Foundation Design and Construction

for the

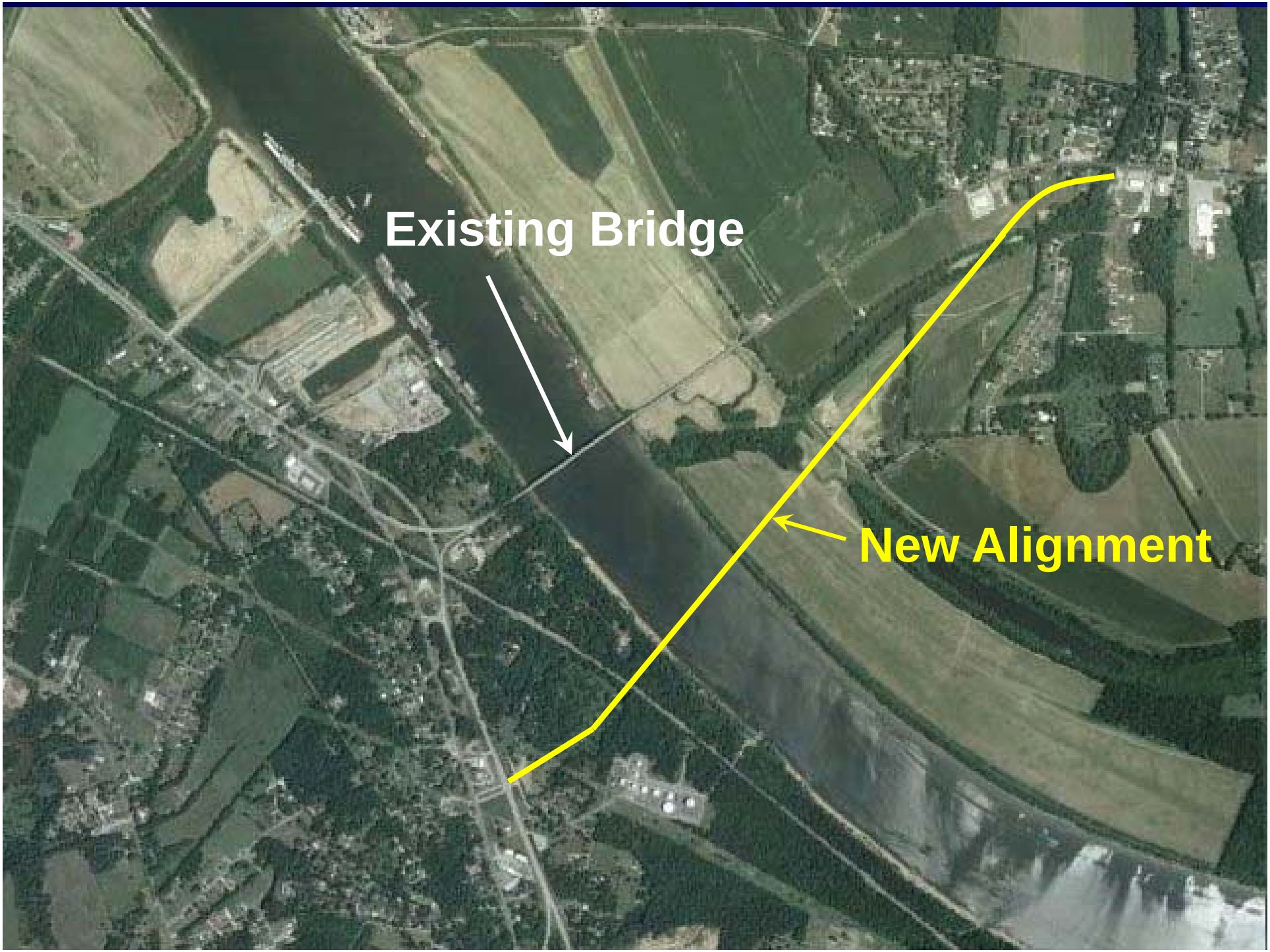
Reidland-Smithland Road Bridge

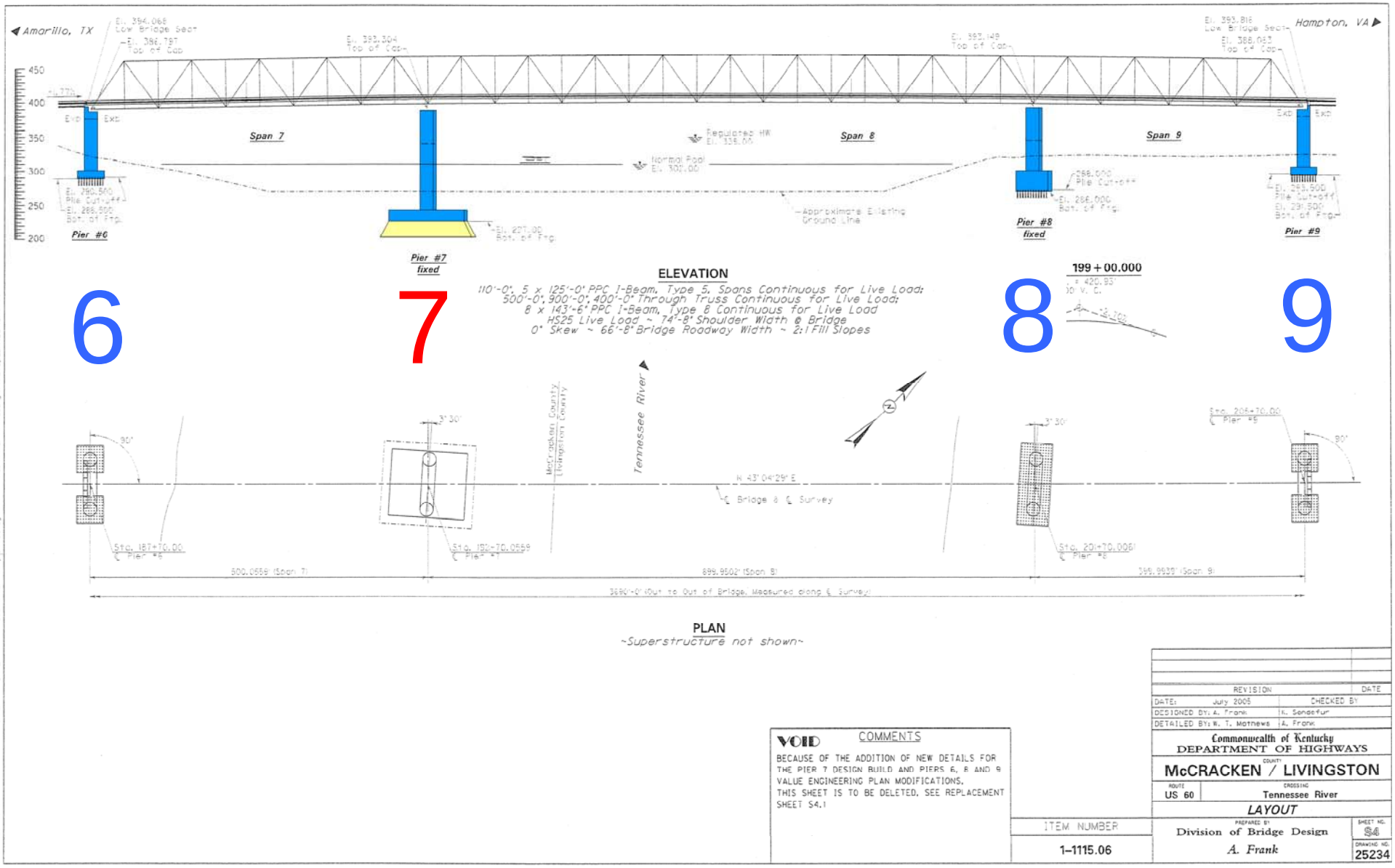
USR 60 over Tennessee River

C.J. Mahan Construction Company

E.L. ROBINSON

the Challenge. the Choice.


Existing Bridge
New Alignment



VOID COMMENTS

BECAUSE OF THE ADDITION OF NEW DETAILS FOR THE PIER 7 DESIGN BUILD AND PIERS 6, 8 AND 9 VALUE ENGINEERING PLAN MODIFICATIONS, THIS SHEET IS TO BE DELETED, SEE REPLACEMENT SHEET S4.1

REVISION	DATE
DATE: July 2005	CHECKED BY:
DESIGNED BY: A. Frank	K. Sendefur
DETAILED BY: W. T. Mathews	A. Frank

