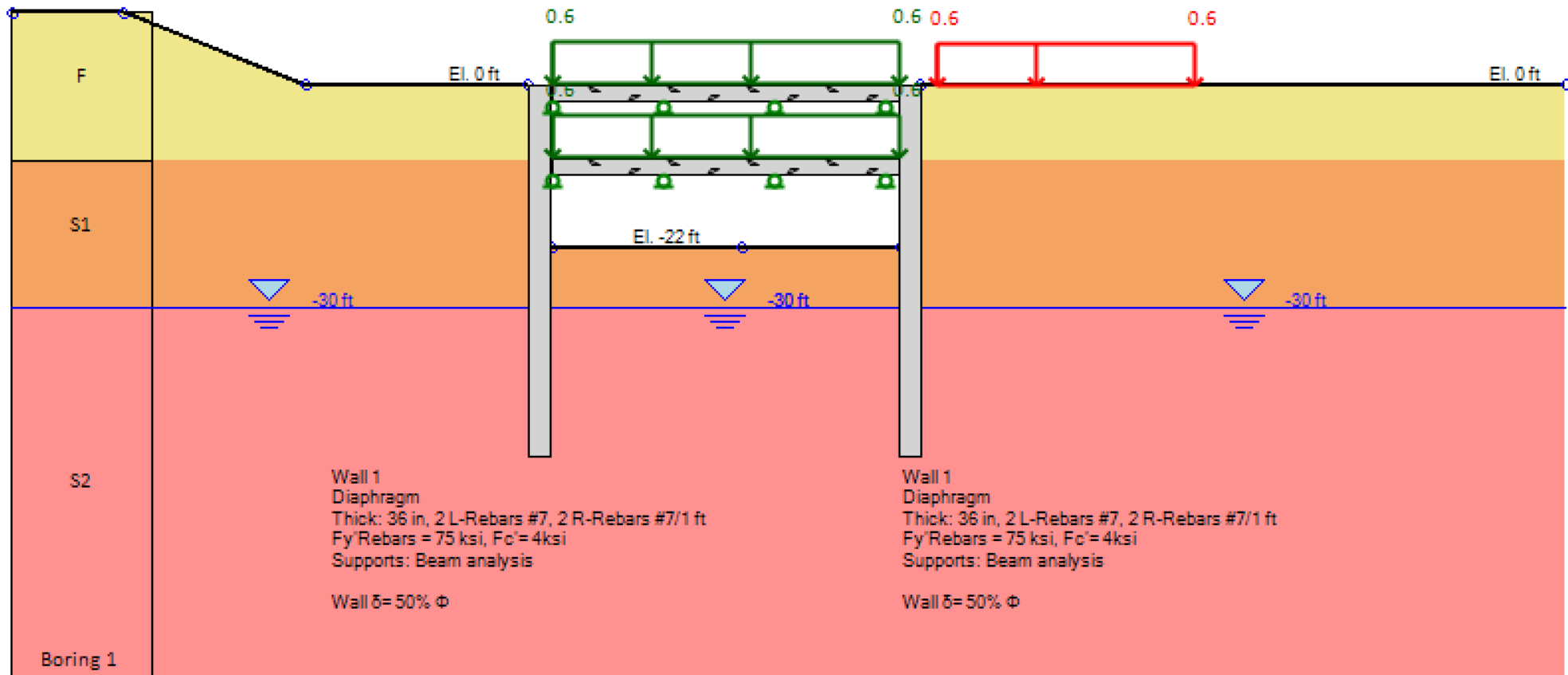


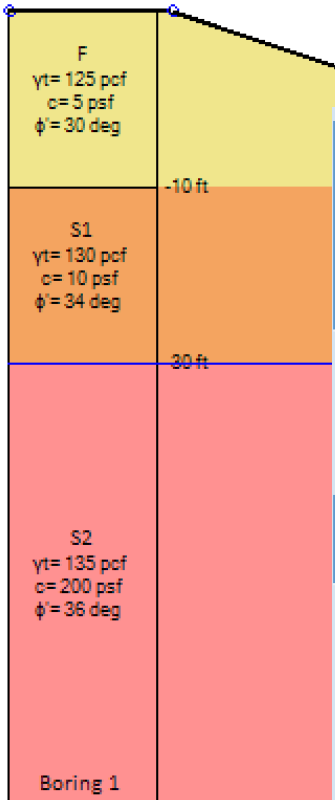
Example 5: Top-Down Excavation

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

General | Advanced features

1. Wall Name
 Wall 1

2. Wall Section Properties
 Section: Wall 1 Edit section data
 Use gravity wall section
 Equivalent wall Thickness: 3 ft

3. Dimensions
 Top EL: 0 ft
 Depth L: 50 ft
 Bottom: -50 ft

 Use custom passive Elev.
 Wall is permeable
 Include wall weight

4. 3D Wall Coordinates
 xWall: 0 ft Out-of-plane y: 0 ft

7. Wall Nodes (Analysis Settings)
 Number of Nodes nD (0-100): 100

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.

Wall Section Drawing (Plan)

A. Wall Type D. Concrete-Rebar F. Draw

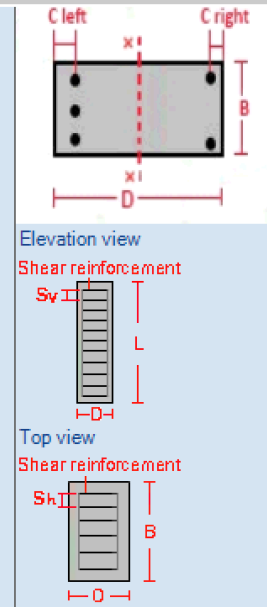
1. Concrete Section Type
 Use more than one reinforcement sections

2. Section Dimensions
