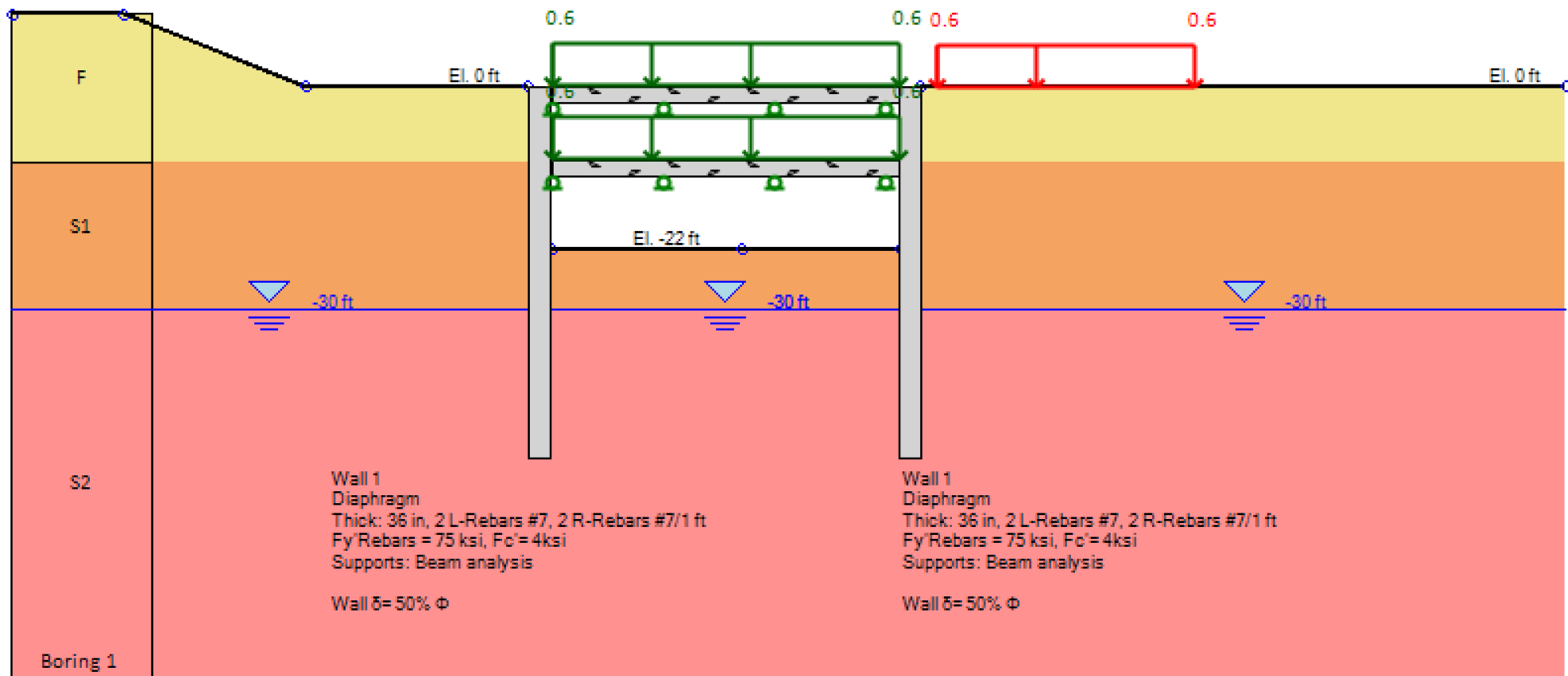


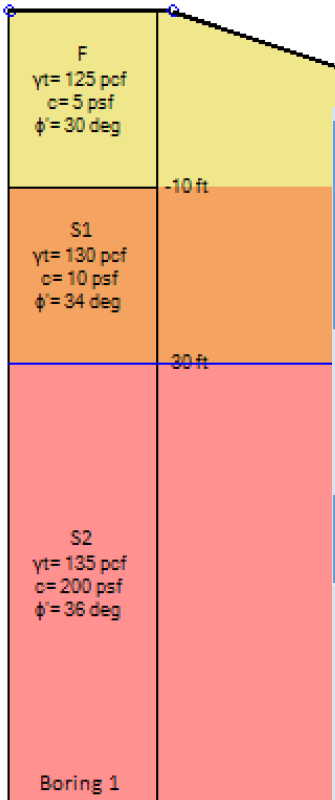
Example 5: Top-Down Excavation

Example 5: Top-Down Excavation with Concrete Slabs Limit Equilibrium – Non-Linear Analysis



