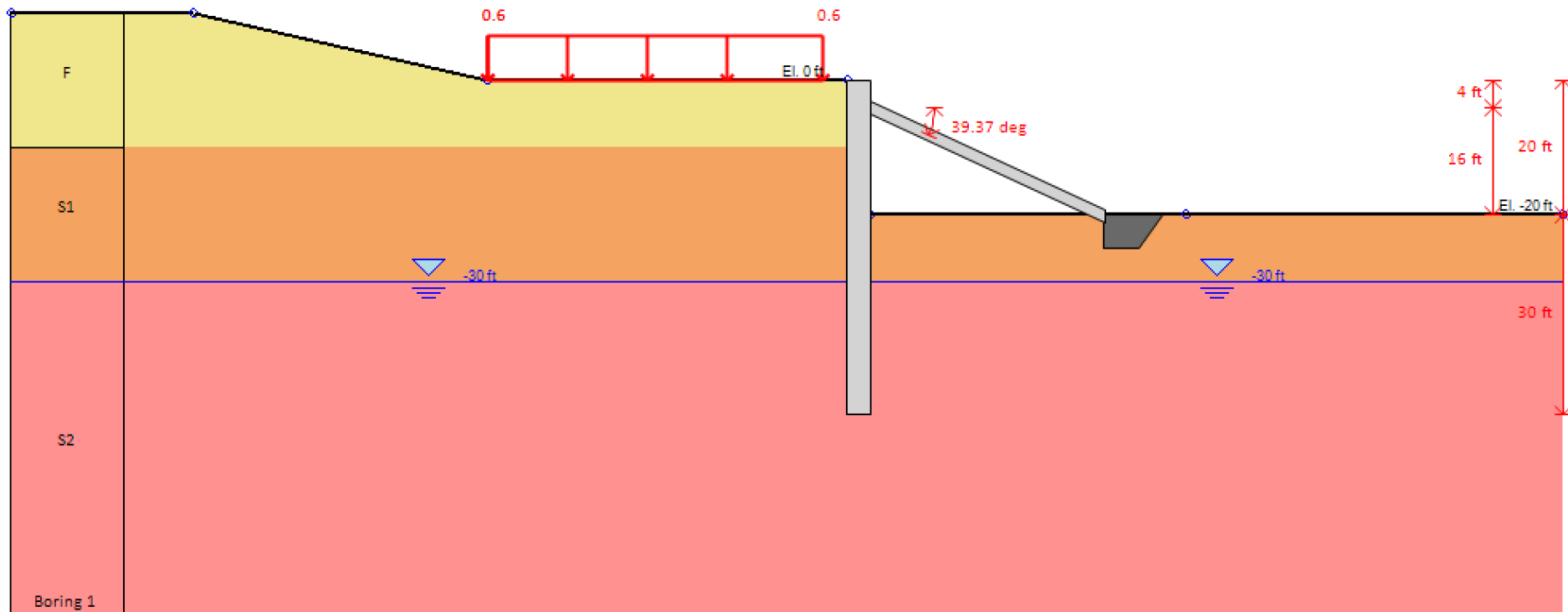


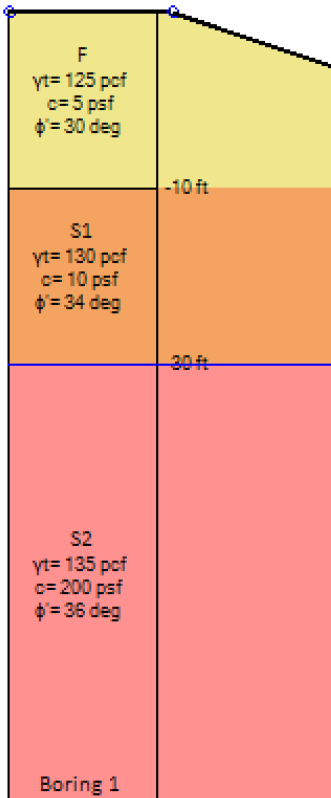
Example 7: Secant Pile Wall Braced with Rakers Limit Equilibrium – Non-Linear – Finite Element Analysis





