	#4	15	#10	15	#10	15	#8	7½	#4	15		3.53	667
	20	19	22½	18½	3	3	I	#4	15	#8	7½	#11	15	#11	15	#4	15	#4	15	#11	15	#10	15	#8	7½	#4	15		3.85	761
	24	20½	24	20½	3	3	II	#4	14	#6	14	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#6	14	#4	14		4.22	712
	28	22	25½	22½	3	3	II	#4	13	#6	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#6	13	#4	13		4.58	708
	32	23	27	24½	3	3	II	#4	12	#6	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#7	12	#4	12		4.93	797
	36	24	28	26½	3	3	II	#4	12	#6	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#8	12	#4	12		5.24	801
18 x 12	0	12	15½	12	3	3	I	#4	18	#6	9	#10	18	#9	18	#4	18	#4	18	#9	18	#8	18	#6	9	#4	18		2.59	400
	2	13	16½	12½	3	3	I	#4	17	#6	8½	#11	17	#8	17	#4	17	#4	17	#9	17	#9	17	#6	8½	#4	17		2.76	426
	4	12½	15½	12	3	3	I	#4	18	#7	9	#10	18	#9	18	#4	18	#4	18	#9	18	#9	18	#7	9	#4	18		2.62	443
	6	13½	17	12½	3	3	I	#4	17	#7	8½	#10	17	#10	17	#4	17	#4	17	#10	17	#8	17	#7	8½	#4	17		2.82	490
	8	14	18	13½	3	3	I	#4	19	#7	9½	#11	19	#11	19	#4	19	#4	19	#11	19	#9	19	#8	9½	#4	19		3.01	527
	12	16	20	15	3	3	I	#4	17	#7	8½	#11	17	#10	17	#4	17	#4	17	#10	17	#10	17	#8	8½	#4	17		3.39	640
	16	18	22	17	3	3	I	#4	16	#7	8	#11	16	#11	16	#4	16	#4	16	#11	16	#10	16	#8	8	#4	16		3.83	663
	20	19½	23	18½	3	3	I	#4	14	#7	7	#11	14	#11	14	#4	14	#4	14	#10	14	#10	14	#8	7	#4	14		4.14	780
	24	21	25	20½	3	3	I	#4	13	#7	6½	#11	13	#11	13	#4	13	#4	13	#11	13	#9	13	#8	6½	#4	13		4.56	815
	28	22½	26½	22	3	3	II	#4	12	#6	12	#11	12	#11	12	#4	12	#4	12	#11	12	#9	12	#6	12	#4	12		4.91	752
	32	24	28	23½	3	3	II	#4	12	#6	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#6	12	#4	12		5.26	788
18 x 14	0	12	15½	12	3	3	I	#4	17	#6	8½	#10	17	#9	17	#4	17	#4	17	#9	17	#8	17	#6	8½	#4	17		2.74	429
	2	13	17	12½	3	3	I	#4	15	#6	7½	#11	15	#7	15	#4	15	#4	15	#9	15	#8	15	#6	7½	#4	15		2.94	442
	4	12½	16	12	3	3	I	#4	19	#7	9½	#10	19	#10	19	#4	19	#4	19	#10	19	#9	19	#7	9½	#4	19		2.81	485
	6	13½	17½	12½	3	3	I	#4	18	#7	9	#11	18	#10	18	#4	18	#4	18	#10	18	#9	18	#8	9	#4	18		3.00	535
	8	14½	18½	13½	3	3	I	#4	18	#7	9	#11	18	#10	18	#4	18	#4	18	#11	18	#8	18	#8	9	#4	18		3.24	559
	12	16½	20½	15	3	3	I	#4	17	#7	8½	#11	17	#11	17	#4	17	#4	17	#11	17	#9	17	#8	8½	#4	17		3.64	636
	16	18	22½	17	3	3	I	#4	15	#7	7½	#11	15	#11	15	#4	15	#4	15	#10	15	#10	15	#8	7½	#4	15		4.07	695
	20	19½	24	18½	3	3	I	#4	14	#7	7	#11	14	#11	14	#4	14	#4	14	#11	14	#9	14	#8	7	#4	14		4.44	740
	24	21½	25½	20	3	3	I	#4	13	#7	6½	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#8	6½	#4	13		4.83	800
	28	23	27	21½	3	3	I	#4	12	#7	6	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#8	6	#4	12		5.20	825
18 x 16	0	11½	16	12	3	3	I	#4	14	#6	7	#9	14	#8	14	#4	14	#4	14	#8	14	#7	14	#6	7	#4	14		2.89	458
	2	13	17½	12½	3	3	I	#4	15	#6	7½	#10	15	#9	15	#4	15	#4	15	#8	15	#7	15	#6	7½	#4	15		3.13	469
	4	12½	16½	12½	3	3	I	#4	16	#7	8	#10	16	#9	16	#4	16	#4	16	#9	16	#8	16	#7	8	#4	16		3.04	528
	6	13½	17½	13	3	3	I	#4	17	#7	8½	#10	17	#10	17	#4	17	#4	17	#10	17	#8	17	#8	8½	#4	17		3.22	580
	8	14½	19	14	3	3	I	#4	17	#7	8½	#11	17	#10	17	#4	17	#4	17	#10	17	#9	17	#8	8½	#4	17		3.49	591
	12	16	21	15½	3	3	I	#4	17	#7	8½	#11	17	#11	17	#4	17	#4	17	#10	17	#10	17	#9	8½	#4	17		3.88	633
	16	18	22½	17½	3	3	I	#4	15	#7	7½	#11	15	#11	15	#4	15	#4	15	#10	15	#10	15	#8	7½	#4	15		4.36	728
	20	19½	24½	18½	3	3	I	#4	14	#7	7	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#8	7	#4	14		4.70	800
	24	21	25½	20½	3	3	I	#4	12	#7	6	#11	12	#11	12	#4	12	#4	12	#10	12	#10	12	#8	6	#4	12		5.11	864
	28	23	27½	22	3	3	I	#4	12	#7	6	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#8	6	#4	12		5.56	880

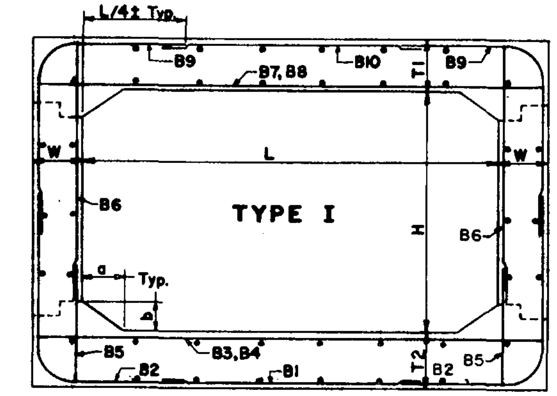
Transverse (parallel to Centerline Culverts) reinforcement bars shall be provided as specified in Design Manual, Part 4, Structures.

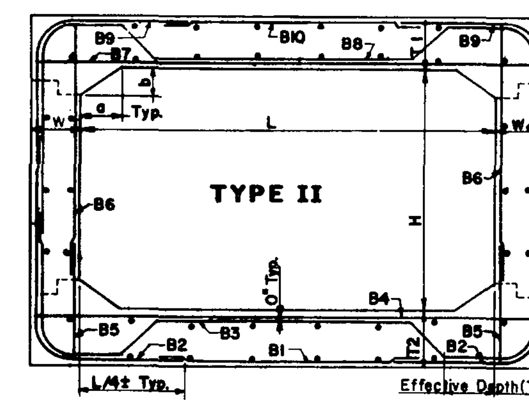
Box Size L x H	Design Depth of Fill, Feet	T1 *	T2	W	a	b	Type of Cross Section	B1 Size	B1 Spacing	B2 Size	B2 Spacing	B3 Size	B3 Spacing	B4 Size	B4 Spacing	B5 Size	B5 Spacing	B6 Size	B6 Spacing	B7 Size	B7 Spacing	B8 Size	B8 Spacing	B9 Size	B9 Spacing	B10 Size	B10 Spacing	Transverse Bars	Cement Concrete Cu. Yds.	Reinf. Bars Lbs.
20 x 8	0	12	15	12	3	3	I	#4	19	#6	9½	#10	19	#9	19	#4	19	#4	19	#10	19	#8	19	#6	9½	#4	19		2.43	410
	2	13½	16½	12½	3	3	I	#4	17	#7	8½	#10	17	#9	17	#4	17	#4	17	#10	17	#8	17	#7	8½	#4	17		2.67	490
	4	13	15½	14	3	3	I	#4	17	#8	8½	#10	17	#8	17	#4	17	#4	17	#10	17	#7	17	#8	8½	#4	17		2.66	514
	6	14	16½	14½	3	3	I	#4	16	#8	8	#10	16	#9	16	#4	16	#4	16	#9	16	#9	16	#8	8	#4	16		2.83	540
	8	14½	17½	15½	3	3	I	#4	15	#8	7½	#10	15	#9	15	#4	15	#4	15	#9	15	#9	15	#9	7½	#4	15		3.00	568
	12	16½	20	17½	3	3	I	#4	15	#8	7½	#11	15	#9	15	#4	15	#4	15	#10	15	#9	15	#9	7½	#4	15		3.45	650
	16	18	21½	20	3	3	I	#4	16	#9	8	#11	16	#11	16	#4	16	#4	16	#11	16	#10	16	#10	8	#4	16		3.84	766
	20	20	23½	22	3	3	II	#4	15	#6	15	#11	15	#11	15	#4	15	#4	15	#11	15	#10	15	#9	15	#4	15		4.28	835
	24	21	24½	24½	3	3	II	#4	14	#7	14	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#10	14	#4	14		4.59	815
	28	22½	26	26½	3	3	II	#4	13	#7	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#10	13	#4	13		4.97	846
	32	23½	27½	28½	3	3	II	#4	12	#7	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#10	12	#4	12		5.31	935
20 x 10	0	12½	15½	12	3	3	I	#4	15	#6	7½	#10	15	#8	15	#4	15	#4	15	#9	15	#7	15	#6	7½	#4	15		2.65	445
	2	13½	17	12½	3	3	I	#4	13	#6	6½	#10	13	#7	13	#4	13	#4	13	#9	13	#7	13	#6	6½	#4	13		2.85	511
	4	13	16	13½	3	3	I	#4	18	#8	9	#10	18	#10	18	#4	18	#4	18	#10	18	#9	18	#8	9	#4	18		2.83	546
	6	14	17½	14	3	3	I	#4	17	#8	8½	#10	17	#10	17	#4	17	#4	17	#10	17	#9	17	#8	8½	#4	17		3.04	580
	8	15½	18½	15	3	3	I	#4	17	#8	8½	#11	17	#10	17	#4	17	#4	17	#10	17	#10	17	#8	8½	#4	17		3.29	623
	12	17½	21	17	3	3	I	#4	15	#8	7½	#11	15	#10	15	#4	15	#4	15	#10	15	#10	15	#8	7½	#4	15		3.77	710
	16	19	23	19½	3	3	I	#4	15	#8	7½	#11	15	#11	15	#4	15	#4	15	#11	15	#10	15	#9	7½	#4	15		4.22	843
	20	20½	24½	21½	3	3	I	#4	14	#8	7	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#9	7	#4	14		4.61	910
	24	22	26	23½	3	3	II	#4	13	#6	13	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#8	13	#4	13		5.00	786
	28	23½	27½	25½	3	3	II	#4	12	#6	12	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#8	12	#4	12		5.40	860
20 x 12	0	12½	16	12	3	3	I	#4	15	#6	7½	#10	15	#8	15	#4	15	#4	15	#9	15	#7	15	#6	7½	#4	15		2.83	461
	2	14	17½	12½	3	3	I	#4	18	#7	9	#11	18	#10	18	#4	18	#4	18	#10	18	#9	18	#7	9	#4	18		3.08	527
	4	13½	17	13	3	3	I	#4	16	#7	8	#10	16	#9	16	#4	16	#4	16	#9	16	#9	16	#7	8	#4	16		3.06	525
	6	14½	18	14	3	3	I	#4	18	#8	9	#11	18	#10	18	#4	18	#4	18	#11	18	#8	18	#8	9	#4	18		3.28	601
	8	15½	19½	15	3	3	I	#4	17	#8	8½	#11	17	#10	17	#4	17	#4	17	#11	17	#9	17	#8	8½	#4	17		3.55	647
	12	17½	22	16½	3	3	I	#4	16	#7	8	#11	16	#11	16	#4	16	#4	16	#11	16	#10	16	#8	8	#4	16		4.00	738
	16	19½	23½	19	3	3	I	#4	14	#7	7	#11	14	#11	14	#4	14	#4	14	#11	14	#9	14	#8	7	#4	14		4.49	841
	20	21	25½	21	3	3	I	#4	13	#7	6½	#11	13	#11	13	#4	13	#4	13	#11	13	#10	13	#9	6½	#4	13		4.94	942
	24	23	27½	22½	3	3	I	#4	12	#7	6	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#8	6	#4	12		5.38	950
20 x 14	0	12½	16½	12	3	3	I	#4	15	#6	7½	#10	15	#8	15	#4	15	#4	15	#9	15	#7	15	#6	7½	#4	15		3.01	478
	2	14	18	12½	3	3	I	#4	18	#7	9	#11	18	#10	18	#4	18	#4	18	#10	18	#9	18	#7	9	#4	18		3.27	543
	4	13½	17½	13	3	3	I	#4	18	#7	9	#11	18	#10	18	#4	18	#4	18	#10	18	#9	18	#8	9	#4	18		3.25	574
	6	14½	18½	14	3	3	I	#4	17	#7	8½	#11	17	#10	17	#4	17	#4	17	#10	17	#9	17	#8	8½	#4	17		3.49	650
	8	16	20	14½	3	3	I	#4	16	#7	8	#11	16	#10	16	#4	16	#4	16	#10	16	#10	16	#8	8	#4	16		3.75	671
	12	17½	22½	17	3	3	I	#4	15	#7	7½	#11	15	#11	15	#4	15	#4	15	#10	15	#10	15	#8	7½	#4	15		4.29	760
	16	20	24½	18½	3	3	I	#4	14	#7	7	#11	14	#11	14	#4	14	#4	14	#11	14	#10	14	#8	7	#4	14		4.77	838
	20	21½	26½	21	3	3	I	#4	12	#7	6	#11	12	#11	12	#4	12	#4	12	#10	12	#10	12	#8	6	#4	12		5.30	982
	24	23½	28	22	3	3	I	#4	12	#7	6	#11	12	#11	12	#4	12	#4	12	#11	12	#10	12	#8	6	#4	12		5.67	1007
20 x 16	0	12½	16½	12	3	3	I	#4	13	#6	6½	#9	13	#8	13	#4	13	#4	13	#8	13	#7	13	#6	6½	#4	13		3.16	501
	2	14	17½	12½	3	3	I	#4	18	#7	9	#11	18	#10	18	#4	18	#4	18	#10	18	#9	18	#7	9	#4	18		3.39	564
	4	13½	18	13	3	3	I	#4	17	#7	8½	#10	17	#10	17	#4	17	#4	17	#10	17	#8	17	#8	8½	#4	17		3.45	556
	6	14½	19	14	3	3	I	#4	15	#7	7½	#10	15	#10	15	#4	15	#4	15	#10	15	#8	15	#8	7½	#4	15		3.69	686
	8	16	20½	15	3	3	I	#4	14	#7	7	#10	14	#10	14	#4	14	#4	14	#10	14	#8	14	#8	7	#4	14		4.02	720
	12	18	23	17	3	3	I	#4	13	#7	6½	#11	13	#10	13	#4	13	#4	13	#10	13	#9	13	#8	6½	#4	13		4.57	814
	16	20	25	19	3	3	I	#4	12	#7	6	#11	12	#10	12	#4	12	#4	12	#10	12	#9	12	#8	6	#4	12		5.10	895
	20	22	27	20½	3	3	I	#4	12	#7	6	#11	12	#11	12	#4	12	#4	12	#10	12	#10	12	#8	6	#4	12		5.57	1003

Transverse (parallel to Centerline Culverts) reinforcement bars shall be provided as specified in Design Manual, Part 4, Structures.

✱ For boxes at grade (i.e. 0' fill) with ½" integral wearing surface (i.e. without bituminous wearing surface course), the values of T1 = tabulated values + ½"

TYPICAL CROSS SECTIONS





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Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD
R. C. BOX CULVERTS
DESIGN

SHEET 4 OF 5 **ST-132**

REINFORCED CONCRETE SINGLE CELL BOX CULVERTS

Box Size L x H	Design Depth of Fill, Feet	Dimensions in Inches					Type of Cross Section	Reinforcement Bars																				Transverse Bars	Approx. Quantities per lin. ft.	
								B1		B2		B3		B4		B5		B6		B7		B8		B9		B10				
		T1	T2	W	a	b		Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing		Cement Concrete Cu. Yds.	Reinf. Bars Lbs.

Transverse (parallel to Centerline Culverts) reinforcement bars shall be provided as specified in Design Manual, Part 4, Structures.

Box Size L x H	Design Depth of Fill, Feet	Dimensions in Inches					Type of Cross Section	Reinforcement Bars																				Transverse Bars	Approx. Quantities per lin. ft.	
								B1		B2		B3		B4		B5		B6		B7		B8		B9		B10				
		T1	T2	W	a	b		Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing	Size	Spacing		Cement Concrete Cu. Yds.	Reinf. Bars Lbs.

Transverse (parallel to Centerline Culverts) reinforcement bars shall be provided as specified in Design Manual, Part 4, Structures.

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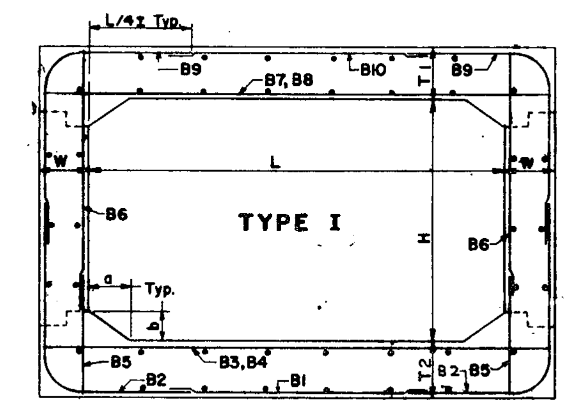
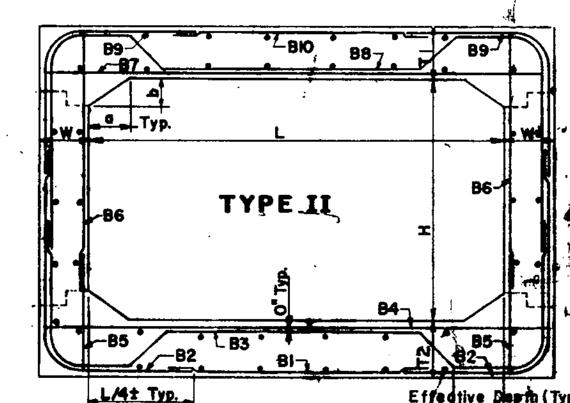
TYPICAL CROSS SECTIONS





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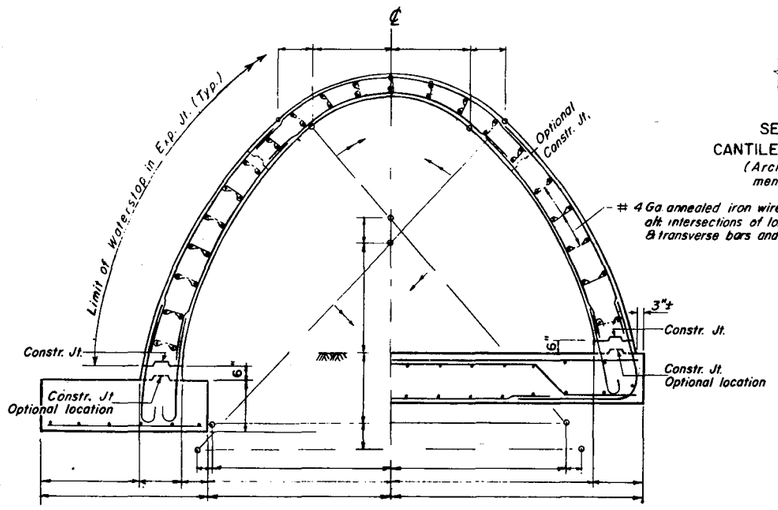
BRIDGE DIVISION

STANDARD
R. C. BOX CULVERTS
DESIGN

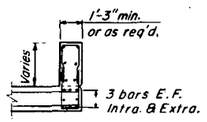
SHEET 5 OF 5

ST-132

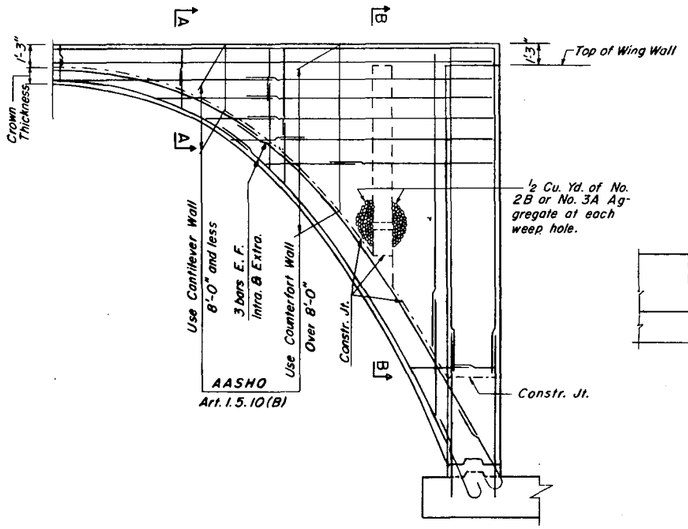


FIXED ARCH TIED ARCH

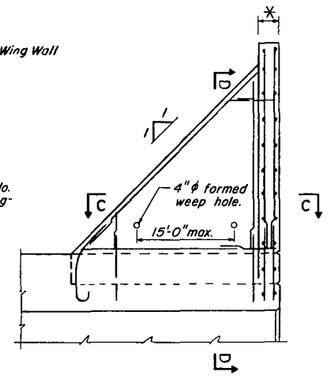
TYPICAL ARCH SECTION



SECTION A-A
CANTILEVER WALL DETAILS
(Arch ring reinforcement not shown.)

