

# Deeper Dredging Analysis for Existing Port Structures Houston Ship Channel



## 1

The client is looking to dredge the Turning Basin Terminal to a deeper depth, from existing 32ft + 2ft to 40ft+2ft.

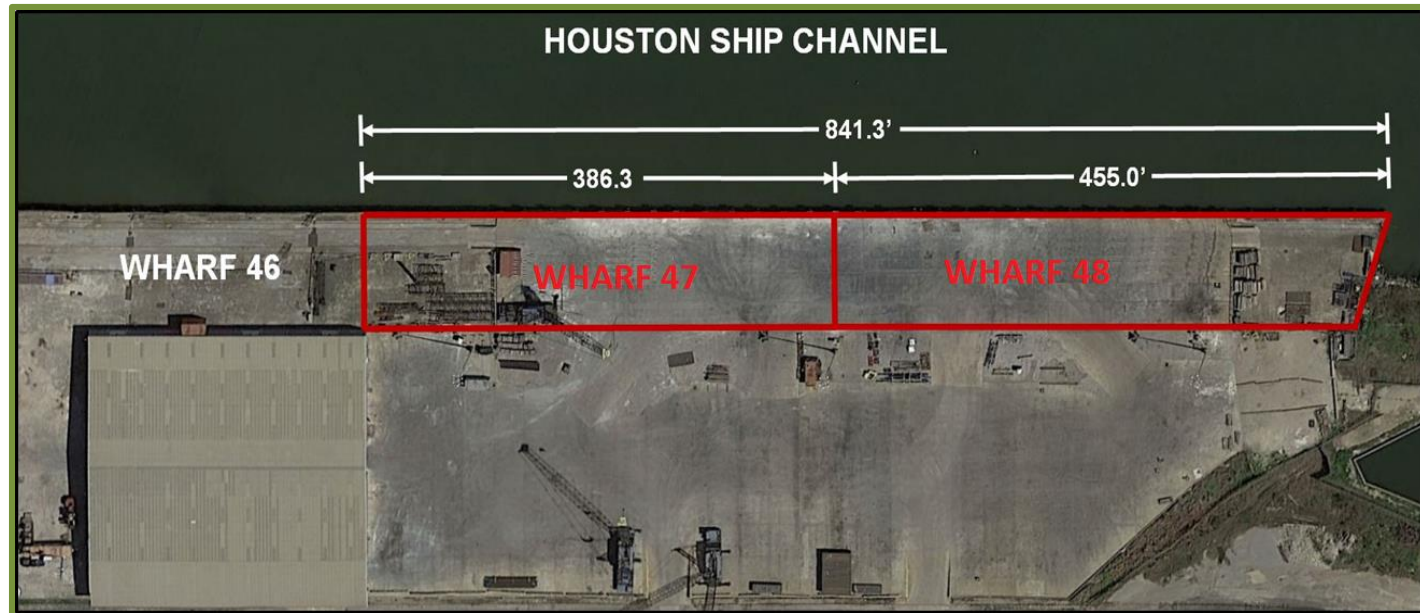
Is it safe?