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

X-Coordinate	X = 0
Wall Type	RC Secant Piles
Pile Diameter	2 ft
Long. Reinforcement	6 #7 Rebars
Shear Reinforcement	#4 Bars @ 6in Spacing
Materials	Grade 75 Rebars, 4 ksi Concrete

General | Advanced features

1. Wall Name
Wall 1

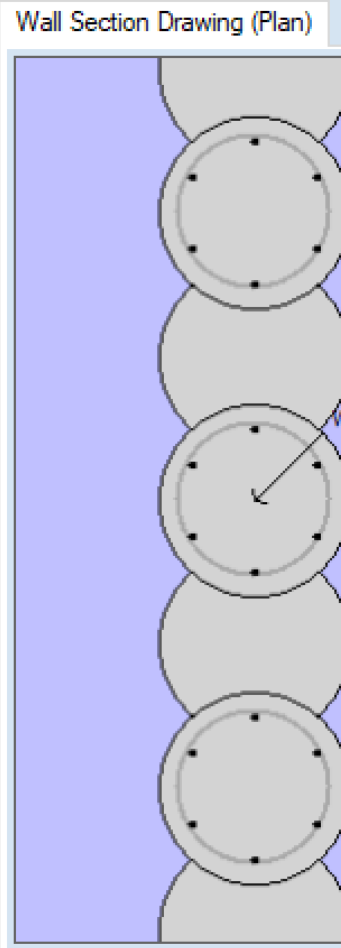
2. Wall Section Properties
Section: Wall 1 Edit section data
 Use gravity wall section
Equivalent wall Thickness: 1.387 ft

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

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.



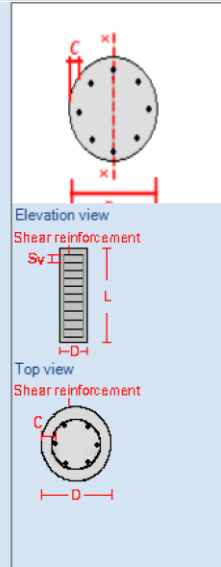
A. Wall Type | D. Concrete-Rebar | F. Draw

1. Concrete Section Type
 Use more than one reinforcement sections Define custom reinforcement

2. Section Dimensions
D: 24 in A: 288 in² lxx: 13824 in⁴ Recalculate box - slice analysis
Eff. conc: 25 % Used with recal button and for secant piles

3. Longitudinal Reinforcement (Tension - Compression)
Top Rebars (left side)
N: 6 Bars #: #7 = AsTop 3.6 in² Ctop: 3 in

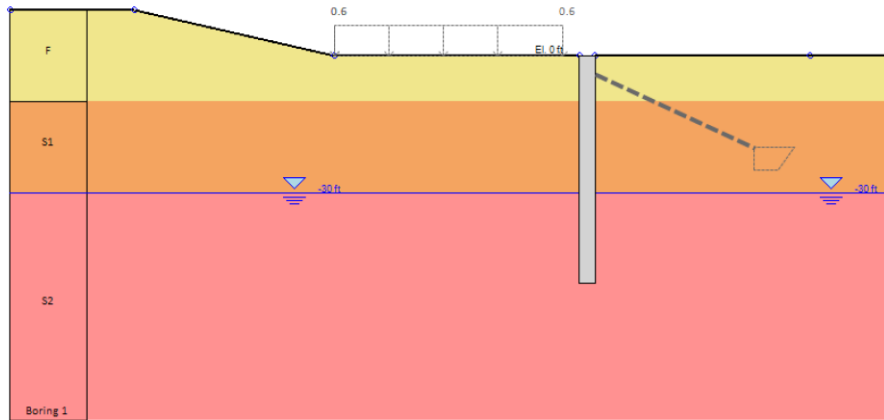
4. Shear Reinforcement
Bar #: #4 = As 0.2 in² sv: 6 in
 Shear reinforcement is spiral Metric Rebars D10 for 10mm Diam
 Treat wall as slab for shear capacity calculations (diaphragm walls only)