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: McCRACKEN / LIVINGSTON

ROUTE: US 60 | CROSSING: Tennessee River

LAYOUT

ITEM NUMBER: 1-1115.06

PREPARED BY: Division of Bridge Design
A. Frank

SHEET NO. S4

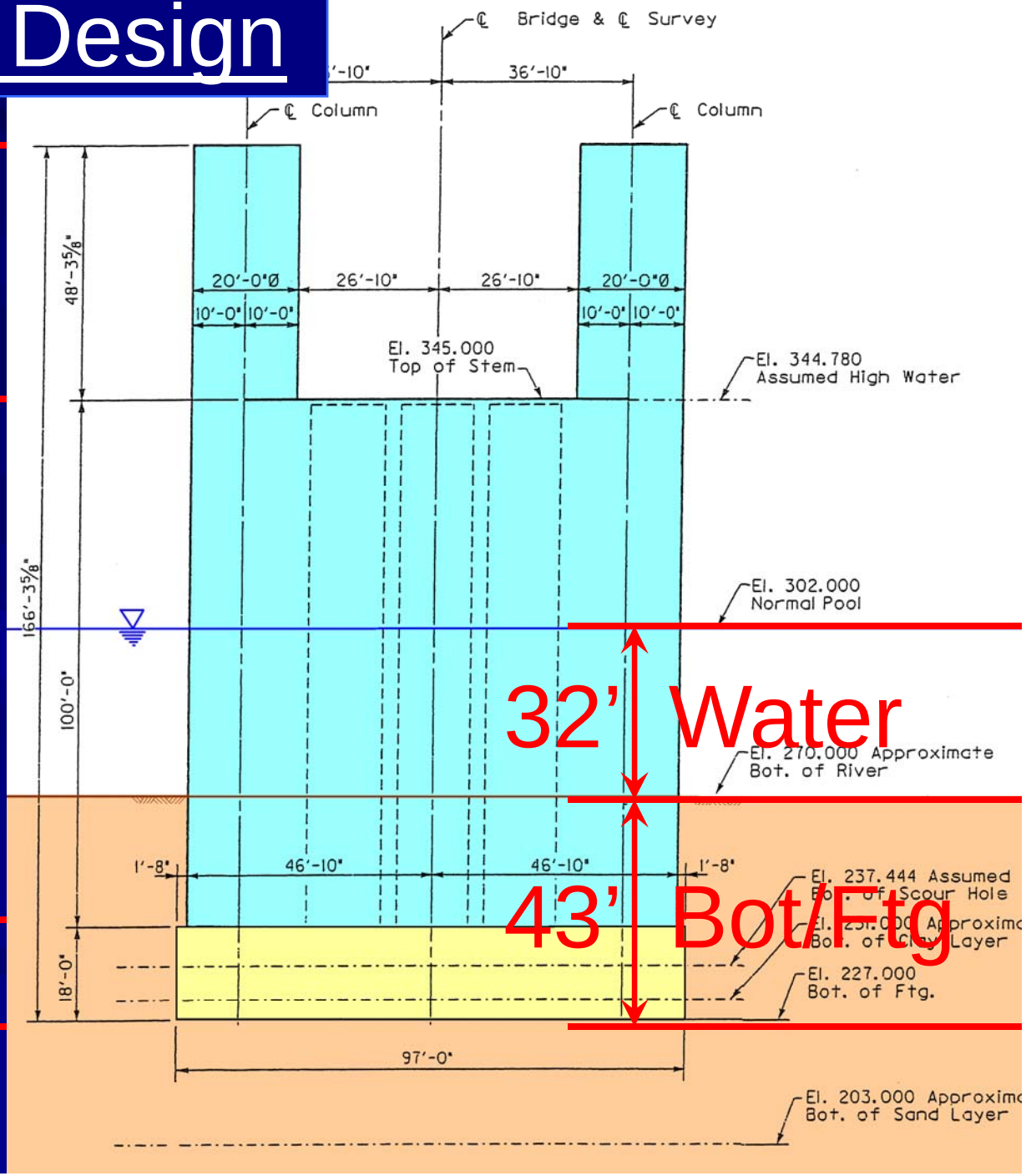
DRAWING NO. 25234

Original Pier 7 Design

48’ Column

100’ Stem

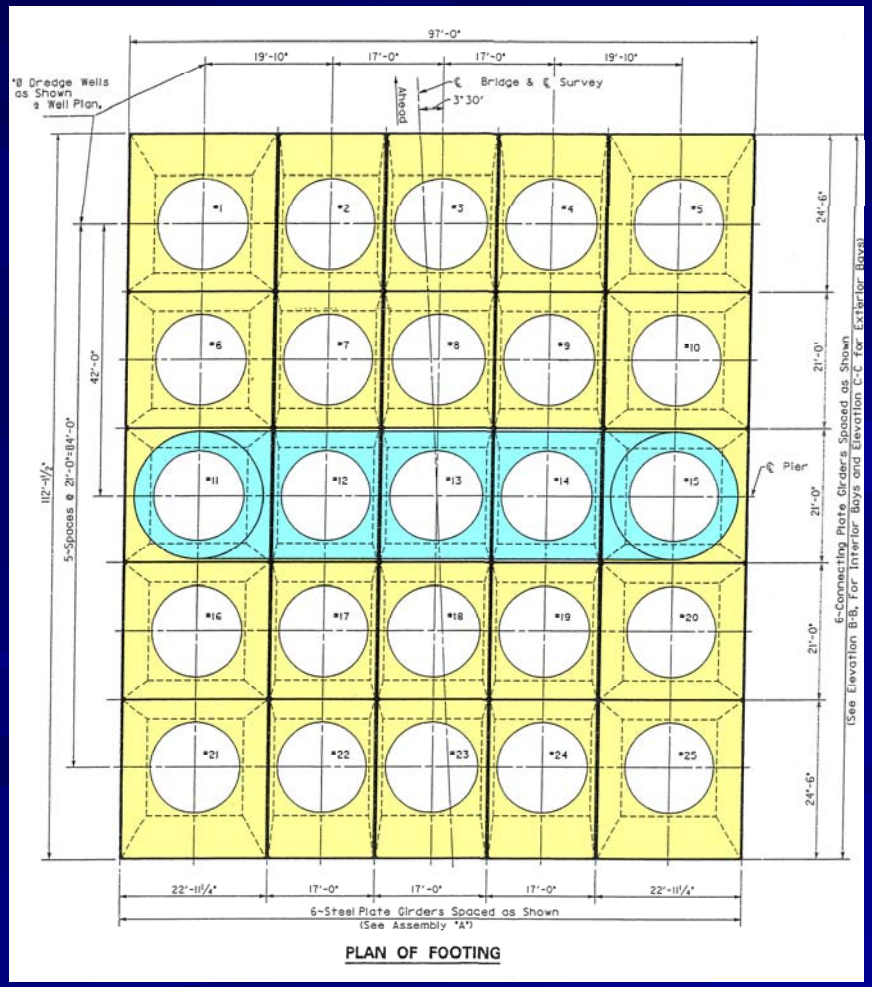
18’ Footing

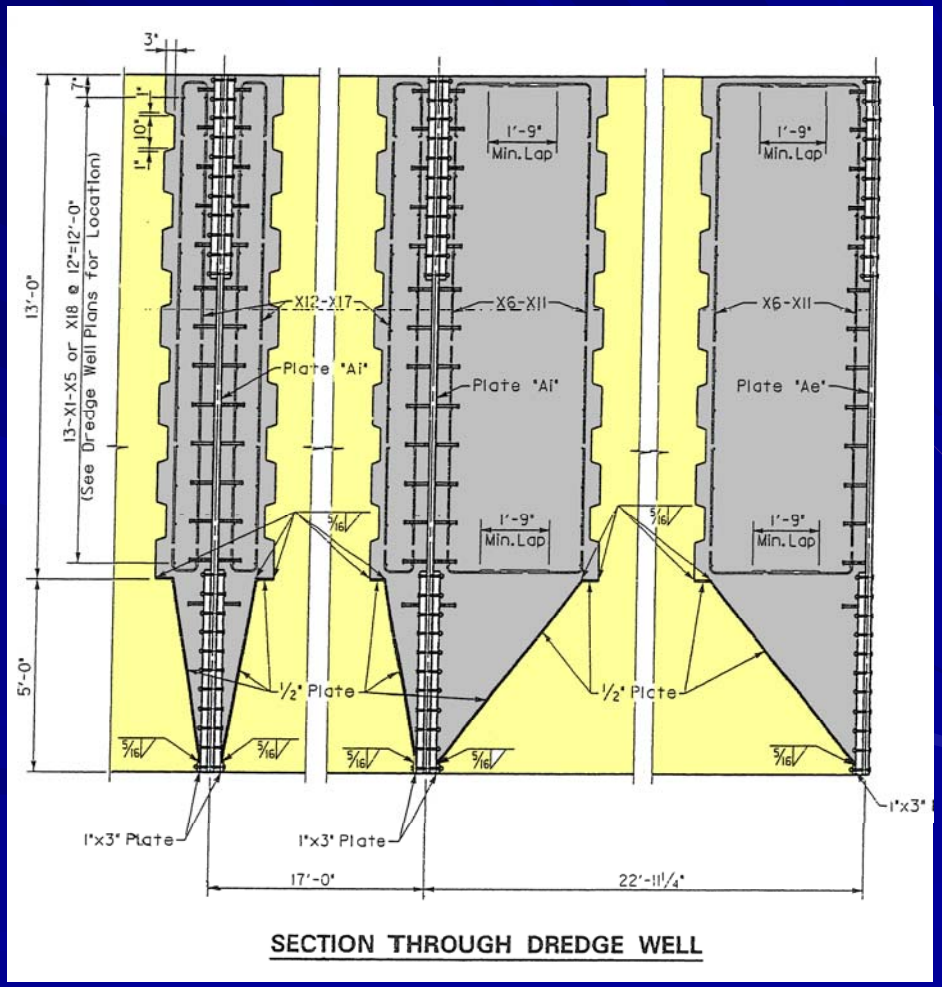


Plan Method: Dredge Well Caisson

3.1 Million Pounds of Structural Steel
$4.5 Million Fabrication Cost

CYTC: Design Build Option



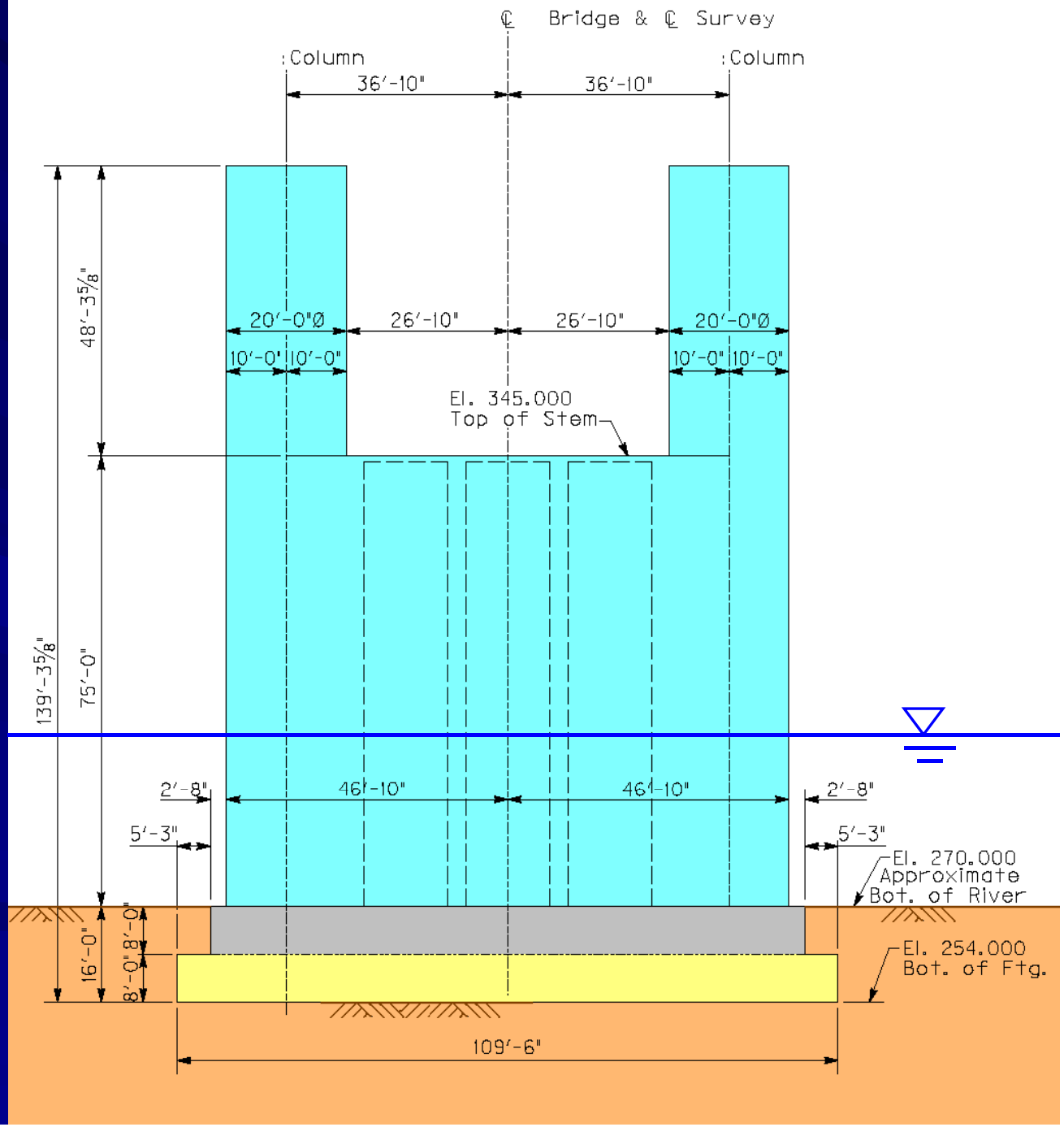


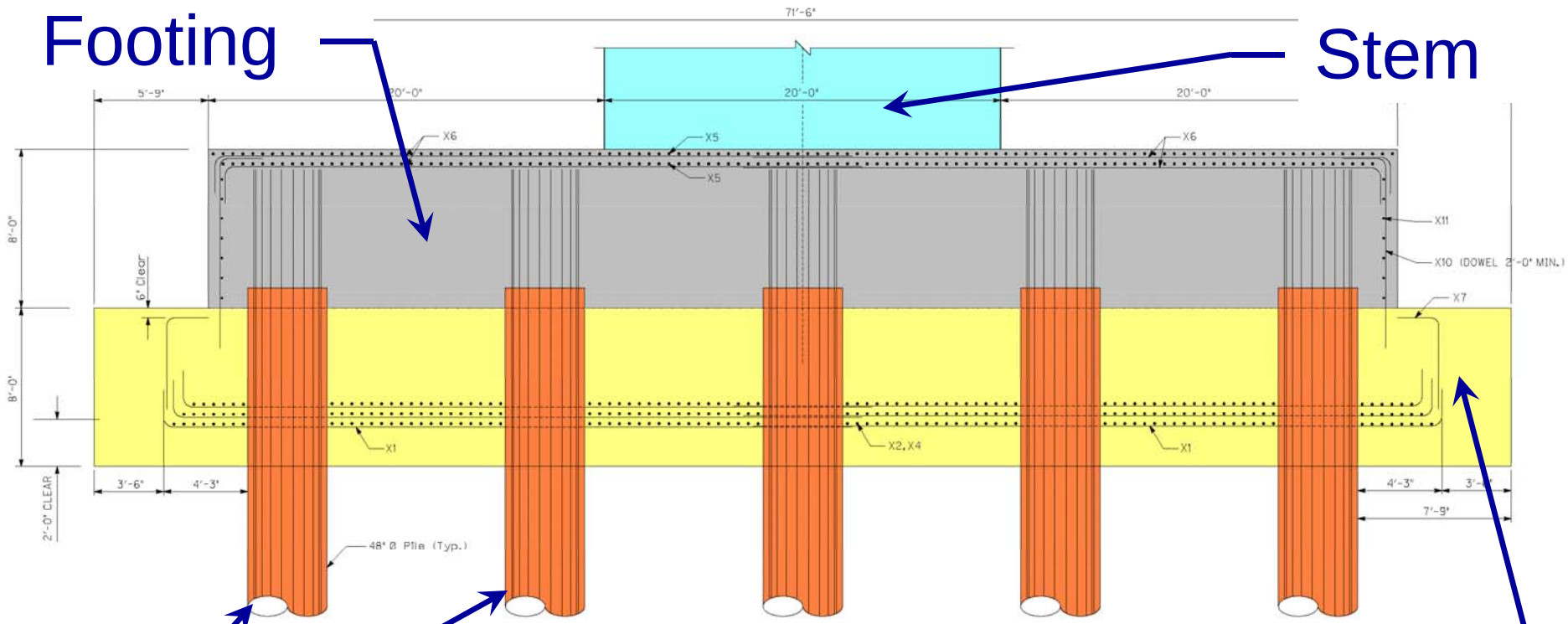
Bid Results

Engineers Estimate:	$23.7 M
American Bridge:	$45.8 M
Massman Construction Co.:	$39.4 M
C. J. Mahan Construction Co.:	$28.4 M

