

# SFOBB-East Span Seismic Safety Project November 9, 2005



# SFOBB East Span Seismic Safety Project



# San Francisco-Oakland Bay Bridge East Span Seismic Safety Project



Pier E9 Following the  
1989 Loma Prieta Earthquake

# Project History

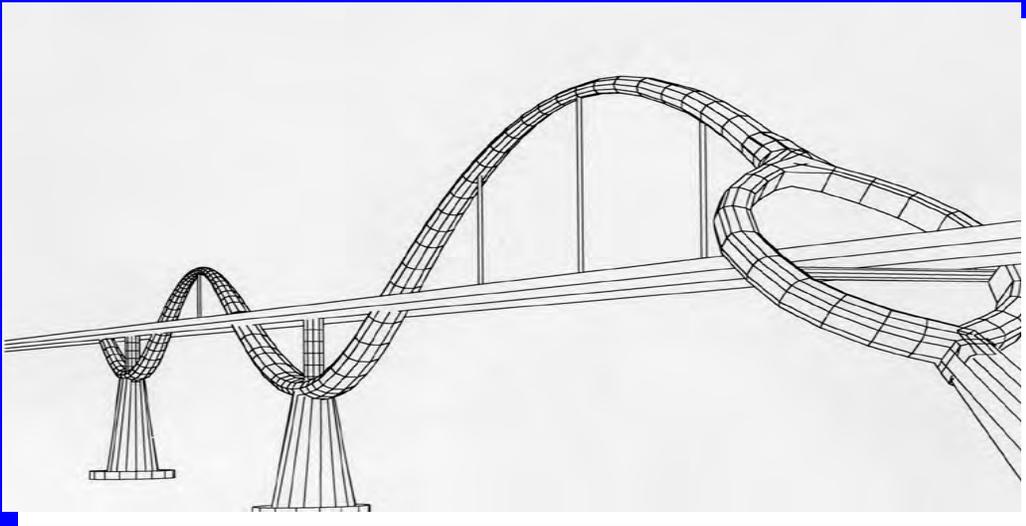
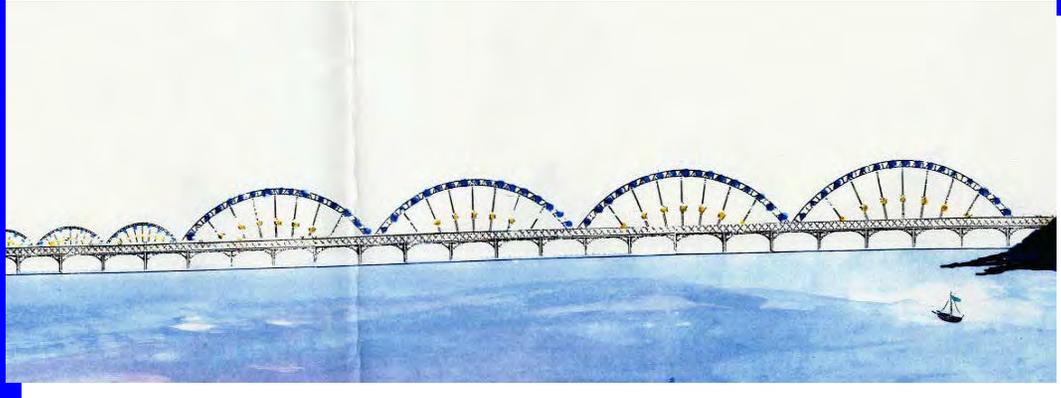


*“The existing eastern span of the Bay Bridge should not be retrofitted, but replaced with a new structure.”*

*“The new eastern span and existing western span should be designed to provide post-earthquake lifeline service.”*

*-- MTC Engineering and Design Advisory Panel*

# Proposed Design



# Self Anchored Suspension Span (SAS)



# San Francisco-Oakland Bay Bridge East Span Replacement Project Limits



# SFOBB East Span (16 Contracts)



## Projects in Construction

- Skyway (75%)
- South/South Detour (20%)
- SAS Marine Foundation E2/T1 (20%)

## Pending

- Connector Span (SAS)

## Projects in Design

- YBI Transition Structure
- Oakland Touchdown
- Storm water Treatment Measures (BMP)
- Existing Bridge Demolition

## Completed:

- Seismic Retrofit Contract 1
- Interim Retrofit
- Pile Installation
- Midden I
- Oakland Geofill
- USCG Road Relocation
- SAS Land Foundation W2
- YBI Electrical Substation

**Skyway**  
(\$1.04 Billion)

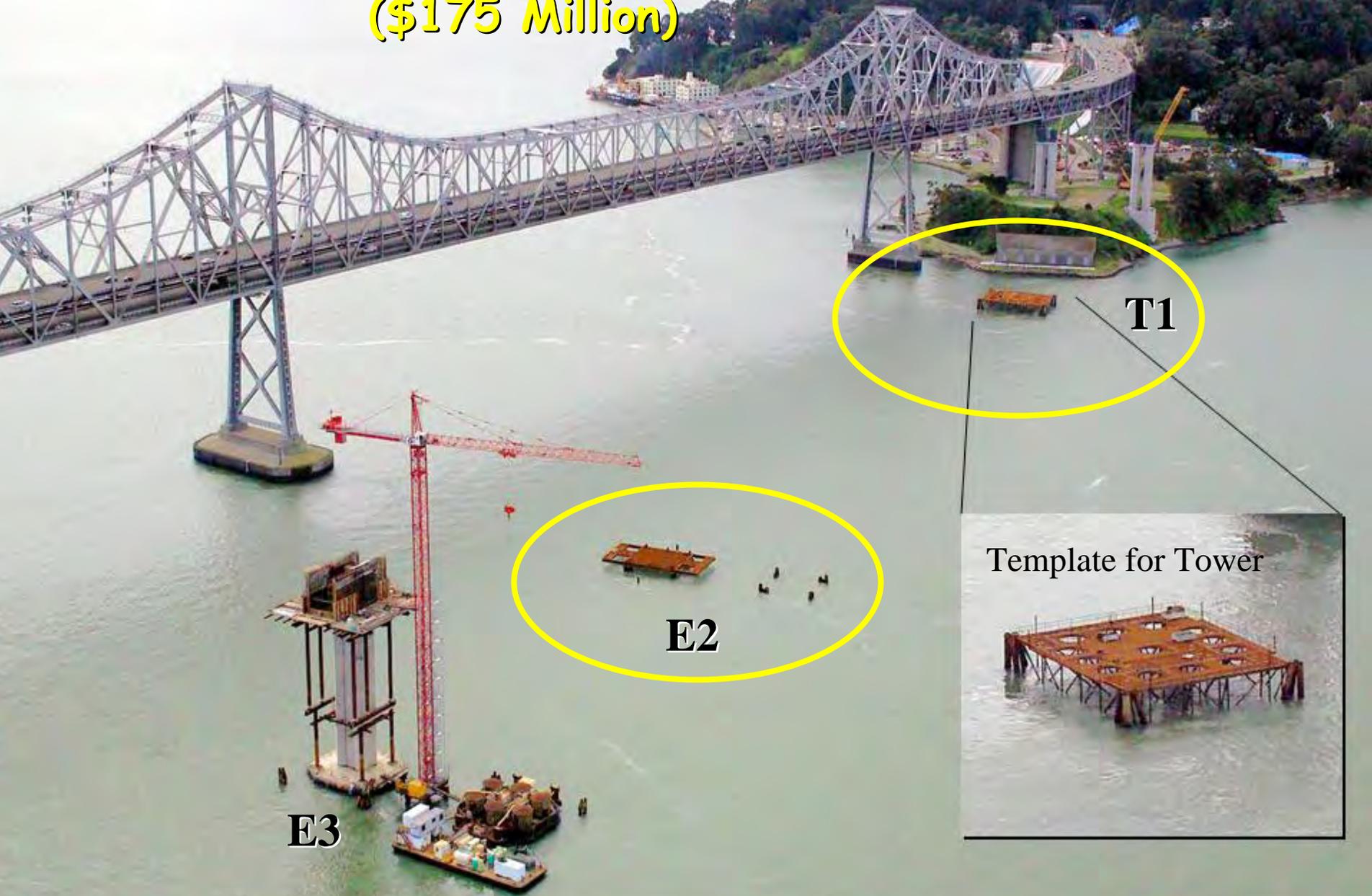
**Self Anchored  
Suspension Span  
Structure (SAS)**  
(Est. \$1.4 Billion)

**W2 Contract**  
(\$20 Million)



# SAS Foundations (E2-T1)

(\$175 Million)