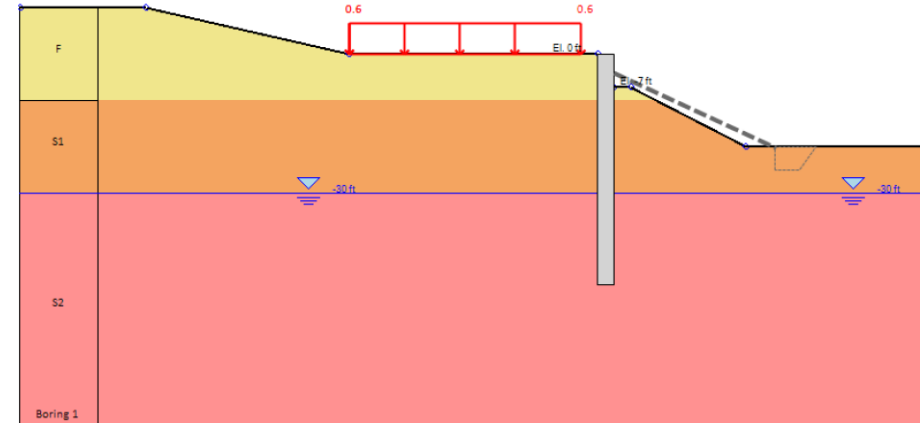
C. Support Section Properties and Elevation

Support Type	Rakers
Elevation on Wall	Z = -4 ft
Hor. Spacing	15 ft
Installation Angle	40 deg
Support Section	HP12x74 (H Beams)

