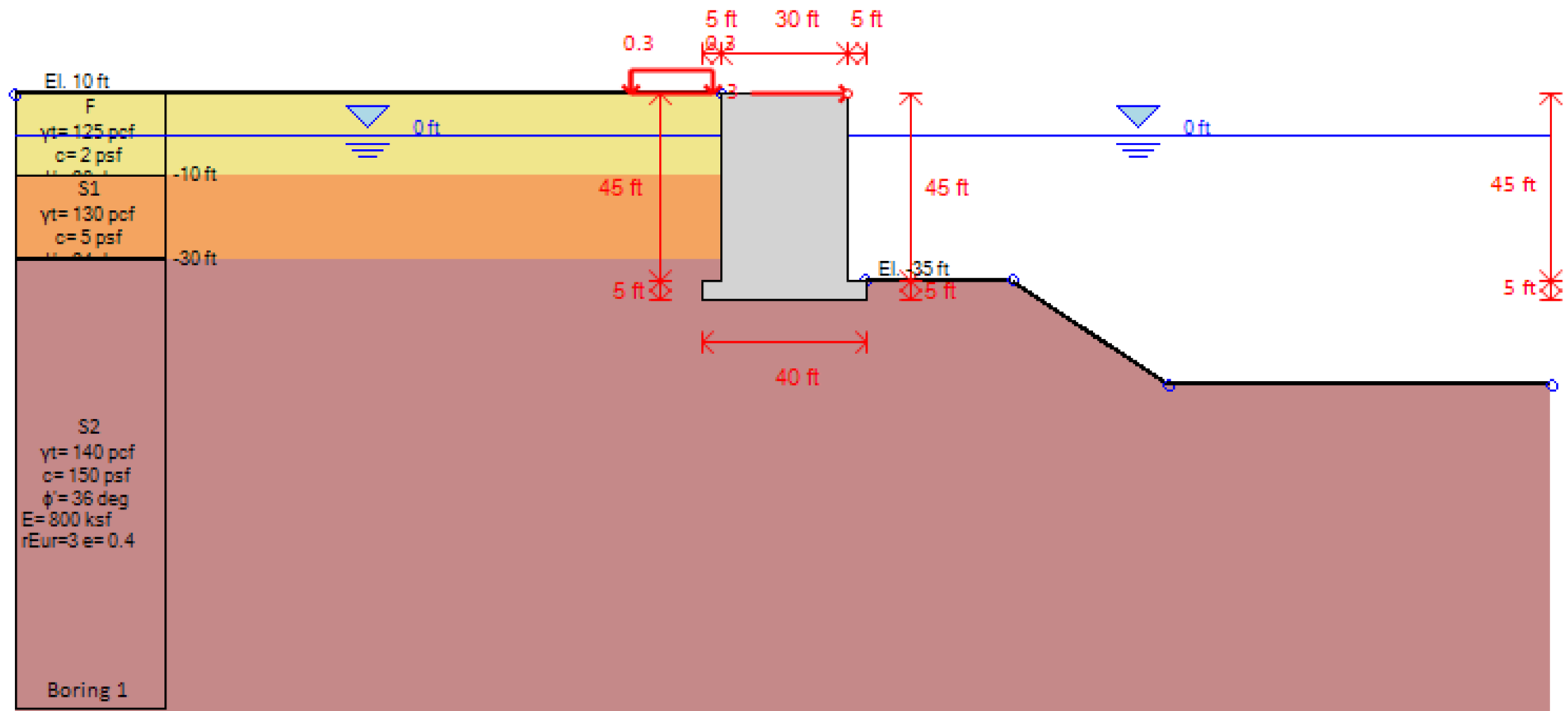


Example 10: Quay Wall - Block Type Caisson Limit Equilibrium – Finite Element Analysis – Slope Stability Analysis



DEEP EXCAVATION

GEOTECHNICAL SOFTWARE
& ENGINEERING

Example 10: Quay Wall - Block Type Caisson

A. Soil Properties and Stratigraphy (Soil Layers)

El. 10 ft	F	yt= 125 pcf c= 2 psf	0 ft	10	F - Sand	125
		$\phi' = 30$ deg E= 300 ksf rEur=3 e= 0.5	-10 ft	-10	S1 - Sand	130
	S1	yt= 130 pcf c= 5 psf $\phi' = 34$ deg E= 500 ksf	-30 ft	-30	S2 - Sand	135
	S2	yt= 140 pcf c= 150 psf $\phi' = 36$ deg E= 800 ksf rEur=3 e= 0.4				800
	Boring 1					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. 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	Ko	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 γ_w : 66

5. Strength Parameters and Poisson Ratio

Drained strength properties

c': 5 psf ϕ' : 34 degrees

Peak - constant vol. (for estimation)

