

# Slauson Ave Bridge over San Gabriel River Modifications for addition of third rail - *Constructability Review Benefits* -

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Special thank to:

Caltrans

BNSF Railway

Hansen and Wilson

County of Los Angeles

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# Modification Locations



# Modifications to Piers and Abutment Embankment



# Project Timeline

1995 - Seismic Retrofit (pending construction)

2003 - 2013  
Third Rail Project

2003  
Initial  
Design

2005  
Constructability  
Review

2007  
Revised  
Design

2013  
Construction  
Completed



1995

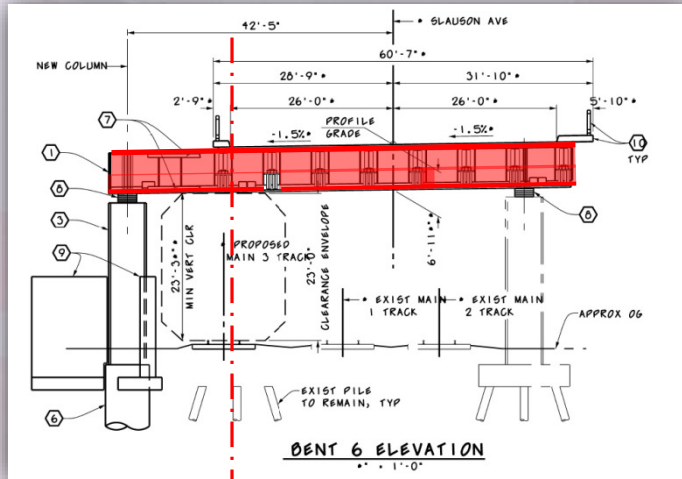
2003

2013

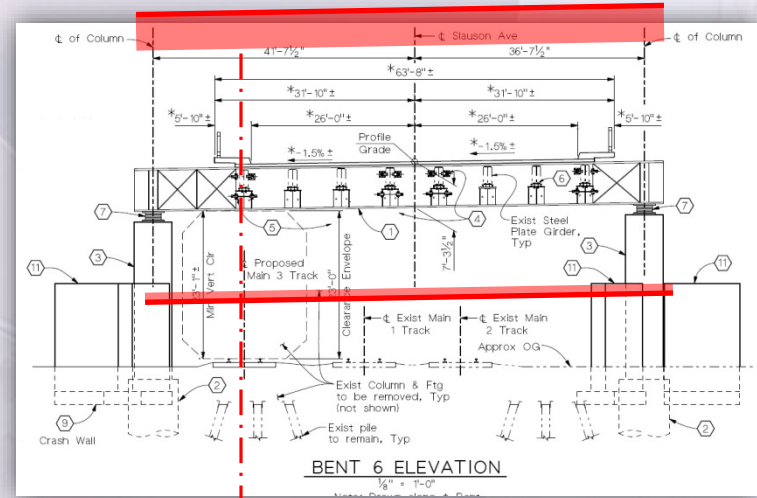
# Pier 6 - Constructability Review

## Original Concept

### Demolition

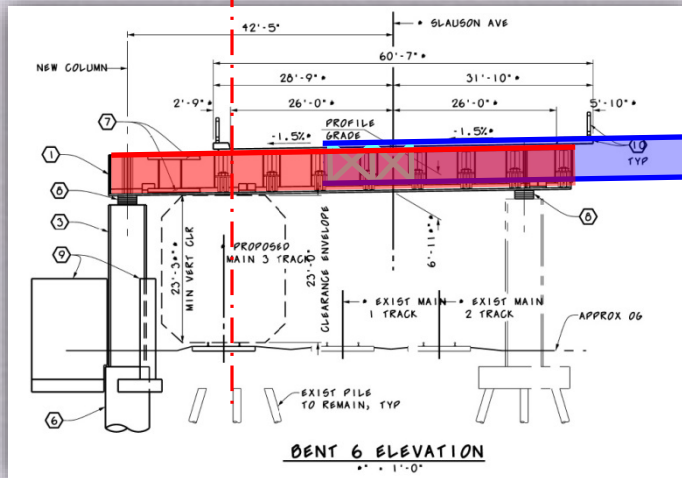


### Construction

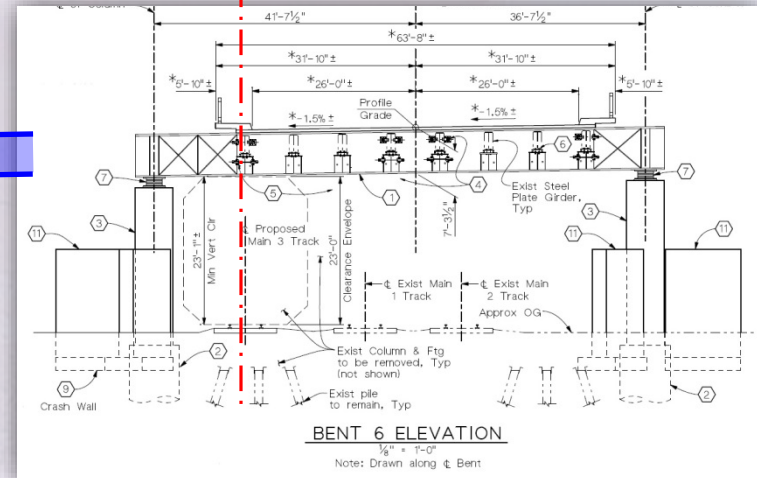


## Revised Concept

### Demolition



### Construction



# Pier 6 – Original Steel Cap Beam



# Pier 6 – Original Steel Cap Beam



# Pier 6 – Original Steel Cap Beam Girder Pedestals – 8 each side of cap





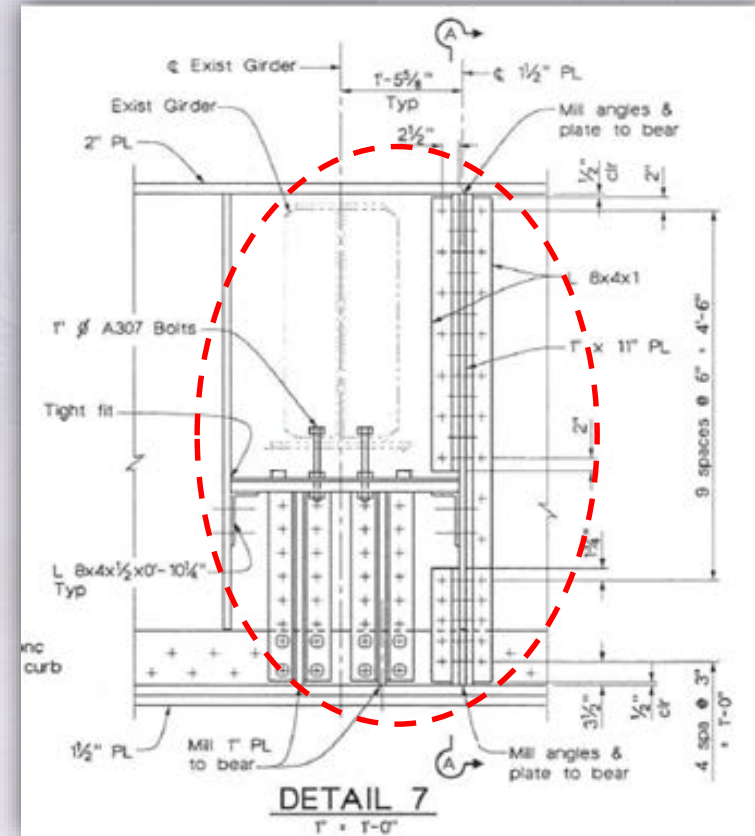
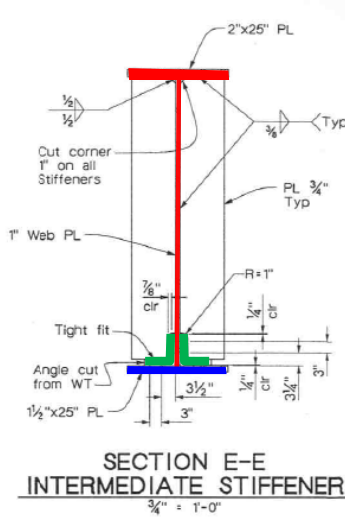
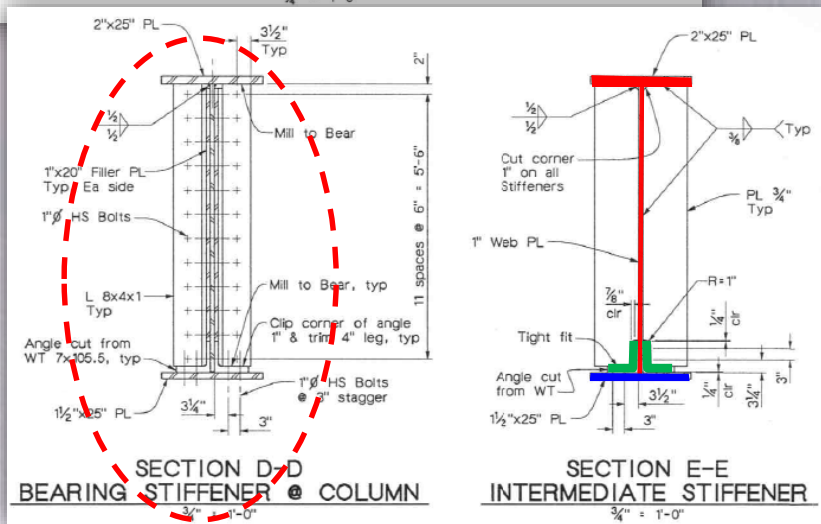
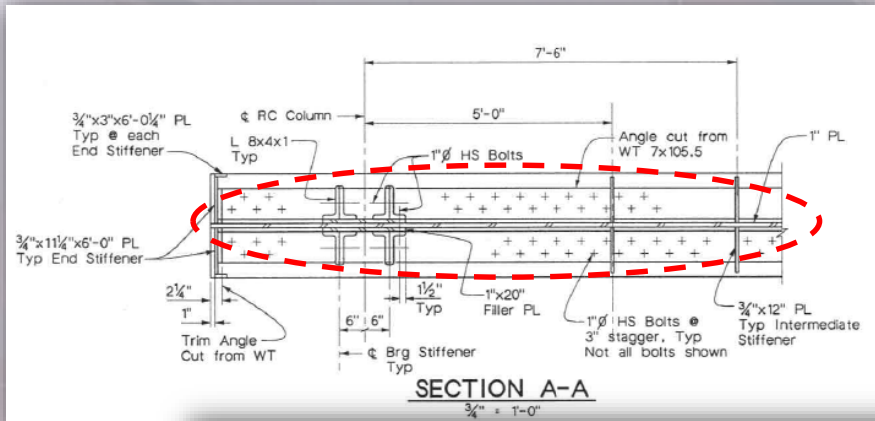
# New Cap Beam Installed (existing deck steel inadvertently removed)