**T1**

**E2**

**E3**

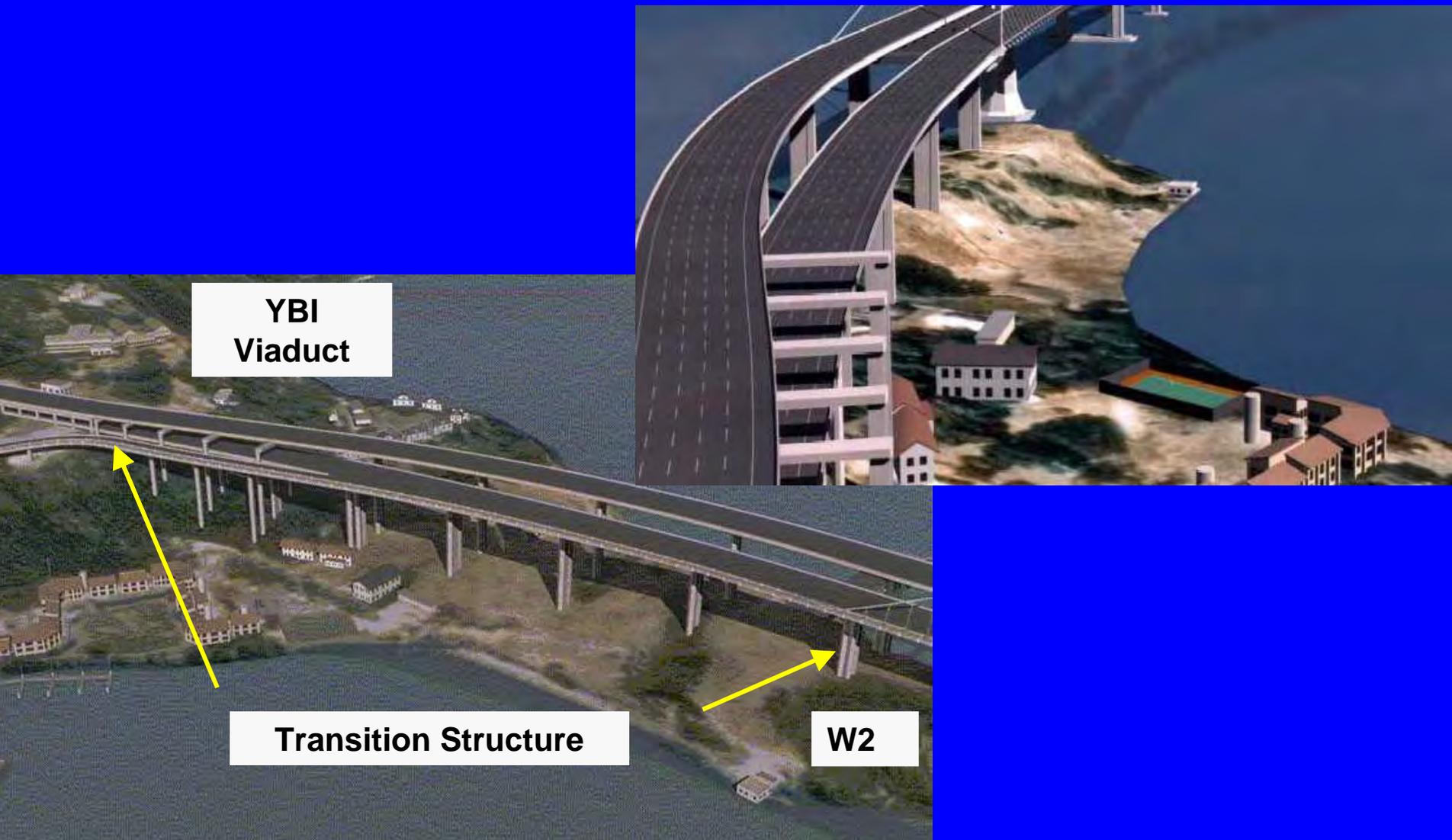
Template for Tower



# Temporary Bypass Structure



# YBI Transition Structure

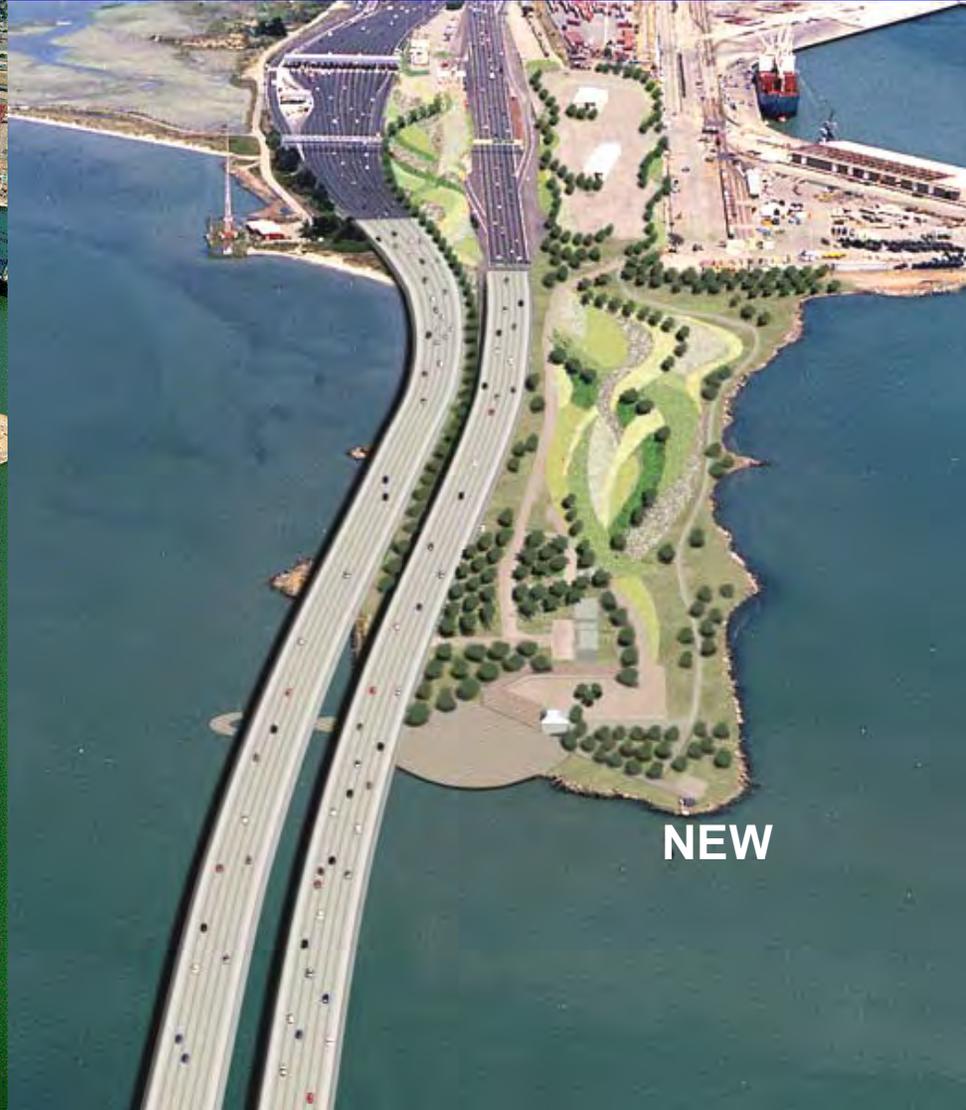


**YBI  
Viaduct**

**Transition Structure**

**W2**

# Oakland Touchdown Structures



# Skyway Structure



04-012024

Contractor: KFM - JV

Bid Price: \$1.04 Billion

First Working Day: Feb 6, 2002

75% Work Complete

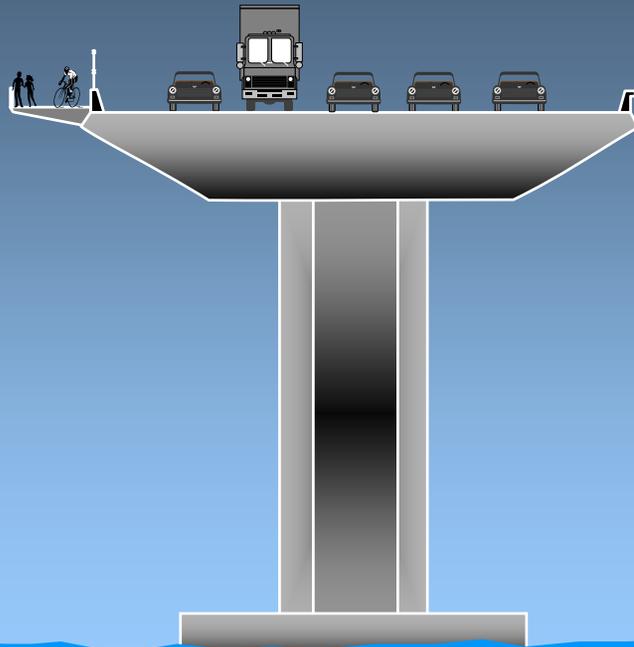
Est. Completion Date: Spring '07

# Skyway Structures

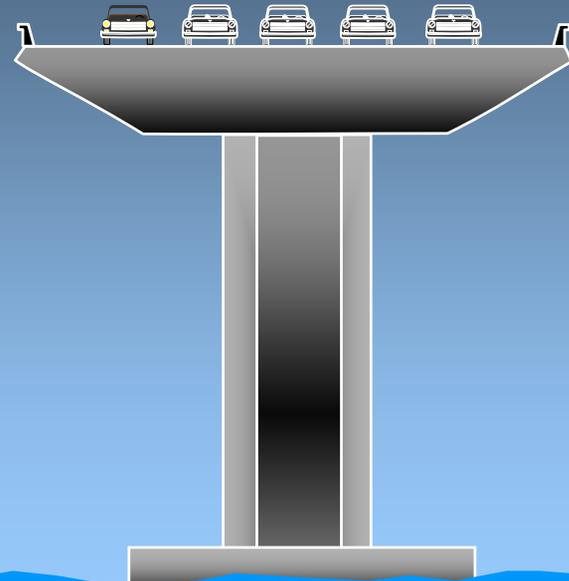


- Two 2.1 km long parallel structures
- 14 piers per structure
- Four rigid frames per structure
- Superstructure Segments erected - balanced cantilever Construction

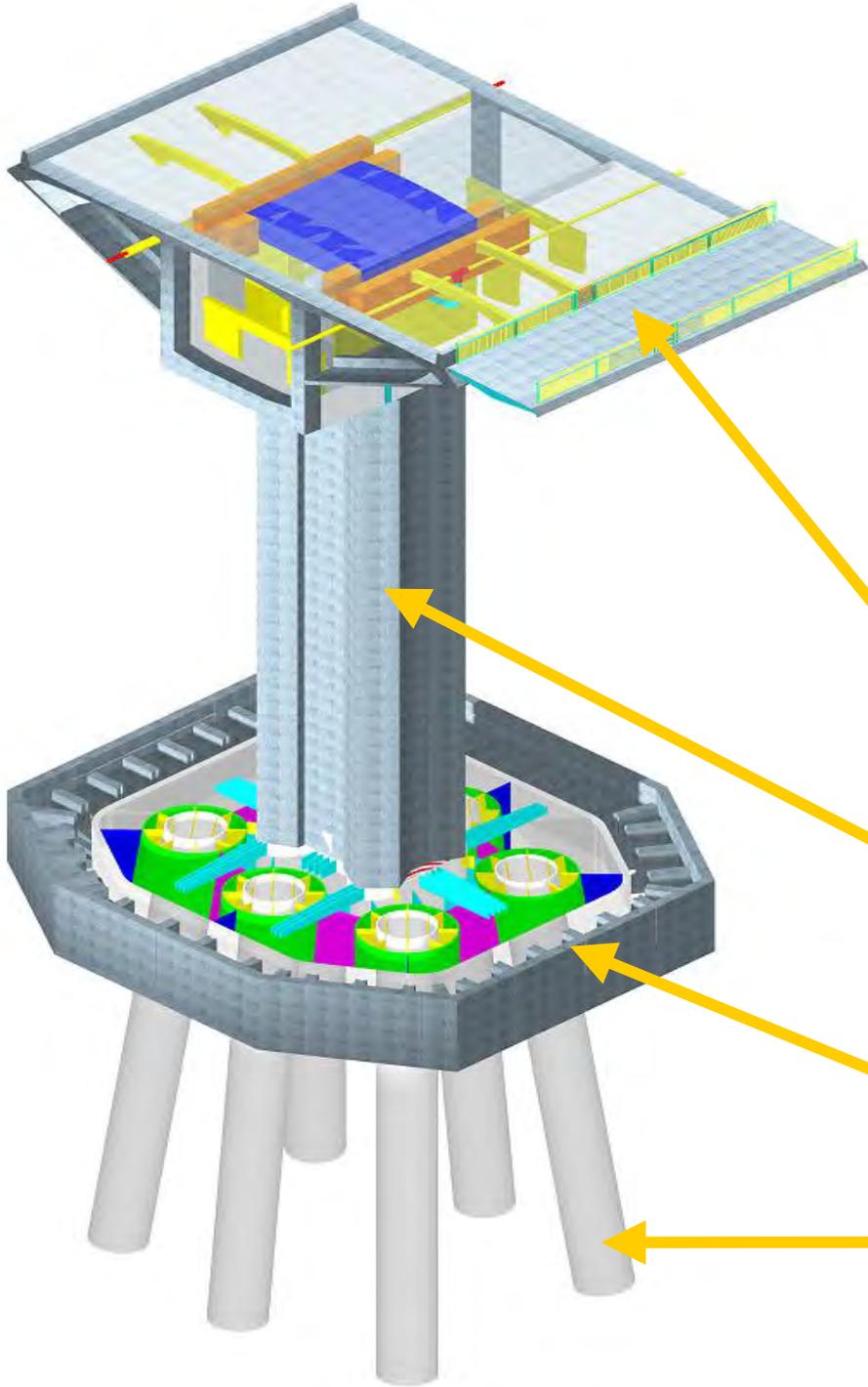
# Skyway Cross Section



Eastbound



Westbound



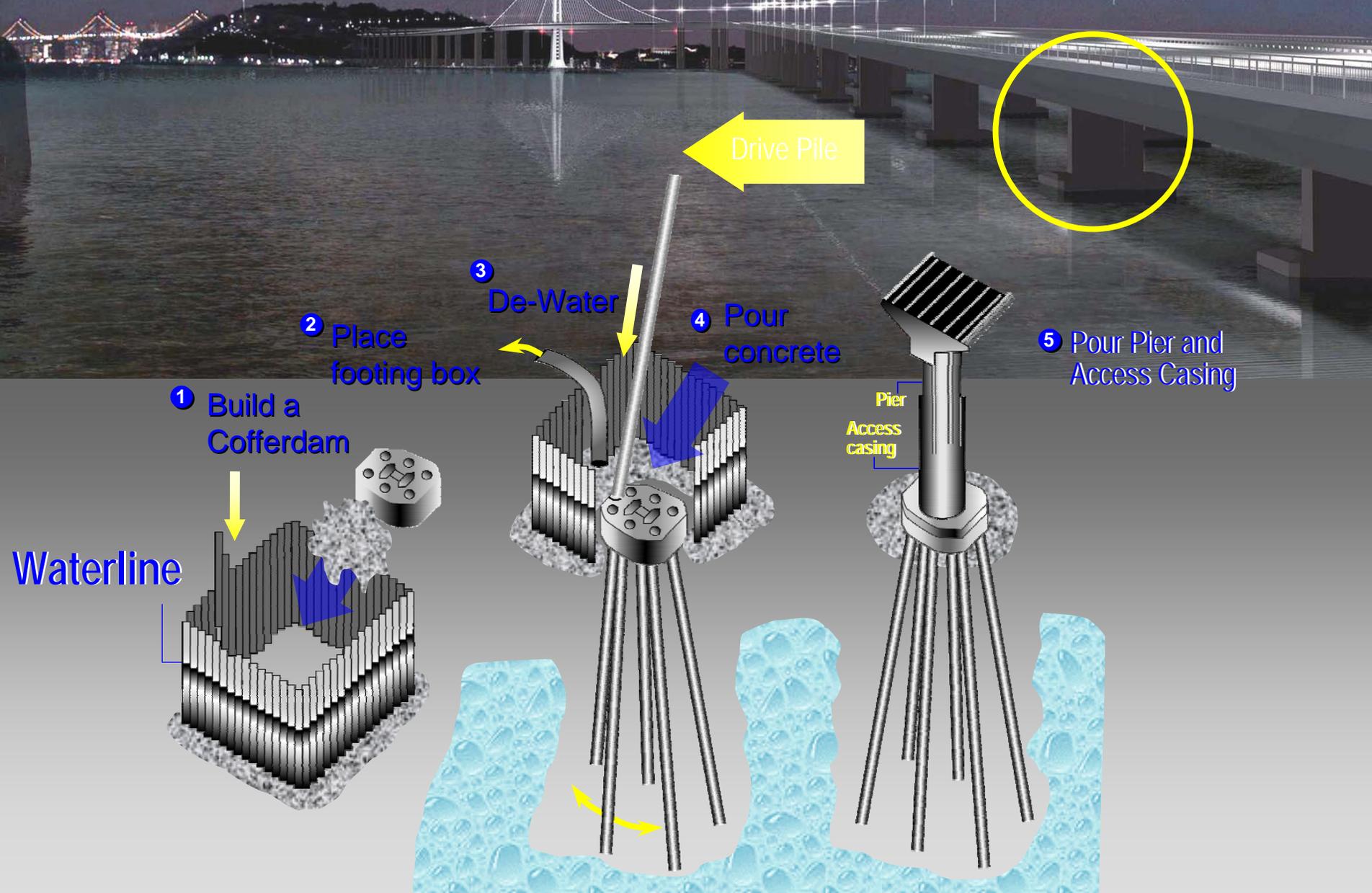
Pier Table

Pier Column

Pile Cap w/ Fender

CISS Piles

# Cross-Section of a New Bay Pier



# Mobilizing Foundations



# Footing Box

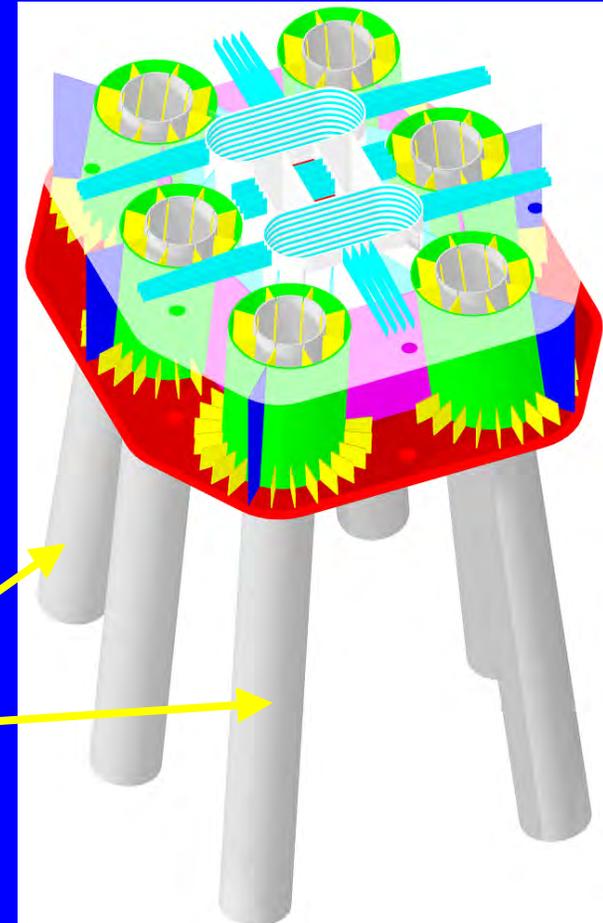
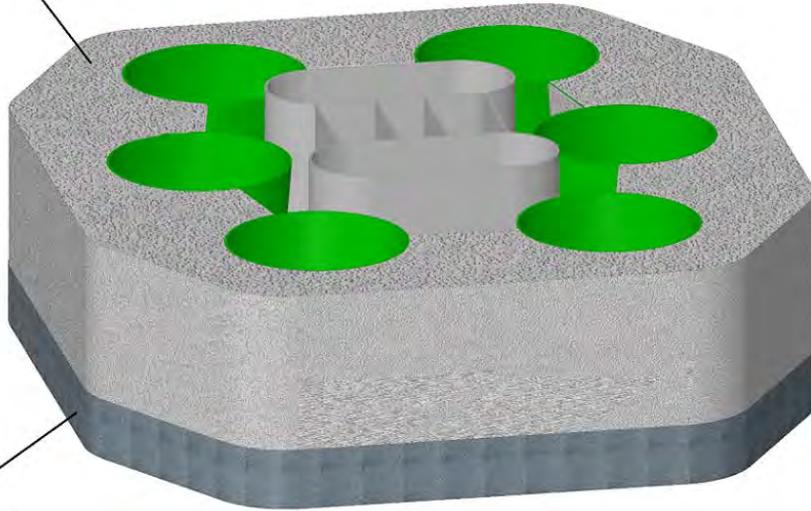


