I-105 GUIDELINES FOR LRT STRAY CURRENT PROVISIONS

Discussion

The following guidelines give the basic requirements for stray current control on prestressed or reinforced concrete box girder bridges of the I-105 Project including the Airport Viaduct. Providing electrical interconnection will mitigate internal stray current corrosion, particularly for prestressing elements. These guideline procedures, plus an insulating coating on the deck, should control LRT stray current. For clarification of any of these provisions, please discuss with the Office of Structure Design's Transit Specialist. Details 1 through 3, 4A & 4B, 5, 6, 7A & 7B, 8 thru 13, plus Standard Sheets 20-24 (XS-10-33) and 20-25 (XS-10-34) illustrate the following guidelines.

I-105 UNDERCROSSINGS, SEPARATIONS,AND VIADUCT INTERCONNECTION OF REINFORCING AND PRESTRESS TENDONS

Deck

CIP Prestressed Bridge:

Lap weld all continuous top longitudinal rebar splices within the width of LRT trackway. Designer must designate these bars on a plan sheet. See Detail 1. (Note: The typical section shown on the bridge General Plan should define the limits of LRT trackway. Usually this is from inside face to inside face of the concrete barriers.)

Reinforced Concrete Bridge:

Provide an extra (non-structural) lap-welded continuous top longitudinal #4 rebar in the deck slab at each girder and within one foot of the inside face of the future concrete barriers. Provide only within the width of the LRT trackway. Designer must designate these bars on a plan sheet. See Detail 1.

Both Bridge Types:

Weld connect the above mentioned longitudinal bars to a transverse collector bar (#9 rebar) at each bent cap, hinge diaphragm, abutment diaphragm and abutment backwall. (See Details 1 through 9.)

Superstructure Hinge

Exothermic weld two #2/0 copper cables to collector bars in both diaphragms; pass #2/0 cable through a 2" duct. See Detail 3.

Abutment with Spread Footing

Provide transverse collector bar (#9 rebar) in the top of abutment backwalls in seat type abutments. Weld connect all backwall exterior face vertical rebars to the collector bar within LRT trackway width. See Detail 4A. Provide transverse collector bar (#9 rebar) at the top of the abutment diaphragm as described under "Deck" subject. See Details 4A & 4B.

Exothermic weld one #2/0 copper cable to each collector bar. See Detail 4A & 4B.Bring cables through abutment back wall if it exists (no duct), direct bury in ground to #5 pull box at end of wingwall.

Apply membrane insulation on abutment diaphragm end surface. See Details 4A & 4B.

Use epoxy coated approach slab tie rods in full width of bridge. Permit only high density mortar blocks.

Abutment with Pile Cap Footing

Same provisions as Abutment with Spread Footing plus the following pile provisions: Permit only alternative "X" and "Y" driven piles. Special details for 16" C.I.D.H. Piles. See Standard Sheets 20-24 (XS-10-33) and 20-25 (XS-10-34). Designer shall eliminate the requirements shown on the standard sheets for epoxy coated reinforcing and epoxy coating insulate at pile tops and pile sides at all abutments.

Prestress Tendons

Weld connect the #9 collector bar to one prestress strand in each prestress anchor plate by using a #6 collector wire. See Detail 5. Place 4 x 4, W4.0 x W4.0 WWF shield over prestress plate area at the abutment blockouts. Weld connect at least one fabric wire to the #6 connector wire. See Detail 5.

Columns

Weld connect one main column bar to the transverse collector bar in the bent cap using a #6 rebar. See Details 6 through 9. Coat column concrete surface below ground and 6" minimum above ground with membrane insulation. Permit only high density mortar blocks to be used. Provide a test box in the column face 3'-0" above finish ground surface. Connect to the one main column bar with a #12 copper wire. See Detail 11.

Columns with Spread Footing

Hinged Column at Footing:

Hinge vertical rebar shall be epoxy coated and no contact to column cage rebar permitted. Provide hinge spiral discontinuity in top of footing. Provide sealant at column hinge joint. See Detail 6.

Fixed Column at Footing:

The one main column bar connected to the deck transverse collector bar shall be electrically continuous (by welding) through the footing. Coat all top of footing surfaces with membrane insulation. Provide 6" deep concrete course beneath footing. Provide depressed keys at top. Permit only high density mortar blocks. See Detail 7B.

Column with Pile Footing

Hinged Column at Footing:

Same details as spread footing. See Detail 6. In addition only Alternative "X" and "Y" driven piles permitted. Special details for 16" C.I.D.H. Piles. See Standard sheets 20-24 (XS-10-33) and 20-25 (XS-10-34) except designer shall eliminate epoxy coated reinforcing and epoxy coating insulation at pile top and sides.

Fixed Column at Footing:

Same as fixed column spread footing details except neoprene sheet insulation used instead of concrete insulation course. See Detail 7A. Pile requirements same as hinged column except *all* requirements of Standard Sheets 20-24 (XS-10-33) and 20-25 (XS-10-34) shall be used

Column/Pile Shaft Type

Hinged Column:
Details similar to hinged column with footing. See Detail 8.

Fixed Column:

One main column bar connected to the deck transverse collector bar shall be electrically continuous (by welding) through the pile shaft, Provide plastic bar end protector epoxy bonded to pile rebar bottom ends. Coat column/pile shaft concrete surfaces in the vicinity of finish ground line with membrane insulation. Permit only high density mortar blocks to be used. See Detail 9.

Traction Power

Pole Anchor:

Insulate. Epoxy coated anchorage hardware in concrete. Includes anchor plate, bolts, nuts. Where possible, coat after assembly. See Detail 12.

OCS Hanger:

Epoxy-coat the anchorages cast into a bridge soffit or elsewhere to support the overhead contact system (OCS). These hangers will mostly occur at overcrossing soffits.

Deck Drains

Insulate drain systems within LRT trackway. Insulate drain systems outside of LRT trackway if directly connected to the LRT trackway drain system. See Detail 10.

Additional details shall be provided during track rail installation. They will be items such as deck surface insulation coating, direct rail fixation insulators, direct rail fixation elastomeric pads, and epoxy coated anchor bolts for rail attachment.

I-105 OVERCROSSINGS GUIDELINES FOR LRT STRAY CURRENT PROVISIONS

Discussion

Stray current at overcrossings shall be controlled by insulation within the trackway (ballast type) area. This barrier will prevent stray current entry through the adjacent overcrossing substructure (bent columns and footings) or station platforms. Many overcrossings have already been constructed so it is impractical to coat insulate the footings, etc. In addition, some overcrossings are not sufficiently wide to attract significant stray current.

Provisions Needed

Designer needs only to require the use of high density mortar blocks in all overcrossings as required for the undercrossings, etc. Other provisions required for the overcrossings will be incorporated outside the bridge in the trackway design.

I-105 OTHER MAJOR STRUCTURES

Retaining Walls

Reinforced concrete walls or mechanically stabilized embankment systems (MSE) with metal elements shall be provided with stray current provisions if they are within 30 feet of LRT tracks. Consult with the Office of Structure Design's Transit Specialist for specific details.

Pumping Plants

Provisions are needed for pump plant storage boxes that are beneath the highway roadways in the vicinity of LRT tracks. The provisions are as follows:

1. Epoxy coated bar reinforcing steel shall be used throughout the entire box structure except in the dry pit shaft when the LRT travelway is 20'-0" or closer to the pumping plant endway. The epoxy coated bar reinforcement shall have all ends coated and any damaged bars shall be recoated with epoxy. When the LRT travelway is greater than 20'-0" from the pumping plant endways, reinforcement shall be as per standard plans. See Detail 13.

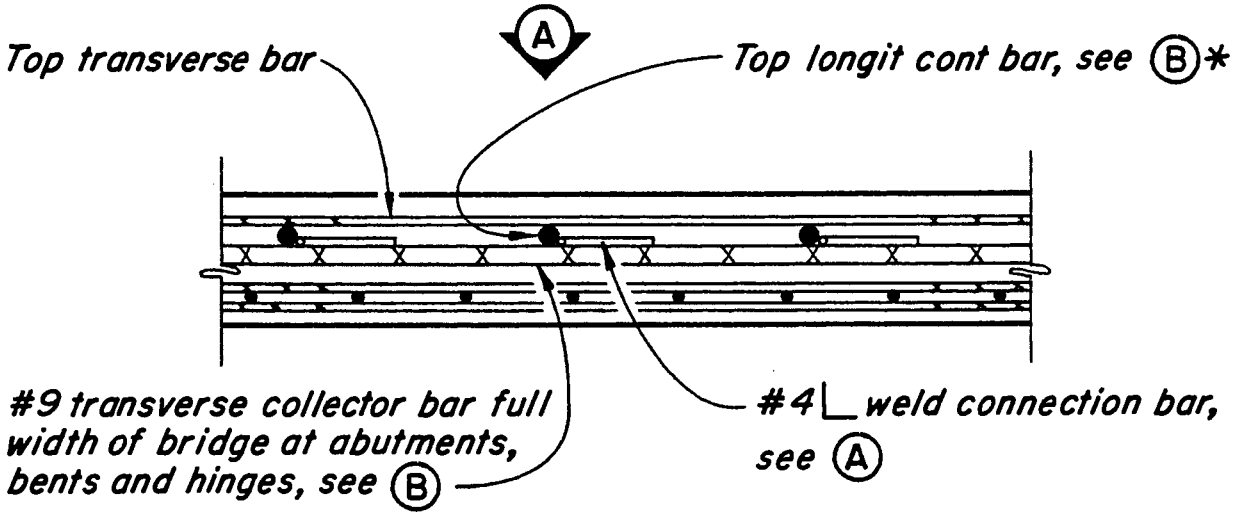
2. Increase bottom slab thickness by 1" to provide 3" clearance from bottom of slab to the bar reinforcing steel.

3. Permit only high density mortar blocks.

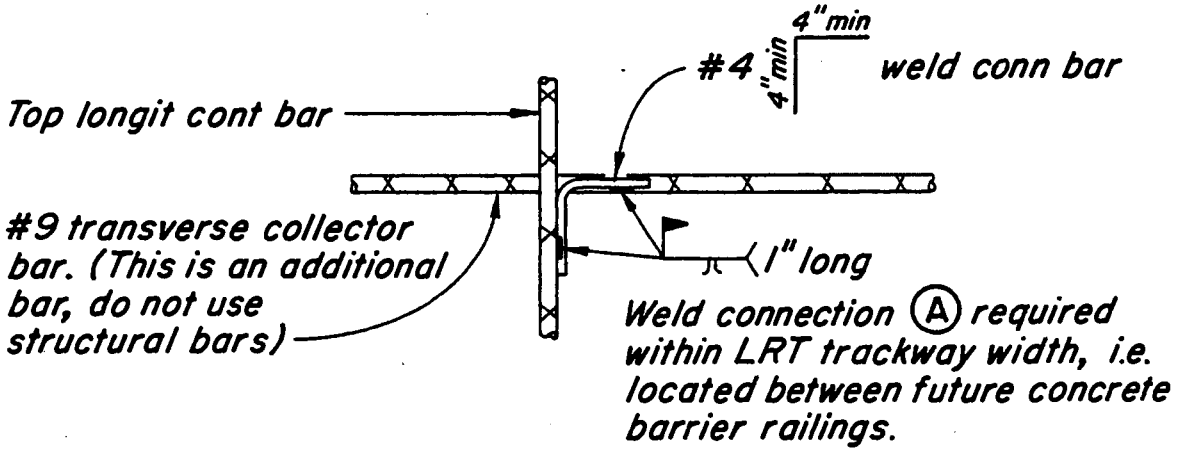
4. Consult with the Office of Structure Design's Transit Specialist regarding site conditions.

LRT Stations

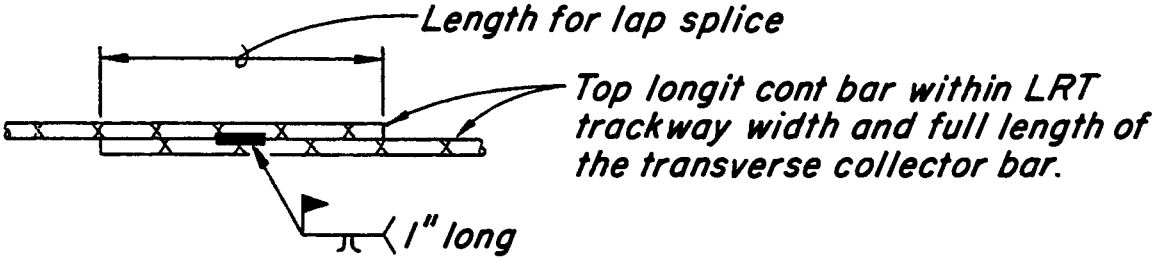
Provisions will be necessary. Specific details will be provided in the future after the station plans have been developed in more detail. The type of structures include platforms, pedestrian overcrossings, stairs, elevators, etc.