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

v: 0.35

6. Permeability

Kx: 0.000328 ft/sec Kz: 0.000328 ft/sec

8. At-rest coefficients

KoNC: 0.440807 nOCR: 0.5 $Ko = KoNC * (OCR)^{nOCR}$

B. Quay Wall - Block Type Caisson Section Properties

Dimensions Materials Results Descriptions

Height ft

Base ft

Top Width ft

Distance to left Top corner ft

Heel Thick ft

Toe width ft

Toe Thick ft

Heel width ft

Use key

Drain back face

Use a rectangular cap at the top

Wall Name: Gravity wall

1. Reinforcement

Use	P1	P2	Rebar	S(in)	No.	Clear(in)	Ast(in2)
<input checked="" type="checkbox"/>	A	B	#9	6...	2	3	2
<input checked="" type="checkbox"/>	B	C	#9	6...	2	3	2
<input checked="" type="checkbox"/>	C	D	#9	6...	2	3	2
<input checked="" type="checkbox"/>	D	E	#9	6...	2	3	2
<input checked="" type="checkbox"/>	E	F	#9	6...	2	3	2
<input checked="" type="checkbox"/>	F	G	#9	6...	2	3	2
<input checked="" type="checkbox"/>	G	H	#9	6...	2	3	2
<input checked="" type="checkbox"/>	H	A	#9	6...	2	3	2

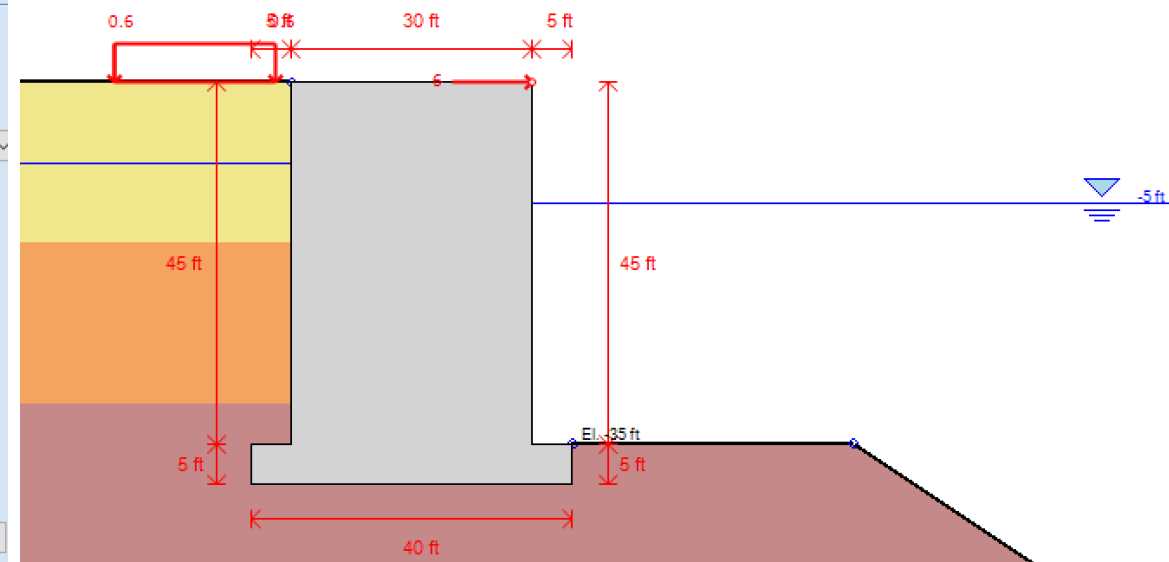
C. Wave Load Conditions & Mooring Loads

Wave Load Options

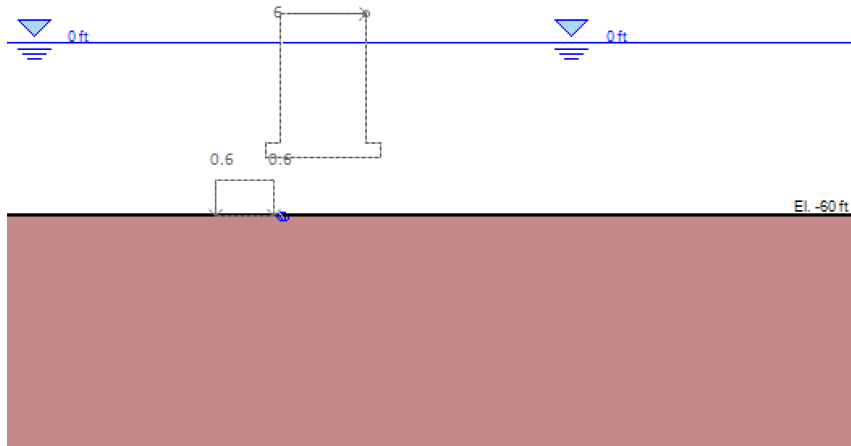
- Wave Pressures Method: Goda
- Critical Wave (CEM 2011): Tropical Depression
- Seaward: SainFlou as modified by McConnell

