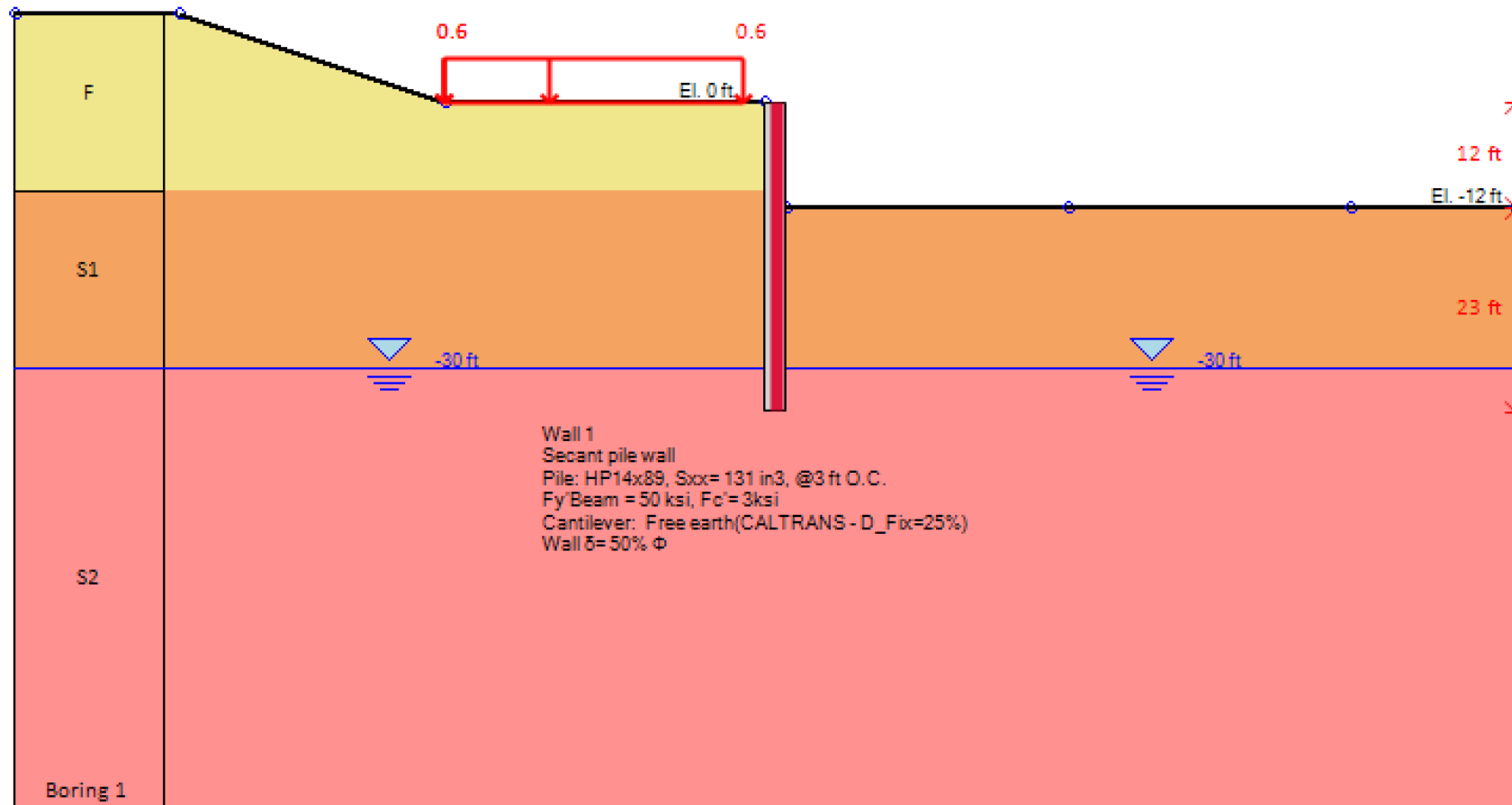


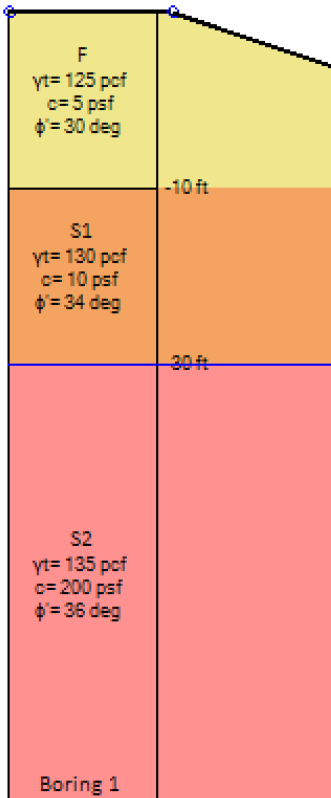
Example 1: Cantilever Secant Pile Wall

Example 1: Cantilever Secant Pile Wall 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	0
Section Type	Secant Piles
Wall Width	2ft diam. piles
Wall Spacing	3ft
Reinforcement	HP14x89 (H Beams)
Concrete Material	3ksi Concrete
Steel Material	A50 Steel
Depth	35ft

General | Advanced features