DECK SLAB SECTION



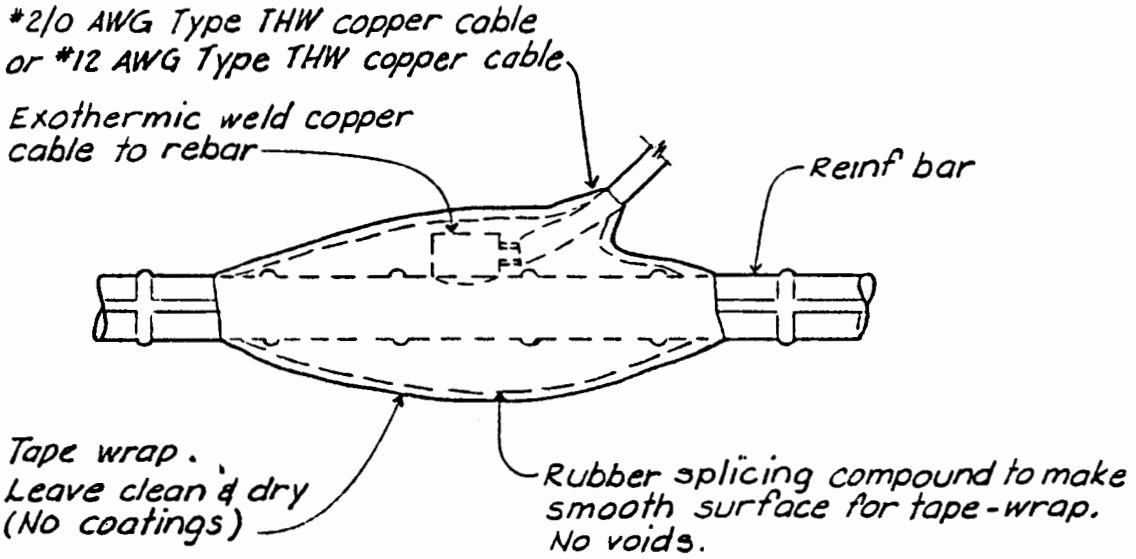
A WELD CONNECTION BAR DETAIL



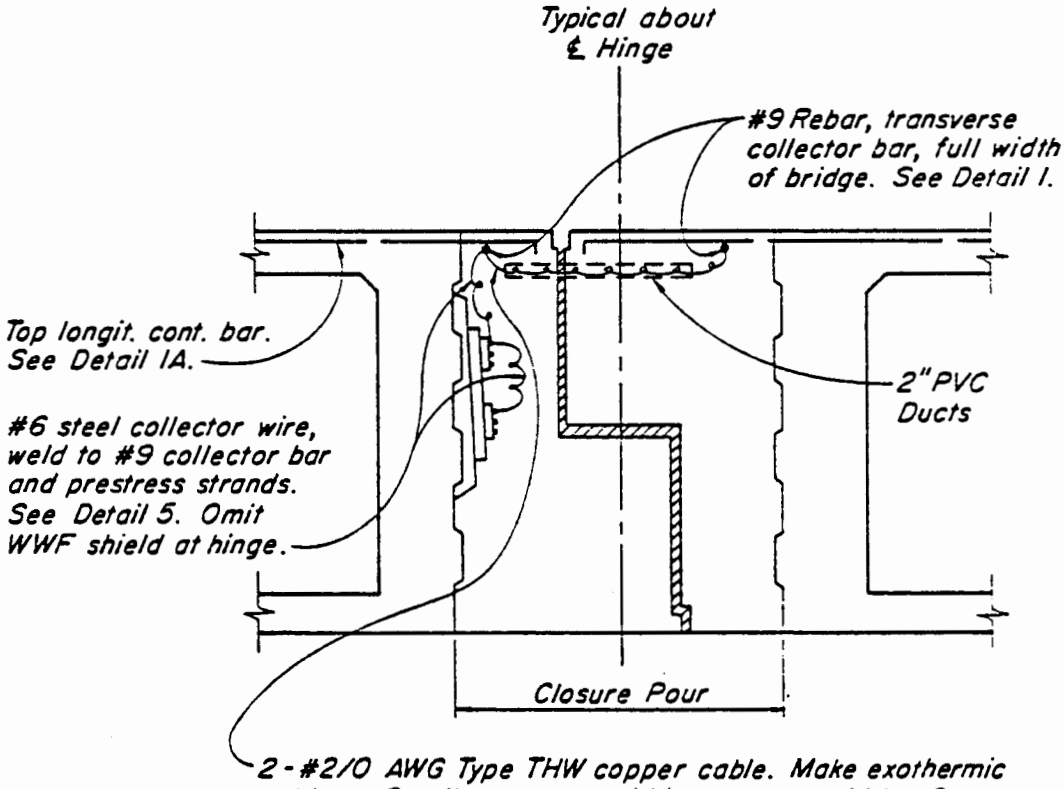
B BAR LAP SPLICE WELD DETAIL

DETAIL 1 - DECK SLAB COLLECTOR BAR

* Designer must designate these bars on plan sheet per instructions in text, "Deck".

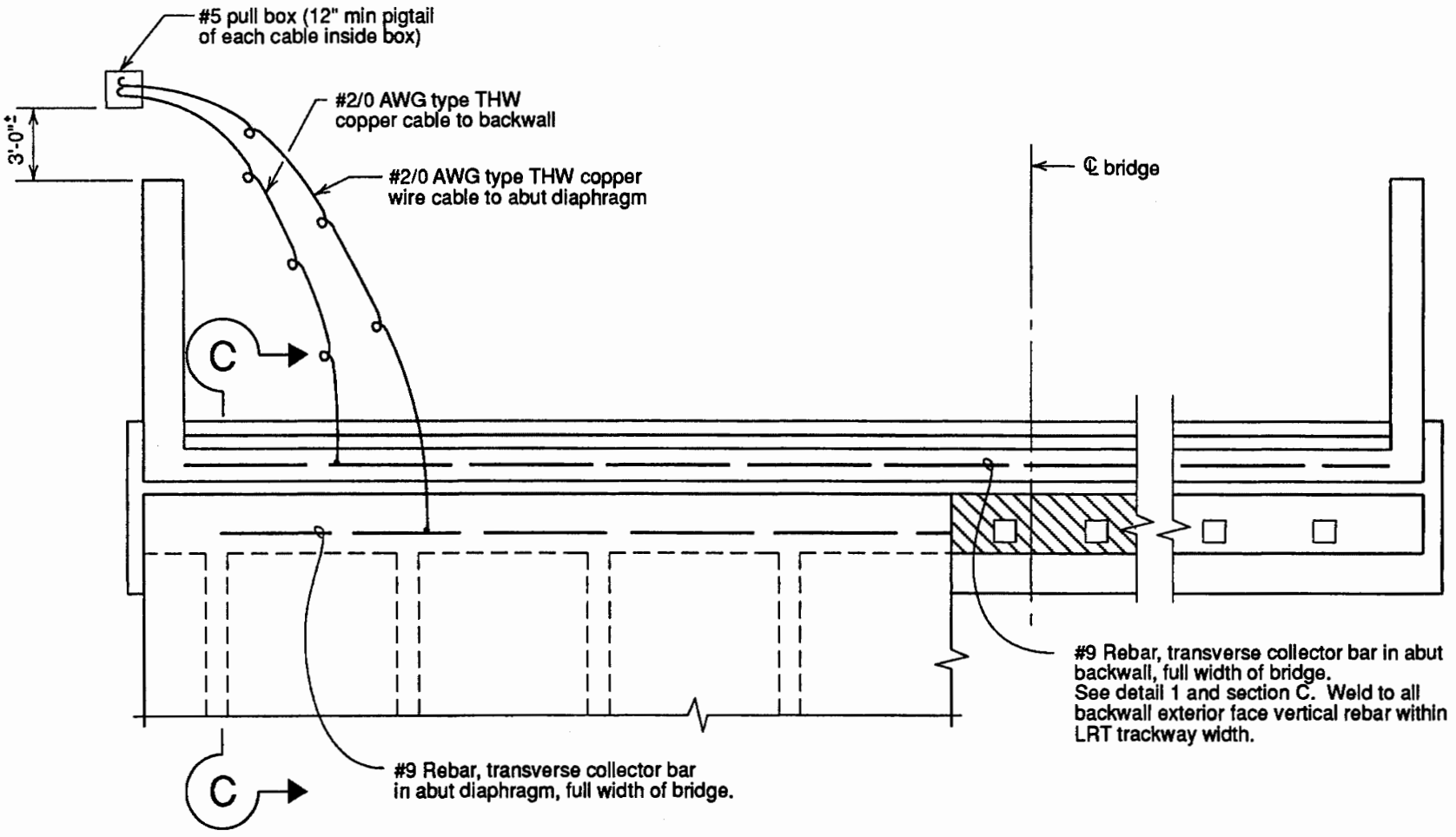


DETAIL 2 – COPPER CABLE TO REBAR CONNECTION



SECTION THRU HINGE

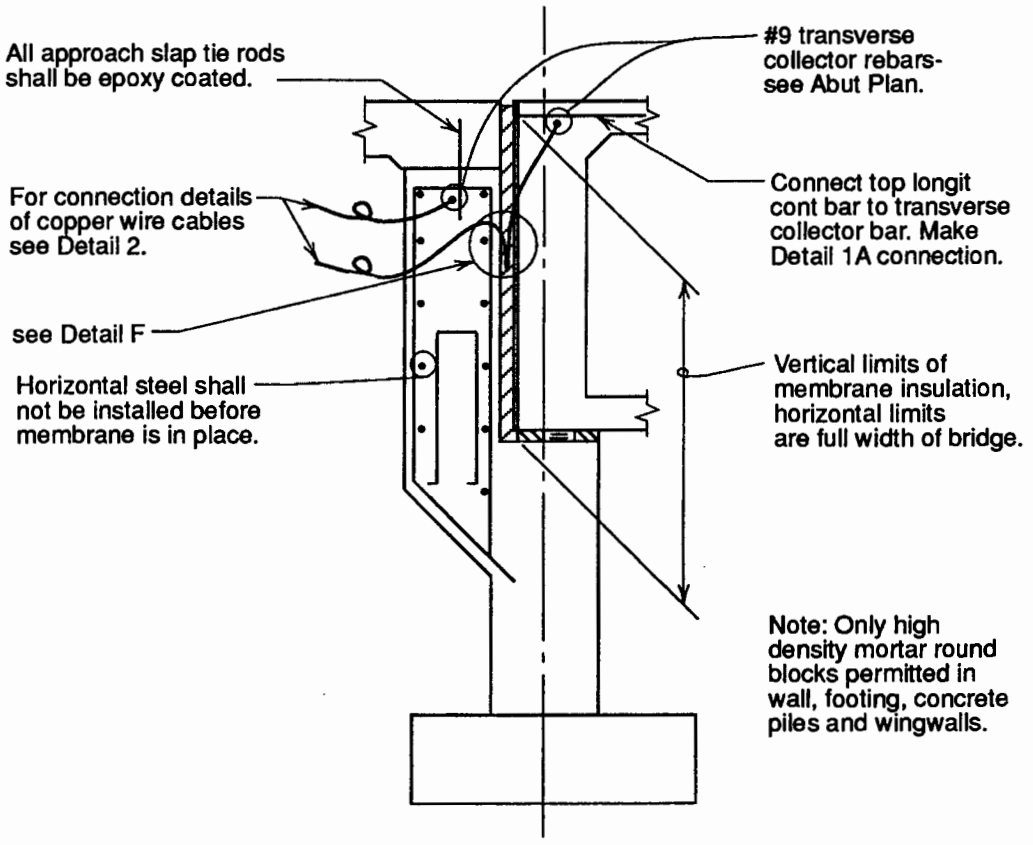
DETAIL 3 - HINGE DETAILS



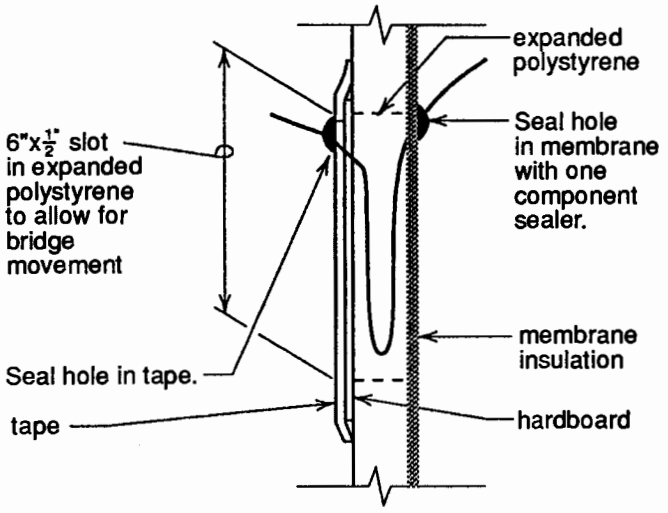
Detail 4A1-Typical Abutment Plan

Decal No. 74.01 (3/90)

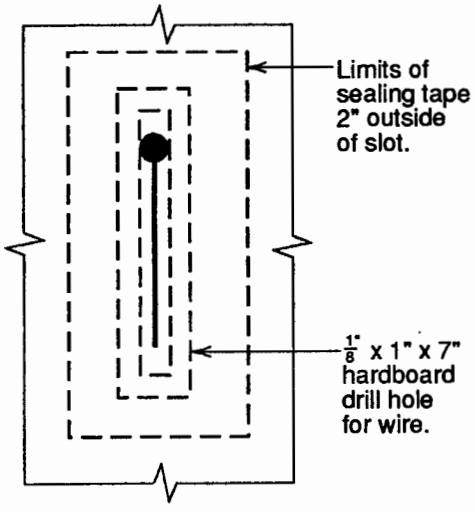
Decal No. 74.02 (3/90)