Design method	Goda	Seaward	SainFlou as modified by McConnell
Design wave Hinc	Leidraad (2.2 Hs)		
Wall side to apply	Automatic		
	Wave is lower from water table (reduce press)		
Wave inclination to wall normal	0	deg	
Select from CEM 2011 Part II Suggestions			
Significant wave height Hs	17.22	ft	
Significant incident wave height at toe of structure Hsi	17.22	ft	
Local wave height H	11.48	ft	
Average of the heighest 1/3 of waves H1_3	11.48	ft	
Average of the heighest 1/10 of waves H1_10	13.06	ft	
Impact waves Cuomo (Significant wave height at toe) Hmo	11.48	ft	
Peak period Tp	7	sec	
Wave period associated with H1_3, T1_3	7	sec	
Average wave period Tavg	6	sec	
Local wave period Tloc	7	sec	
Storm duration	6	Hours	
Overtopping	Do not calculate overtopping		
Goda Method Parameters			
λ_1	1	λ_2	1
λ_3	1		
Options for structures protected by Rubble-Mounds			
	Ignored		
<input type="checkbox"/>	Use uplift for seaward base action		
<input type="checkbox"/>	Use landward value for base pressures for seaward action		
<input type="checkbox"/>	Use adjustment factor for low wave base pressure		
Cuomo Factor Cr	1		
Wave length method	User defined		
Wave length	100	ft	
Pressure reductions for broken top	Ignored		

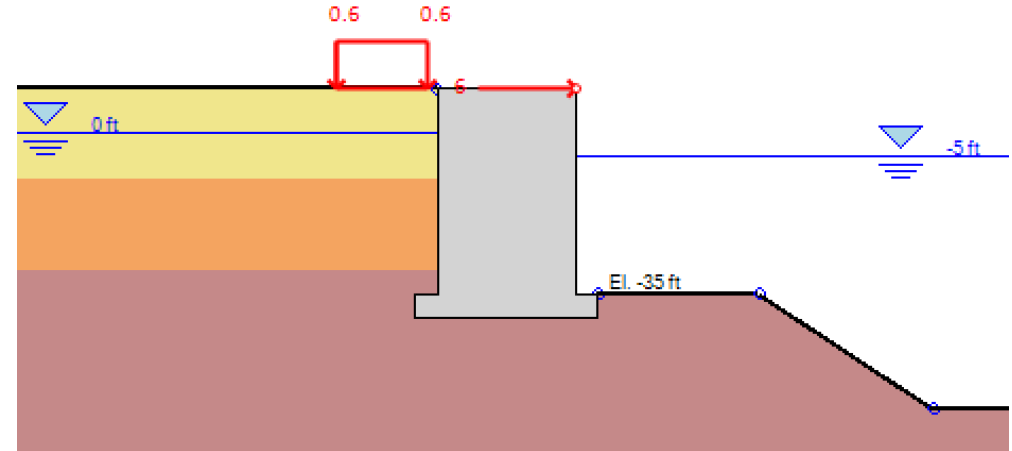
Mooring Loads		
Mooring load for operating conditions	6	klf
Mooring load for extreme conditions (high waves)	4	klf
Mooring load for seismic conditions	3	klf