# Houston Ship Channel & Turning Basin

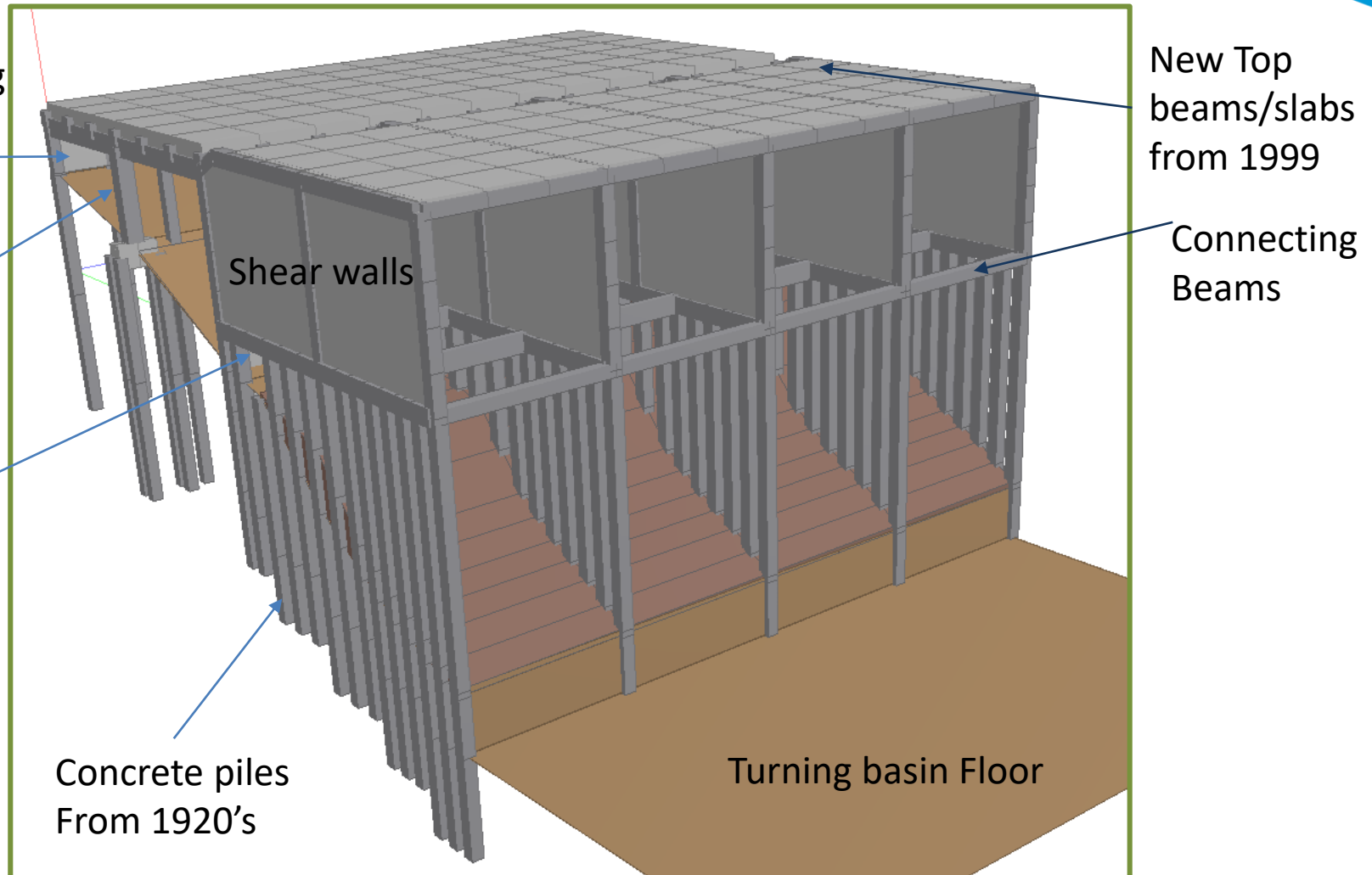




# Turning Basin Wharves 47 and 48 Project



# Wharves 47-48 Construction History



*Explain using the model*

# Wharves 47 and 48

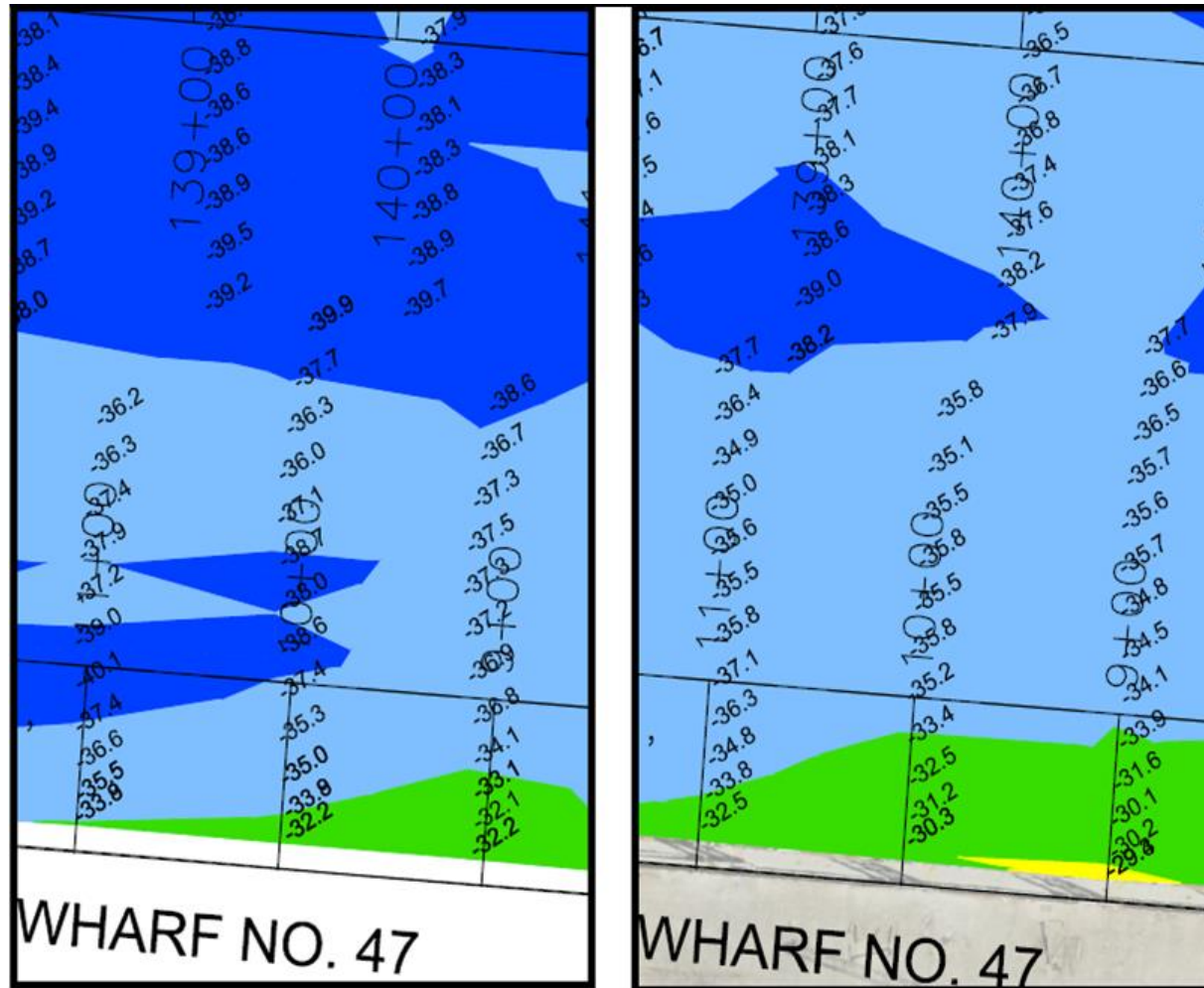


Berthing line



View from waterside

# Bathymetric Data



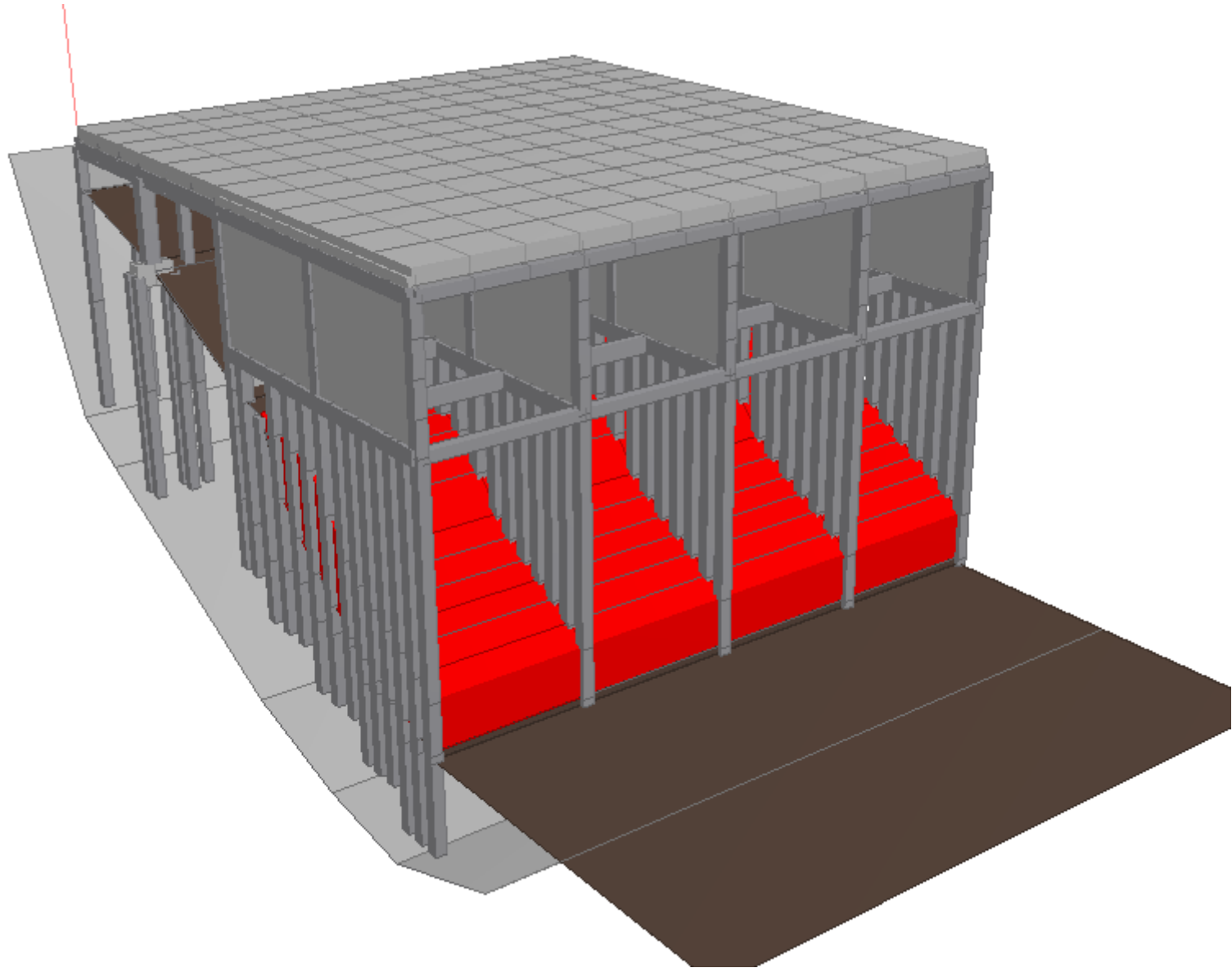
## 2

Answering the Question  
Is it safe to dredge?