Ⓒ - Abutment Section



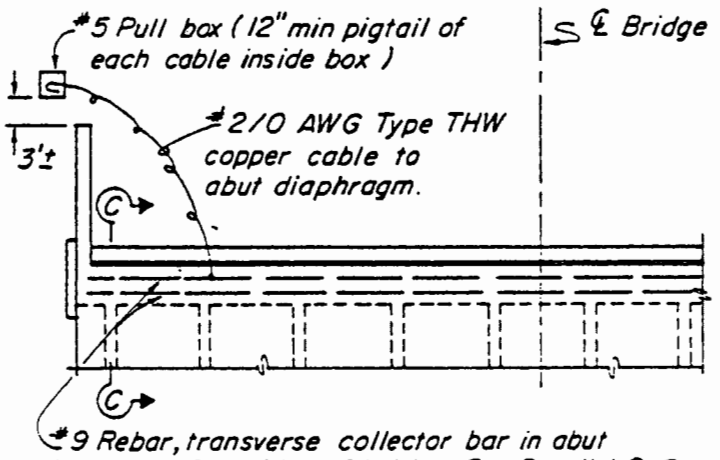
Detail F



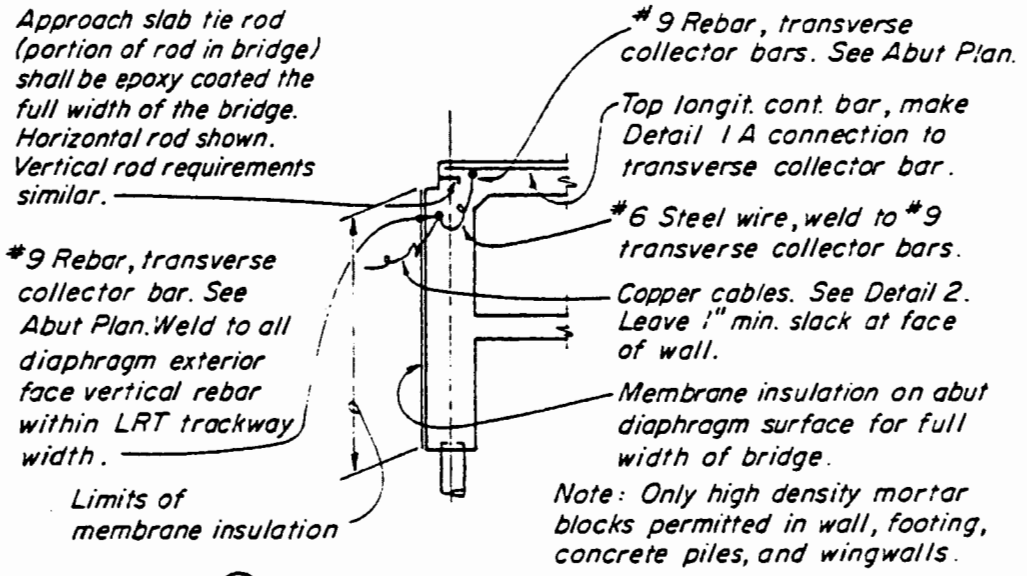
Front View of Detail F

DETAIL 4A2-ABUTMENT DETAILS
Seat Abutment Type with Backwall
(Offset backwall shown. Flush backwall details similar.
Spread footing shown. Pile cap footing similar.)

DECAL NO. 74.1 (4/87)

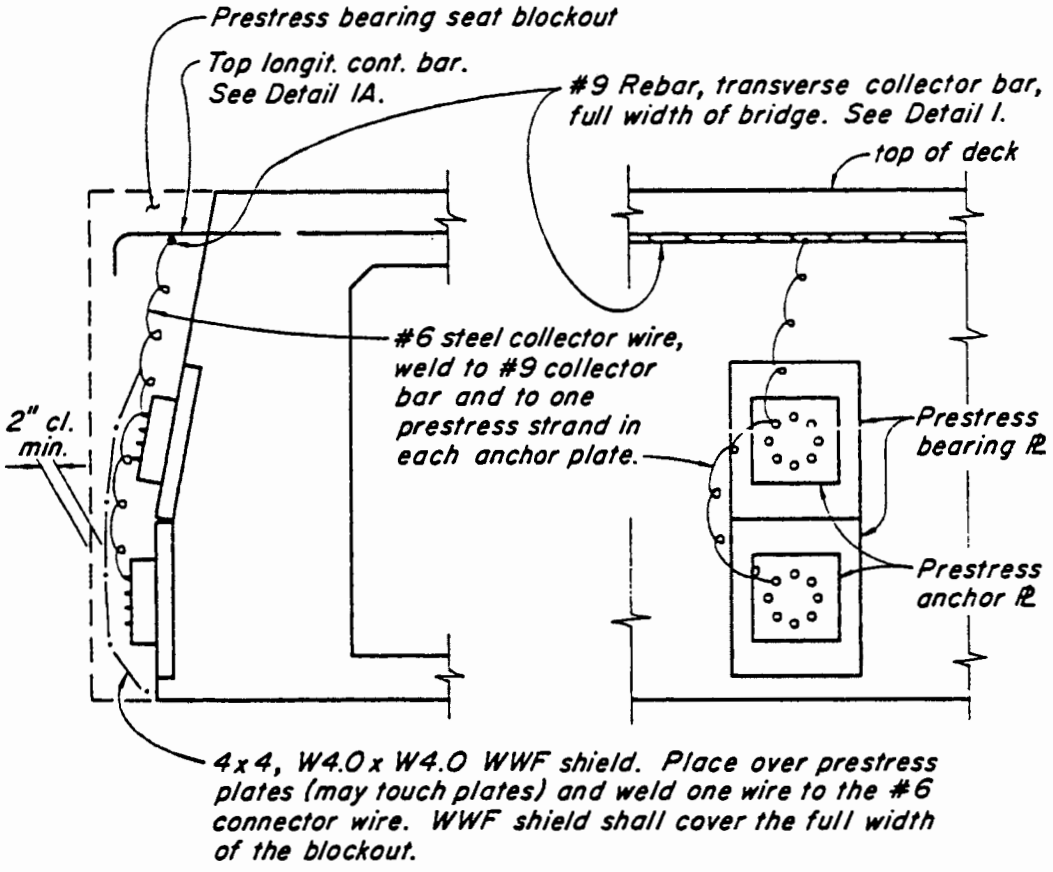


TYPICAL ABUTMENT PLAN



©-ABUTMENT SECTION

DETAIL 4B-ABUTMENT DETAILS-
Diaphragm Type Abutment



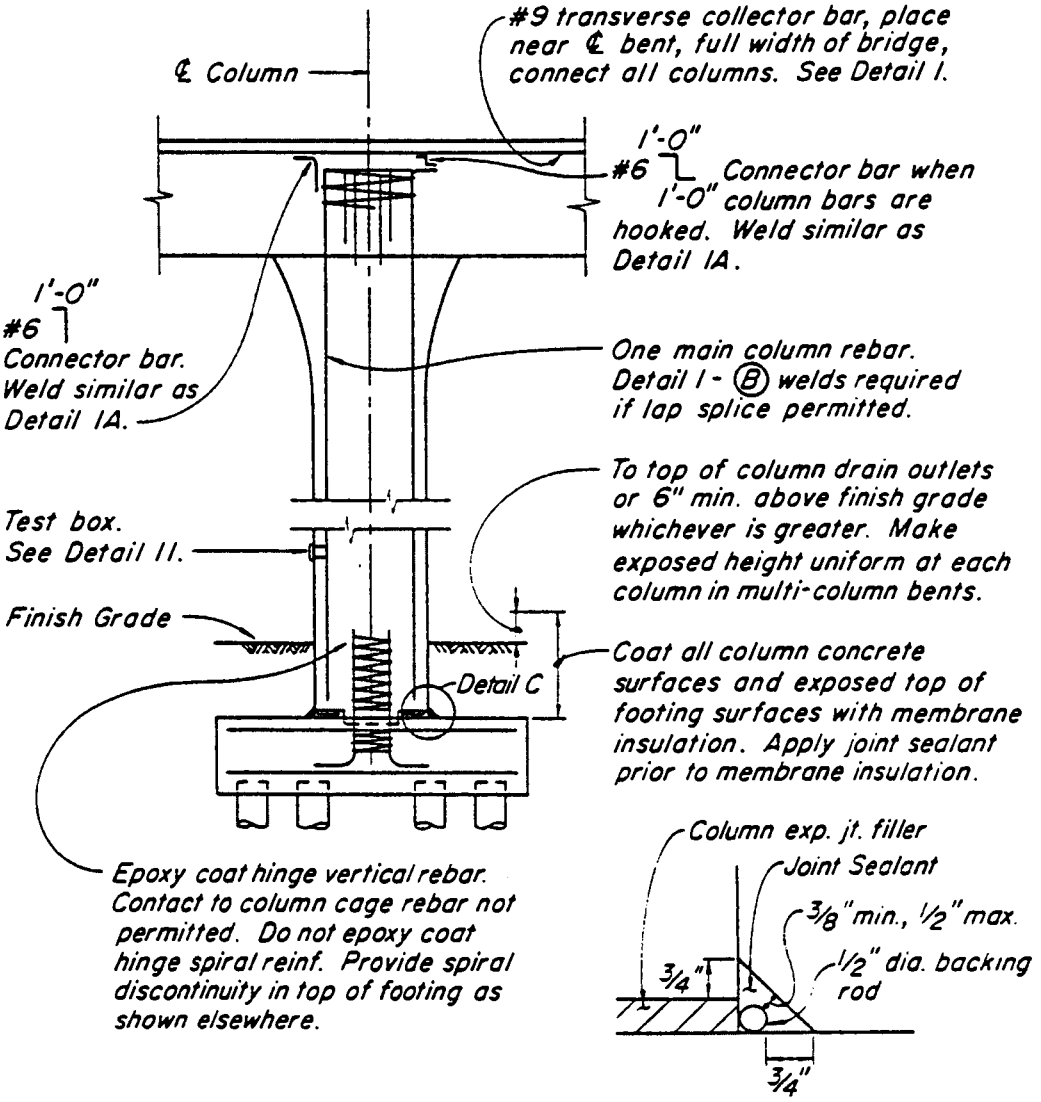
Note: Details typical for all girders, full width of bridge.

SIDE SECTION END ELEVATION

DETAIL 5 – PRESTRESS TENDON CONNECTION

DECAL NO. 75 (4/87)

DECAL NO. 76 (4/87)



COLUMN ELEVATION

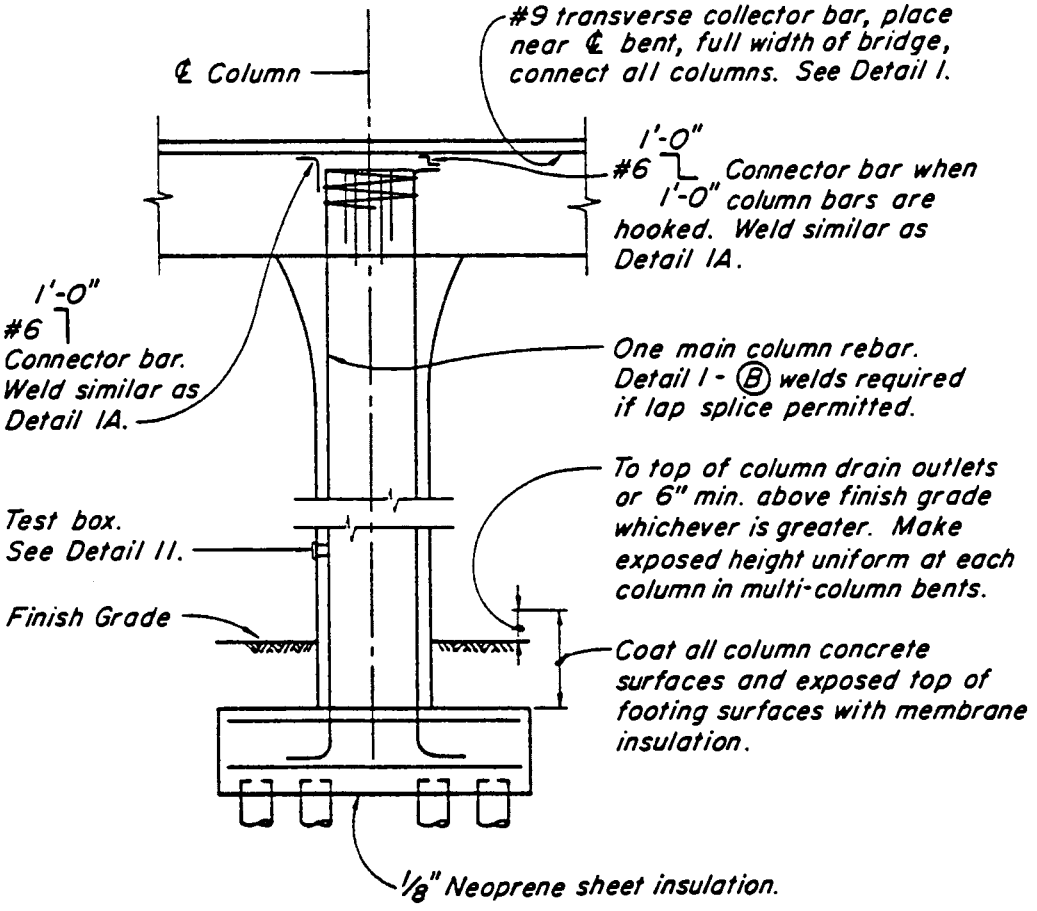
DETAIL C

NOTES:

Hinged column w/pile cap footing shown. Hinged column w/spread footing similar.

Only high density mortar blocks permitted in column, footing, or concrete piles.