 D 36 in A 432 in² bxx 46656 in⁴ Recalculate box - slice analysis
 B 12 in Eff. conc 25 %
Used with recal button and for secant piles

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

4. Shear Reinforcement
 Bar# #5 = As 0.31 in² sV 6 in sH 6 in
 Shear reinforcement is spiral Metric Rebars D10 for 10mm Diam
 Treat wall as slab for shear capacity calculations (diaphragm walls only)

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
L_{free}: 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 Effect

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

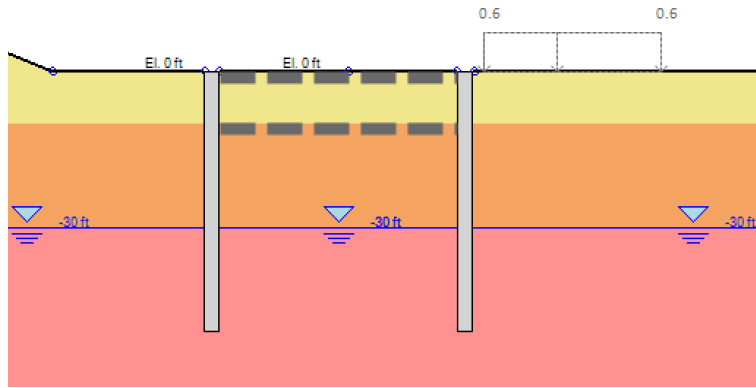
4. Section Dimensions
D: 24 in A: 288 in² I_{xx}: 13824 in⁴ Load: 0.3 k/ft
B: 12 in Recalculate Properties

5. Longitudinal Slab Reinforcement

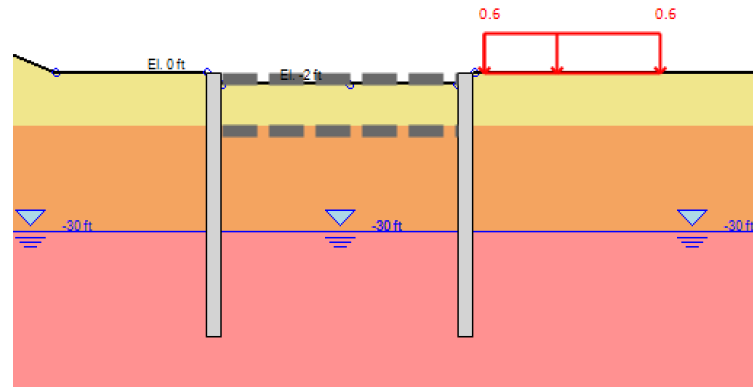
Top Rebars Use bar spacing instead of number of bars C_{top}: 1.5 in
N: 2 Bars #: #9 = As_{Top} 2 in²