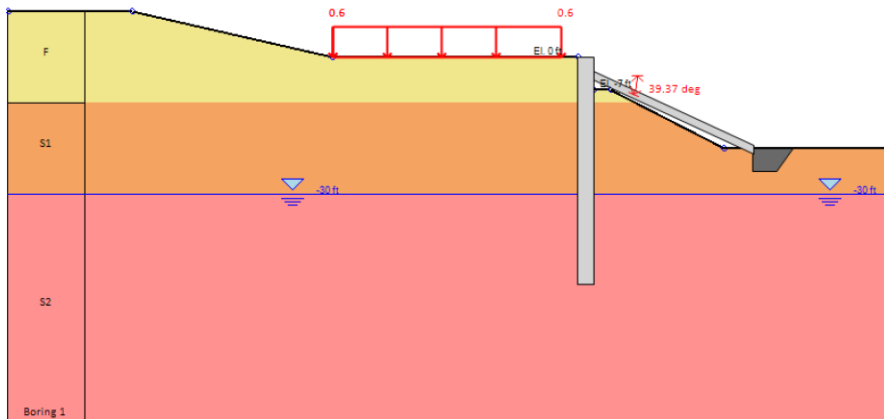
D. Model in Construction Stages



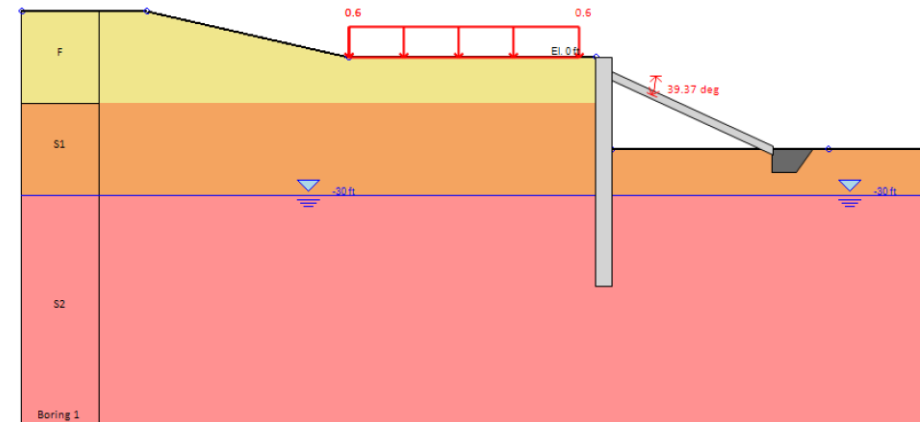
Stage 0: At-rest Conditions



Stage 1: Berm Excavation



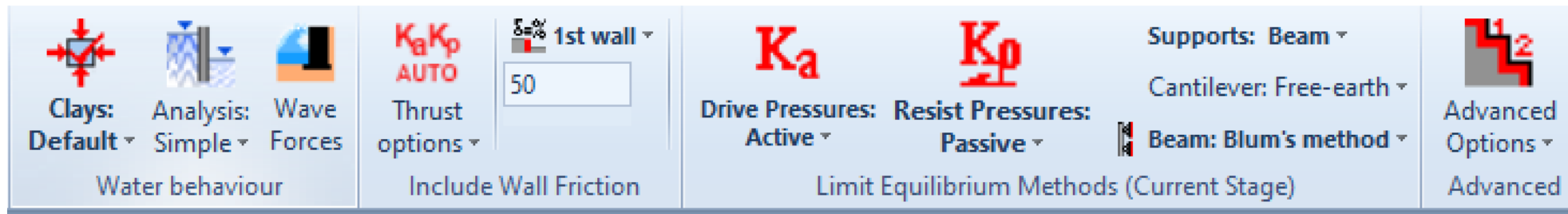
Stage 2: Raker & Heelblock Installation



Stage 3: Final Excavation

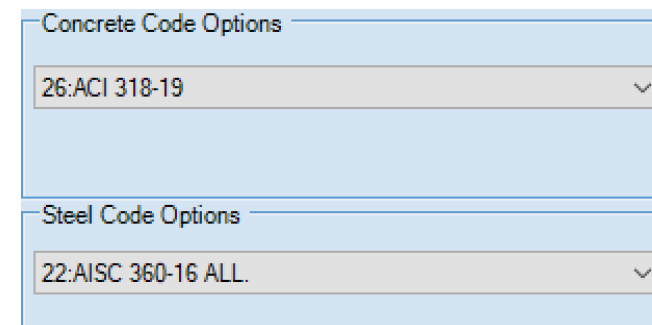
E1. Analysis Settings & Design Codes

- 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 (All Stages)



The screenshot shows the software's analysis settings interface. It includes several sections: 'Water behaviour' with 'Clays: Default', 'Analysis: Simple', and 'Wave Forces'; 'Include Wall Friction' with 'K_aK_p AUTO' and a 'Thrust options' dropdown set to '50'; 'Limit Equilibrium Methods (Current Stage)' with 'Drive Pressures: Active' and 'Resist Pressures: Passive'; 'Supports: Beam' and 'Cantilever: Free-earth'; 'Beam: Blum's method'; and 'Advanced Options'.