DETAIL 6 - HINGED COLUMN DETAILS w/FOOTING

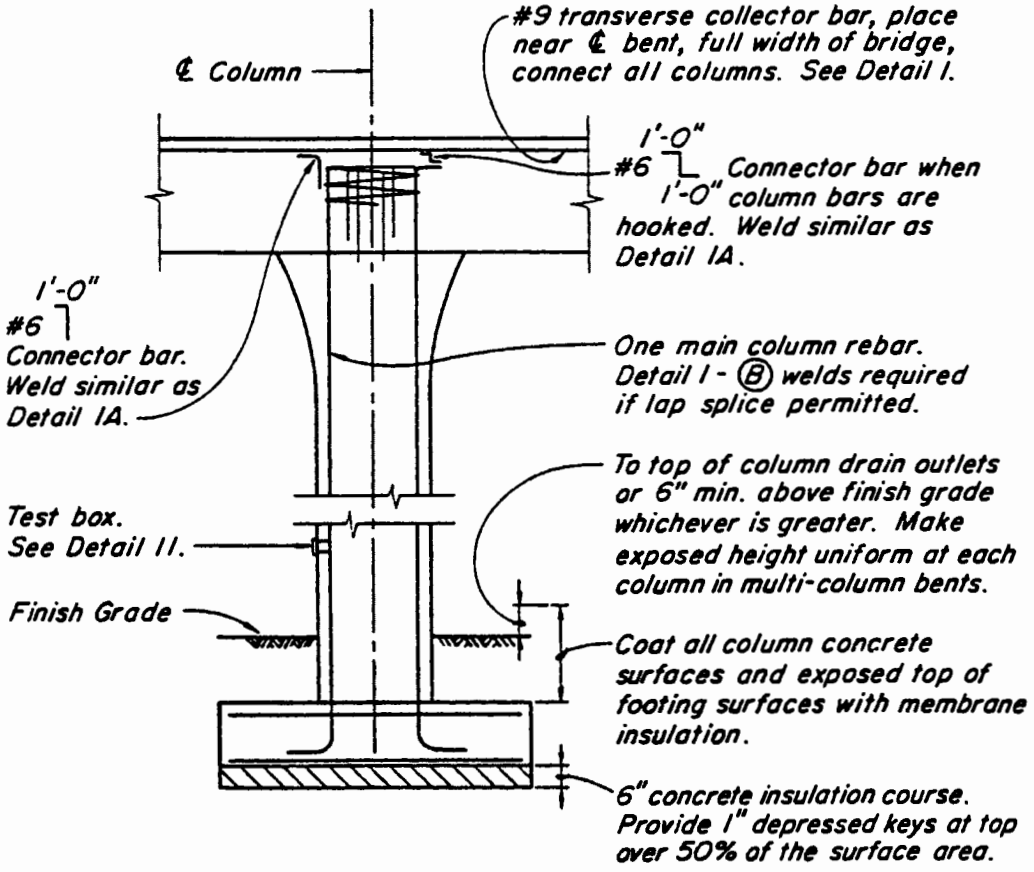


Note: Only high density mortar blocks permitted in columns, footings, and concrete piles.

COLUMN ELEVATION

DETAIL 7A - FIXED COLUMN DETAILS w/PILE CAP FOOTING

DECAL NO. 77A (4/87)



Note: Only high density mortar blocks permitted in columns and footings.

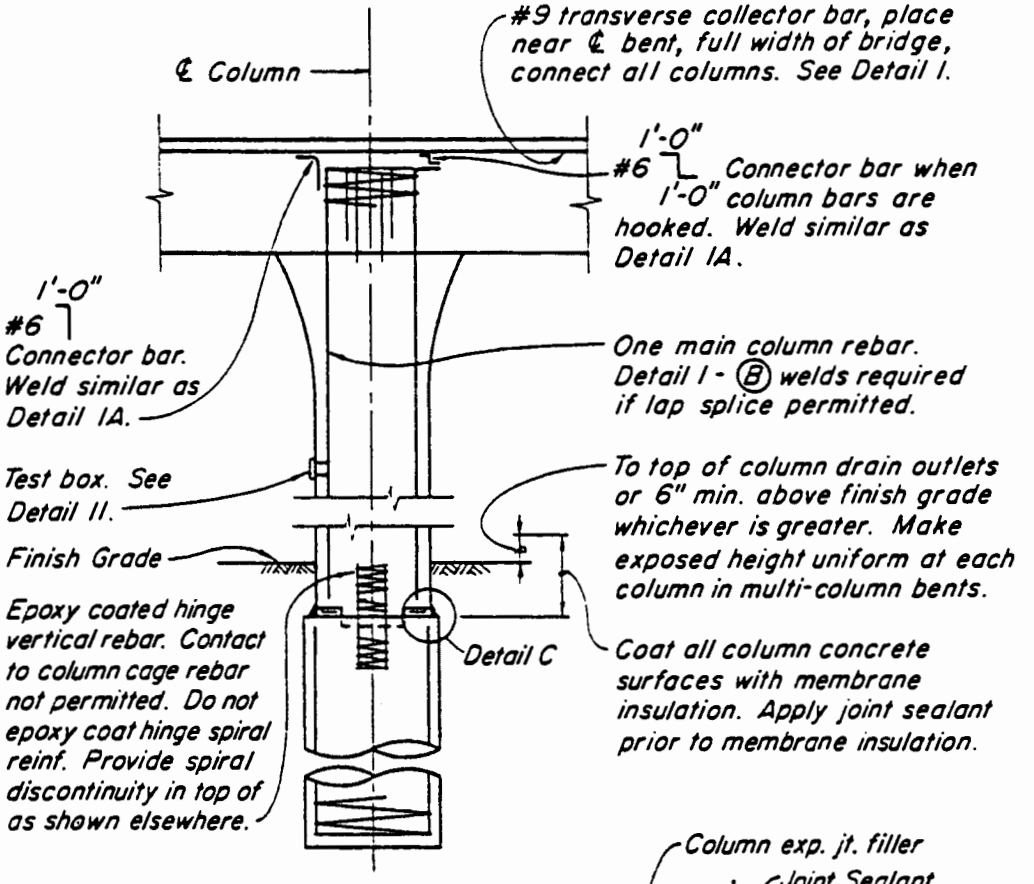
COLUMN ELEVATION

DETAIL 7B - FIXED COLUMN DETAILS w/ SPREAD FOOTING

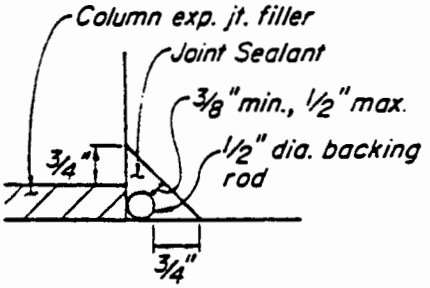
NOTE TO DESIGNER

Designer may eliminate concrete insulation course & use the neoprene sheet insulation method as shown on DETAIL 7A if footing sliding is not a significant factor in their opinion. Designer must show DETAIL 7A in whole except any reference or illustration of piles are to be removed.

DECAL NO. 77B (4/87)



COLUMN ELEVATION



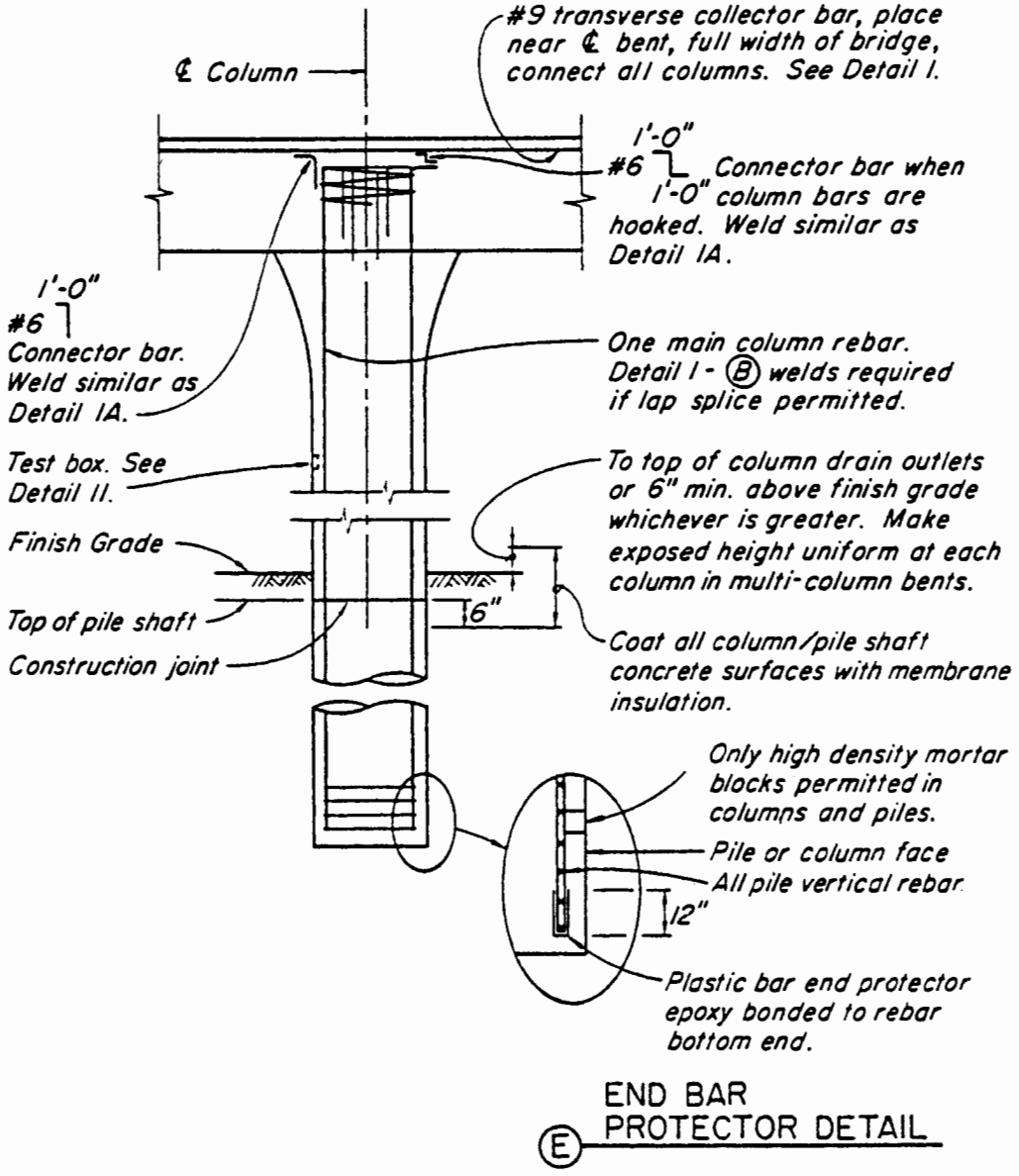
DETAIL C

NOTES:

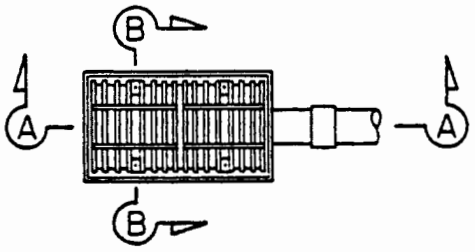
Use Detail 9 - (E) for pile shaft rebar.

Only high density mortar blocks permitted in columns and pile shafts.

DETAIL 8 - HINGED COLUMN DETAILS, PILE SHAFT TYPE

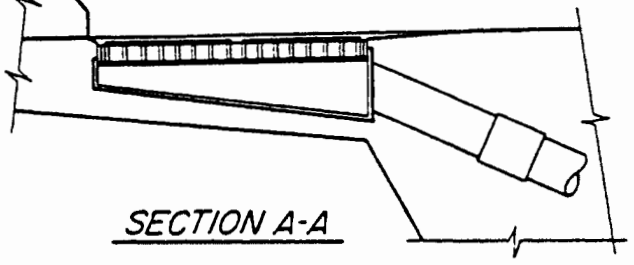


DETAIL 9 - COLUMN DETAILS, PILE SHAFT TYPE

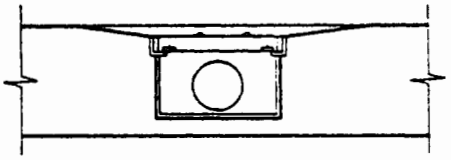


TYPE D-2M PLAN

Note: Within LRT trackway width epoxy insulate all drain box surfaces in contact with concrete including bolt anchors. Tape wrap steel drain pipe where embedded in concrete. If the LRT trackway drainage system is connected to the highway bridge drainage system then the combined system shall require the above provisions.



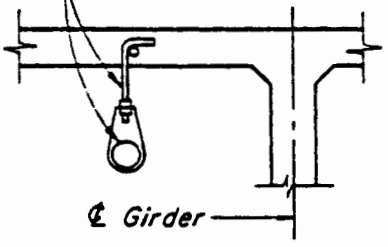
SECTION A-A



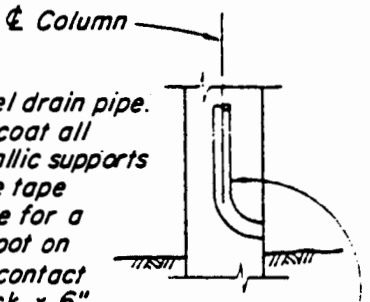
SECTION B-B

DECK DRAIN ASSEMBLY

Epoxy coat hanger rod or install 1/8" thick neoprene rubber bushing around pipe at each strap.



