

GulfQuest

National Maritime Museum of the Gulf of Mexico



Structural Challenges for Design

Presented by:
Robert A. Harvey, P.E.



Main Features of GulfQuest

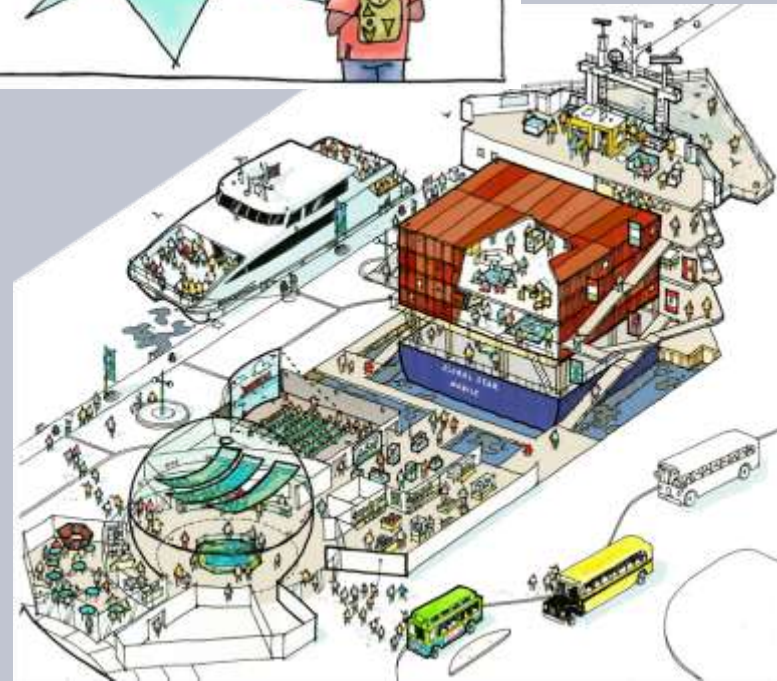


- GulfQuest is a Maritime Museum that emphasizes the rich seafaring history of the Gulf Coast
- Unique building shape, a concrete ship
- On the waterfront
- Small footprint, floor space increases on higher floors
- Bridge, Dome
- Exterior hanging stairs
- Ships bridge and roof, great view of Mobile River waterfront



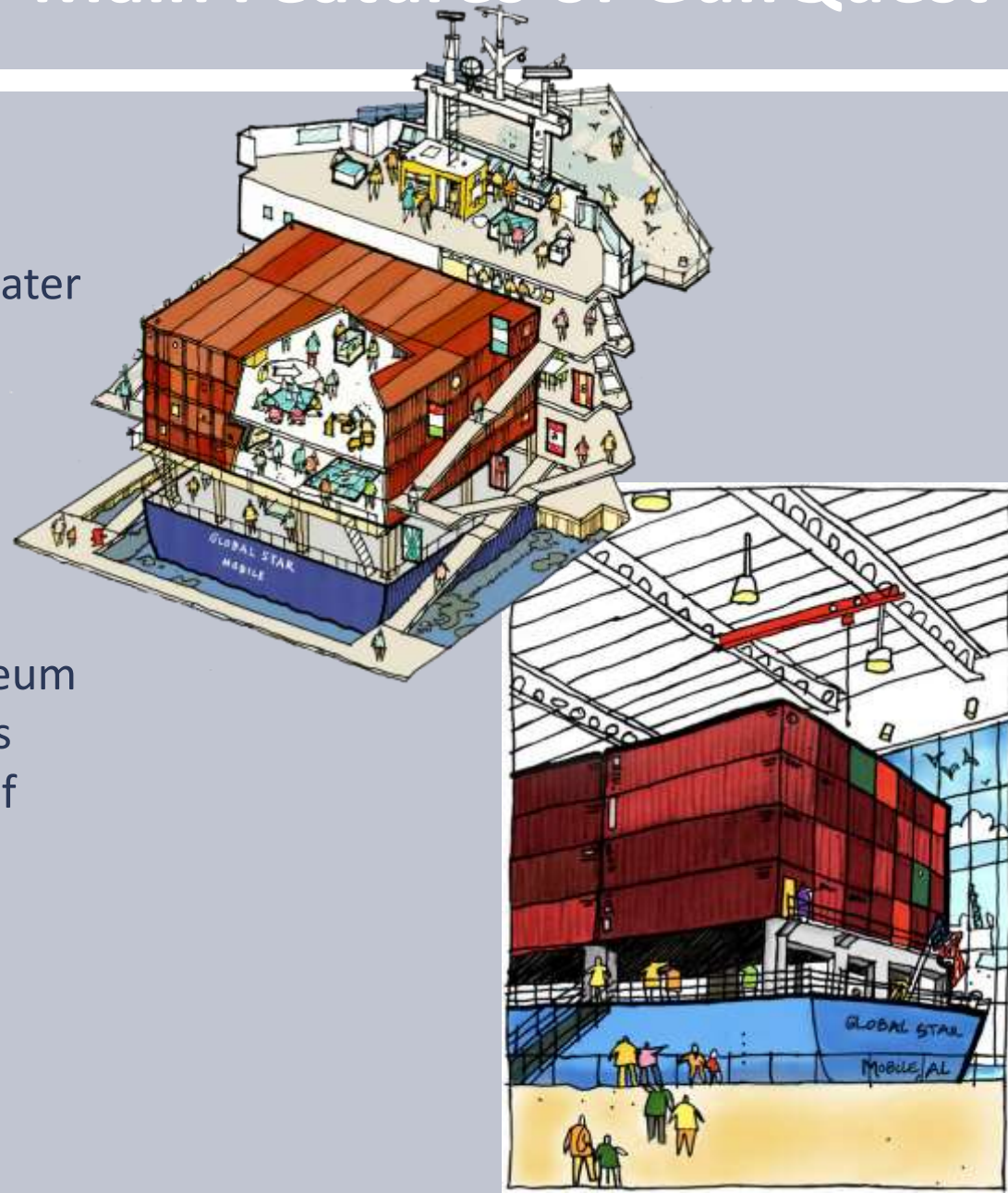
Main Features of GulfQuest

- Within the 90,000 sq. ft. enclosure:
 - Rotunda (3 stories, globe, and grand entry point)
 - Theater
 - Café
 - Store
 - Atrium



Main Features of GulfQuest

- Within the 90,000 sq. ft. enclosure (continued):
 - Discovery dock and water feature
 - Full size replica of a container ship
 - Museum displays in container ship
 - Visitor access to museum displays utilizes ramps hung from atrium roof
 - Ship's bridge



- Construction Program Management: Hoar Construction
- First contract: surcharge material for north slab on grade (El. 16.0) – surcharge from El. +8.0 to +16.5
 - Contract cost: \$92,000
 - Contractor: Adams and Son Construction
 - Surcharge height: 8'6"
 - 82 days
 - 1"-3" settlement, greatest toward the river