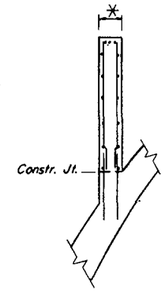


ELEVATION

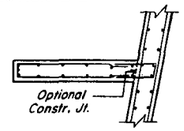


SECTION B-B

* 1'-3" minimum or as required.



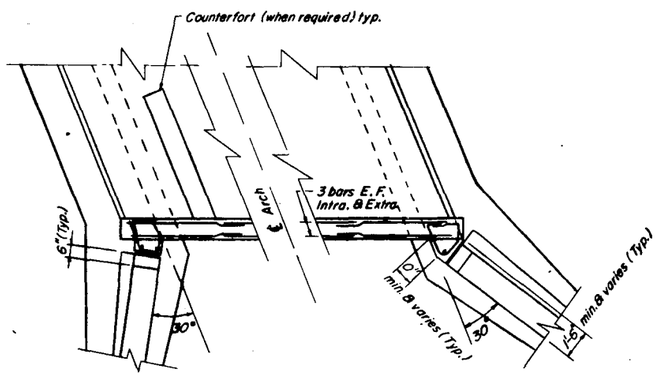
SECTION D-D



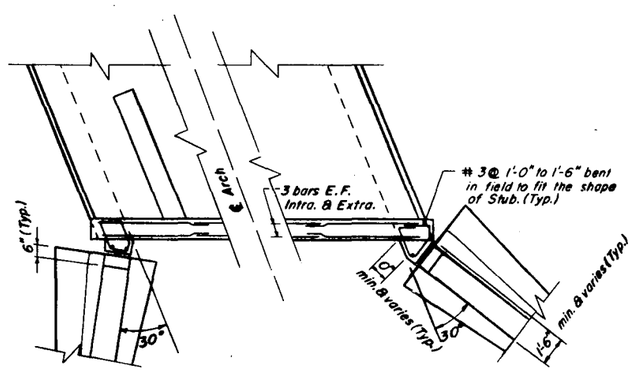
SECTION C-C

COUNTERFORT WALL DETAILS

TYPICAL SPANDREL WALL DETAILS
(Showing reinforcement bars layout.)



FIXED ARCH



TIED ARCH

LAYOUT OF WING WALLS

Details shown are typical and shall be modified as required and to be simple as possible.

NOTES

6" apron at inlet and outlet shall be provided with tied arches, for details see ST-132.

Trussed bars in tie slab shall be used when required to resist diagonal tension if and when economical.

For Construction and Expansion Joint details, see ST-132.

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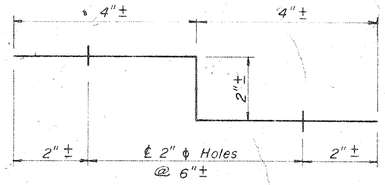
BRIDGE DIVISION

STANDARD
R.C. ARCH CULVERTS
DETAILS

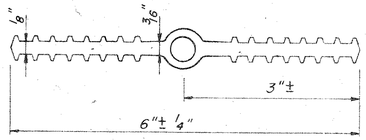
SHEET 1 OF 1

ST-133



METAL
(Copper sheet: 16 oz./sq. ft.)

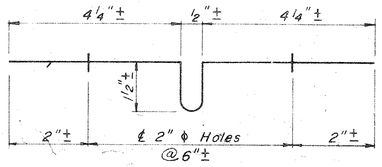
TYPE C1



POLYVINYL CHLORIDE

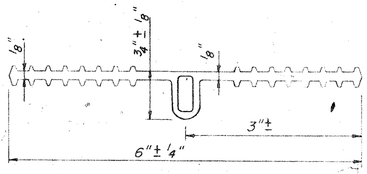
TYPE C2

WATERSTOPS FOR CONSTRUCTION JOINTS



METAL
(Copper sheet: 16 oz./sq. ft.)

TYPE E1



POLYVINYL CHLORIDE

TYPE E2

WATERSTOPS FOR EXPANSION JOINTS

NOTES

MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPECIFICATIONS FORM 408.

EITHER TYPE C1 OR TYPE C2 WATERSTOP SHALL BE USED IN CONSTRUCTION JOINTS WHEN SPECIFIED, AND EITHER TYPE E1 OR TYPE E2 WATERSTOP SHALL BE USED IN EXPANSION JOINTS.

APPROVED: MAR. 18, 1969
CHIEF ENGINEER

APPROVED: MAR. 18, 1969
BRIDGE ENGINEER

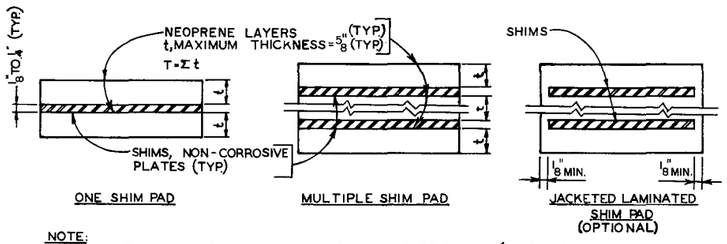
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD

WATERSTOP DETAILS

SHEET 1 OF 1

S - 141



NOTE:
PINS AND PLATE SUPPORTS SHALL BE SHOWN ON FABRICATOR S' SHOP DRAWINGS.

LAMINATED SHIM BEARING PADS

DESIGN CRITERIA

1- (A) 20% MAXIMUM SHEAR STRAIN.
(B) MAXIMUM CHANGE IN TEMP. OF CONCRETE 50° F.
(C) THERMAL COEFFICIENT OF CONCRETE 0.000006.
(D) NEOPRENE TO BE 50 OR 60 DUROMETER. 70 DUROMETER (NOMINAL) SHALL NOT BE USED.
TOTAL THICKNESS OF NEOPRENE MATERIAL:
T.(IN INCH.) = Σt = 0.018 × (BEAM LENGTH IN FT.)

2- D.L.+L.L. BEARING PRESSURE: 700 PSI MAXIMUM FOR MOULDED PADS.
600 PSI MAXIMUM FOR PADS CUT TO SIZE AFTER FABRICATION
250 PSI MINIMUM (FOR DL ONLY)

INSTRUCTIONS: L=LENGTH(IN.); W=WIDTH(IN.); T=THICKNESS (IN.); (D.L)=DEAD LOAD (LB.) (L.L)=LIVE LOAD(LB.)

1. CHECK FOR BEARING HARDNESS:

COMP. STRESS $(P.S.I.) = \frac{(D.L)+(L.L)}{L\ W}$

SHAPE FACTOR $= \frac{L\ W}{2(L+W)(t)}$ THIS SHAPE FACTOR NOT TO EXCEED 7.0

COMP. STRAIN SHALL NOT EXCEED 15%.

2. CHECK SLIPPAGE:

BEAM TRAVEL PAD CAN ABSORB WITHOUT SLIP (IN.) $= \frac{(DL)T}{5\ L\ W} \times \frac{1.8}{K}$

$K = \begin{cases} 110 (\text{HARDNESS OF } 50) \\ 160 (\text{HARDNESS OF } 60) \end{cases}$

BEAM TRAVEL THAT WILL OCCUR (IN.) = 0.005CN (BEAM LENGTH IN FT.)
A. TEMPERATURE RANGE FOR CONCRETE 70° F.
B. LOWEST TEMPERATURE FOR SHEAR MODULUS OF NEOPRENE 0° F.
BEAM TRAVEL THAT WILL OCCUR MUST BE LESS THAN THE AMOUNT PAD CAN ABSORB.

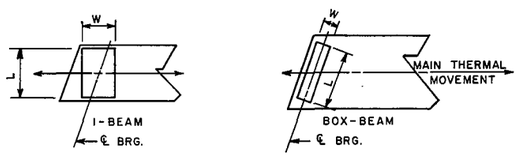
3- MAX. SHIM THICKNESS TO BE 50% OF A SINGLE NEOPRENE LAYER, BUT NOT MORE THAN 1/4" AND NOT LESS THAN 1/8".

4- SELECTION OF NEOPRENE MATERIAL, NUMBER OF SHIMS AND GENERAL PAD DESIGNS SHALL BE MADE TO PROVIDE THE LEAST AMOUNT OF HORIZONTAL FORCE EXERTED BY THE BEARING TO THE SUBSTRUCTURE. COMPUTATIONS VERIFYING THAT THIS CONDITION IS MET OR SHOWING THAT HORIZONTAL FORCE TRANSMITTED TO THE SUB-STRUCTURE IS NOT EXCESSIVE, SHALL BE SUBMITTED WITH EACH PAD DESIGN. DESIGNS SHALL BE APPROVED BY THE BRIDGE ENGINEER.

DATA:

1- FOR COMPRESSIVE STRESS/STRAIN CURVES & SHAPE FACTOR INFORMATION, REFER TO MANUFACTURERS' RECOMMENDATIONS.

2- STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES 1969 EDITION BY A.A.S.H.O. WITH....EXCEPTIONS AS NOTED IN THE DESIGN CRITERIA.



PLAN
REFER TO
PDH STANDARDS SERIES ST-200

DESIGNED: H.P.K. & I.C.P.
DRAWN : R.L.A. & F.C.F. & M.L.H.
CHECKED: H.P.K. & I.C.P. & H.L.S.
DATE : 11/61 12/69

J. H. WEIL CO. CRONAFLEX-10F 4

SPECIFICATIONS

1. DESCRIPTION: LAMINATED METAL SHIM NEOPRENE BEARING PADS SHALL BE FABRICATED TO THE DIMENSIONS AS SHOWN ON THE DESIGN DRAWINGS AND/OR APPROVED SHOP DRAWINGS AND MUST CONFORM TO THE REQUIREMENTS OF THE PROPOSAL.
FOR THE PURPOSE OF THESE SPECIFICATIONS THE BRIDGE ENGINEER SHALL MEAN THE CHIEF BRIDGE ENGINEER IN THE CENTRAL OFFICE.

2. DESIGN: COMPUTATIONS WILL BE REQUIRED FOR PAD DESIGNS. DESIGNS SHALL BE IN ACCORDANCE WITH THE DESIGN CRITERIA.

3. SHOP DRAWINGS: THE CONTRACTOR SHALL SUBMIT TWO SETS OF SHOP DRAWINGS AND COMPUTATIONS TO THE BRIDGE ENGINEER FOR APPROVAL. NINE SETS OF PRINTS AND ONE SET OF TRACINGS OR WHITE PRINTS OF A QUALITY SUITABLE FOR MICROFILMING, ACCORDING TO FORM 409/1080.1 (C), OF THE APPROVED DRAWINGS MUST BE FURNISHED TO THE BRIDGE ENGINEER FOR HIS FILE AND DISTRIBUTION THE CONTRACTOR SHALL NOT PROCEED WITH THE MANUFACTURE OF THE PADS UNTIL THE FINAL SHOP DRAWINGS HAVE BEEN APPROVED. THE PROCESS OF FABRICATION USED FOR THE SHIM PADS SHALL BE DESCRIBED ON THE SHOP DRAWINGS.

4. MATERIALS: UNLESS OTHERWISE SPECIFIED MATERIALS SHALL CONFORM TO THE FOLLOWING REQUIREMENTS:
A. NON-CORROSIVE PLATES
1. STEEL ASTM A-242. (COLD ROLLED)
2. STAINLESS STEEL ASTM 167 OR ASTM 176
3. ALUMINUM ASTM 6209-ALLOY GS11A TEMPER T6.
B. PLATES FOR JACKETED SHIM PADS
1. ALL MATERIAL CONFORMING TO ITEMS 4.A. 1 TO 3
2. CARBON STEEL AISI C1010 TO C1020; ASTM A-245 GRADE C AND D.
C. NEOPRENE LAYERS IN ACCORDANCE WITH SECTION 1080 OF SPECIFICATIONS FORM 409/1967 OR SUBSEQUENT REVISIONS.
D. TYPES OF VULCANIZING ADHESIVES TO BE APPROVED BY THE ENGINEER

5. MANUFACTURE OF LAMINATED METAL SHIM NEOPRENE BEARING PADS:
A. GENERAL:
PADS MAY BE MOULDED IN ACCORDANCE WITH DESIGN DIMENSIONS OR FABRICATED IN LARGE PIECES AND CUT TO SPECIFIED SIZE. PADS SHALL BE ASSEMBLED USING UNCURED NEOPRENE AS SPECIFIED ON THE SHOP DRAWINGS AND FULLY MOULDED IN ONE OPERATION STARTING WITH UNCURED STOCK (NEOPRENE) AND VULCANIZING BETWEEN BONDED SURFACES.
B. CUTTING OF METAL PLATES:
METAL PLATES FOR PADS ASSEMBLED WITH UNCURED NEOPRENE MAY BE CUT WITH SHEARS. CUT EDGES SHALL BE SMOOTH AND BURR REMOVED. ALL DEFORMATIONS OR ROUGH EDGES CAUSED BY CUTTING SHALL BE REMOVED.
C. PREPARATION AND POSITIONING OF METAL PLATES:
METAL SURFACES SHOULD BE CLEANED OF ALL OIL, GREASE, RUST, SCALE, DIRT OR OTHER CONTAMINANTS THRU GRIT BLASTING AND DEGREASED BEFORE AND AFTER GRIT BLASTING.
ALUMINUM SURFACES SHALL, IN ADDITION TO BLASTING, BE PREPARED CHEMICALLY BY THE USE OF COMMERCIALLY AVAILABLE CONVERSION COATINGS. THE TYPE OF COATING TO BE LISTED ON THE SHOP DRAWING.
THE SHIMS AND UNCURED NEOPRENE LAYERS SHALL BE POSITIONED ACCURATELY BY SUPPORTING-PINS OR ANY OTHER APPROVED METHODS AS SHOWN ON THE SHOP DRAWINGS. WHEN PIN SUPPORTS ARE USED, FOR MULTIPLE SHIM PADS, THE INTERMEDIATE SHIM PLATES SHALL BE SUPPORTED BY PINS ON SIDES OF THE PAD. INTERIOR PINS SHALL NOT BE USED. THE HOLES FORMED IN THE FINISHED OUTER NEOPRENE LAYERS SHALL BE FILLED, AFTER CURING AND REMOVAL OF PINS, WITH A NEOPRENE COMPOUND CONTAINING A MINIMUM OF 50% NEOPRENE SOLIDS. THE SOLIDS SHALL BE OF THE SAME MATERIAL AS THE NEOPRENE LAYERS OTHER METHODS OF FABRICATION MAY BE USED IF SHOWN ON APPROVED SHOP PLANS.
D. APPLICATION OF ADHESIVE:
APPLICATION SHALL BE MADE IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS. WHEN SPRAYING OF ADHESIVES IT IS NECESSARY TO HAVE THE ADHESIVE REACH THE METAL PART WET.
E. DRYING OF ADHESIVES, HANDLING OF CEMENTED PARTS AND PREPARATION OF UNCURED NEOPRENE COMPOUND:
THIS SHALL BE IN ACCORDANCE WITH GOOD PRACTICE AND AS RECOMMENDED BY THE MANUFACTURER OF THE VULCANIZING ADHESIVE.
F. FABRICATION OF PADS:
PREPARED LAYERS OF NEOPRENE AND METAL SHIMS SHALL BE PLACED IN A PRESS AND SUBJECTED TO SUFFICIENT PRESSURE AND TEMP. TO MAINTAIN INTIMATE CONTACT OF THE ENTIRE SURFACE DURING VULCANIZING VULCANIZATION SHALL CONFORM TO THE PREVAILING PRACTICE. CURED NEOPRENE SHALL CONFORM TO THE REQUIREMENTS OF ITEM 4C.
G. FINISHING OF PADS:
THE FINISHED CUT PADS SHALL BE MACHINED SMOOTH AND BUFFED TO REMOVE ALL NICKS AND CUT MARKS CAUSED BY THE CUTTING OR THE FABRICATION PROCESS ON NEOPRENE PAD. THE FINAL PRODUCT SHALL HAVE A NEAT AND SMOOTH APPEARANCE. PADS FULLY MOULDED IN ONE OPERATION WITH NEAT AND SMOOTH EDGES AND SIDES, NEED NOT BE MACHINED.
PADS SHOWING UNBONDED SURFACES AT ANY PLACE SHALL BE REJECTED UNLESS THEY ARE REBONDED THROUGH VULCANIZING.
H. FABRICATION TOLERANCES:
THE NOMINAL THICKNESS OF A SINGLE NEOPRENE LAYER MAY VARY ± .150 INCHES; NOMINAL TOTAL PAD THICKNESS MAY VARY ± 1/16 INCH (TOTAL THICKNESS INCLUDES METAL SHIMS); NOMINAL PAD LENGTH AND WIDTH MAY VARY -1/8" AND + 3/8".
NEOPRENE EDGES OF THE CUT PAD SHALL BE SMOOTH AND SHALL NOT SHOW NICKS OR CUTS.

6. NOTICE OF FABRICATION: PENNSYLVANIA DEPARTMENT OF HIGHWAYS, BUREAU OF MATERIALS, TESTING AND RESEARCH, BOX 2926, 1118 STATE STREET, HARRISBURG, PENNA. 17105, SHALL BE NOTIFIED IN WRITING TEN (10) DAYS IN ADVANCE OF THE SCHEDULED FABRICATION (GIVING ESTIMATED TIME AND DATE, PLACE AND COMPLETION DATE OF THE FABRICATION.)

7. CERTIFICATION: ALL SHIPMENTS OF THIS MATERIAL MUST BE ACCOMPANIED BY A NOTARIZED COPY OF THE CERTIFICATE OF COMPLIANCE EXECUTED ON FORM 480 (AVAILABLE AT PENNSYLVANIA DEPARTMENT OF HIGHWAYS, HIGHWAY AND SAFETY BUILDING, HARRISBURG, PENNA.) AND SHALL BE GIVEN TO THE ENGINEER UPON ARRIVAL AT THE POINT OF DELIVERY. THREE (3) COPIES OF THIS CERTIFICATE MUST BE FORWARDED TO THE PENNSYLVANIA DEPARTMENT OF HIGHWAYS, BUREAU OF MATERIALS, TESTING AND RESEARCH.
FORM 480 SHALL BE AMENDED WITH THE FOLLOWING STATEMENTS: "PADS ARE FABRICATED IN STRICT ACCORDANCE WITH THE APPROVED SHOP DRAWING #_____ IN THE PERIOD FROM_____TO_____."
"SHIMS USED ARE CONFORMING TO A.S.T.M._____"

8. INSPECTION: ALL PADS MAY BE INSPECTED BY THE ENGINEER AT THE FABRICATOR'S PLANT; HOWEVER, FINAL INSPECTION MAY BE MADE AT THE BRIDGE SITE PRIOR TO PLACING THE PADS IN THEIR PERMANENT POSITION. THE DEPARTMENT RESERVES THE RIGHT TO INSPECT THE COMPLETE PROCESS COVERING MANUFACTURE OF PADS.
A. NEOPRENE TEST PADS OF THE SAME MATERIAL USED IN THE FABRICATION OF THE BRIDGE PADS, SHALL BE SUBMITTED TO THE DEPARTMENT IN ORDER THAT TEST SAMPLES AS REQUIRED MAY BE CUT FROM THESE PADS.
ONE LAMINATED METAL SHIM NEOPRENE BEARING PAD OF ACTUAL SIZE WILL BE REQUIRED FOR EVERY TWENTY (20) SHIM PADS OR FRACTION THEREOF DELIVERED FOR EACH BRIDGE PROJECT, UNLESS OTHERWISE DIRECTED BY THE ENGINEER. THE FABRICATOR SHALL CERTIFY IN WRITING THAT THE NEOPRENE FOR THE ABOVE SAMPLES ARE FROM THE SAME BATCH-LOT AS THE DELIVERED BRIDGE BEARING PADS. ALL SAMPLES SHALL BE SUPPLIED AT NO COST TO THE DEPARTMENT, AND SHALL BE SUBMITTED FOR TESTING AT LEAST 30 DAYS BEFORE ERECTION OF SUPERSTRUCTURE.
B. APPROVAL OF PLANT:
TO QUALIFY FOR APPROVAL THE PLANT DESIRING TO FABRICATE LAMINATED METAL SHIM BEARING PADS WILL HAVE TO SUBMIT A WRITTEN OUTLINE OF THEIR FABRICATION AND QUALITY CONTROL METHODS USED.
SAMPLES AND CERTIFICATION WILL BE REQUIRED FOR TESTING AND APPROVAL IN ACCORDANCE WITH ITEMS 7, 8A AND 9.
PADS WILL BE SUBJECT TO REJECTION IF THEY SHOW ANY SEPARATION OR FAIL TO MEET THE REQUIREMENTS OF THESE SPECIFICATIONS.

9. TESTS: THE FOLLOWING TESTS MAY BE MADE ON RANDOMLY SELECTED SAMPLES OR ON SAMPLES AS SPECIFIED ON THE SHOP DRAWING.
A. BOND TEST FOR LAMINATED NEOPRENE SHIM BEARING PADS, PTM 301.
B. SHEAR DEFORMATION TEST FOR BEARING PADS, PTM 302.
C. OTHER TESTS AS DESCRIBED IN SECTION 1080 OF SPECIFICATION FORM 409.

10. ERECTION: PLACEMENT OF PADS SHALL NOT BE STARTED UNLESS A VERIFIED COPY OF FORM 480 HAS BEEN RECEIVED AT THE PROJECT SITE FROM THE BUREAU OF MATERIALS, TESTING AND RESEARCH.