# Pier 6 - Removal of Steel Bent Cap



# Bent 6 Steel Cap Beam (initial replacement details)



**4,000 1" HS Bolts**  
**150 hrs. of labor**

# Preparing for Installation of New Steel Cap Beam

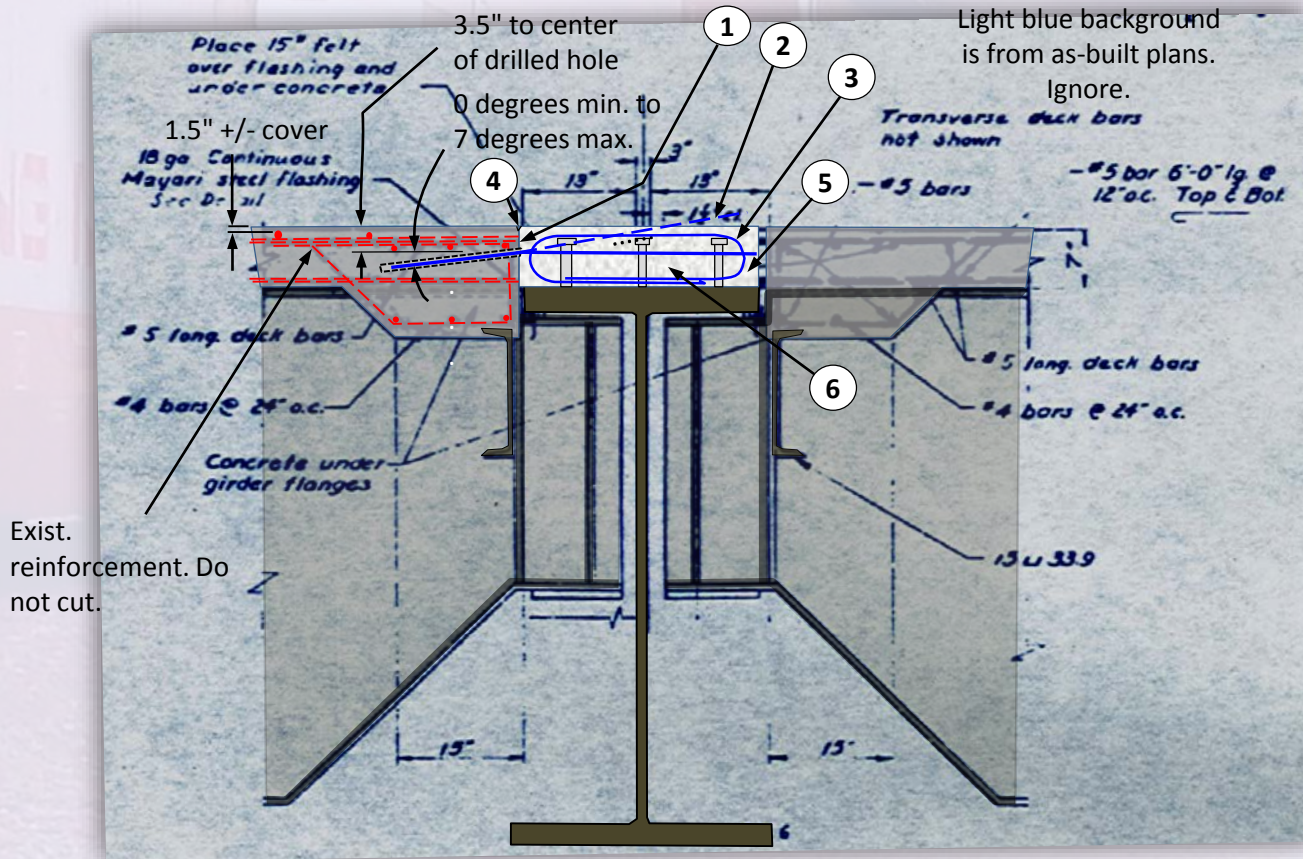



# Bent 6 Replacement of Steel Cap Beam During Single Night Closure



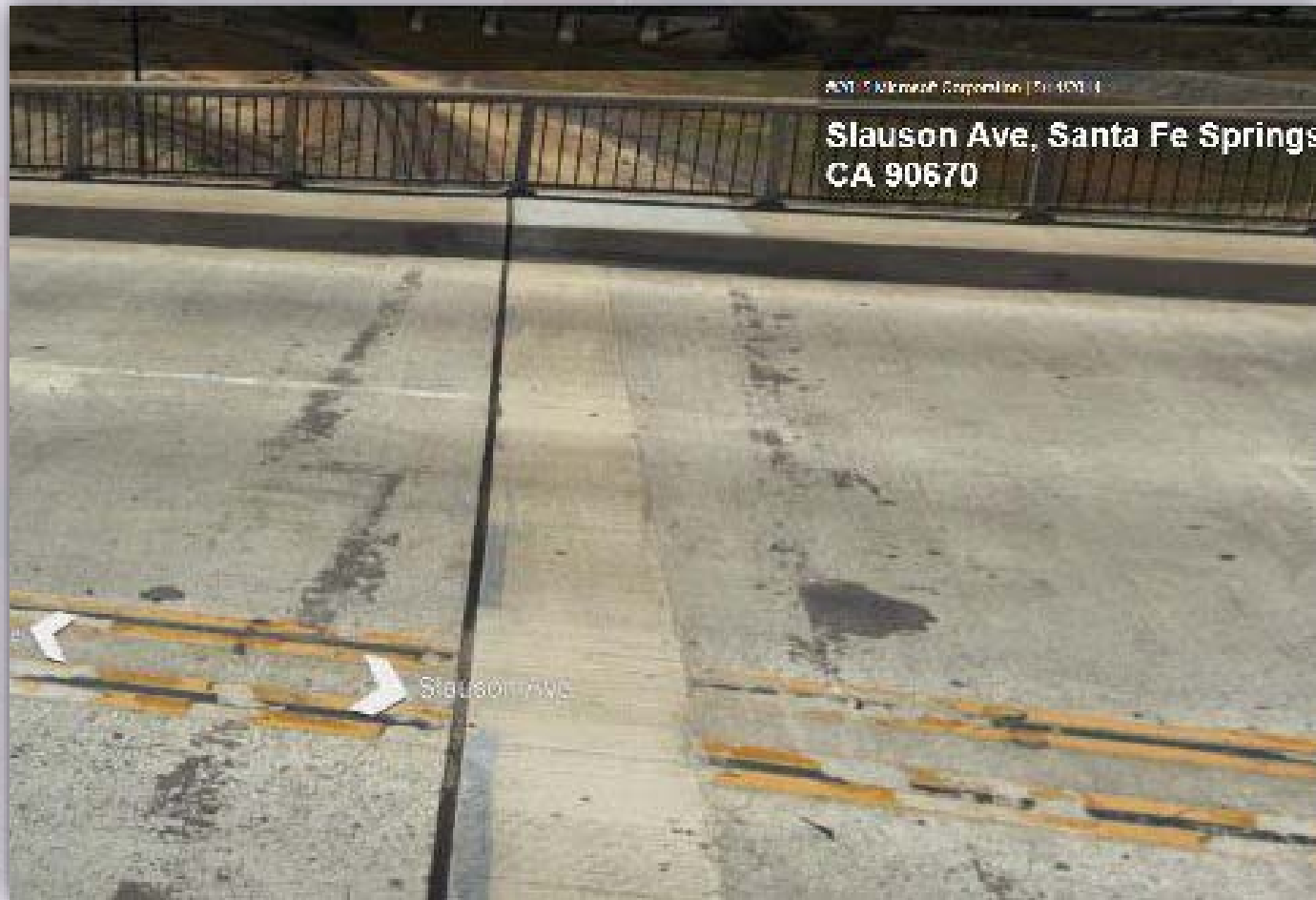
# Deck Closure

## (Drill and epoxy bond new bars)



- 1 Roughen face of existing deck to 1/4" min. amplitude.
- 2 Drill and epoxy bond #6 galvanized dowel @ 6" c-c into 11" deep hole. Use Simpson SET epoxy. Prebend bar or bend into closure pour after epoxy is fully cured. Alternative: use 3/4" diameter HS rod, Fy = 60ksi min.
- 3 #5  @ 12" per project plans
- 4 If directed by the Engineer, sawcut 1/4" +/- "V" groove after closure pour concrete has cured.
- 5 Closure pour concrete, see Submittal 16.
- 6 New transverse reinforcement not shown, see project plans.