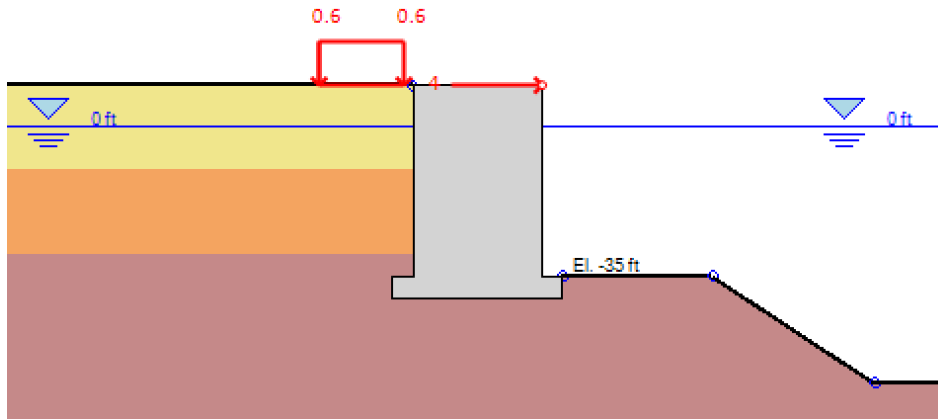
D. Model in Construction Stages



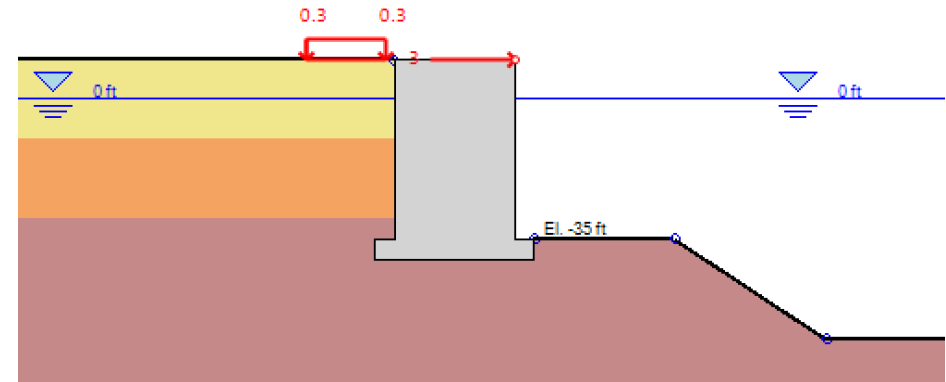
Stage 0: At-rest Conditions



Stage 1: Wall Installation & Backfill -
Operating Conditions



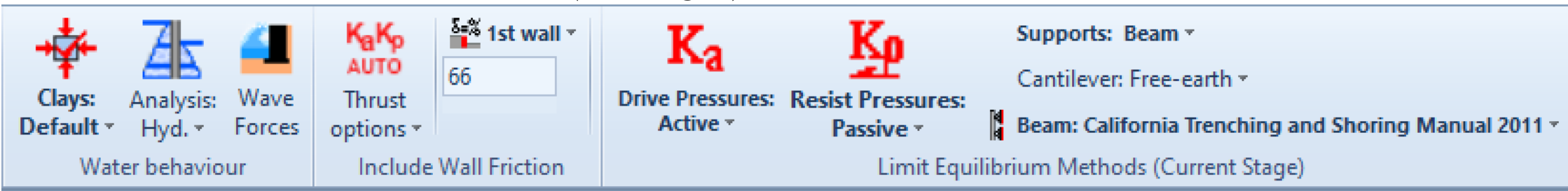
Stage 2: Low Wave Conditions



Stage 3: Seismic Conditions

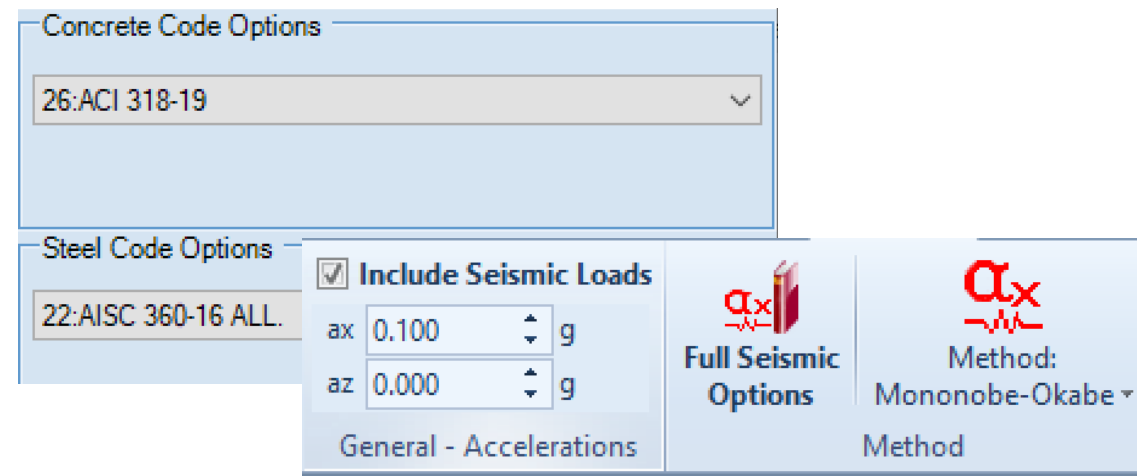
E. Analysis Settings & Design Codes

- Wall Friction: 66% of the soil friction
- Water Pressures: Simplified Flow
- Cantilever Method (LEM): Free Earth Method
- Soil Pressures: Active & Passive (All Stages)