Approved: MARCH 3, 1970
Chief Engineer

Approved: MARCH 3, 1970
Chief Bridge Engineer

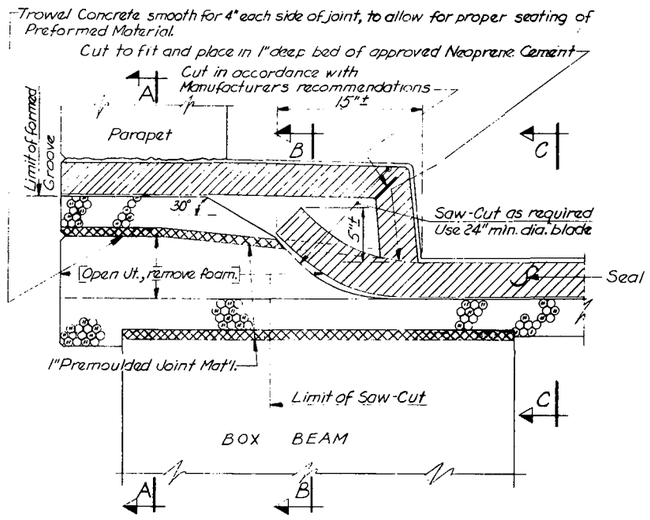
COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HIGHWAYS
BRIDGE UNIT
PRESTRESSED CONCRETE BRIDGE STANDARDS

LAMINATED METAL SHIM NEOPRENE BEARING PAD FOR PRESTRESSED CONCRETE BRIDGES

SHEET 1 OF 1

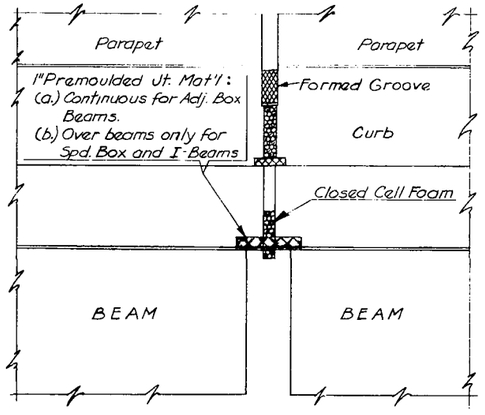
ST-210

PREPARED BY DIVISION OF BRIDGE ENGINEERING

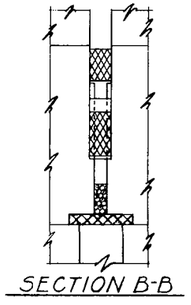


SECTION THRU JOINT

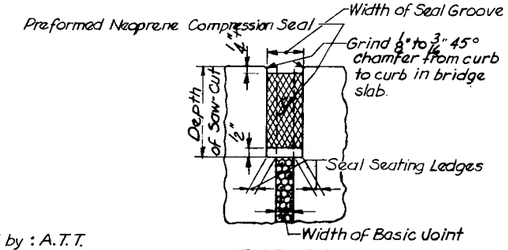
(Details of Joint for Spd and Box Beam Bridge, Adj. Box Beam and I-Beam Bridges Similar)



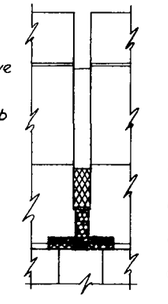
SECTION A-A



SECTION B-B



TYPICAL JOINT



SECTION C-C

Designed by : A.T.T.
Drawn by : C.E.F.
Traced by : C.E.F.
Checked by : M.P.K., F.C.S., E.S.H., H.L.S.

PREFORMED NEOPRENE COMPRESSION SEALS FOR BRIDGE-JOINTS

A - GENERAL INFORMATION

- A COMPRESSION SEAL FOR WATERPROOFING A BRIDGE-JOINT AND SEALING AGAINST INCOMPRESSIBLE MATERIALS IS EFFECTIVE IF IT SUSTAINS A POSITIVE PRESSURE AGAINST THE WALLS OF THE JOINT. THE SEAL MUST BE UNDER COMPRESSION AT ALL TIMES.
- THE POTENTIAL OF THE PREFORMED NEOPRENE COMPRESSION SEALS IS LIMITED BY THE FACTORS *1 AND *2. A DESIGN ENGINEER, WHEN COMPUTING THE SEAL-GROOVE WIDTH, MUST CONSIDER THESE 2 FACTORS IN RELATION TO THE WIDTH OF THE SEALS.

*1-MINIMUM SEAL-GROOVE WIDTH MUST BE GREATER THAN THE WIDTH AT WHICH THE COMPRESSED SEAL WOULD EXTRUDE. (THE COMPRESSED SEAL WIDTH, WITHOUT EXTRUSION, IS THE SUM OF THE WALLS AND WEBS OF THE SEAL.)

*2-MAXIMUM SEAL-GROOVE WIDTH MUST BE LESS THAN THE NOMINAL SEAL WIDTH. ALLOW FOR APPROXIMATELY 25% PERMANENT SET IN THE SEAL.

3-SEAL-GROOVE WIDTH (AT TIME OF SEAL INSTALLATION) IS RECOMMENDED TO BE AT LEAST 60% OF THE NOMINAL SEAL WIDTH. THIS FACTOR HAS BEEN USED IN COMPUTING THE VALUES GIVEN IN COLUMN 8, TABLE 1.

B - DESIGN

1-SELECT WIDTH OF BASIC-JOINT AND SHAPE OF SEAL FROM TABLE 1.

2-SHOW DETAILS ON THE CONSTRUCTION DRAWINGS OF THE BASIC-JOINT, THE SAW-CUT SEAL-GROOVE, THE FORMED SEAL-GROOVE AND THE SEAL.

C - DESCRIPTION: THE SEALED-JOINT CONSISTS OF THE BASIC-JOINT, THE SEAL-GROOVE (SAW-CUT IN THE SLAB AND FORMED AT THE CURB OR SIDEWALK) AND THE INSTALLED SEAL. THE SEALED-JOINT IS CONSTRUCTED AT VARIOUS STAGES OF DECK CONSTRUCTION; THEREFORE ALL OPERATIONS MUST BE PRECISELY CONTROLLED.

D - CONSTRUCTION

1-BASIC-JOINT IN SLAB: PLACE TWO STRIPS OF PREMOULDED CLOSED-CELL FOAM, OR APPROVED EQUAL, TO FORM THE BASIC-JOINT AS SPECIFIED ON THE CONSTRUCTION DRAWINGS. THE DEPTH OF THE UPPER STRIP IS EQUAL TO THE DEPTH OF THE SPECIFIED SEAL, PLUS 3/4". THIS UPPER STRIP WILL BE REMOVED LATER. AT THE TIME OF CASTING CONCRETE ADJACENT TO THE JOINT, THE AMBIENT TEMPERATURE MUST BE BETWEEN 35° MINIMUM AND 90° MAXIMUM.

2-SEAL-GROOVE, SAW-CUT IN SLAB:

a - THE SEAL-GROOVE WIDTH IS THE AVERAGE WIDTH, TO THE NEAREST 1/16", OF THE BASIC-JOINT WIDTH (USE AT LEAST 5 MEASUREMENTS ALONG THE ENTIRE LENGTH) PLUS THE TWO SEAL-SEATING-LEDGE WIDTHS. (SEE TYP. JT. DETAIL). PROCEED WITH SAW-CUTTING, AS SOON AS PRACTICAL, AFTER THE SEAL-GROOVE WIDTH HAS BEEN DETERMINED. COMPLETE SAW-CUTTING IN ONE CONTINUOUS OPERATION.

b - USE A HEAVY-DUTY, DOUBLE DIAMOND-BLADED, SELF-PROPELLED CONCRETE SAW TO CUT THE SEAL-GROOVE DEPTH IN THE SLAB. (THE SEAL-GROOVE IN THE CURB OR SIDEWALK WILL BE FORMED LATER, WHEN THESE ARE CAST.) BEGIN EACH SAW-CUT AT THE CENTERLINE OF BRIDGE, STOP 12"± BEYOND THE GUTTER LINE.

c - TO ACHIEVE SMOOTH AND TRUE SEAL-SEATING-LEDGES, INSERT A 3" MINIMUM WIDE CHISEL IN THE SAW-CUT, AND USE THE CHISEL AS A LEVER TO BREAK THE CONCRETE AT THE LEDGES. REMOVE THE UPPER STRIP OF FOAM AND THE BROKEN CONCRETE.

3-SEAL-GROOVE, FORMED IN CURB OR SIDEWALK:

a - INSTALL PREMOULDED MATERIAL AND FOAM IN CURB OR SIDEWALK AS SHOWN ON THE CONSTRUCTION DRAWINGS.

b - CAST CURB OR SIDEWALK WITH FORMED SEAL-GROOVE AS SHOWN ON THE CONSTRUCTION DRAWINGS.

E - INSTALLATION OF SEAL ("TOP" OF SEAL IS MARKED).

1-AFTER CURB OR SIDEWALK CONCRETE IS CURED, REMOVE ALL FOREIGN MATERIAL, INCLUDING ANY SURPLUS (REMNANTS OF) CONCRETE FROM THE GROOVE. USE A STIFF BROOM OR COMPRESSED AIR TO THOROUGHLY CLEAN THE SEAL-GROOVE IN BOTH SLAB AND CURB OR SIDEWALK. THE GROOVE SHOULD BE DRY OR DAMP-DRY.

2-SWAB A LUBRICANT-ADHESIVE ON THE FACES OF THE GROOVE. COMPLY WITH ALL INSTRUCTIONS SPECIFIED BY THE ADHESIVE MANUFACTURER (EXAMPLE: TEMPERATURE LIMITATIONS).

3-WHILE THE ADHESIVE IS WET, INSTALL THE SEAL. USE MANUFACTURER'S RECOMMENDED HAND OR POWER DRIVEN TOOLS TO THOROUGHLY INSERT THE SEAL. (ASCERTAIN THAT THE ADHESIVE COVERS BOTH FACES OF THE GROOVE AND THAT THE FULL LENGTH OF THE SEAL IS IN CONTACT WITH THE FACES OF THE GROOVE.)

a - FOR CURB OR SIDEWALK INSTALLATION, SEALS MAY BE NOTCHED ON THE BOTTOM SURFACE TO PERMIT BENDING. THE TOP SURFACE OF THE SEAL MUST BE CONTINUOUS.

b - IF COMPRESSION TOOLS ARE USED, THE SURFACE OF THE TOOLS MAY BE LUBRICATED WITH A SOAP-SUDS SOLUTION. DO NOT ALLOW LARGE AMOUNTS OF THE SUDS TO PENETRATE THE FRESHLY SWABBED GROOVE.

c - DO NOT STRETCH THE SEAL DURING INSTALLATION. THIS WOULD CAUSE CONTRACTION LATER AND A TENDENCY TO PULL LOOSE FROM THE GROOVE FACE.

d - ASCERTAIN THAT THE INSTALLED SEAL IS IN A SUBSTANTIALLY COMPRESSED CONDITION, THAT THE TOP OF THE SEAL IS ¼" MIN., ½" MAX. BELOW THE PAVEMENT SURFACE, AND THAT THE INTERSECTION OF THE VERTICAL AND THE HORIZONTAL SEALS AT THE GUTTER LINE IS WATERPROOF.

NOTE: IF MORE PRACTICAL, INSTALL THE SEAL IN TWO STAGES.

1-AFTER SEAL-GROOVE IN THE SLAB HAS BEEN SAW-CUT, FINISHED AND CLEANED, INSTALL THE SEAL. COMPLY WITH ALL INSTRUCTIONS CONCERNING CLEANING THE GROOVE, APPLYING THE ADHESIVE, AND INSTALLING THE SEAL.

2-INSTALL PREMOULDED MATERIAL AND FOAM IN THE CURB OR SIDEWALK AS SHOWN ON THE CONSTRUCTION DRAWINGS.

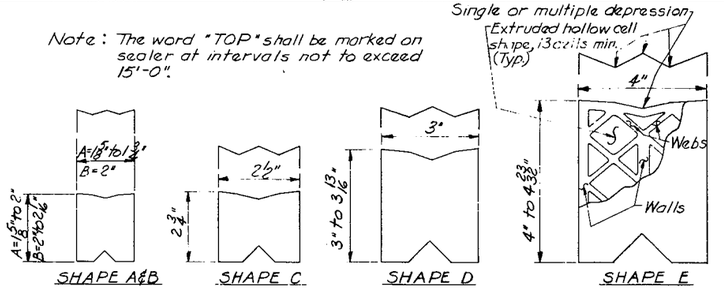
3-CAST THE CURB OR SIDEWALK, WITH THE FORMED SEAL-GROOVE, AS SHOWN ON THE CONSTRUCTION DRAWINGS.

4-AFTER THE CONCRETE IS CURED, CLEAN THE FORMED SEAL-GROOVE, APPLY THE ADHESIVE AND INSTALL THE SEAL.

GENERAL INSTRUCTIONS

- The Seal shall be of a type and size as specified on this sheet and meet the current specifications for Preformed Neoprene Compression Seals.
- Use of other shapes and/or special designs shall be approved by the Chief Bridge Engineer in the Central Office.
- Tolerances for outside and inside dimensions, wall and web thicknesses are given in the specifications.
- Select Shape of Seal as listed in the table for Joints at Piers or at Abutments utilizing either approach slabs or backwalls.
- Do not select shapes or basic joints which require the joint width to be larger than 1⅝" at normal temperature or 2¼" at minimum temperature.

Note: The word "TOP" shall be marked on sealer at intervals not to exceed 15'-0".



PREFORMED NEOPRENE COMPRESSION SEALS

TABLE #1

Limit for 2¼" Maximum opening of Groove

TYPE OF JOINT ①	EXP. LENGTH ②	WIDTH OF BASIC JT. @ CONSTR. TIME ③	THEOR'L. WIDTH OF LEDGES ④	SEAL-GROOVE (WIDTH OF SAW-CUT) ⑤	SHAPE OF SEAL ⑥	MIN. VOIDS % ⑦	* ⑧
Fix	———	½"	2×¼=½"	Equal to width of Basic Jt. at time of Saw-Cutting, plus width of Ledges.	A	57.2	1"
Exp.	Up to 50'	½"	2×¼=½"		A	57.2	1"
Exp.	50' to 51'	¾"	2×⅜=¾"		B	62.5	1¼"
Exp.	51' to 69'	1"	2×½=1"		C	62.5	1½"
Exp.	69' to 86'	1¼"	2×⅝=1¼"		D	64.6	1¾"
Exp.	86' to 119'	1½"	2×¾=1½"		E	58.2	2¼"

* Recommended min. width of Saw-Cut Seal Groove at time of installation of Sealer.

VALUES IN TABLE ARE BASED ON THE FOLLOWING DATA AND ASSUMPTIONS:

- Total expansion length as given in column ②.
- Temperature at time of placing concrete adjacent to Basic Joint, (+35° to +90°). Groove width computed for assumed temperature range of 0° to 100°. (10° min. Rise, 65° max. rise; 35° min fall, 90° max. fall).
- Assumed 75% compressibility of Foam if left in Basic Joint.
- Assumed 25% permanent set based on nominal width of Seal.
- Minimum width of Seal fully compressed to be the maximum number of webs in any cross-section. (Top and Bottom walls not considered).
- Fabrication tolerances of the Neoprene Seal as described in the current specifications
- No allowances have been made for Construction tolerances.
- Seals having a minimum percent (%) of voids as given in column ⑦.
- Seals designed with a pattern of voids which allows almost complete closure of voids without over-straining the solid material (walls & webs) and also prevents upward protrusion of the Seal.
- Table prepared for 90° skew bridges. (For other skews, the width of joints becomes less critical).

APPROVED: _____
Bridge Engineer

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

DECK JOINT FOR PREFORMED NEOPRENE COMPRESSION SEAL

PRESTRESSED CONCRETE BRIDGES

SHEET 1 OF 1

ST-211

Designed By: Division Of Bridge Engineering, Central Office, P.D.H.

CRACK CLASSIFICATIONS

To be used as a guide in crack evaluation

GENERAL

- Cracks may be entirely eliminated or be kept at a minimum if beams are fabricated in accordance with app'd. shop dwg's. and current specifications. (All details on shop drawings shall be in accordance with P.D.H. Prestressed Standards, with additions made as desired by different plants.)
- Some cracks may appear even if concrete mixture, placement, beam fabrication & curing have been carefully done in accordance with the latest practice.
- Listed below are certain cracks, their probable causes & means of elimination or control.

Note: To minimize cracking it is important that strands be released within one half hour after steam curing has been stopped & before the beam has cooled. Maintenance of the release control is most important for outdoor plants.

Type 1-Crack (V-crack) - Appears in ends of beams regardless of skew. These cracks are more severe at acute corner as compared to the obtuse corner. Beams showing these cracks are generally those with a high percentage of prestressing reinforcement &/or a dense strand pattern.
Cause-High stress concentration due to dense arrangement of strands.
· Possible unequal release or unbalaced force on skew side, temperature effect.
Cure-Disperse strand pattern; use of less economical strand pattern; heavy end grid reinforcement. (Use draped strands, Partial unbonding)

Type 2-Crack (Entrant crack) - Appears at beam notch. It may appear in beams with a low or high percentage of prestressing reinforcement.
Cause-Stress concentration due to sharp changes in section, temperature and/or tension stresses, inadequate bond length or area of reinf. steel, temperature effect at notch.
Cure-Increase bond length of reinforcing or area of reinforcing. Carefully finish the re-entrance angle face by providing a 4"± tooled bead. Unbonding of part of reinforcing (when permitted) may reduce cracking. Changing strand release sequence and reducing time between cutting steam & detensioning may be helpful. (Use draped strands, release well above specified release strength, partial unbonding).

Type 2A-Crack (Change of sect. crack) - Crack generally at top of beam near the change in section from hollow beam to solid beam at inserts & lifting hook locations.
Cause-Crack may be induced due to stress concentration caused by a combination of changes of section, tension stresses and stresses caused through handling of the beam or due to stacking or lifting of the beam.
Cure-Increase top reinforcing; move up c.g. of strands. Use less economical strand patterns, draped strands. Relocate lifting hooks to be at least 12" away from change of section. Use load equalizer yoke for lifting beams. Supervise carefully the stacking and pickup of beams and support for hauling of beams.

Type 3-Crack (Skewed end crack) - Crack at sharp point of skewed end of beams (box beams).
Cause-Stress concentration because of close strand spacing; ineffective mild reinforcing.
Cure-Furnish sufficient end grid reinforcing; disperse strands; draping; bond breaking where permitted.

Type 3A-Crack (Horiz. end crack) - Horizontal crack close to top row of strand pattern.
Cause-Same as for type 3, and temperature effect (too rapid cool off)
Cure-Same as for type 3 & furnish sufficient bond length for bottom & top stirrups, and for vertical end face bars maintain specified clearance for bars in bulkhead area. Stay within specified steam cut off time.

Type 4-Crack (Shrinkage crack) - Lateral crack appears over top of beam anywhere along beam length.
Cause-High cement factor or curing problems - not releasing strand within ½ hour after stopping of curing.
Cure-Reduction of cement factor or immediate release, or as otherwise recommended.

Type 4A-Crack (Horiz. Shrinkage crack) - Crack appears at web of beam, continuous or non-continuous, generally above bottom slab or bottom flange in prestressed I-beams.
Cause-Same as for type 4.
Cure-Same as for type 4, keeping the beams wet during the full curing period.

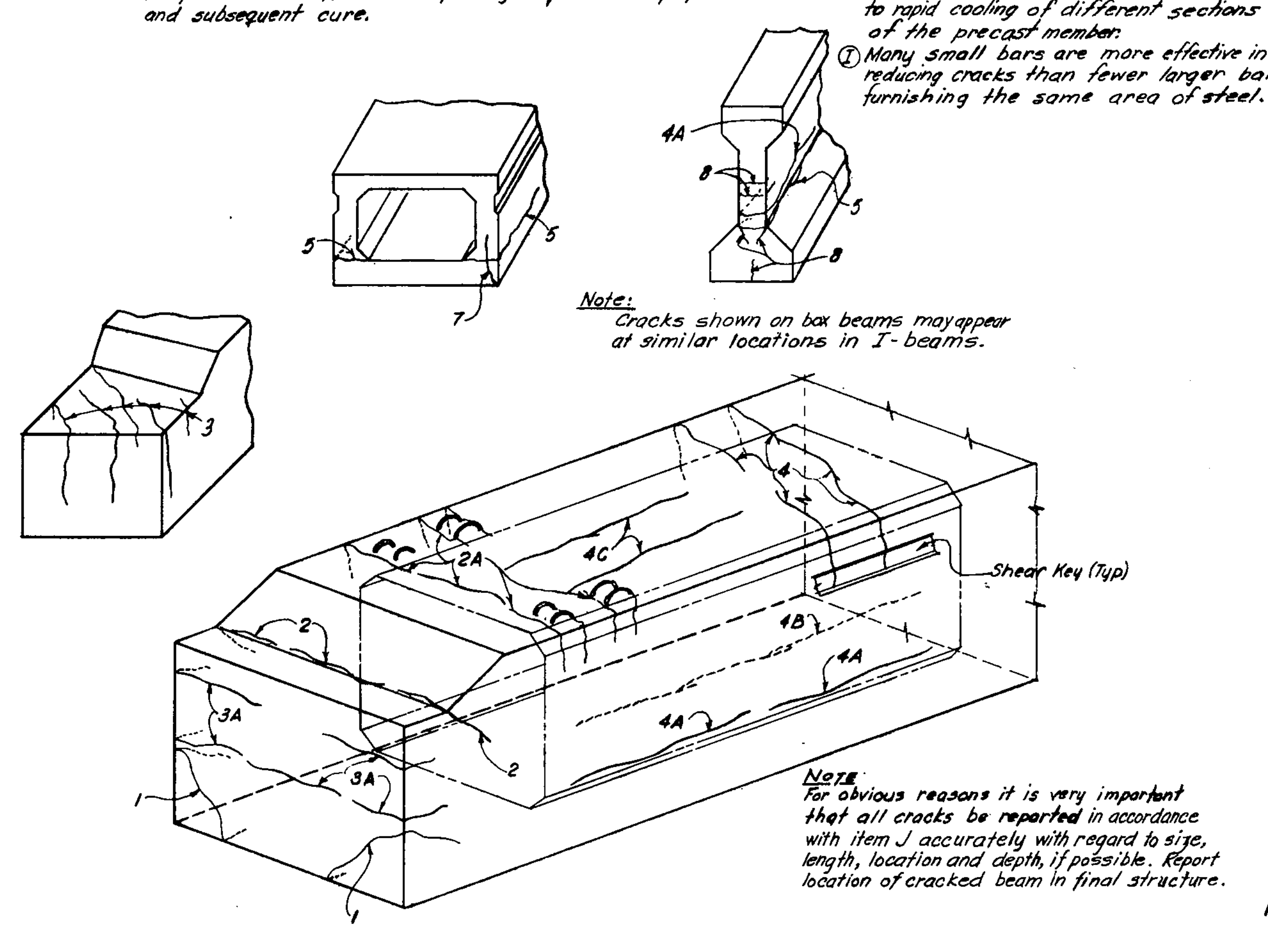
Type 4B-Crack (Bott. Shrinkage crack) - Crack appears at bottom of box beams, near the center of beams. continuous or non-continuous.
Cause-Same as for type 4.
Cure-Same as for type 4.

Type 4C-Crack (Top longitudinal shrinkage crack) - Crack appears longitudinal along top of box beams.
Cause-Due to differential in temperature during curing of the beam; steel bars too close to top of beam or floating of void:
Cure-Use of effective breather tubes; proper bar clearance. securing of void.