# Footling Boxes

Light Weight  
Concrete

Self Consolidating Concrete

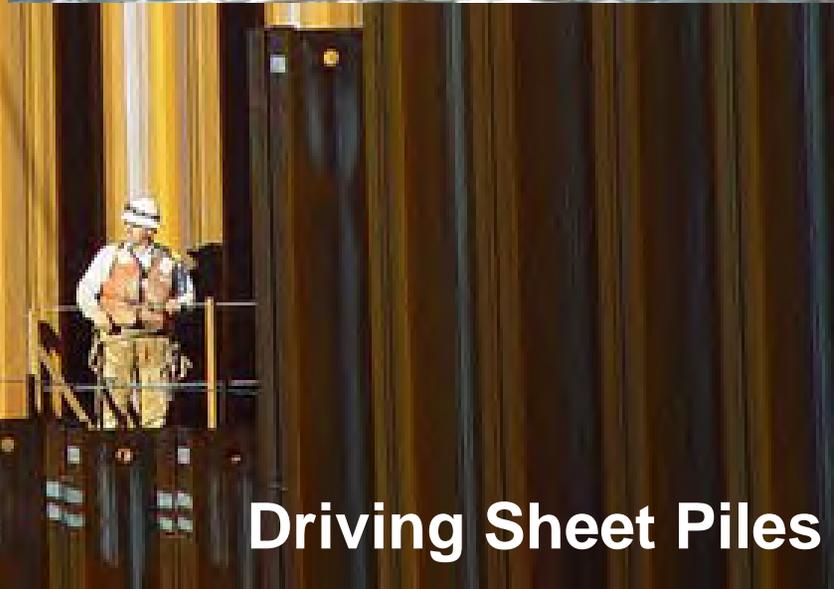
Normal  
Weight  
Concrete



**Pile Batter Varies  
1:8 to 1:12**

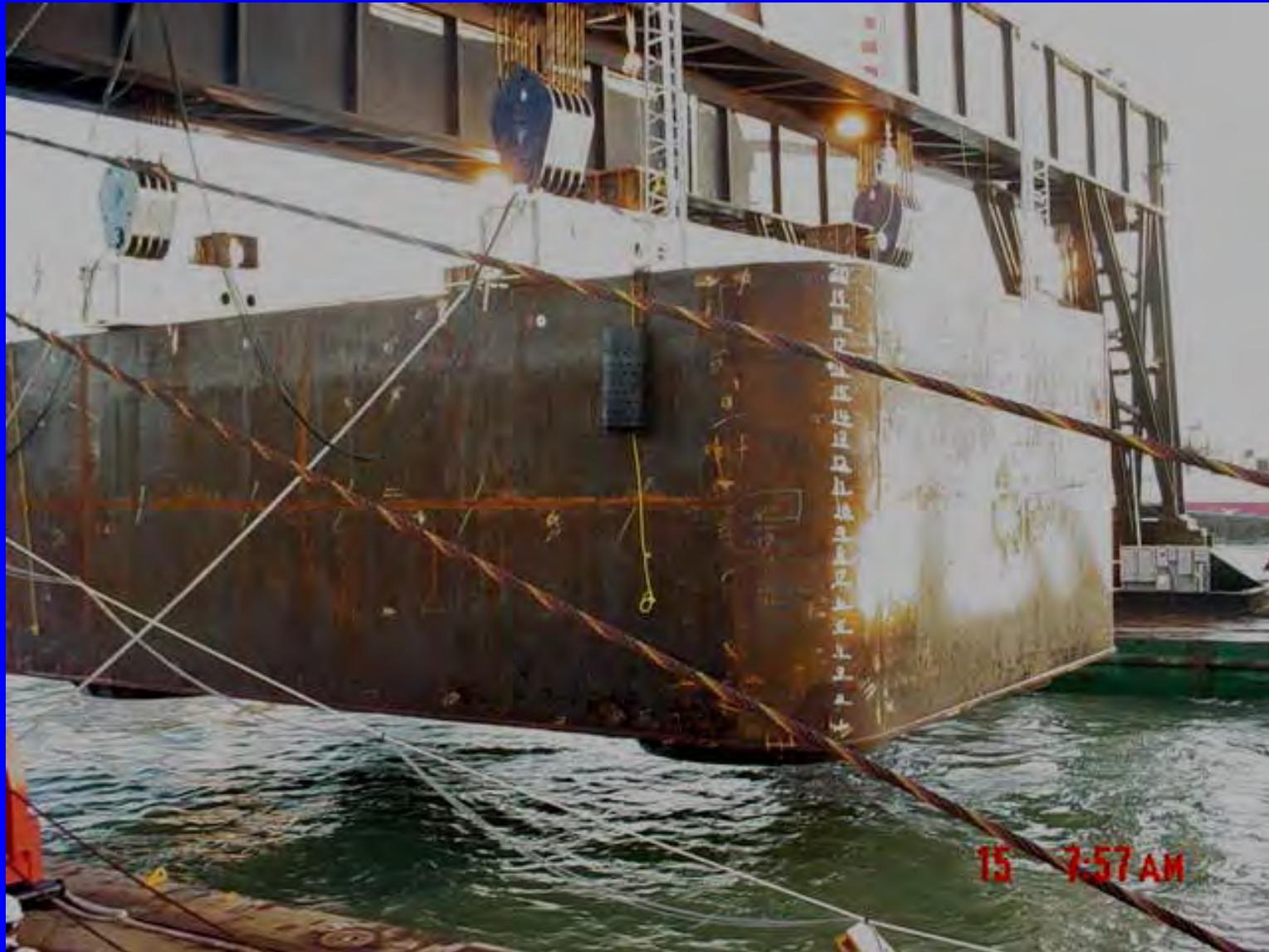
# Driving Sheet Piles for Cofferdam



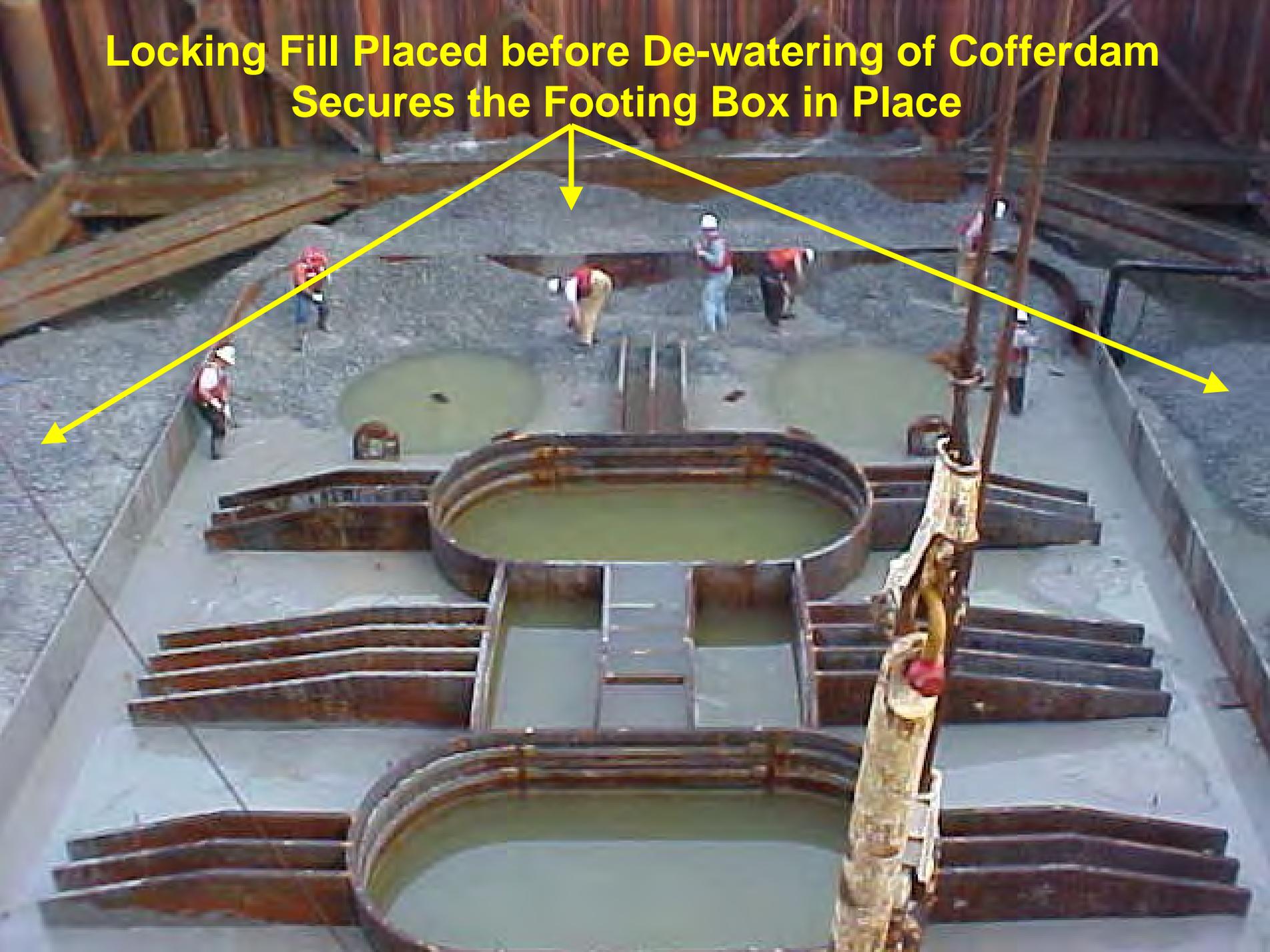


**Driving Sheet Piles**

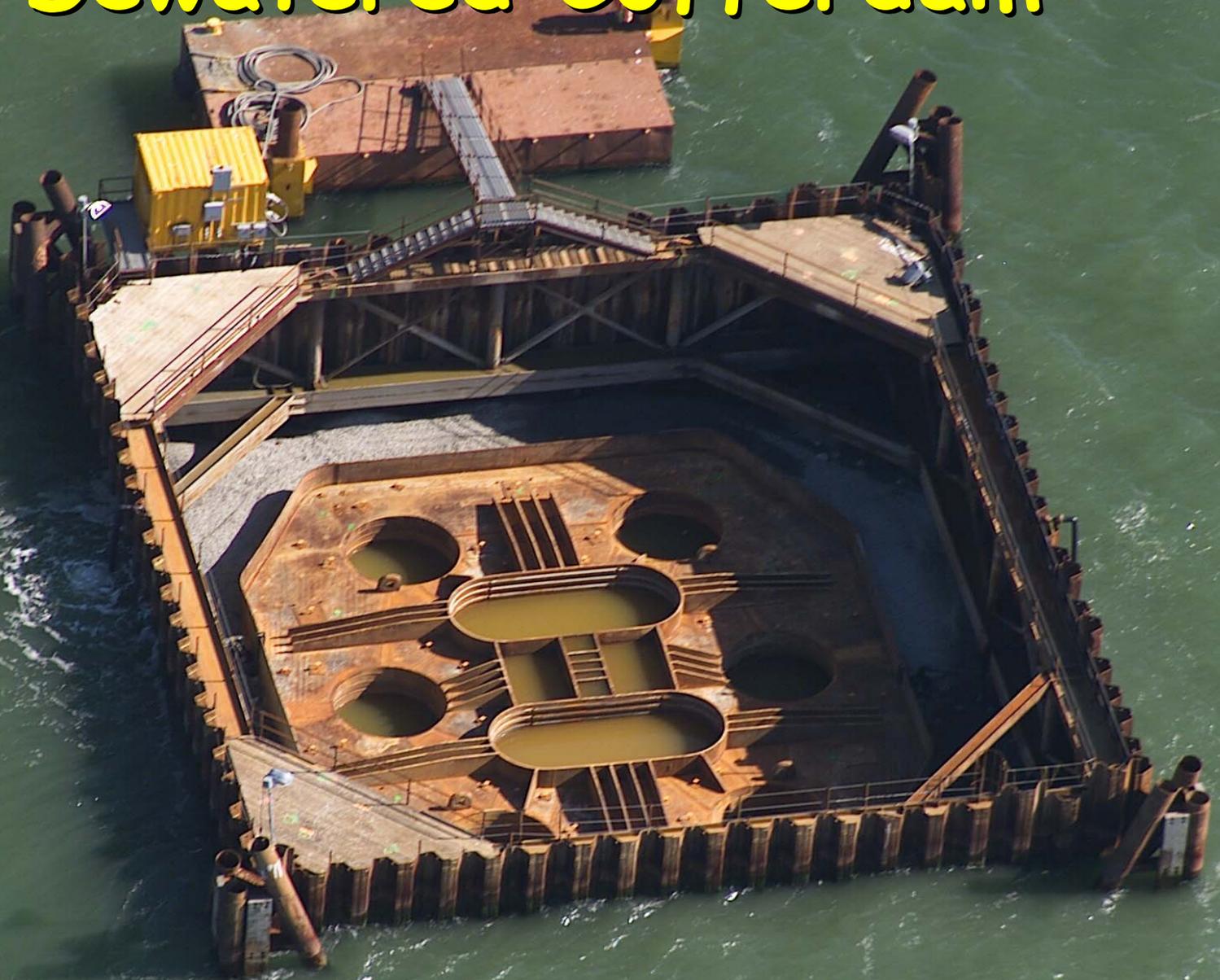
# Setting of Footing Box



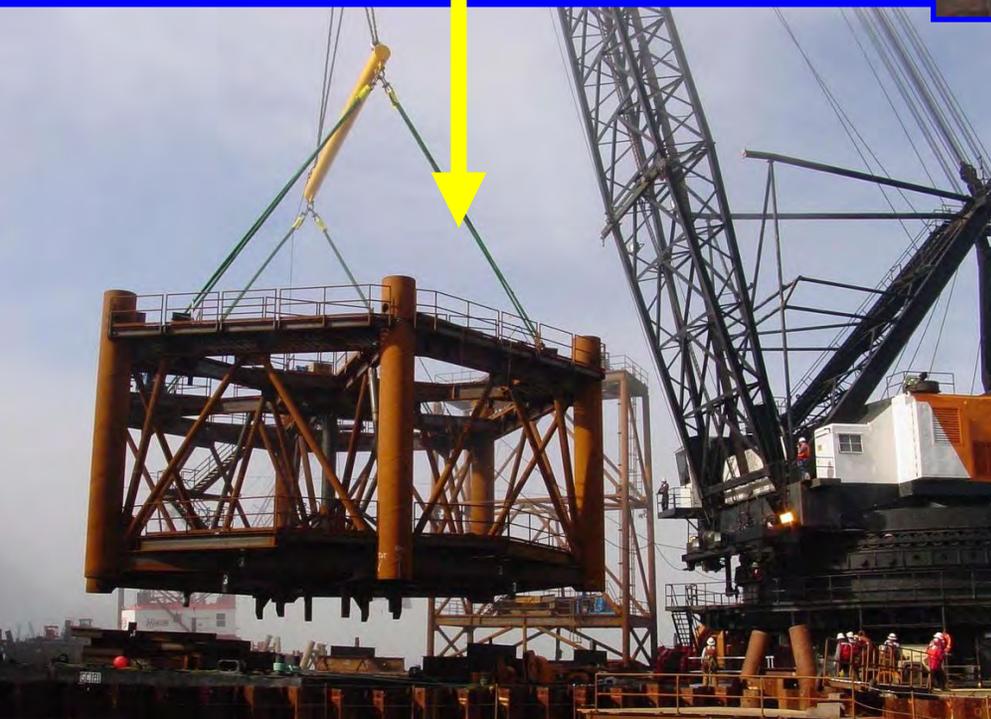
**Locking Fill Placed before De-watering of Cofferdam  
Secures the Footing Box in Place**



# Dewatered Cofferdam



# Lower Pile Driving Template Frame



# Upper Pile Driving Template Frame



**Menck MHU 1700  
Hydraulic Pile  
Hammer**



**Energy  
Delivered  
500 KJ**

# CISS PILES



51 to 76 mm  
