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 UNDERCROSINGS, 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:

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.
Top transverse bar

Top longit cont bar, see (B)*

#9 transverse collector bar full width of bridge at abutments, bents and hinges, see (B)

#9 transverse collector bar. (This is an additional bar, do not use structural bars)

Weld connection (A) required within LRT trackway width, i.e. located between future concrete barrier railings.

WELD CONNECTION BAR DETAIL

Length for lap splice

Top longit cont bar within LRT trackway width and full length of the transverse collector bar.

BAR LAP SPLICE WELD DETAIL

DETAIL 1 - DECK SLAB COLLECTOR BAR

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

Decal No. 71 (4/87)
DETAIL 2 - COPPER CABLE TO REBAR CONNECTION

*2/0 AWG Type THW copper cable or *12 AWG Type THW copper cable

Exothermic weld copper cable to rebar

Tape wrap. Leave clean & dry (No coatings)

Rubber splicing compound to make smooth surface for tape-wrap. No voids.
Top longit. cont. bar. See Detail IA.

#6 steel collector wire, weld to #9 collector bar and prestress strands. See Detail 5. Omit WWF shield at hinge.

2-#2/0 AWG Type THW copper cable. Make exothermic weld to #9 collector bars within trackway width. See Detail 2. Route cables thru 2" PVC duct and leave slack in cable for bridge expansion movement. Seal duct ends to prevent concrete or water intrusion.

SECTION THRU HINGE

DETAIL 3 - HINGE DETAILS
#5 pull box (12" min pigtail of each cable inside box)

#2/0 AWG type THW copper cable to backwall

#2/0 AWG type THW copper wire cable to abut diaphragm

#9 Rebar, transverse collector bar in abut diaphragm, full width of bridge.

#9 Rebar, transverse collector bar in abut diaphragm, full width of bridge. See detail 1 and section C. Weld to all backwall exterior face vertical rebar within LRT trackway width.

Detail 4A1-Typical Abutment Plan

Decal No. 74.01 (3/90)
All approach slap tie rods shall be epoxy coated.

For connection details of copper wire cables see Detail 2.

Horizontal steel shall not be installed before membrane is in place.

Vertical limits of membrane insulation, horizontal limits are full width of bridge.

Note: Only high density mortar round blocks permitted in wall, footing, concrete piles and wingwalls.

6"x2" slot in expanded polystyrene to allow for bridge movement

Seal hole in membrane with one component sealer.

Seal hole in tape.

tape

expanded polystyrene

Seal hole in membrane with one component sealer.

membrane insulation

hardboard

Limits of sealing tape 2" outside of slot.

3/4 x 1" x 7" hardboard drill hole for wire.

DETAIL 4A2-ABUTMENT DETAILS
Seat Abutment Type with Backwall
(Offset backwall shown. Flush backwall details similar. Spread footing shown. Pile cap footing similar.)
0 Pull box (12" min pigtail of each cable inside box)

2/0 AWG Type THW copper cable to abut diaphragm.

9 Rebar, transverse collector bar in abut diaphragm, full width of bridge. See Detail 1 & Section C.

TYPICAL ABUTMENT PLAN

Approach slab tie rod (portion of rod in bridge) shall be epoxy coated the full width of the bridge. Horizontal rod shown. Vertical rod requirements similar.

9 Rebar, transverse collector bar. See Abut Plan. Weld to all diaphragm exterior face vertical rebar within LRT trackway width.

Limits of membrane insulation

9 Rebar, transverse collector bars. See Abut Plan.

Top longit. cont. bar, make Detail 1A connection to transverse collector bar.

6 Steel wire, weld to #9 transverse collector bars.

Copper cables. See Detail 2. Leave 1" min. slack at face of wall.

Membrane insulation on abut diaphragm surface for full width of bridge.

Note: Only high density mortar blocks permitted in wall, footing, concrete piles, and wingwalls.

C - ABUTMENT SECTION

DETAIL 4B - ABUTMENT DETAILS -

Diaphragm Type Abutment
Prestress bearing seat blockout
Top longit. cont. bar.
See Detail IA.

#9 Rebar, transverse collector bar, full width of bridge. See Detail I.

#6 steel collector wire, weld to #9 collector bar and to one prestress strand in each anchor plate.

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

4x4, W4.0 x W4.0 WWF shield. Place over prestress plates (may touch plates) and weld one wire to the #6 connector wire. WWF shield shall cover the full width of the blockout.

SIDE SECTION
END ELEVATION

DETAIL 5 - PRESTRESS TENDON CONNECTION
#9 transverse collector bar, place near C. bent, full width of bridge, connect all columns. See Detail I.

#6 Connector bar when 1'-0" column bars are hooked. Weld similar as Detail IA.

One main column rebar. Detail I - 3 welds required if lap splice permitted.

To top of column drain outlets or 6" min. above finish grade whichever is greater. Make exposed height uniform at each column in multi-column bents.

Coat all column concrete surfaces and exposed top of footing surfaces with membrane insulation. Apply joint sealant prior to membrane insulation.

Epoxy coat hinge vertical rebar. Contact to column cage rebar not permitted. Do not epoxy coat hinge spiral reinf. Provide spiral discontinuity in top of footing as shown elsewhere.

**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**
#9 transverse collector bar, place near C bent, full width of bridge, connect all columns. See Detail I.

One main column rebar. Weld similar as Detail IA.

Connector bar when 1'-0" column bars are hooked. Weld similar as Detail IA.

To top of column drain outlets or 6" min. above finish grade whichever is greater. Make exposed height uniform at each column in multi-column bents.