A. Soil Properties and Stratigraphy (Soil Layers)

Elev. (ft)	Soil (-)	γ_t (pcf)	C' or S_u (psf)	ϕ' (deg)	E_{oed} (ksf)	E_{ur} (ksf)	m (-)
0	F - Sand	125	5	30	500	1500	0.5
-10	S1 - Sand	130	10	34	800	2400	0.4
-30	S2 - Sand	135	200	36	1200	3200	0.4



1. General Boring Information - Coordinates

Name: Boring 1

Coordinates X: -65.617 ft Y: 0 ft

The x coordinate controls where the boring is shown in your design. Each design section uses one boring (soil strata). You can use a different boring for each design section.

SPT Data Option (Applies to Design Section)

SPT Record: Not assigned [Add edit SPT records]

Pass same SPT log to boring (3D visualizations)

CPT Record Option (Applies to Design Section)

CPT Record: Not assigned [Add edit CPT records]

2. Boring Layers - Layer Elevations

	Top Elev. (ft)	Soil Type	OCR	K_o	Edit
	10	F	1	0.5	Edit
	-10	S1	1	0.4408...	Edit
	-30	S2	1	0.412	Edit
*					

A. General C. Elasto-plastic D. Bond E. Adv. F. Piles

4. Unit Weights - Density

γ_t : 130 pcf γ_{bulk} : 125 pcf $\gamma' = 67.6$

5. Strength Parameters and Poisson Ratio

Drained strength properties

c' : 10 psf ϕ' : 34 degrees

Peak - constant vol. (for estimation)

ϕ_{cv} : Omitted degrees ϕ_{peak} : Omitted degrees

ν : 0.35



B. Wall Section Properties, Wall Position and Depth

<p>General Advanced features</p> <p>1. Wall Name Wall 1</p> <p>2. Wall Section Properties Section Wall 1 Edit section data <input type="checkbox"/> Use gravity wall section Equivalent wall Thickness: 3 ft</p> <p>3. Dimensions Top EL. 0 ft Depth L. 50 ft Bottom -50 ft <input type="checkbox"/> Use custom passive Elev. <input type="checkbox"/> Wall is permeable <input type="checkbox"/> Include wall weight</p> <p>4. 3D Wall Coordinates xWall 0 ft Out-of-plane y 0 ft</p> <p>7. Wall Nodes (Analysis Settings) Number of Nodes nD (0-100) 100</p> <p>Limit equilibrium analyses use nD to divide wall into smaller elements. BEF uses Mesh DELTA as defined in the "Analysis Tab" in then main form and recalculates nD.</p>	<p>Wall Section Drawing (Plan)</p> <p>A. Wall Type D. Concrete-Rebar F. Draw</p> <p>1. Concrete Section Type <input type="checkbox"/> Use more than one reinforcement sections</p> <p>2. Section Dimensions D 36 in A 432 in² bxx 46656 in⁴ Recalculate box - slice analysis B 12 in Eff. conc 25 % <small>Used with recal button and for secant piles</small></p> <p>3. Longitudinal Reinforcement (Tension - Compression) Top Rebars (left side) N 2 Bars # #7 = AsTop 1.2 in² Ctop 3 in Bottom Rebars (Right Side) N 2 Bars # #7 = AsBot 1.2 in² Cbot 3 in</p> <p>4. Shear Reinforcement Bar# #5 = As 0.31 in² sV 6 in sH 6 in <input type="checkbox"/> Shear reinforcement is spiral Metric Rebars D10 for 10mm Diam <input type="checkbox"/> Treat wall as slab for shear capacity calculations (diaphragm walls only)</p>	<table border="1"> <tr> <td>X-Coordinate</td> <td>X = 0</td> </tr> <tr> <td>Wall Type</td> <td>Concrete Diaphragm</td> </tr> <tr> <td>Thickness</td> <td>3 ft</td> </tr> <tr> <td>Long. Reinforcement</td> <td>2 #7 Rebars (each side)</td> </tr> <tr> <td>Shear Reinforcement</td> <td>#5 Bars @ 6in Spacing</td> </tr> <tr> <td>Materials</td> <td>Grade 75 Rebars, 4ksi Concrete</td> </tr> </table> <p>Elevation view Shear reinforcement Sv Top view Shear reinforcement Sh</p>	X-Coordinate	X = 0	Wall Type	Concrete Diaphragm	Thickness	3 ft	Long. Reinforcement	2 #7 Rebars (each side)	Shear Reinforcement	#5 Bars @ 6in Spacing	Materials	Grade 75 Rebars, 4ksi Concrete
X-Coordinate	X = 0													
Wall Type	Concrete Diaphragm													
Thickness	3 ft													
Long. Reinforcement	2 #7 Rebars (each side)													
Shear Reinforcement	#5 Bars @ 6in Spacing													
Materials	Grade 75 Rebars, 4ksi Concrete													