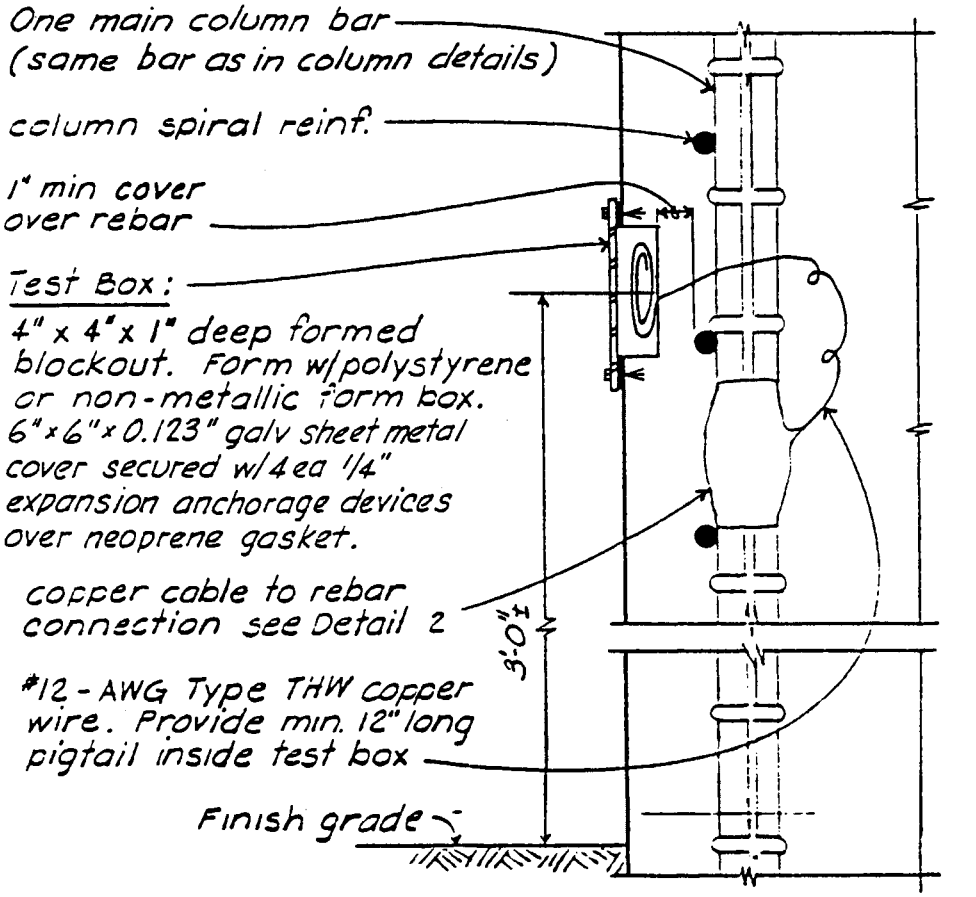
PIPE HANGER DETAIL



Tape wrap the steel drain pipe. In addition, epoxy coat all reinf. steel or metallic supports in contact with the tape wrapped drain pipe for a distance of one foot on each side of the contact point. A 1/8" thick x 6" wide neoprene rubber bushing may be substituted for the epoxy coating at each contact point.

COLUMN DRAIN

DETAIL 10 - DECK DRAIN DETAILS

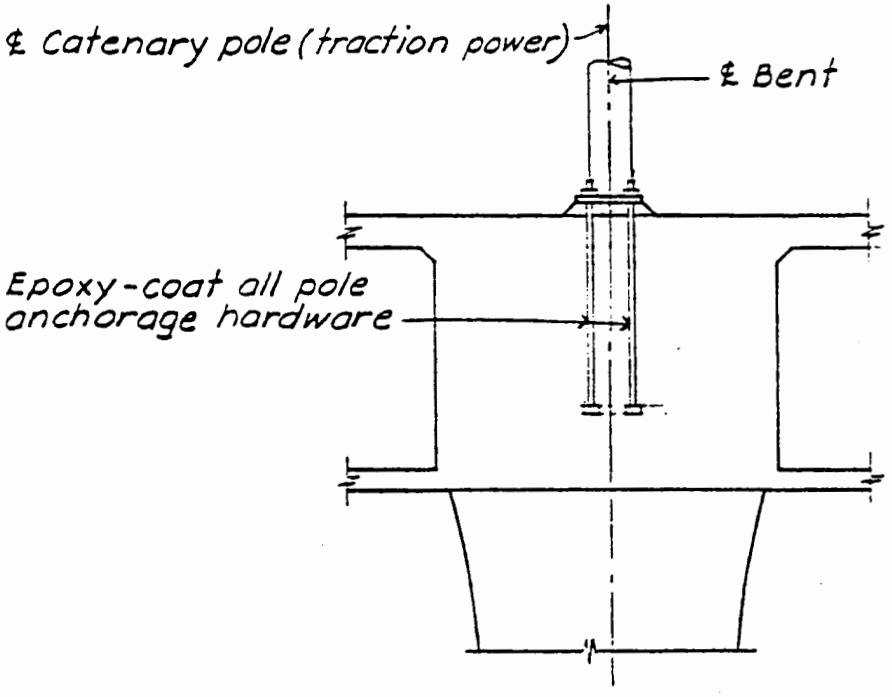


COLUMN ELEVATION

Installation Locations for Test Boxes:

1. *At all single column bents.*
2. *At multi-column bents:*
   (a) *All columns within trackway width. If no columns within trackway width, install at column nearest trackway location.*
   (b) *All outside columns of the bridge.*

DETAIL 11 - COLUMN TEST BOX

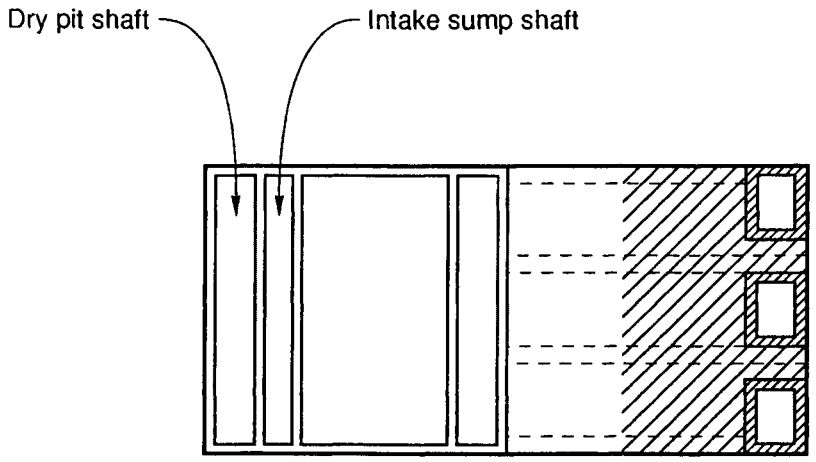


CATENARY POLE DETAIL
(shown at column cap)

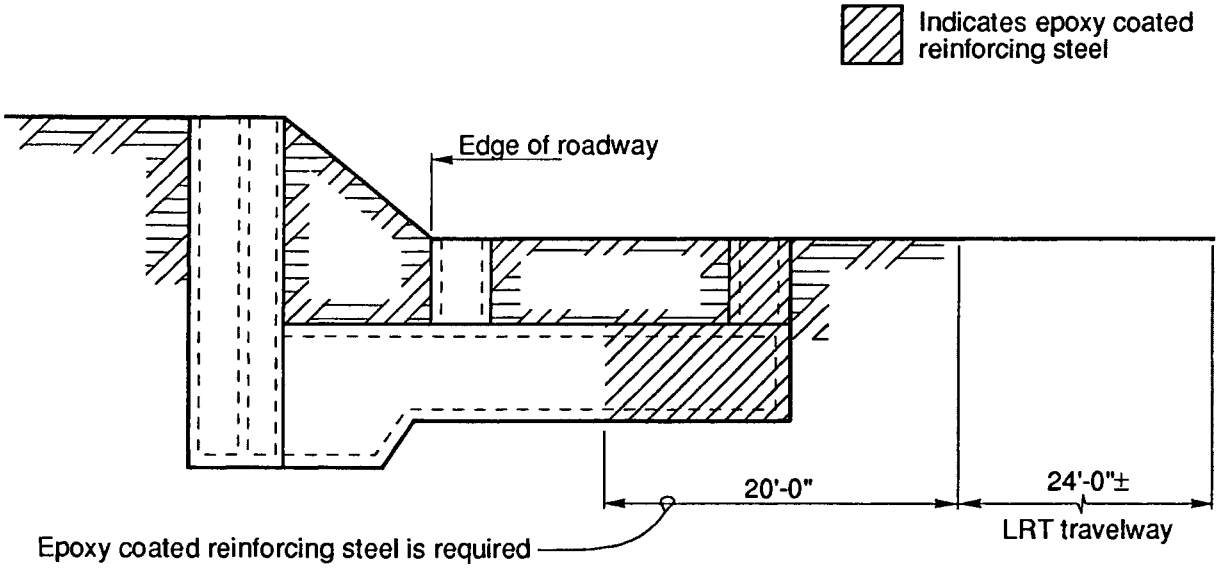
Note:
Overhead Catenary System (OCS) anchorages cast into bridge soffits or elsewhere shall be epoxy-coated.

OVERHEAD CONTACT SYSTEM DETAIL

DETAIL 12 - TRACTION POWER SYSTEM DETAIL



Plan



Elevation

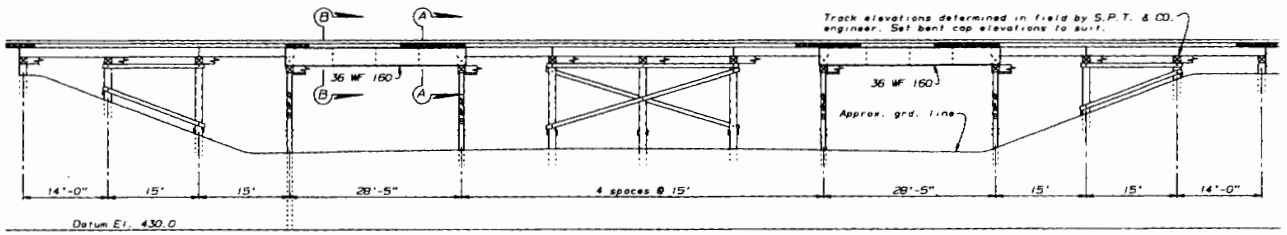
Detail 13 - Pumping Plant Provision

RAILROAD COMPANIES

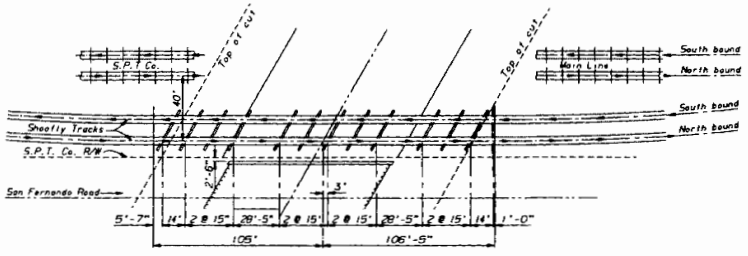
Following is a tabulation of the legal titles of various railroads in the State of California. The correct name as given below should be used on General Plans, Public Utilities Commission sheets, and special provisions for projects which involve a crossing of a railroad. The titles of some of the major Railroads may be abbreviated on detail sheets. The exact legal titles of Railroad companies not given herein should be verified before use.

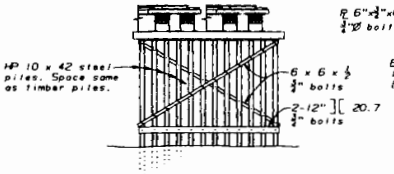
PUR RR NO.	TITLE	ABBREVIATIONS
	SOUTHERN PACIFIC TRANSPORTATION COMPANY	SPT Co.
2.	THE ATCHISON, TOPEKA AND SANTA FE RAILWAY COMPANY	AT&SF Ry Co.
3.	UNION PACIFIC RAILROAD COMPANY	UPRR Co.
4.	THE WESTERN PACIFIC RAILROAD COMPANY	WPRR Co.
5.	NORTHWESTERN PACIFIC RAILROAD COMPANY	NWPRR Co.
8.	SACRAMENTO NORTHERN RAILWAY	SNRy
9.	BURLINGTON NORTHERN, INC.	
10.	ALAMEDA BELT LINE	
11.	ALMANOR RAILROAD COMPANY	
12.	AMADOR CENTRAL RAILROAD COMPANY	
13.	THE ARCATA AND MAD RIVER RAILROAD COMPANY	
16.	THE OAKLAND TERMINAL RAILWAY	
17.	CALIFORNIA WESTERN RAILROAD	
18.	CAMINO, PLACERVILLE AND LAKE TAHOE RAILROAD COMPANY	C,P&LTRR Co.
23.	HARBOR BELT LINE RAILROAD	
25.	LOS ANGELES JUNCTION RAILWAY COMPANY	
26.	McCLOUD RIVER RAILROAD COMPANY	
28.	MODESTO AND EMPIRE TRACTION COMPANY	
33.	QUINCY RAILROAD COMPANY	
34.	RICHMOND BELT RAILWAY	
36.	SAN DIEGO AND ARIZONA EASTERN RAILWAY COMPANY	SD&AERy Co.
38.	SANTA MARIA VALLEY RAILROAD COMPANY	
39.	SIERRA RAILROAD COMPANY	
41.	STOCKTON TERMINAL AND EASTERN RAILROAD	ST&ERR
42.	SUNSET RAILWAY COMPANY	
44.	TRONA RAILWAY COMPANY	
45.	VENTURA COUNTY RAILROAD COMPANY	
47.	YREKA WESTERN RAILROAD COMPANY	YWRR Co.
49.	HOLTON INTERURBAN RAILWAY COMPANY	HIURy Co.
55.	HOWARD TERMINAL RAILWAY	
59.	STOCKTON PUBLIC BELT RAILROAD	
61.	CENTRAL CALIFORNIA TRACTION COMPANY	
67.	PETALUMA AND SANTA ROSA RAILROAD COMPANY	P&SRRR Co.
75.	TIDEWATER SOUTHERN RAILWAY COMPANY	TSRy Co.
77.	VISALIA ELECTRIC RAILROAD COMPANY	
78.	SACRAMENTO-YOLO PORT DISTRICT BELT RAILROAD	
79.	PARR TERMINAL RAILROAD	