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



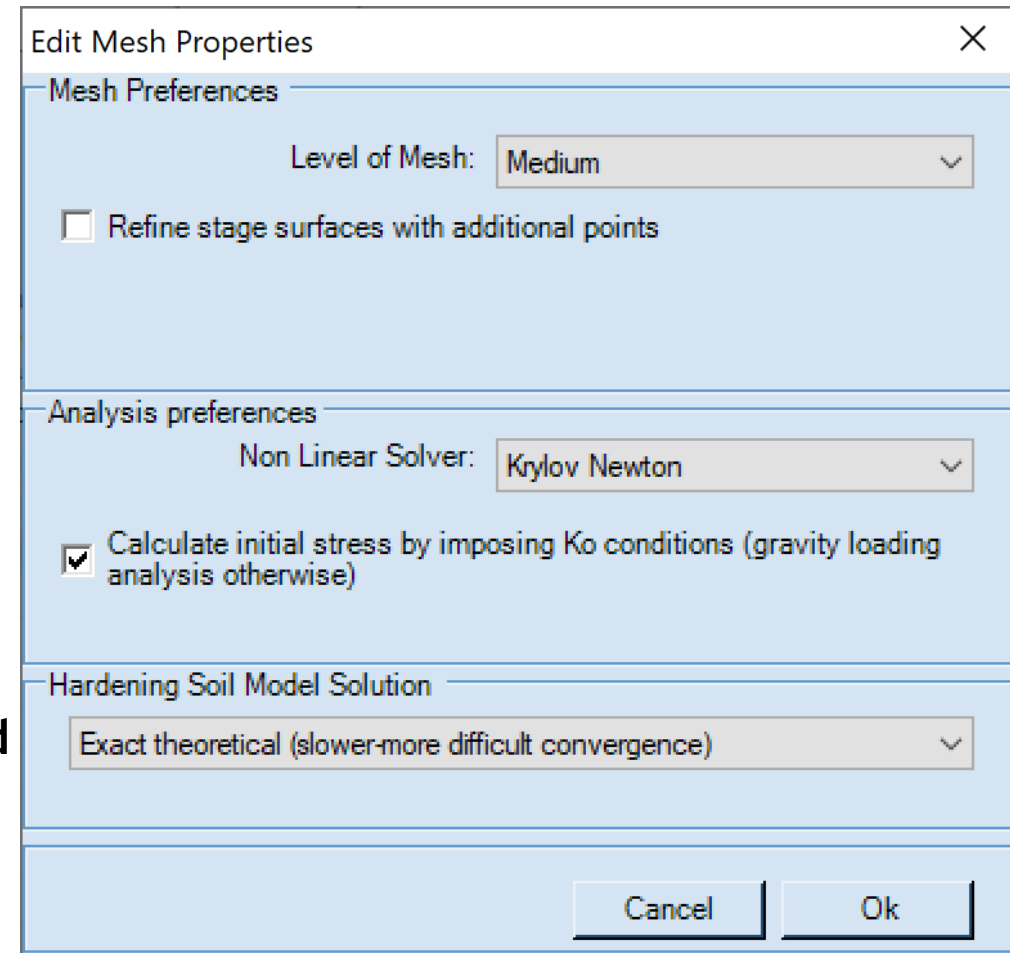
The screenshot shows the design code options. Under 'Concrete Code Options', the dropdown menu is set to '26:ACI 318-19'. Under 'Steel Code Options', the dropdown menu is set to '22:AISC 360-16 ALL.'.

E2. Additional FEM Analysis Settings & Tips

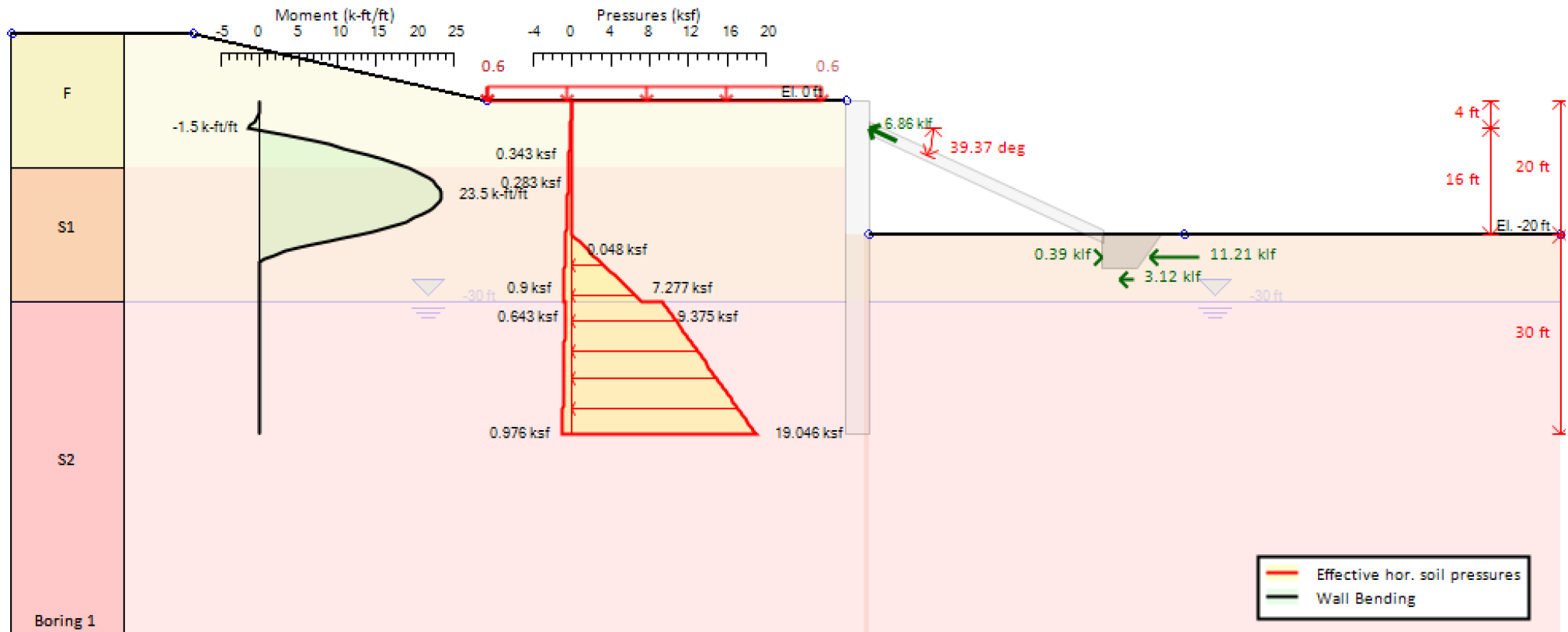
- **Generated Mesh Density: Medium**
- **Non-Linear Solver: Krylov Newton Method**
- **Hardening Soil Model: Exact Theoretical**