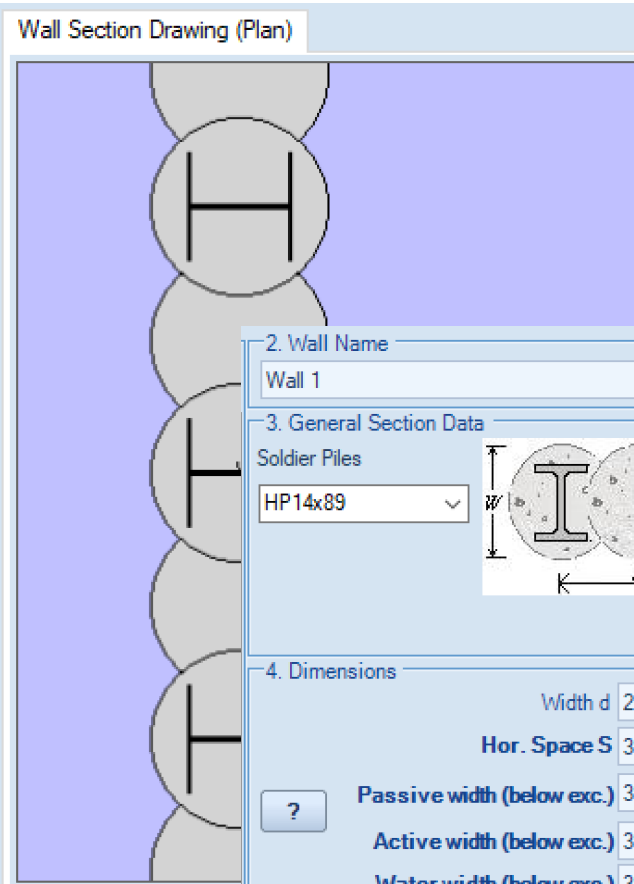
1. Wall Name
Wall 1

2. Wall Section Properties
Section: Wall 1 Edit section data
 Use gravity wall section
Equivalent wall Thickness: 0.582 ft

3. Dimensions
Top EL: 0 ft
Depth L: 35 ft
Bottom: -35 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.



2. Wall Name
Wall 1

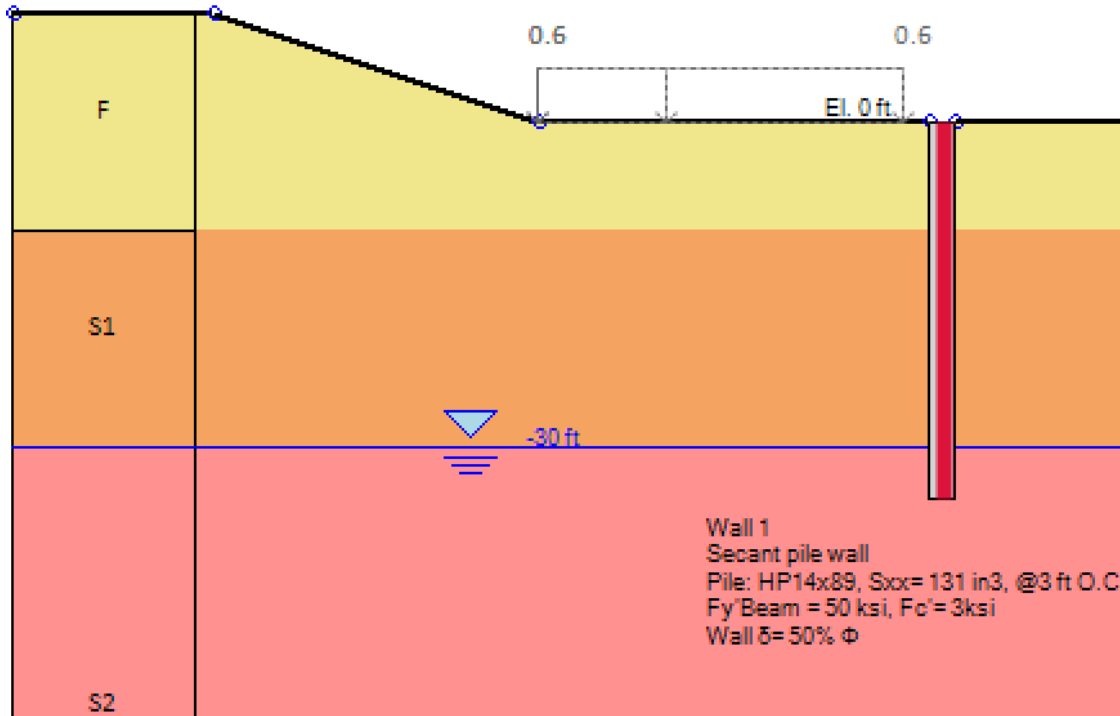
3. General Section Data
Soldier Piles
HP14x89