C. Support Section Properties and Elevations

A. General | B. Options | C. Results | D. Notes | E. Envelope

1. Dimensions

1.1 Coordinates at Wall
 X 3 ft
 Z -1 ft

1.2 Angles
 α -180 deg

1.3 Lengths
 Lfree 47 ft
 Horizontal Spacing 1 ft

2. Support Type and Structural Section Used
 Structural Section 2 ft

Include slab weight in vertical stress (tr) End Moment Connection Effecti

2. Unbraced Lengths Options
 Use user-defined unbraced lengths Vertical Unbraced Length LuV 1

3. Slab Live Load
 0.6 ksf Apply same load to all stages

Change support type

Support	First Slab	Second Slab
Support Type	2 ft Concrete Slab	2 ft Concrete Slab
Elevation on Wall	Z = - 1 ft	Z = - 11 ft
Hor. Spacing	Continuous	Continuous
Long. Reinforcement	2 #9 Bars/ft of Slab (top and bottom)	
Materials	Grade 60 Rebars, 3 ksi Concrete	

Concrete: Fc 3ksi fc' 3 ksi
 E 3122 ksi

Rebar: Grade 60 fy 60 ksi

Color

Bottom

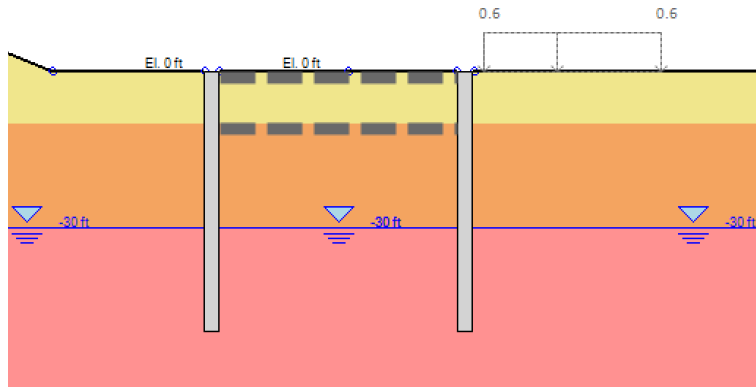
4. Section Dimensions
 D 24 in A 288 in² Ixx 13824 in⁴ Load 0.3 k/ft
 B 12 in Recalculate Properties

5. Longitudinal Slab Reinforcement

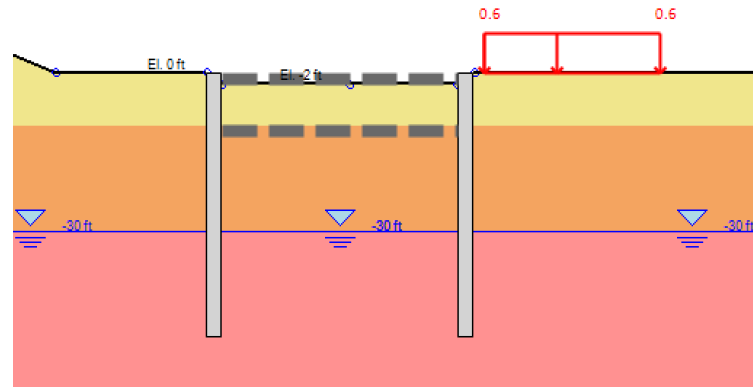
Top Rebars Use bar spacing instead of number of bars Ctop 1.5 in
 N 2 Bars # #9 = AsTop 2 in²