# Closure Pour Completed (including restored sidewalks and railing)



# Pier 6 – New Steel Cap Beam in Place





# Bent 6 New Steel Cap Beam with Seismic Isolation Bearings, Cap to Girder Struts for Stabilization, End of Cap Beam "X" Stiffeners for Rotation Reduction



**Struts**

**"X" Stiffeners**

**Seismic Isolation Bearings**

# Pier 6 – Struts used for Stability

(locking west side girders to cap +  
reducing rotation along cap axis)



# Pier 6 – Struts used for Stability

(locking west side girders to cap +  
reducing rotation along cap axis)



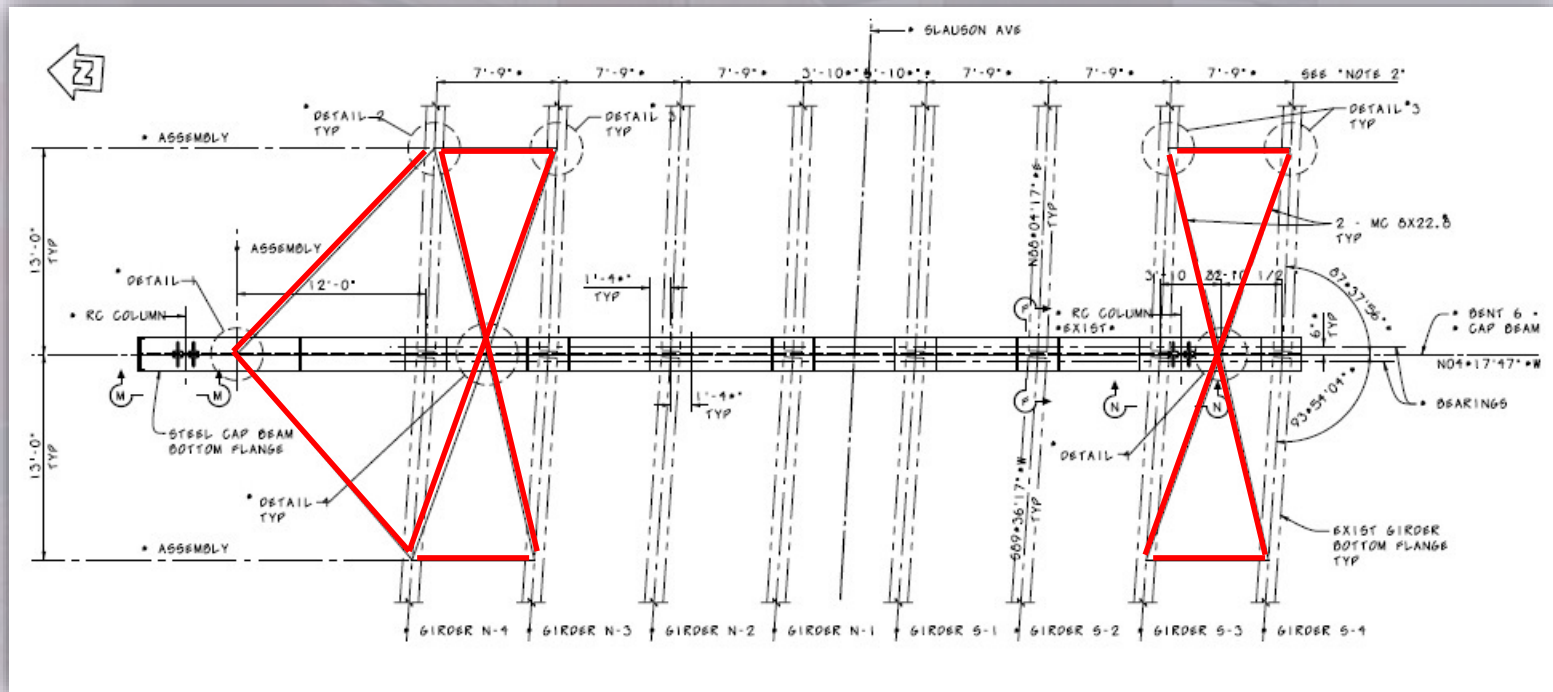
# Pier 6 – Struts used for Stability

(locking west side girders to cap +  
reducing rotation along cap axis)



# Pier 6 – Original Plan for Stability

(Lateral cross bracing top and bottom)

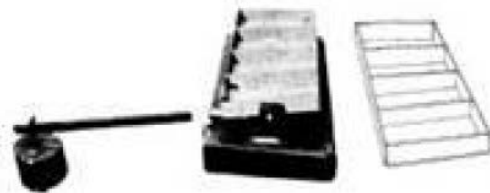


Steel angle bracing, connecting girder and cap beam flanges, both top and bottom.

# O.W.Blodgett

## “X” Stiffeners to Reduce Axial Rotation

Cross  
bracing



No  
bracing



Diagonal  
bracing



(Source: Design of Weldments, Blodgett,  
O. W)

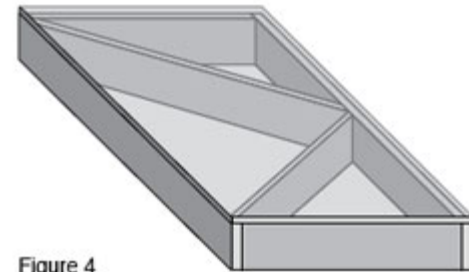
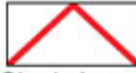