Type 5-Crack (Cold joint crack) - Crack appears at junctions - increments of pours, generally between bottom flange or slab and web and may be continuous.
Cause-Premature hardening of concrete, due to delays between increments of pours.
Cure-Better fabrication control, addition of retarder in concrete.

Type 6-Crack (Plastic deformation crack) - Crack apparently is discovered at locations of type 1 to 3 after beam has been stored for a period of time. Length of time from release to discovery may vary.
Cause-Increase in concrete stress caused by creep and plastic deformation.
Cure-As this cracking is affected by time, temperature variations & numerous other variables, serious cases of cracking will have to be investigated and studied. No general cure can be recommended at this time for this type of crack. (Thorough study of plant operation may lead to recommendation of change in operational procedure which may help to eliminate cracking.)

Type 7-Crack - Crack appears at chamfer strip.
Cause-Poor work control; improper vibration, cold joints at poorly finished bottom slab, yielding of forms while concrete is still in a semi-plastic stage. (Generally due to extremely poor workmanship)
Cure-Reinspection of bed, forms and pouring sequence will pinpoint cause and subsequent cure.



Note: Cracks shown on box beams may appear at similar locations in I-beams.

Note: For obvious reasons it is very important that all cracks be reported in accordance with item J accurately with regard to size, length, location and depth, if possible. Report location of cracked beam in final structure.

Type 8 Cracks - In addition to the above, cracks may occur in I-beams at location 8 or in the case of pre-post tensioned beams, somewhere close to the sheathing. Cutting sequence of the strands may have a direct influence on end cracking in straight or draped strand beams.

GENERAL OBSERVATIONS

Ⓐ Precast concrete will crack due to plastic deformation, shrinkage, variable moisture, temperature effects & stresses

Ⓑ In precast prestressed concrete this cracking can be eliminated in the compression zone of the member.

Ⓒ Additional reinforcing will not eliminate cracks but only reduce size of cracks.

Ⓓ End-tension design stresses are not the primary cause of cracks as cracks may appear in members with zero stresses.

Ⓔ There is very little known on the effect cracks will have on the life of a reinf. concrete member under cyclic loadings. Therefore cracks shall be kept to a minimum.

Ⓕ If camber variation within beams of one structure is great this may indicate that concrete strength, release or inside beam dimensions vary considerable between sets of beams and that concrete strength indicated by cylinder breaks may be misleading.

Ⓖ If cracks are longer on one side or horizontal camber appears in the beam indications are that strands were not released symmetrically.

Ⓗ Cracking may be induced or increased due to rapid cooling of different sections of the precast member.

Ⓘ Many small bars are more effective in reducing cracks than fewer larger bars furnishing the same area of steel.

INSTRUCTIONS

Ⓙ All cracks in prestressed beams shall be recorded on a sketch and a form available and two (2) copies mailed to the Bureau of Materials, Testing and Research (MTR).

Ⓚ Beams having cracks exceeding the dimensions given below for the following types and for any type of cracking other than that shown, shall not be accepted for shipment unless approval for structure adequacy has been requested and received from the Bureau of MTR.
Beams with cracks of the types below, not exceeding the dimensions given may be accepted for shipment as directed by the Engineer, provided all cracks exceeding .004 inches in width are sealed as directed by the Engineer with an approved epoxy paste, and sketches submitted to the Bureau of MTR for their study and records.

Type	Width	Length of Crack
1	.008"	max. crack length 1/8 of beam depth each way
2, 2A	.010"	max. crack length 1/4 of beam depth each way
3, 3A	.008"	non-continuous crack; each not exceeding 2 ft. in length
4	.008"	shall not project below bottom of shear key
4B, C	.006"	non-continuous crack; each not exceeding 3 ft. in length. Total length of crack not to exceed 1/3 length of beam
4A, 5	.002"	non-continuous crack; each not exceeding 2 ft. in length. Total length of cracks not to exceed 1/2 bm. length. No cracks in middle 1/3 of beam
6	.003"	subject to length restriction for types 1 to 3
7	.005"	Max. crack length 1½ ft.
8	—	Depending on condition

Ⓛ Width of cracks shall be measured with a "Finescale Magnifying Comparator" or equal at the approximate center of crack.

Ⓜ Crack width measurements with an automobile feeler gauge is not satisfactory.

Ⓝ All cracks less than .003 inches in width shall be classified as hair cracks.

Ⓞ Beams showing hair cracks of types 1, 2, 3, 4, 6 need not be recorded individually; one sketch describing typical cracks, frequency of occurence will be sufficient.

Ⓟ Any other cracks not listed above shall be reported at once, with approved sketches to the Bureau of MTR.

Approved: 3/17/70
Chief Engineer

Approved: 1/22/70
Chief Bridge Engineer

Commonwealth of Pennsylvania
Department of Highways
BRIDGE UNIT

INSTRUCTIONS FOR ACCEPTANCE OF PRESTRESSED BEAMS WITH CRACKS. CRACK CLASSIFICATION

SHEET 1 OF 1 P-800

Prepared by Division of Bridge Engineering, P.D.H.

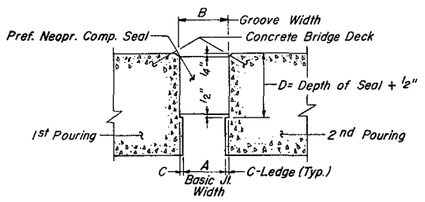
TABLE I ▲

For Saw Cut Grooves					
Expansion Lengths	Movement Classification	Nom. Width of Seal	Thickness of Foam Joint Filler "A"	Seal Groove Width "B"	Remarks
Fix Jt.	0.5"	1.25" to 2.0"	0.5"	0.8 (Nom. Width of Seal)	
Up to 50'	1.0"	2.0" & 2.5"	0.375" or 0.5"	To be Computed by the Designer. See Example	
50' to 65'	1.0"	2.0"	0.375		**
65' to 80'	1.0"	2.5"	0.5"		
80' to 100'	1.0"	2.5"	0.5"		**
*100' to 150'	1.5"	3.5"	1.0"		
*150' to 160'	1.5"	4.0"	1.0"		
*160' to 200'	1.5"	4.0"	1.0"		**

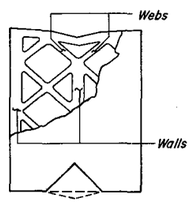
* For Expansion Length above 100' Armored Preformed Neoprene Compression Dam under certain conditions might be more suitable because of considerably large joint opening of Saw Cut Joint in cold weather.

▲ The development of "Table I" is based on design criteria as stated in the General Information on this sheet.

** Foam Joint Filler to be removed immediately after Concrete hardens.



TYPICAL JOINT DETAIL



TYPICAL CROSS SECTION OF SEAL

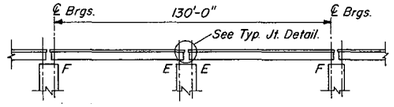
INFORMATION & CONSTRUCTION DETAILS TO BE SHOWN ON THE DESIGN DRAWINGS :

- Movement classification of Joint, (use Table I).
- Selected type of seal (from Bulletin 15 ***) with Nominal Width as shown in Table I of this Sheet, with movement matching the joint classification (do not specify manufacturer and identification code). "Other seals as listed in Bulletin 15, with movement capacity not less than that specified, may be substituted for the seal specified. In such event the Contractor shall be responsible for any and all necessary revisions to the drawings. This substitution is subject to the review and approval of the Chief Bridge Engineer. All work and materials necessitated by this substitution shall be at no extra cost to the Department."
- Table showing width of Seal Groove at 0°F thru 100°F for every 10°F.
- Width of Basic Joint (Foam Joint Filler thickness),-use Table I of this sheet.
- Specify if Foam shall be removed after concrete has hardened or not,-use Table I of this sheet.
- Recommended opening of joint for installation of seal is 60% of seal's nominal width.
- Sections with all necessary dimensions and information required to construct the joint,-similar to those shown on sheet 2.

*** Bulletin 15 is a tentative list of commercial producers of construction materials approved by Penn Dots Bureau of Materials, Testing & Research, and can be purchased from Penn Dots Publication Department.

EXAMPLE :

Preformed Neoprene Compression Seal is to be used in a P/S Concrete Bridge Deck Joint with a total expansion length of 130'.-Select a Seal, determine the width of basic Jt. & seal groove and recommended opening for seal installation.



SOLUTION

STEP 1 From Table I for Expansion Length of 130', find Movement Classification 1.5", Nominal Width of Seal 3.5" and Thickness of Foam Joint Filler = 1.0".

STEP 2 Selection of Seal : With known Movement Classification and Nominal Width go to Bulletin 15 and select one which has 3.5" Nominal Width of the listed seals.

STEP 3 Determination of Seal Groove Width "B" for every 10°F from 0°F thru 100°F.
Width @ 0°F = 80% of Seals Nominal Width or = 0.8 x 3.5" = 2.80"
@ 10°F = 2.8" - 0.000006 x 130' x 12 x 10° = 2.8 - 0.0936 = 2.71
•
•
•
@ 100°F = 2.8" - 0.000006 x 130' x 12 x 100° = 2.8 - 0.936 = 1.864"
A table, simmilar to Table II shown below, must be shown on Design Drawings.

STEP 4 Recommened Width of Joint Opening (Groove) for Seal Installation = 60% of Seals Nominal Width or in this case "B" = 0.6 x 3.5" = 2.1".

NOTE If desired, detailed design computations, concerning the above Example, could be obtained from the Division of Bridge Engineering.

TABLE II

Temp. (°F) ≠	Seal Groove Width "B"
0	2.80
10	2.71
20	2.61
30	2.52
40	2.43
50	2.33
60	2.24
70	2.14
80	2.05
90	1.96
100	1.86

- For temperatures other than those listed in the table, determine "B" by interpolation.

≠ Atmospheric temperature at time of forming, or sawcutting the Seal Groove.

GENERAL INFORMATION

- This Standard consist of two (2) sheets :
  - Sheet 1, containing Design Information.
  - Sheet 2, containing Construction Details.
- The Standard shall be used as a guide, only, in the preparation of Design Drawings. No reference shall be made to this Standard on Design Drawings. In special cases and if suitable, this Standard may be listed in the Supplemental Drawing Block for general information.

A Design Information

- A Compression Seal for waterproofing a bridge joint and sealing against incompressible materials is effective if it sustains a positive pressure against the walls of the joint. The Seal must be under compression at all times.
- The potential of the Preformed Neoprene Compression Seals is limited by the Factors ▲1 and ▲2. A Design Engineer, when computing the Seal Groove Width, must consider these 2 Factors in relation to the Width of the Seals.

▲1 Minimum Width of Seal Groove must be greater than the width of totally compressed seal (width consisting of the sum of walls and webs thicknesses only).

▲2 Maximum Width of Seal Groove must equal or be less than 80% of the Nominal Seal Width.

- The Seal shown on this sheet is for general information only. Seals of other shapes may be used provided they are listed in the current Bulletin 15.

B DESIGN ASSUMPTIONS — Used In The Preparation Of This Standard.

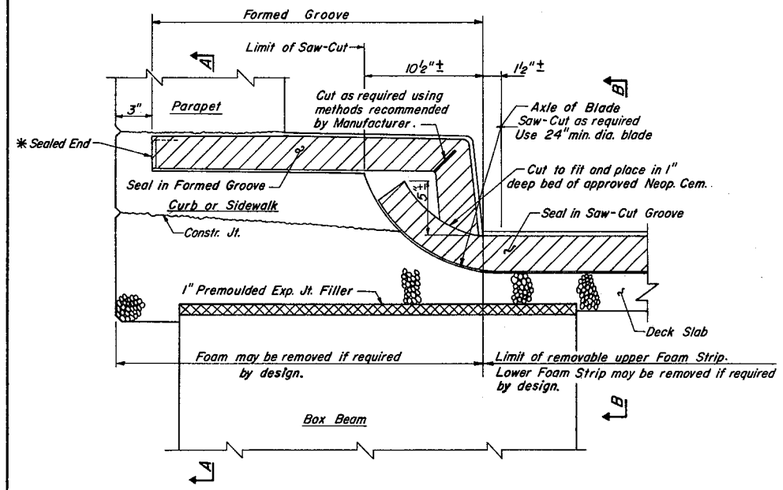
1. DESIGN CRITERIA :
   - Thermal Coeficient of Concrete = 0.000006 / °F.
   - Temperature Range = 0° F to + 100° F.
   - Temperature at time of pouring concrete adjacent to basic joint = + 35°F to + 90° F.
   - Compressibility of the Foam = 75%.
   - Minimum opening of basic joint assumed 1/16" if Foam Joint Filler is specified to be removed immediately after concrete hardens.
   - Design allowances for compressibility of the seal = 20% at 0° F.
   - To secure proper sawcutting, the ledge width is preferred to be a minimum of 0.4". This value was used in computing the values shown in Table I.
   - The temperature used in this Standard is the atmospheric temperature measured in degrees Fahrenheit as specified in Form 408, 1001. 3 (p) 4.a.
   - No allowances have been made for Construction Tolerances.
2. COMPUTATIONS : See the Example.

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

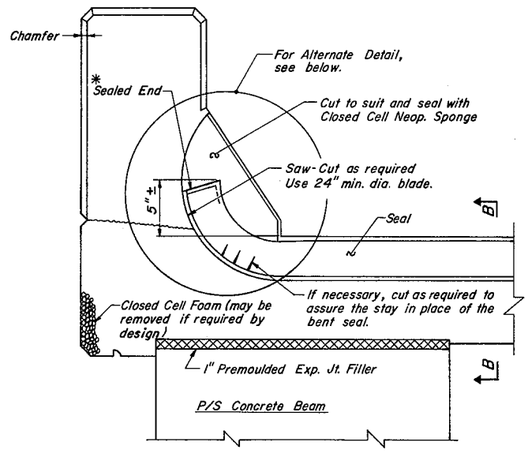
BRIDGE JOINT FOR PREFORMED NEOPRENE COMPRESSION SEAL DESIGN INFORMATION FOR PRESTRESSED CONCRETE BRIDGES

Recommended MARCH 1, 1973	Approved MARCH 1, 1973	Sht. 1 Of 2
Chief Bridge Engineer	Deputy Chief Highway Engineer	BD-212

BARCLAY BROTHERS, INC. #4101-B



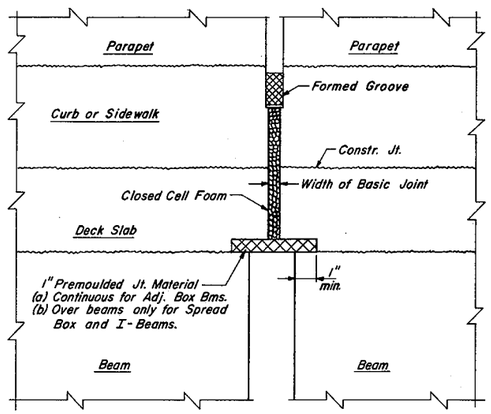
SECTION THRU JOINT WITH SIDEWALK
(Details of Joint for Spread Box Beam, Adjacent Box Beam and I-Beam Bridges similar.)



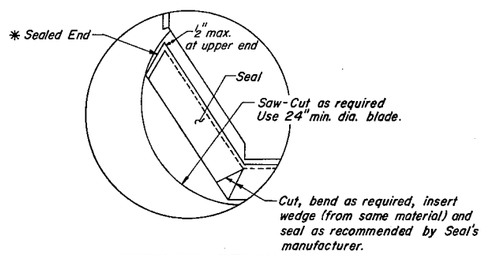
SECTION THRU JOINT WITH STANDARD CURB

GENERAL NOTES & INSTRUCTIONS

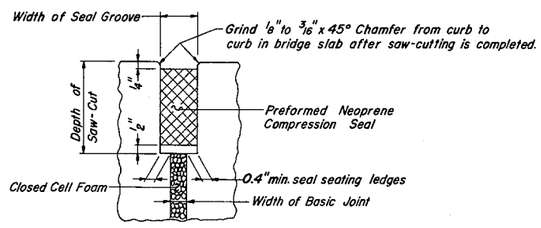
- Materials and workmanship shall be in accordance with Specifications Forms Forms 408 and 409.
- The sealed joint is constructed at various stages of deck construction; therefore all operations must be precisely controlled and executed as specified in Section 1008.3 of Form 408.
- Ascertain that the top of the installed seal is ¼" minimum to ½" maximum below the deck surface and that the intersection of the vertical and the horizontal seals at the gutter line is waterproof.
- Details shown on this sheet are for joints at piers and for bridges with 90° skew or less. For joints at abutments and/or for sharp skews, modifications shall be made, as required, by the designer and shall be shown on the Design Drawings.
- Armored Preformed Neoprene Compression Dam similar to BC-363 may be specified providing the design is based on the criteria on this standard and details and data are shown on the Design Drawings.



SECTION A-A



ALTERNATE DETAIL

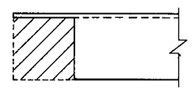


SECTION B-B

* Alternates for Sealed Ends

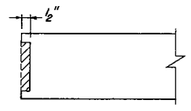
ALTERNATE "A"

Pay limit of seal for Alternate A is extened by 6" for each Sealed End.



Cut and remove cross hatched area, then bend top over to seal end.

ALTERNATE "B"



Cut out and remove seals' webs and replace with Closed Cell Neoprene Sponge.

Seal contact area with approved adhesive.

Commonwealth of Pennsylvania
DEPARTMENT OF TRANSPORTATION
BUREAU OF DESIGN

BRIDGE JOINT FOR PREFORMED NEOPRENE COMPRESSION SEAL
CONSTRUCTION DETAILS FOR PRESTRESSED CONCRETE BRIDGES

Recommended MARCH 1, 1973	Approved MARCH 1, 1973	Sht. 2 Of 2
Chief Bridge Engineer	Deputy Chief Highway Engineer	BD-212

BARCLAY BROTHERS, INC. #4101-B

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FENCE

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION
ST-301	1	6-12-69	PROTECTIVE FENCE

RAILING

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION
ST-311	1	[illegible]	[illegible]
ST-312	1	6-12-69	ALUM. BRIDGE RAILING & Guard Rail Connection
ST-313	1	6-12-69	STEEL BRIDGE RAILING & Guard Rail Connection
ST-314	1	6-12-69	ALUMINUM BRIDGE RAILING
ST-316	1	6-12-69	STEEL BRIDGE RAILING
ST-316	[illegible]	[illegible]	[illegible]
ST-317	1	6-12-69	PEDESTRIAN-TRAFFIC BARRIER

ELECTRICAL

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION
ST-[illegible]	[illegible]	6-12-69	ELECTRICAL DETAILS FOR [illegible]
ST-[illegible]	[illegible]	6-12-69	LIGHTING POLE ANCHORAGE

MISCELLANEOUS

DWG. NO.	SHT. NO.	APPD. DATE	DESCRIPTION
ST-391	1	9-23-68	PRECAST CEMENT CONCRETE BLOCK SLOPE WALL
ST-332	2 SHTS	12-22-69	PERM. METAL DECK FORMS

NOTE

THESE STANDARDS (EXCEPT ST-317) MAY BE REFERRED TO ON THE PLANS IN LIEU OF SHOWING SPECIFIC DETAILS, PROVIDED COORDINATING INFORMATION IS SHOWN ON THE PLANS.

APPROVED: JUNE 12, 1969
[illegible]
CHIEF ENGINEER

APPROVED: JUNE 12, 1969
B J Kotalik
BRIDGE ENGINEER

Commonwealth of Pennsylvania

DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARDS
FOR
BRIDGE APPURTENANCES

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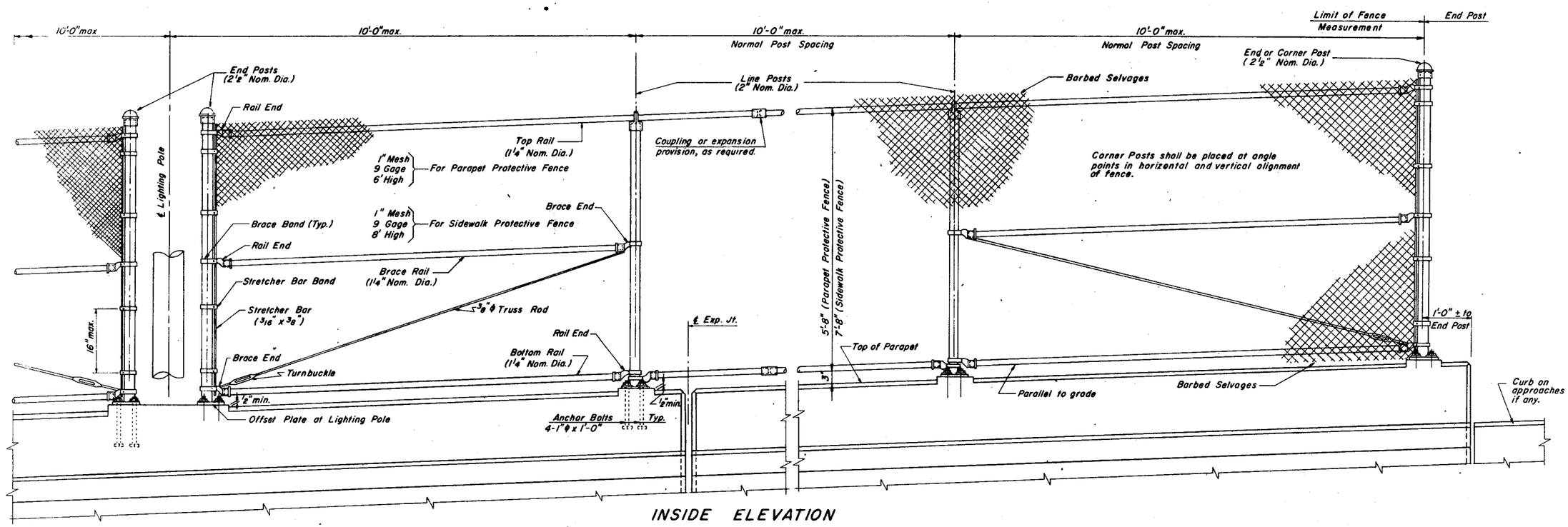
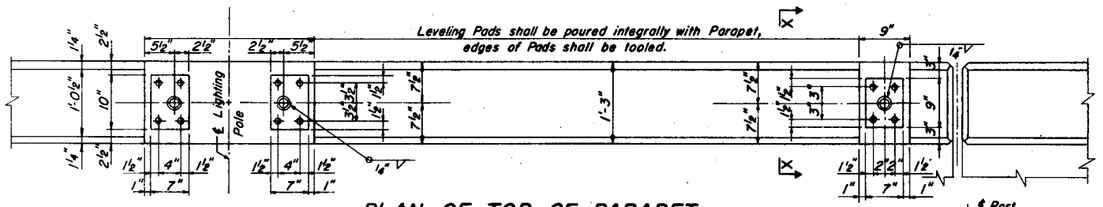
SHEET 1 OF 1

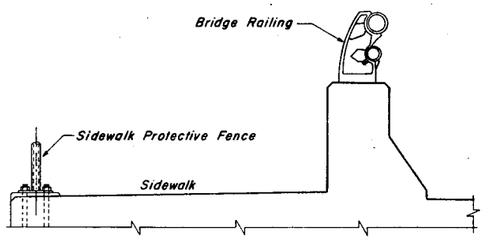
ST-300



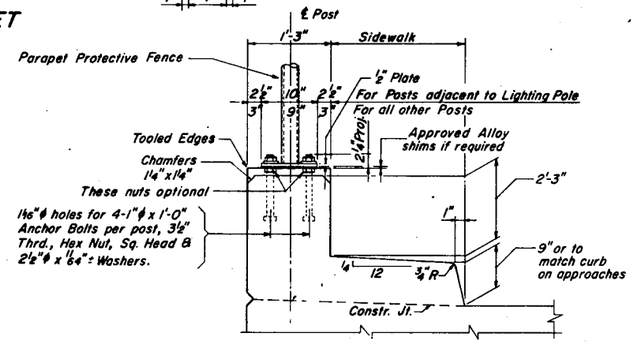
INSIDE ELEVATION



PLAN OF TOP OF PARAPET



ALTERNATE SECTION X-X



SECTION X-X

NOTES

MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPECIFICATIONS FORMS 408 AND 409.