Railroad Shoofly

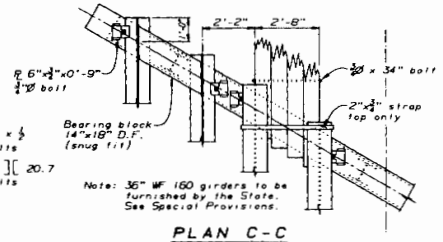


ELEVATION - SHOOFLY TRESTLE

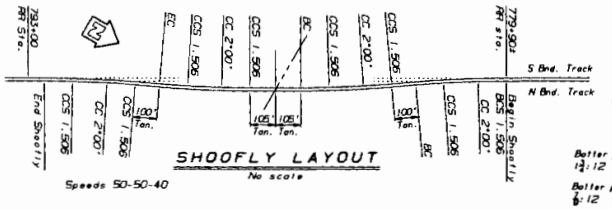




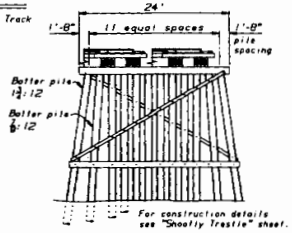
STEEL PILE BENT
⅛" = 1'-0"



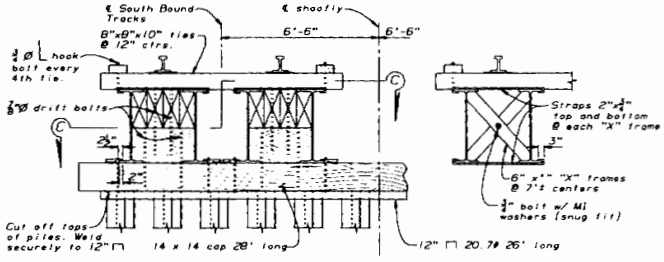
PLAN C-C
¼" = 1'-0"



SHOOFLY LAYOUT
No scale
Speeds 50-50-40



TIMBER PILE BENT
⅛" = 1'-0"



SECTION A-A

SECTION B-B

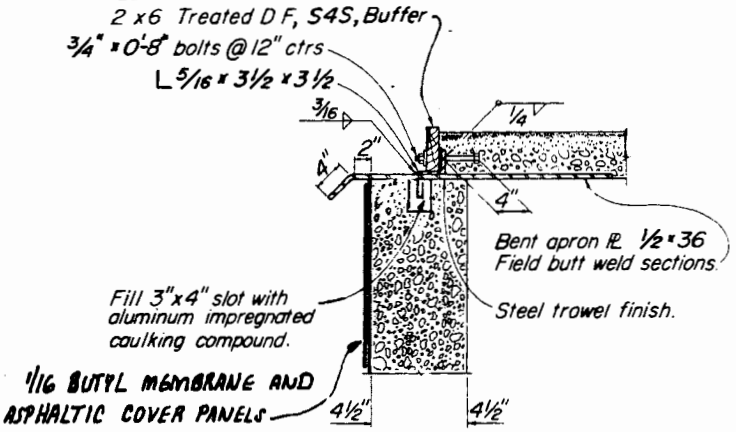
WHENEVER HIGHWAY TRAFFIC IS CARRIED UNDER A RAILROAD SHOOFLY TRESTLE, THE OPENING BETWEEN TIES SHOULD BE PLANKED TO PREVENT MATERIAL FALLING THROUGH ONTO THE HIGHWAY. THE PLANKING SHOULD BE DONE ONLY OVER THE HIGHWAY PORTION OF THE TRESTLE.

SHOOFLY CURVE DATA
(All curves identical)

T.C.	= 4°50'
D	= 2°00'
L_E	= 106.88'
d	= 1:506
L_S	= 132.75'
S.T.	= 187.29'
Super	= 2¼"

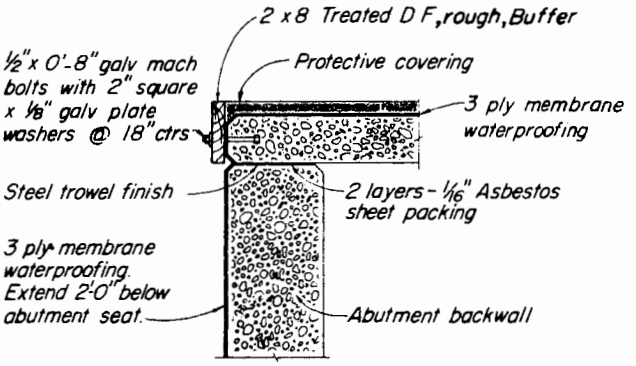
Note to Designers: The is a sample layout. Check with railroad for actual requirements.

WATERSTOPS AT TOP OF RAILROAD UNDERPASS ENDWALLS



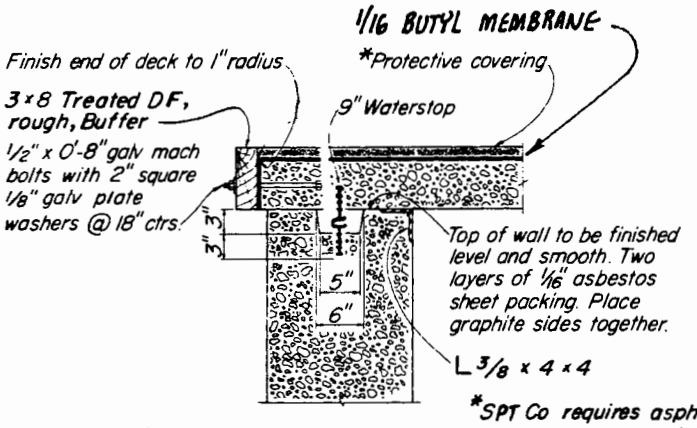
AT and SF Ry Co.

CONCRETE BALLAST TROUGH



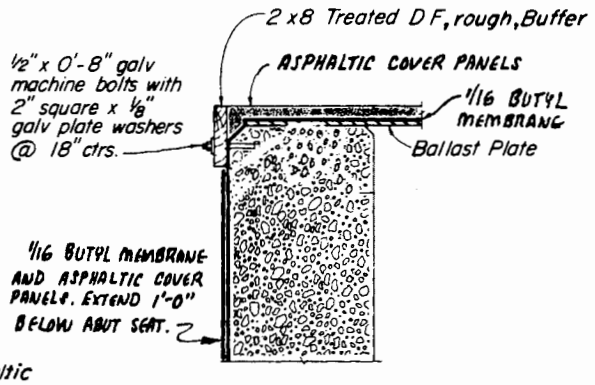
UPRR Co.

CONCRETE BALLAST TROUGH



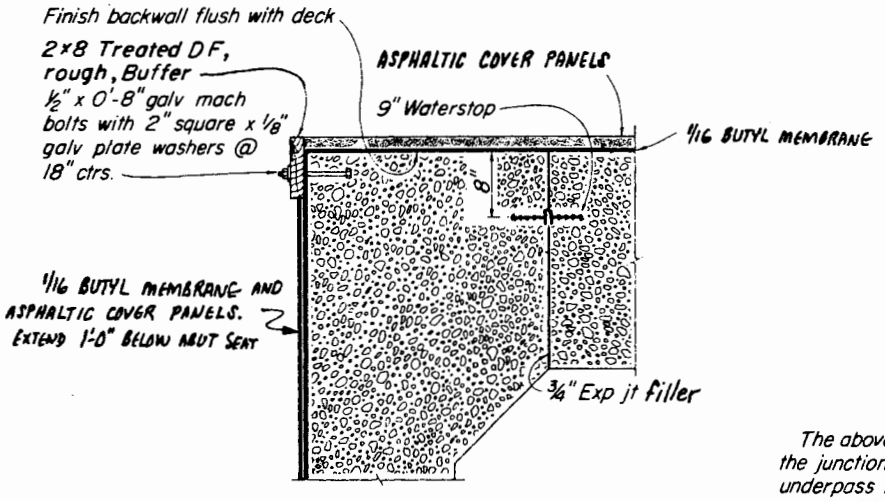
SPT Co. and UPRR Co.

CONCRETE BALLAST TROUGH



SPT Co

STEEL BALLAST TROUGH



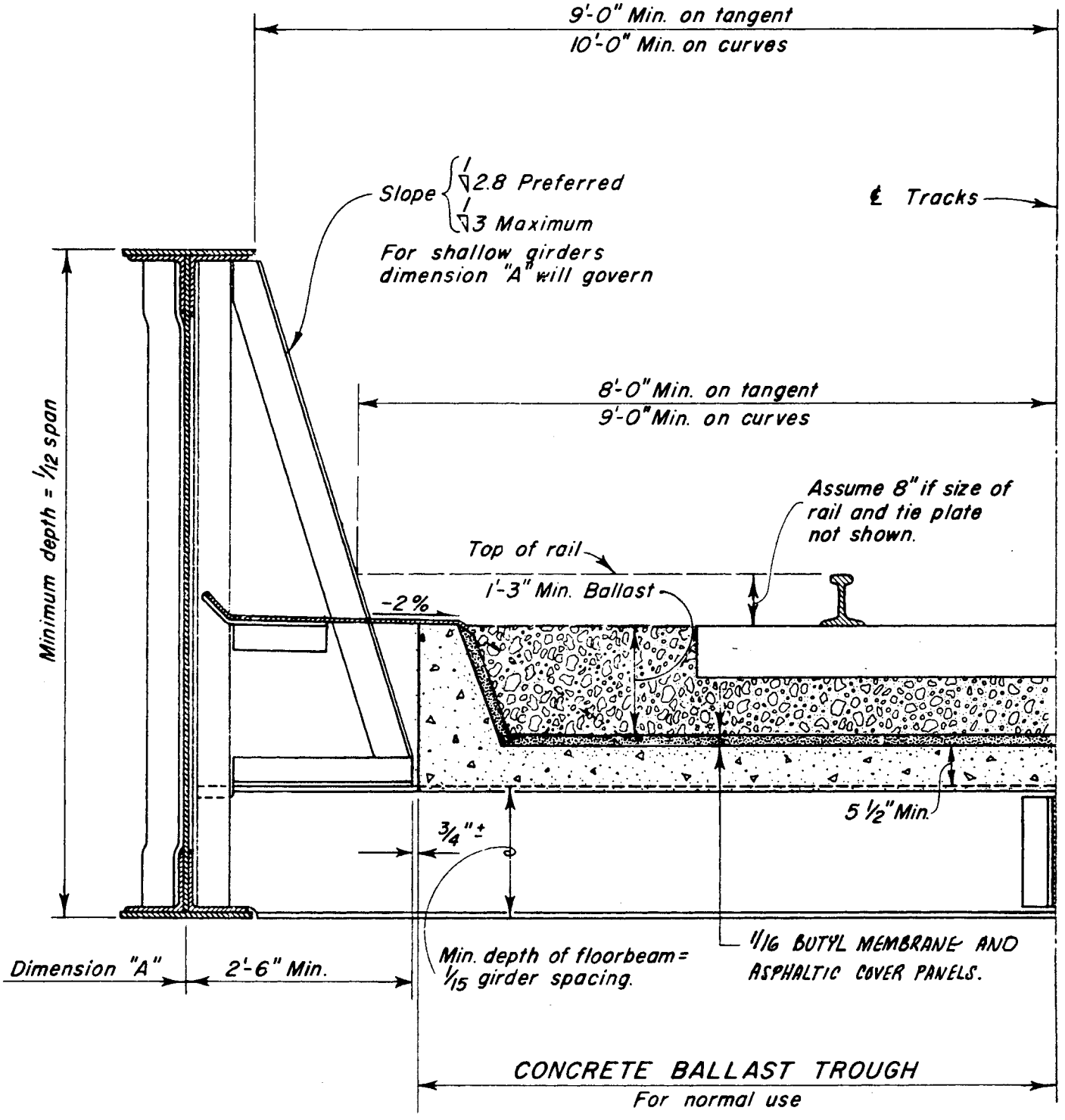
SPT Co

CONCRETE BALLAST TROUGH

The above details are offered as suggested treatment of the junction between superstructure and substructure at underpass bridge ends. The treatment illustrated has been approved in the past by the indicated railroad interests.