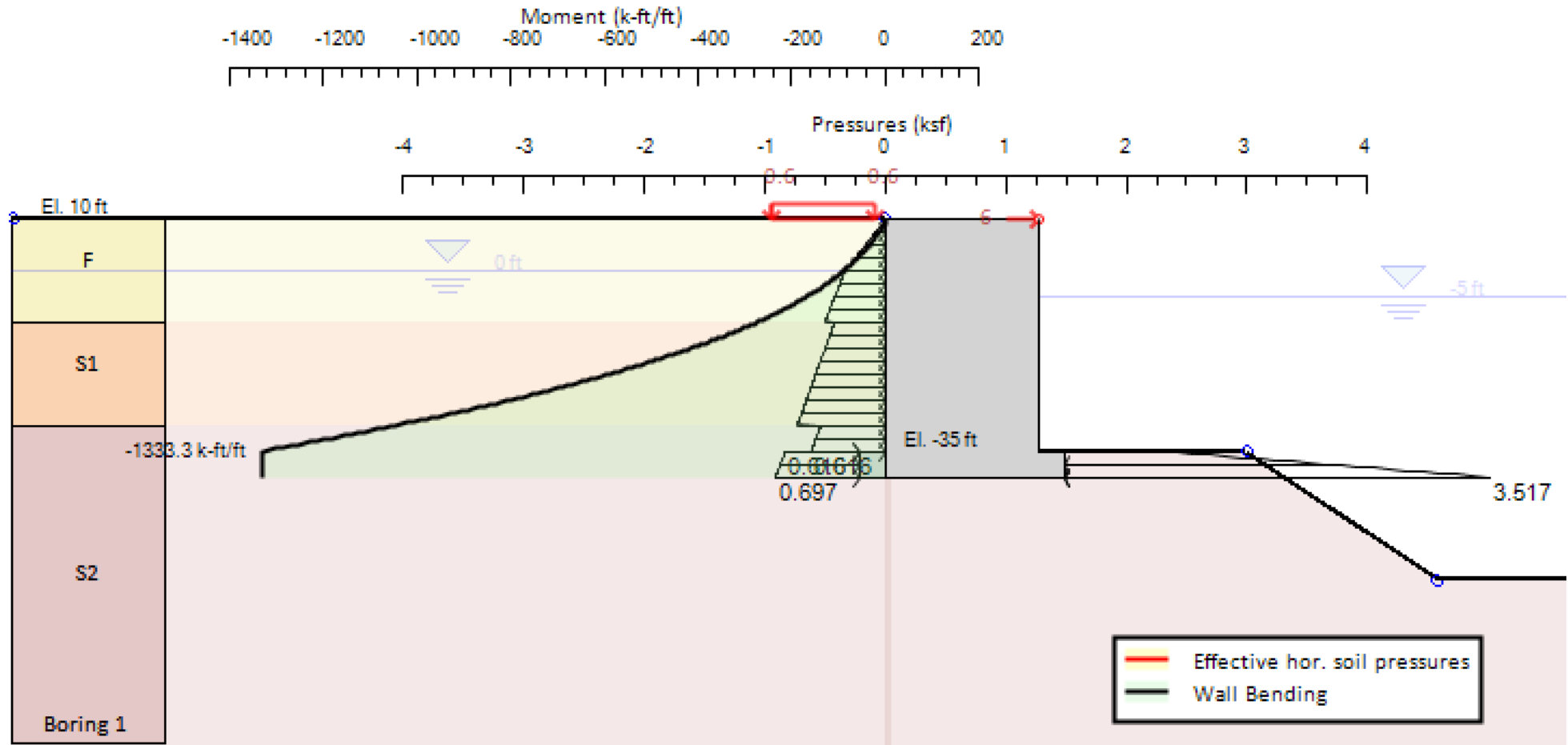
The screenshot shows a software interface for analysis settings. It includes several sections: 'Clays: Default', 'Analysis: Hyd.', 'Wave Forces', 'Thrust options' with 'KaKp AUTO' and 'Include Wall Friction' checked, a dropdown for '1st wall' with a value of '66', 'Drive Pressures: Active', 'Resist Pressures: Passive', 'Supports: Beam', 'Cantilever: Free-earth', and 'Beam: California Trenching and Shoring Manual 2011'. A note at the bottom indicates '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 3)
- Seismic Pressures Method: Mononobe-Okabe