Bottom Rebars
 N 2 Bars # #9 = AsBot 2 in² Cbot 3 in

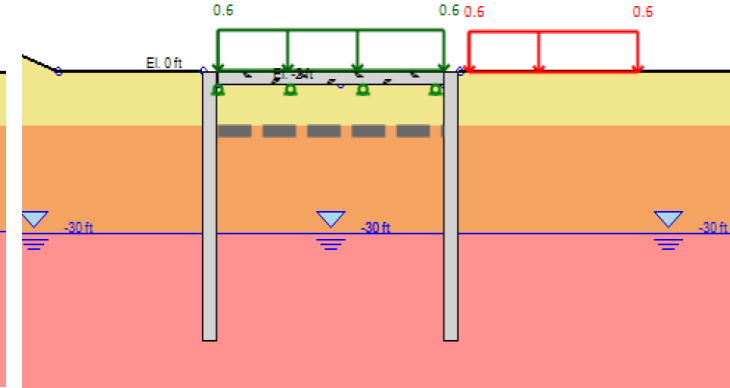
D. Model in Construction Stages



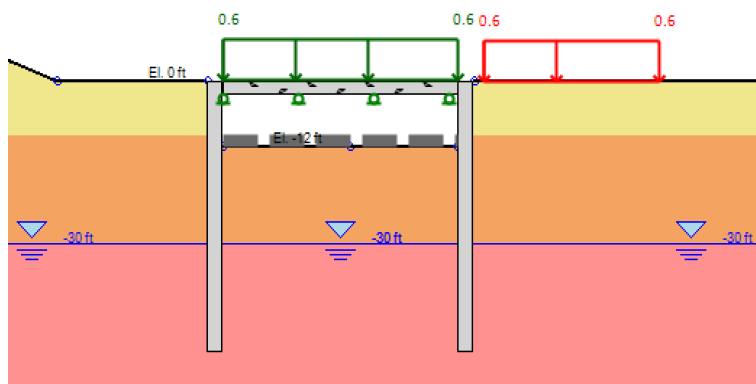
Stage 0: At-rest Conditions



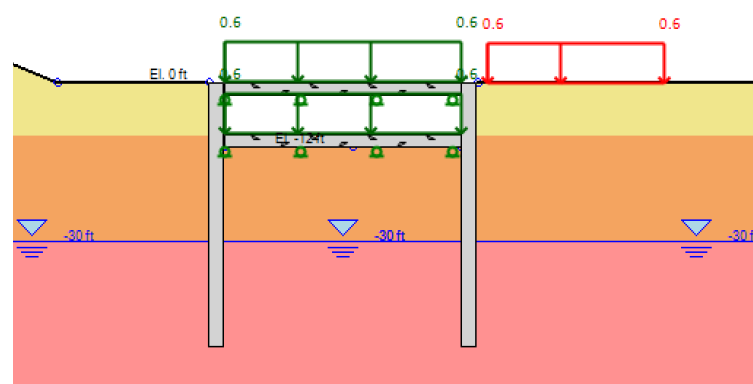
Stage 1: Initial Excavation



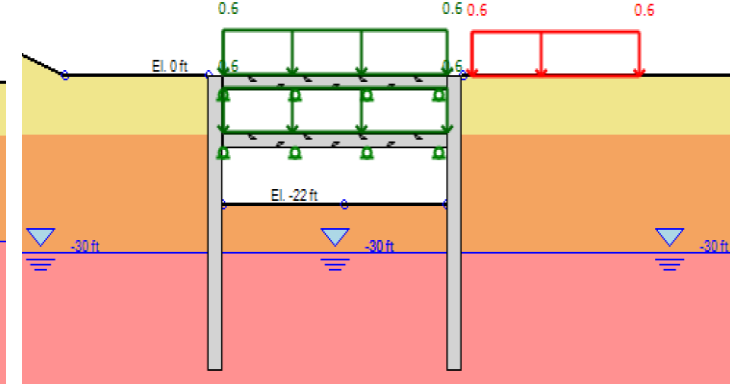
Stage 2: Support Installation



Stage 3: Excavation



Stage 4: Support Installation



Stage 5: Excavation

E. Analysis Settings & Design Codes

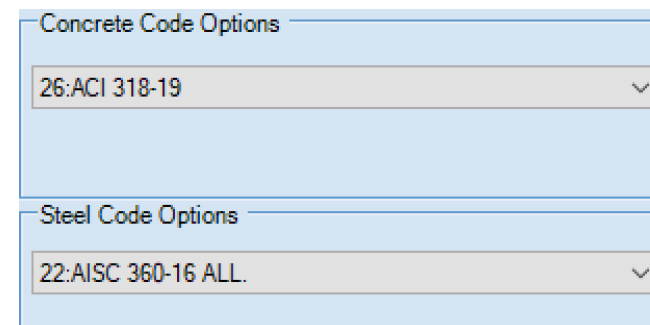
- Wall Friction: 50% of the soil friction
- Water Pressures: Simplified Flow
- Cantilever Method (LEM): Free Earth Method
- Beam Analysis Method: Blum's
- Soil Pressures: Active & Passive (Stages 0 to 3), FHWA Apparent (Stages 4 to 5)