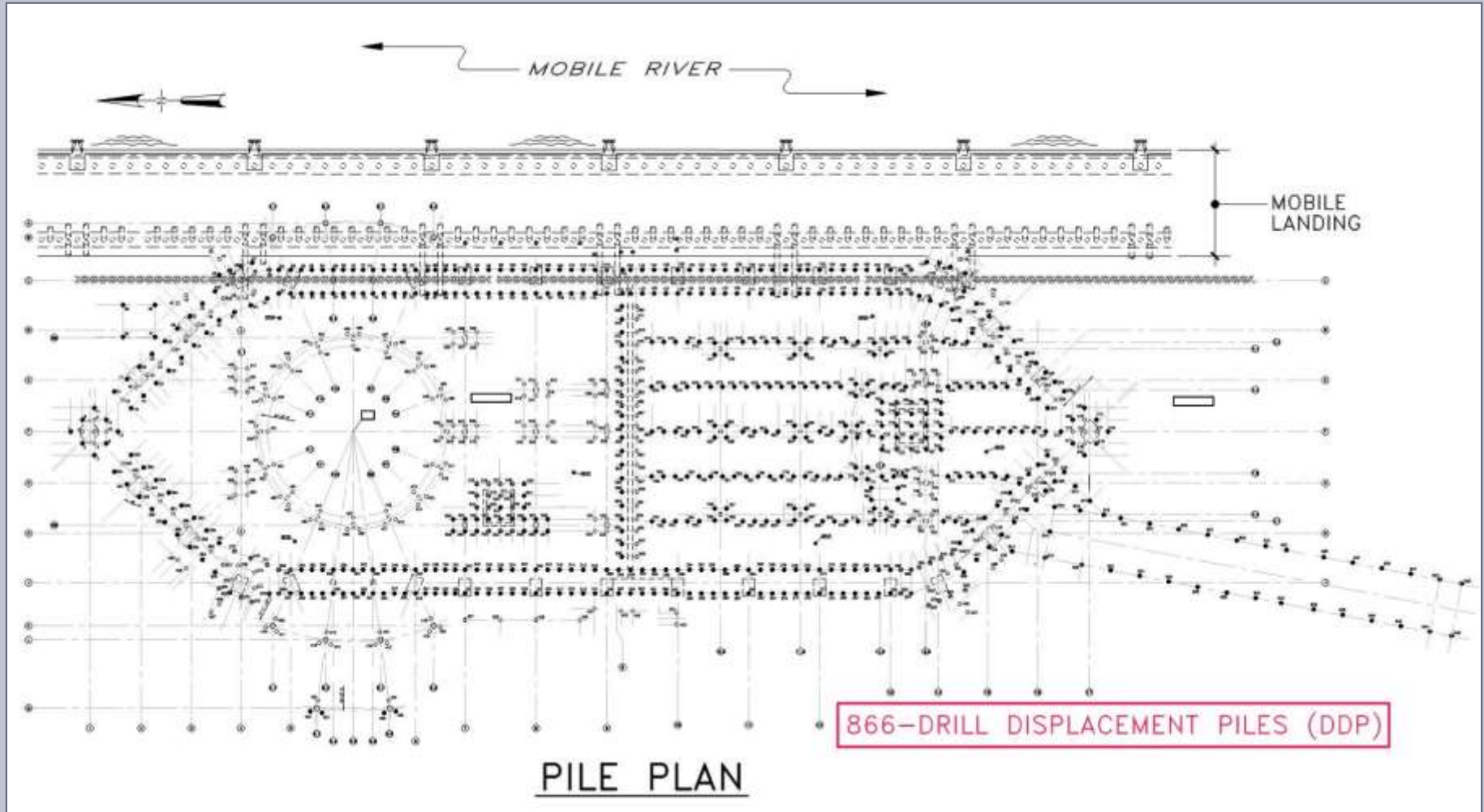


Foundation

- Piling and dewatering contract, \$2.5-million
- General Contractor – Vance McCown
- Subcontractor – Berkel & Company (drilled displacement piles)
- Subcontractor – Burns (dewatering)
- Founded on 866, 16-inch diameter drill displacement piles
- First floor north (El. 16.) floor slab on compacted fill (surcharged)



Foundation



Foundation



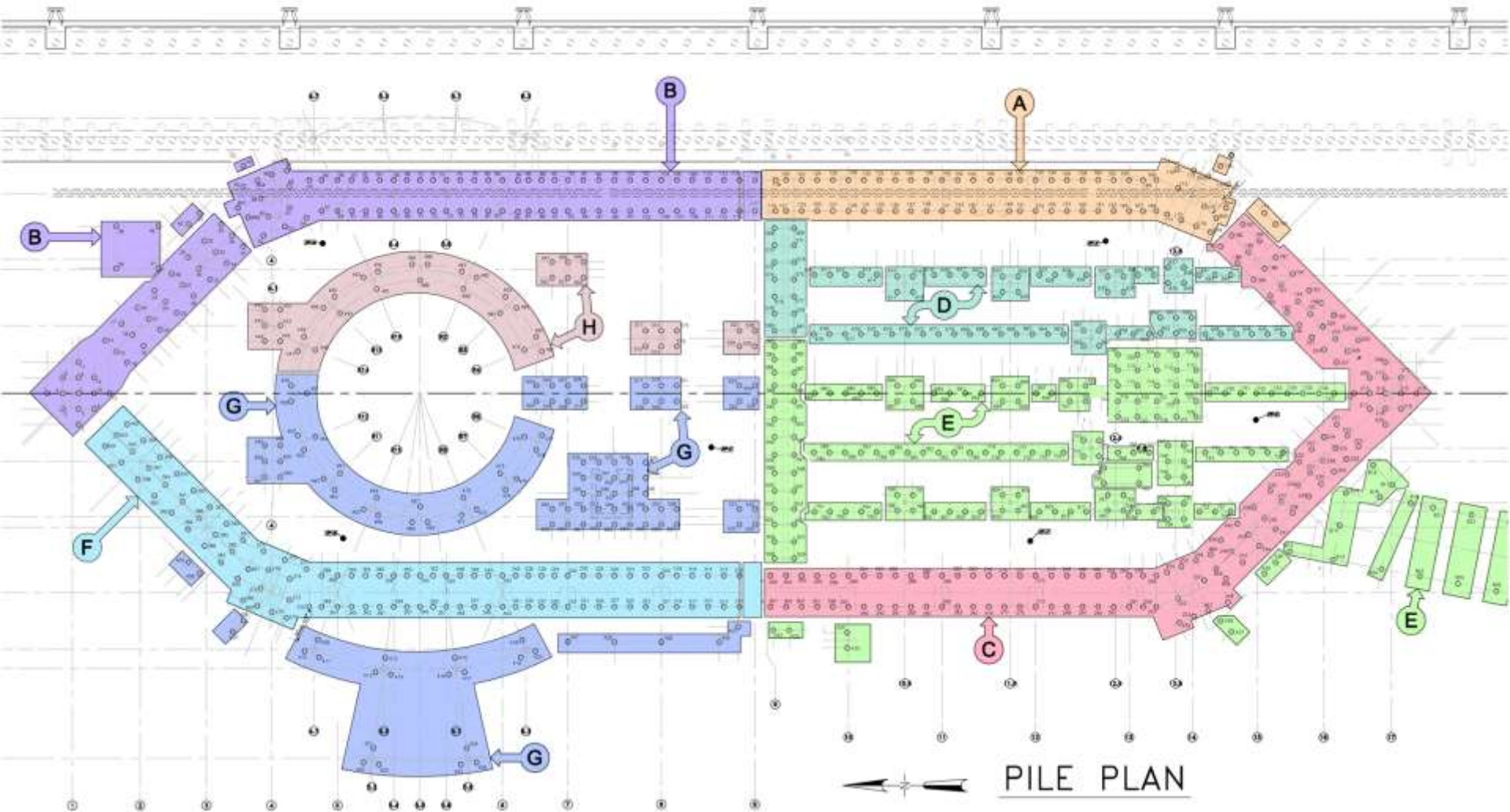
- Shoring
- Well points and dewatering system
- Drill displacement piles
- Basement floor elevation at +6", outside grade is +8.0 ft.
- Basement floor is water proofed to prevent water intrusion

Foundation

TABLE OF DDP PILE INSTALLATION CRITERIA

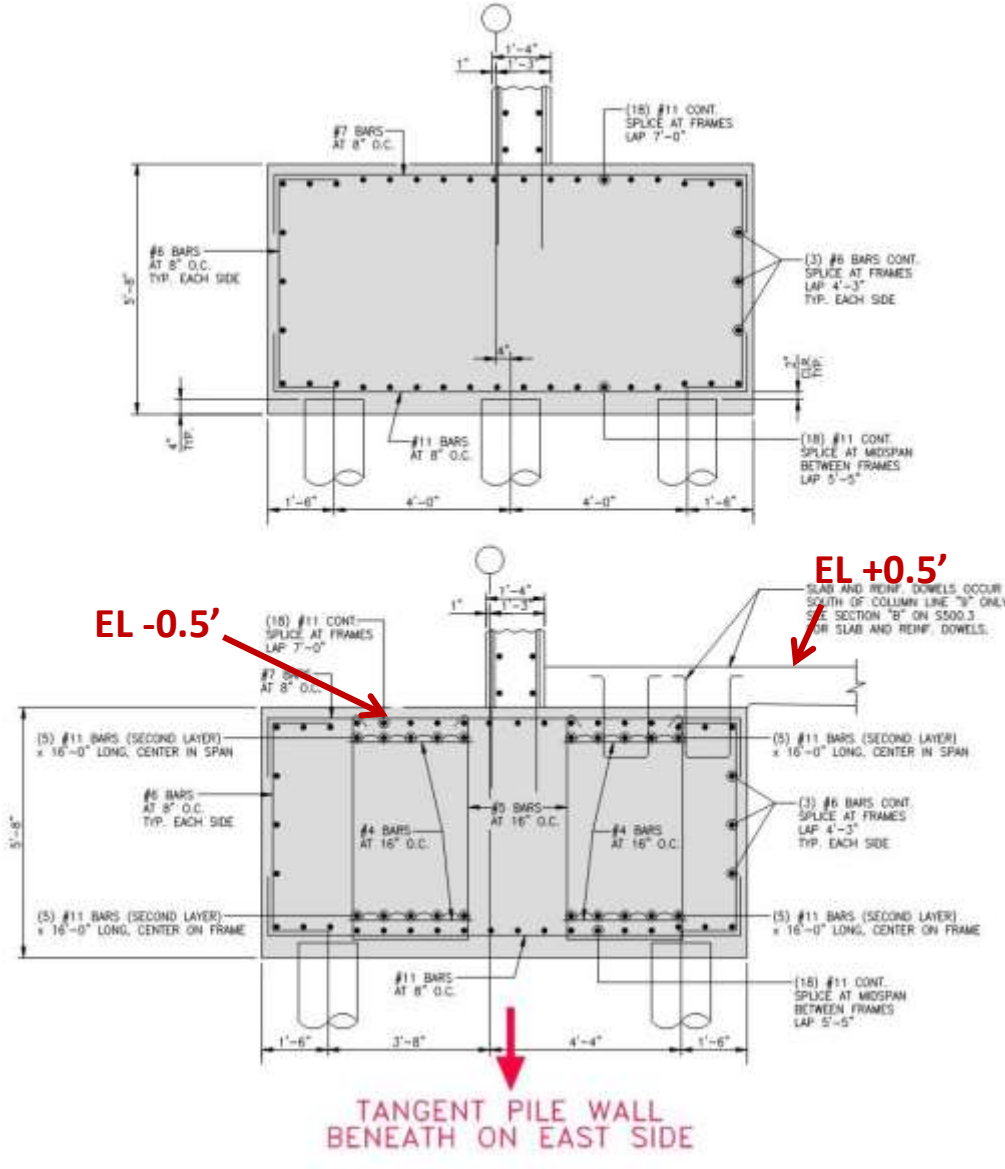
LEGEND	PILE ZONE	GENERAL ZONE DESCRIPTION	REQUIRED PILE TIP ELEVATION	REQUIRED IE CUMULATIVE VALUE
	A	SOUTHEAST PERIMETER	-40.0 (or refusal*)	Minimum of 300
	B	NORTHEAST/DIAG. PERIMETER	-40 min.	Minimum of 300
	C	SOUTHWEST AND S. PERIMETER	-30 min.	Minimum of 300
	D	EAST BASEMENT	-35 min. / -40 max.	Minimum of 300
	E	WEST BASEMENT	-30 min. / -35 max.	Minimum of 300
	F	NORTHWEST/DIAG. PERIMETER	-35 min.	Minimum of 300
	G	NORTHWEST MAIN FLOOR	-30 min. / -35 max.	Minimum of 250
	H	NORTHEAST MAIN FLOOR	-35 min. / -40 max.	Minimum of 250