ANCHOR MATERIALS SHALL CONFORM TO ASTM DESIGNATION A36, AND SHALL BE GALVANIZED CONFORMING TO SECTION 1052.16 OF FORM 409.

MATERIALS SHALL NOT BE PAINTED.

FENCE POSTS AND ANCHOR BOLTS SHALL BE TRULY VERTICAL. RAILS SHALL BE PARALLEL TO GRADE.

IF LIGHTING POLES ARE NOT INSTALLED, GAPS SHALL BE CLOSED WITH A SEPARATE PIECE OF FABRIC.

FOR ELECTRICAL DETAILS FOR STRUCTURES, REFER TO STD. DWG. ST-321. FOR LIGHTING POLE ANCHORAGE DETAILS, REFER TO STD. DWG. ST-322.

AT BRIDGE EXPANSION JOINTS, THE FABRIC AND RAILS SHALL BE FREE TO EXPAND OR CONTRACT.

FOR SPACING OF POSTS AND LOCATION OF EXPANSION JOINTS, REFER TO DESIGN DRAWINGS.

FENCE SHALL BE MEASURED CONTINUOUSLY BETWEEN CENTERS OF END POSTS AND SHALL INCLUDE ALL FENCE POSTS, RAILS, ANCHOR BOLTS WITH WASHERS AND NUTS FOR FENCE POSTS & LIGHTING POLES, LIGHTING POLE ANCHOR ANGLES, PROTECTIVE WOOD BLOCKS, FABRIC, TRUSS RODS, ETC. NO DEDUCTION IN MEASUREMENT WILL BE MADE FOR GAPS AT LIGHTING POLES.

APPROVED: JUNE 12, 1969
CHIEF ENGINEER

APPROVED: JUNE 12, 1969
B Z Kotalik
BRIDGE ENGINEER

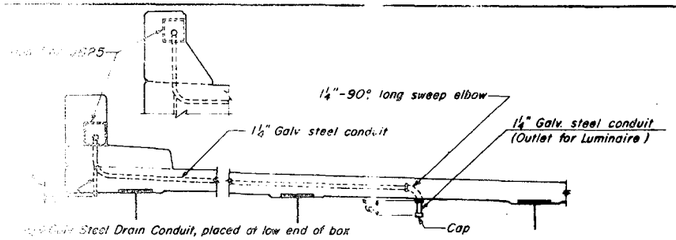
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD

PROTECTIVE FENCE

SHEET 1 OF 1

ST-301

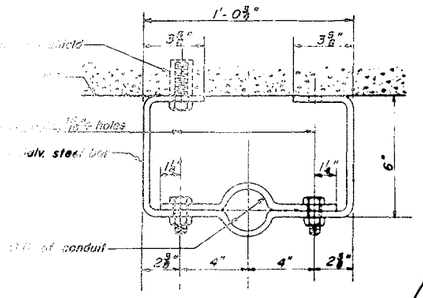


Steel Drain Conduit, placed at low end of box

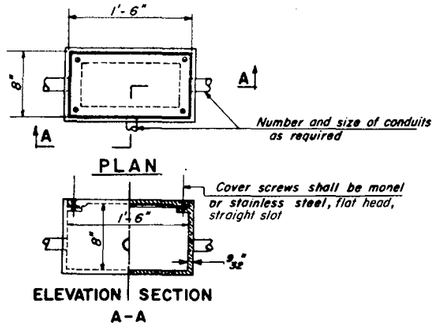
TYPICAL INSTALLATION OF JUNCTION BOX JB25

CONDUITS & FITTINGS FOR UNDERBRIDGE LIGHTING

Refer to design drawings for location of outlets for future Luminaires.



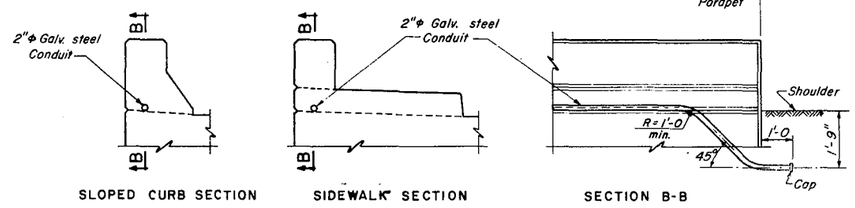
CONDUIT HANGER



ELEVATION | SECTION A-A

JUNCTION BOX JB25

(Section 718.7 (a) Form 408)



SLOPED CURB SECTION | SIDEWALK SECTION | SECTION B-B

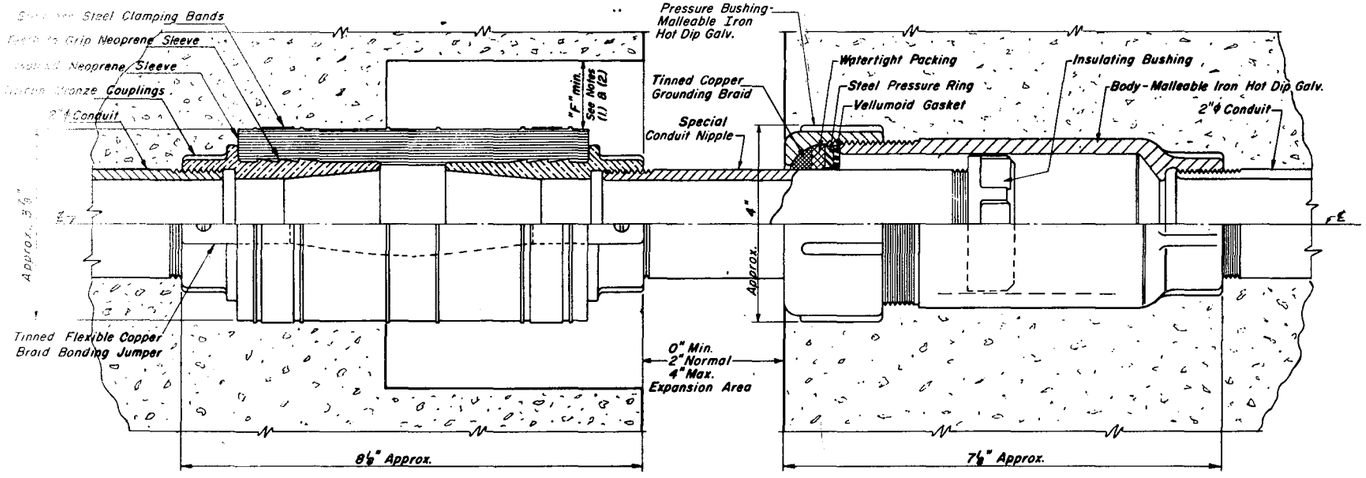
CONDUIT DETAILS AT ENDS OF BRIDGE

NOTES

Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.

Conduit beyond concrete shall be protected as specified in section 718.6 (C), Form 408.

(1.) Provide opening in concrete. Distance "F" all around from edge of fitting to inside of opening to be at least 1" to provide for ¾" maximum deflection.
(2.) If the deflection which must be provided for is less than ¾", the size of the opening in the concrete may be reduced. Dimension "F" should equal deflection required + ¼".



CONDUIT EXPANSION AND DEFLECTION JOINT FITTINGS

O-Z Electrical Mfg. Co. Inc. - EAXDX-200N
Appleton Electric Co.
Spring City Electrical Mfg. Co.
} Or Approved Equal.

APPROVED: JUNE 12, 1969
W. Trukaitis
Chief Engineer

APPROVED: JUNE 12, 1969
B.F. Kotalik
Bridge Engineer

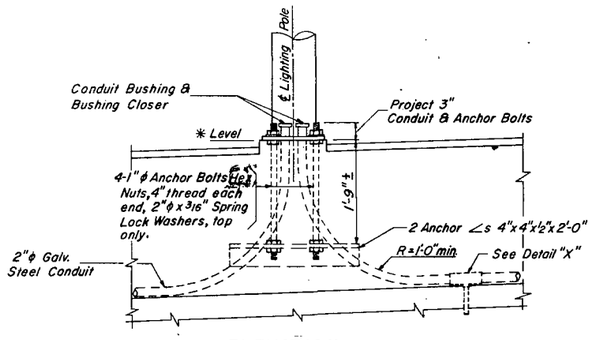
APPROVED: JUNE 12, 1969
R.R. Shaw
Electrical Engineer

Commonwealth of Pennsylvania
Department of Highways
BRIDGE DIVISION

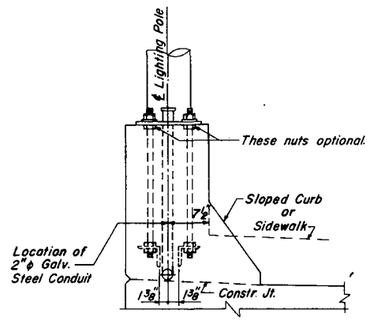
STANDARD ELECTRICAL DETAILS FOR STRUCTURES

SHEET 1 OF 1

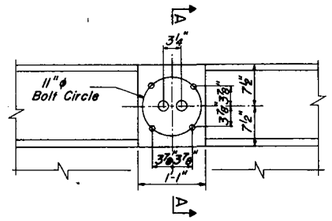
ST-321



ELEVATION



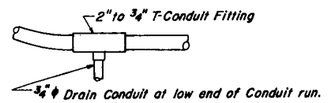
SECTION A-A



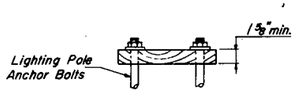
PLAN

* Leveling pad shall be poured integrally with parapet. Edges of pad shall be tooled. Minimum height of leveling pad shall be ½".

DETAIL A



DETAIL "X"

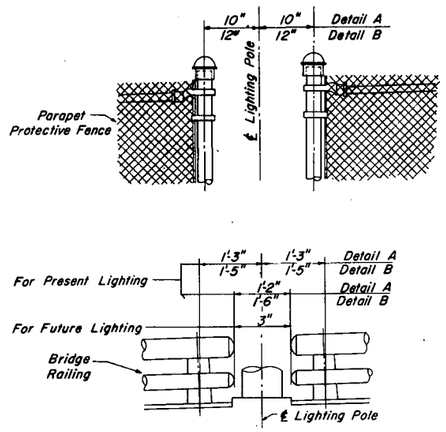


PROTECTIVE WOOD BLOCK

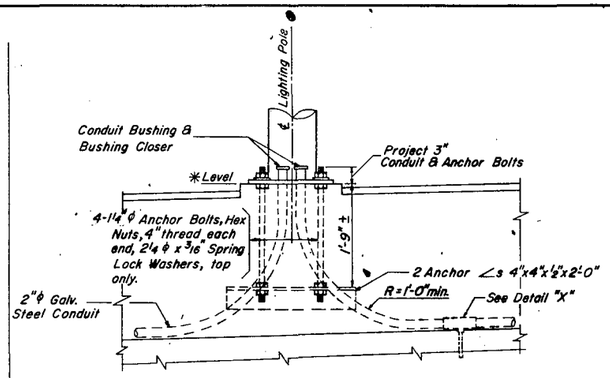
Hardwood 11⅝" square

Protective wood blocks with holes bored to fit bolt spacing and conduit, shall be painted with two coats of Aluminum paint before installation.

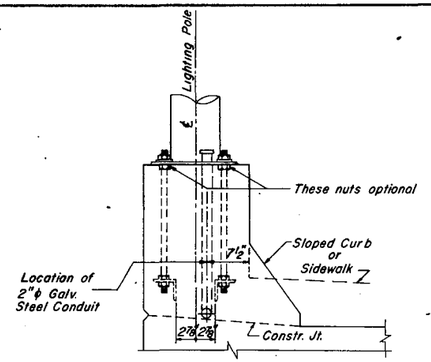
For future lighting: Conduit, lighting pole anchor bolts, nuts and washers above concrete shall be protected as specified for conduits in Section 718.6 (C) of Form 408. Protective wood blocks shall then be placed and firmly secured. Wood blocks shall be installed before fence/railing.



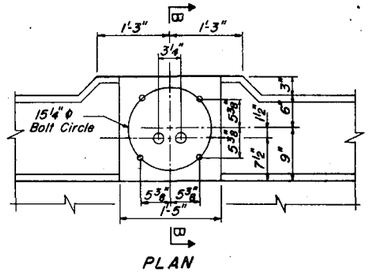
FENCE/RAILING DETAILS AT LIGHTING POLE



ELEVATION



SECTION B-B



PLAN

* Leveling pad shall be poured integrally with parapet. Edges of pad shall be tooled. Minimum height of leveling pad shall be ½".

DETAIL B

LIGHTING POLE MOUNTING HEIGHTS	USE
35'-0 Max.	Detail A
40'-0 to 55'-0	Detail B

NOTES

FOR PRESENT LIGHTING, TEMPLATE FURNISHED BY MANUFACTURER FOR SETTING ANCHOR BOLTS SHALL BE USED.

ANCHOR MATERIALS SHALL CONFORM TO ASTM DESIGNATION A36 AND SHALL BE GALVANIZED CONFORMING TO SECTION 1052.16 OF FORM 409, EXCEPT ANCHOR ANGLES SHALL NOT BE GALVANIZED.

MATERIALS SHALL NOT BE PAINTED EXCEPT PROTECTIVE WOOD BLOCKS.

LIGHTING POLE ANCHORAGES SHALL BE USED ONLY WHEN LIGHTING POLES OR FUTURE LIGHTING POLES ARE SPECIFIED. POLES SHALL BE TRULY VERTICAL WITH BASES LEVEL.

APPROVED: JUNE 12, 1969
CHIEF ENGINEER

APPROVED: JUNE 12, 1969
BRIDGE ENGINEER

APPROVED: JUNE 12, 1969
ELECTRICAL ENGINEER

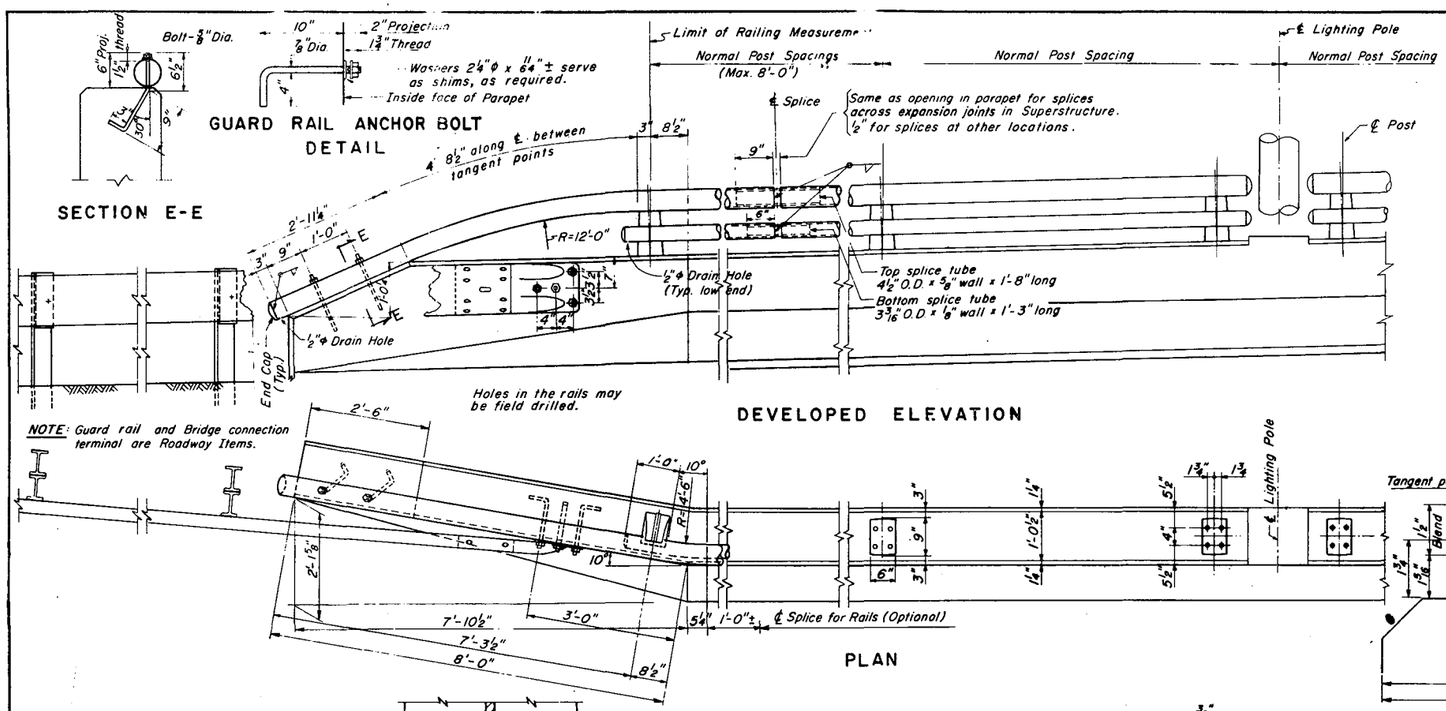
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD

LIGHTING POLE ANCHORAGE

SHEET 1 OF 1

ST-322



NOTES

Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.

Design Specifications: Design Division of 1965-AASHO "Standard Specifications for Highway Bridges.

Shims and end caps shall be of approved aluminum alloy. Shims shall be flush with base of post and end caps shall be flush with rails.

Anchor materials shall conform to ASTM Designation A36, and shall be galvanized conforming to Section 1052.16 of Form 409. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.

Materials shall not be painted.

Posts and post anchor bolts shall be normal to grade and rails, except curved rails, shall be parallel to grade.

For Electrical Details for Structures, refer to Std. Dwg. ST-321.
For Lighting Pole Anchorage details, refer to Std. Dwg. ST-322.
Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rails shall be as long as pratical, with a minimum of three posts between splices, unless otherwise required for expansion. ℄ Rail splices shall be located 1'-0" minimum from ℄ posts except as specified.

For spacing of posts and location of expansion joints, refer to Design drawings.

Railing shall be measured continuously between centers of end posts and shall include all railing posts, rails, end caps, toggle bolts, anchor bolts with washers and nuts for rails, posts, guard rail end section connections and lighting poles, lighting pole anchor angles and protective wood blocks.

APPROVED: JUNE 12, 1969
Chief Engineer

APPROVED: JUNE 12, 1969
Bridge Engineer

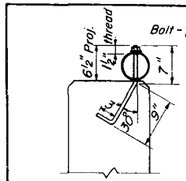
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD

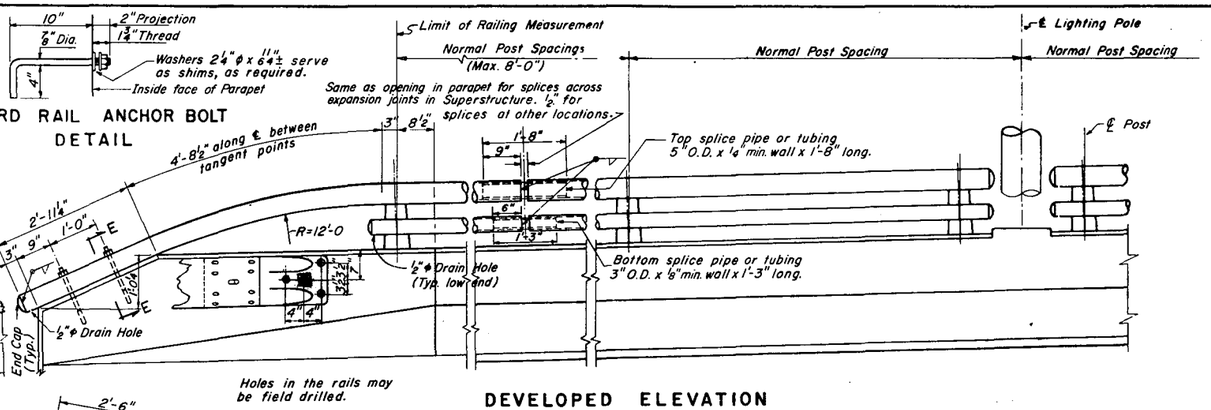
ALUMINUM BRIDGE RAILING AND GUARD RAIL CONNECTION

SHEET 1 OF 1

ST-312



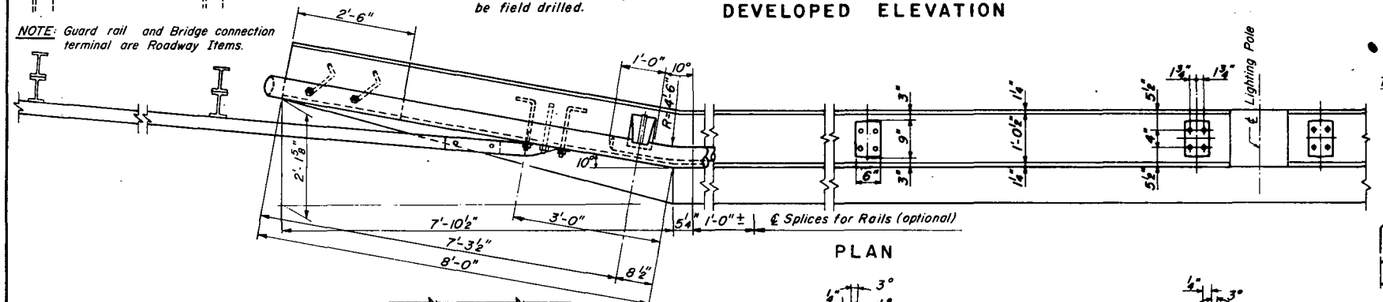
SECTION E-E



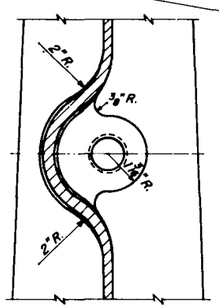
GUARD RAIL ANCHOR BOLT DETAIL

DEVELOPED ELEVATION

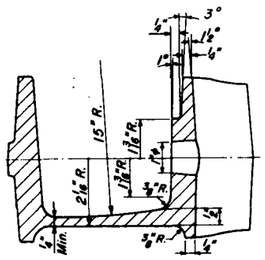
NOTE: Guard rail and Bridge connection terminal are Roadway Items.