Thick

2.5 M

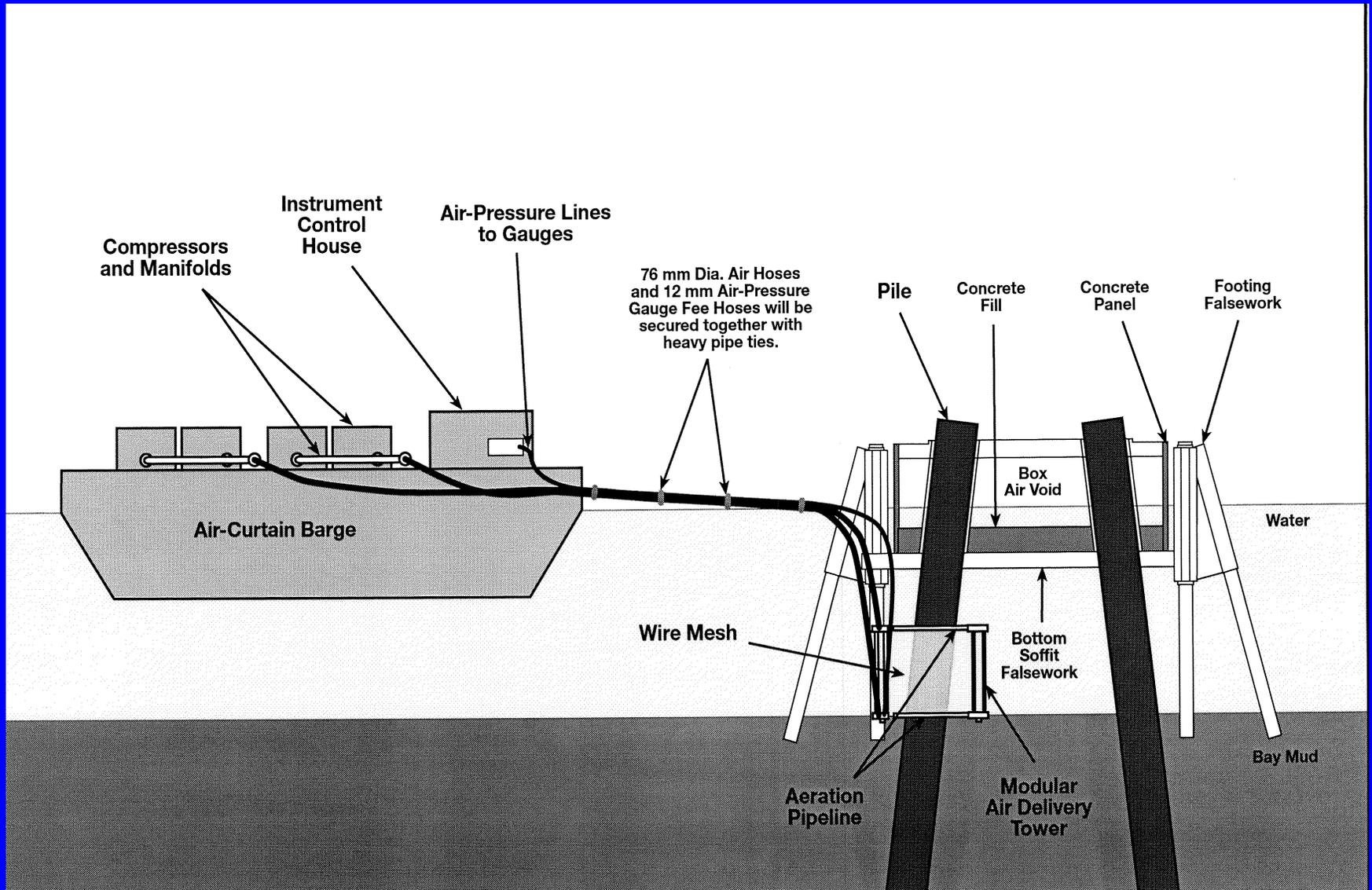


**Energy Attenuation System  
for Pile Driving Operations  
(a.k.a. "Bubble Curtain")**

**To Prevent Fish Kill**



# Energy Attenuation Schematic

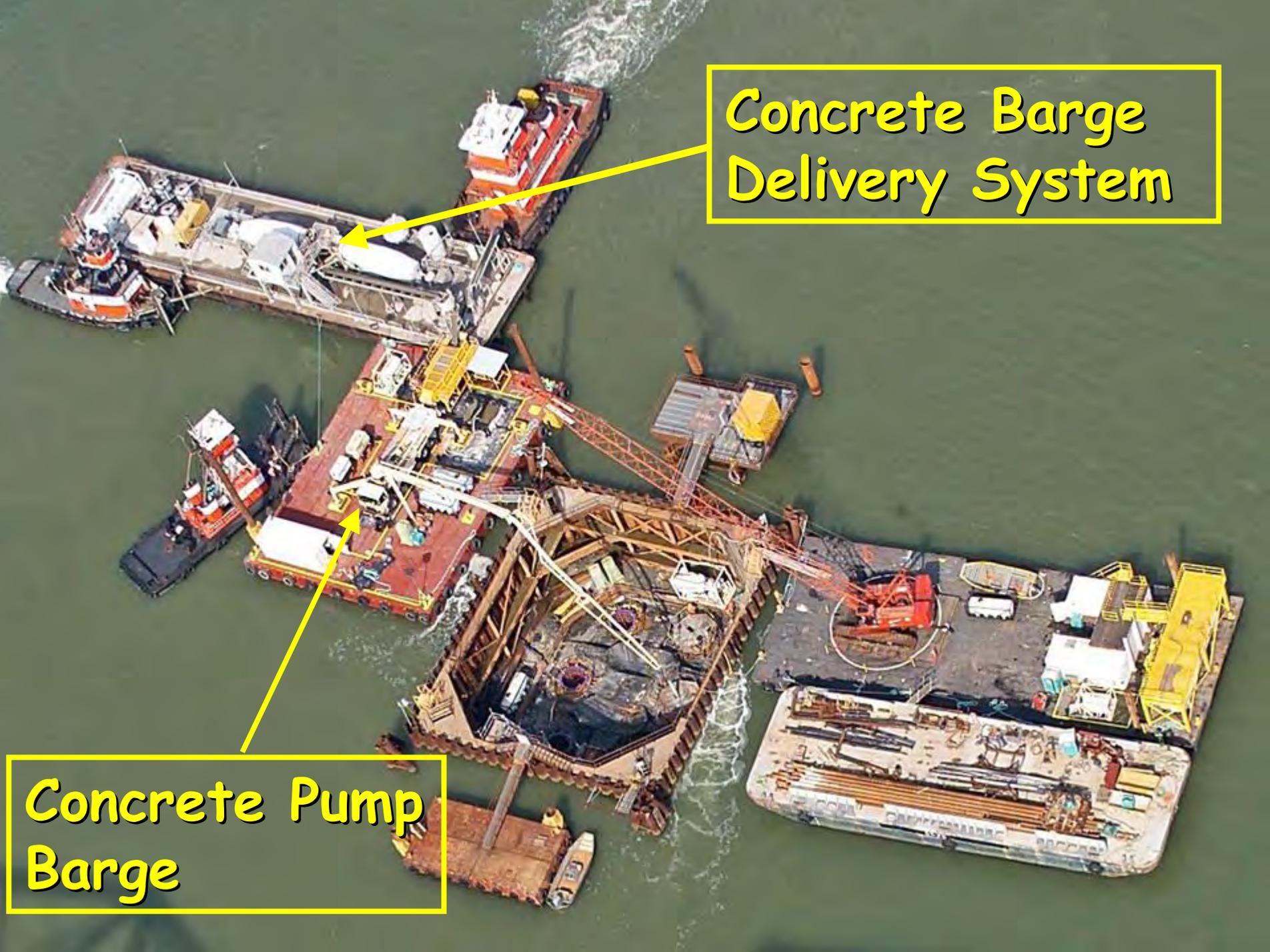


# Pile Driving Energy Attenuation System



# Pile Cleanout Operation





**Concrete Barge  
Delivery System**

**Concrete Pump  
Barge**

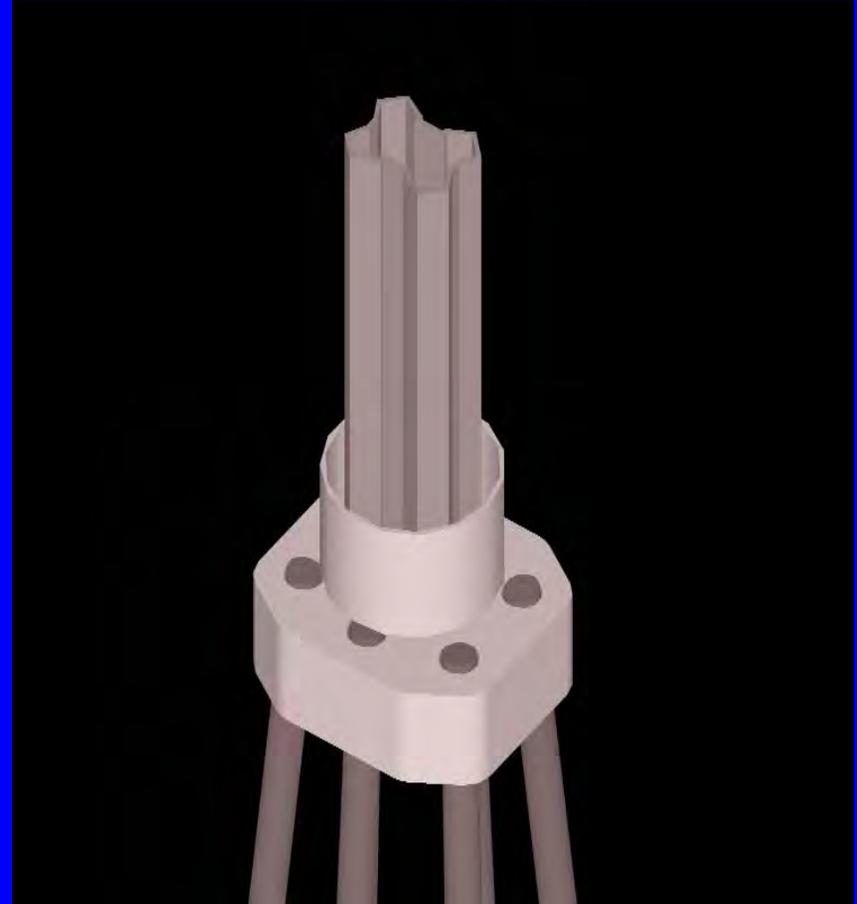
# Pier Columns



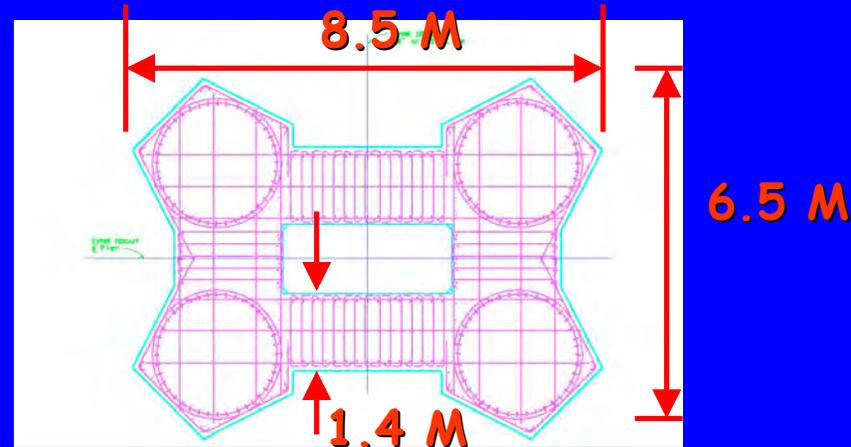
# Piers & Access Casings Highlight

## Piers & Access Casings Facts

- 28,400 CM Concrete
- Tallest pier is 35 M
- Corrosion Control Concrete
- 50 % Blast Furnace Slag
- 6% Air Entrainment to Limit Strength (25 to 40 MPa)
- Epoxy Coated Rebar