Pier 7

Design-Build Alternate for Pier 7





Design – Build Foundation at Pier 7

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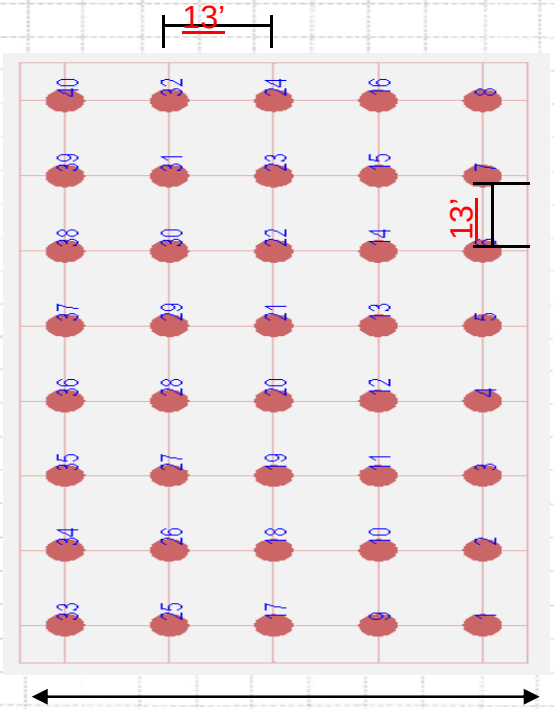
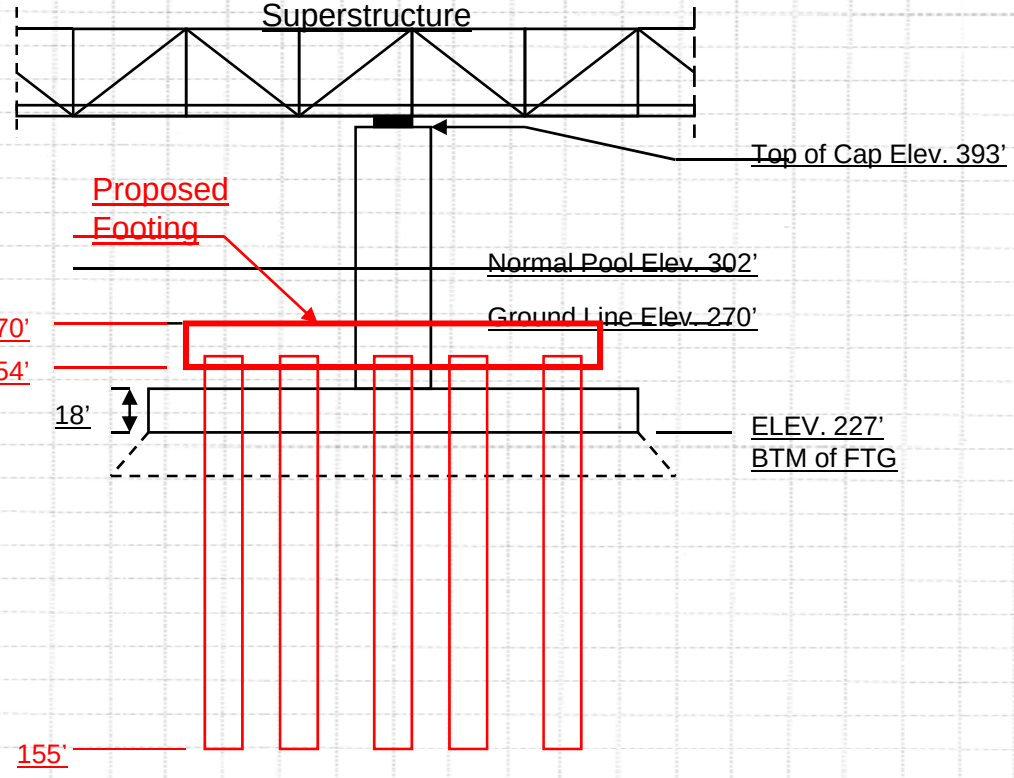
PIER 7 Top of Footing at Mudline

A scour evaluation was performed, the scour depth was determined to be 35 feet



Pile Layout



Side View

Design Logic for a Pile Foundation

- Determine a preferred minimum depth for the cofferdam
- Address scour concerns
- Establish a design footing elevation
- Establish an acceptable construction procedure
- Do not use a traditional cofferdam concrete seal

Pile Group Uplift Capacity

Weight of Structural Tremie = 9200 Kips

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JOB US-60 over Tennessee River
SHEET NO. 3 OF 3
CALCULATED BY J.N. DATE 4/14/2006
CHECKED BY DATE
SCALE PIER 7 Design Build

PIER 7 Piles Uplift Capacity

Assumptions:
1. The average total unit weight of the pile and soil is 137 pcf.
2. The effective weight of the soil and pile is 75 pcf or 0.075 kcf. (buoyancy weight)
3. The unit shear on the perpendicular surface of the group is assumed 1 ksf.
4. The scourable depth of 30 feet was not included in the uplift capacity evaluation. The pile length below scour bottom is 85 feet.

AASHTO 17th Edition Section 4.5.6.6

Use 48" diameter open ended Pipe Piles

The design uplift capacity of a single pile = .333 x ultimate frictional capacity determined by static analysis

From Static Analysis, the ultimate frictional capacity of a single pile is 4800 Kips.

The design uplift capacity of a single pile = 1600 Kips

AASHTO Section 4.5.6.6.2 design capacity of a pile group is the lesser of:
1. The single pile uplift design capacity multiplied by the number of piles in the group.
2. Two-third of the effective weight of the pile group and the soil contained within a block defined by the perimeter of the group and the embedded length of the piles.
3. One-half the effective weight of the pile group and the soil contained within a block defined by the perimeter of the group and the embedded pile length plus one-half the total soil shear on the perpendicular surface of the group.

Design capacity of a pile group is the smaller of:
1. 40x1600 = 64,000 Kips.
2. (2/3)x{95x56x85x(.075)} = 22,610 Kips.
3. (1/2)x{95x56x100x(.075)}+2x(56+95)x100x1 = 19,995 + 30200 = 50,150 Kips

USE a design uplift capacity of the pile group = 22,610 Kips

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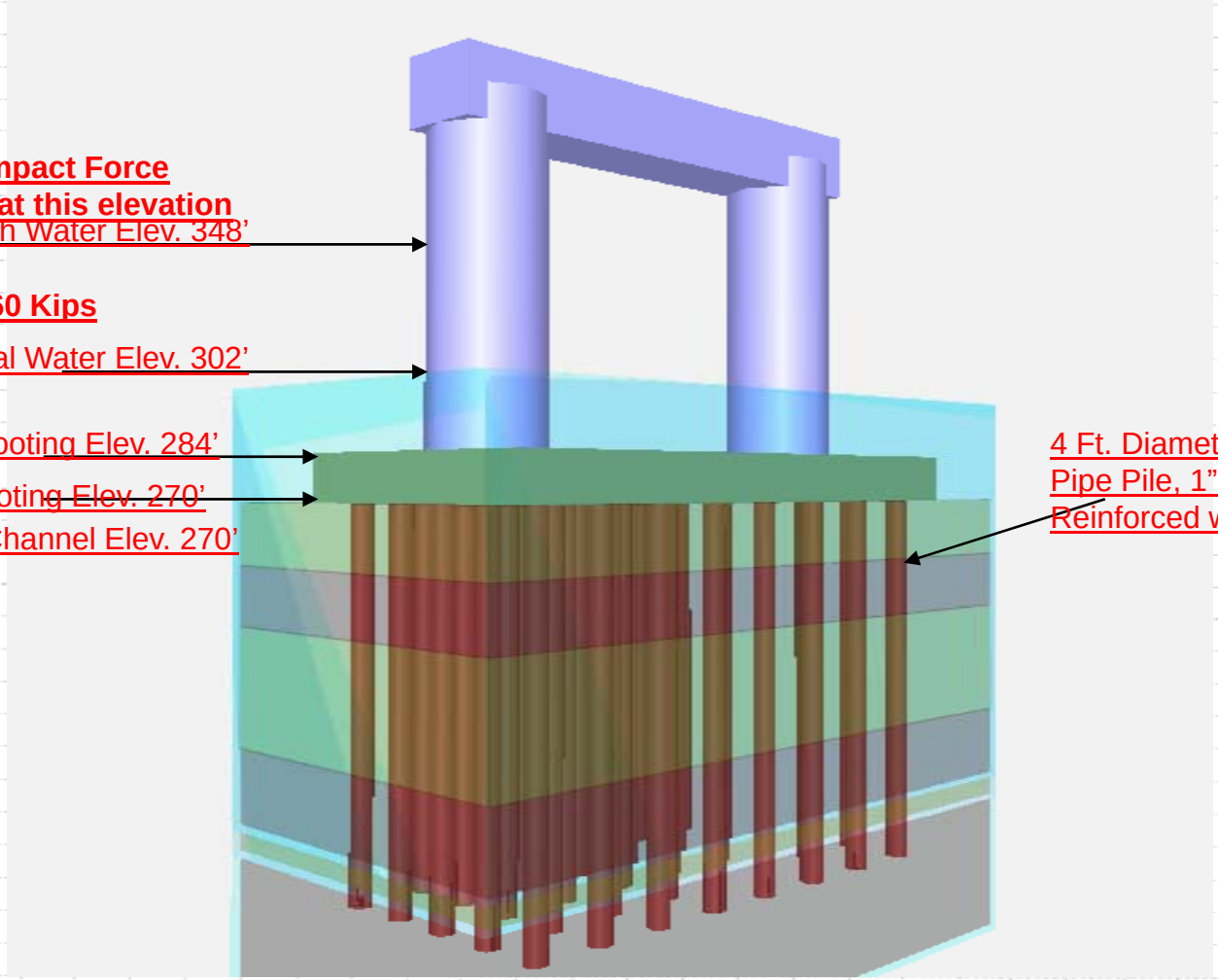
JOB US-60 over Tennessee River
SHEET NO. 5 OF 7
CALCULATED BY J.N. DATE 11/23/2005
CHECKED BY DATE
SCALE PIER 7 Design Build

48” Diameter CIP Open Ended Pipe Piles



3-Dimentional view of Pier 7

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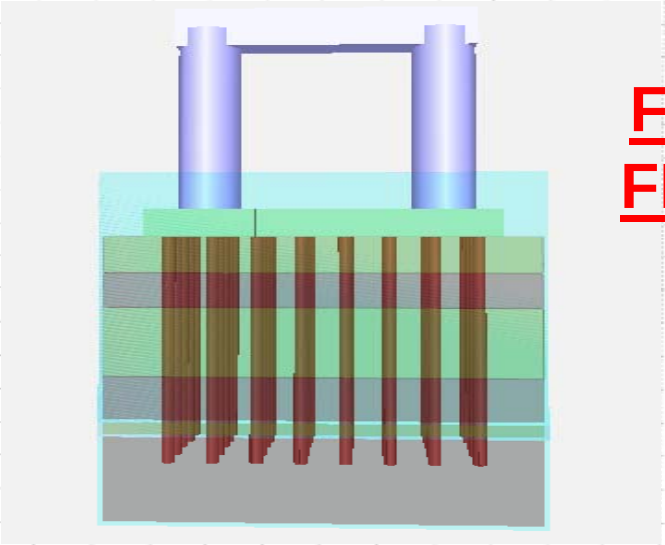
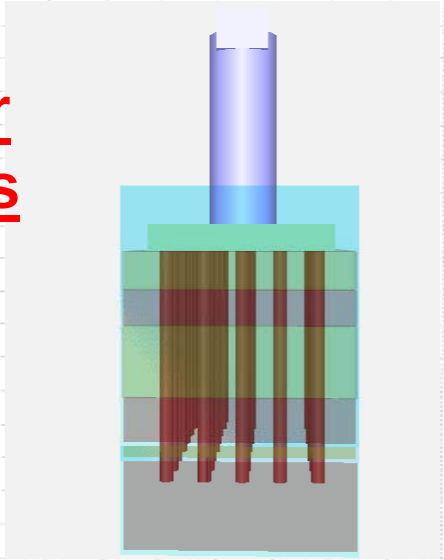
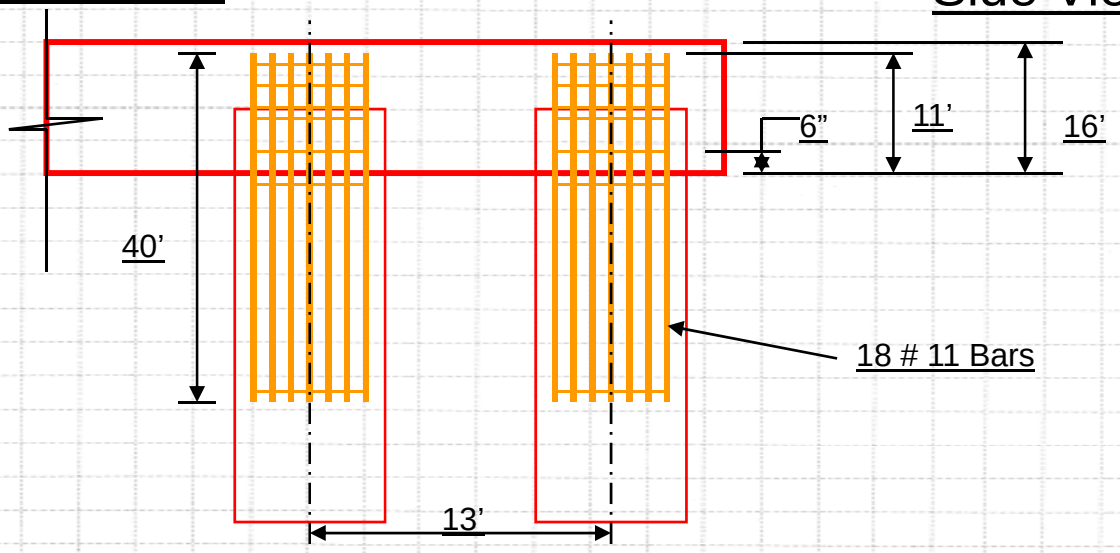