- Drill displacement piles



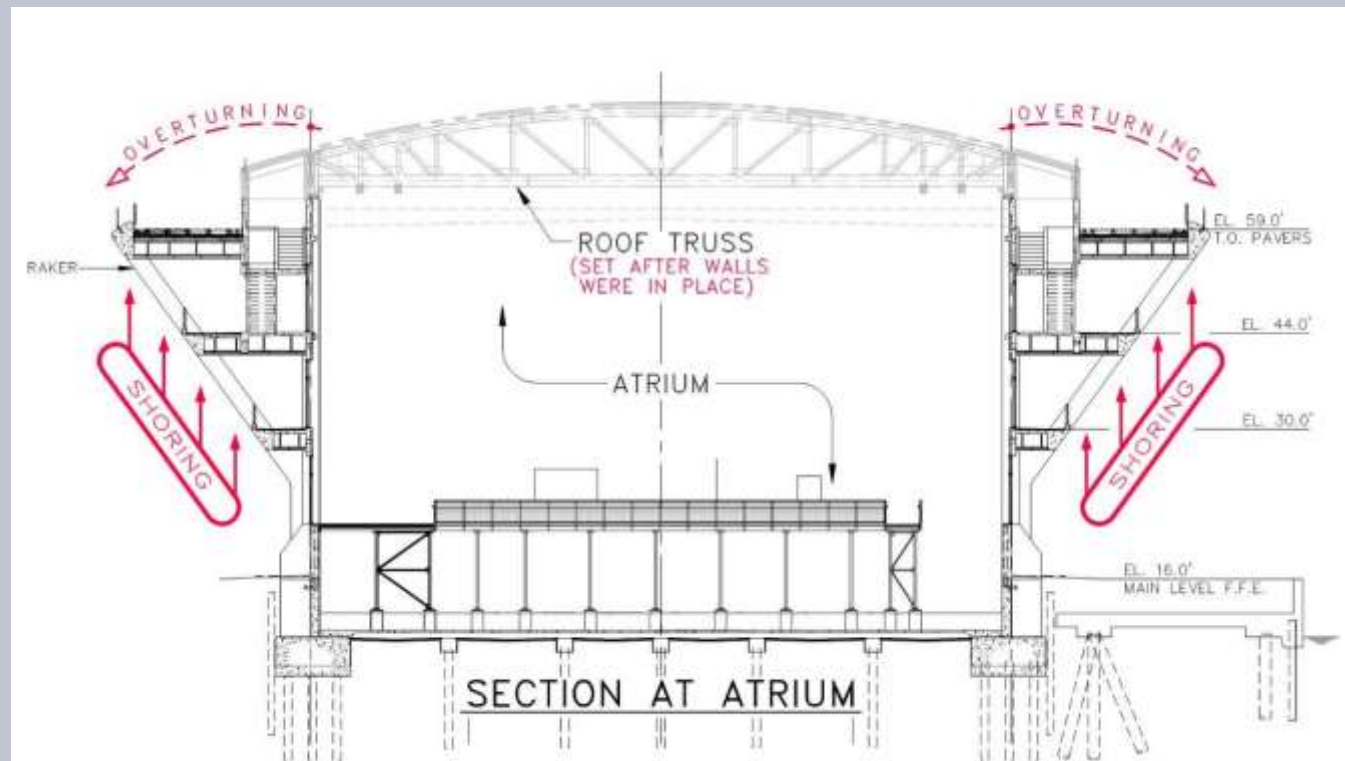
Foundation

- Interference of existing timber, Tangent Pile Wall beneath on east side.
- Pile cap reinforcement was increased from 60 to 75 KSI



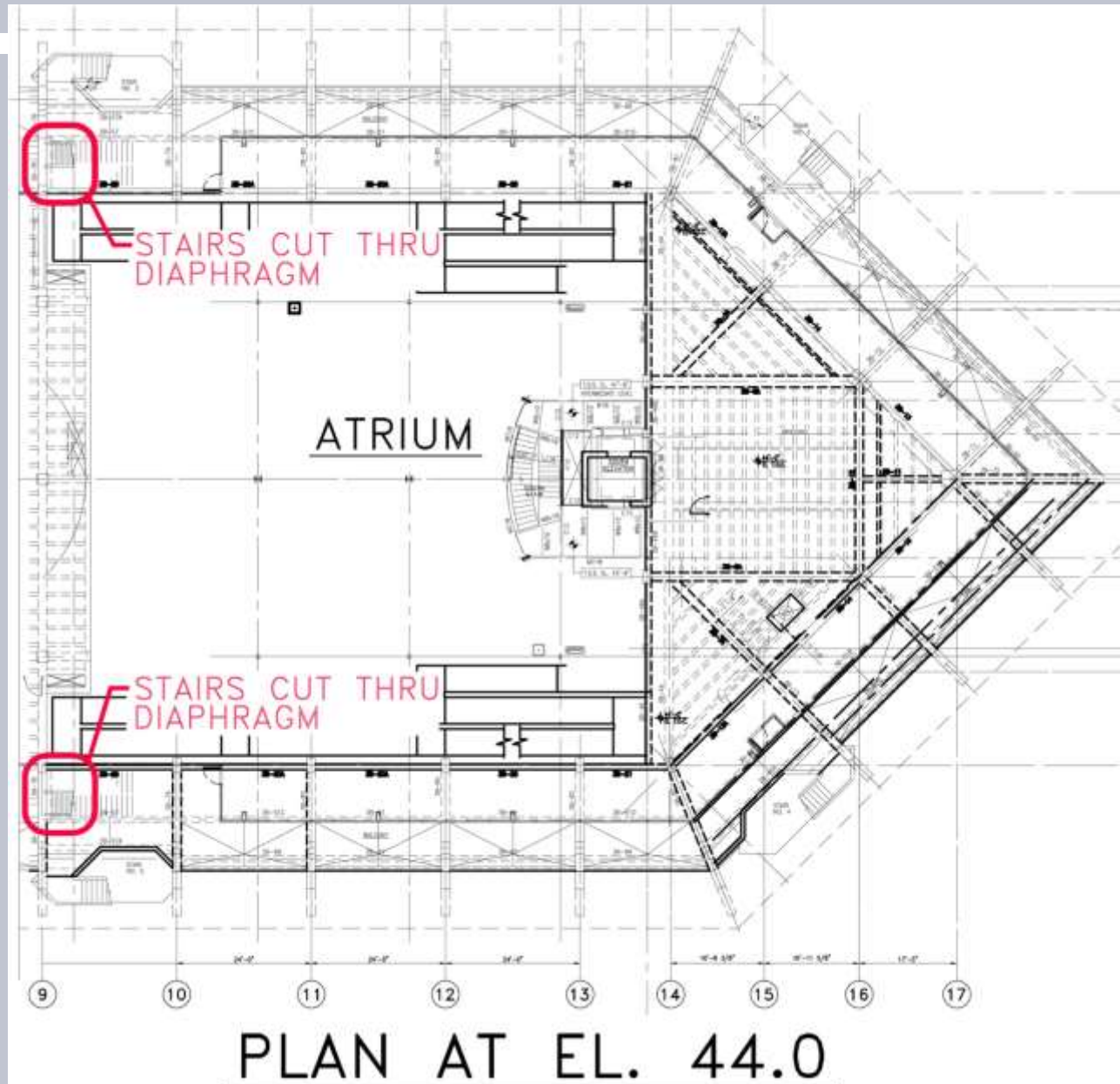
Framing System at Atrium

- Structural Contract: W.G. Yates, \$14.4M
- Original design used some post tension. Changed to CIP at recommendations of precast manufacturer.
- Atrium east and west walls were unstable, overturning outward.
- Complicated formwork and shoring, rakers
- Diaphragms at floors, El. 30.0', El. 44.0' and roof were considered.