Post Dredge Stability Analysis



# Global Stability/Failure

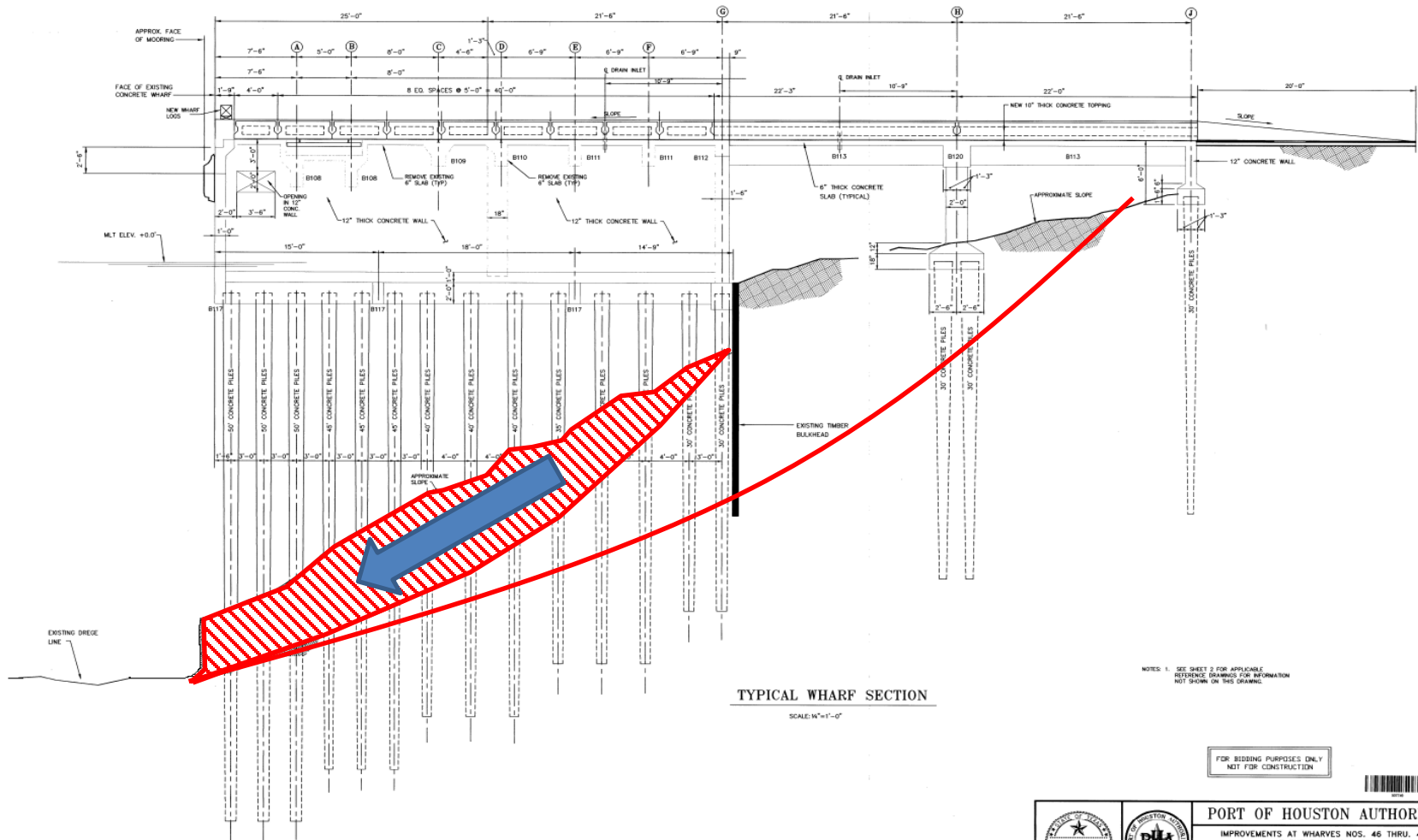


## Local Failure Possibilities

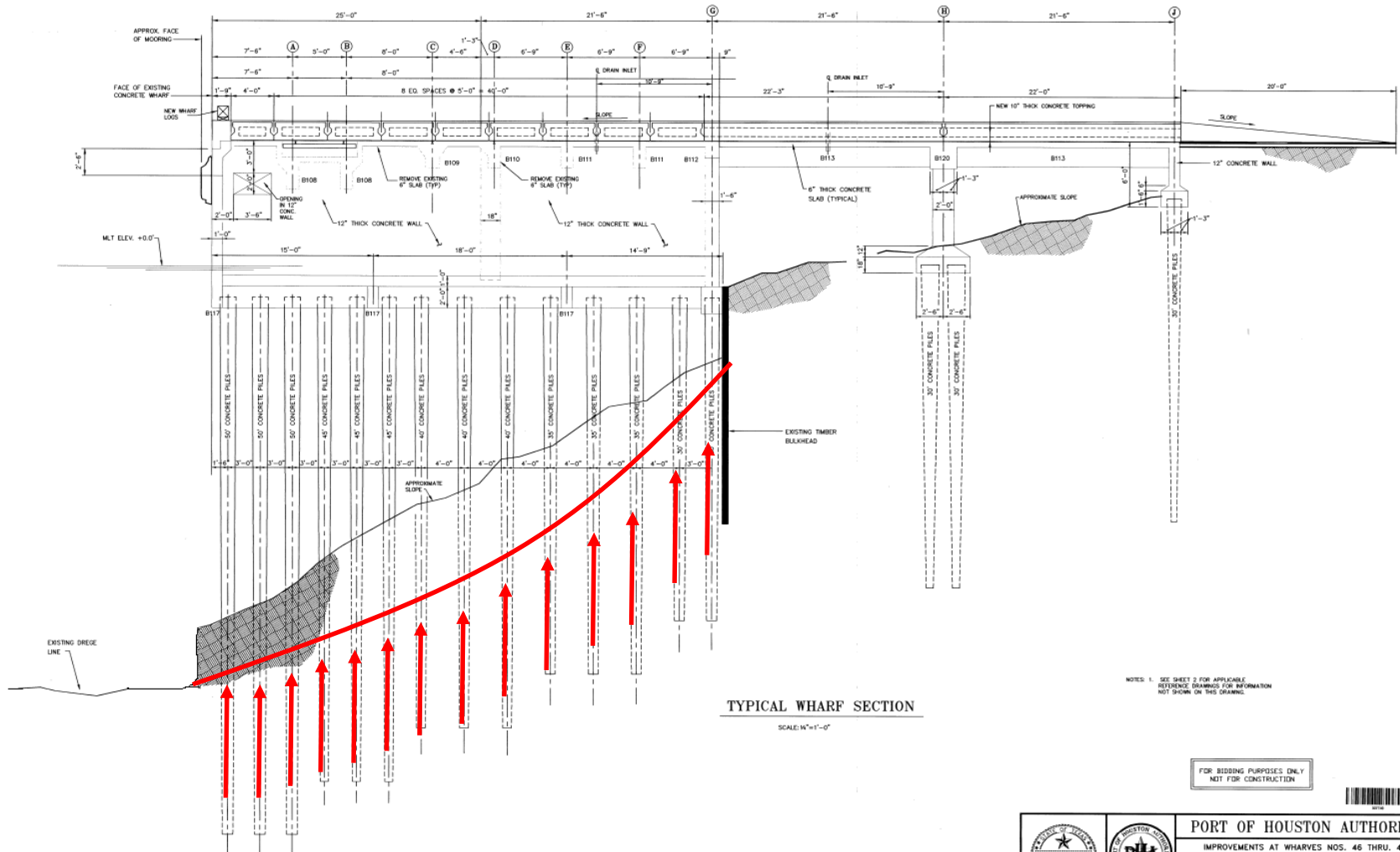
1. Slope Stability Failure under the structure
2. Insufficient Pile Vertical Capacity
3. Insufficient Pile Horizontal Capacity
4. Structural Components Failure