FB-Multi Pier FEM Analysis



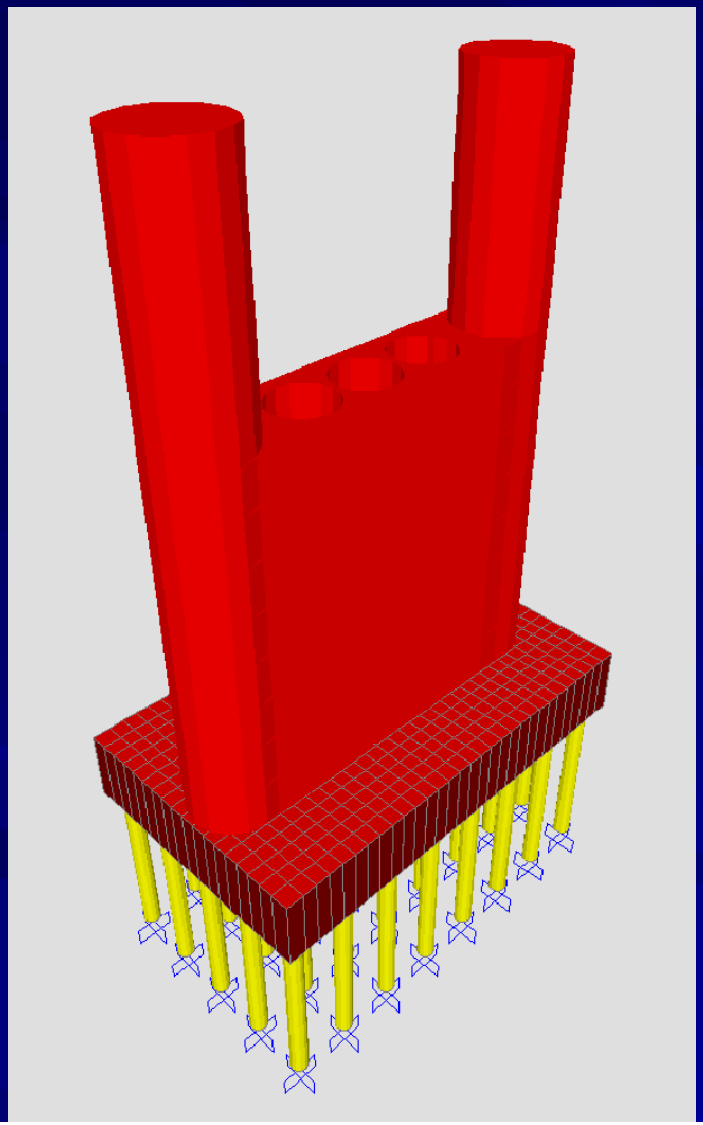
Front View

Side View

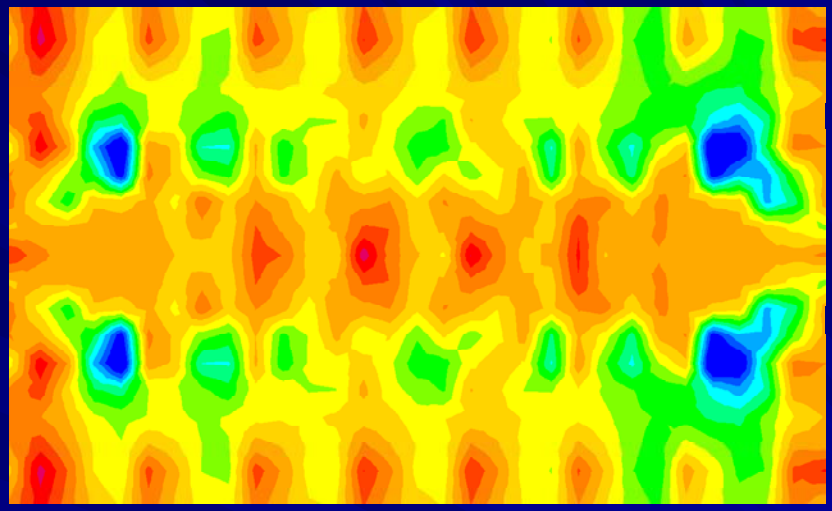


Detail of pile to cap connection

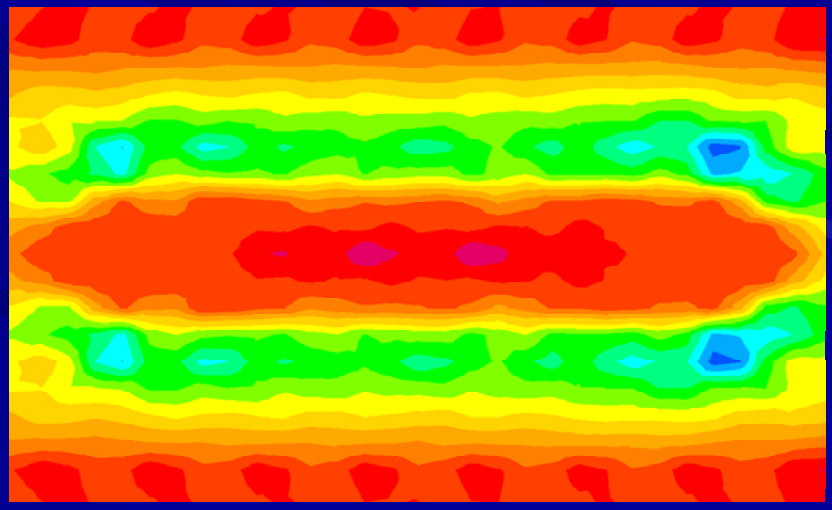
SAP 2000 FEM Analysis



Moment in longitudinal direction



Moment in transverse direction

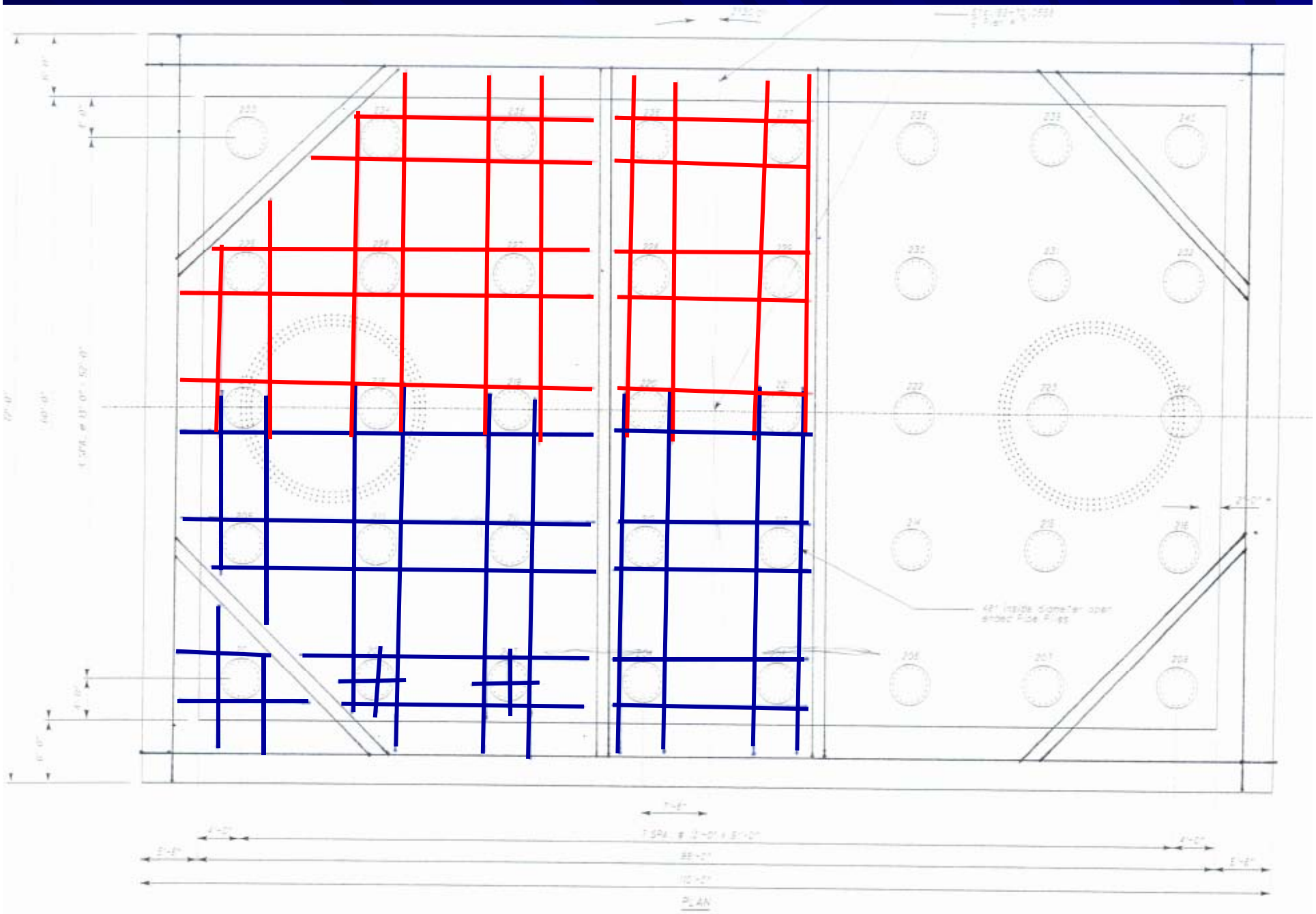


Pile Design

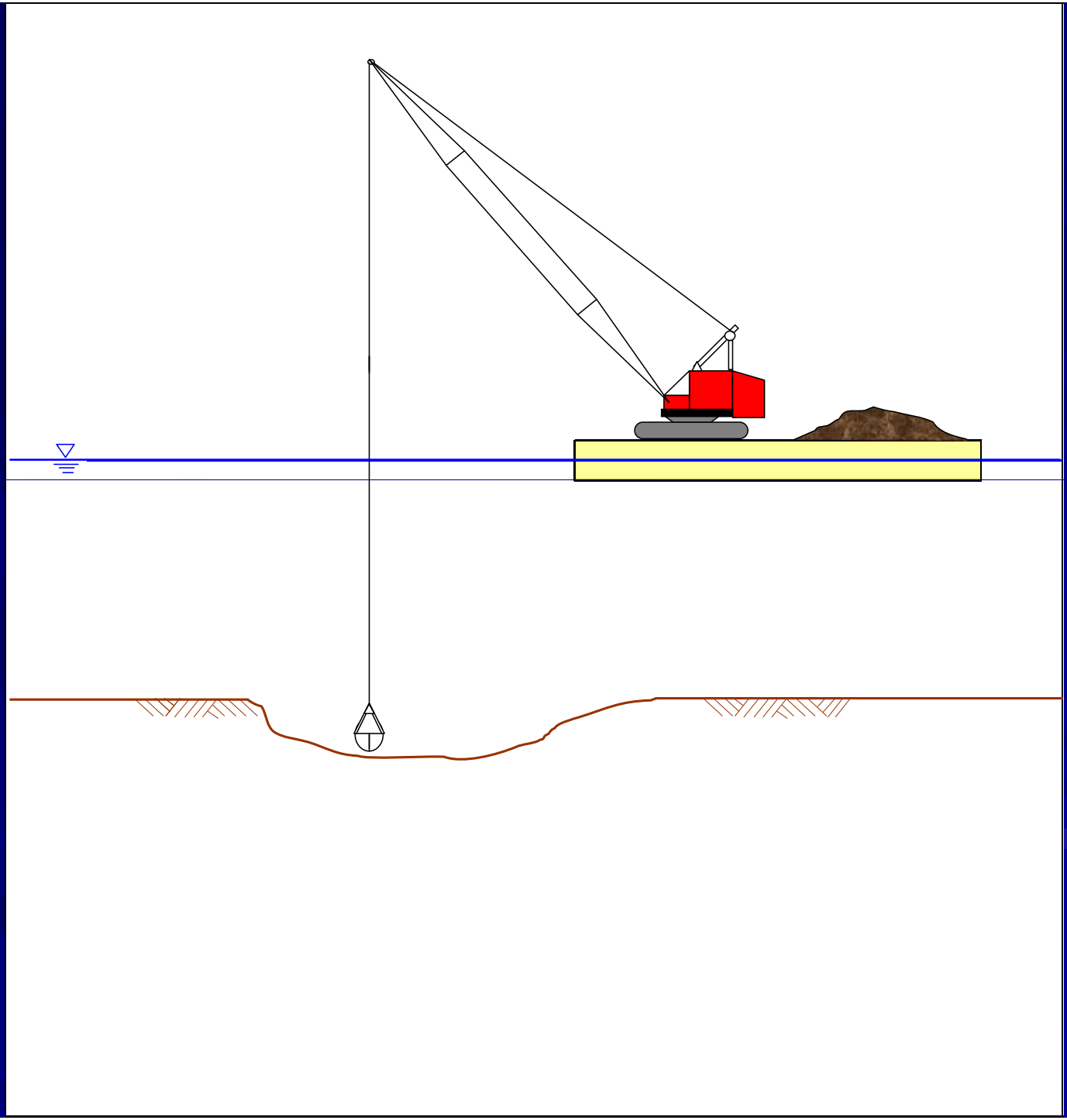
- Structural Design
- Geotechnical Design
- Scour (35 Feet)
- Barge Impact Load (6600 Kips)
- Drivability
- Pile wall thickness (1 inch)
- Pile reinforcement (18 # 11 top 50 feet)
- Pile plug (5 feet ?)