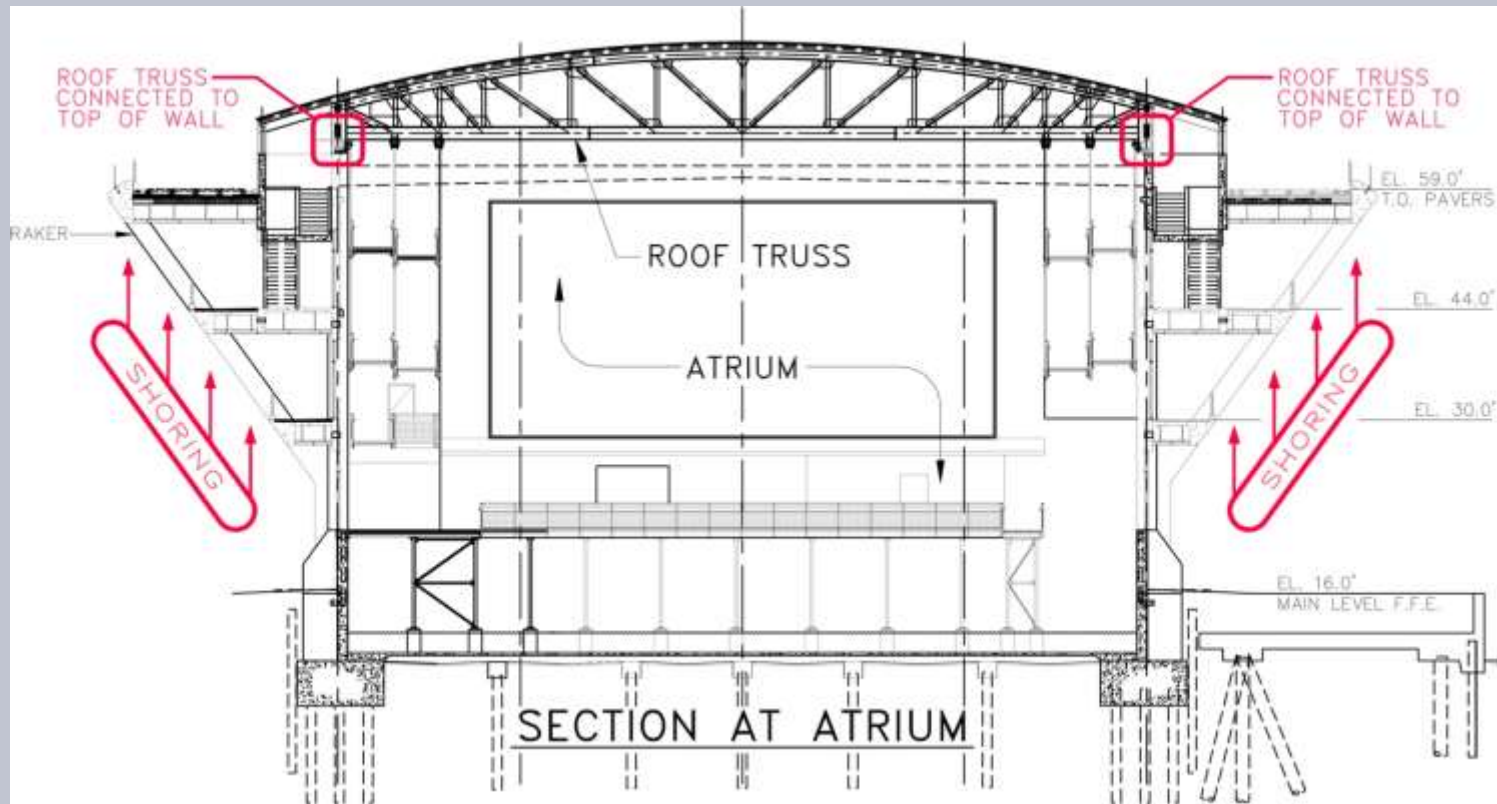
Framing System at Atrium

- Stair cut into diaphragm.

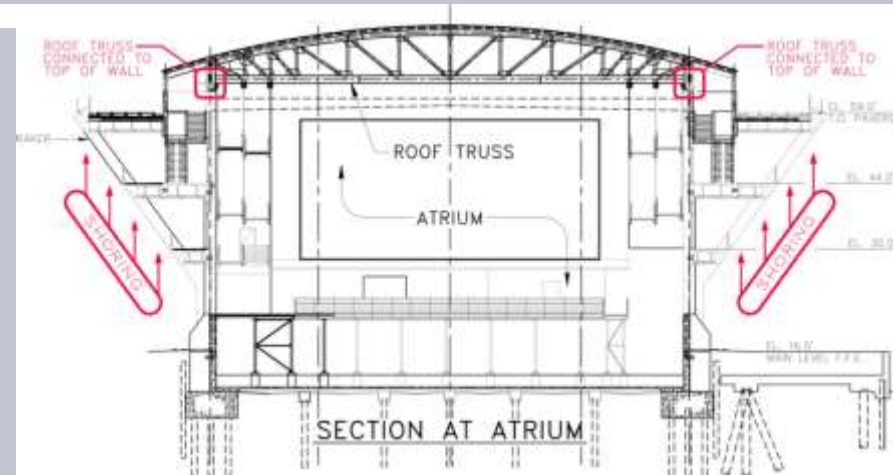


Framing System at Atrium

- Col. Lines 10-13
 - Used roof truss lower chord to tie East wall to West wall. The original roof design used an arch.
 - East and West wall shoring left in place until roof was in place.