The screenshot shows a software interface for analysis settings. It is divided into several sections:

- Water behaviour:** Clays: Default, Analysis: Simple, Wave Forces.
- Include Wall Friction:** Thrust options: $K_a K_p$ AUTO, a dropdown menu set to "1st wall", and a text input field containing "50".
- Limit Equilibrium Methods (Current Stage):** Drive Pressures: FHWA, Resist Pressures: Passive, and a checkbox for "Beam: Blum's method".
- Advanced Options:** Supports: Beam, Cantilever: Free-earth, and a dropdown menu for "Advanced Options".

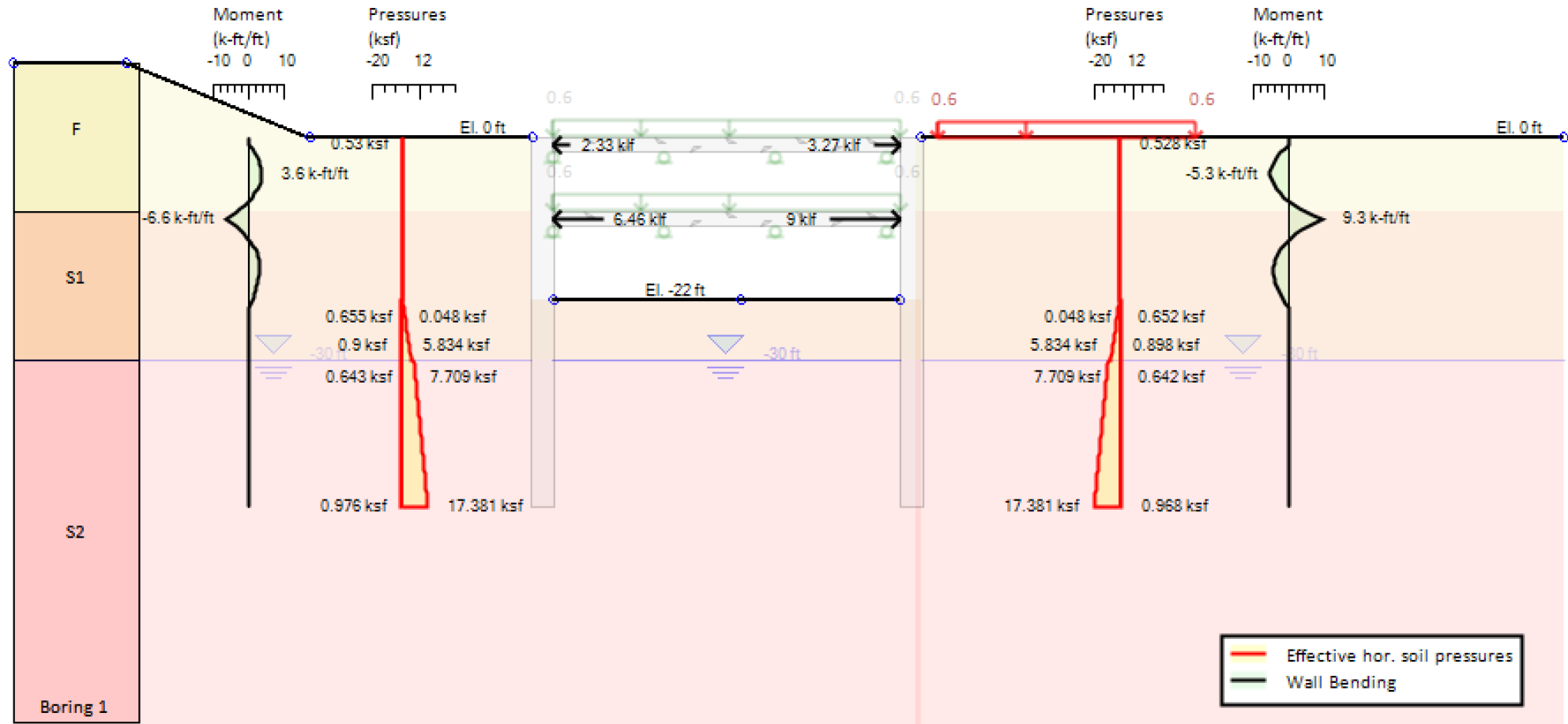
- Steel Code: AISC 360-16 Allowable
- Concrete Code: ACI 318-19
- Analysis Code: None (Service Conditions)