# Prefabricated Column Section



300 Ton  
Pick

700 Ton  
Crane



# Completing Pier Columns





# Completing Pier Columns

Access Casing

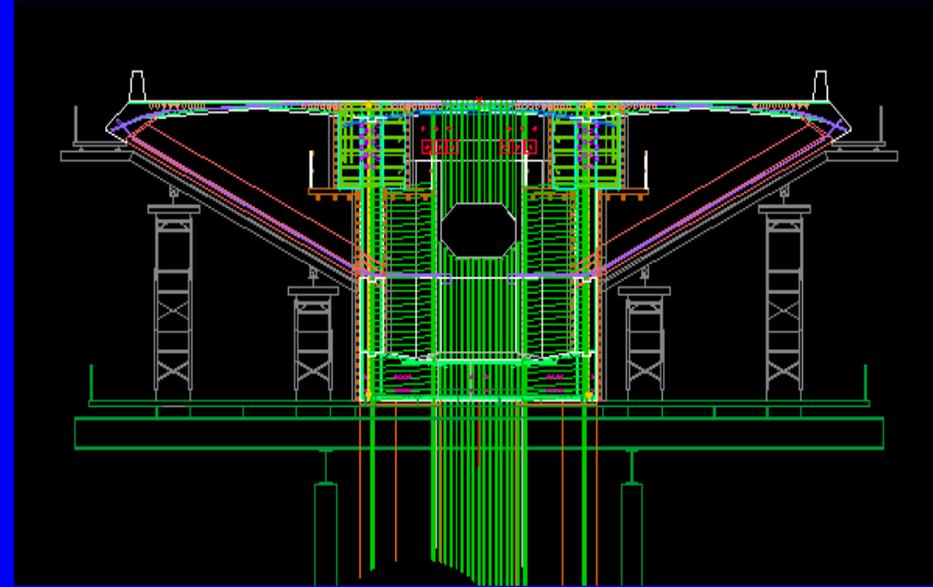


# Pier Tables

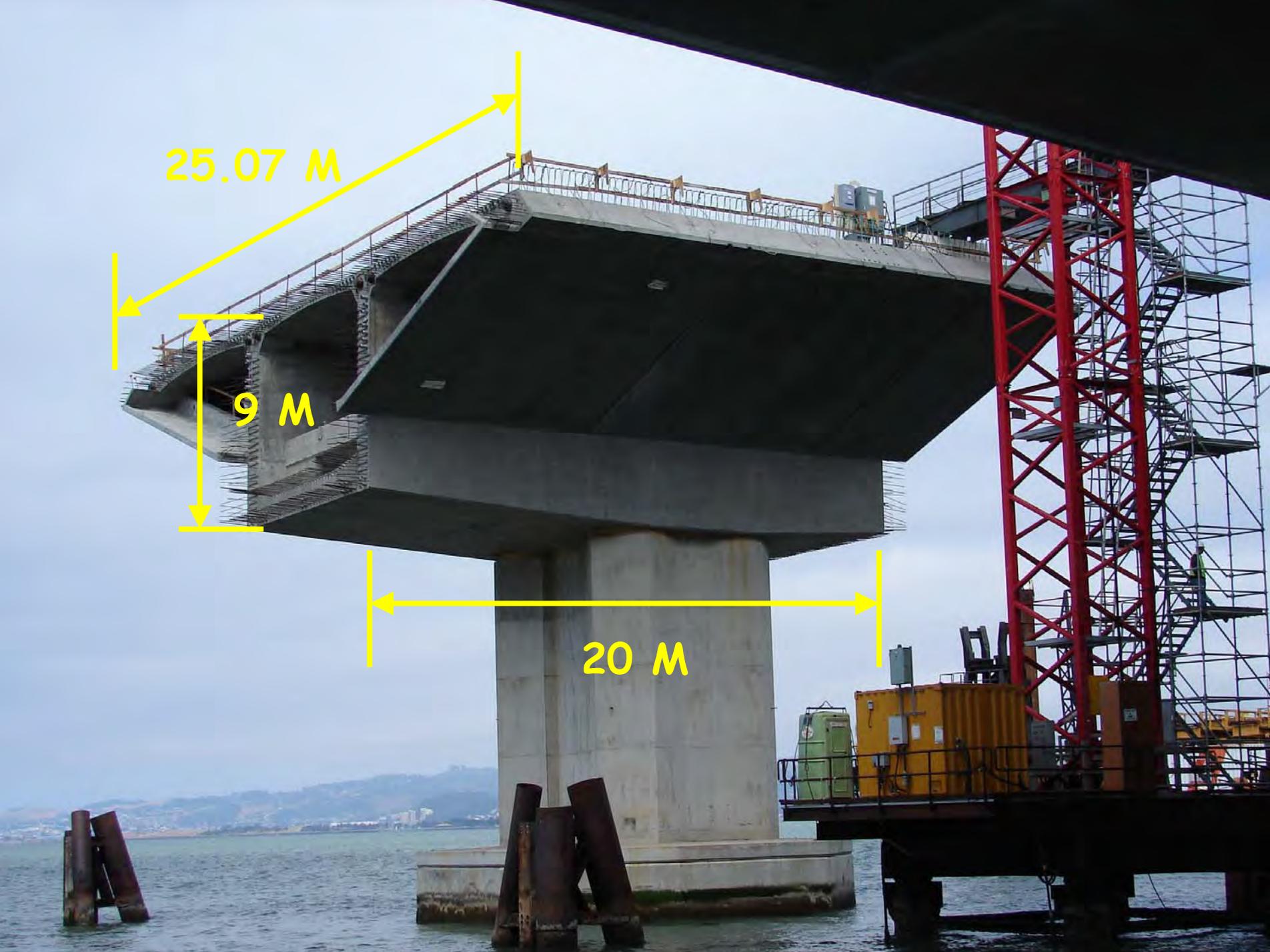


# Pier Table Highlights

- 1100 CM Concrete per Pier Table
- 10,000 psi Concrete
- Depth Varies 5.5 to 9 M
- 21 Week Construction Cycle