These four instability/failure possibilities may make up a sequence of failures

# Local Instability/Failure Sequence Step 1

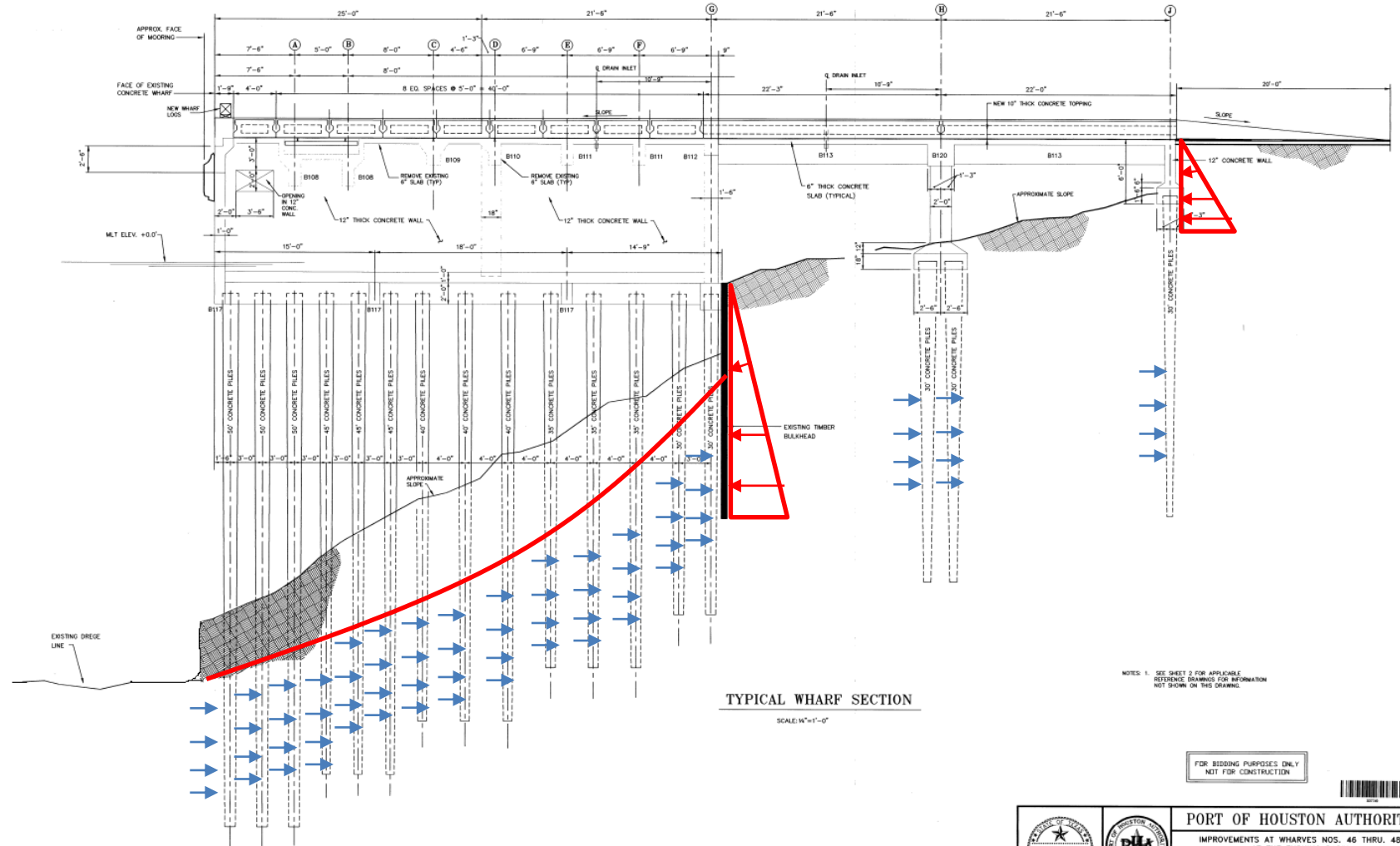


# Local Failures Sequence Step 2: Pile Axial Capacity Reduction

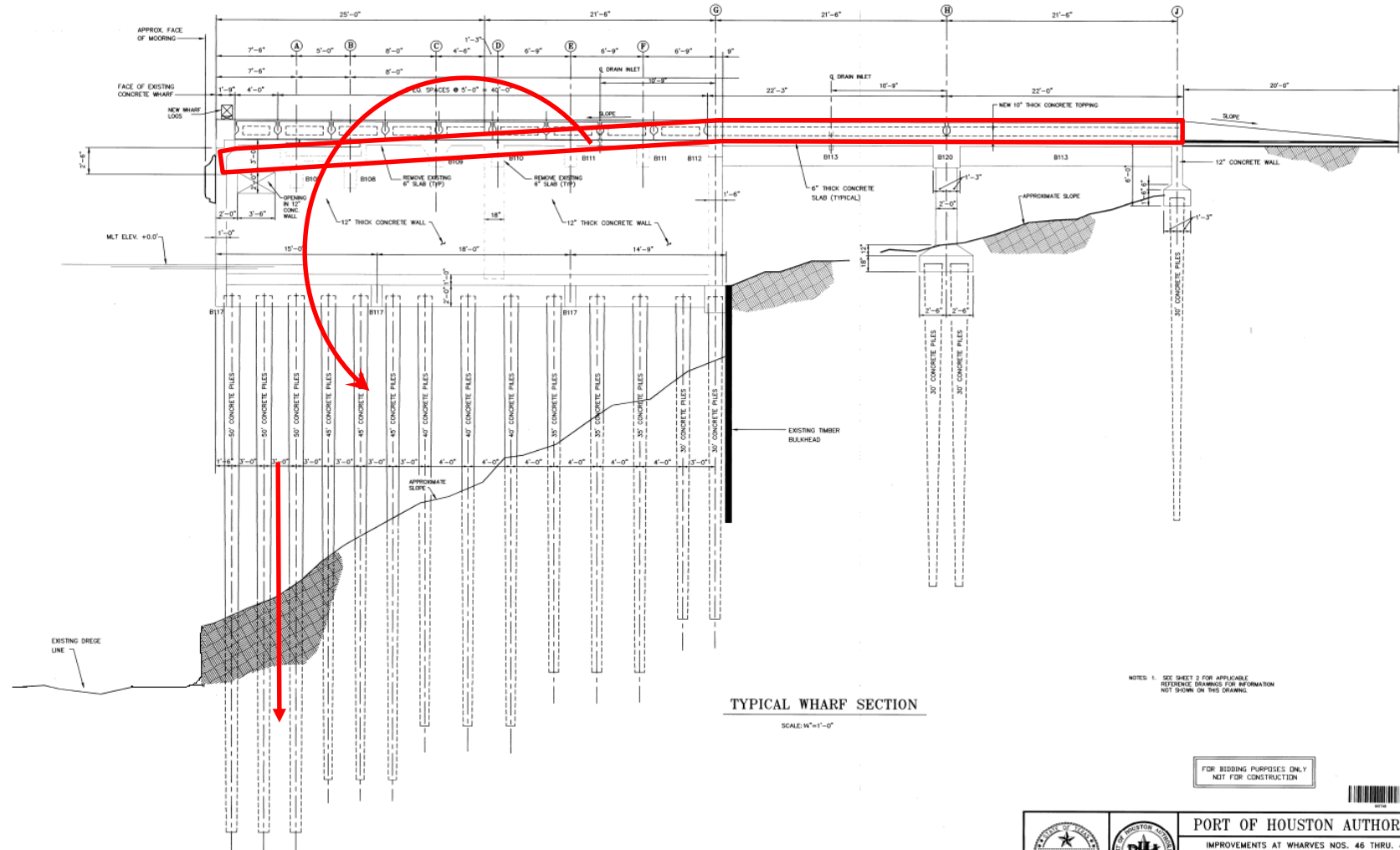




# Failure Sequence : Step 3 Structural Sliding



## Local