FEM Analysis - Model Convergence Tips:

- ✓ **Always consider a small cohesion for frictional soils**
- ✓ **Always use wall friction for all your walls**
- ✓ **Create a strict staging**
- ✓ **Sometimes an initial stage with green field conditions (not activated walls) might be required**
- ✓ **Always assume realistic prestress values for the anchors (if used)**

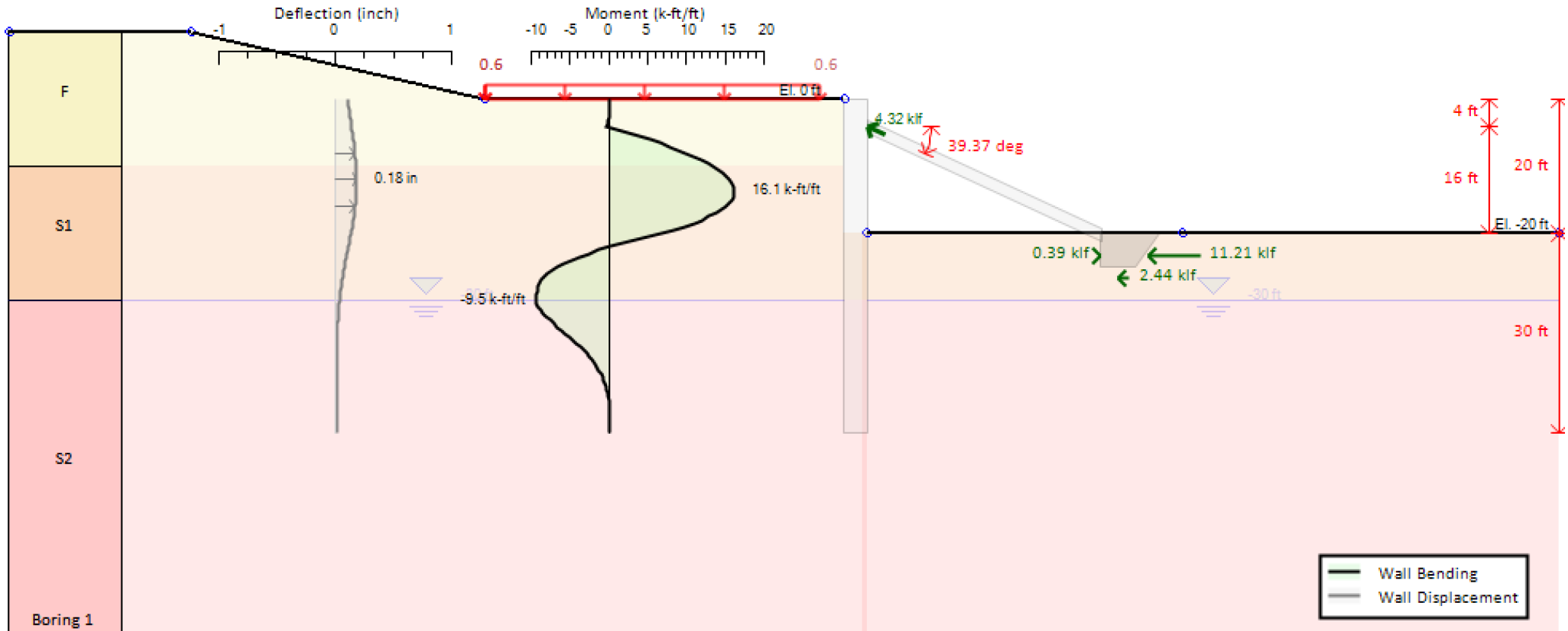