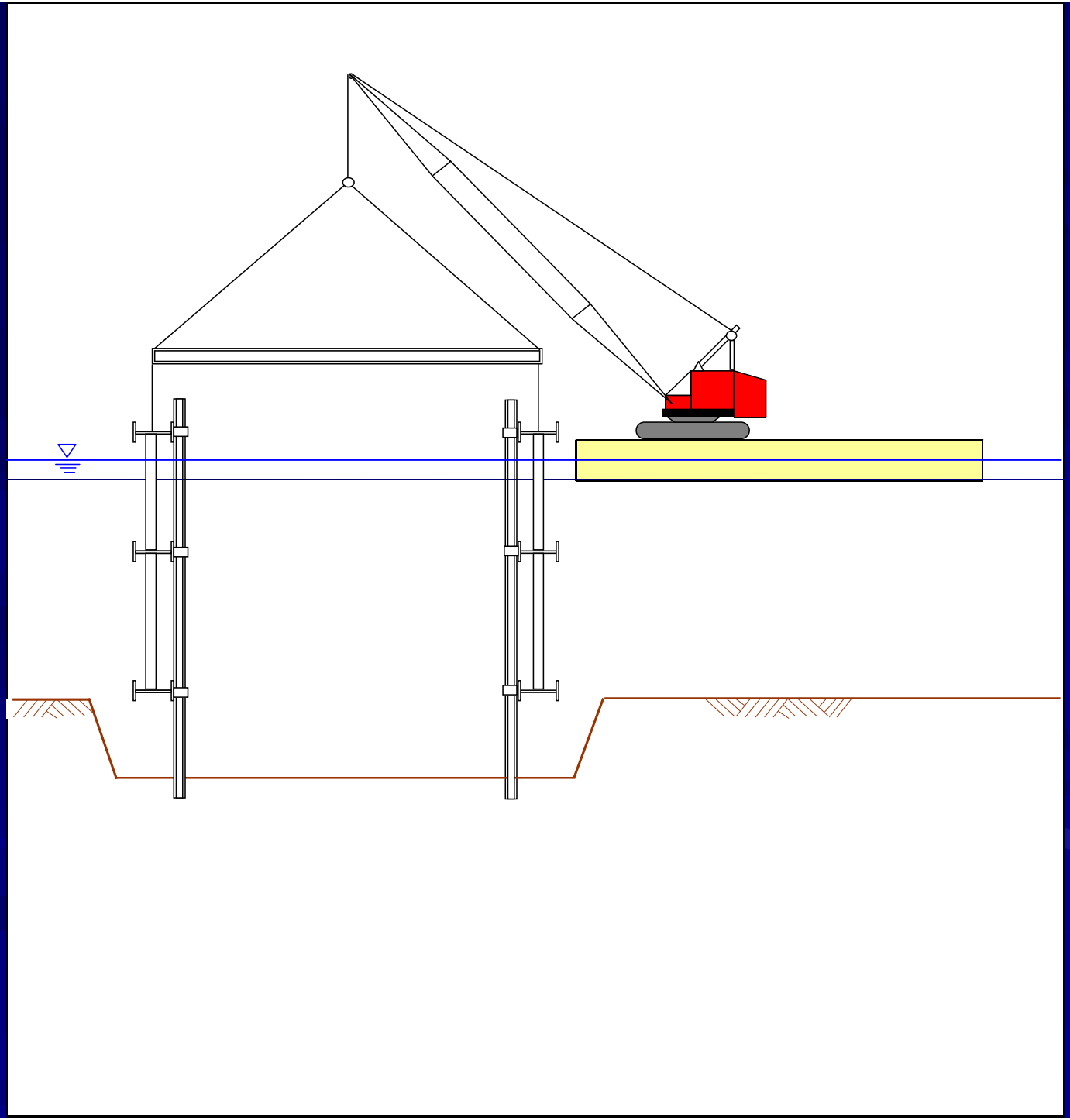
Pier 7 Pile Loads

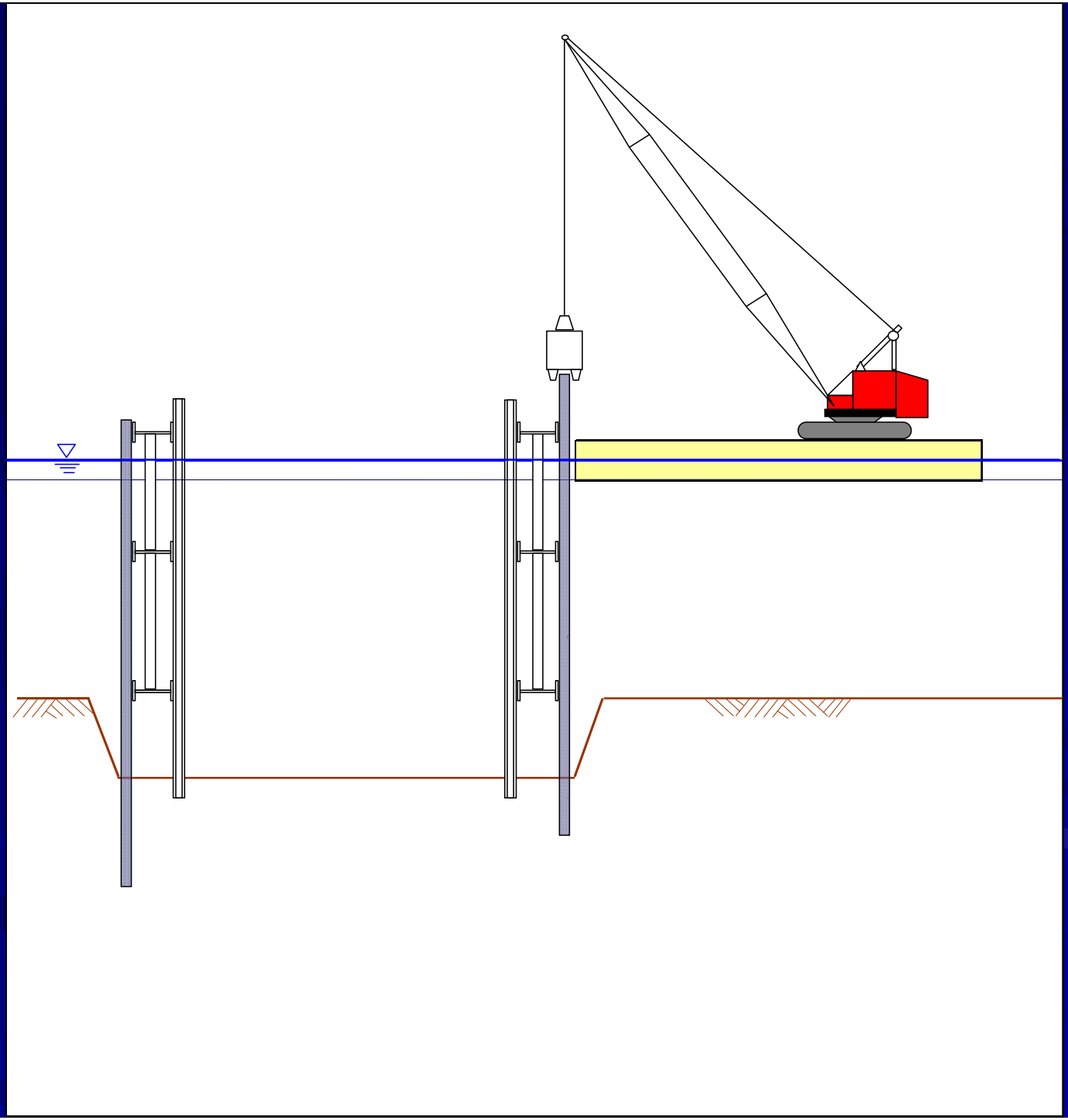
- Load on 48 inch OEP Pile
  - Design = 870 Tons
  - Ultimate = 1960 Tons
- Dynamic Load Test Measurements
  - EOID = ?
  - BOR = 2150 Tons