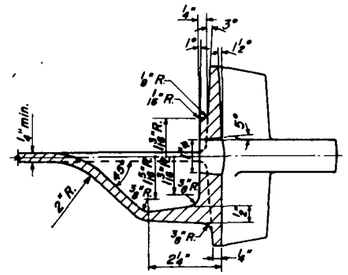
PLAN



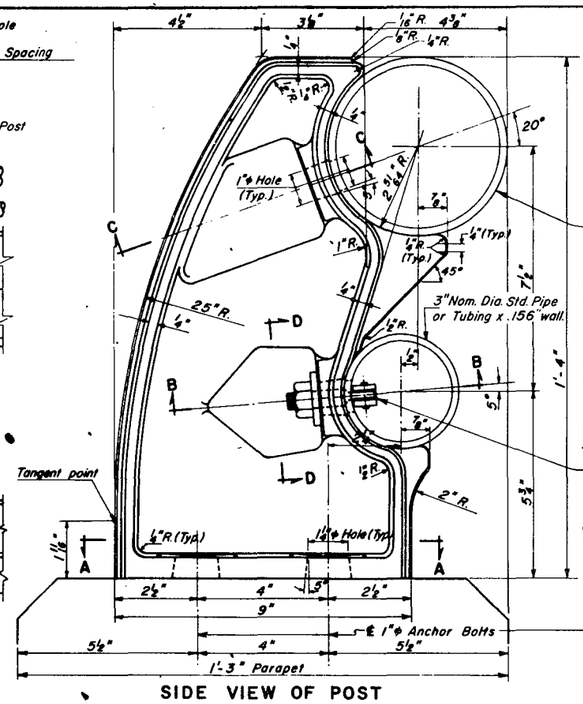
SECTION D-D



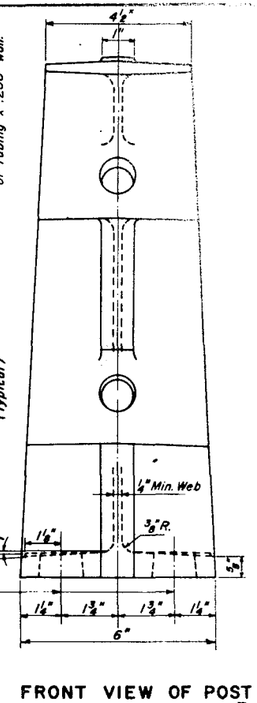
SECTION C-C



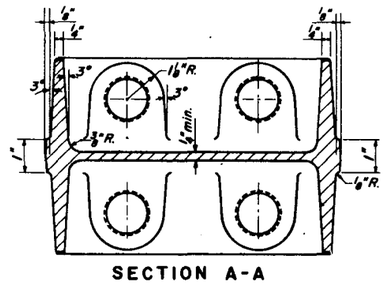
SECTION B-B



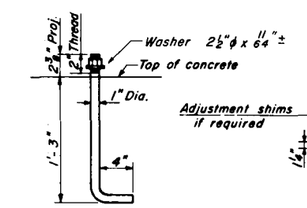
SIDE VIEW OF POST



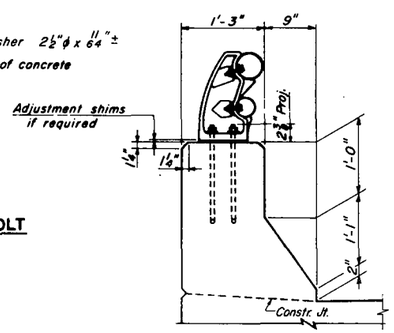
FRONT VIEW OF POST



SECTION A-A



POST ANCHOR BOLT DETAIL



TYPICAL SLOPED CURB SECTION

NOTES

Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.

Design Specifications: Design Division of 1965 - AASHO "Standard Specifications for Highway Bridges."

Anchor materials shall conform to A.S.T.M. Designation A36.

Steel shall be galvanized conforming to Section 1052.16 of Form 409. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.

Materials shall not be painted.

Posts and post anchor bolts shall be normal to grade and rails, except curved rails, shall be parallel to grade.

Shims and end caps shall be of approved steel. Shims shall be flush with base of post and end caps shall be flush with rails.

For Electrical Details for Structures, refer to Std. Dwg. ST-321.
For Lighting Pole Anchorage details, refer to Std. Dwg. ST-322.

Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rails shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion. ℄ Rail Splices shall be located 1'-0" minimum from ℄ Posts except as specified.

For spacing of posts and location of expansion joints, refer to Design Drawings.

Railing shall be measured continuously between centers of end posts and shall include all railing posts, rails, end caps, toggle bolts, anchor bolts with washers and nuts for rails, posts, guard rail end section connections and lighting poles, lighting pole anchor angles and protective wood blocks.

APPROVED: JUNE 12, 1969
Chief Engineer

APPROVED: JUNE 12, 1969
Bridge Engineer

Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

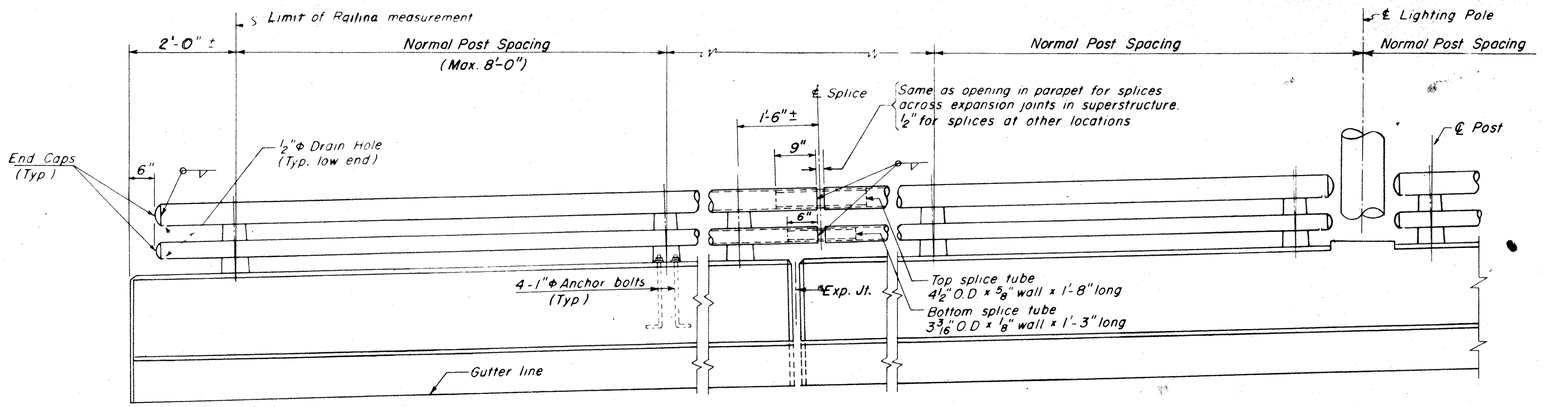
STANDARD

STEEL BRIDGE RAILING AND GUARD RAIL CONNECTION

SHEET 1 OF 1

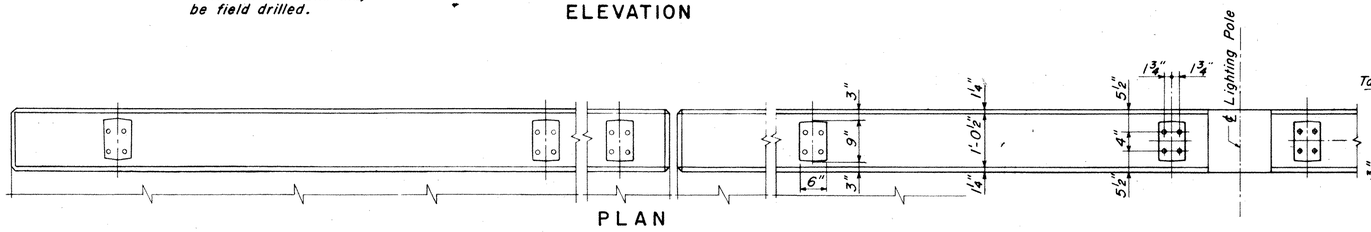
ST-313

41388 PEL x

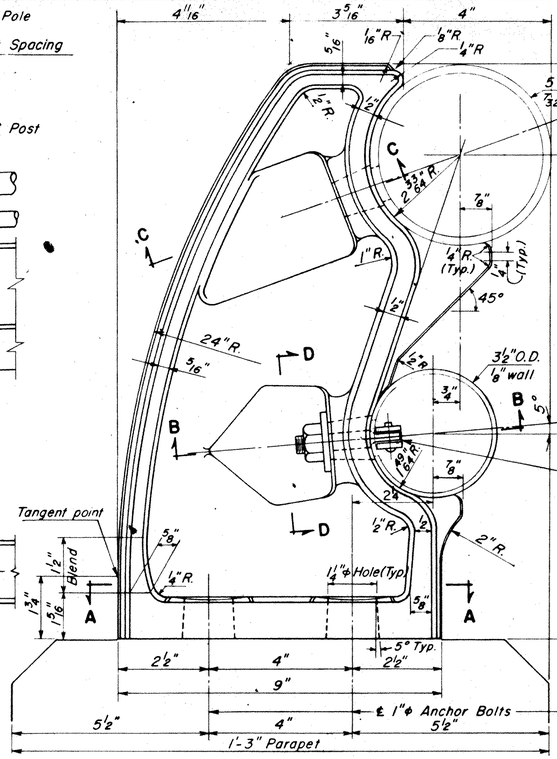


Holes in the rails may be field drilled.

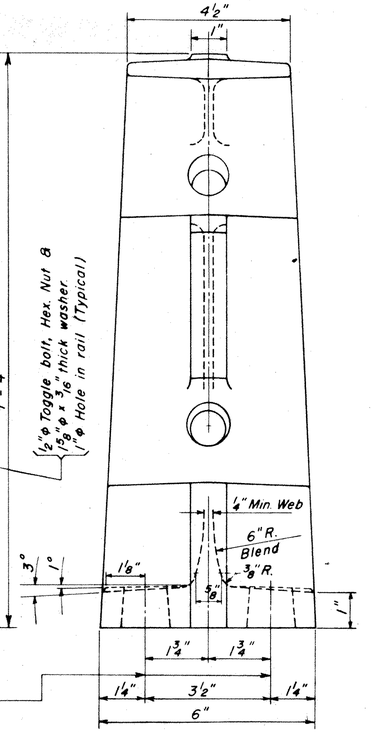
ELEVATION



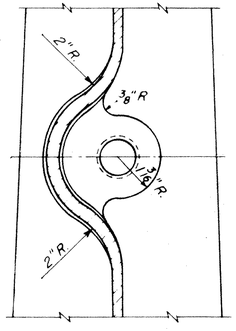
PLAN



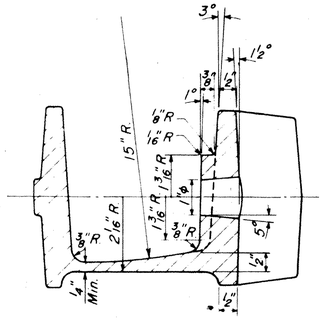
SIDE VIEW OF POST



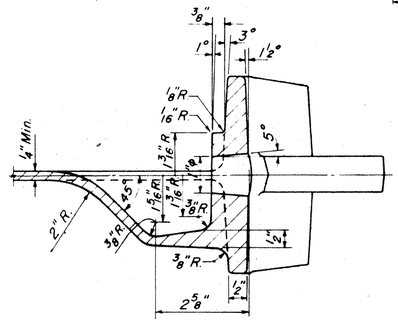
FRONT VIEW OF POST



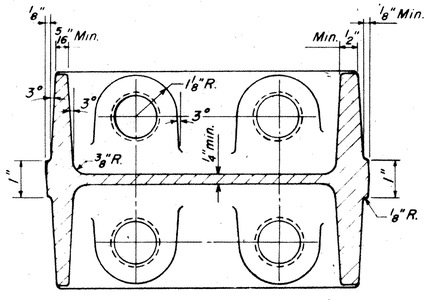
SECTION D-D



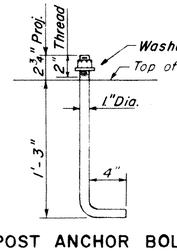
SECTION C-C



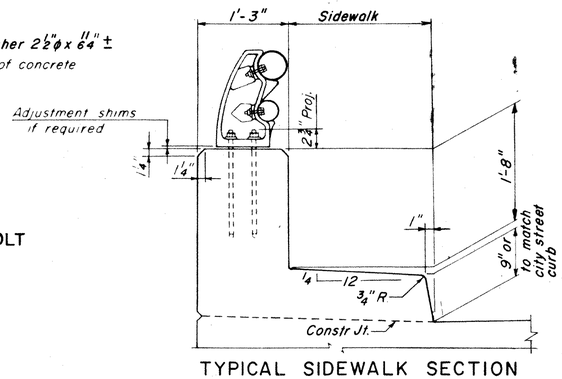
SECTION B-B



SECTION A-A



POST ANCHOR BOLT DETAIL



TYPICAL SIDEWALK SECTION

NOTES

Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.

Design Specifications: Design Division of 1965 - AASHO "Standard Specifications for Highway Bridges."

Shims and end caps shall be of approved aluminum alloy. Shims shall be flush with base of post and end caps shall be flush with rails.

Anchor materials shall conform to A.S.T.M. Designation A36, and shall be galvanized conforming to Section 1052.16 of Form 409. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.

Materials shall not be painted.

Posts and post anchor bolts shall be normal to grade and rails shall be parallel to grade.

For Electrical Details for Structures, refer to Std. Dwg. ST-321.
For Lighting Pole Anchorage details, refer to Std. Dwg. ST-322.
Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rails shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion. ℄ Rail splices shall be located 1'-6" ± from ℄ posts.

For spacing of posts and location of expansion joints, refer to Design drawings.

Railing shall be measured continuously between centers of end posts and shall include all railing posts, rails, end caps, toggle bolts, anchor bolts with washers and nuts for posts and lighting poles, lighting pole anchor angles and protective wood blocks.

APPROVED: JUNE 12, 1969
Chief Engineer

APPROVED: JUNE 12, 1969
Bridge Engineer

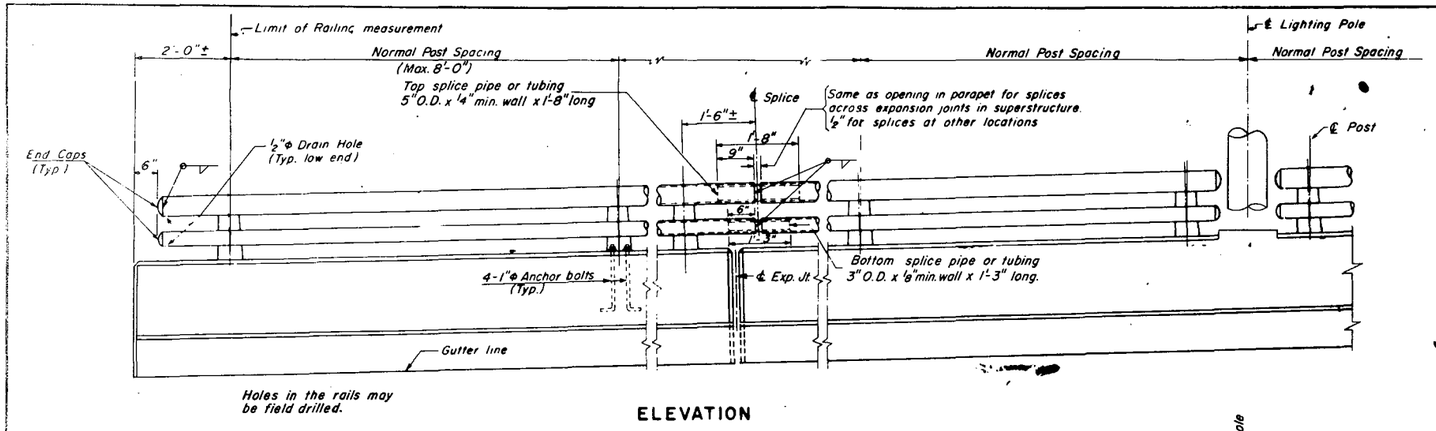
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD

ALUMINUM BRIDGE RAILING

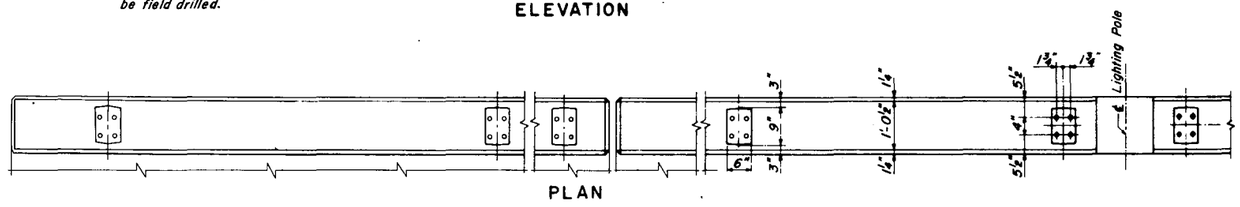
SHEET 1 OF 1

ST-314

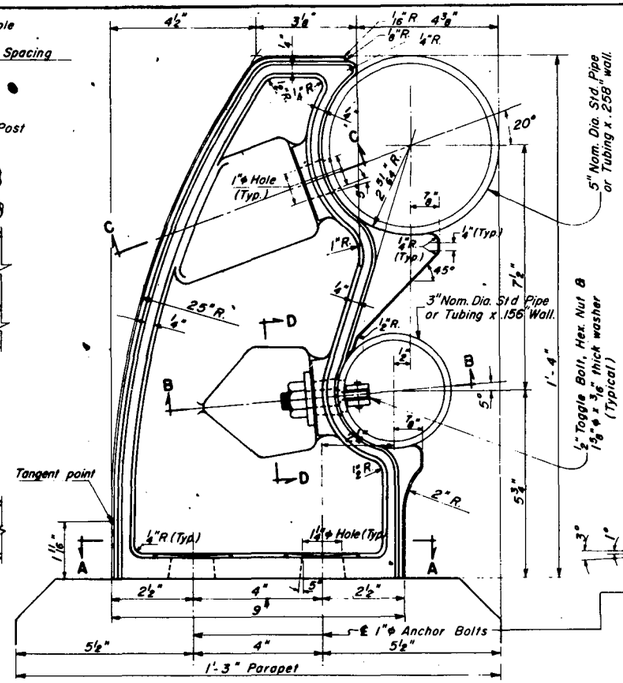


Holes in the rails may be field drilled.

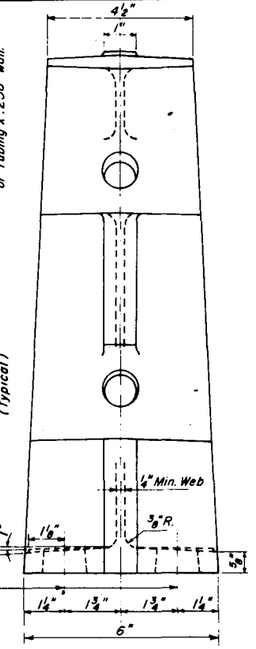
ELEVATION



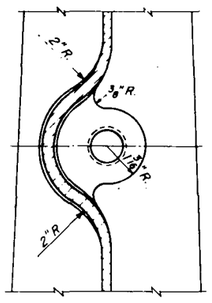
PLAN



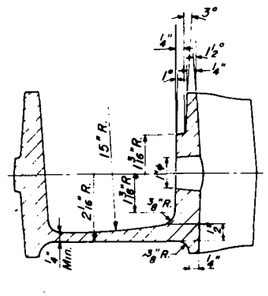
SIDE VIEW OF POST



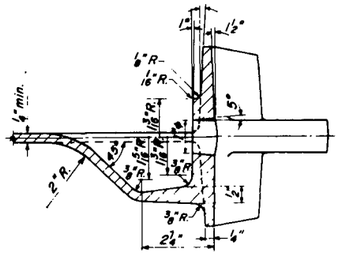
FRONT VIEW OF POST



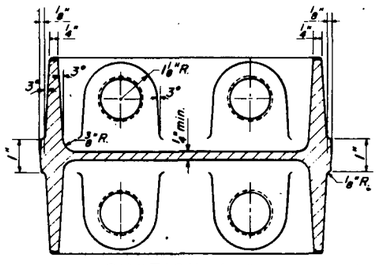
SECTION D-D



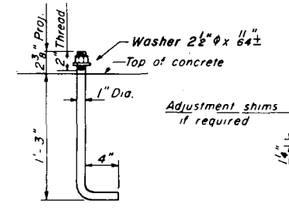
SECTION C-C



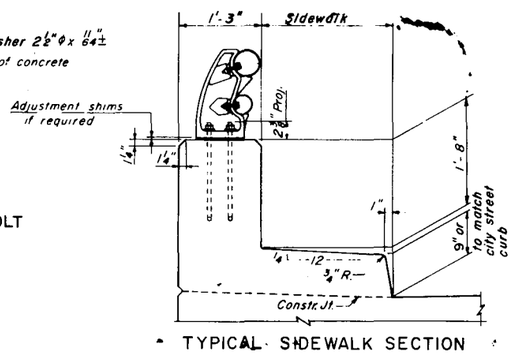
SECTION B-B



SECTION A-A



POST ANCHOR BOLT DETAIL



TYPICAL SIDEWALK SECTION

NOTES

Materials and workmanship shall be in accordance with Specifications Forms 408 and 409.