Bottom Rebars C_{bot}: 3 in
N: 2 Bars #: #9 = As_{Bot} 2 in²

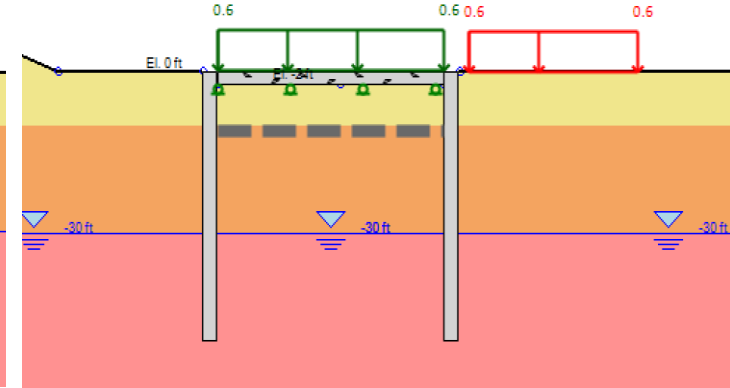
D. Model in Construction Stages



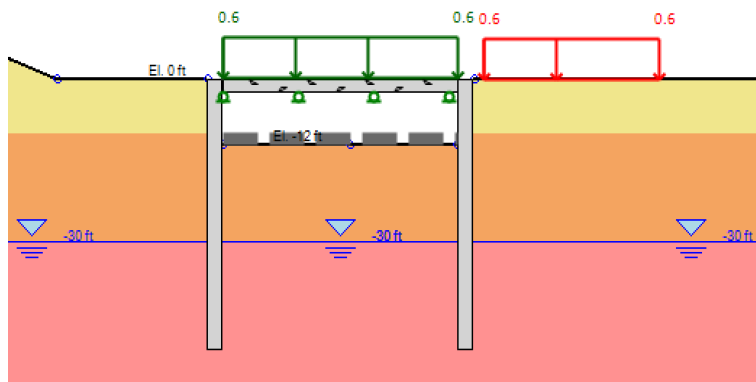
Stage 0: At-rest Conditions



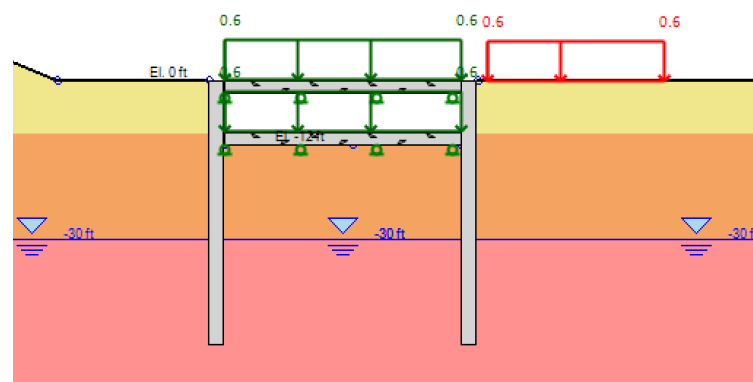
Stage 1: Initial Excavation



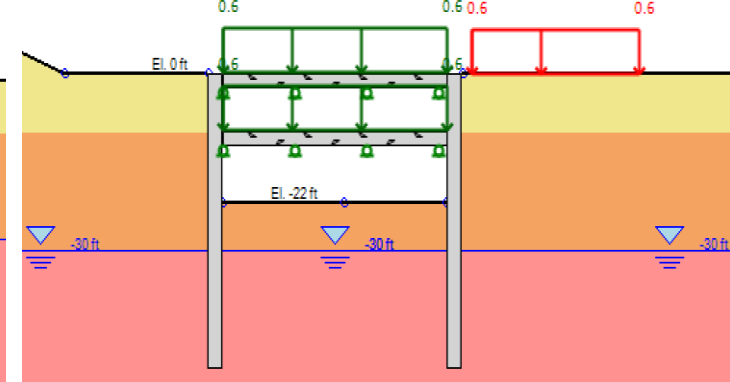
Stage 2: Support Installation



Stage 3: Excavation



Stage 4: Support Installation



Stage 5: Excavation

E. Analysis Settings & Design Codes