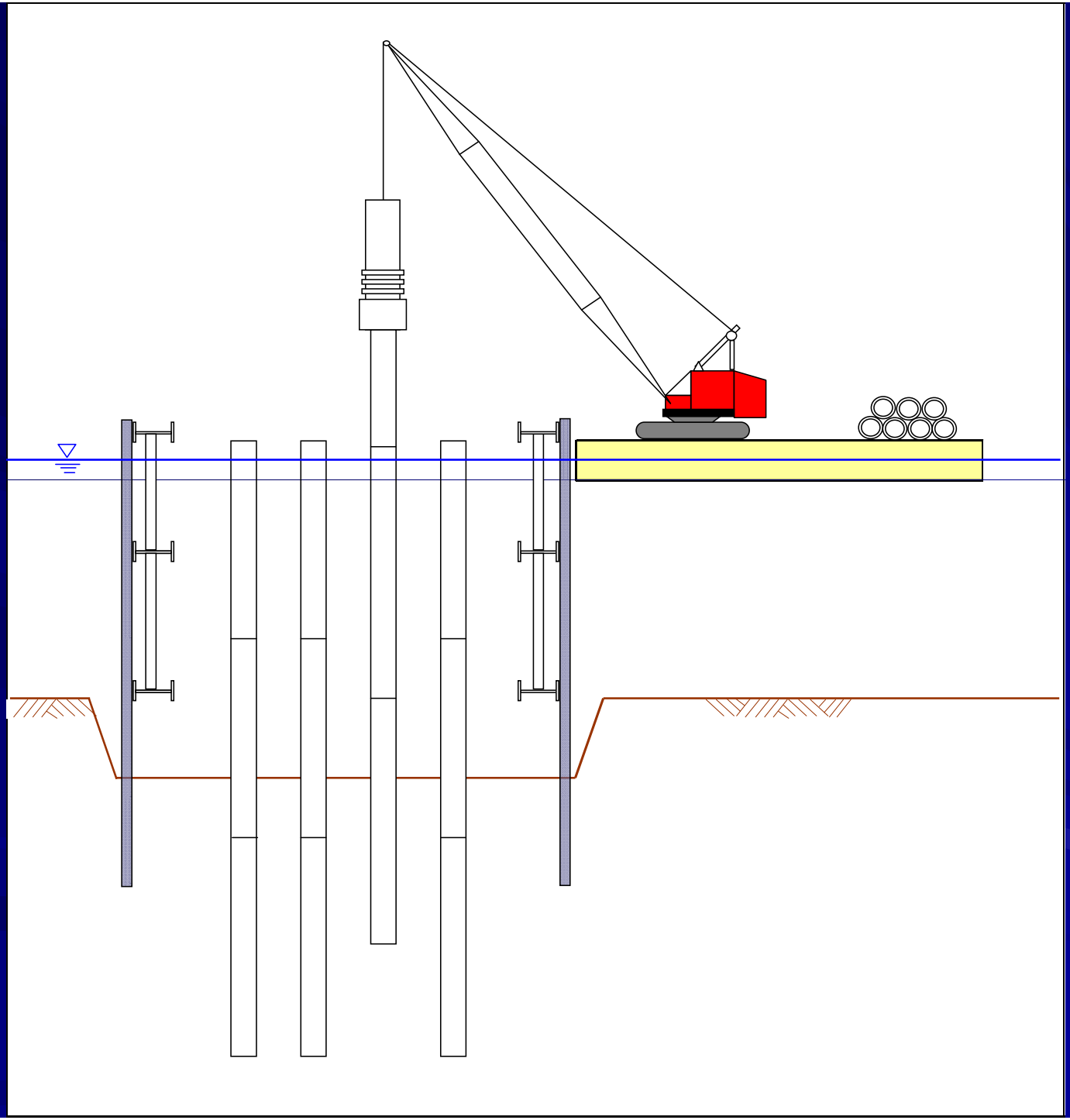

PLAN

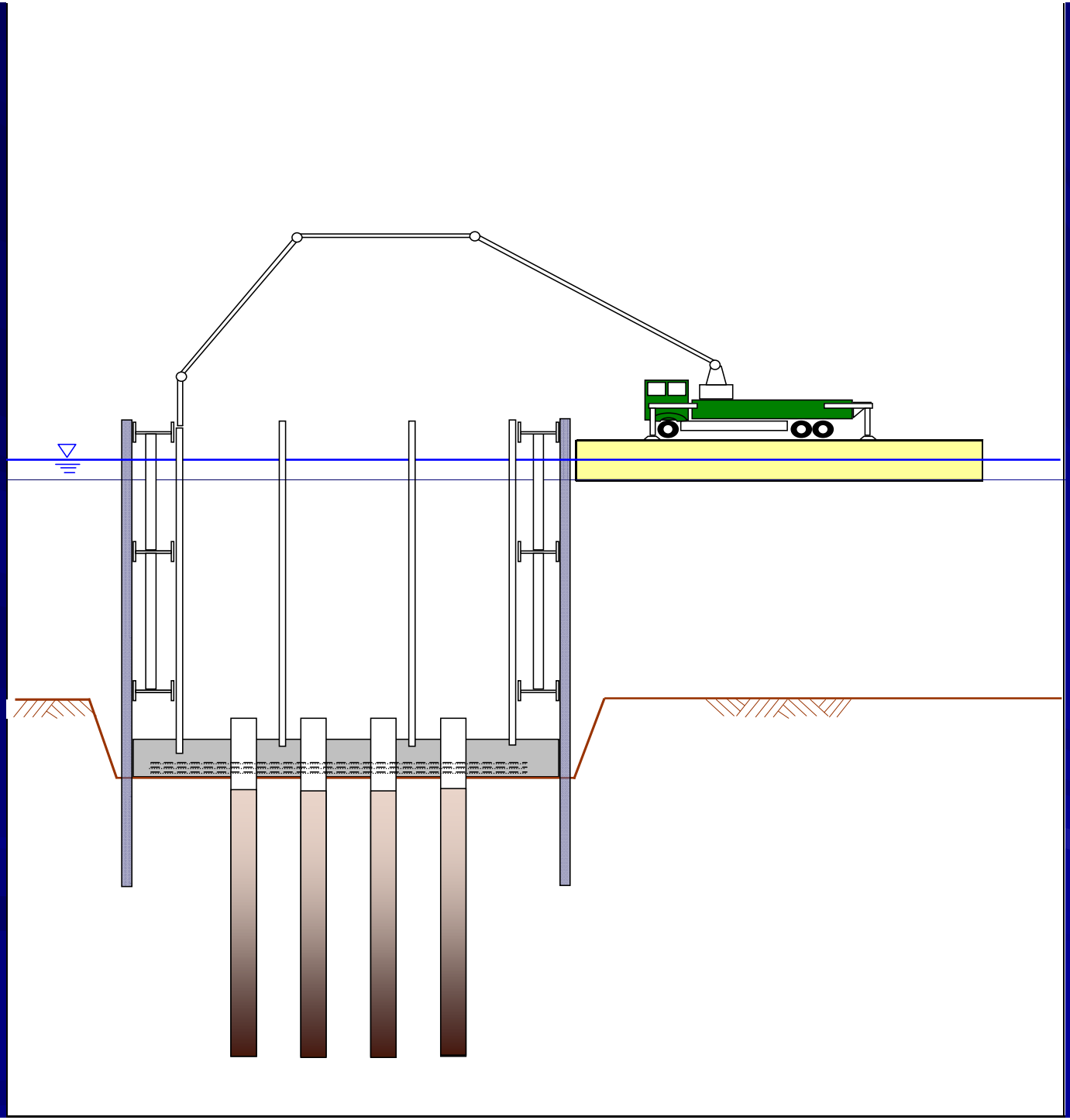
Pier 7 Construction

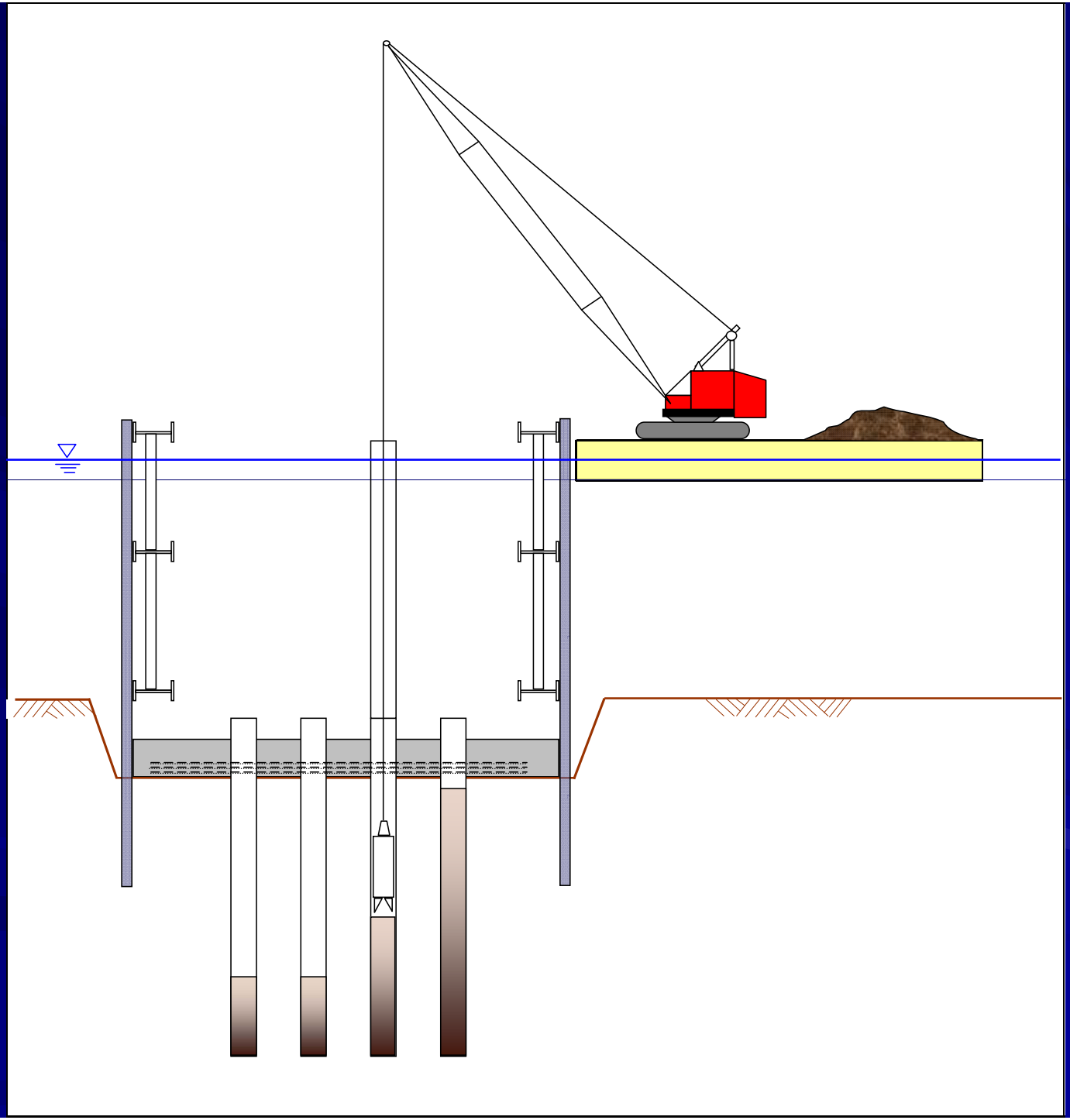


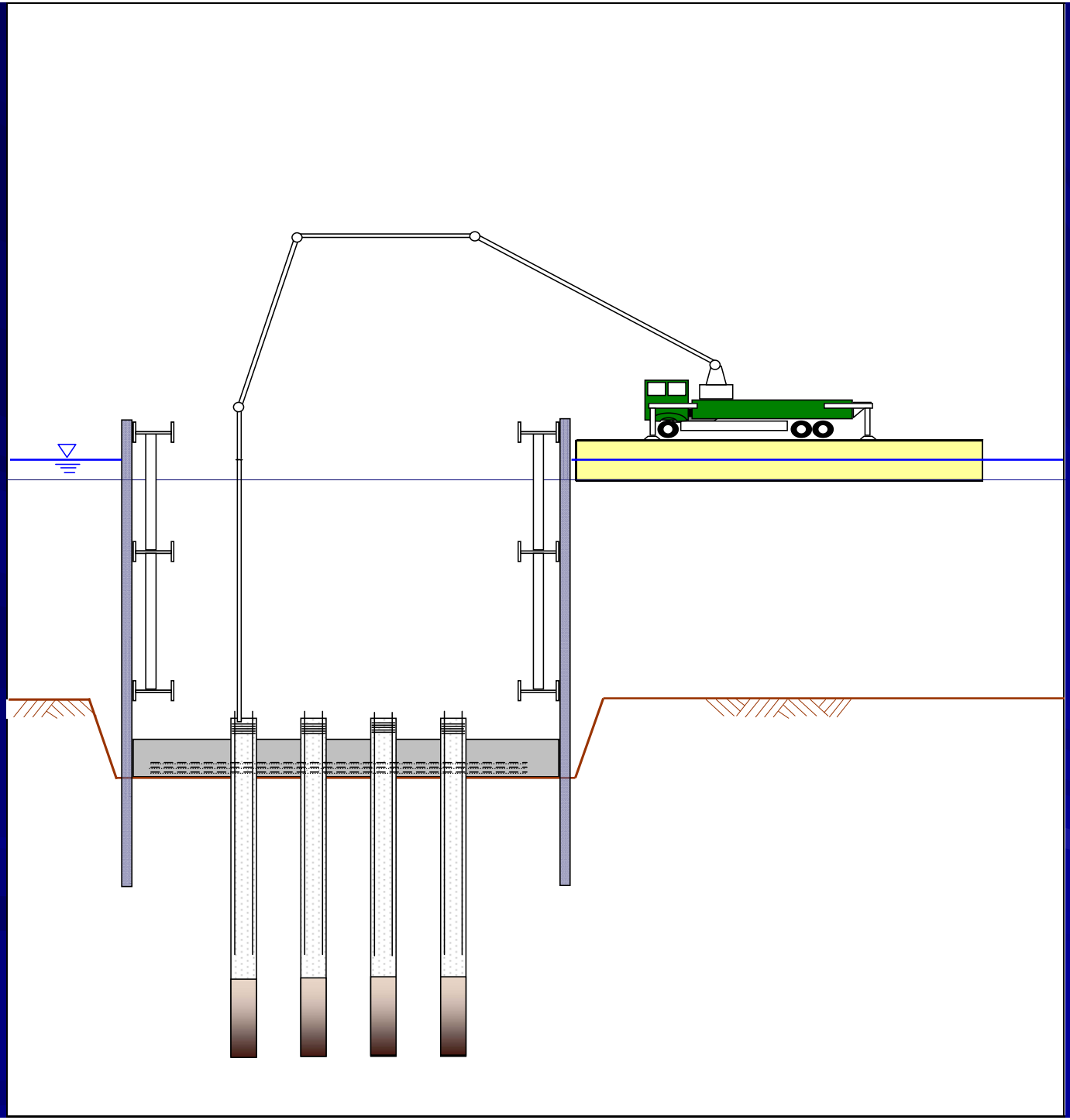


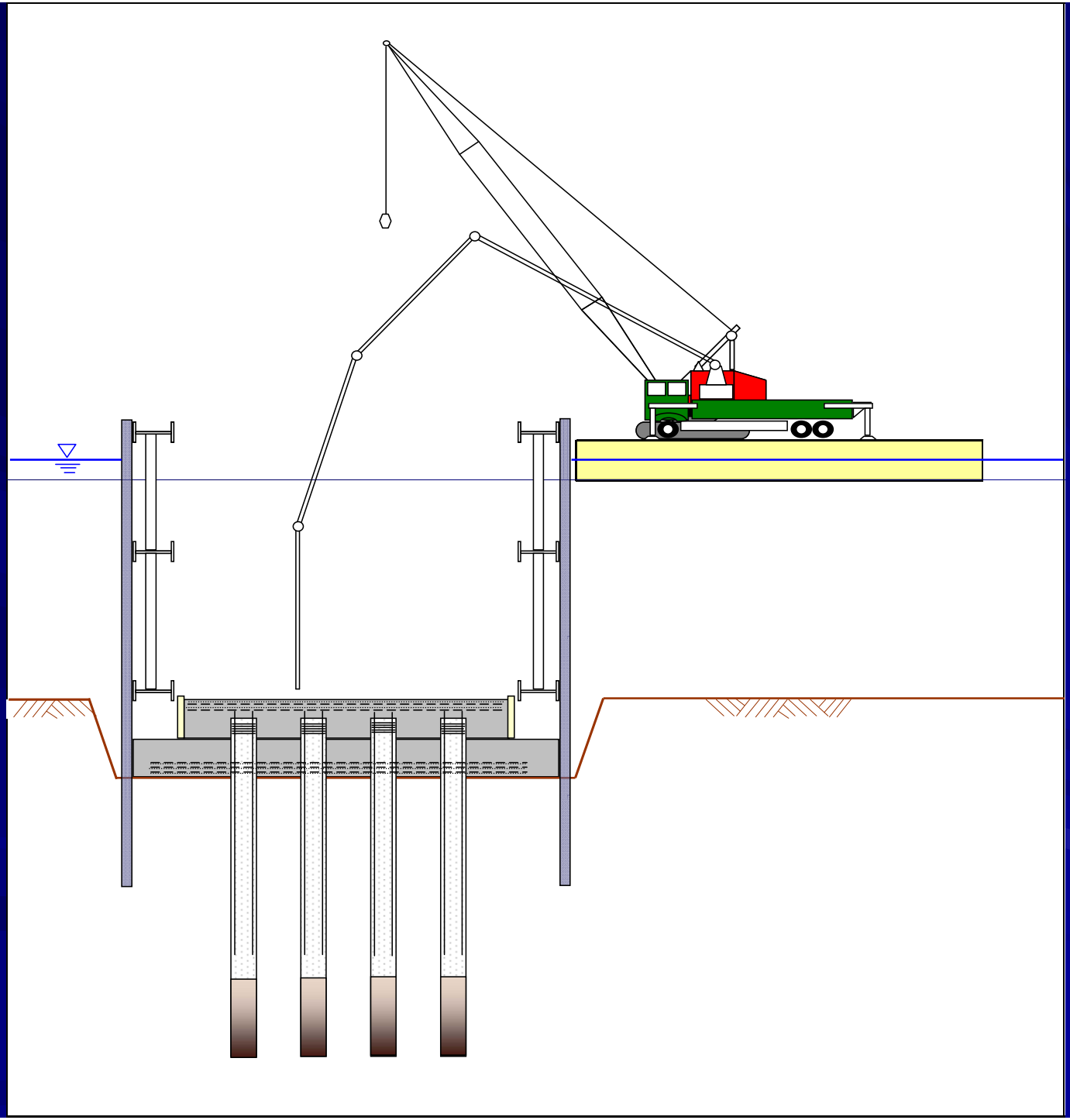