Failure Sequence Step 4: Structural failure



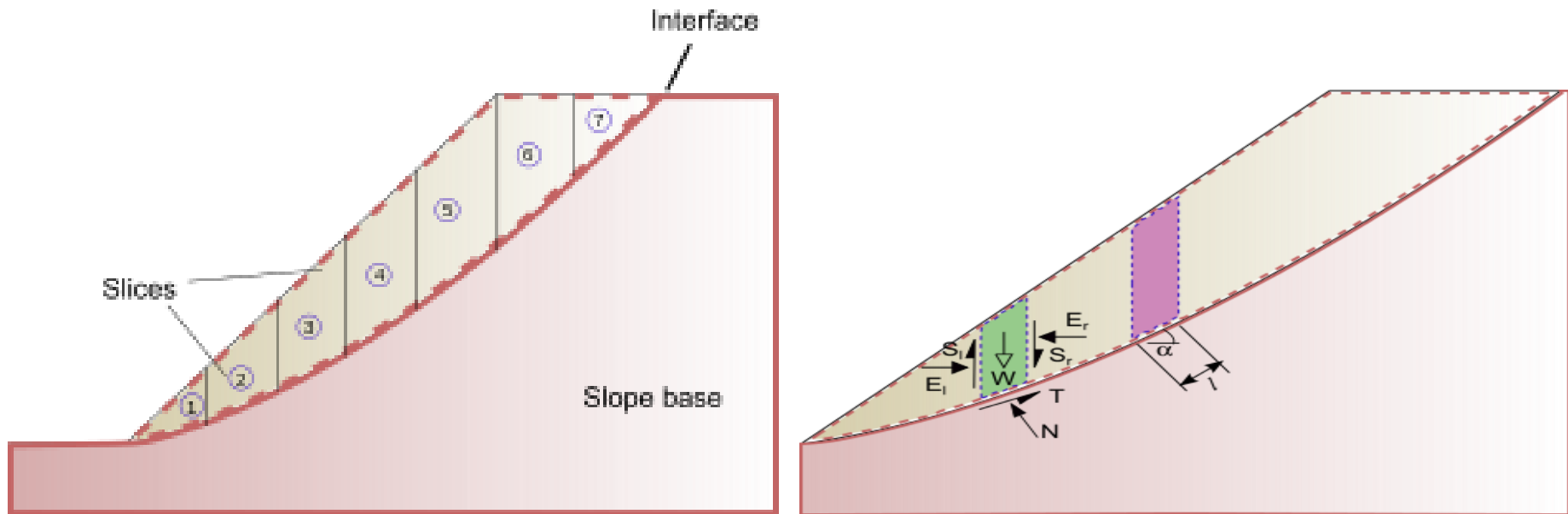


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Is just the global stability check sufficient?

Let us analyze!

# Analysis Method: Modified Bishop Method

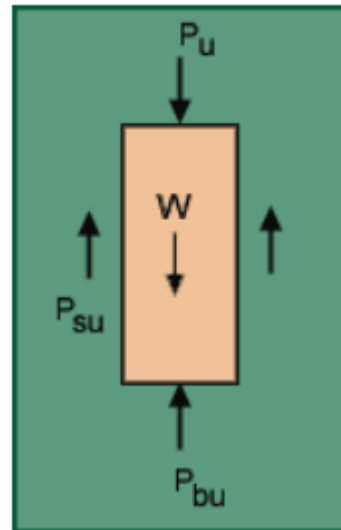
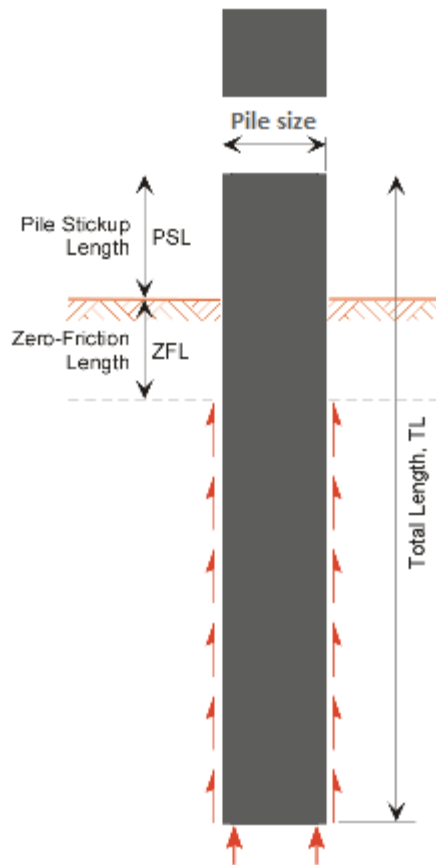