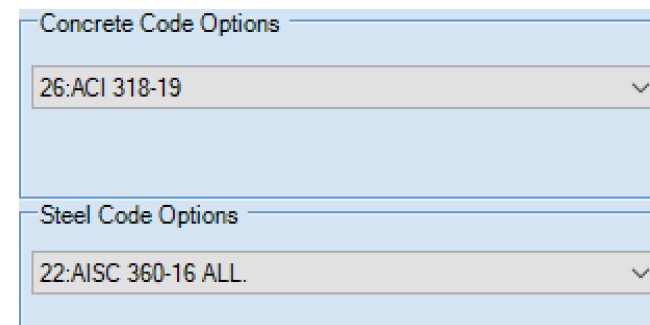
- Wall Friction: 50% of the soil friction
- Water Pressures: Simplified Flow
- Cantilever Method (LEM): Free Earth Method
- Beam Analysis Method: Blum's
- Soil Pressures: Active & Passive (Stages 0 to 3), FHWA Apparent (Stages 4 to 5)



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".

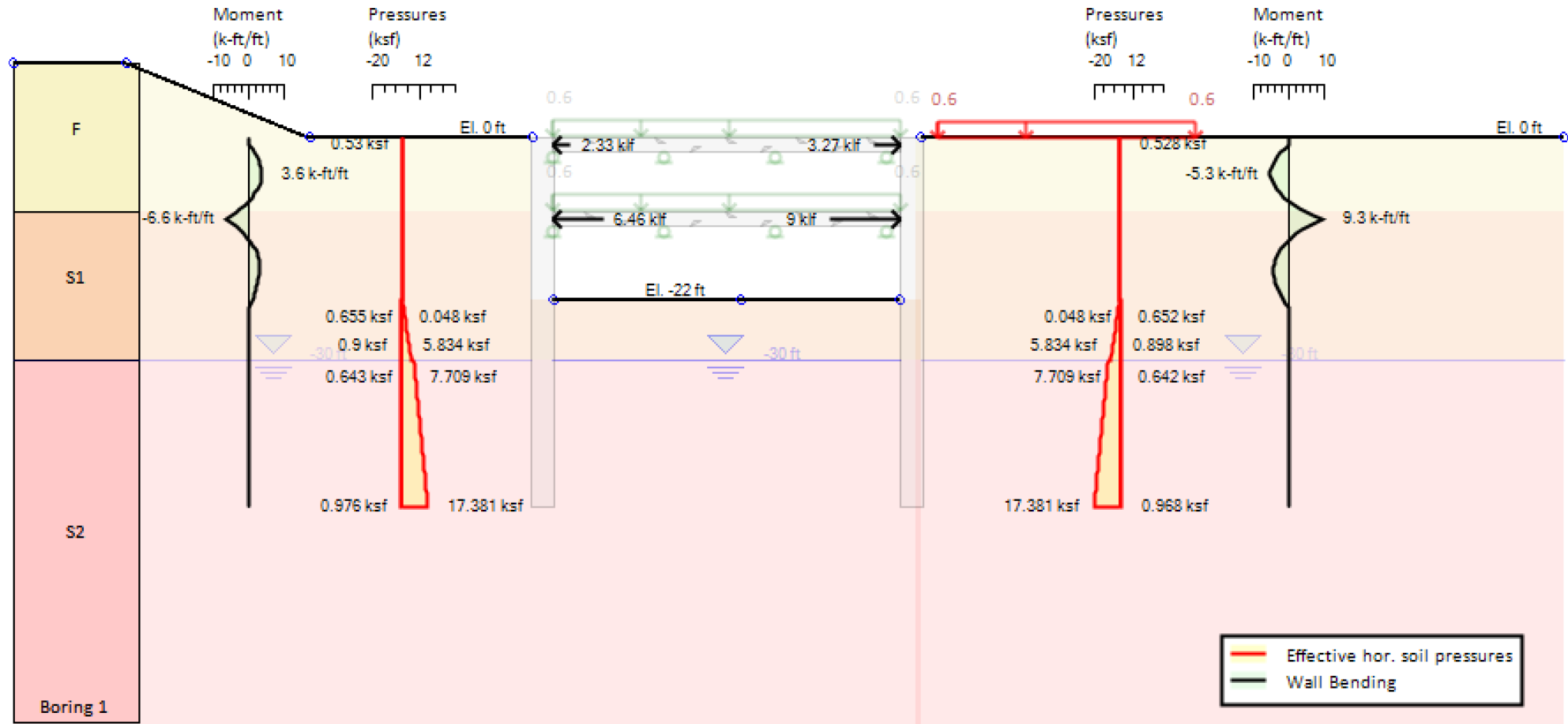
- Steel Code: AISC 360-16 Allowable
- Concrete Code: ACI 318-19
- Analysis Code: None (Service Conditions)