Figure 4

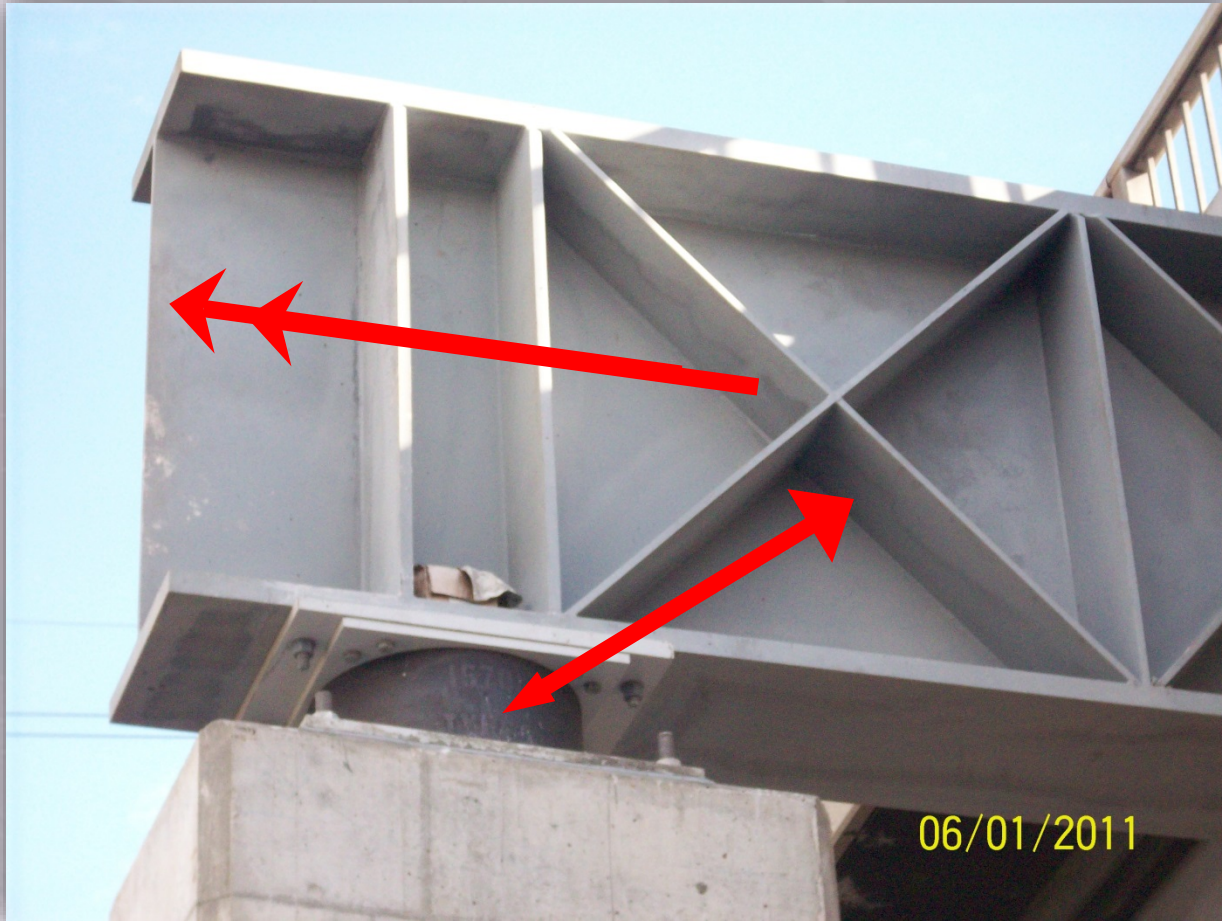
Table 1

 Single brace	$R = 3.54 I$
 Double brace	$R = 10.6 I$

$I$  = moment of inertia of brace

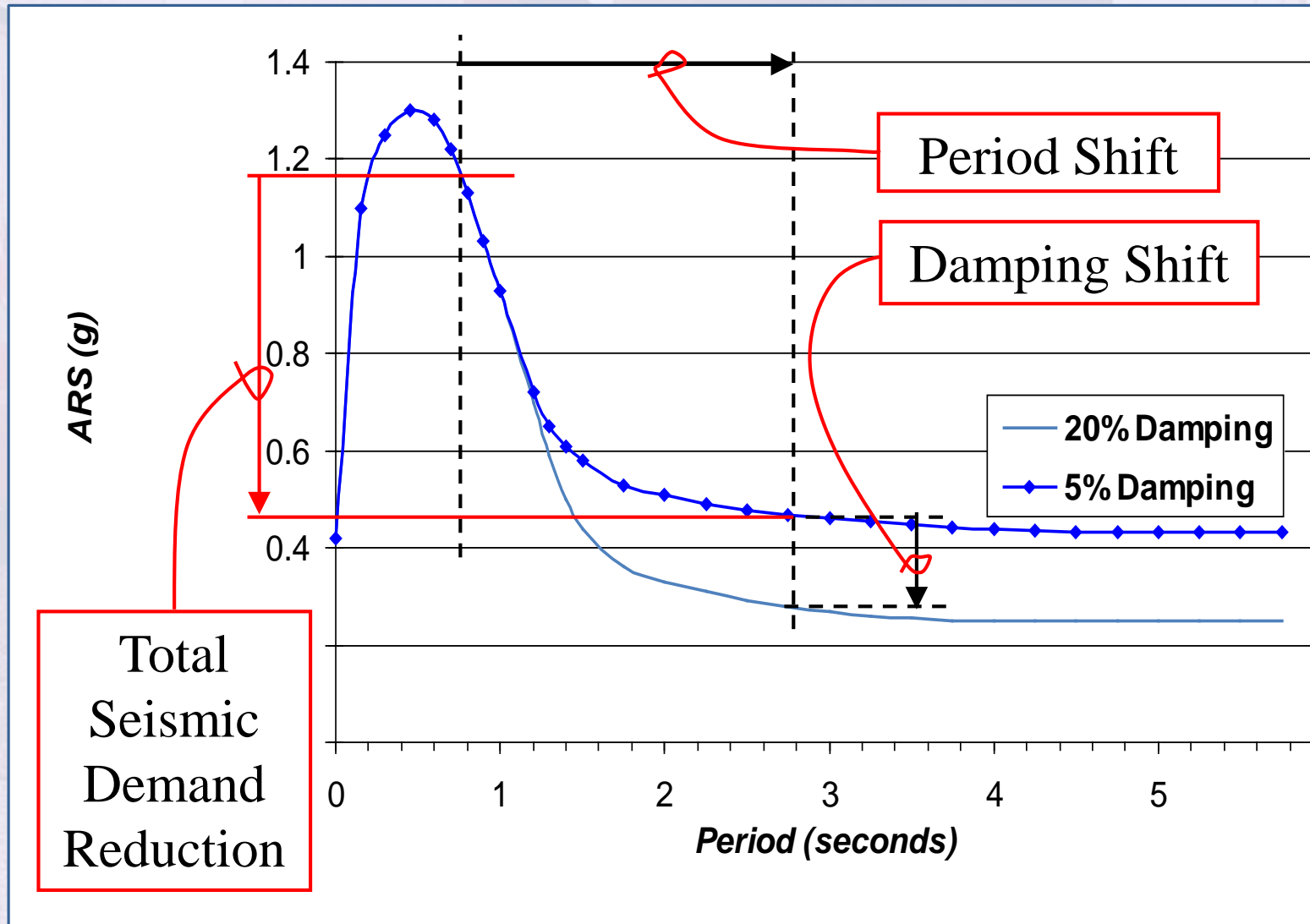
# Pier 6

## “X” Stiffeners to Reduce Axial Rotation



Reduced rotation from 6.0 Degrees to 0.5 Degree at maximum EQ force delivered from Bearing

# Seismic Isolation Bearing Benefits in Reducing Seismic Demand





# Seismic Isolation Bearing

Friction Pendulum Type -  
disassembled to show inner  
Concave Slider Bearing



Lead Core Elastomeric  
Type Cross section to show  
inner lead core



# Seismic Isolation Bearing

## Lead Core Rubber



# PTFE Bearings

(Supporting girder ends on new steel cap)



**12 inch longitudinal  
movement capacity**



# PTFE Bearings

(Supporting girder ends on new steel cap)