The screenshot shows two dropdown menus for design code options:

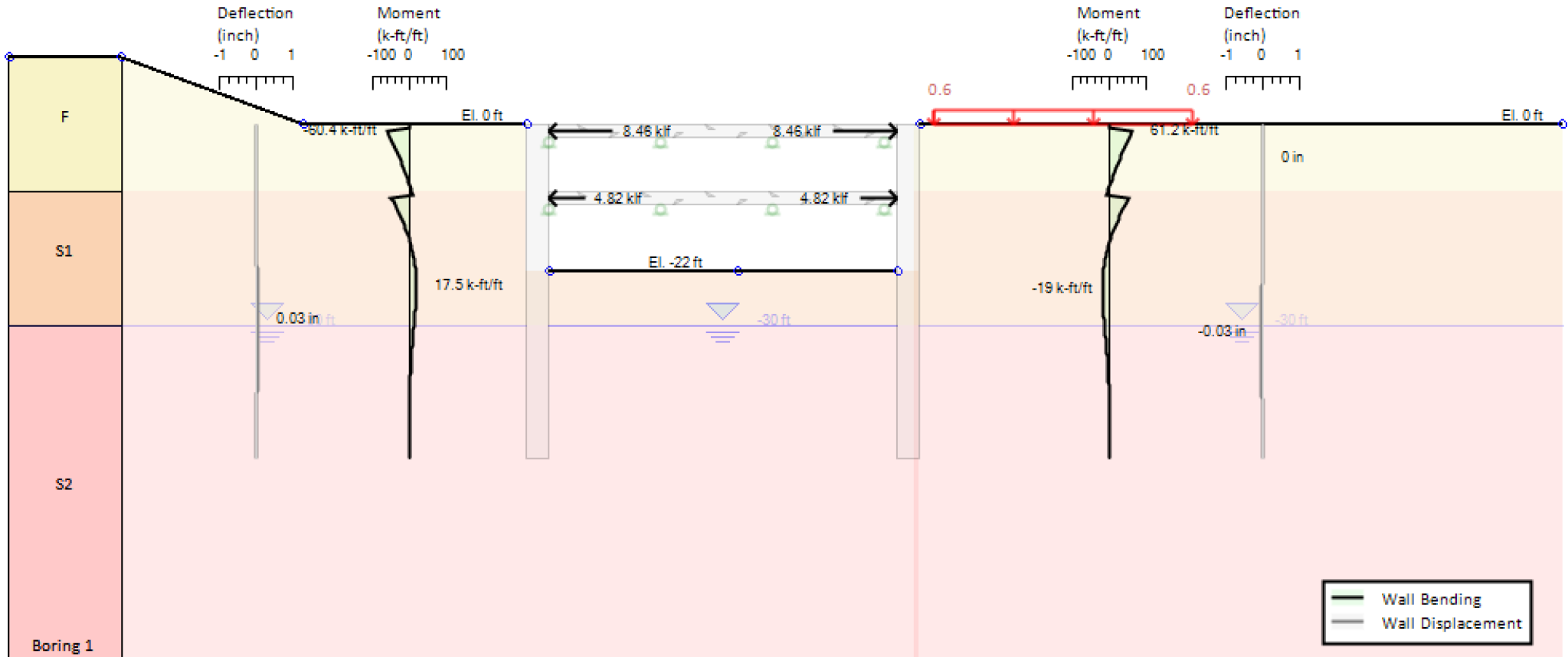
- Concrete Code Options:** 26:ACI 318-19
- Steel Code Options:** 22:AISC 360-16 ALL.