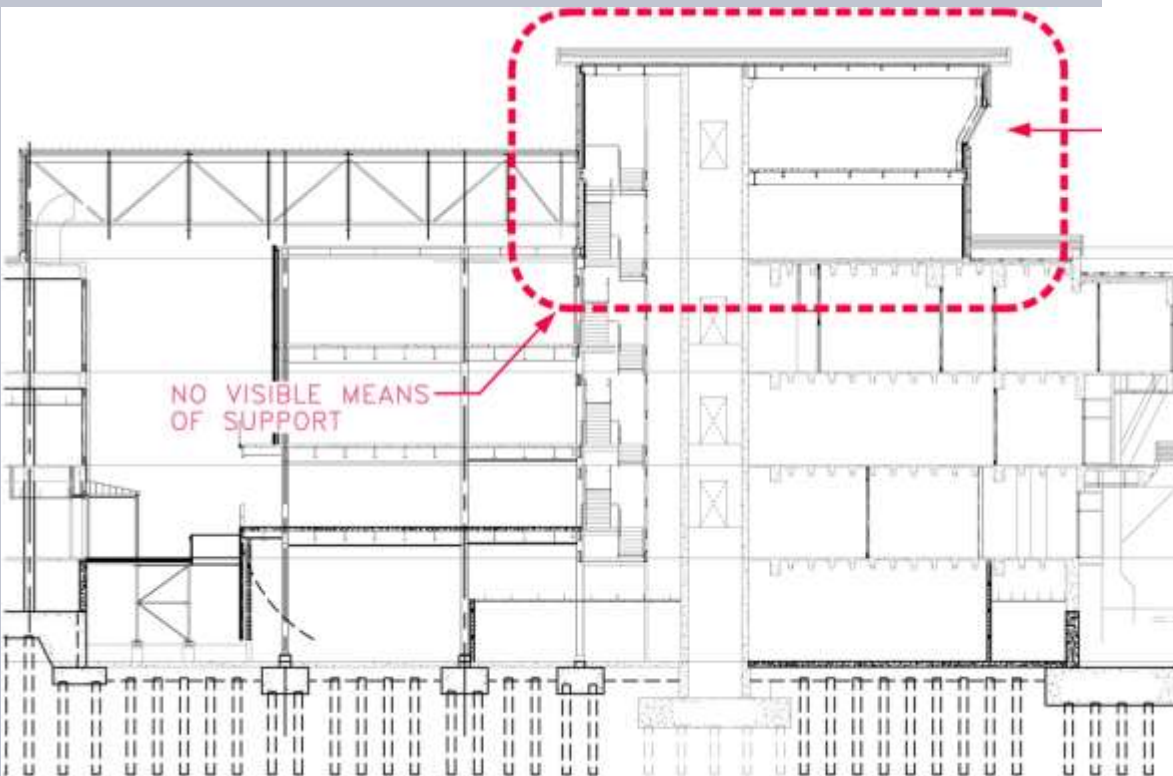
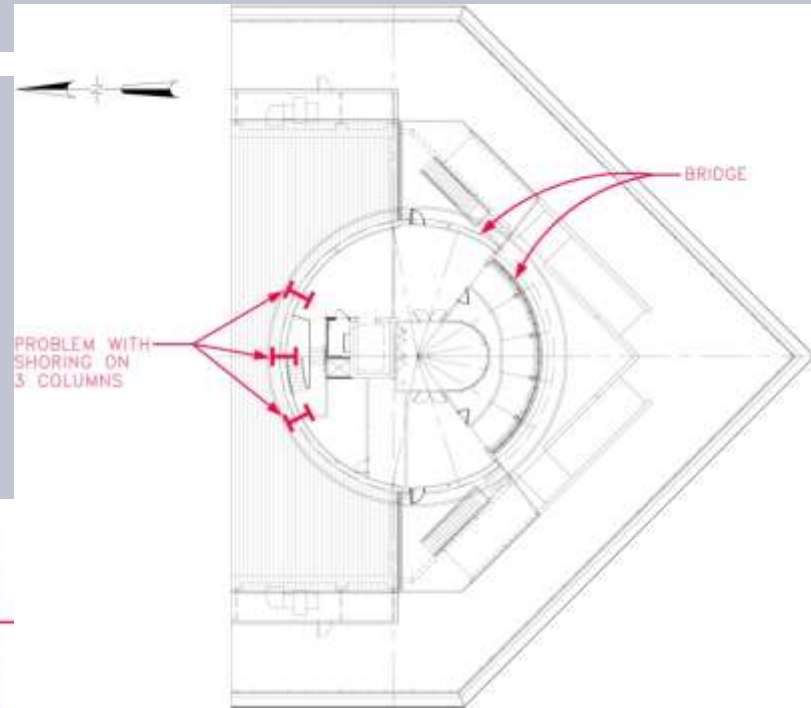
Framing System at Atrium



SHORING

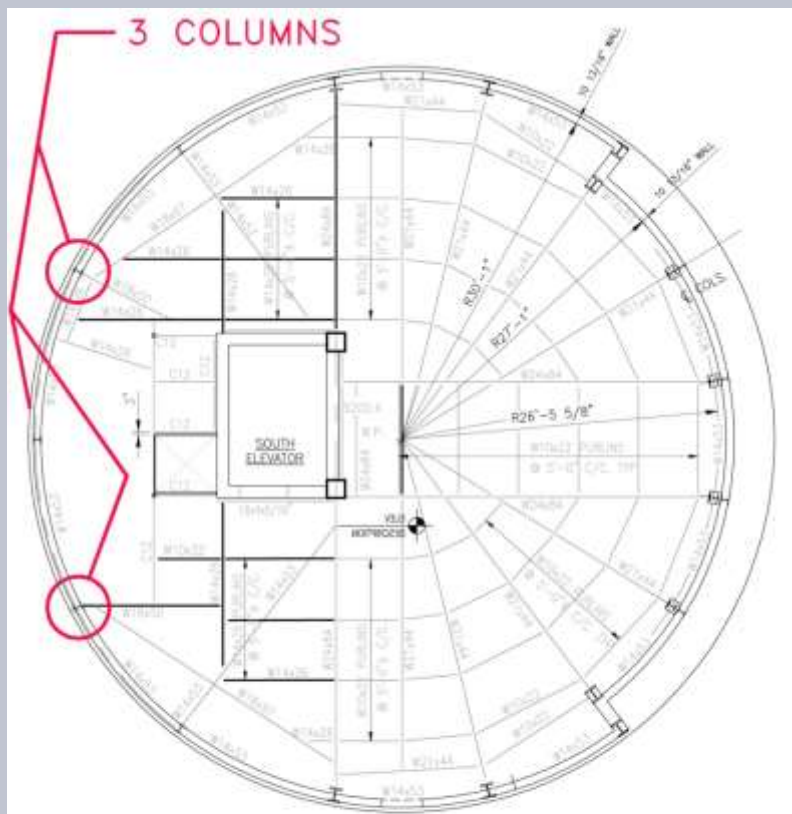
Bridge Framing

- The circular bridge was originally designed out of concrete – problems with shoring on three columns at Northside; no visible means of support.

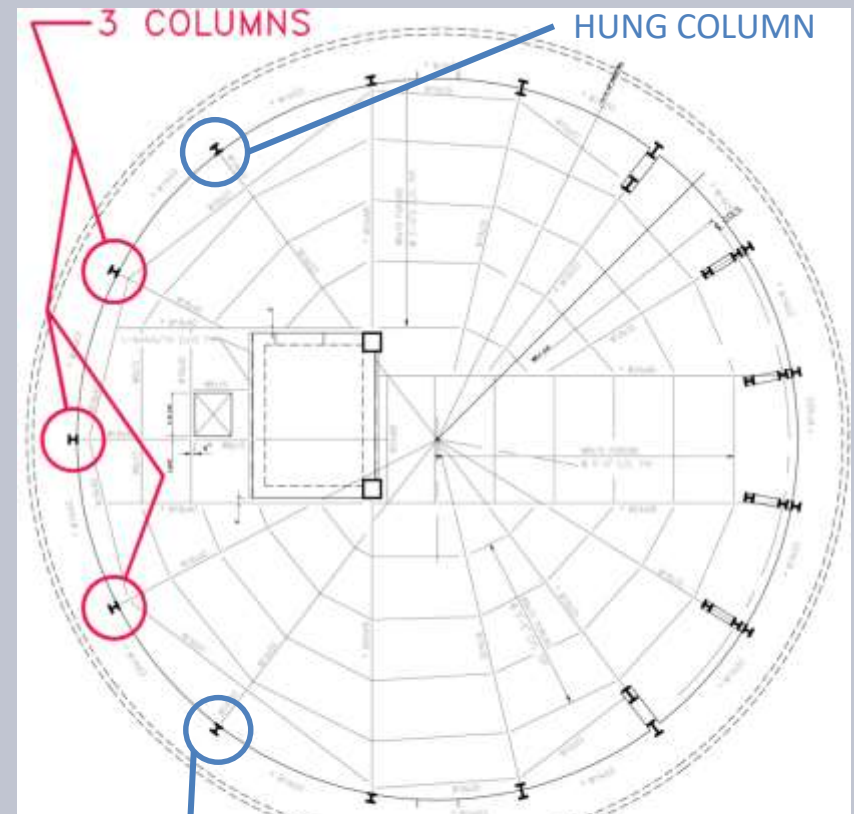


Bridge Framing

- Design changed from concrete to steel
- Installation challenges
- Steel fabricator (Steel, Inc.) and steel erector (Atlanta Steel Erectors)