Analysis Software : GSTABL

FOS accepted in industry : 1.2

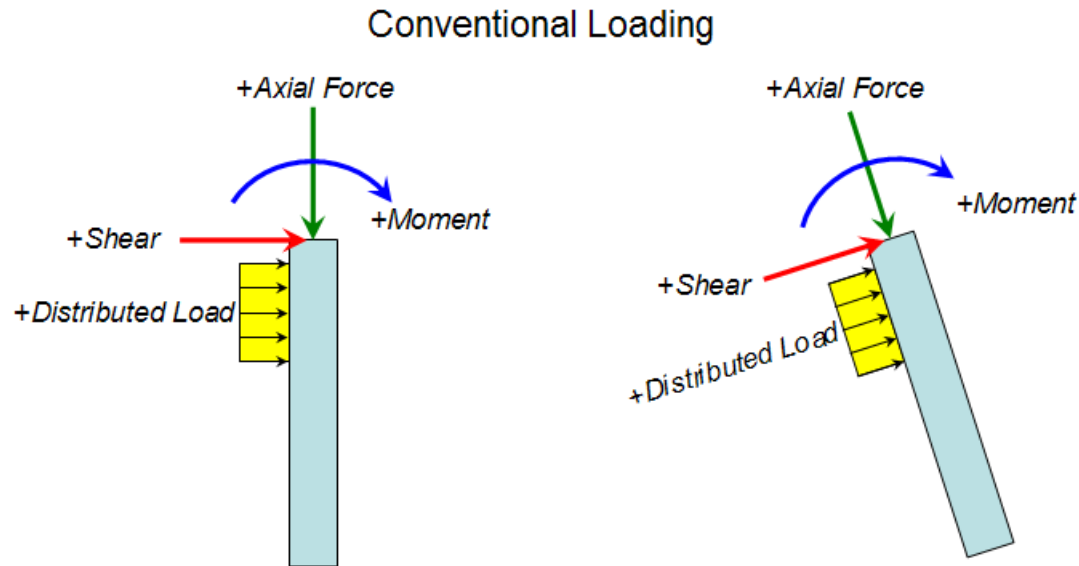


# Analysis Method: Compression Pile Capacity



Analysis Software  
: APILE  
FOS accepted in  
industry: 2

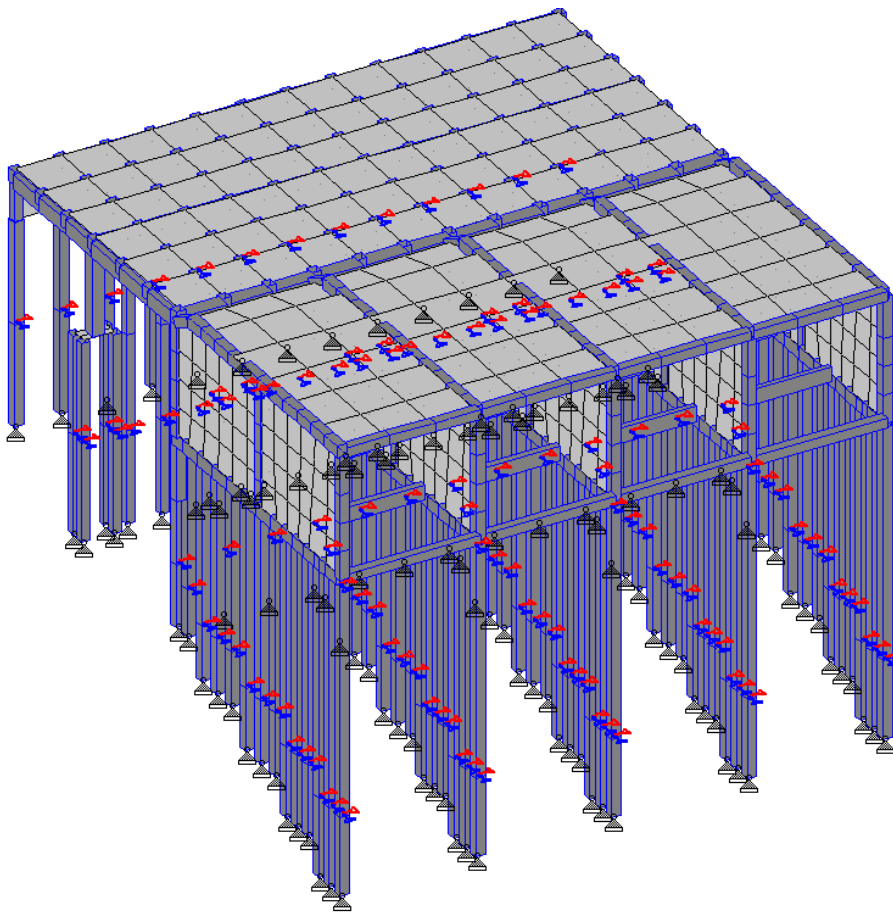
# Analysis Method: Lateral Pile Capacity



Analysis Software : LPILE

# Analysis Method: Pile Capacity Requirements

Analysis Software : STAAD Pro



## Loads included:

- *Dead Load*
- *Live load*
- *Lateral earth pressure*
- *Hydrostatic pressure*
- *Mooring loads*
- *Berthing loads*

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# Analyses Results

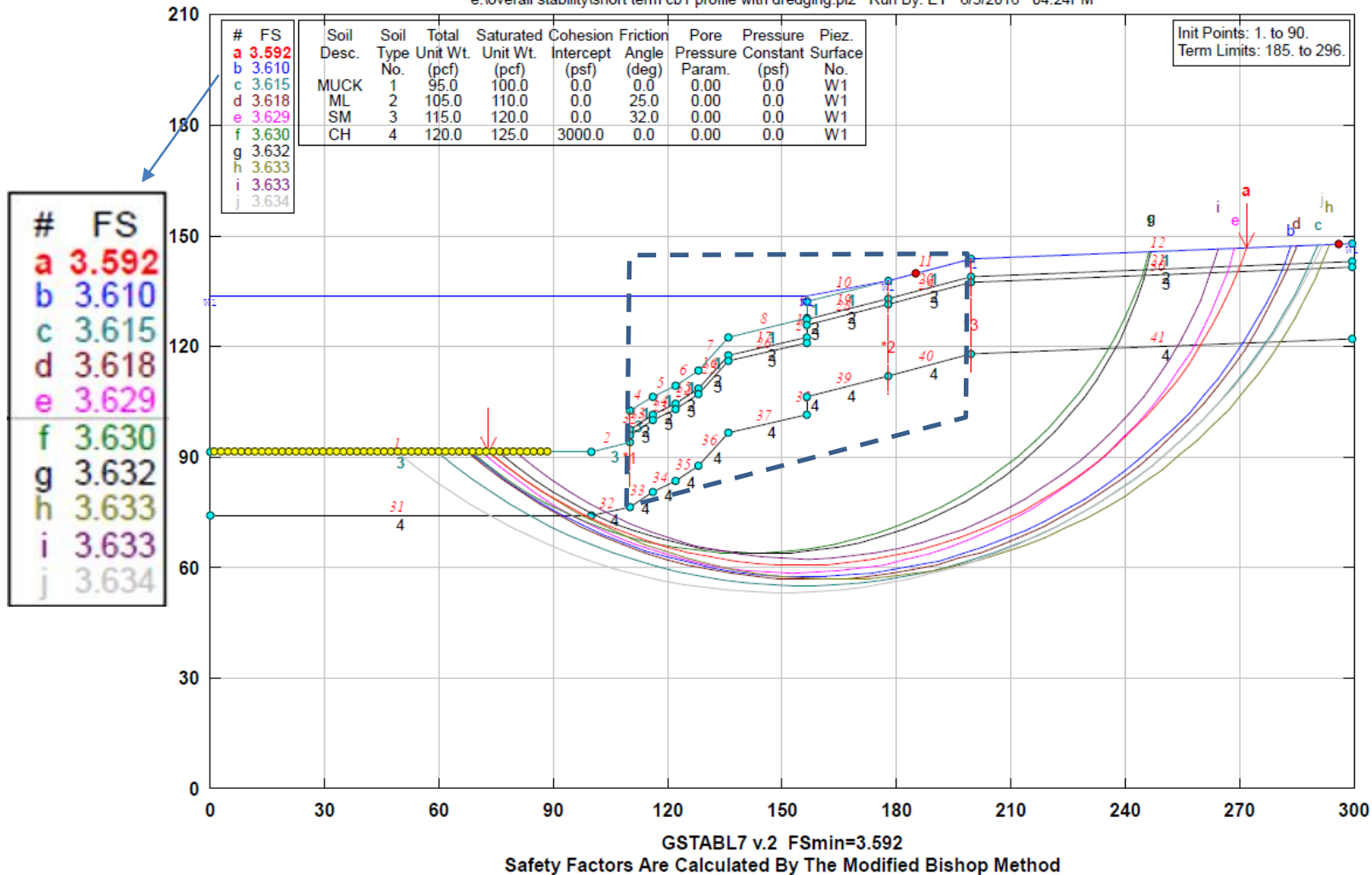
What do the results say!