The screenshot shows two dropdown menus for design code options:

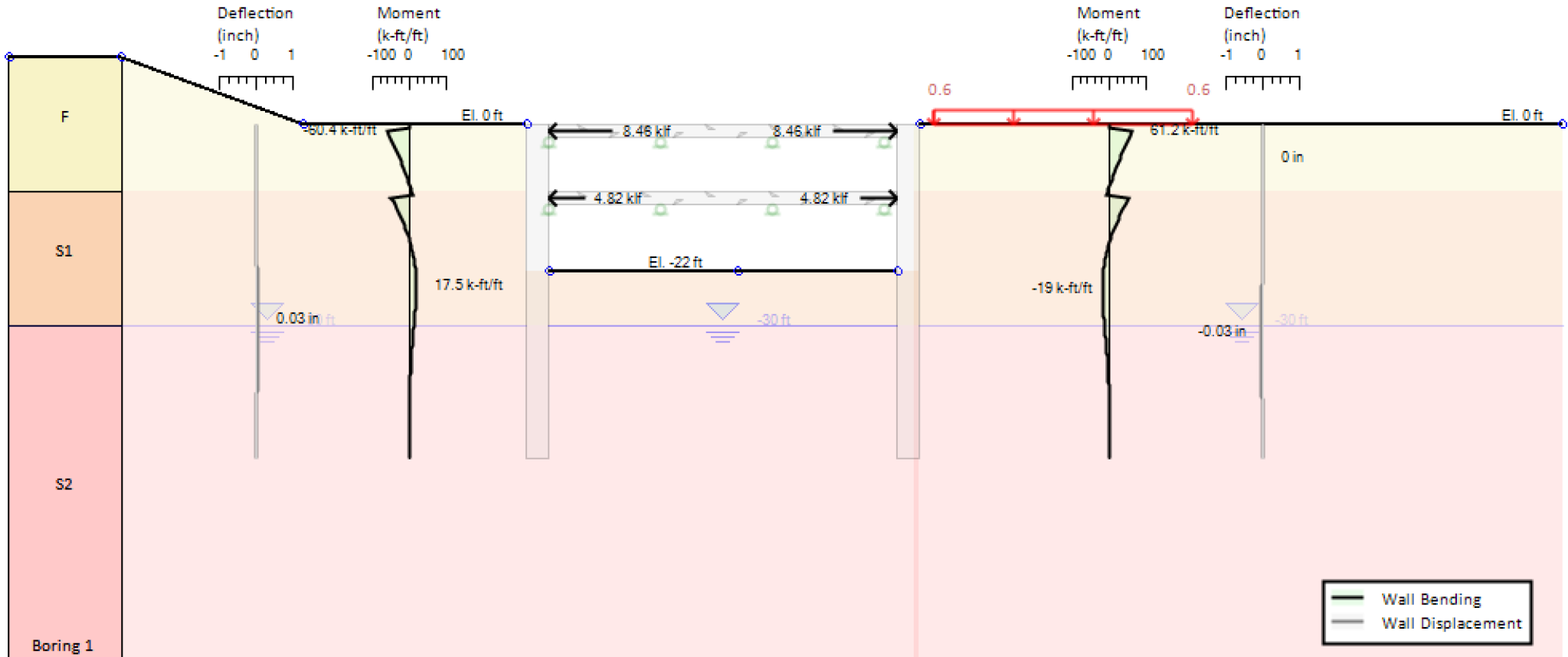
- Concrete Code Options:** 26:ACI 318-19
- Steel Code Options:** 22:AISC 360-16 ALL.