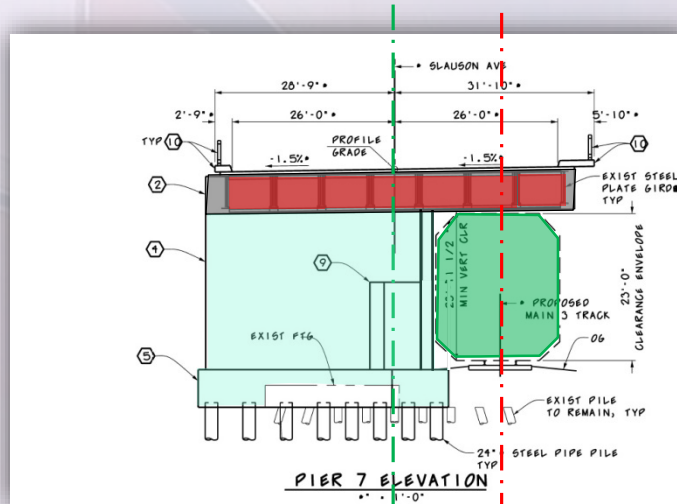
# Existing External Cap

to be Replaced by Cantilevered Internal Cap

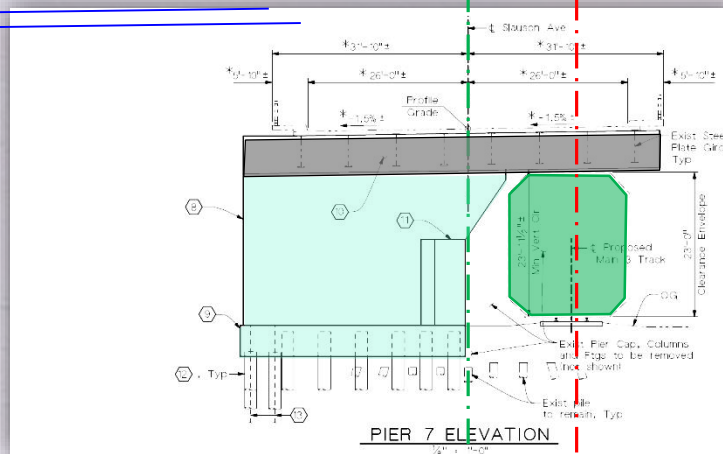


# Pier 7 - Constructability Review

## Original Concept Construction

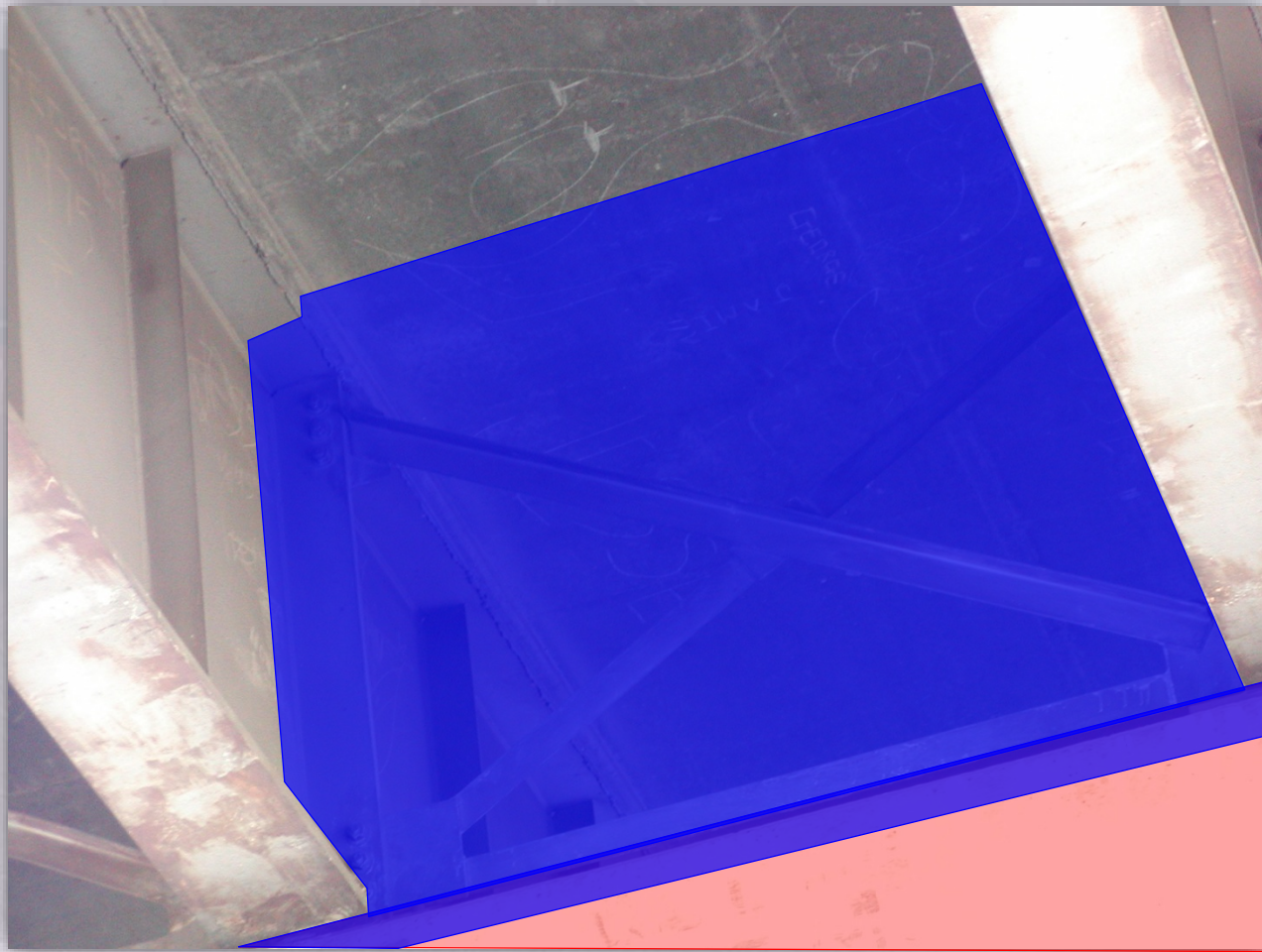


## Revised Concept Construction



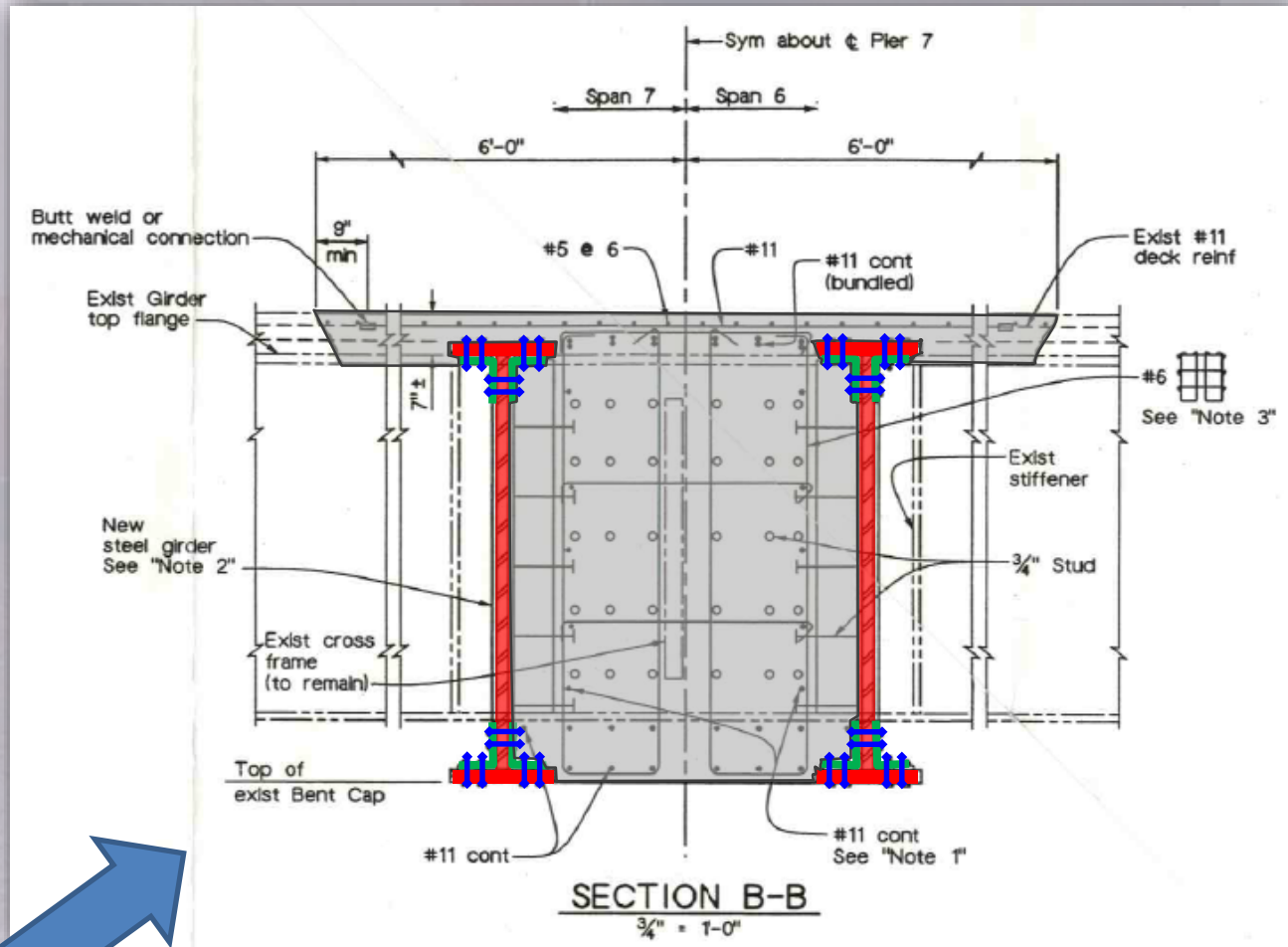
# Existing External Cap

to be Replaced by Cantilevered Internal Cap





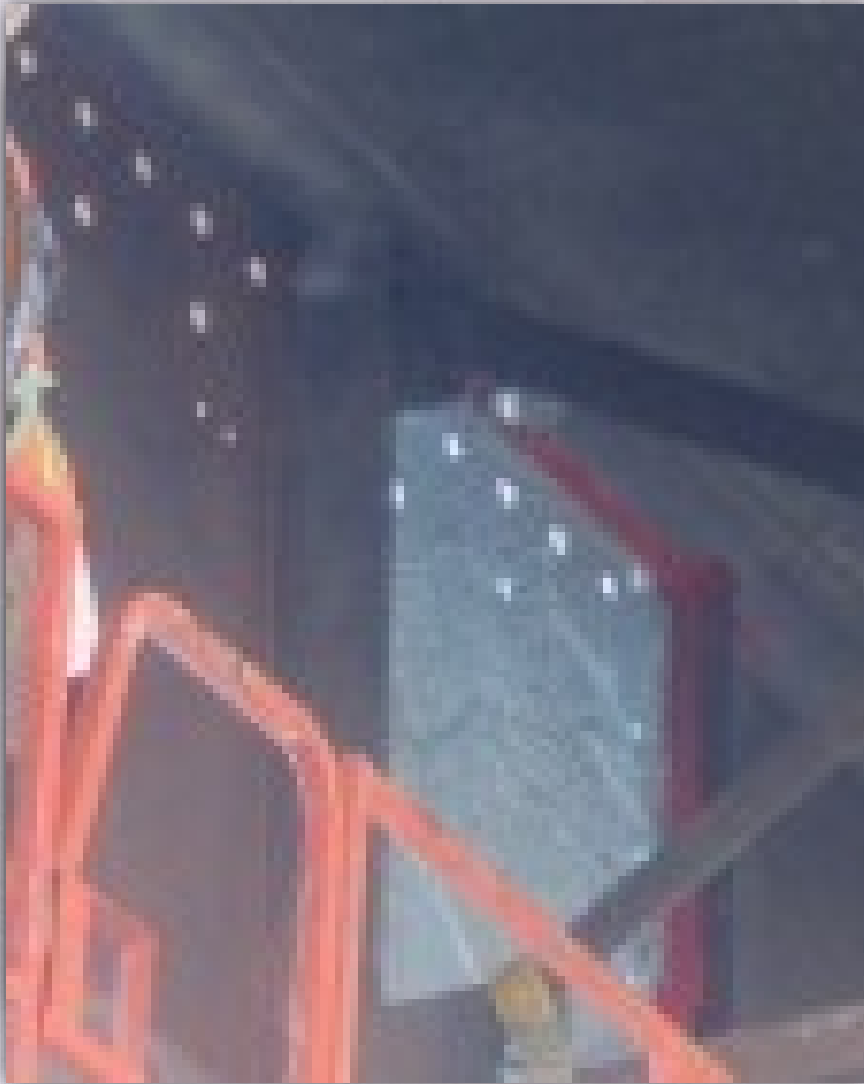