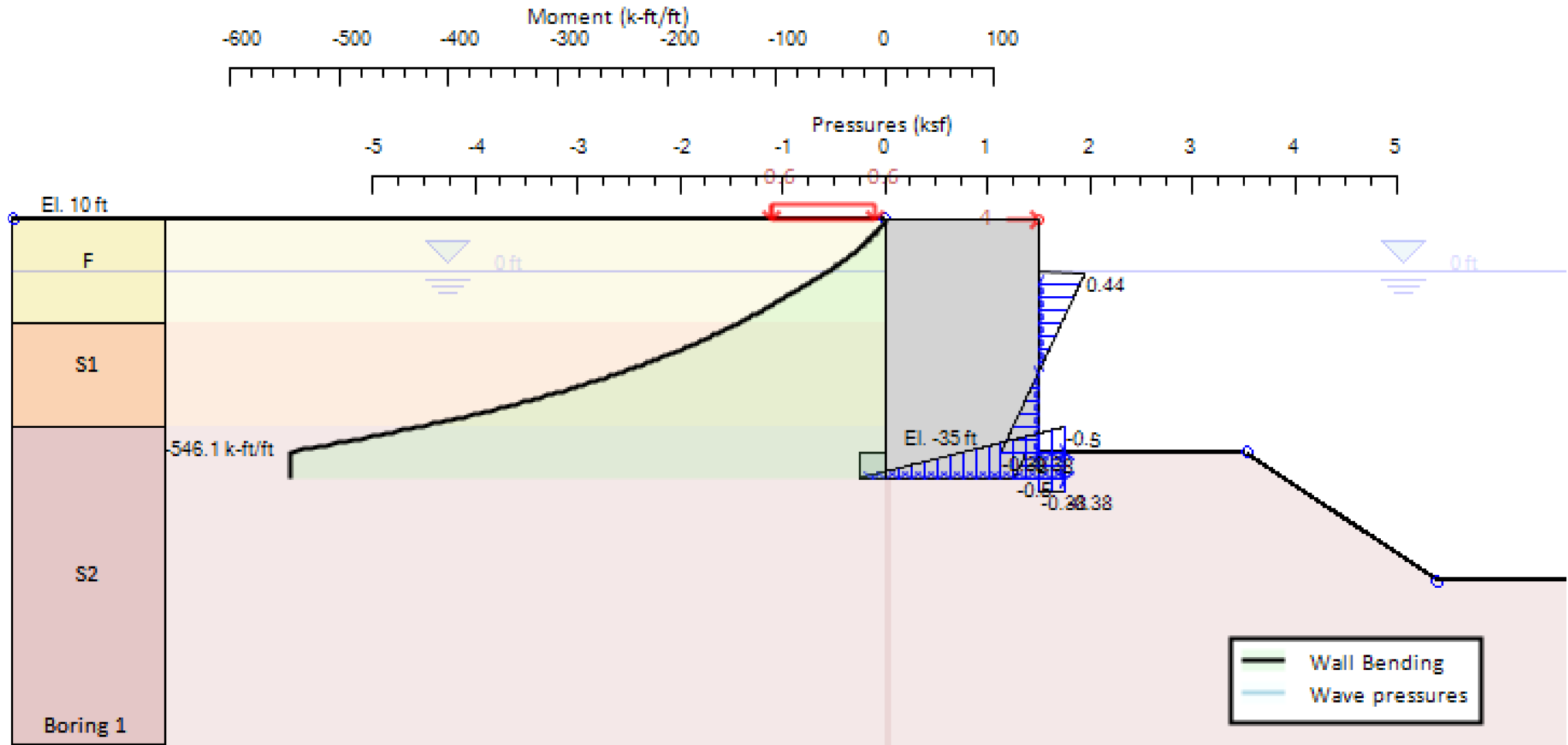
The screenshot shows a dialog box for design codes and seismic options. It includes 'Concrete Code Options' with '26:ACI 318-19' selected, 'Steel Code Options' with '22:AISC 360-16 ALL.' selected, and 'Full Seismic Options' with 'Include Seismic Loads' checked. The seismic acceleration values are 'ax: 0.100 g' and 'az: 0.000 g'. The 'Method' is set to 'Mononobe-Okabe'.