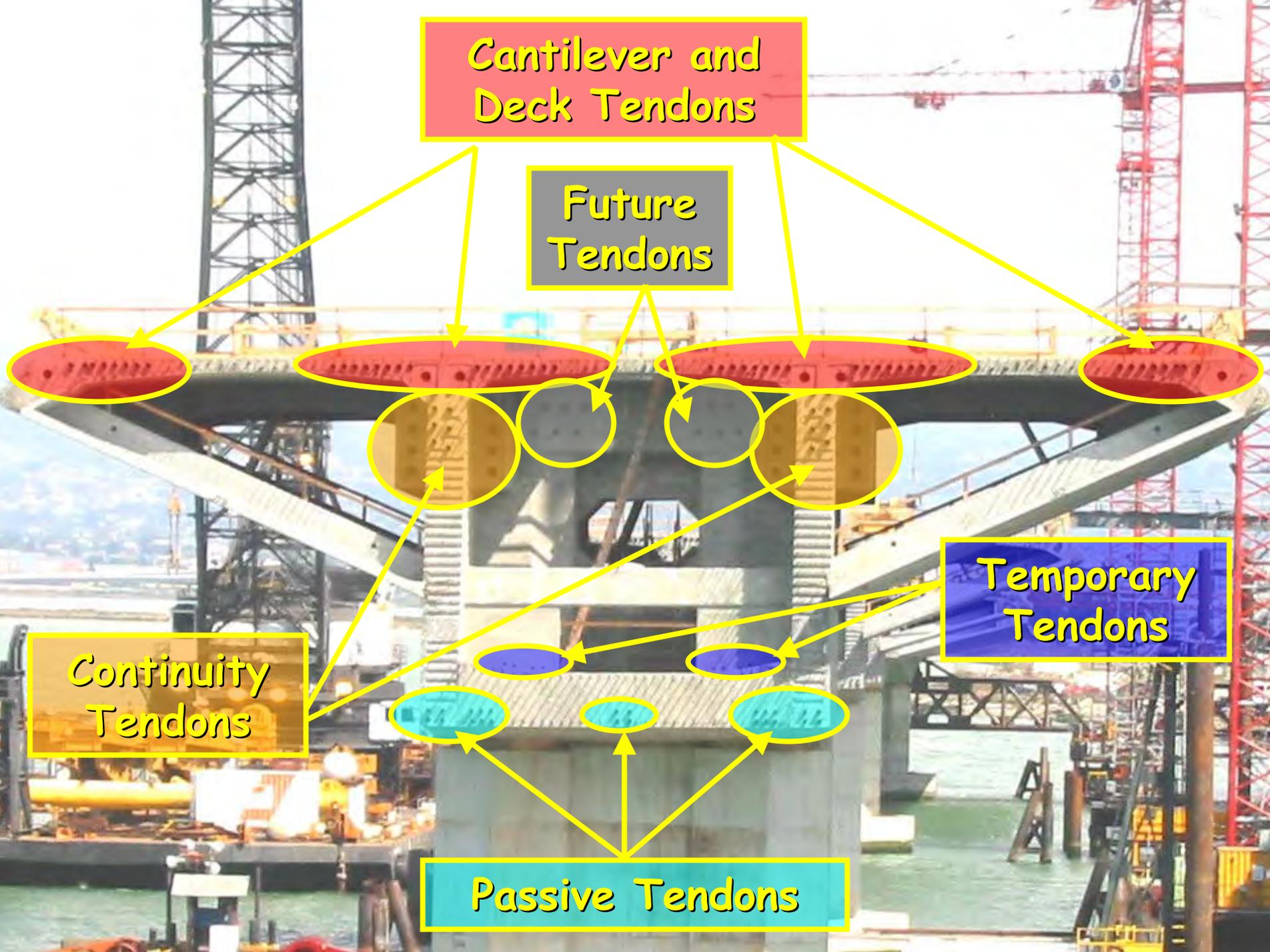




25.07 M

9 M

20 M



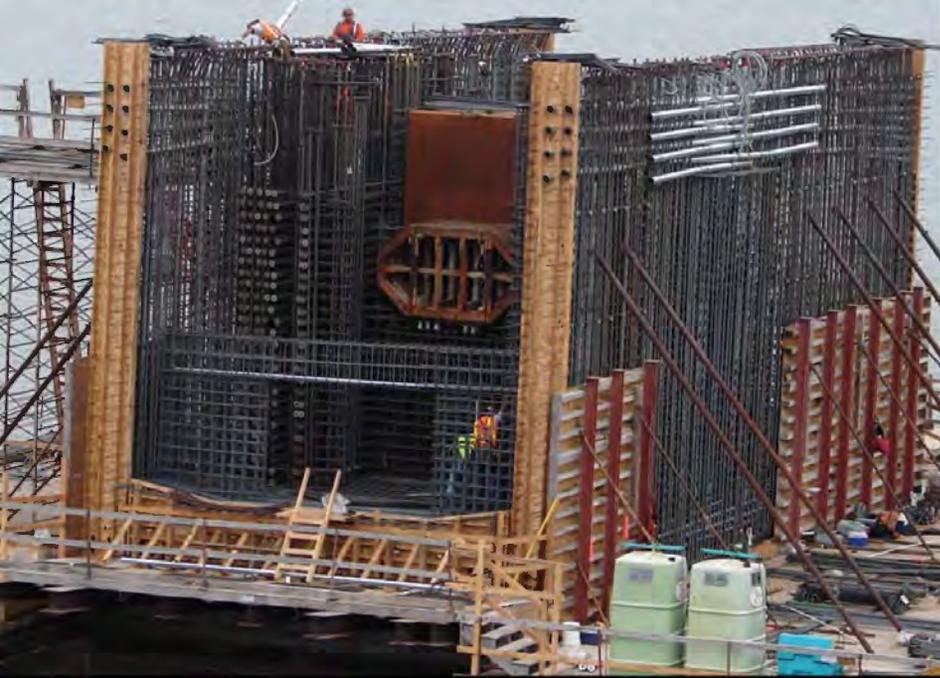
Cantilever and Deck Tendons

Future Tendons

Temporary Tendons

Continuity Tendons

Passive Tendons







**Jobsite-SFOBB**

**Stockton Precast Yard**

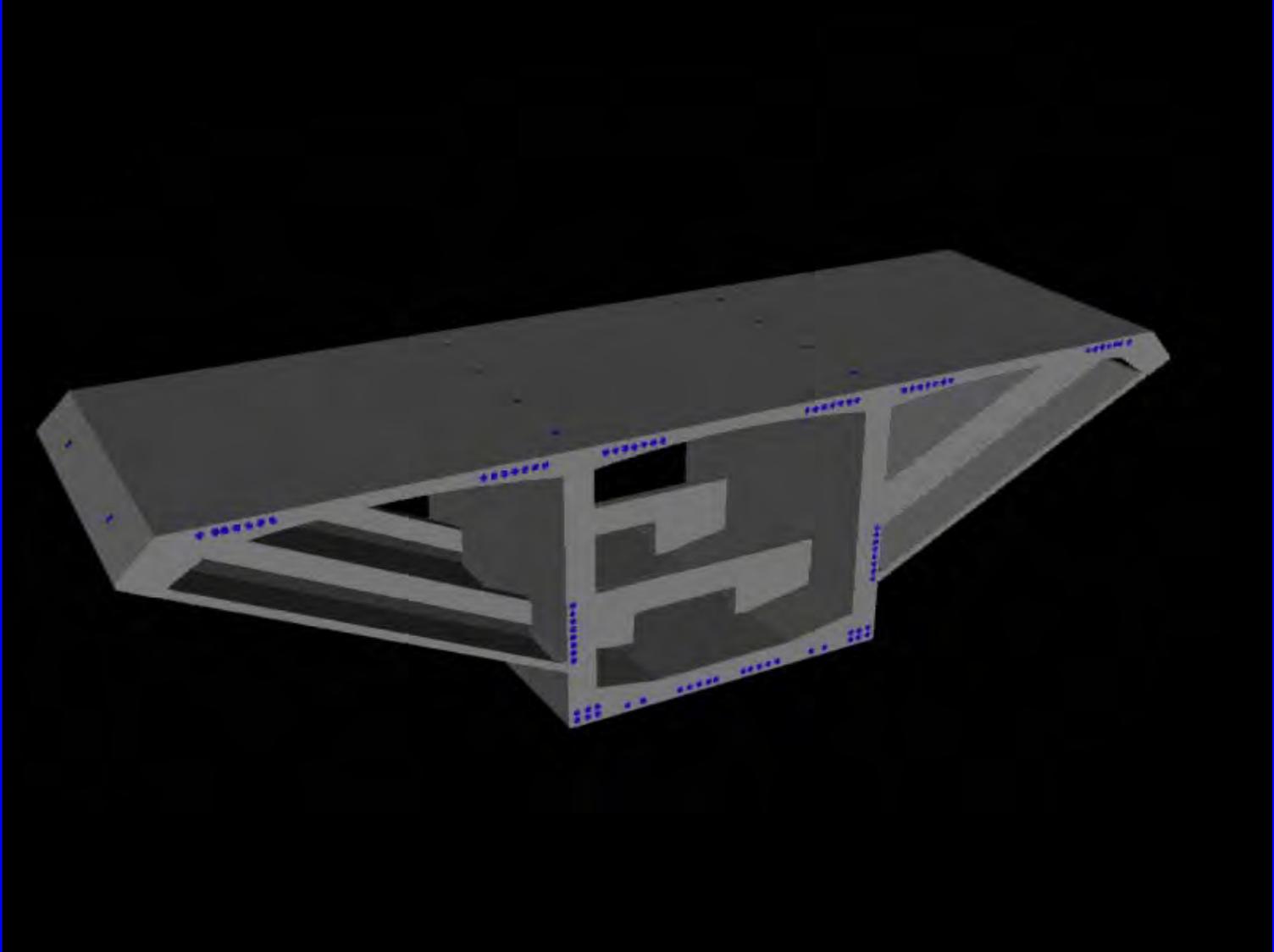
**Stockton**

**San Francisco**

**Modesto**

B

# Segment Components



# Rebar Staging and Assembly



Prefabrication of  
Rebar and Panel  
Sections

# Flying Prefabricated Section into Casting Bed Forms





**Match Cast Segments**

# Completed Typical Segments



2003

# 800 Ton Straddle Carrier



Heaviest Segment  
780 Tons

**Loading out  
Segment for  
Transport to  
Site.**



# Journey to Oakland

Jobsite in  
Oakland



Stockton  
Precast Yard