# Bent 7 Replace External Cap w/ Internal Cap (initial replacement details)





# Pier 7 – New Internal Bent Cap

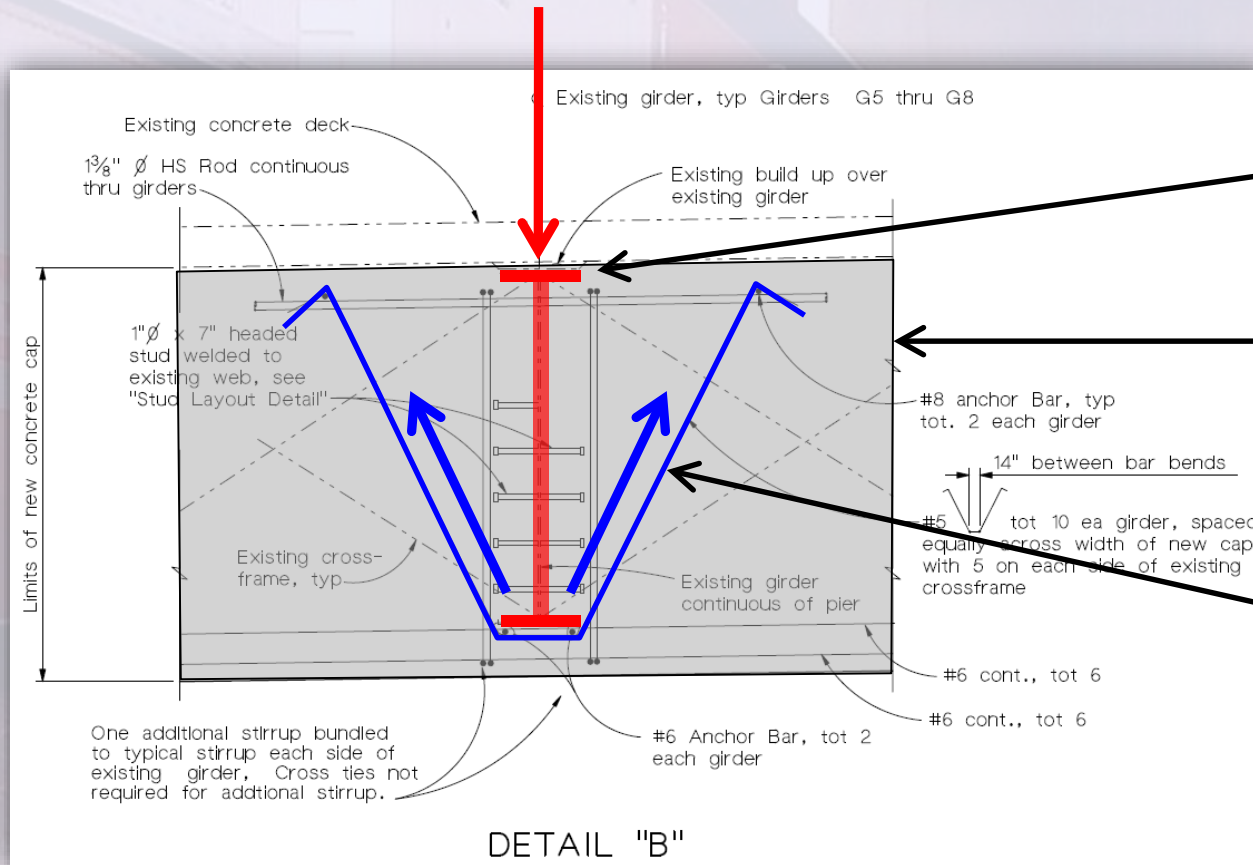
(Drilled holes through steel girder webs for HS rod placement)



# Pier 7 - Continuous HS rods (installed through all 8 steel girders)



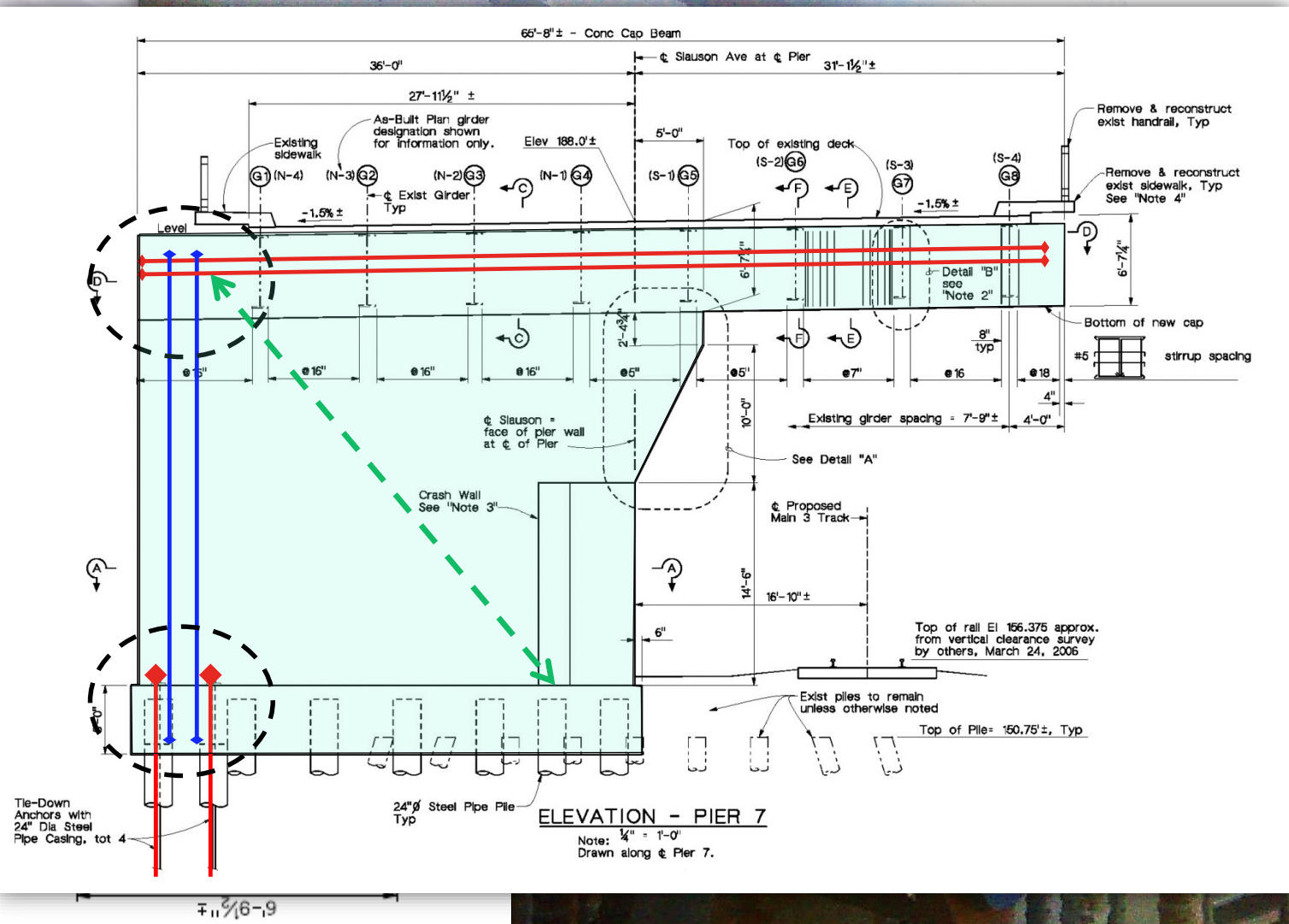
# Pier 7 – Transfer Reinforcement (to transfer girder forces into new cap Beam)