Coat all column concrete surfaces and exposed top of footing surfaces with membrane insulation.

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 NC. 77A (4/87)
#9 transverse collector bar, place near column, full width of bridge, connect all columns. See Detail I.

1'-0" #6 Connector bar when 1'-0" column bars are hooked. Weld similar as Detail I. A.

To top of column drain outlets or 6" min. above finish grade whichever is greater. Make exposed height uniform at each column in multi-column bents.

Coat all column concrete surfaces and exposed top of footing surfaces with membrane insulation.

6" concrete insulation course. Provide 1" depressed keys at top over 50% of the surface area.

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)
#9 transverse collector bar, place near \( \varphi \) bent, full width of bridge, connect all columns. See Detail I.

1'-0"

1'-0"

#6 Connector bar when 1'-0" column bars are hooked. Weld similar as Detail IA.

One main column rebar. Detail I - 2 welds required if lap splice permitted.

To top of column drain outlets or 6" min. above finish grade whichever is greater. Make exposed height uniform at each column in multi-column bents.

Coat all column concrete surfaces with membrane insulation. Apply joint sealant prior to membrane insulation.

**NOTES:**

Use Detail 9 - 5 for pile shaft rebar.

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

**DETAIL C**

**DETAIL 8 - HINGED COLUMN DETAILS, PILE SHAFT TYPE**
#9 transverse collector bar, place near % bent, full width of bridge, connect all columns. See Detail I.

1'-0" 

#6 Connector bar when 1'-0" column bars are hooked. Weld similar as Detail IA.

One main column rebar. Weld similar as Detail IA. If lap splice permitted.

To top of column drain outlets or 6" min. above finish grade whichever is greater. Make exposed height uniform at each column in multi-column bents.

Coat all column/pile shaft concrete surfaces with membrane insulation.

Only high density mortar blocks permitted in columns and piles.

Plastic bar end protector epoxy bonded to rebar bottom end.

DETAIL 9 - COLUMN DETAILS, PILE SHAFT TYPE
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.

DECK DRAIN ASSEMBLY

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

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.
One main column bar
(same bar as in column details)

column spiral reinf.

1" min cover
over rebar

Test Box:
4" x 4" x 1" deep formed
blockout. Form w/poly styrene
or non-metallic form box.
6" x 6" x 0.123" galv sheet metal
cover secured w/4 ea 1/4"
expansion anchorage devices
over neoprene gasket.
copper cable to rebar
connection see Detail 2

#12 - AWG Type THW copper
wire. Provide min. 12" long
pigtails inside test box

Finish grade ~

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 II - COLUMN TEST BOX
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
Epoxy coated reinforcing steel is required

24'-0"±
LRT travelway

20'-0"

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.

<table>
<thead>
<tr>
<th>PUR RR NO.</th>
<th>TITLE</th>
<th>ABBREVIATIONS</th>
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<td>1.</td>
<td>SOUTHERN PACIFIC TRANSPORTATION COMPANY</td>
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<td>2.</td>
<td>THE ATCHISON, TOPEKA AND SANTA FE RAILWAY COMPANY</td>
<td>AT&amp;SF Ry Co.</td>
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<tr>
<td>37.</td>
<td>PARR TERMINAL RAILROAD</td>
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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

Finish end of deck to 1" radius.

3 x 8 Treated DF, rough, Buffer

1/4" x 0.08" galv mach bolts with 2" square

1/4" galv plate washers @ 18" ctrs.

1/4" BUTYL MEMBRANE

SPT Co. and UPRR Co.

CONCRETE BALLAST TROUGH

Finish backwall flush with deck.

2 x 8 Treated DF, rough, Buffer

1/2" x 0.8" galv mach bolts with 2" square x 1/8" galv plate washers @ 18" ctrs.

1/4" BUTYL MEMBRANE

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

9'-0" Min. on tangent
10'-0" Min. on curves

Slope  
\[ \begin{align*}
&\text{Preferred} \\
&\text{Maximum}
\end{align*} \]

For shallow girders

For normal use

CONCRETE BALLAST TROUGH
For normal use

Typical Half Section
THROUGH PLATE GIRDER - STEEL BALLAST TROUGH
S.P.T. CO. REQUIREMENTS

9'-0" Min. on tangent
10'-0" Min. on curves

8'-0" Min. on tangent
9'-0" Min. on curves

Assume 8" if size of rail and tie plate not shown.

Top of rail

1'-3" Min. Ballast

STEEL BALLAST TROUGH
For minimum structure depth

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. B-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
LIMITING DIMENSIONS:

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

Flange overhang
- D1 ≥ 8" but 2'-6" min.
- D2 ≥ 0.67 D1 but 1'-9" min.

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

\( \Theta \) AT & SF requires for continuous spans but not simple spans.

\( \Theta \) ASPHALTIC COVER PANELS

\( \Theta \) 1/16" Butyl membrane
Through Plate Girder
Walk Plate Details

Part Plan of Walk Plate

Detailer:
It is difficult or impossible to place a single length of deck plate between two Type "A" brackets. Walk plates should be made in two sections and supported by a Type "B" bracket between Type "A" brackets.
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: \( f_s = 24,000 \text{ psi}, \text{ except} \)

20,000 psi in transverse deck
slabs and stirrups

\( f_c = 1,300 \text{ psi}, \text{ except} \)

1,200 psi in transverse deck
slabs

\[ n = 10 \]

PRESTRESSED
CONCRETE: See 'Prestressing Notes'

STRUCTURAL
STEEL: \( f_s = 20,000 \text{ psi} \)

FOOTING
PRESSURE: (Tons Per Square Foot)

ALLOWABLE DESIGN