**BRIDGE FLOOR FRAMING
EL. 74'-7"**



HUNG COLUMN

**BRIDGE ROOF FRAMING
EL. 90'-7"**

Bridge Framing



DETAIL

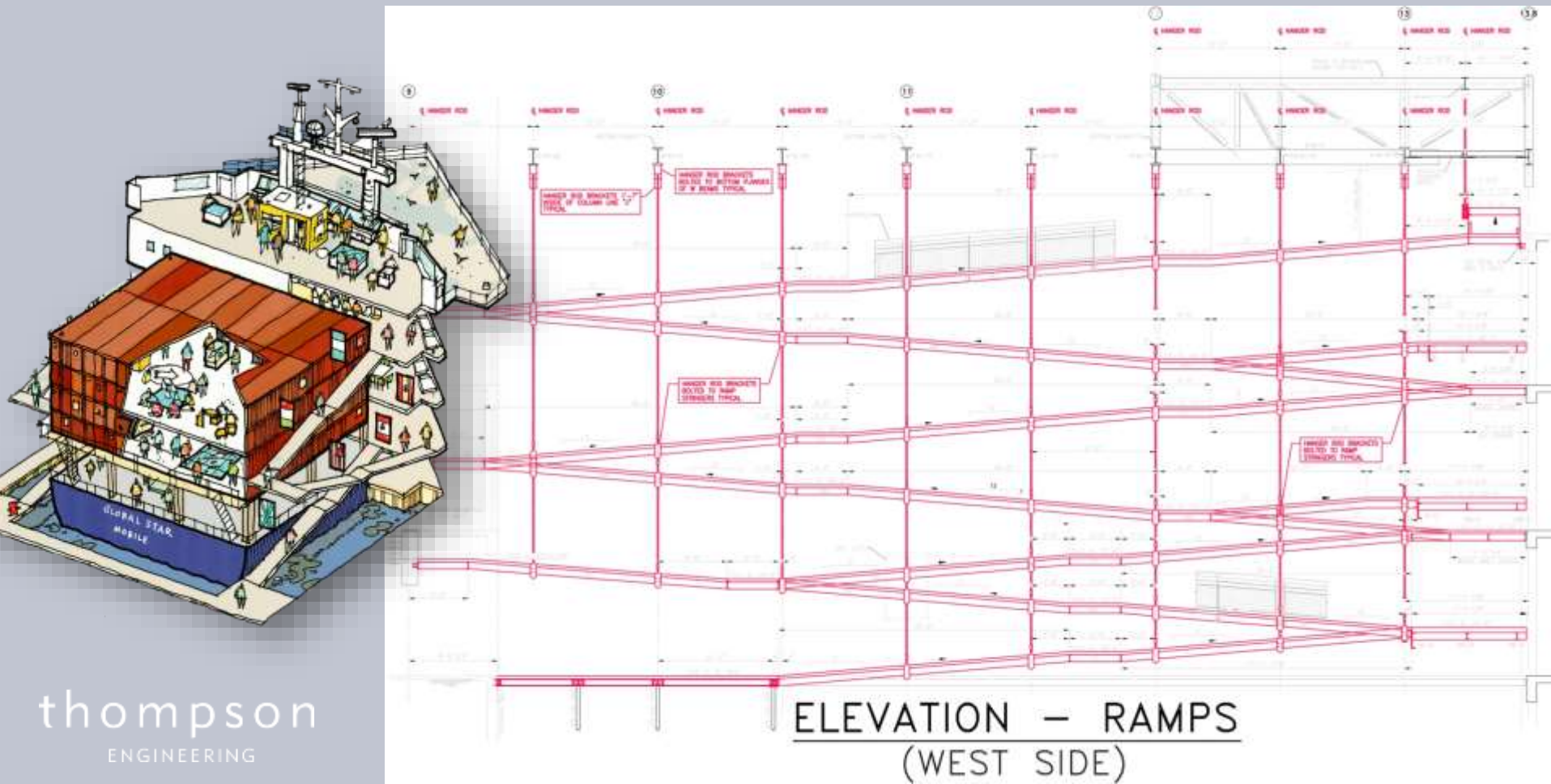


Completed Bridge



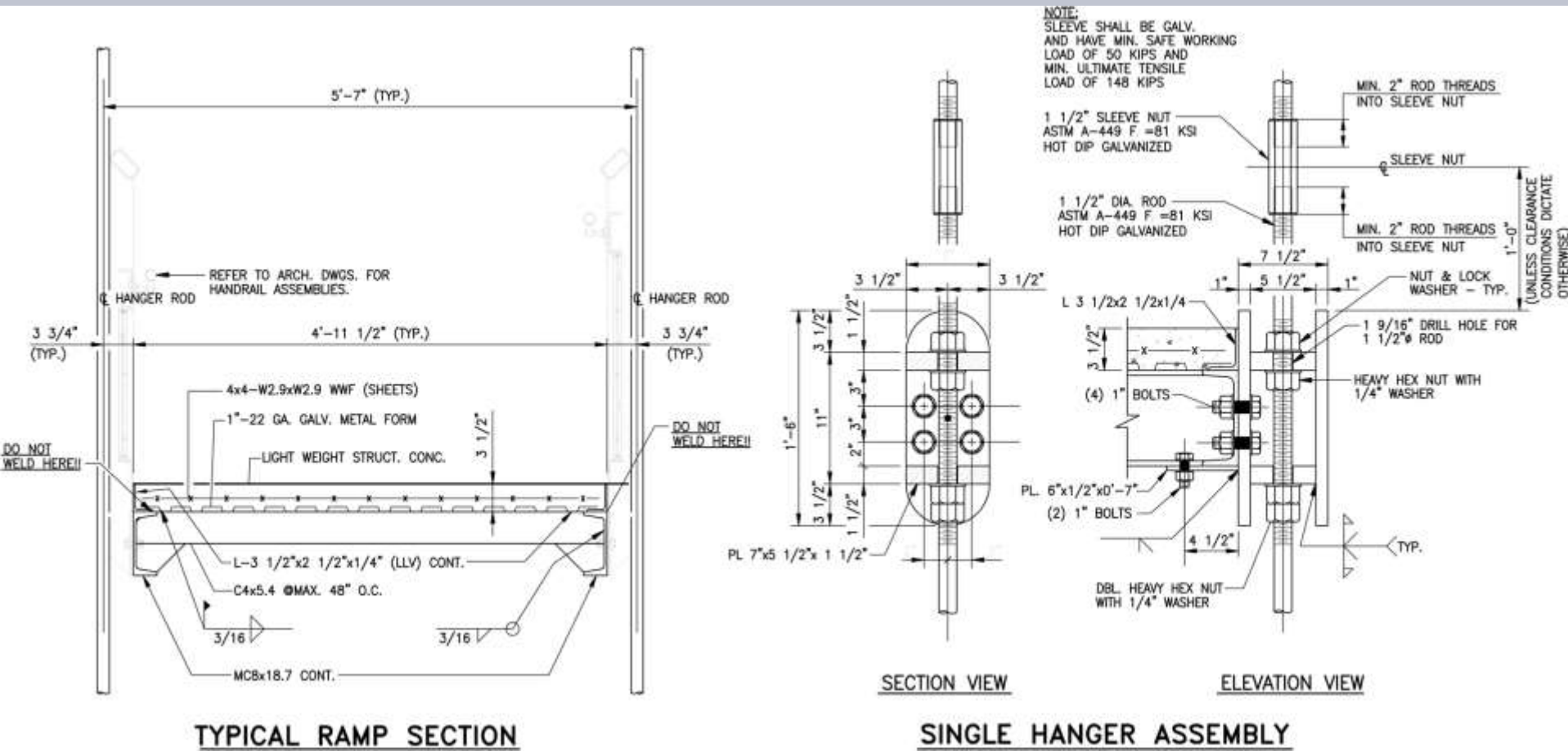
Hanging Ramps

- Access to three story museum venues by ramps hanging from rods
- Ramps are more complicated than illustration