Design Specifications: Design Division of 1965- AASHO "Standard Specifications for Highway Bridges."

Anchor materials shall conform to A.S.T.M. Designation A36.

Steel shall be galvanized conforming to Section 1052.16 of Form 408. Toggle bolts may be cadmium plated to conform to ASTM A165, Type TS, in lieu of galvanizing.

Materials shall not be painted.

Posts and post anchor bolts shall be normal to grade and rails shall be parallel to grade.

Shims and end caps shall be of approved steel. Shims shall be flush with base of post and end caps shall be flush with rails.

For Electrical Details for Structures, refer to Std. Dwg. ST-321.

For Lighting Pole Anchorage details, refer to Std. Dwg. ST-322.

Rail splices shall be located between posts at expansion joints and at other locations where necessary. Rails shall be as long as practical, with a minimum of three posts between splices, unless otherwise required for expansion. ℄ Rail splices shall be located 1'-6"± from ℄ Posts.

For spacing of posts and location of expansion joints, refer to Design drawings.

Railing shall be measured continuously between centers of end posts and shall include all railing posts, rails, end caps, toggle bolts, anchor bolts with washers and nuts for posts and lighting poles, lighting pole anchor angles and protective wood blocks.

APPROVED: JUNE 12, 1969
CHIEF ENGINEER

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BRIDGE DIVISION

STANDARD

STEEL BRIDGE RAILING

SHEET 1 OF 1

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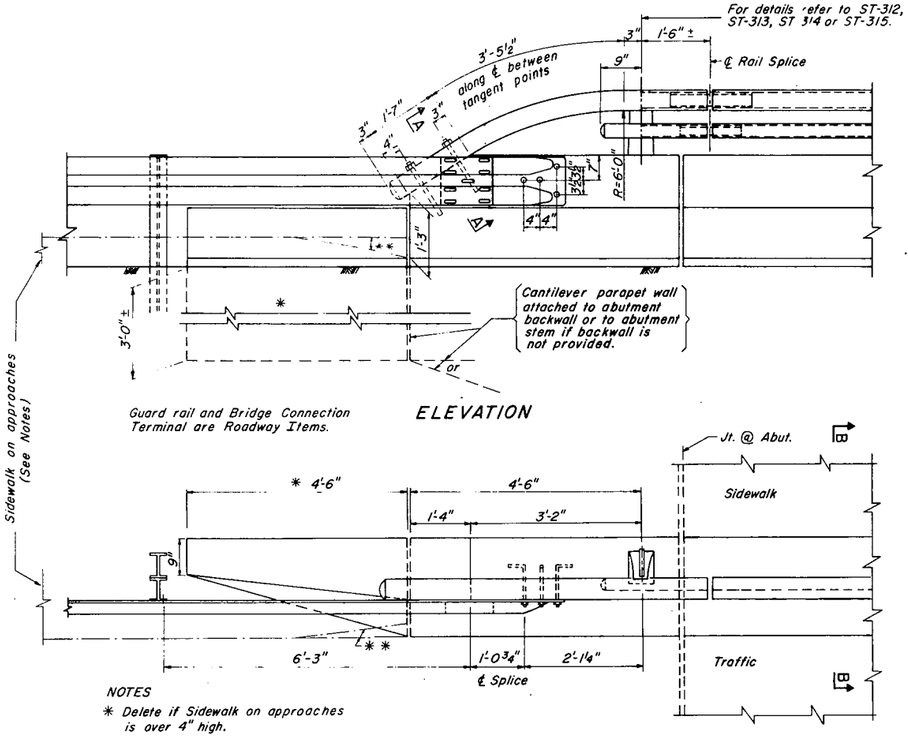


Guard rail and Bridge Connection Terminal are Roadway Items.

ELEVATION

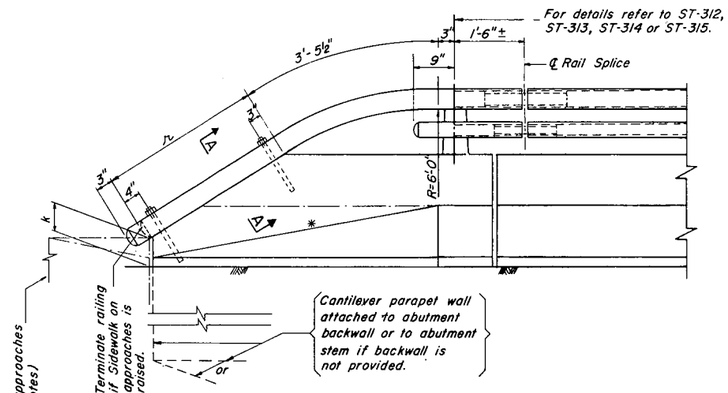
NOTES

* Delete if Sidewalk on approaches is over 4" high.

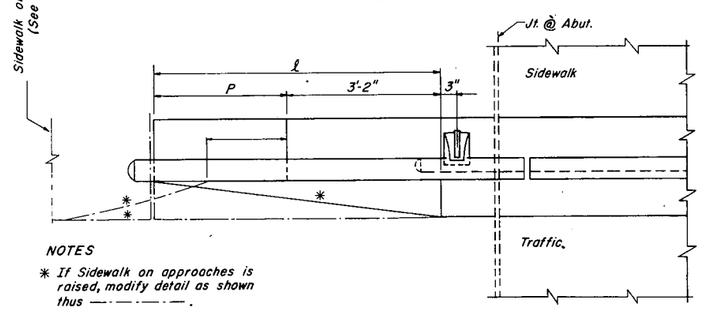
** Chamfer Sidewalk to match sloped portion of parapet.

PLAN

DETAIL A



ELEVATION



NOTES

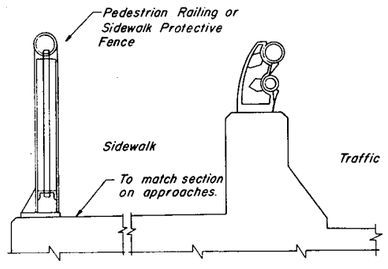
* If Sidewalk on approaches is raised, modify detail as shown thus —·—·—·—.

** Chamfer Sidewalk to match sloped portion of parapet. See Sketch A.

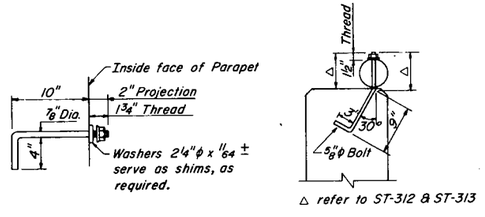
PLAN

DETAIL B

k	r	P	ℓ
4"	3'-7½"	3'-1"	6'-3"
6"	3'-3¾"	2'-9⅜"	5'-11¾"
8"	3'-0"	2'-6⅛"	5'-8⅛"
10"	2'-8⅛"	2'-3⅛"	5'-5¼"

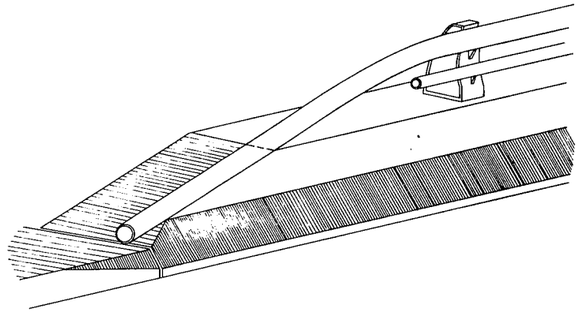


SECTION B-B



GUARD RAIL ANCHOR BOLT DETAIL

SECTION A-A



SKETCH A

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DIVISION OF BRIDGE ENGINEERING

STANDARD PEDESTRIAN-TRAFFIC BARRIER

SHEET 1 OF 1

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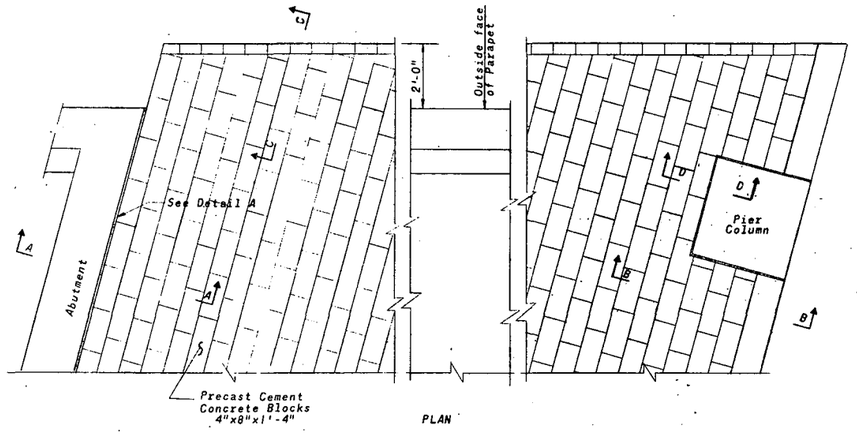
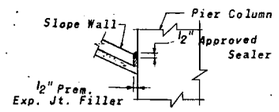
P128 D PEL-X POLYCHROME CORPORATION

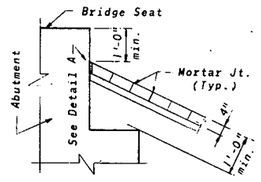


PLAN

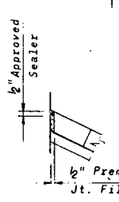


Jt.(Typ.) between Slope Wall and Pier Column.

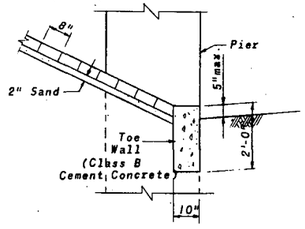
SECTION DD



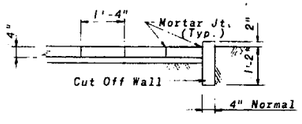
SECTION AA



DETAIL A



SECTION BB

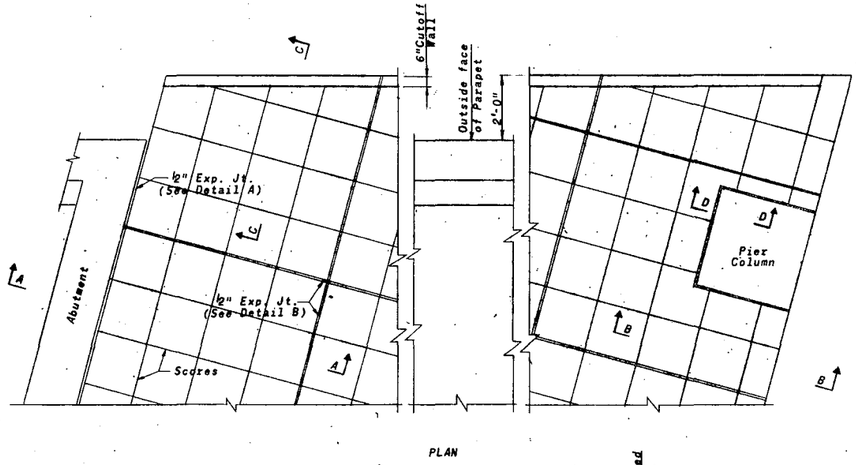


SECTION CC

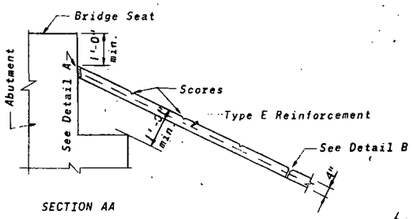
Dimensions shown for Precast Cement Concrete Blocks are nominal.

PRECAST CEMENT CONCRETE BLOCK

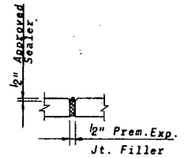
SECTION 673.3 (a). FORM 408



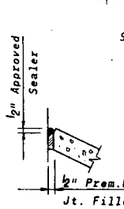
PLAN



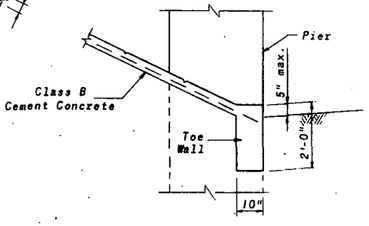
SECTION AA



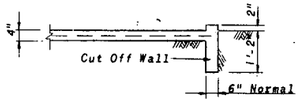
DETAIL B



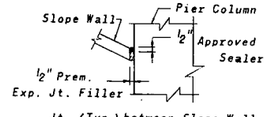
DETAIL A



SECTION BB



SECTION CC



Jt. (Typ.) between Slope Wall and Pier Column.

SECTION DD

CAST-IN-PLACE CEMENT CONCRETE SLABS

SECTION 673.3 (b). FORM 408

NOTES

Materials, workmanship and method of payment shall be in accordance with Section 673 of Form 408.

Slope wall shall be constructed from either Precast Cement Concrete Blocks or Cast-in-Place Cement Concrete Slabs in accordance with Section 673.3(a) or 673.3(b) respectively, or other approved design.

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CHIEF ENGINEER

APPROVED: 9-23-68
BRIDGE ENGINEER

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DEPARTMENT OF HIGHWAYS
BRIDGE DIVISION

STANDARD

PRECAST CEMENT CONCRETE BLOCK SLOPE WALL

SHEET 1 OF 1

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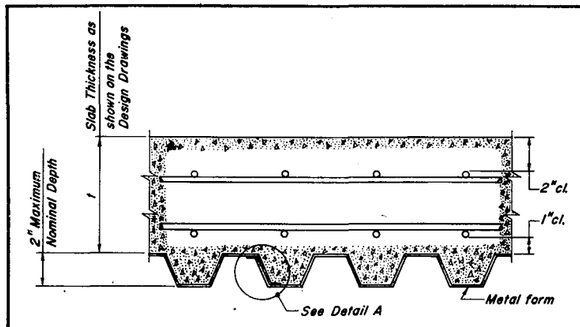
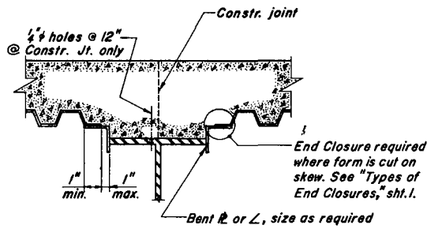
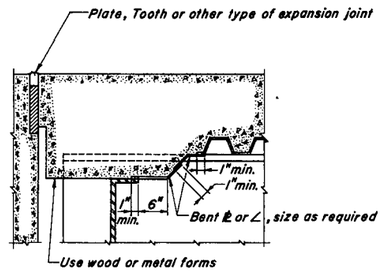
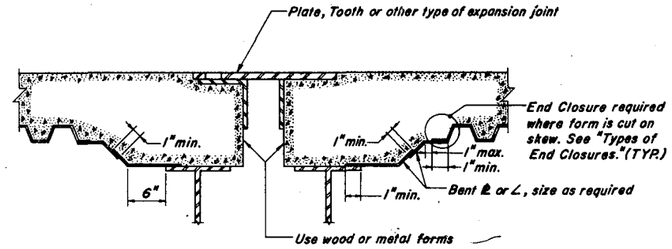


TYPICAL LONGITUDINAL SECTION



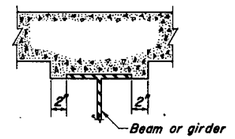
DETAIL AT TRANSVERSE CONSTR. JT'S. AND METAL INTERIOR DIAPHRAGMS





DETAILS AT EXPANSION JOINTS

DETAIL A



TYPICAL HAUNCH DETAIL
FOR STEEL BEAMS AND GIRDERS,

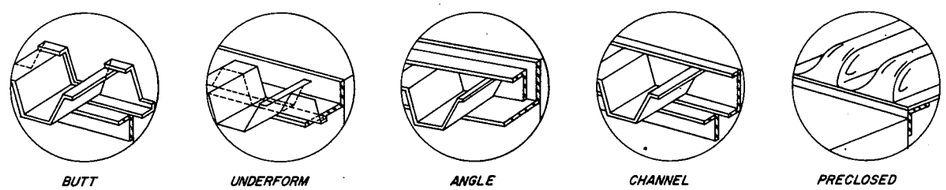
(Detail showing support system for forms to be shown on the shop drawings. Welding to flanges in tension areas will not be permitted)

EXAMPLE:

GIVEN: Beam Spacing = 7'-11" c/c
Beam Flange Width = 12"
Slab Thickness, t = 8 1/2"
Grade C Form

REQUIRED: Section Modulus, S and Moment of Inertia, I of. Form

SOLUTION: Design Span, l = (7'-11")-(12")-(2") = 6'-9" or 81"
From Table on Sht.2, for l = 81"
t=7" S = .2904
t=10" S = .3617
S by interpolation for t = 8 1/2", = .3260 in³/ft.
S for Grade C Form = 0.24)(.3260) = .4042 in³/ft
I for t = 8 1/2", = .4284 in⁴/ft.



TYPES OF END CLOSURES

NOTES:

MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH SPECIFICATIONS FORMS 408 AND 409, AND THE SPECIAL PROVISIONS.

THIS STANDARD SHALL BE USED AS A GUIDE IN THE PREPARATION OF SHOP DETAIL DRAWINGS.

HAUNCH DETAILS SHOWN ON THE DESIGN DRAWINGS SHALL BE MAINTAINED.

GAGE AND SIZE OF SUPPORTING ELEMENTS AND FORM SHALL BE SHOWN ON THE SHOP DRAWINGS. MINIMUM THICKNESS OF THE FORMS SHALL BE 22 GAGE.

ALL FORM SUPPORTS AND THEIR ATTACHMENT SHALL BE DESIGNED TO CARRY DEAD LOAD OF DECK SLAB PLUS 50 LBS. PER SQUARE FOOT FOR CONSTRUCTION LOADS.

ALL FORMS SHALL BE SECURELY FASTENED TO FORM SUPPORTS AND SHALL HAVE A MINIMUM BEARING OF 1 INCH EACH SIDE.

FORM SHEETS SHALL BE ATTACHED PROMPTLY TO AVOID HAZARDS THAT CAN RESULT FROM LATERAL MOVEMENT OR SUDDEN UPLIFT.

ALL ATTACHMENTS SHALL BE MADE BY WELDS, BOLTS, CLIPS, OR OTHER APPROVED MEANS AND SHALL BE WATERTIGHT.

FIELD CUTTING OF FORMS, SUPPORTS AND CLOSURES SHALL BE PERFORMED WITH SAW, SHEAR OR OTHER APPROVED MEANS.

WHEN TWIN BRIDGES ARE CONSTRUCTED ADJACENT TO EACH OTHER AND DIVIDED BY AN OPEN OR A PREFORMED JOINT, METAL FORMS IN THE CANTILEVER AREA BETWEEN THE BRIDGES MAY BE USED ONLY WITH THE PERMISSION OF THE CHIEF BRIDGE ENGINEER.

APPROVED: DEC. 22, 1969
CHIEF ENGINEER

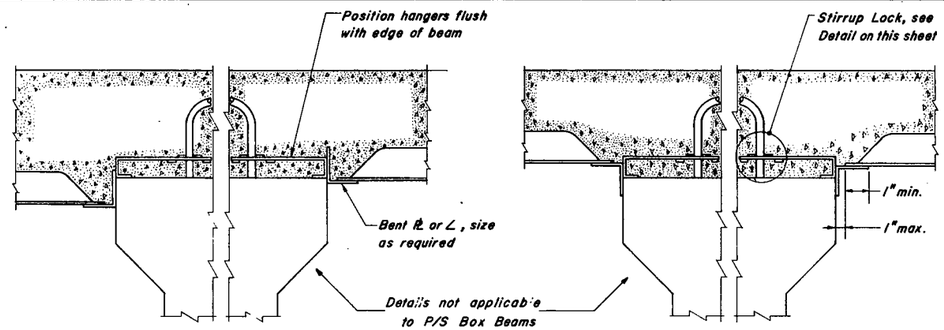
APPROVED: DEC. 22, 1969
BRIDGE ENGINEER

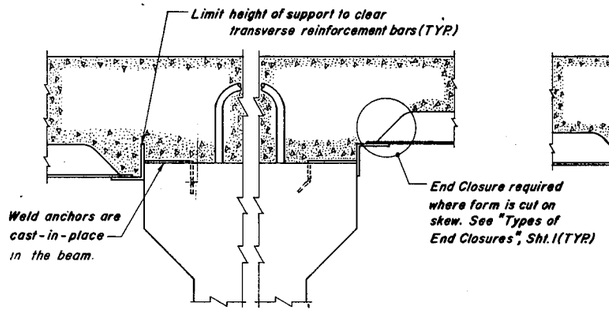
Commonwealth of Pennsylvania
DEPARTMENT OF HIGHWAYS
DIVISION OF BRIDGE ENGINEERING

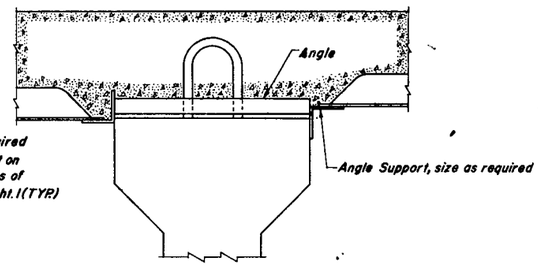
STANDARD

PERMANENT METAL DECK FORMS

ST-332

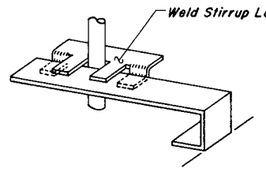




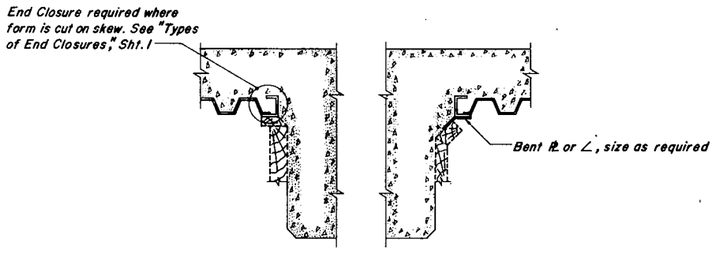


TYPICAL TRANSVERSE SECTIONS

ATTACHMENT OF FORMS TO P/S I-BEAMS FOR VARIOUS CONDITIONS. SIMILAR FOR P/S BOX BEAMS



STIRRUP LOCK



DETAIL AT CONCRETE DIAPHRAGM

REQUIRED SECTION MODULUS AND MOMENT OF INERTIA OF FORM

S, Sect. Modulus in.³ per ft. *		I, Design Span, In. ⊗	I, Moment of Inertia in.⁴ per ft. *		
t, Slab Thickness			t, Slab Thickness		
7"	10"		≤ 8"	8 1/2"	10"
.0574	.0714	36	.0371	.0376	.0434
.0673	.0838	39	.0471	.0478	.0551
.0780	.0972	42	.0589	.0598	.0690
.0897	.1116	45	.0724	.0735	.0848
.1020	.1270	48	.0879	.0892	.1029
.1152	.1434	51	.1054	.1069	.1234
.1291	.1607	54	.1251	.1269	.1465
.1439	.1791	57	.1471	.1492	.1722
.1594	.1984	60	.1716	.1741	.2009
.1757	.2188	63	.1987	.2016	.2326
.1928	.2401	66	.2284	.2317	.2674
.2108	.2674	69	.2610	.2648	.3056
.2294	.2858	72	.2966	.3009	.3473
.2490	.3101	75	.3352	.3401	.3925
.2694	.3354	78	.3770	.3825	.4414
.2904	.3617	81	.4222	.4284	.4943
.3124	.3889	84	.4709	.4778	.5513
.3351	.4172	87	.5232	.5308	.6126
.3586	.4465	90	.5792	.5876	.6781
.3828	.4767	93	.6604	.6700	.7732
.4080	.5080	96	.7498	.7607	.8779
.4339	.5402	99	.8480	.8604	.9929
.4606	.5735	102	.9556	.9695	1.1188
.4881	.6077	105	1.0730	1.0886	1.2563
.5164	.6429	108	1.2010	1.2185	1.4062
.5455	.6792	111	1.3402	1.3597	1.5693
.5754	.7164	114	1.4910	1.5127	1.7457
.6060	.7546	117	1.6543	1.6784	1.9369
.6375	.7938	120	1.8306	1.8573	2.1433

* Use straight line interpolation for slab thickness between 7" and 10", and multiply the values shown in the table by;
1.00 for grades D and E
1.24 for grade C
1.34 for grade B
1.51 for grade A

⊗ l = design span, in., shall be taken as clear distance between the flanges of the supporting beams minus two inches, measured parallel to the form flutes.