F1. LEM Analysis Results



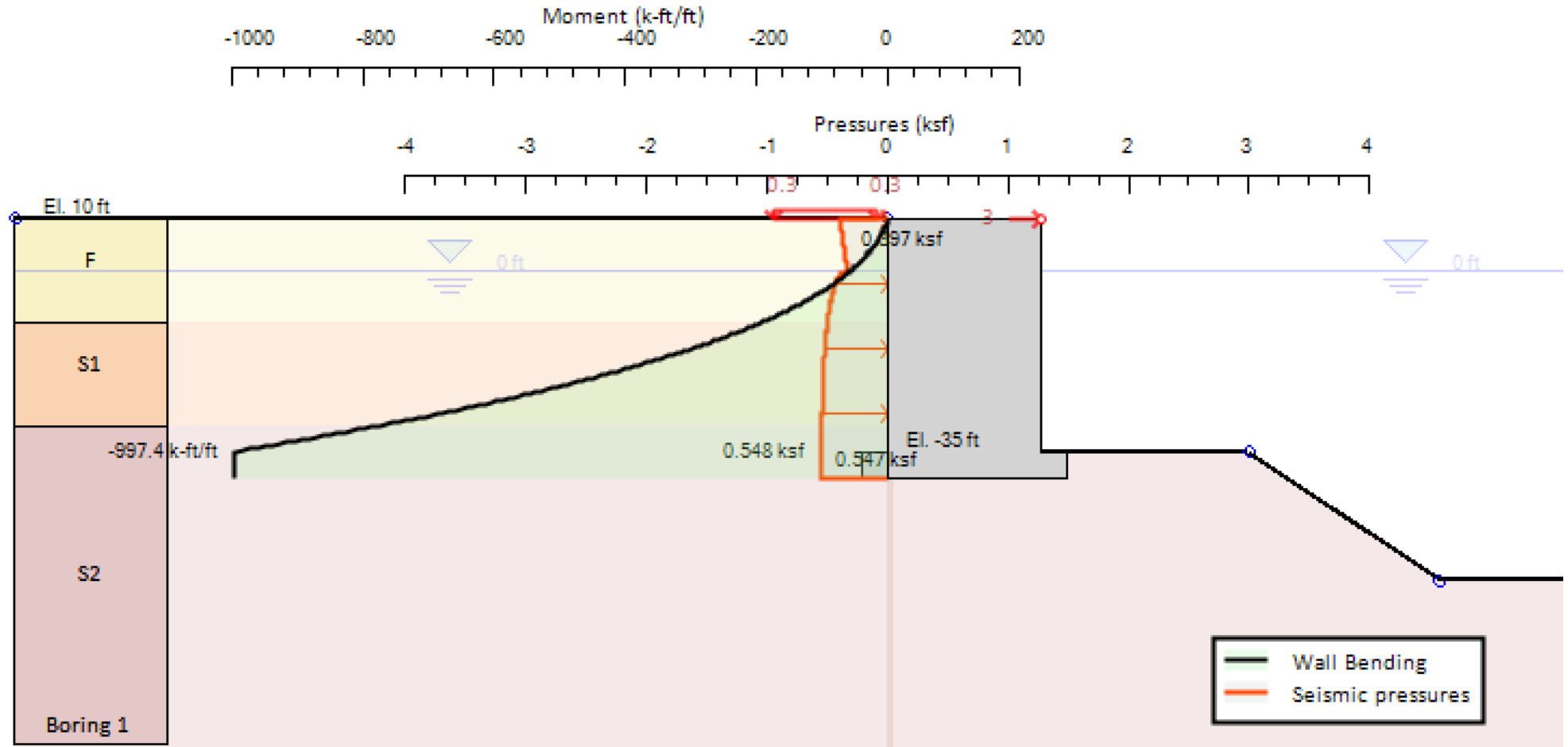
Wall Moment Diagram & Soil Pressures - Operating Conditions

F2. LEM Analysis Results



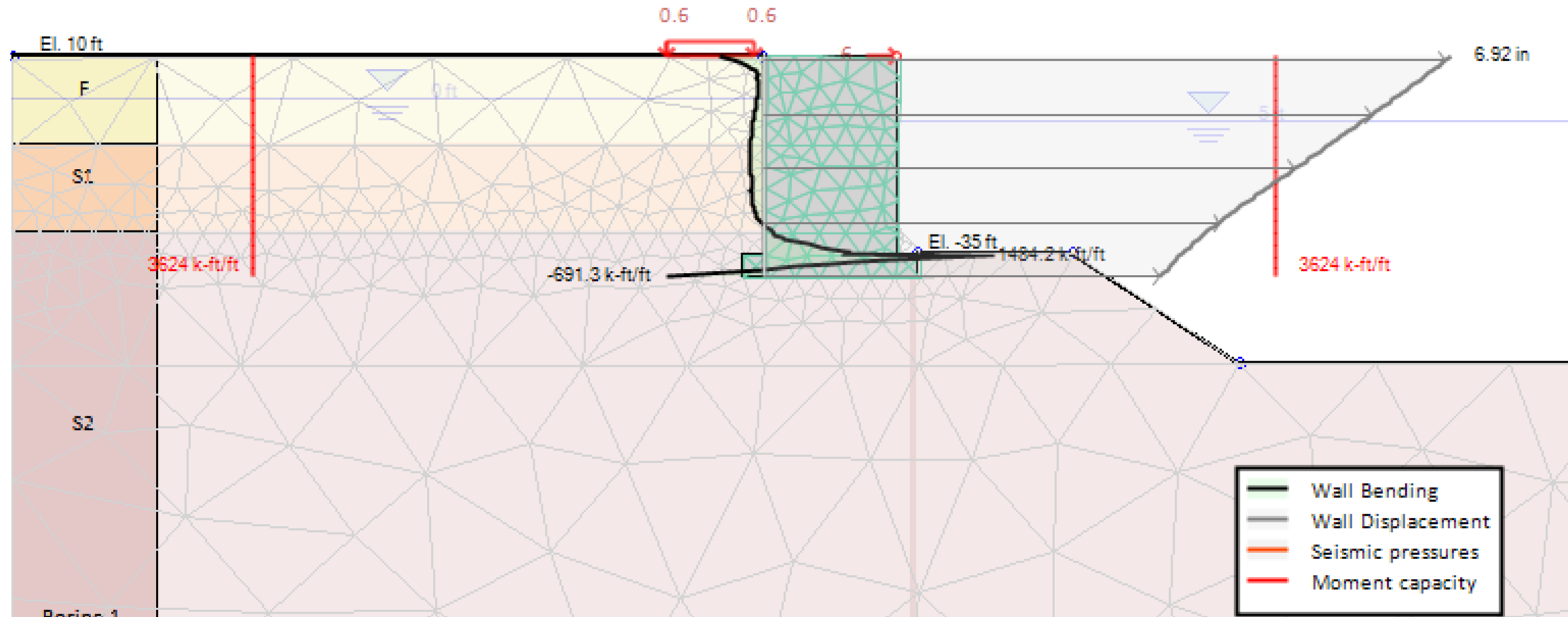
Wall Moment Diagram & Wave Pressures - Low Wave Conditions