THROUGH PLATE GIRDER - CONCRETE BALLAST TROUGH

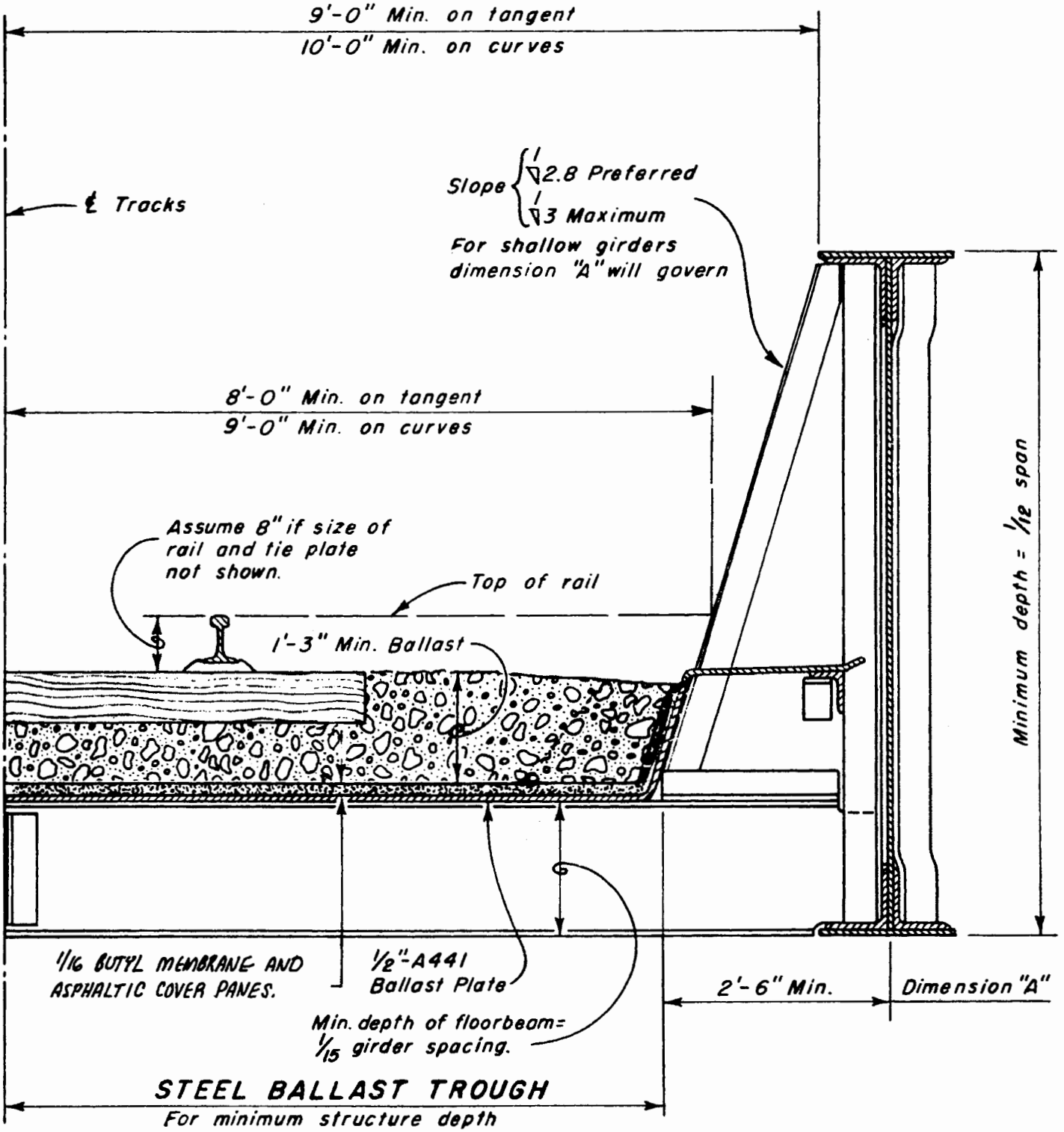
S.P.T. CO. REQUIREMENTS



TYPICAL HALF SECTION

THROUGH PLATE GIRDER - STEEL BALLAST TROUGH

S.P.T. CO. REQUIREMENTS

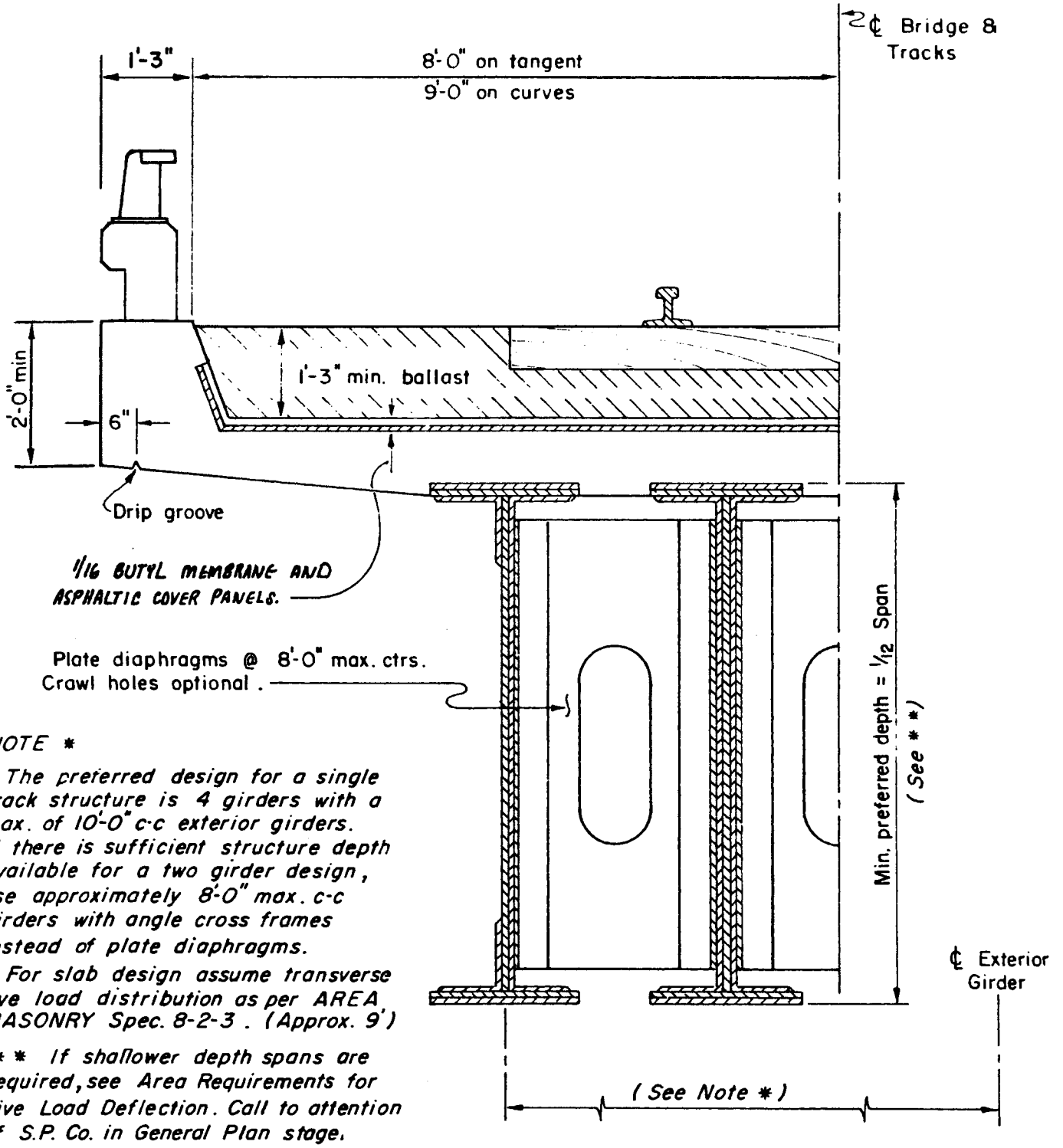


The steel ballast trough is more expensive than concrete and should only be used when a minimum structure depth is absolutely necessary.

TYPICAL HALF SECTION

DECK PLATE GIRDER

S.P.T. CO. REQUIREMENTS



*NOTE **

The preferred design for a single track structure is 4 girders with a max. of 10'-0" c-c exterior girders. If there is sufficient structure depth available for a two girder design, use approximately 8'-0" max. c-c girders with angle cross frames instead of plate diaphragms.

For slab design assume transverse live load distribution as per AREA MASONRY Spec. 8-2-3. (Approx. 9')

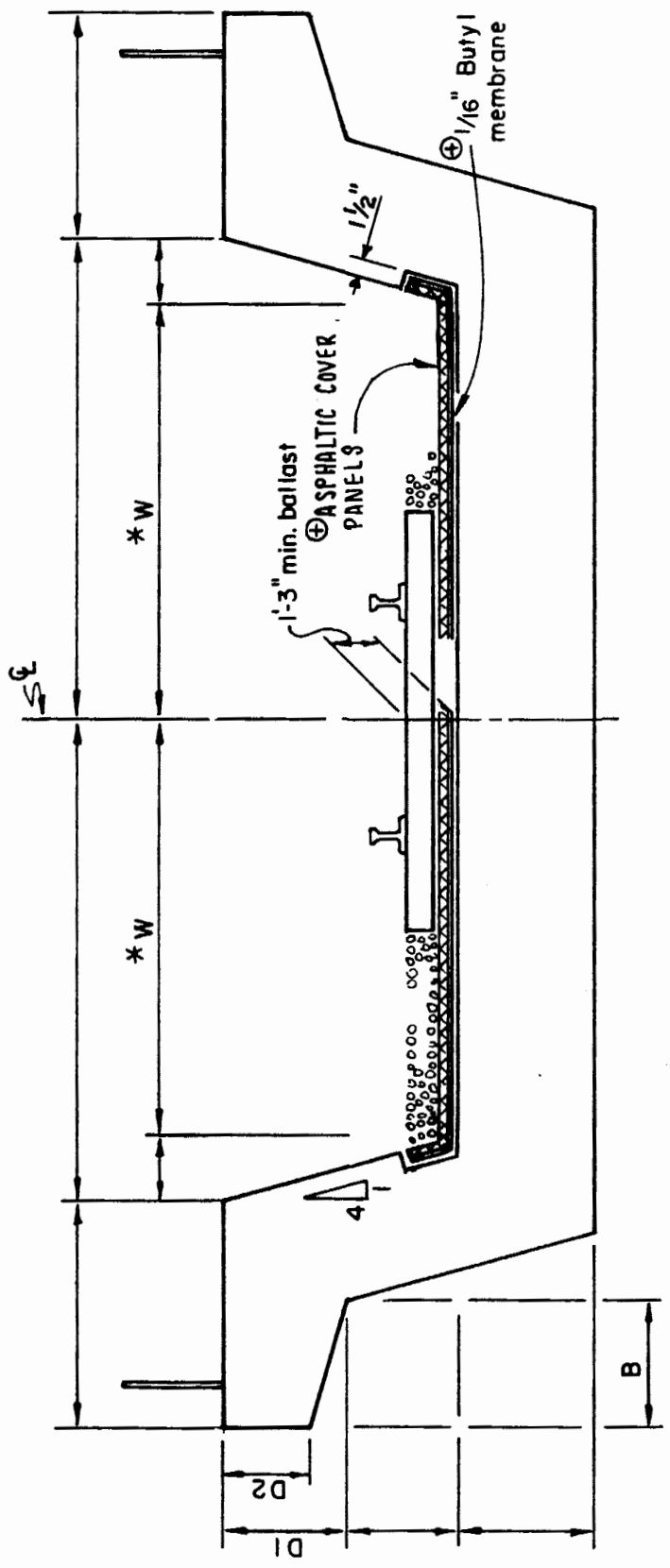
** *If shallower depth spans are required, see Area Requirements for Live Load Deflection. Call to attention of S.P. Co. in General Plan stage.*

TYPICAL HALF SECTION

THROUGH CONCRETE GIRDERS

CONCRETE DIMENSIONS AND WATERPROOFING

S.P.T. CO. REQUIREMENTS



All other dimensions can be varied to suit design conditions.

Requested by SPT CO. 12-27-68.

* JOINT AGREEMENT BETWEEN AASHO AND AAR. PPM 21-4-72

LIMITING DIMENSIONS :

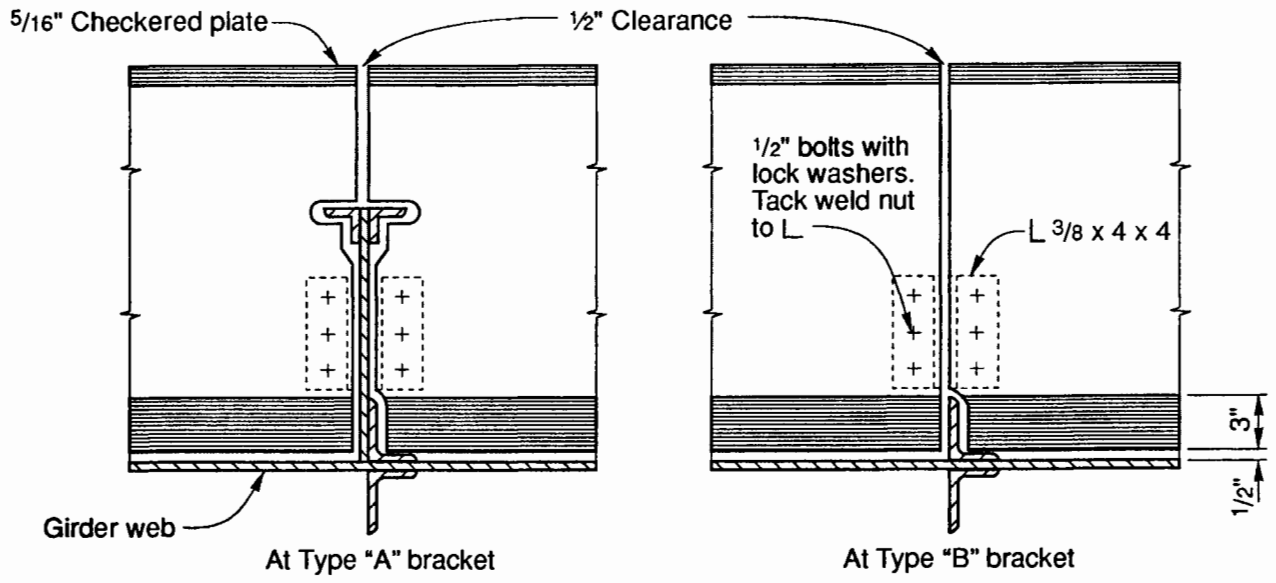
Side clearance W = 8'-0" for tangent track
W = 9'-0" for curve track

Flange overhang D1 ≥ B but 2'-6" min.
D2 ≥ 0.67 D1 but 1'-9" min.