# Global Slope Stability

## Short term - CB1 profile with dredging EL -42

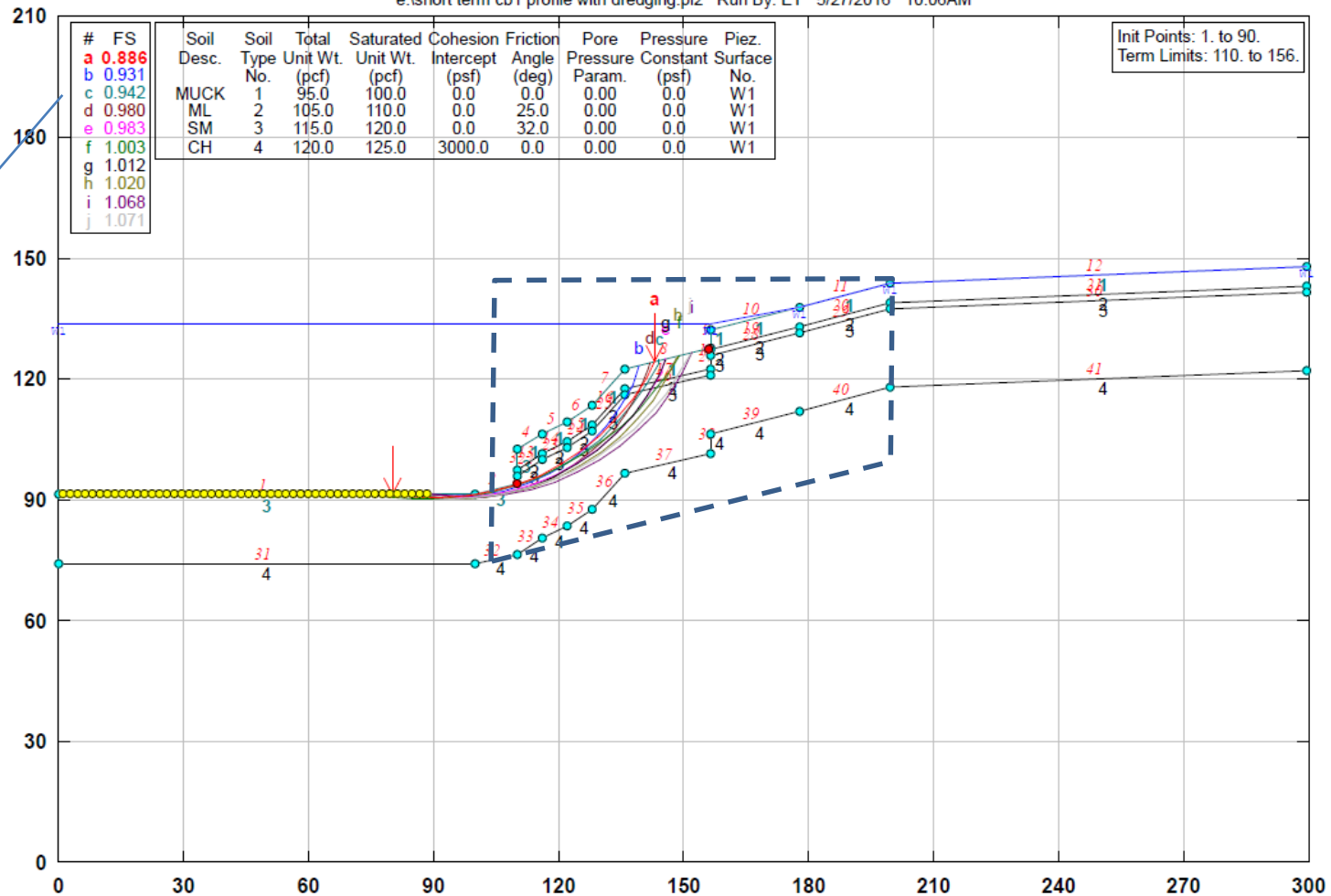
e:\overall stability\short term cb1 profile with dredging.pl2 Run By: ET 6/3/2016 04:24PM