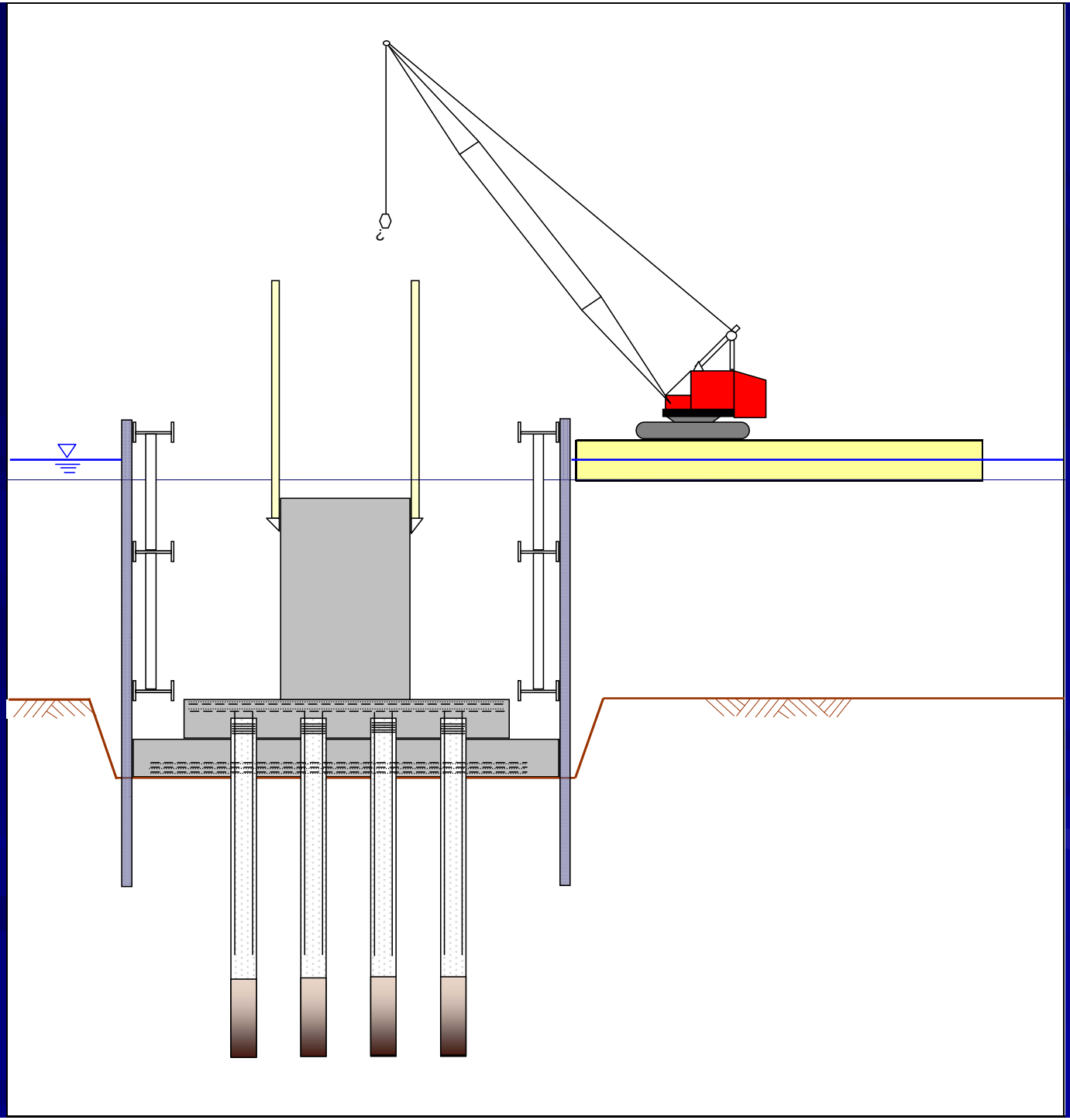


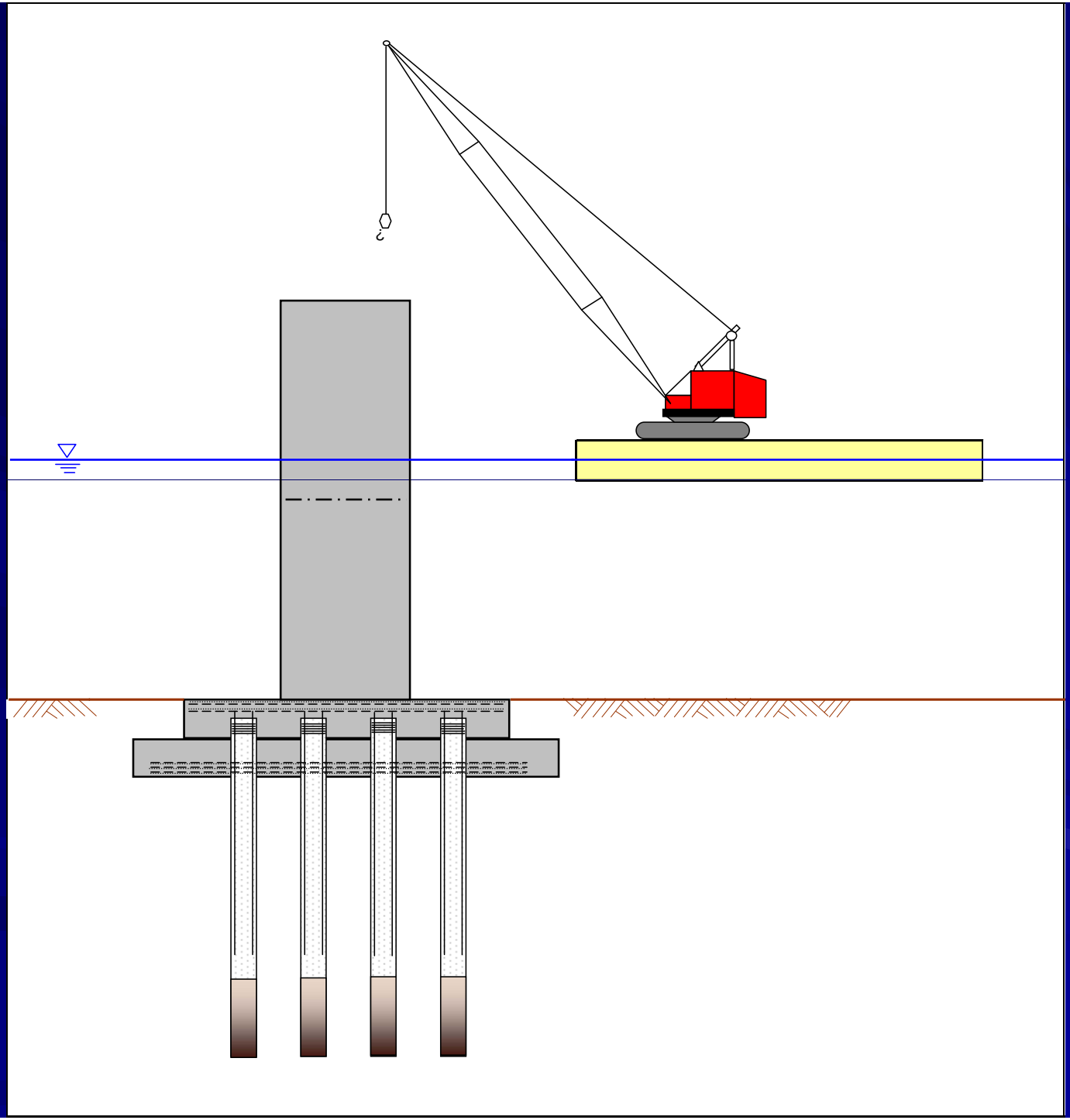


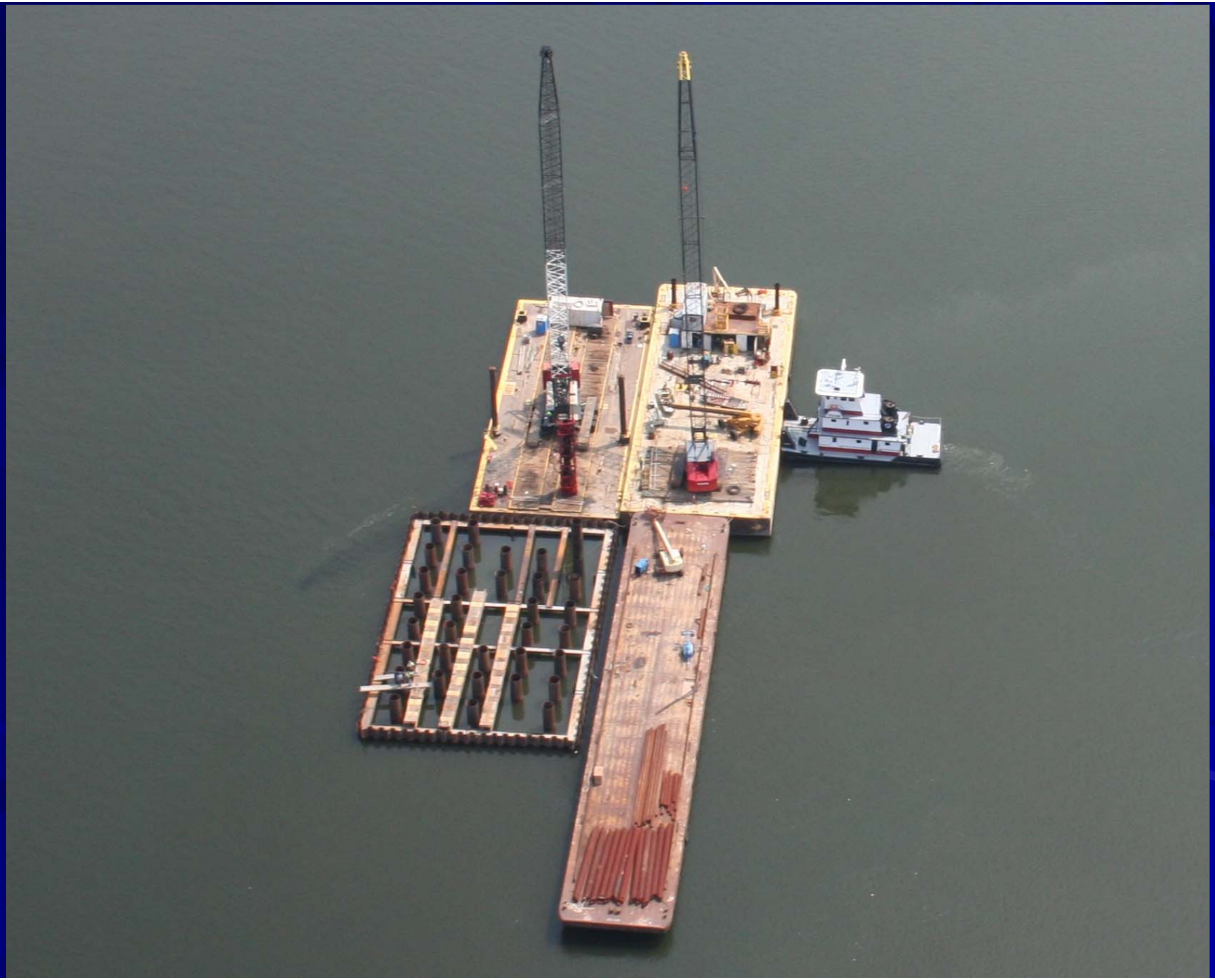






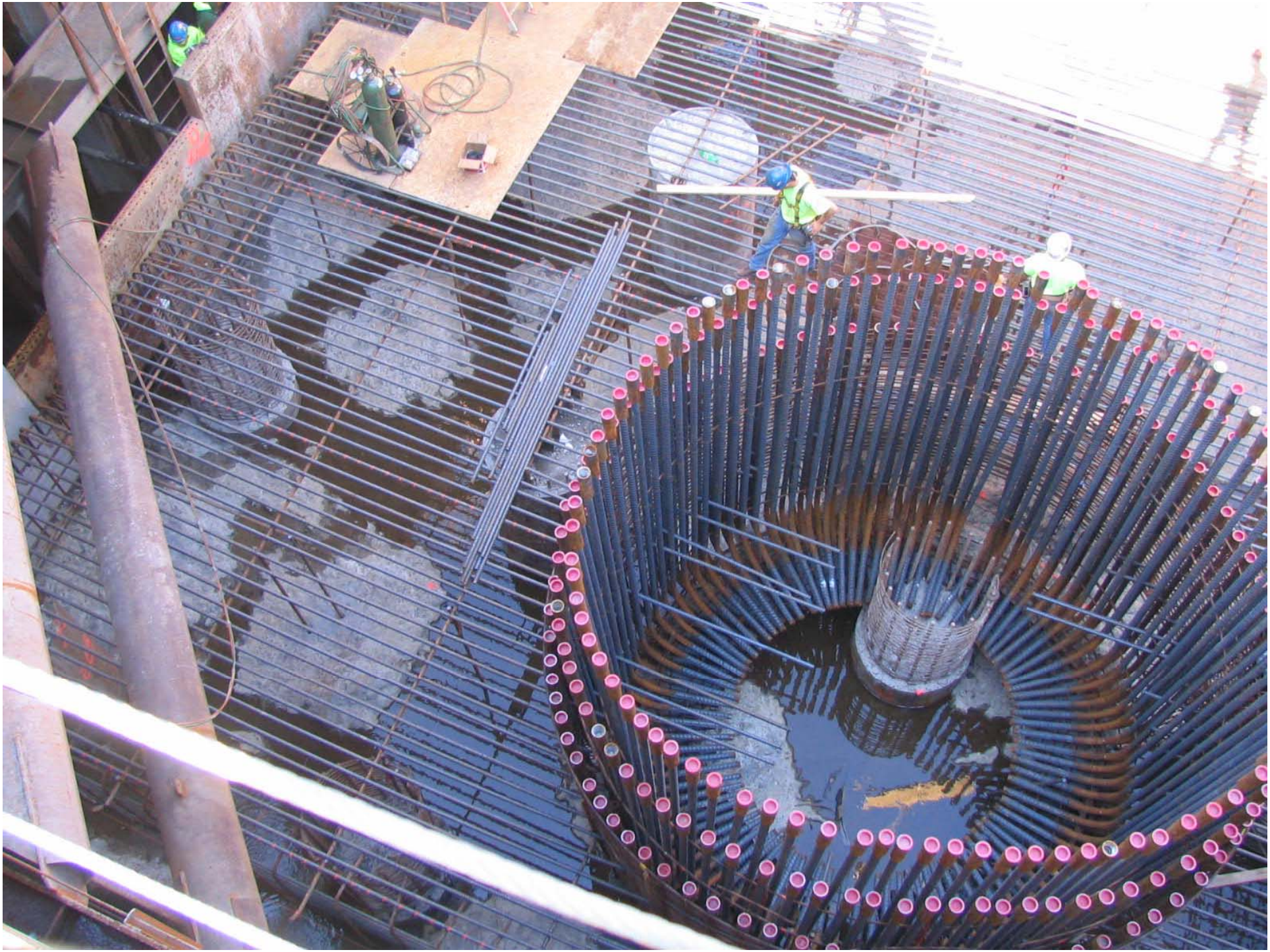


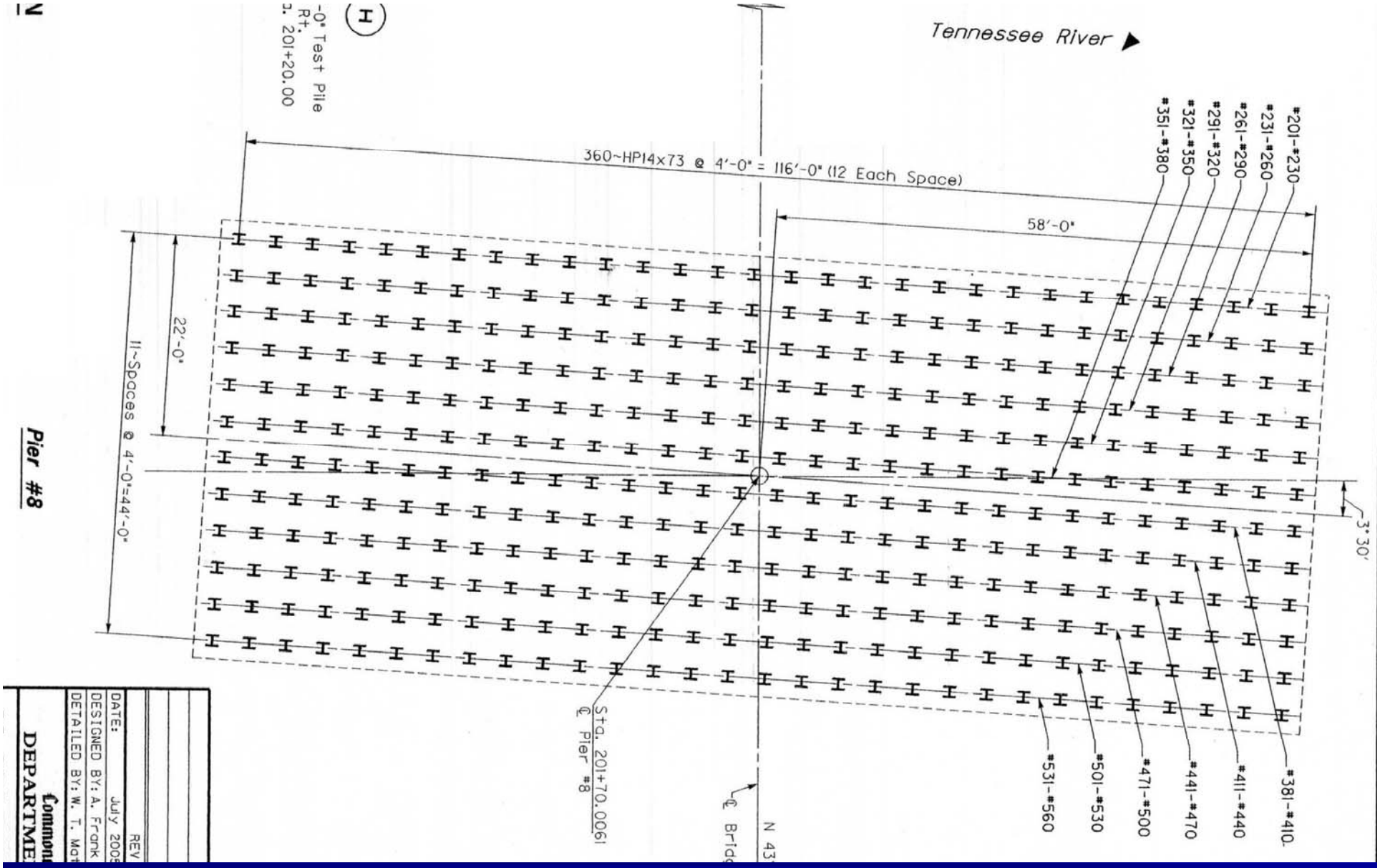