★ Use straight line interpolation for slab thickness between 8 1/2" and 10".
The values of I shown in the table are based on the deflection requirements in the Design Specifications. If economical and practical forms may be cambered to account for deflection or a portion thereof, in which case, values of I may be adjusted.

DESIGN SPECIFICATIONS

PERMANENT METAL DECK FORMS SHALL BE DESIGNED FOR THE DEAD LOAD OF FORM, REINFORCEMENT AND CONCRETE PLUS 50 POUNDS PER SQUARE FOOT FOR CONSTRUCTION LOADS. THE FOLLOWING ALLOWABLE STRESSES SHALL BE USED IN THE DESIGN:

GRADE OF METAL FORM	YIELD (PSI)	ALLOWABLE STRESS (PSI)
A	33,000	23,900
B	37,000	26,800
C	40,000	29,000
D	50,000	36,000
E	80,000	36,000

MAXIMUM DEFLECTION UNDER WEIGHT OF FORM, REINFORCEMENT AND CONCRETE SHALL NOT EXCEED 1/180 OF THE FORM SPAN OR 1/2-INCH, WHICHEVER IS LESS. MAXIMUM DEFLECTION UNDER 60 POUNDS PER SQUARE FOOT OF LIVE LOAD SHALL NOT EXCEED 1/360 OF THE FORM SPAN OR 1/4-INCH, WHICHEVER IS LESS.

THE MINIMUM THICKNESS OF THE FORM SHALL BE 22 GAGE.

APPROVED: DEC. 22, 1969
CHIEF ENGINEER

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BRIDGE ENGINEER

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DEPARTMENT OF HIGHWAYS
DIVISION OF BRIDGE ENGINEERING

STANDARD

PERMANENT METAL DECK FORMS

SHEET 2 OF 2

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DESIGN

CRITERIA

GENERAL

AASHO Code, 1961 and Section 6.14 dated June 22, 1966, of Specifications Form 408/1960.
Values in table are based on: maximum moment (working or ultimate) of loadings as specified.
Live load deflection (max.) = L/800
Skew Limits - 60° min., 90° max.

LOADINGS

Live Loads (imposed on Composite Section)
- AASHO H520 or
- Interstate 2-24000 lb. axles, 4 ft. apart for:
  - Moments: up to 36 ft. span
  - Shear: up to 22 ft. span
- AASHO - impact

Dead Loads (in addition to plank and deck slab):
- ½" wearing surface (integral with slab)
- Safety Curb and Parapet (imposed on Composite Section)
- 30 lb/sq. ft. future wearing surface (imposed on Composite Sect)

Ultimate Load Factors
- 1.5 Dead Load + 2.5 × (live load + impact)
- Structures under fill require special design

Transverse Distribution of Loads
- Wheel load $\frac{S}{5}$ (S = width of plank) for moment and shear
- Dead load of one curb and one parapet distributed equally to 4 beams

Prestress Losses - Decrease in steel stress from initial to final prestress is calculated by the BPR formula:
6000 + 16 f'cs + 0.04 fsi ≧ 20%

MATERIALS

Concrete

Prefabricated plank
release strength: f'ci = 5000 psi
28-day concrete cylinder strength: f'c = 5500 psi min.

Cast-in-place deck slab
28-day cylinder strength: f'c = 3000 psi
Slab concrete is transformed into plank concrete
Slab Area × Conversion Factor = Plank Area
Conversion Factor = $\frac{n}{n_c} = \frac{1}{1.83}$
$N = \frac{E_c \text{ plank}}{E_c \text{ slab}}$ Ec = 1,800,000 × 500 f'c
f'c plank = 6000 psi; f'c slab = 3000 psi

Prestressing strands
Minimum area of prestressing strands: 0.3% of cross-sectional area of the basic plank

ALLOWABLE STRESSES: According to Design Criteria - Sheet 1 of ST-202 except:
For slabs, use fc = 1000 psi (design compressive stress)
For basic plank (20' to 27' span), use f'ci = 6√f'ci (temporary tensile stress) in end zone of beam

TABLE 1 DESIGN

PLANK DEPTH	SLAB TH	STRAND SIZE ϕ	STRAND SIZE ksi	SPAN (ft)	NO. STRANDS	INITIAL P/S FORCE (Kips)	"g" (in)	CAMBER (in)	REMARKS
10"	4"	1/4"	250	15	40	252.0	3.10	0.126	*
				16	40	252.0	2.72	0.180	
				17	40	252.0	2.32	0.244	
				18	42	264.6	2.14	0.308	
				19	46	289.8	2.16	0.366	
				20	50	315.0	2.17	0.433	
10"	4"	3/8"	270	20	20	322.0	2.27	0.424	DO NOT UNBOND
				21	22	354.2	2.35	0.488	
				22	24	386.4	2.43	0.553	
				23	26	418.6	2.50	0.621	
				24	30	483.0	2.76	0.668	
10"	5"	3/8"	270	24	28	450.8	2.68	0.613	
				25	30	483.0	2.70	0.698	
				26	32	515.2	2.70	0.792	
				27	34	547.4	2.68	0.906	
12"	4"	3/8"	270	27	28	450.8	2.45	0.726	* UNBOND ACCORDING TO SECTION 6.14.1(1)
				28	32	515.2	2.79	0.779	
				29	34	547.4	2.81	0.869	
12"	5"	3/8"	270	29	32	515.2	2.68	0.824	
				30	34	547.4	2.72	0.905	
				31	38	611.8	3.00	0.942	
12"	6"	3/8"	270	31	36	579.6	2.85	0.910	
				32	38	611.8	2.85	1.009	
				33	42	676.2	3.07	1.055	
				34	44	708.4	3.00	1.218	

INSTRUCTIONS

- Detail all planks in the same bridge cross-section to have equal number of strands.
- Design all planks in the same bridge cross-section, according to the plank with the maximum moment. In any case, investigate strength of planks under sidewalks.
- On design drawings, designate initial prestress force and center of gravity of prestress force (from bottom of plank).
- On shop drawings, show number of strands required for initial prestress force, and the practical strand pattern with eccentricity shown in Table 1.
- The values of "g" are for the strand pattern on this sheet.

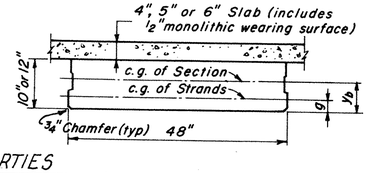


TABLE 2 PROPERTIES

ITEM	UNIT	10" PLANK				12" PLANK			
Vol. of Plank	cy/ft.	0.123				0.148			
SECTION PROPERTIES		BASIC	4" Slab	5" Slab	6" Slab*	BASIC	4" Slab	5" Slab	6" Slab
Area	in²	471.75	587.61	620.72	653.82	567.75	683.61	716.72	749.82
y_b	in	4.980	6.315	6.725	7.144	5.970	7.289	7.691	8.102
Z_t @ Slab	in³	—	1164	1314	1481	—	1559	1726	1910
Z_t @ Plank	in³	793	2270	3120	4332	1138	2718	3528	4604
Z_b @ Plank	in³	800	1325	1519	1732	1149	1757	1977	2215
I	in⁴	3983	8365	10218	12373	6861	12804	15203	17947

Z_t = Section Modulus @ top
Z_b = Section Modulus @ bottom
y_b = Distance: c.g. of Section to bottom of plank
I = Moment of inertia

*Less economical than 12" Plank with 4" Slab, therefore, not included in Design Table.

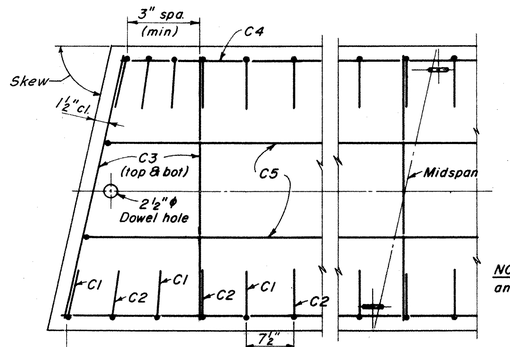
Design per P.D.H. Computer Program #31.0.140

Design: HPK
Drawn: JCE, BAP
Check: FCS, HLS

Dec. 7, 1966

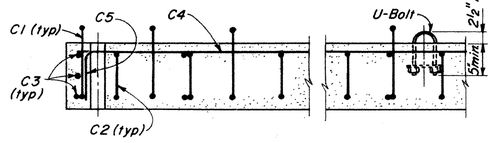
J. N. WEIL CO., CRONAFLEX

FABRICATION

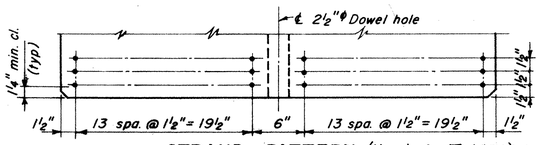


10" Plank C1 @ 15", alternate with C2 @ 15"; C3, top & bot @ 22½"
12" Plank C1 @ 18", alternate with C2 @ 18"; C3, top & bot @ 27"

PLAN



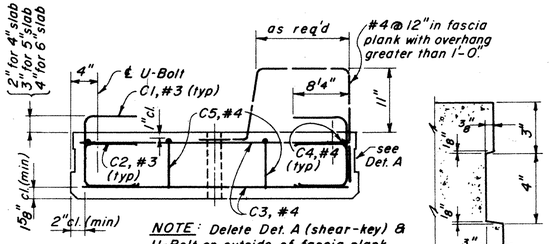
SECTION at ℄ PLANK



STRAND PATTERN (Used for Table I)
Scale: 1½" = 1'-0"

NOTE: Cut strands flush with face of concrete and paint with bitumastic or equal. We will allow a modified pattern of 2" or 1¾" Spacing of Strands.

NOTE: Arrange reinforcement to clear U-Bolts and to be symmetrical about midspan.

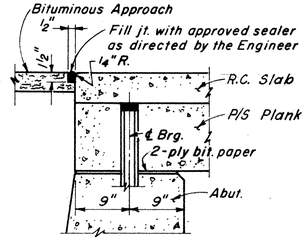


NOTE: Delete Det. A (shear-key) & U-Bolt on outside of fascia plank.

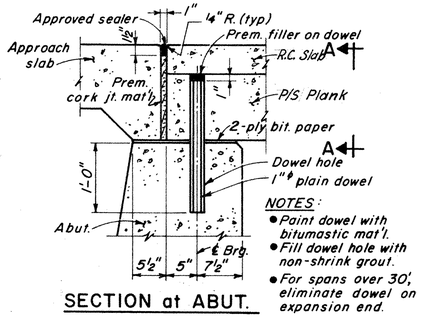
END ELEVATION

DETAIL A
Scale: 3" = 1'-0"

CONSTRUCTION



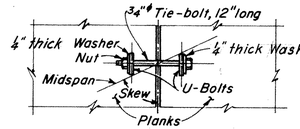
TYP. SECTION at ABUT.
with BITUMINOUS APPROACH
(Details same as shown below, except as noted)



SECTION at ABUT.
with CONCRETE APPROACH

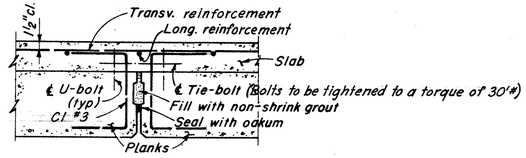
NOTES:
- Paint dowel with bitumastic mat'l.
- Fill dowel hole with non-shrink grout.
- For spans over 30', eliminate dowel on expansion end.

NOTE: Tighten nut before setting subsequent beam.



TIE-BOLT

NOTE: Tie-bolt details may be modified on shop drawings, subject to approval by the Bridge Engineer.



SECTION A-A at midspan

SLAB REIN. & JT. DETAIL

Slab thick.	Slab Rein. Trans.	Slab Rein. Long.
4"	#4 @ 8½"	#4 @ 12"
5"	#4 @ 6½"	#4 @ 9½"
6"	#4 @ 5¾"	#4 @ 8"

REFERENCES

REFER TO ST-202,

SHEET #1 FOR:
- GENERAL NOTES
- DESIGN CRITERIA (EXCEPT AS AMENDED BY CRITERIA ON THIS SHEET) (DELETE NOTES FOR NEOPRENE BEARING PADS)
- WATERPROOFING AT ABUTMENT (EXCEPT AS SHOWN ON THIS SHEET)
- BEAM FABRICATION TOLERANCES (EXCEPT THAT CAMBER TOLERANCE SHALL BE ¼" MAX. (DELETE VOID AND TIE-ROD DATA)

SHEET #2 FOR:
- ABUTMENT DESIGN DETAILS
  - DRILLING OF HOLES FOR DOWELS

SHEET #3 FOR:
- DIVISOR DETAILS
- DEFLECTION JOINT
- OVERHANG DETAILS
- CURB AND PARAPET DETAILS
- GENERAL BRIDGE PLAN (DELETE VOID, PIER AND TIE-ROD DATA)

SHEET #5 FOR:
- CAMBER: NOTES, DIAGRAM AND INSTRUCTIONS
- NON-BEARING AREA DETAIL
- INSTRUCTIONS

SHEET #6 FOR:
- ALUMINUM DRAINS

SHEET #7 FOR:
- SHEAR KEY IN BEAM
- JOINT MATERIAL

GENERAL NOTES

- Design information taken from tables 1 & 2 may be used in lieu of computations.
- Design computations must be provided for 48" wide planks under sidewalks & for any 36" & 24" wide plank. In this case, reinforcement & details modified as required must be shown on shop drawings.
- Use this Standard for simple spans only.
- Details on this Standard may be modified on shop drawings, subject to approval by the Bridge Engineer.

Approved: DEC - 8 1966
H. H. Jensen
Bridge Engineer

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HIGHWAYS
BRIDGE UNIT

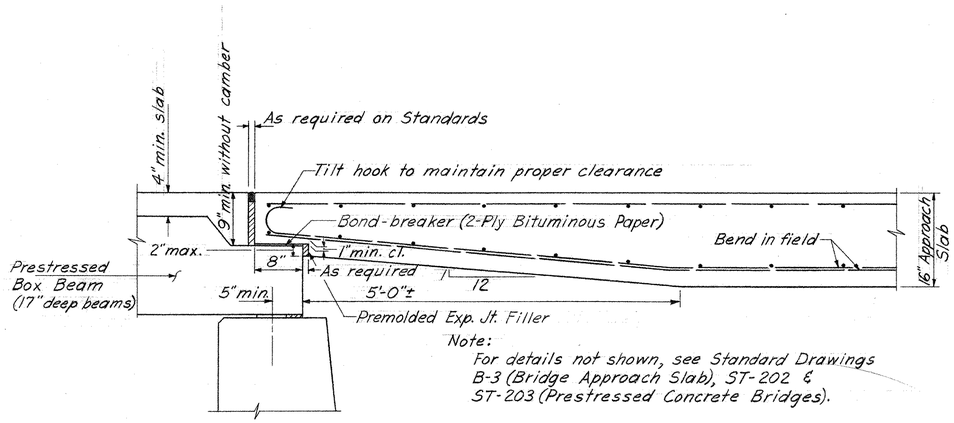
PRESTRESSED CONCRETE BRIDGE

4 FT. ADJACENT PLANK BEAMS

COMPOSITE

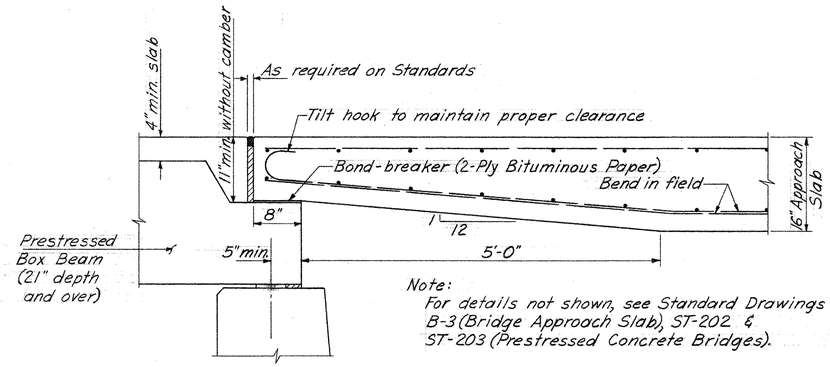
Scale: 1" = 1'-0", unless noted
SHEET 1 OF 1

S-3912



17" DEEP ADJACENT COMPOSITE BOX BEAMS WITH 9" DEEP APPROACH SLAB NOTCH

Scale: 1"=1'-0"

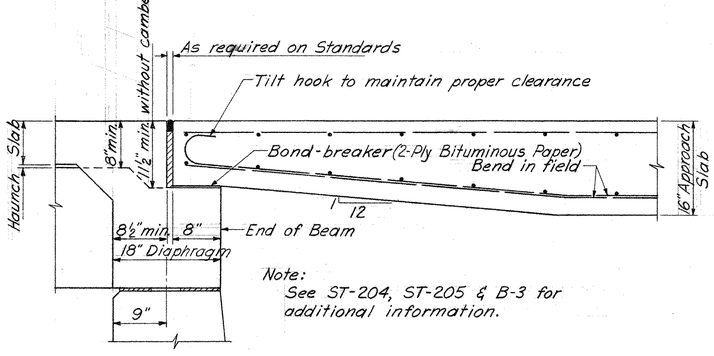


21" TO 48" DEEP ADJACENT COMPOSITE BOX BEAMS WITH 11" DEEP APPROACH SLAB NOTCH

Scale: 1"=1'-0"

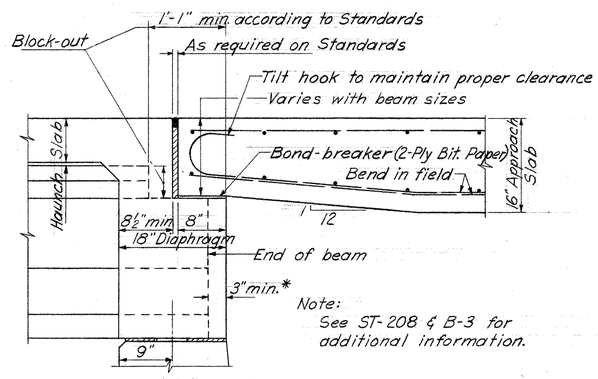
Notes for Construction Revision

- When making construction changes in the field this drawing is to serve as a guide for modifying notch details shown on P/S Standard Drawings (ST-200 Series), for accommodating the Standard 16" Approach Pavement Slab (B-3).
- At beam ends, burn off reinforcement protruding into approach slab notch.
- *Increase in field, providing overhang, if required.



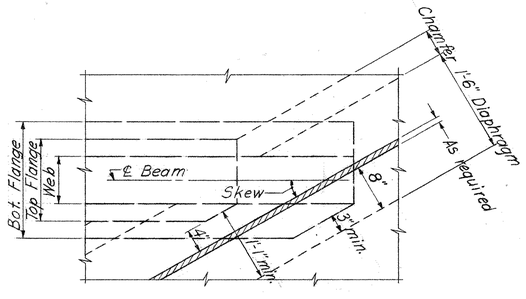
SPREAD BOX BEAMS WITH APPROACH SLAB NOTCH 11½" OR DEEPER

Scale: 1"=1'-0"



I-BEAMS

Scale: 1"=1'-0"



PLAN - I-BEAMS

Scale: 1"=1'-0"

AUG 28 1968

APPROVED: B.J. Kotalik

Bridge Engineer

Commonwealth of Pennsylvania

DEPARTMENT OF HIGHWAYS

BRIDGE DIVISION

PRESTRESSED CONCRETE BRIDGE SUPERSTRUCTURE

16" APPROACH SLAB NOTCH

S-3916

Designed by: H.P.K.
Drawn by: B.A.P.
Checked by: H.L.S.

H.L.S. 8/27/68

#128 B PEL-X SPEIDEL CORPORATION

Prepared by Division of Bridge Engineering, B.D.N.

Sht. 2/2 Revised 1/4/69