4. Dimensions
Width d: 2 ft
Hor. Space S: 3 ft
Passive width (below exc.): 3 ft >
Active width (below exc.): 3 ft >
Water width (below exc.): 3 ft >

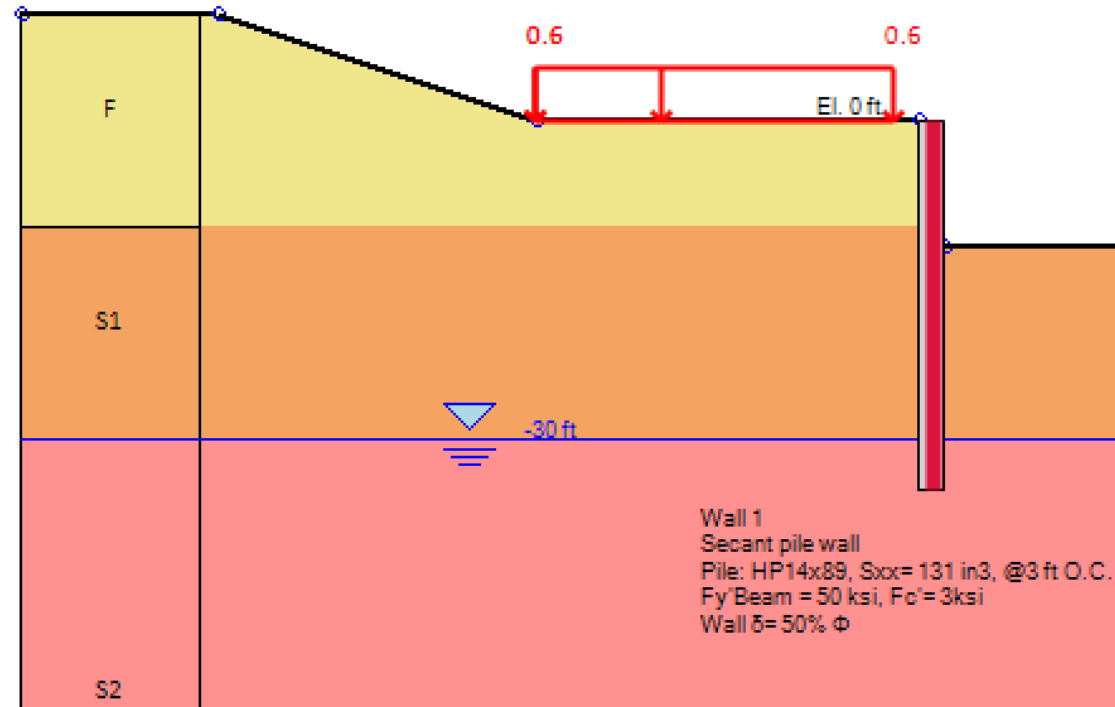
5. Structural Materials
Concrete - Rebar Materials
Concrete mat.
Fc: 3ksi Edit
Unreinforced piles
Same as reinforced pi

The "passive width and active width below exc." are used to multiply soil pressures on the wall element below the

C. Model in Construction Stages



Stage 0: At-rest Conditions



Stage 1: Cantilever Excavation

Stage 2: Copy of Stage 1 - Include Seismic Loads

D. Analysis Settings & Design Codes

- Wall Friction: 50% of the soil friction
- Water Pressures: Simplified Flow
- Cantilever Method (LEM): Free Earth Method + CALTRANS Approximations for displacements
- Soil Pressures: Active & Passive (All Stages)