F1. LEM Analysis Results



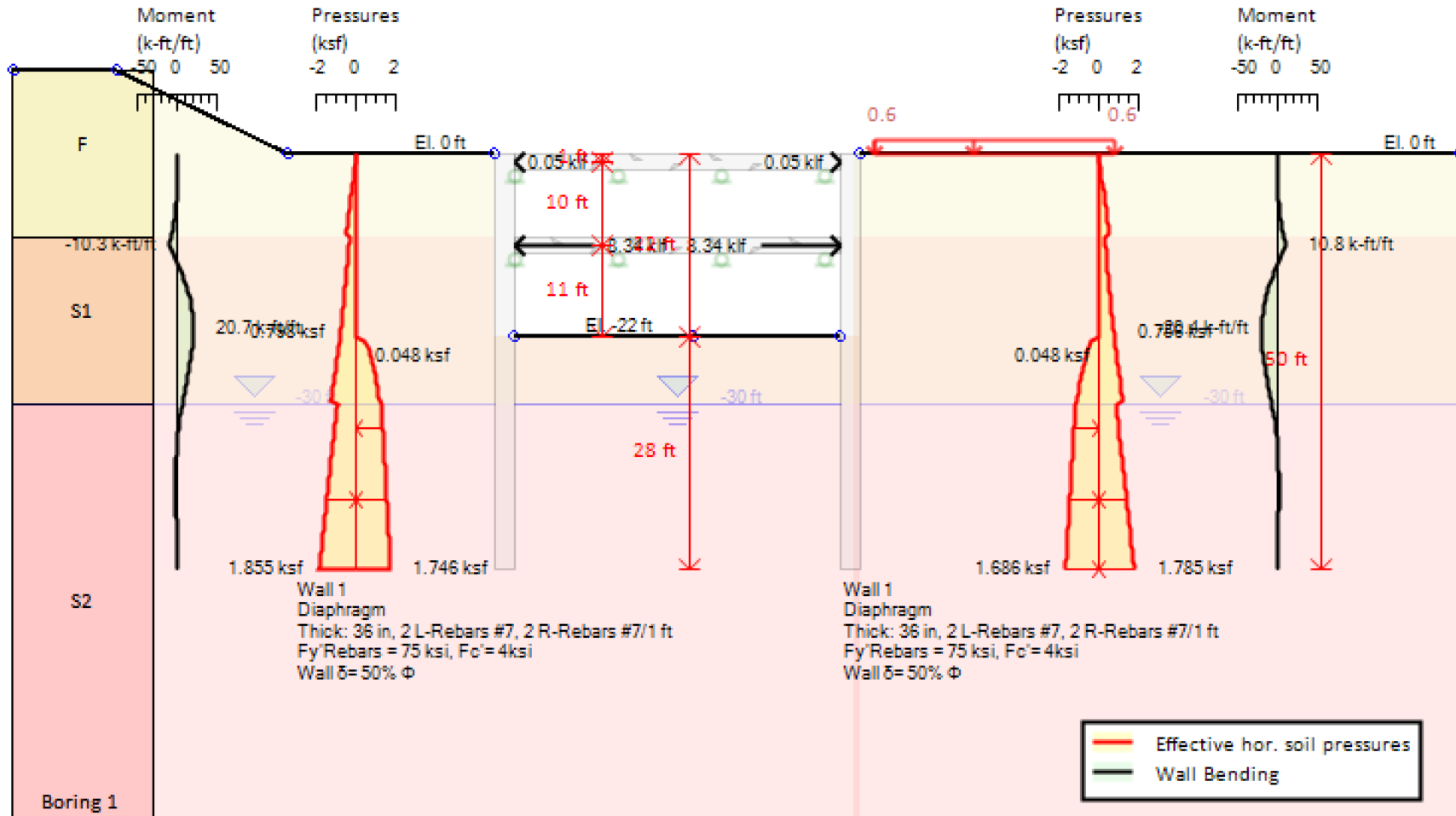
Wall Moments, Support Reactions & Soil Pressures - Stage 5