- **Exist Steel Girders**
- **New Internal Concrete Cap Beam**
- **“Hanger” Steel to Transfer Girder Vertical Forces into New Cap Beam**

# Pier 7 - Continuous HS rods (Ends – crossing with vertical hold down strut)

← HS Rods Group



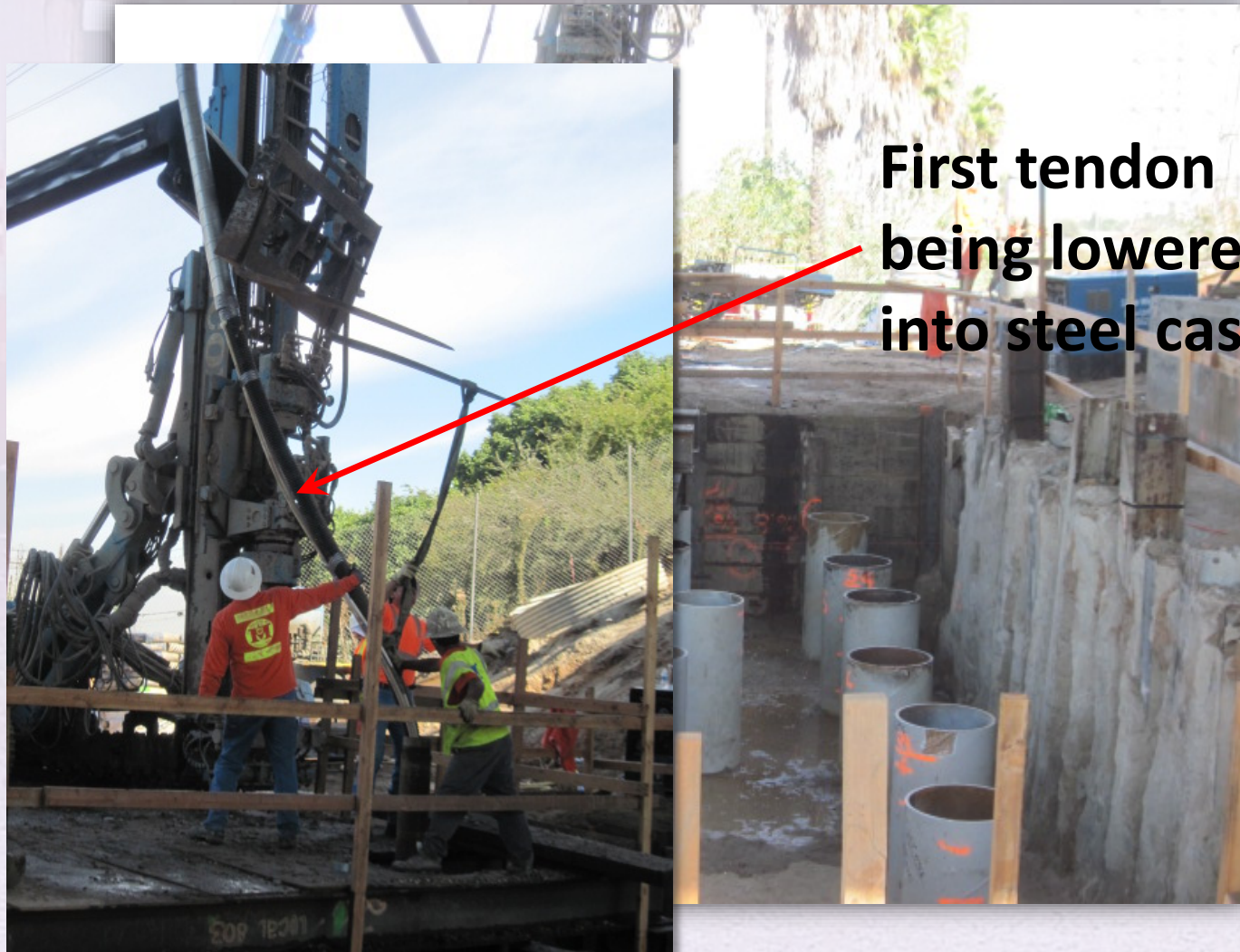
# Pier 7 – Pipe piles

(Extended into footing for full fixity)



# Pier 7 – Tie down anchors

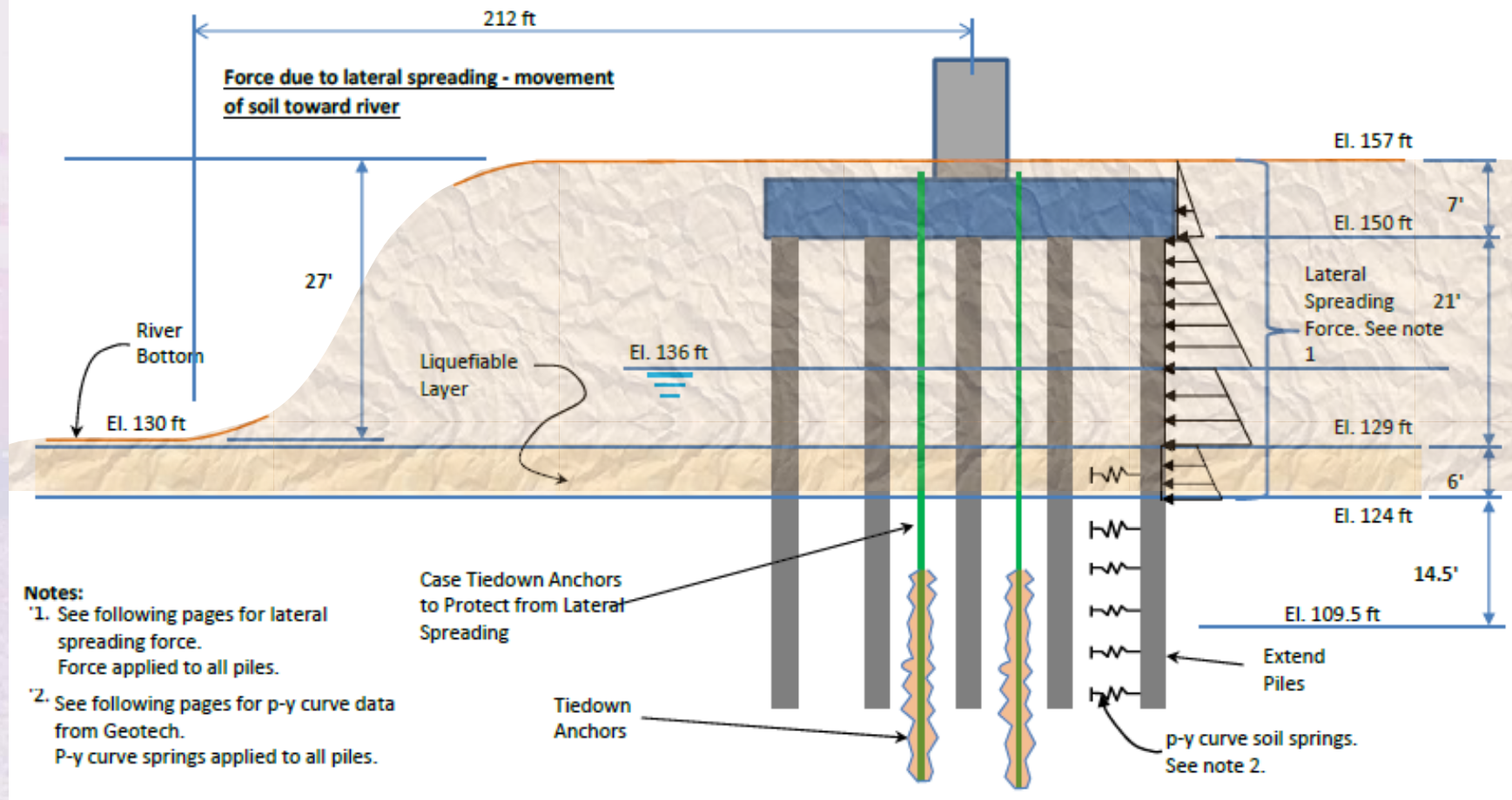
(Effective continuation of vertical tension strut - HS rods - from new internal cap beam)