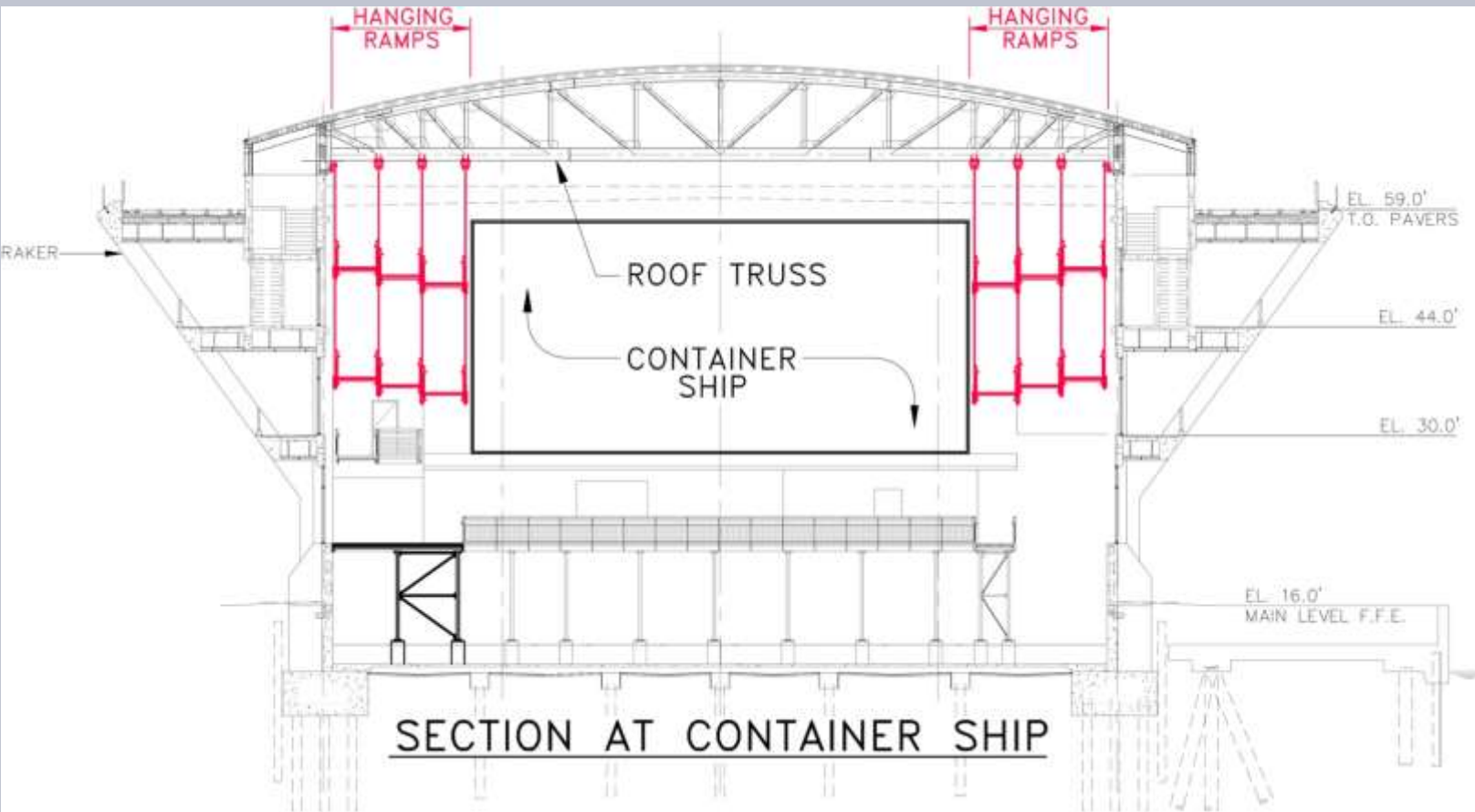
Hanging Ramps

- Design – 5-foot wide walkway
- 3½-inch concrete deck on metal deck
- 8-inch channel framing (MC 8X18.7)
- Hanger assembly
- 1½-inch dia. rods, ASTM A-449
- 12-feet on center



Hanging Ramps

- Installation challenges
- Precast or CIP?
- Pumped concrete



Hanging Ramps



ELEVATION



METAL DECK



**METAL DECK AND
GUARD RAIL**



METAL DECK AND GUARD RAIL

Hanging Ramps



HANGAR ASSEMBLY



HANGER ASSEMBLY



RAMP AFTER CONCRETE PLACEMENT



RAMP AFTER CONCRETE PLACEMENT

Hanging Stairs



STAIR ELEVATION



Exterior hanging stair

EAST ELEVATION

- Six (6) exterior hanging stairs
- Resemble hanging life boats
- Precast concrete stairs hung by SS rods

Exterior hanging stair

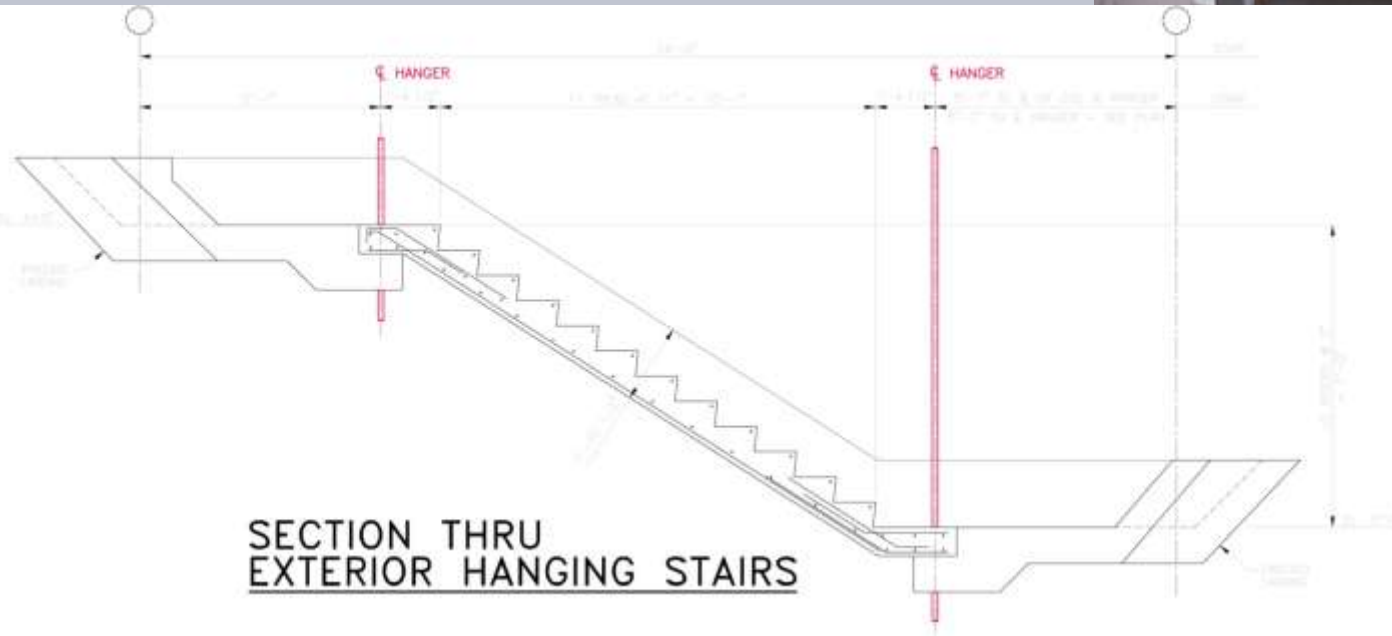
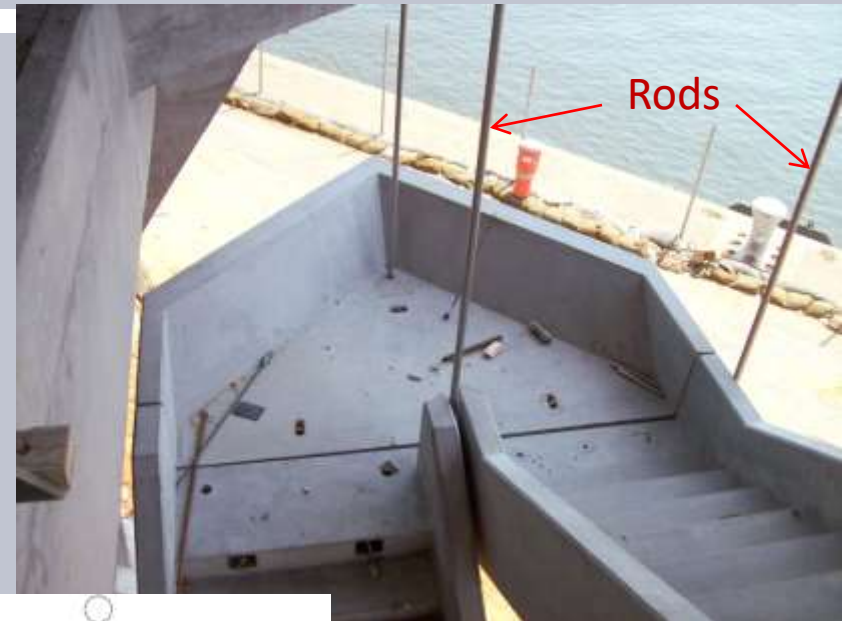