# 1<sup>st</sup> Shipment passing under the Antioch Bridge



July 23, 2004

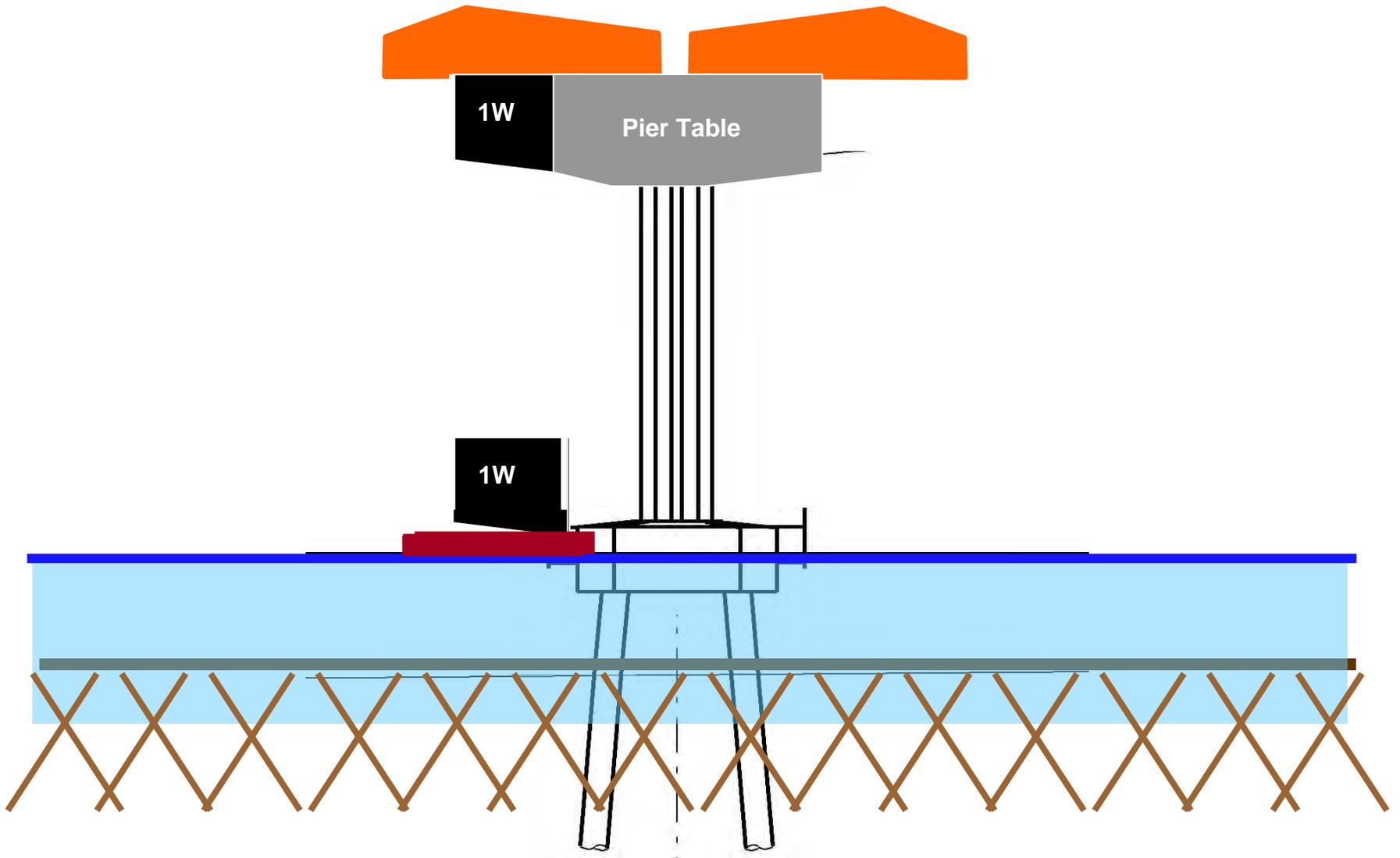
July 26, 2004



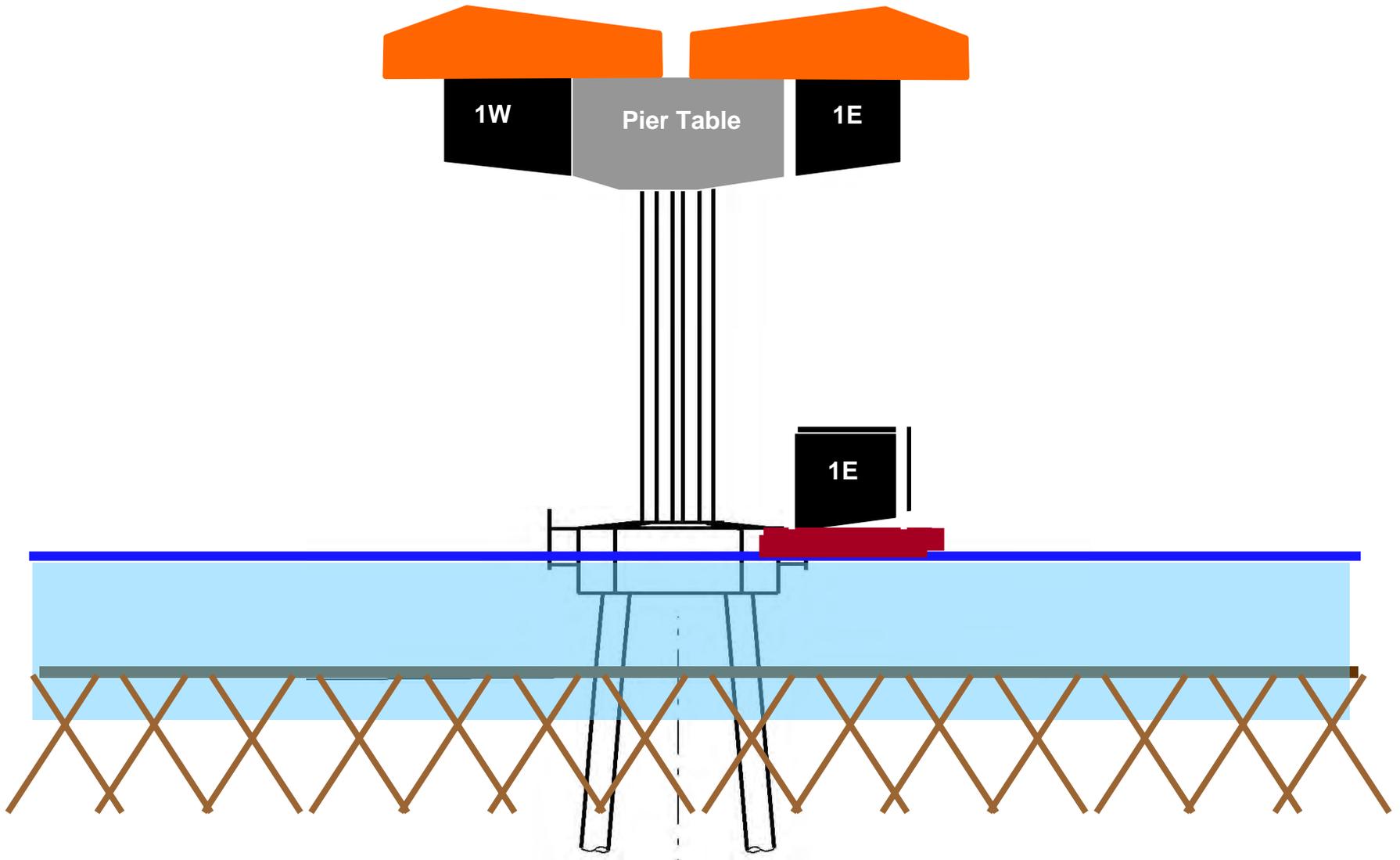
**452 Segments**  
**28 Piers**



# Balanced Cantilever Construction

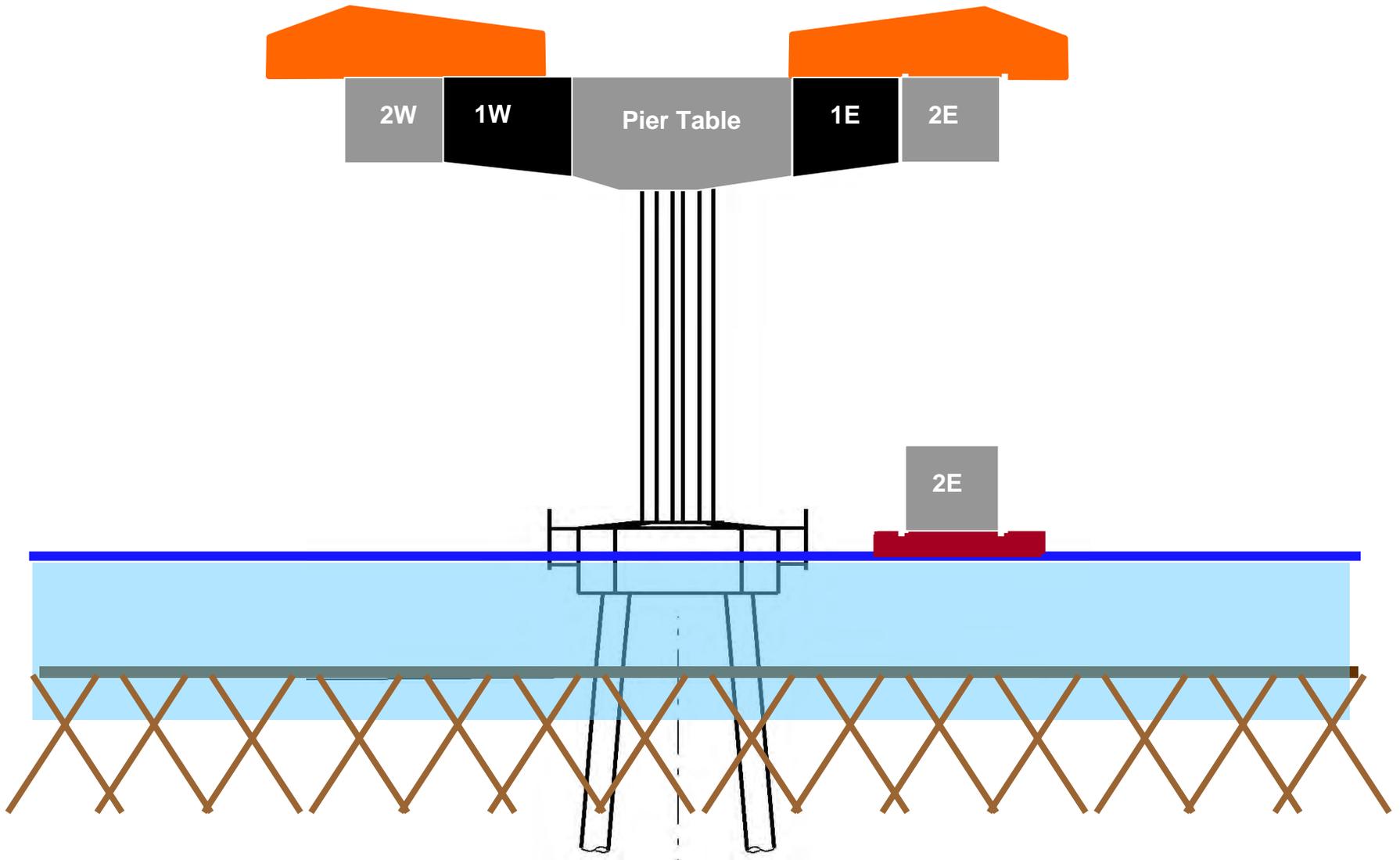


# Balanced Cantilever Construction

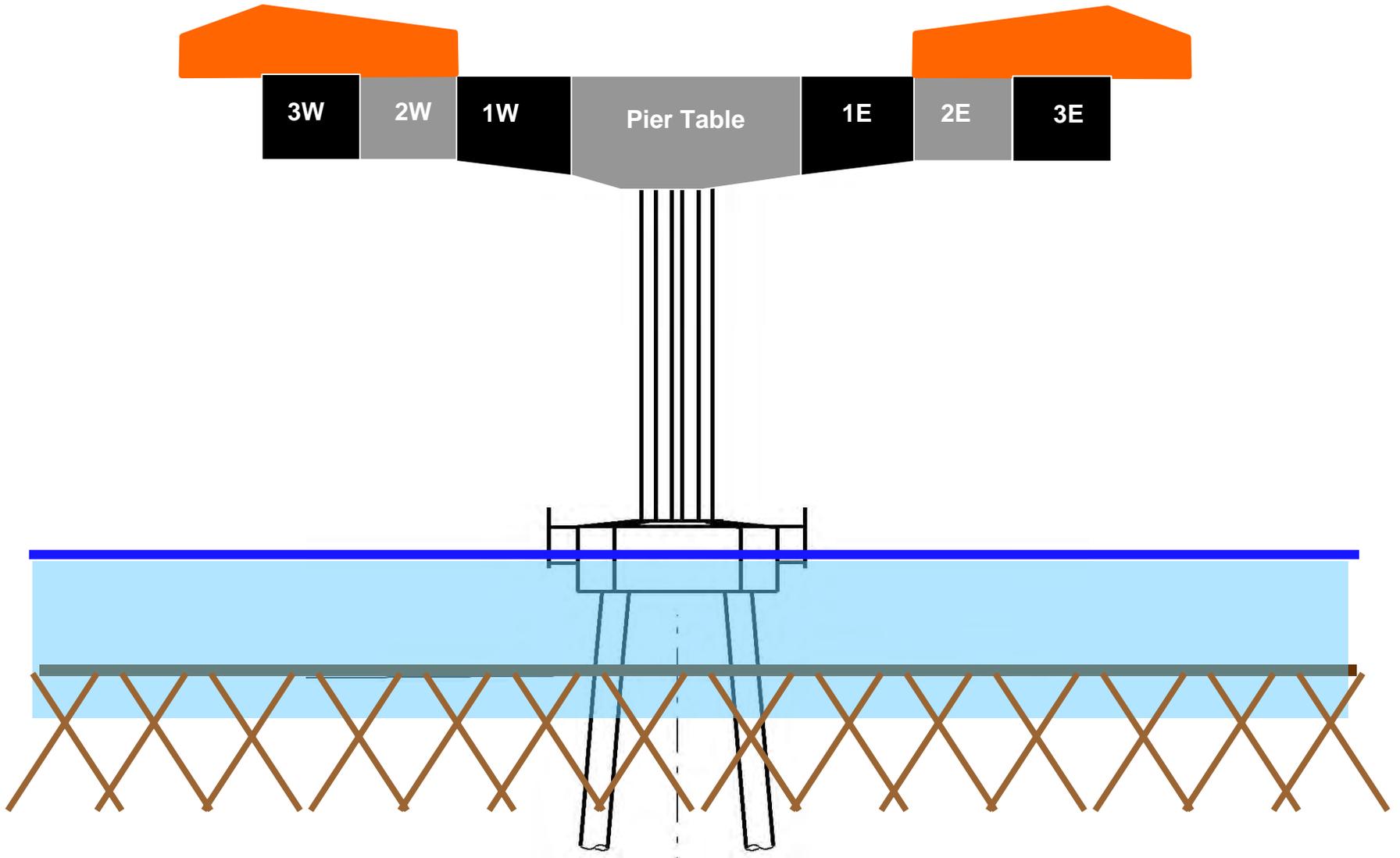




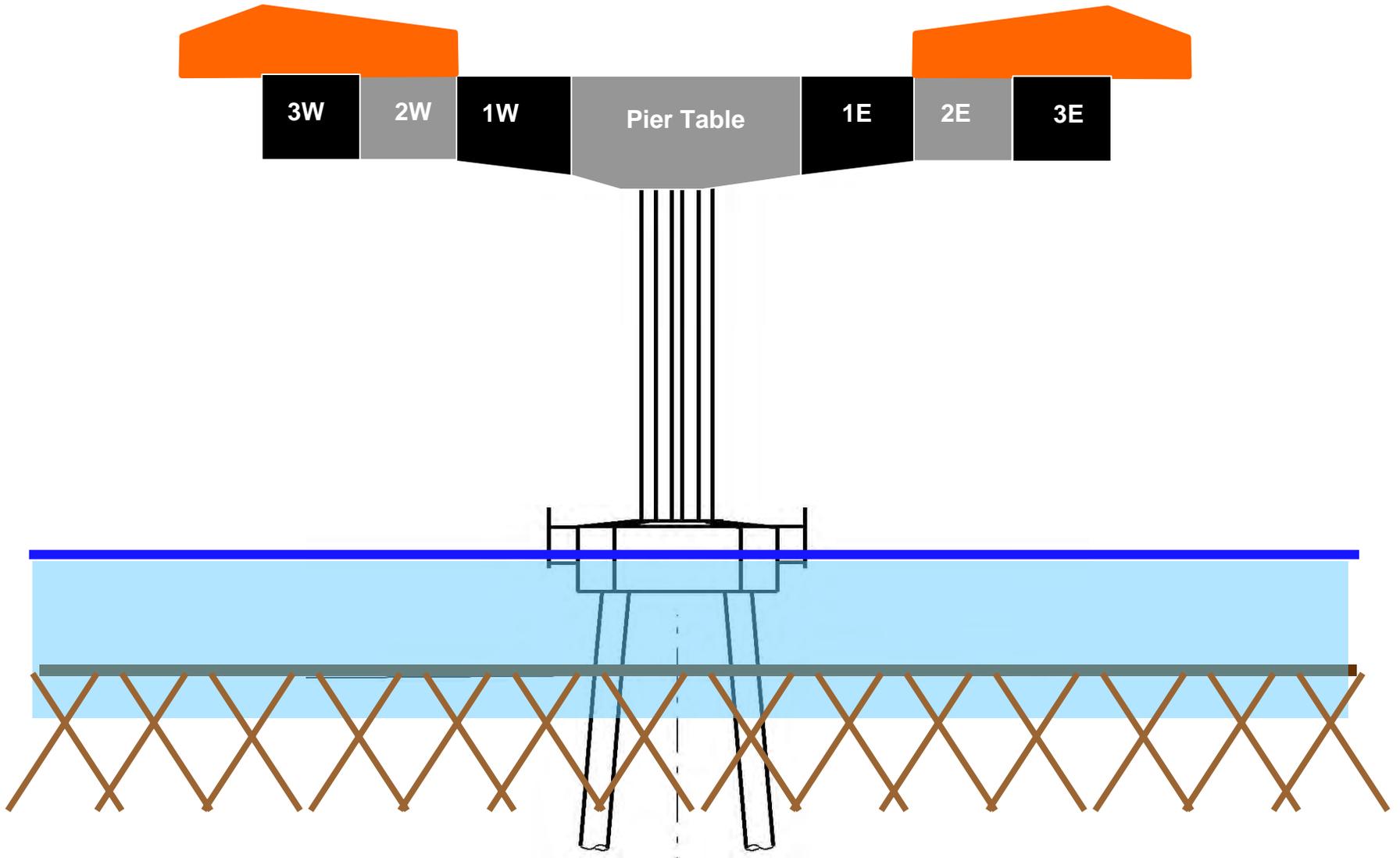
# Balanced Cantilever Construction



# Balanced Cantilever Construction

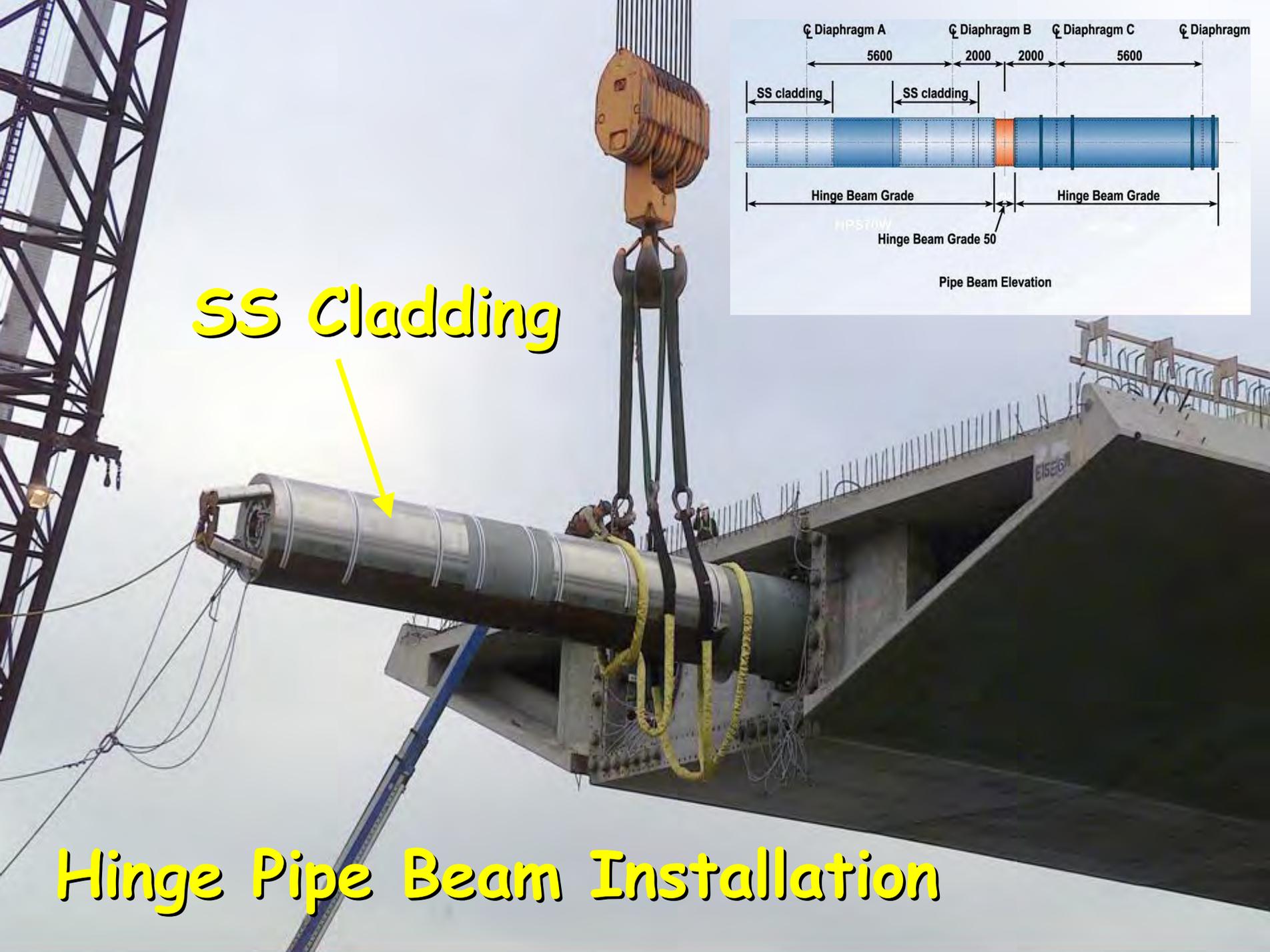


# Balanced Cantilever Construction

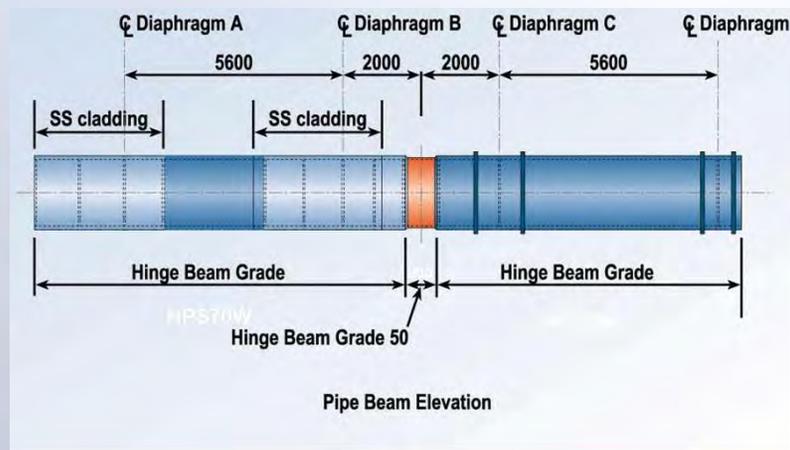


**Hinge  
Segment**





**SS Cladding**



**Hinge Pipe Beam Installation**









# Constructability Issues



## Mock-ups

- Specified prior to Work
- Constructability
- Welding Processes
- Conflict Resolution