F1. LEM Analysis Results



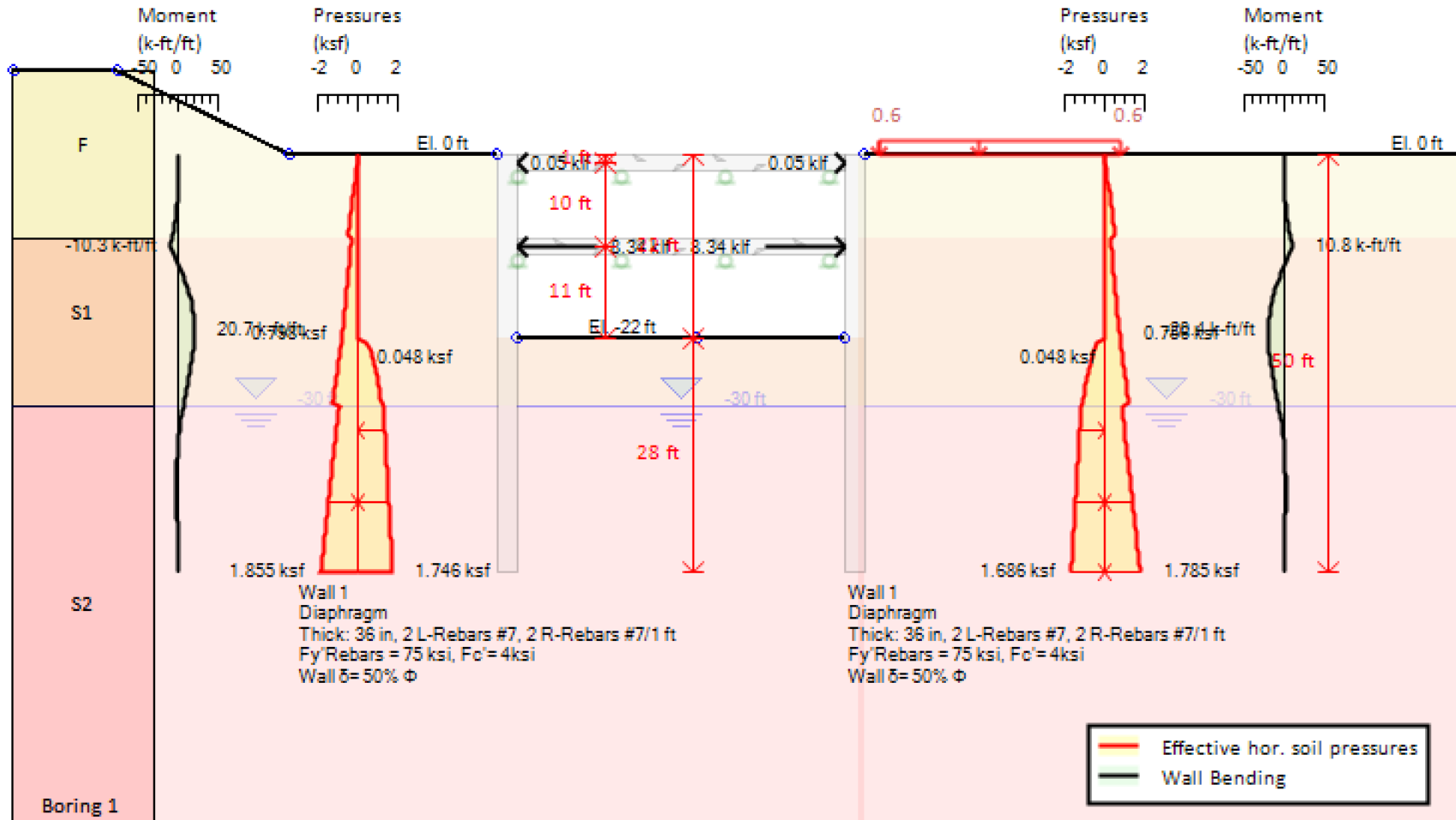
Wall Moments, Support Reactions & Soil Pressures - Stage 5