Clays: Default ▾ Analysis: Simple ▾ Wave Forces
 Water behaviour

$K_a K_p$ AUTO Thrust options ▾
 Include Wall Friction

1st wall ▾
 50

K_a Drive Pressures: Active ▾
 K_p Resist Pressures: Passive ▾

Supports: Beam ▾
 Cantilever: Free-earth ▾
 Beam: California Trenching and Shoring Manual 2011 ▾

Limit Equilibrium Methods (Current Stage)

- Steel Code: AISC 360-16 Allowable
- Concrete Code: ACI 318-19
- Analysis Code: None (Service Conditions)
- Seismic Pressures: Adesign = 0.1g (Stage 2)
- Seismic Pressures Method: Mononobe-Okabe

Concrete Code Options

26:ACI 318-19 ▾

Steel Code Options

22:AISC 360-16 ALL.

Include Seismic Loads
 ax 0.100 ▾ g
 az 0.000 ▾ g
 General - Accelerations

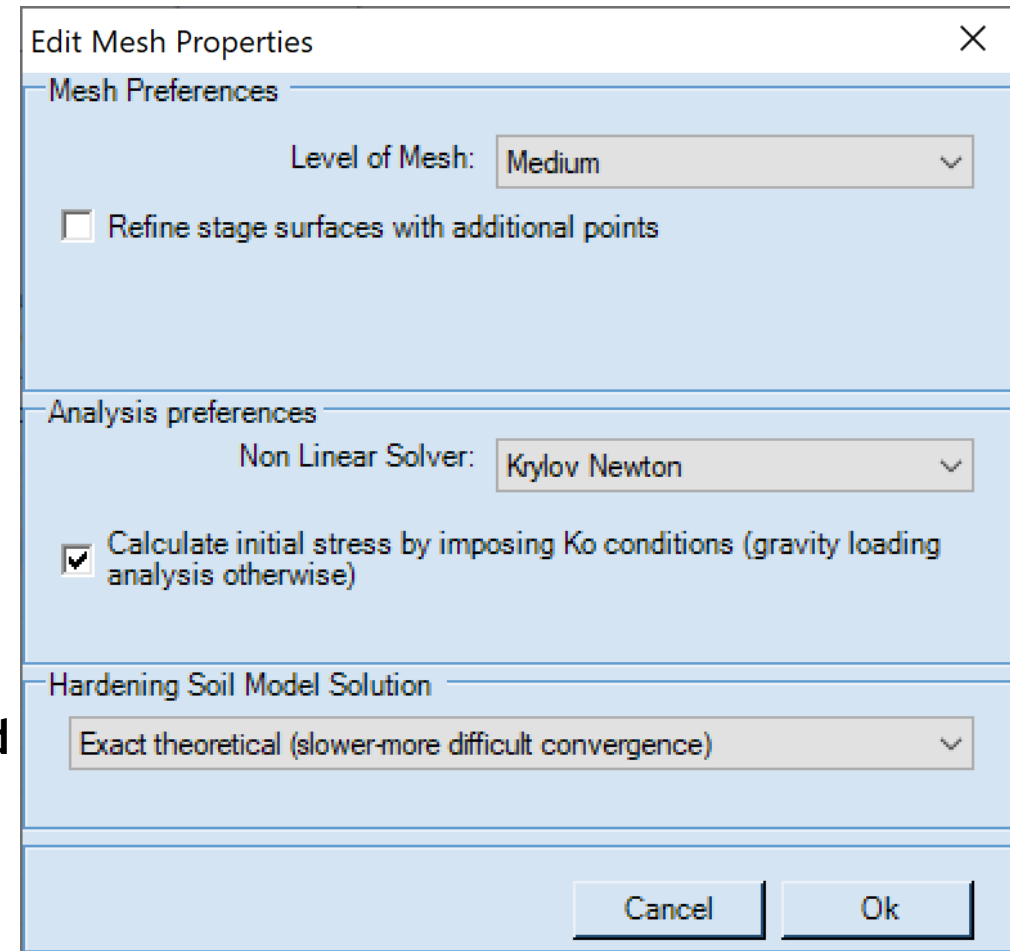
α_x Full Seismic Options
 α_x Method: Mononobe-Okabe ▾
 Method