F. LEM Analysis Results



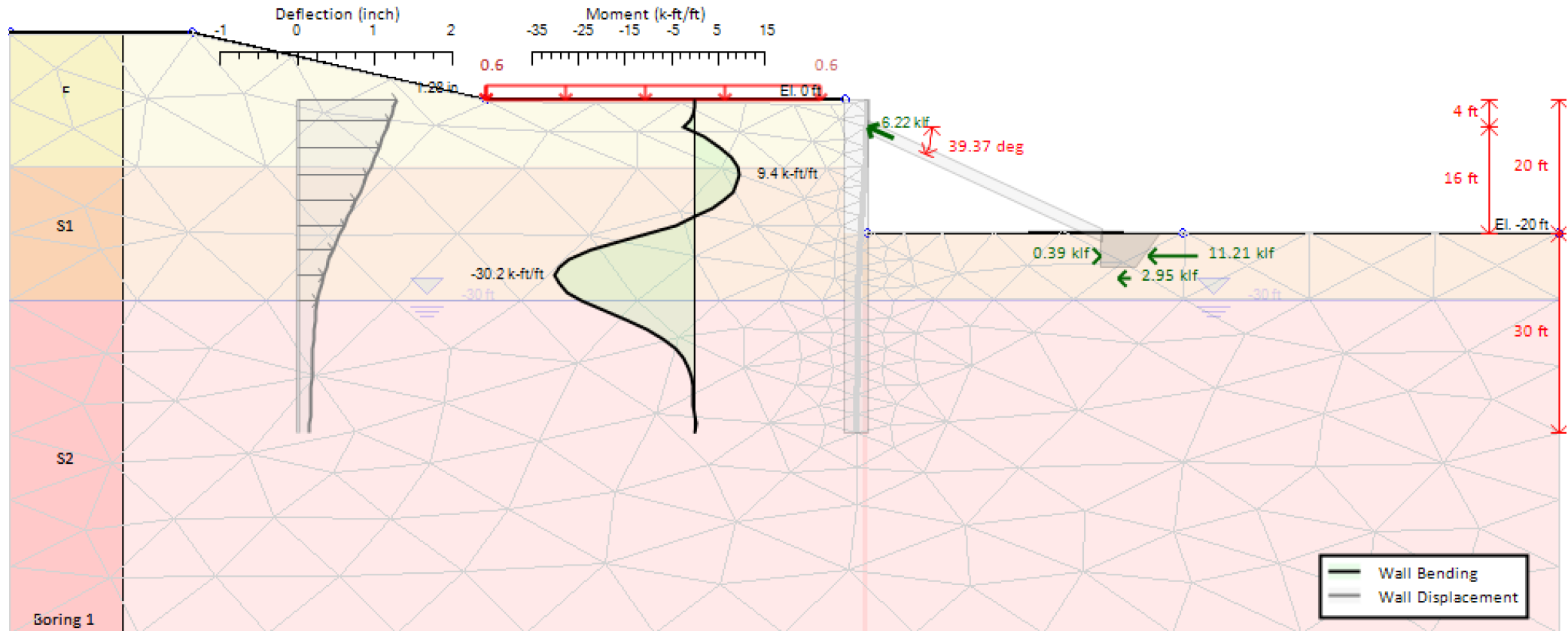
Wall Moments, Support Reactions & Soil Pressures - Stage 4

G. Non-Linear Analysis Results



Wall Moments, Displacements & Support Reactions - Stage 5

H. FEM Analysis Results



Wall Moments, Displacements & Support Reactions - Stage 5

Thank You!

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