## WELDING

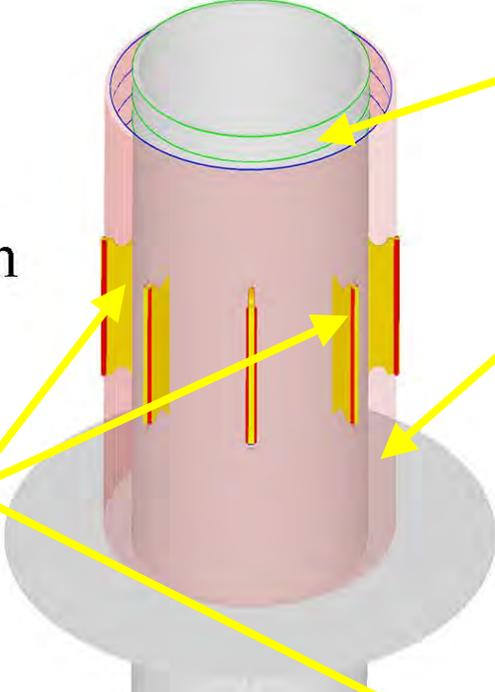
Pre-qualified  
Procedures

Final  
Pile Head  
Connection

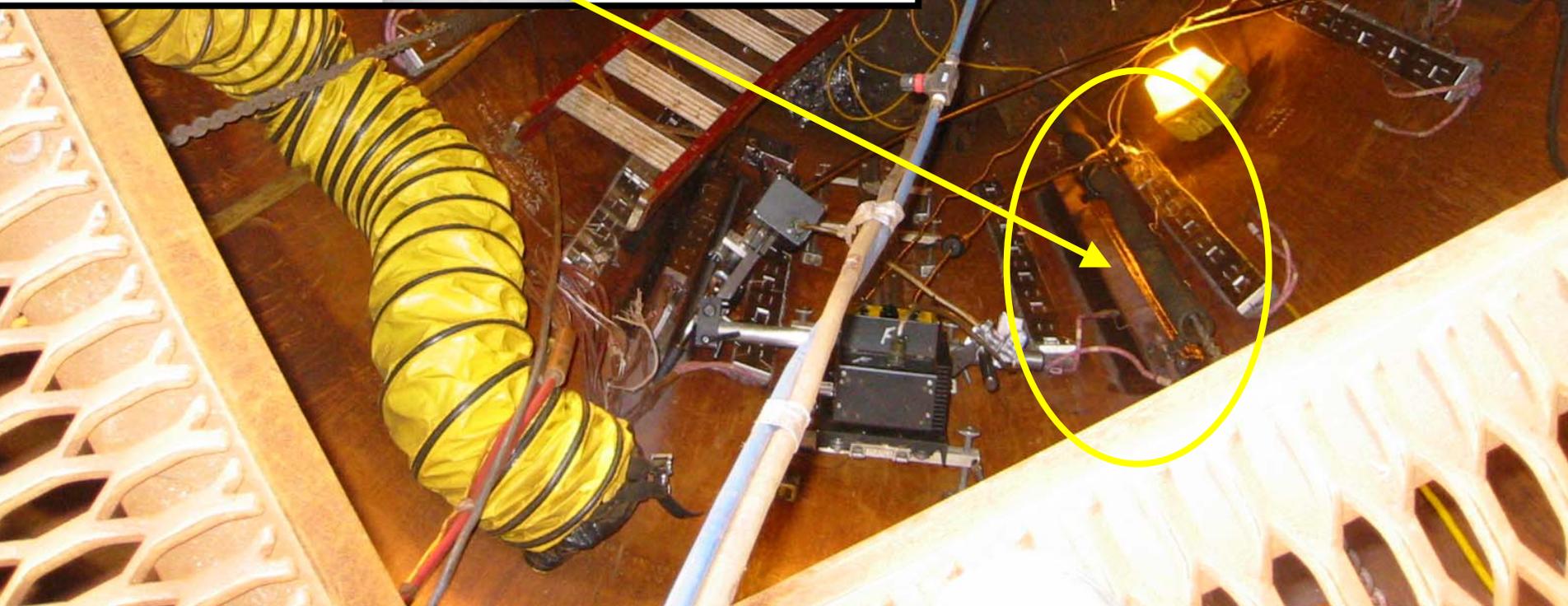
Pile

Footing  
Sleeve

Connection  
Plate



# Welded Pile Head Connections

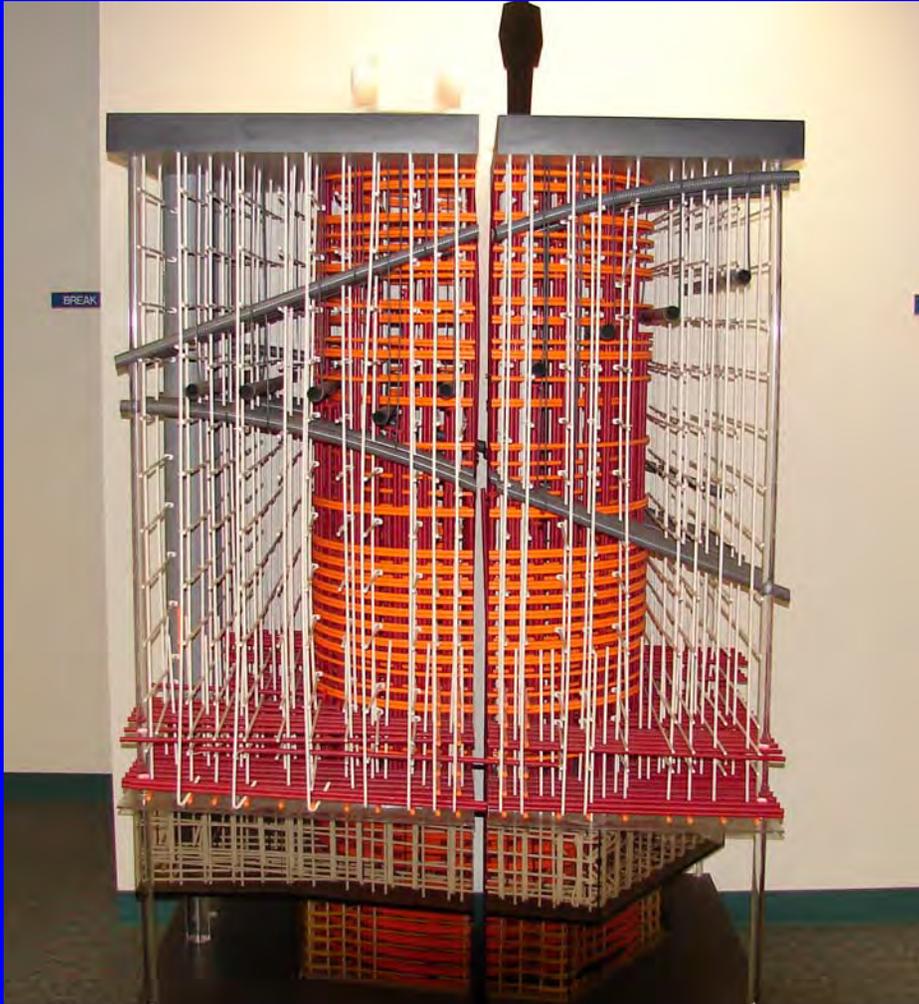


# Pier Table Rebar Congestion

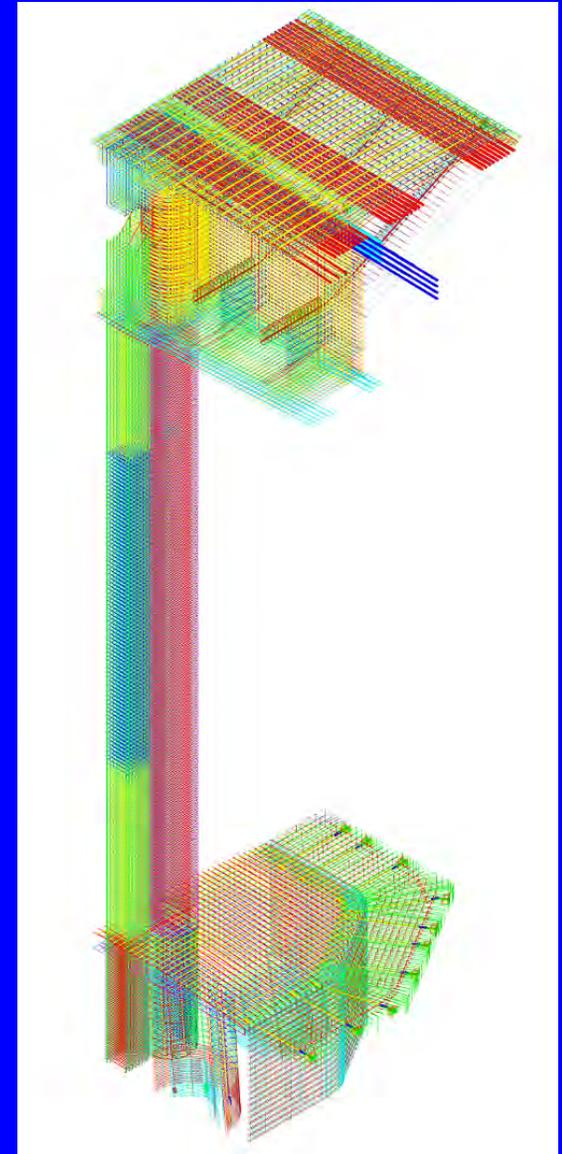
Full Size  
Pier Table Mock-up  
(prior to Construction)



# W2 Footing & Column Interface



# Quarter Section of Skyway Pier



# Pier 7 - Port of Oakland

**"Mission Control"**

Concrete  
Batch Plant

PIO

Caltrans

SAS & YBI

Skyway

KFM



# Skyway "Mission Control"



**Resolve  
Constructibility  
Issues & Produce  
Composite Drawings**







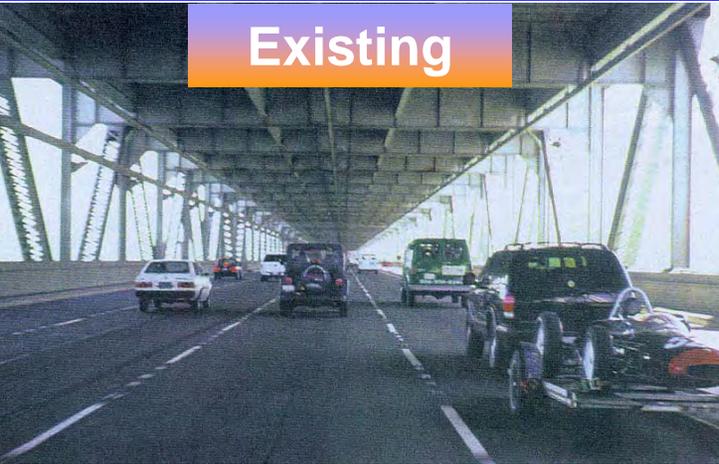
# New East Span View



Existing

View Driving to San Francisco

# New East Span Motorists' View



View Driving to the East Bay

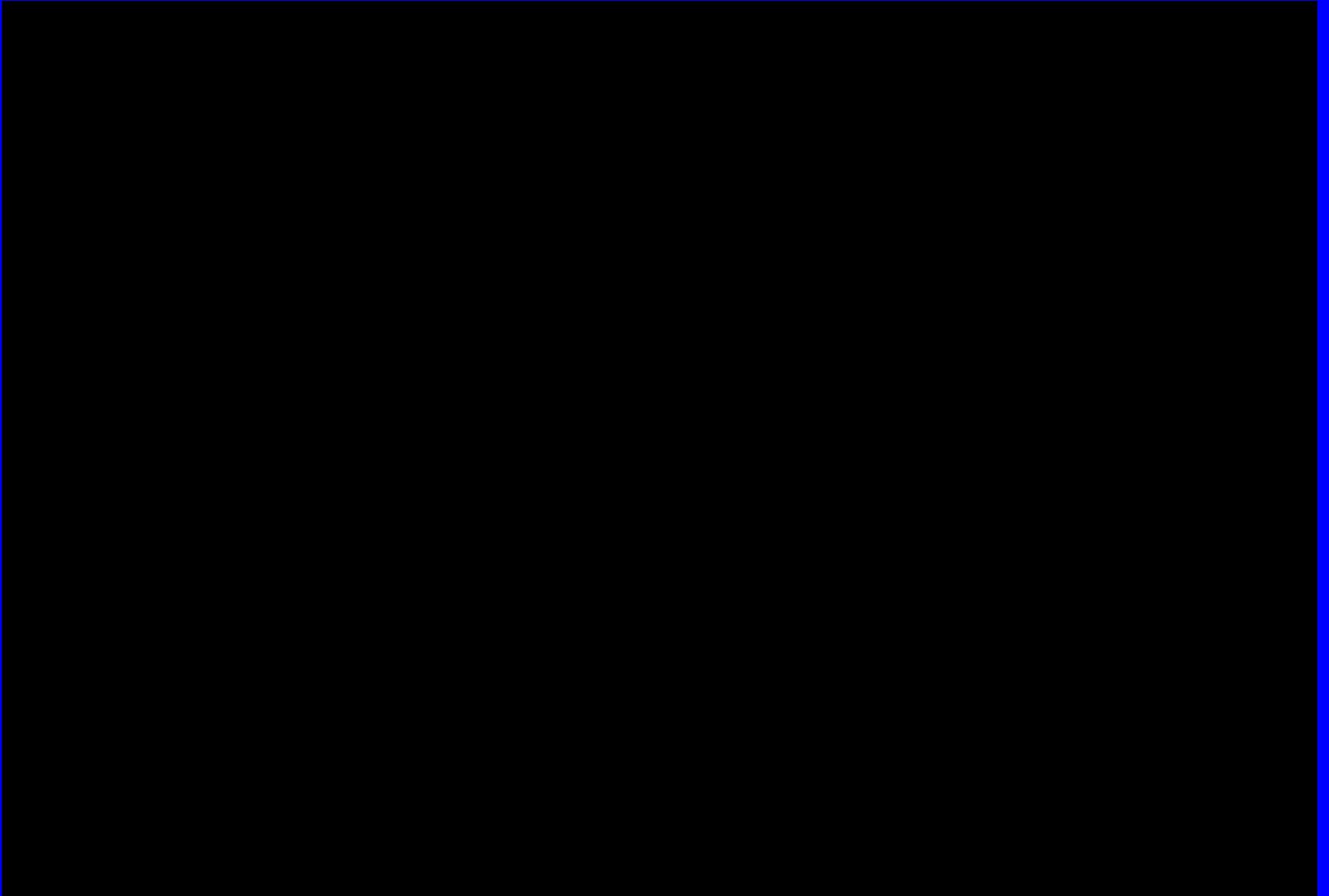
# Night Views



# Bicycle/Pedestrian Path



# Motorist's View Driving



<http://www.dot.ca.gov/dist4/>  
<http://www.newbaybridge.org>