D2. Additional FEM Analysis Settings & Tips

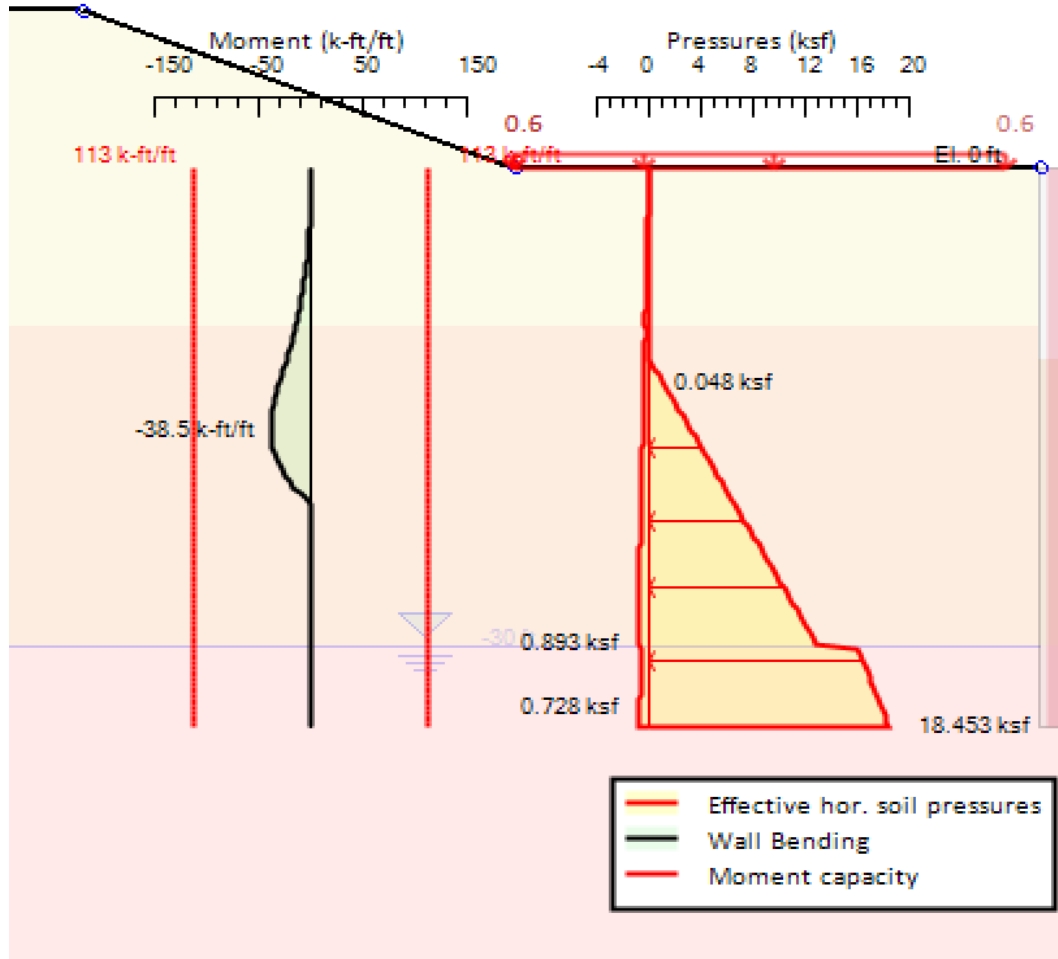
- **Generated Mesh Density: Medium**
- **Non-Linear Solver: Krylov Newton Method**
- **Hardening Soil Model: Exact Theoretical**

FEM Analysis - Model Convergence Tips:

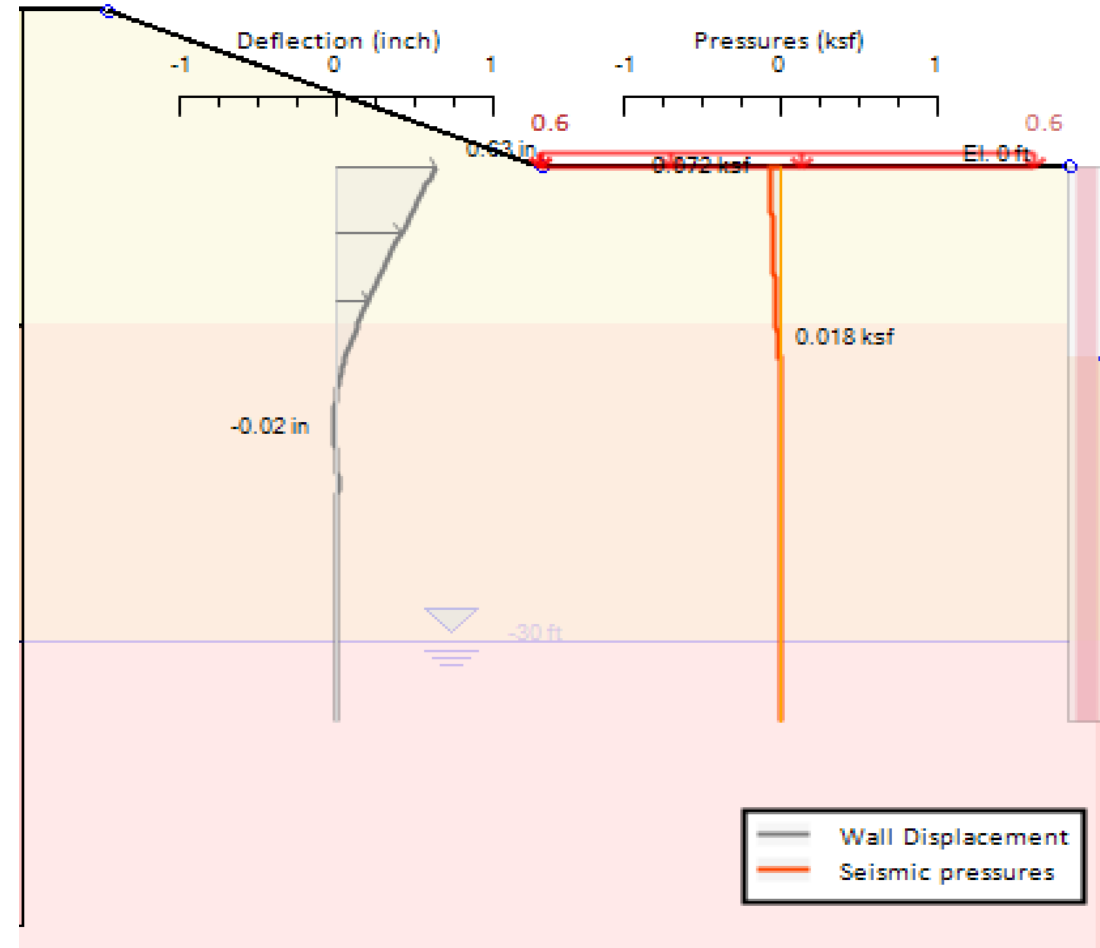
- ✓ **Always consider a small cohesion for frictional soils**
- ✓ **Always use wall friction for all your walls**
- ✓ **Create a strict staging**
- ✓ **Sometimes an initial stage with green field conditions (not activated walls) might be required**
- ✓ **Always assume realistic prestress values for the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