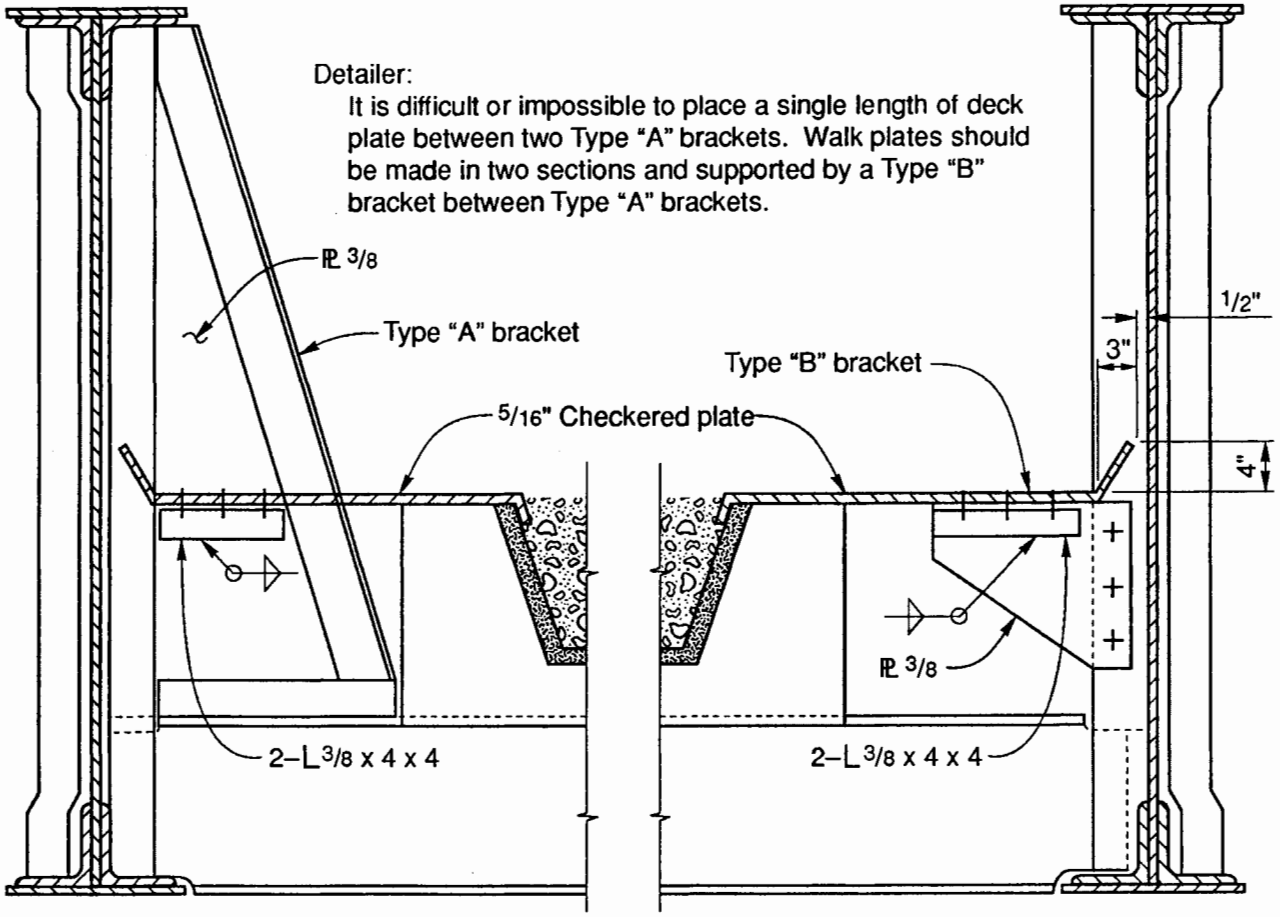
⊕ AT & SF requires for continuous spans but not simple spans.

Through Plate Girder

Walk Plate Details

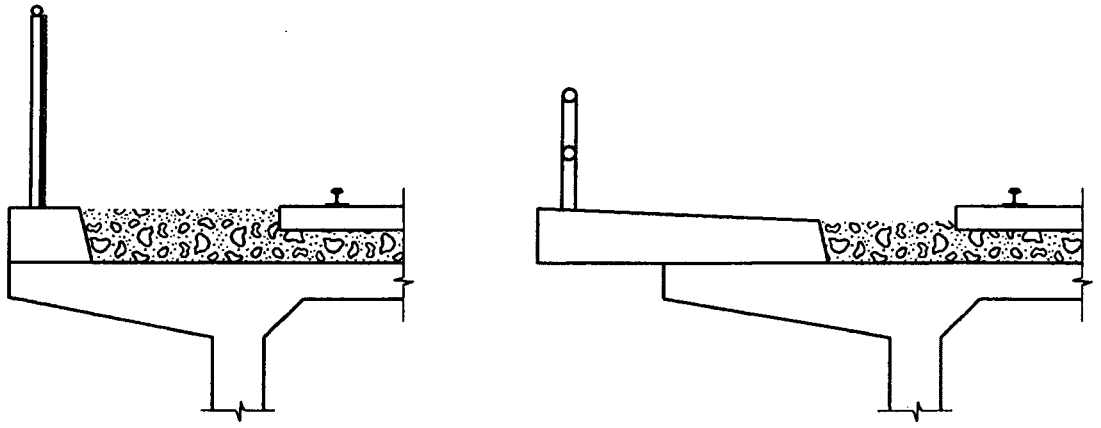


Part Plan of Walk Plate

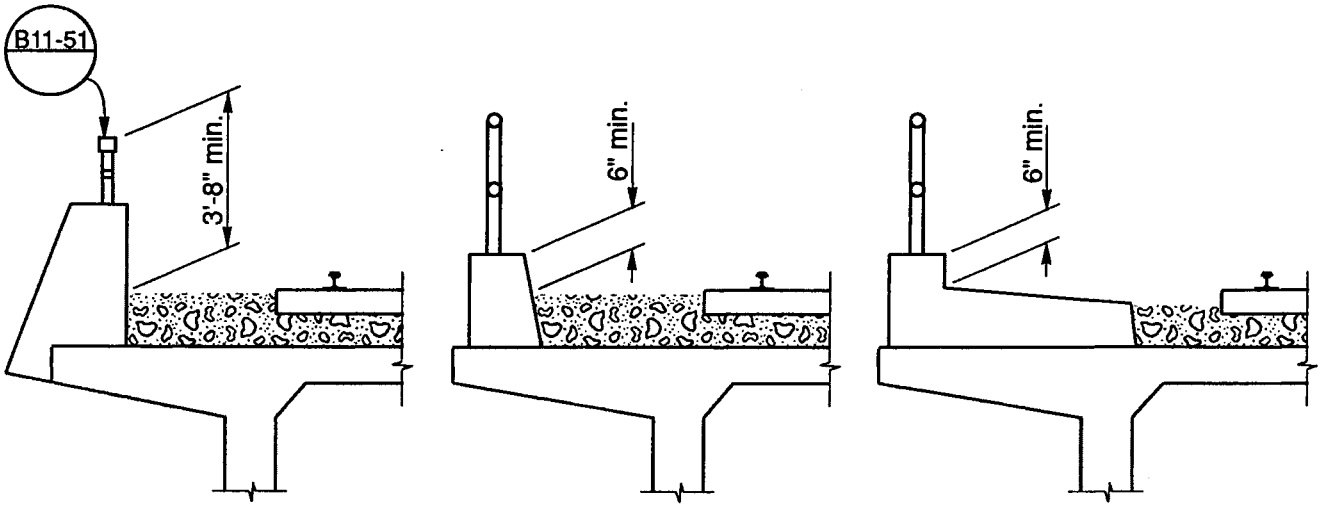


Railroad Underpass Curbs

Track ballast on railroad deck type structures has a tendency to be thrown about and frequently falls off the structure if it is not properly retained. A concrete curb or rail with a minimum height of 6 inches above the ballast should be used. Chain link fencing does not do an adequate job.



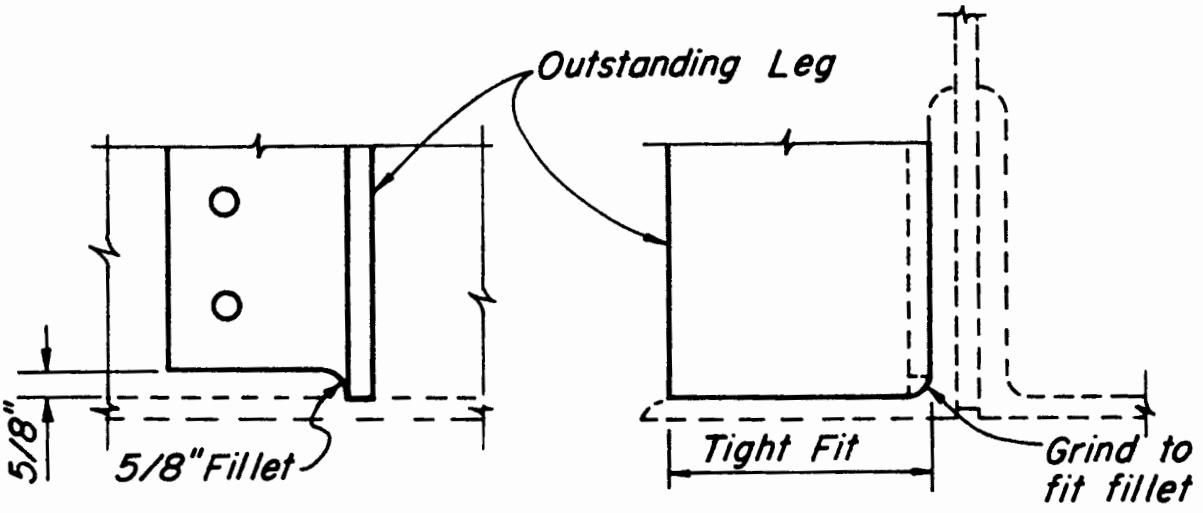
Unacceptable Details



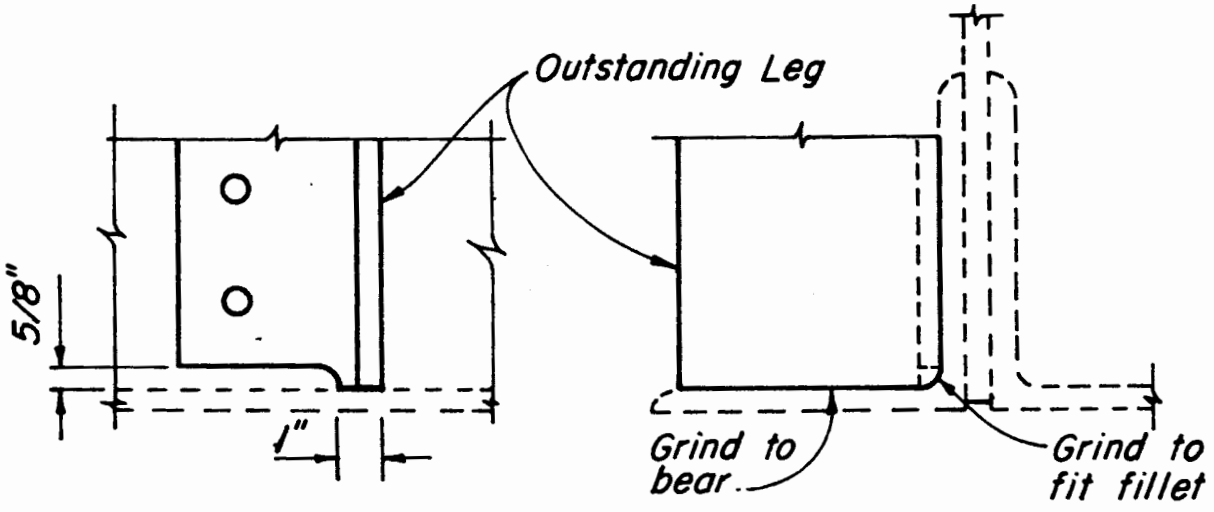
Acceptable Details

ANGLE STIFFENER FIT CRITERIA

S.P.T. CO. REQUIREMENT



INTERMEDIATE STIFFENER



BEARING STIFFENER

RAILROAD STANDARD NOTES

R. R. DECK PLATE GIRDER BEARINGS:

In order to correct for rolling, fabrication and/or erection tolerances it may be necessary to vary the thickness of (or bevel) the sole plate to obtain bearing for the full length of bearing bars.

BEARING PINS (A.T. & S. F. RY. STRUCTURES ONLY):

Pins to be forged steel ASTM A235 Class Cl from carbon steel ASTM A273, C 1045.

ALL A. T. & S. F. RY. STEEL BRIDGES (Omit items which do not apply):

All structural steel, except for ballast trough, checkered plate, handrail, and minor details, shall be copper-bearing steel.

Railroad General Notes

These notes are available as Standard CADD Pattern No. 51

RAILROAD GENERAL NOTES
LOAD FACTOR DESIGN

DESIGN: A.R.E.A., DATED (Current Issue)
(1983 AASHTO with Interims and Revisions by CALTRANS)

LIVE LOADING: COOPER E-

REINFORCED CONCRETE:

$f_y = 60,000$ psi

$f'_c = 3,250$ psi

$n = 9$

Transverse Deck Slabs (Working Stress Design)

$f_s = 20,000$ psi

$f_c = 1,200$ psi

$n = 10$

PRESTRESSED CONCRETE: See 'Prestressing Notes'

FOOTING PRESSURE: (Tons Per Square Foot)

ALLOWABLE	DESIGN

Railroad General Notes

These notes are available as Standard CADD Pattern No. 52

RAILROAD GENERAL NOTES
WORKING STRESS DESIGN

DESIGN: A.R.E.A., DATED (Current Issue)
(1983 AASHTO with Interims and Revisions by CALTRANS)

LIVE LOADING: COOPER E -

REINFORCED CONCRETE: f_s = 24,000 psi, except
20,000 psi in transverse deck slabs and stirrups

f_c = 1,300 psi, except
1,200 psi in transverse deck slabs

n = 10

PRESTRESSED CONCRETE: See 'Prestressing Notes'

STRUCTURAL STEEL: f_s = 20,000 psi

FOOTING PRESSURE: (Tons Per Square Foot)

ALLOWABLE	DESIGN