# Local Slope Stability

## Short term - CB1 profile with dredging EL -42

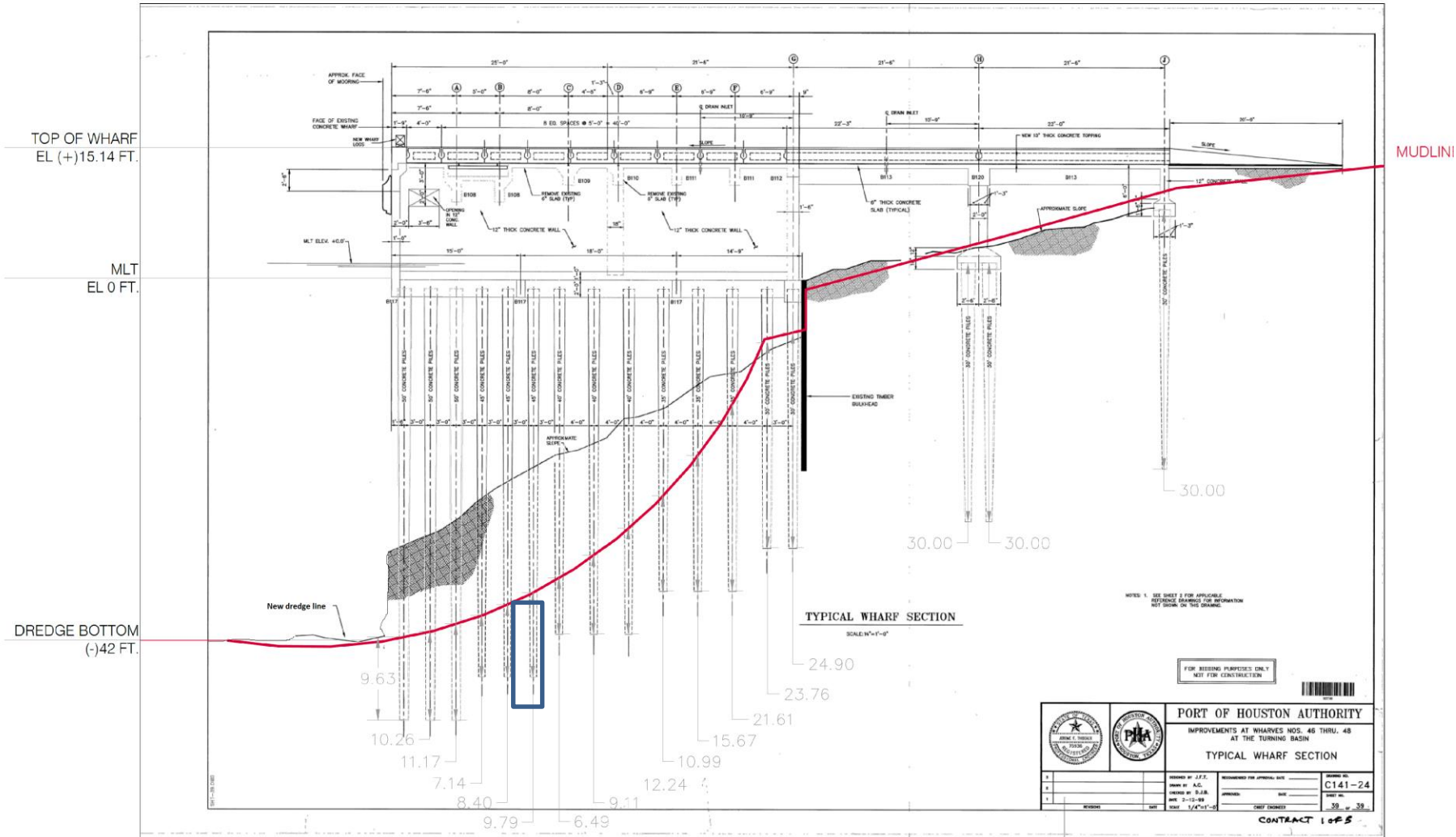
e:\short term cb1 profile with dredging.pl2 Run By: ET 5/27/2016 10:06AM



# Pile Axial Capacity Analysis

AT -42 FT.

EXISTING LAYERS AFTER DREDGING - AFTER SLOPE STABILITY ANALYSIS - FOR i



# Analyses Results :

Pile No	FOS	Pile No	FOS
1	0.96	8	0.79
2	1.09	9	1.20
3	1.18	10	0.90
4	0.66	11	1.31
5	0.82	12	1.85
6	0.90	13	2.36
7	0.55	14	2.67

# Conclusions

Global stability factor of safety is acceptable. Global sliding failure is not indicated.

Local slope stability FOS less than 1 for multiple slip planes, slope failure is indicated



Axial pile capacity reduces,  
50% of the piles under the shear wall  $FOS < 1$ .  
85% of the piles under the shear wall  $FOS < 2$ .



Structural failure indicated in all of the beams running perpendicular to the berthing line

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My answer the question  
“Can we dredge to 42ft depth?”

NO

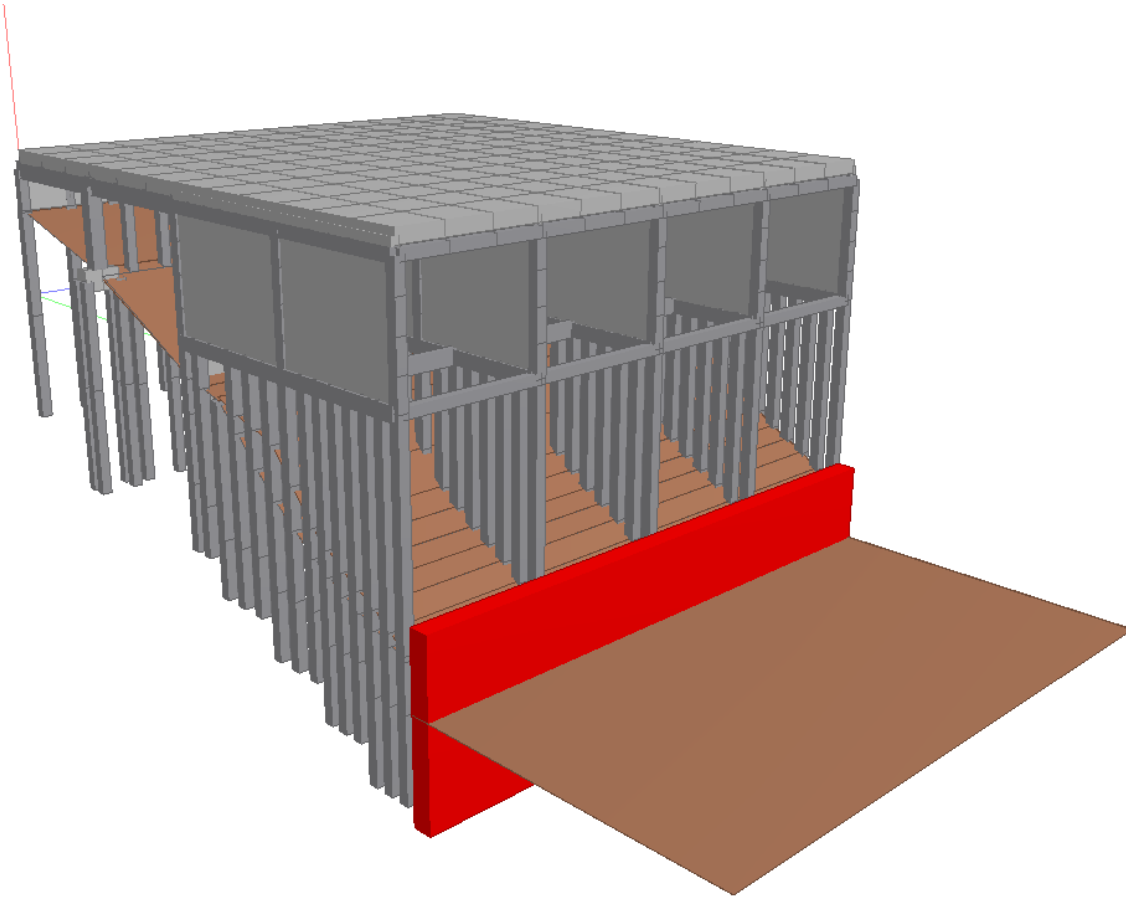
## 7

# Remediation Concepts



# Possible Remediation Concepts:

Add a toe-wall



# Possible Remediation Concepts:

Soil Stabilization