E. LEM Analysis Results

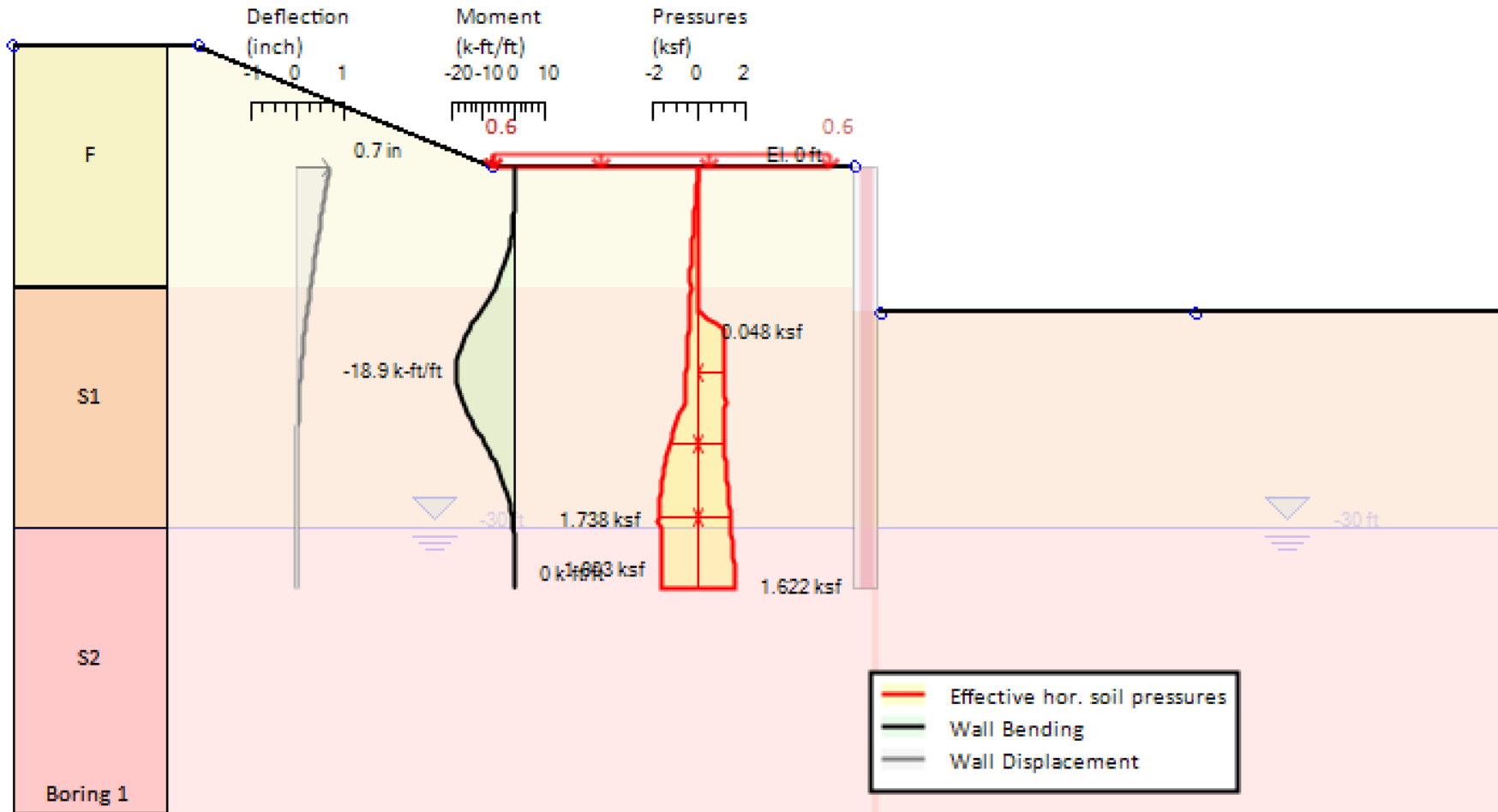


Wall Moments & Soil Pressures - Stage 1



Est. Displacements & Seismic Pressures - Stage 2

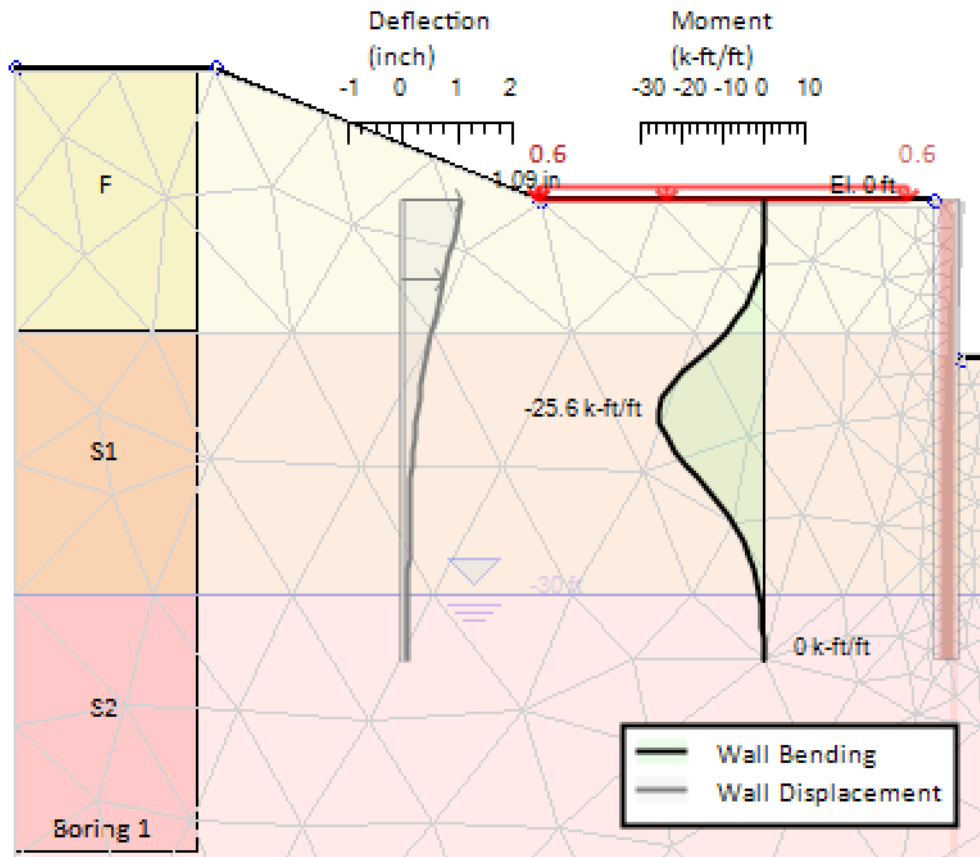
F. Non-Linear Analysis Results



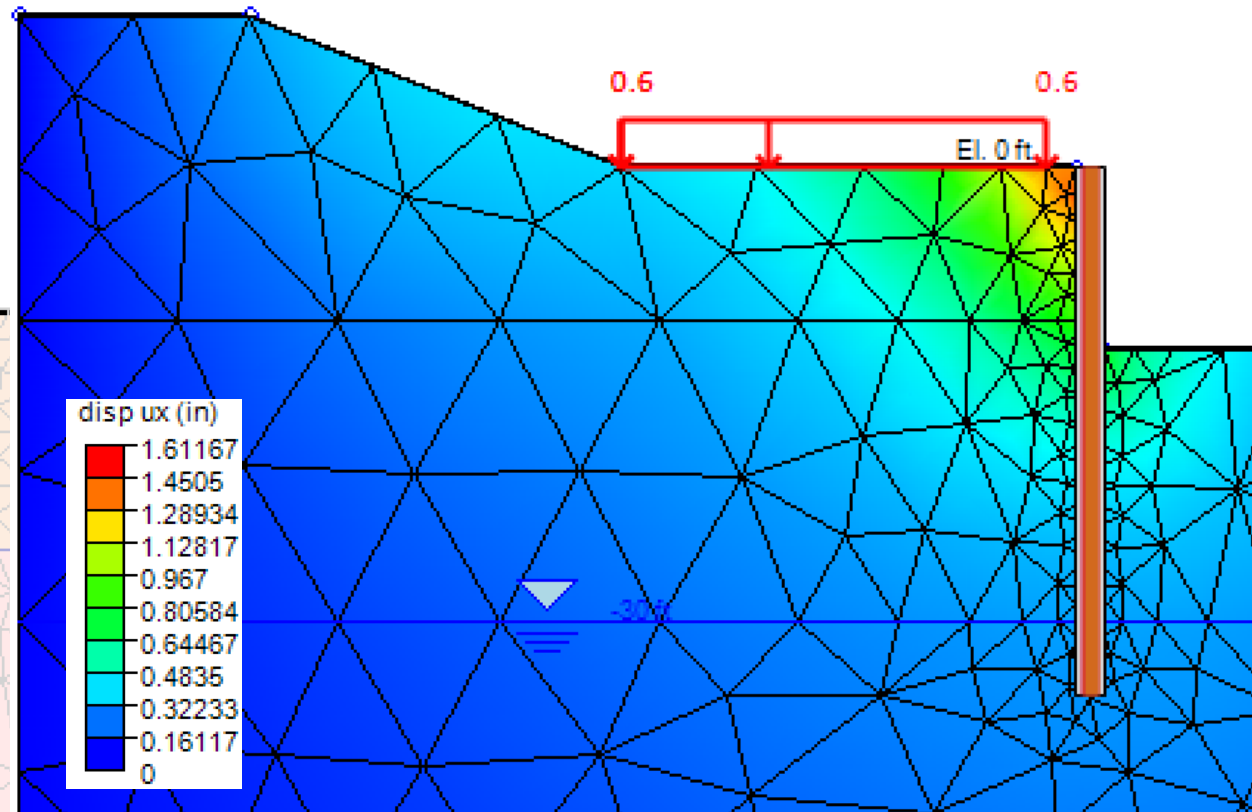
Wall Moments, Displacements & Soil Pressures - Stage 1

Example 1: Cantilever Secant Pile Wall

G. FEM Analysis Results



Wall Moments & Displacements - Stage 1



FEM Mesh and Soil Displacement Shadings - Stage 2

Thank You!

More Examples & Videos:

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