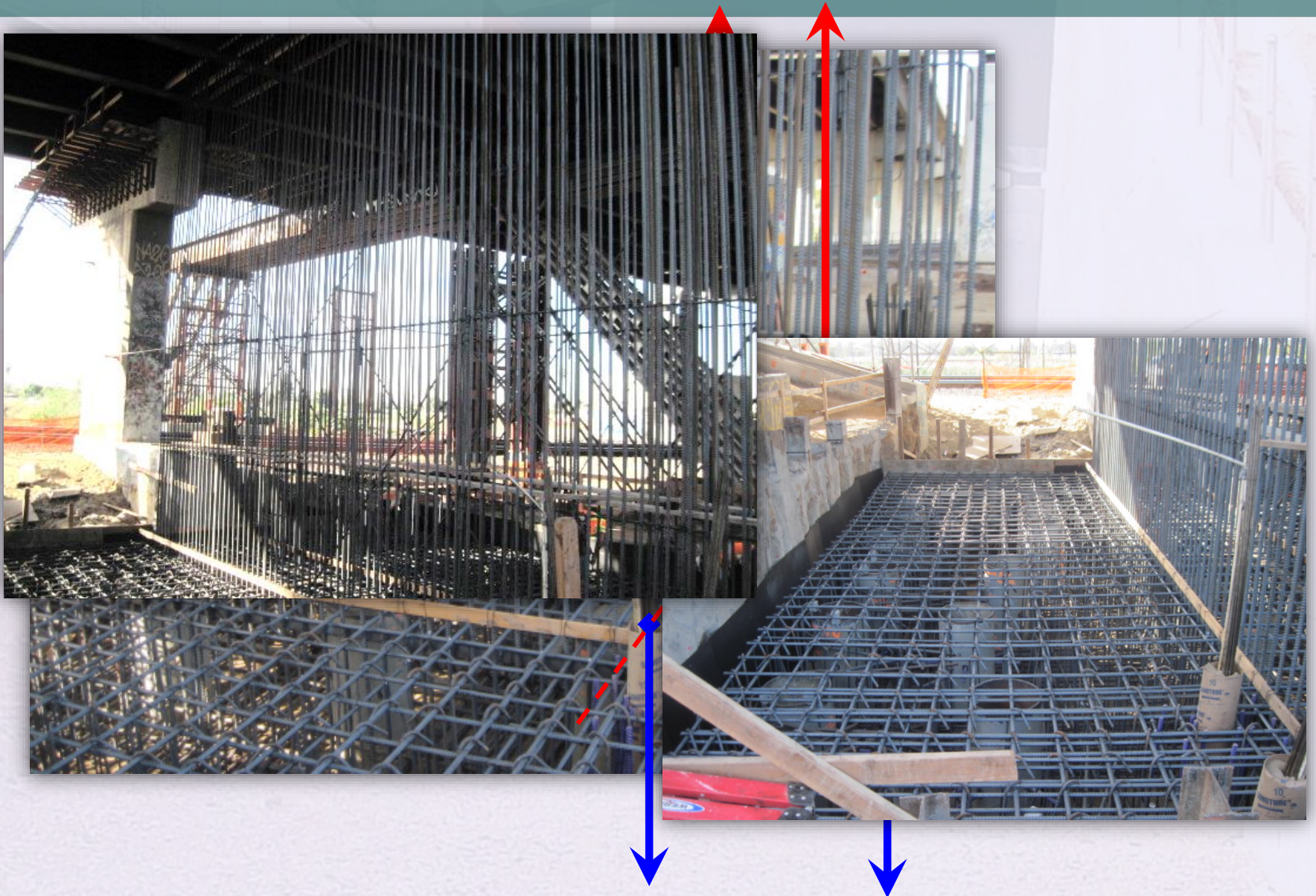
**First tendon  
being lowered  
into steel casing**



# Pier 7 - Pipe Pile Foundation Designed to Resist Lateral Spreading Forces Including Protection of Tie-Down Anchors

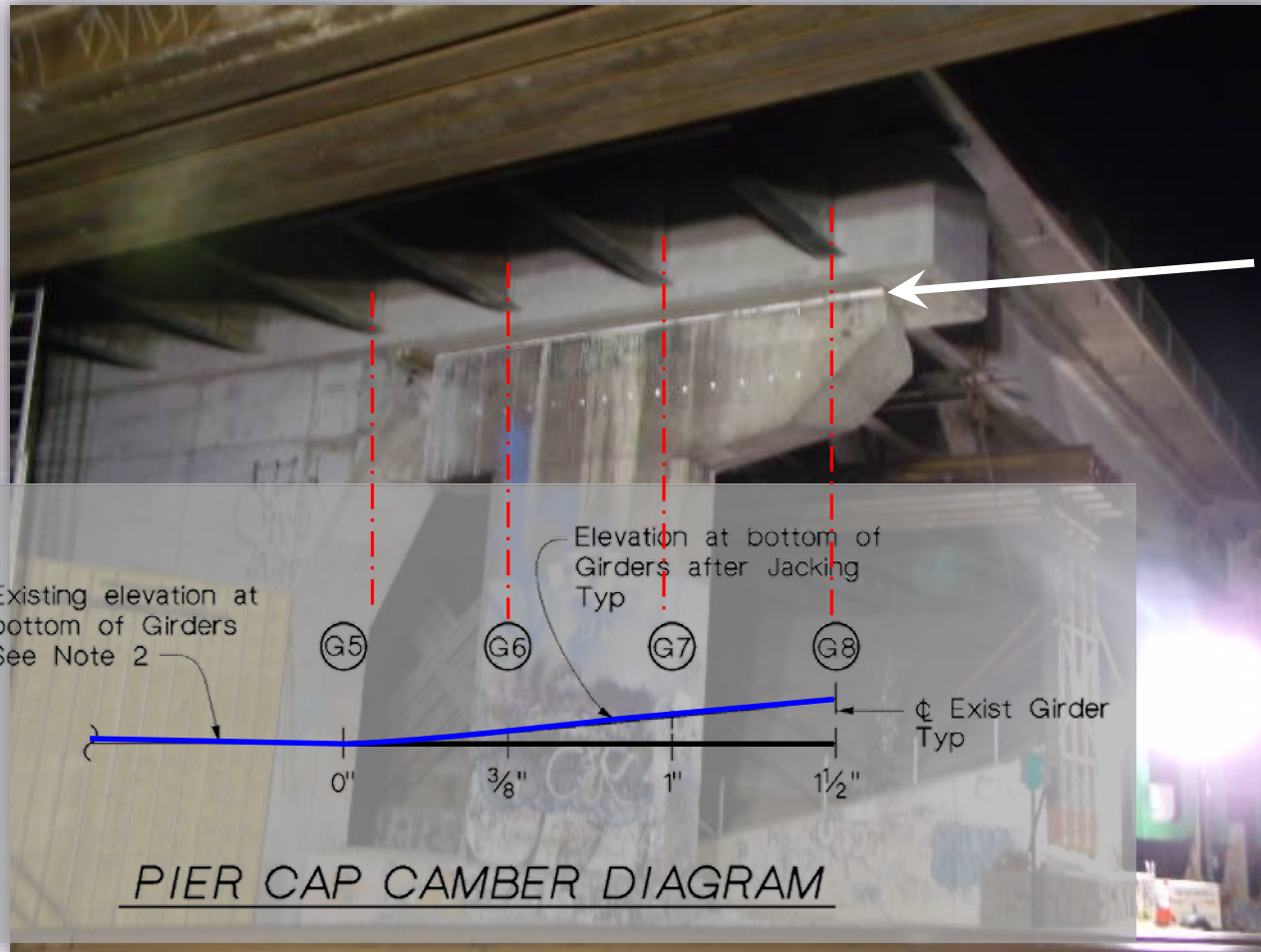


# Pier 7 – Highly reinforced



# Pier 7 – nearly complete

(Half of original 2 column Pier used for temporary construction support)



- **Camber Strip**
- **Initial + Long Term DL Deflection**

# Pier 7 – complete ( 32 foot cantilever)



# Summary

	Original Concept	Revised Concept
<b><u>Cost (of Construction)</u></b>	\$6.4 million	<b>\$3.4 million</b>
<b><u>Risk (to cost &amp; schedule)</u></b>	High	<b>Low</b>
<b><u>Safety (during construction)</u></b>	Of higher concern	<b>Improved</b> - Reduced hours worked over highly active rails
<b><u>Performance (life cycle)</u></b>	High maintenance	<b>Reduced</b> maintenance
<b><u>Architecture (“cleaner look”)</u></b>	Looks like a modification	<b>Cleaner Look</b> - Looks less like a modification

Slauson Ave Bridge over San Gabriel River  
Modifications for addition of third rail  
*- Constructability Review Benefits -*

Thank You

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