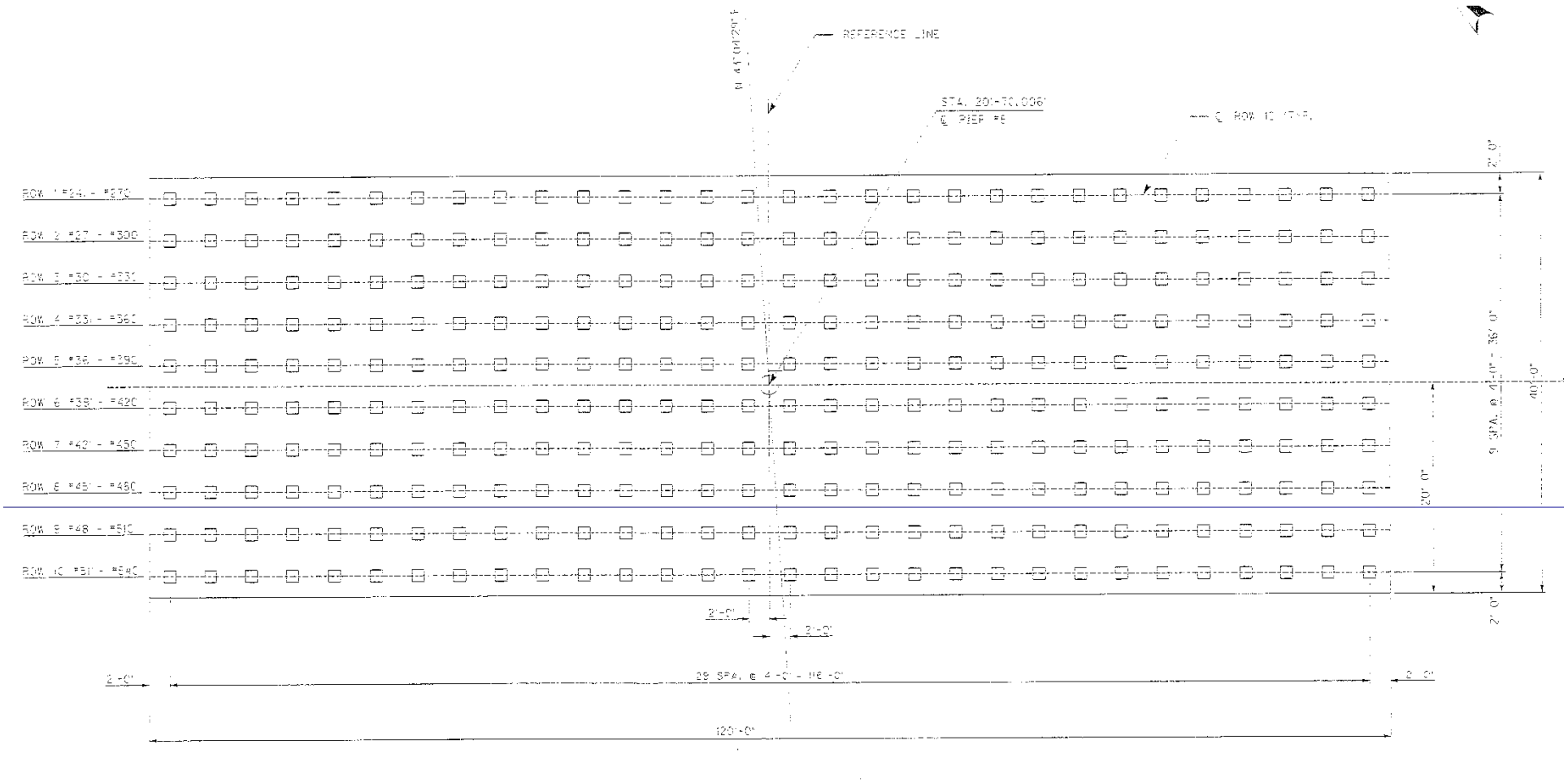

10/20/2007


09/10/2008





Pier 8 Plan: 360 ea. 14” Steel H-Piles @ 56’



Plan

14" Square Precast Prestressed Reinforced Concrete Piles

Pier #8 VECP: 300 each 14" Precast Concrete Piles @ 40'

Pier #8

Pier #9