F2. LEM Analysis Results



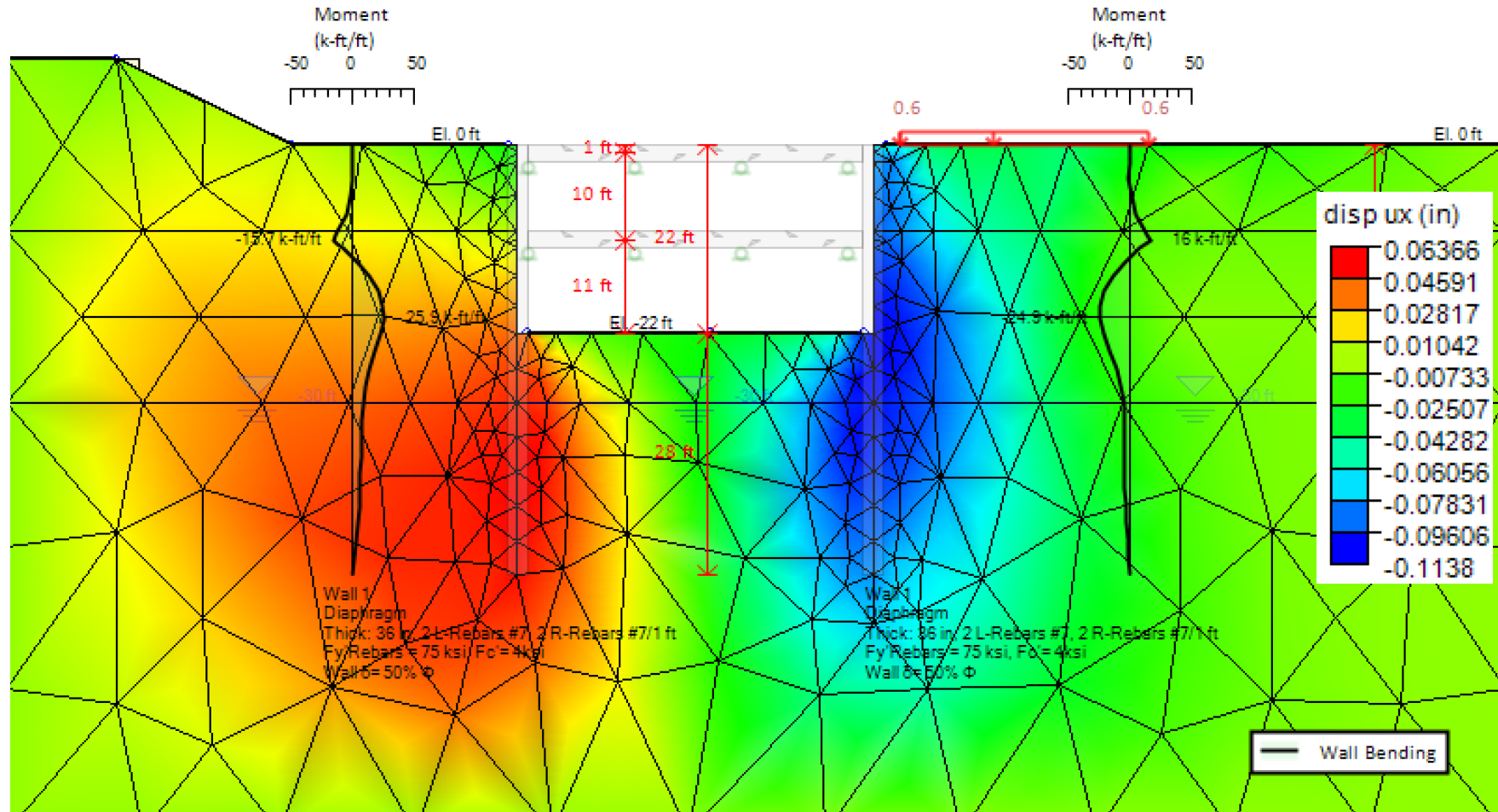
Wall Moments & Displacements, Support Reactions - Stage 5

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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