SOUTH ELEVATION

Hanging Stairs



INTERMEDIATE LANDING

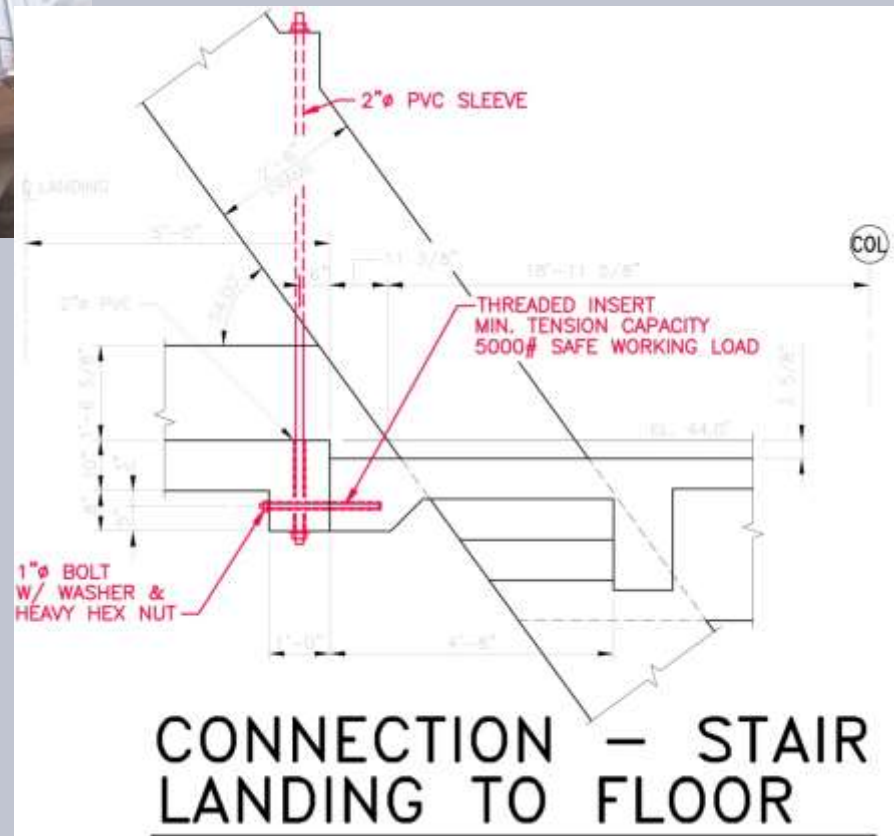


- Design
- Details

Hanging Stairs



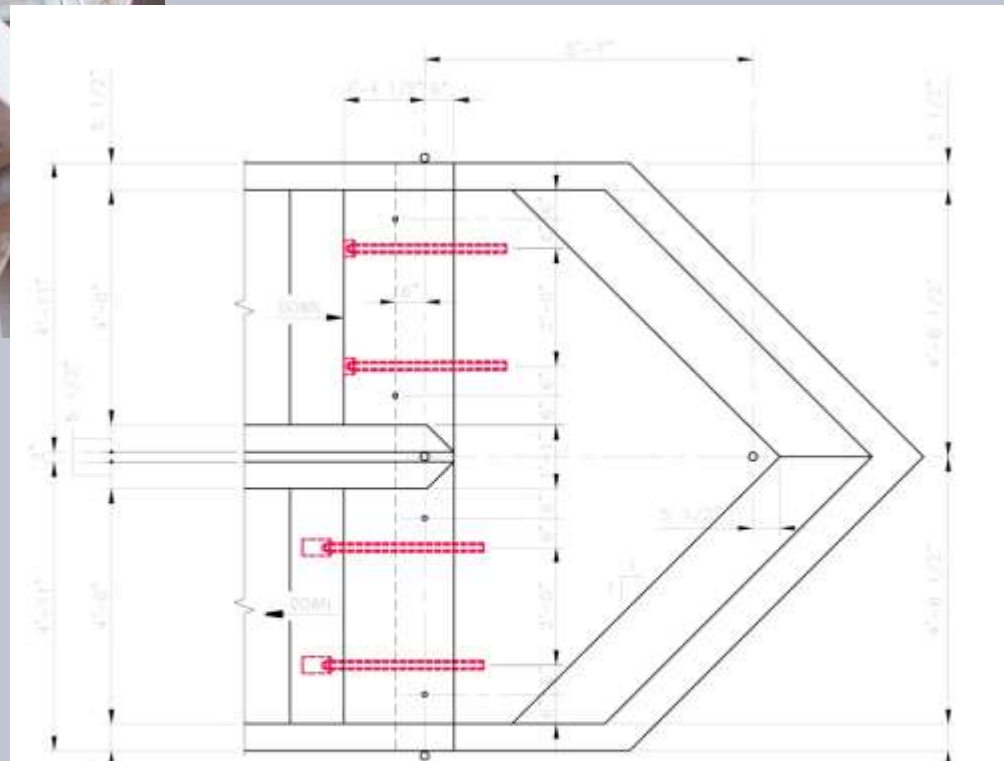
- 1 ½-inch diameter rods
- AISI 316 (SS) Strain Hardened
- F_y (min) = 50 KSI
- F_u (min) = 90 KSI
- Stair connected to floor



Hanging Stairs



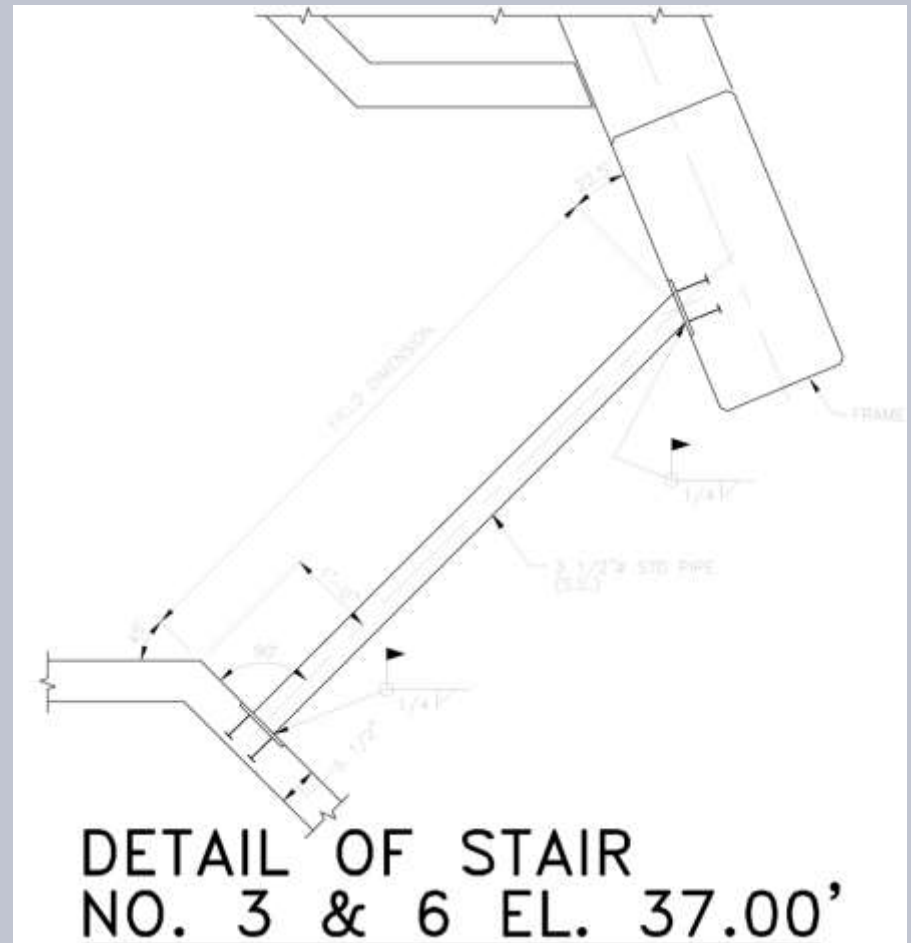
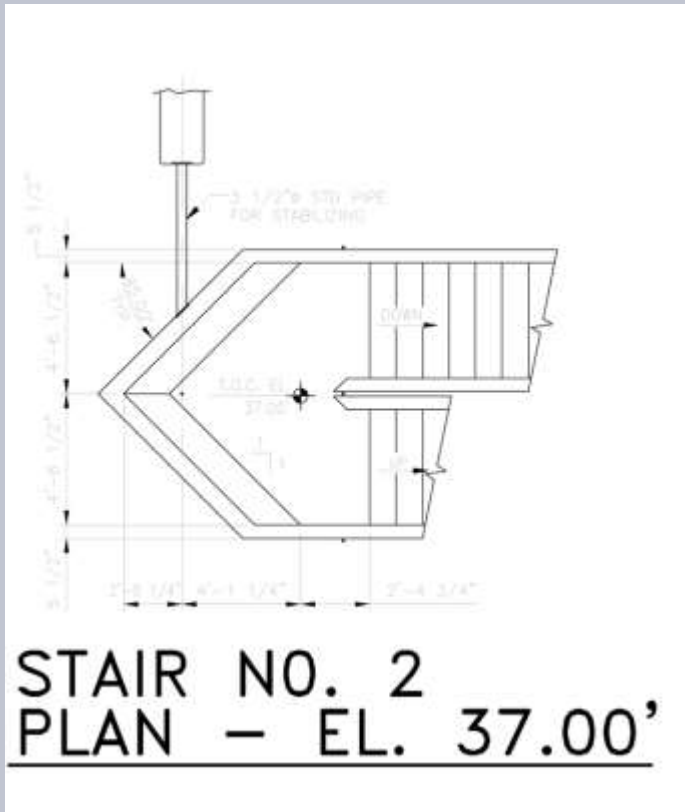
- 1 ½-inch diameter rods
- AISI 316 (SS) Strain Hardened
- F_y (min) = 50 KSI
- F_u (min) = 90 KSI
- Stair connected to floor



INTERMEDIATE LANDING
PLAN – EL. 23.0' & 37.0'
STAIR NO. 1 THRU 6

Hanging Stairs

- Stability at intermediate landings, stabilizing pipe



Hanging Stairs

- Installation challenges – holes in concrete beams/Rakers for SS rods



HOLES OMITTED – SOME RAKERS WERE DRILLED FOR ROD



HOLE OMITTED – RETROFIT BRACKET FOR ROD

Hanging Stairs



STAIR LANDING



STAIR LANDING ERECTION



**STAIR LANDING
ERECTION**

- Installation challenges
- Heavy stair loads
- Landing 6-11 Kips
- Stair Stringer 11 Kips