F2. LEM Analysis Results



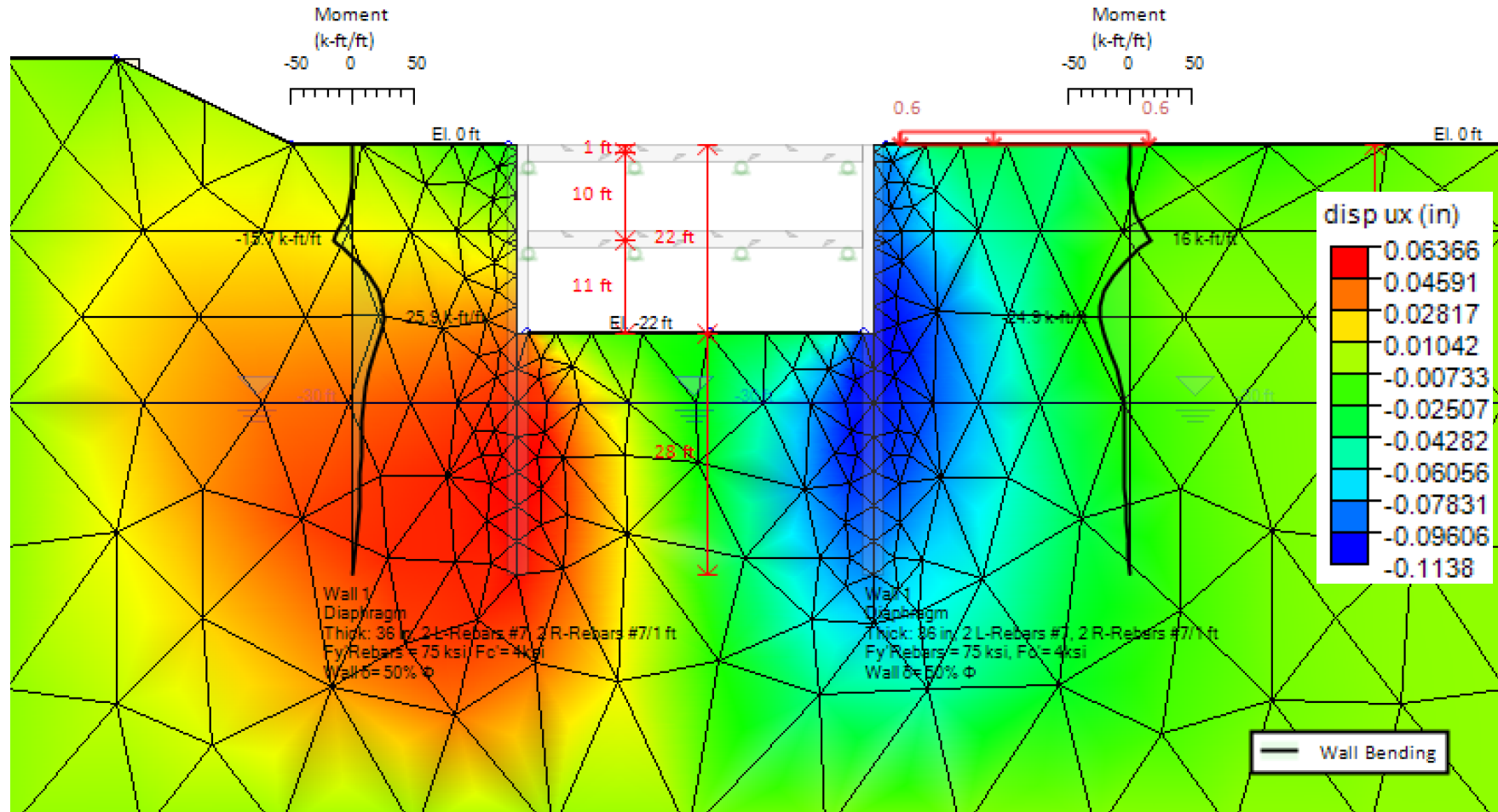
Wall Moments & Displacements, Support Reactions - Stage 5

G. Non-Linear Analysis Results



Wall Moments, Support Reactions & Soil Pressures - Stage 5

H. FEM Analysis Results



Wall Moments, Generated Mesh & Soil Displacement Shadings - Stage 5

Thank You!

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