F3. LEM Analysis Results



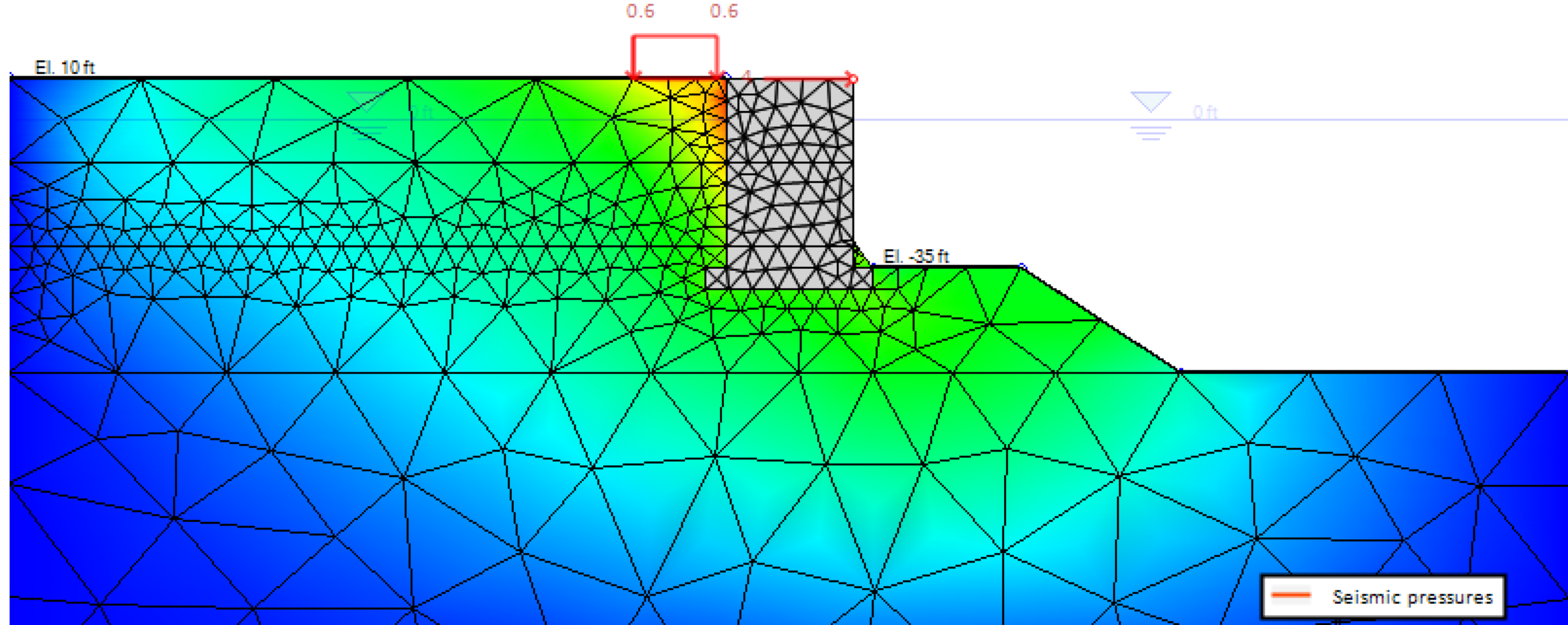
Wall Moment & Seismic Pressure Diagrams - Seismic Conditions

G1. FEM Analysis Results



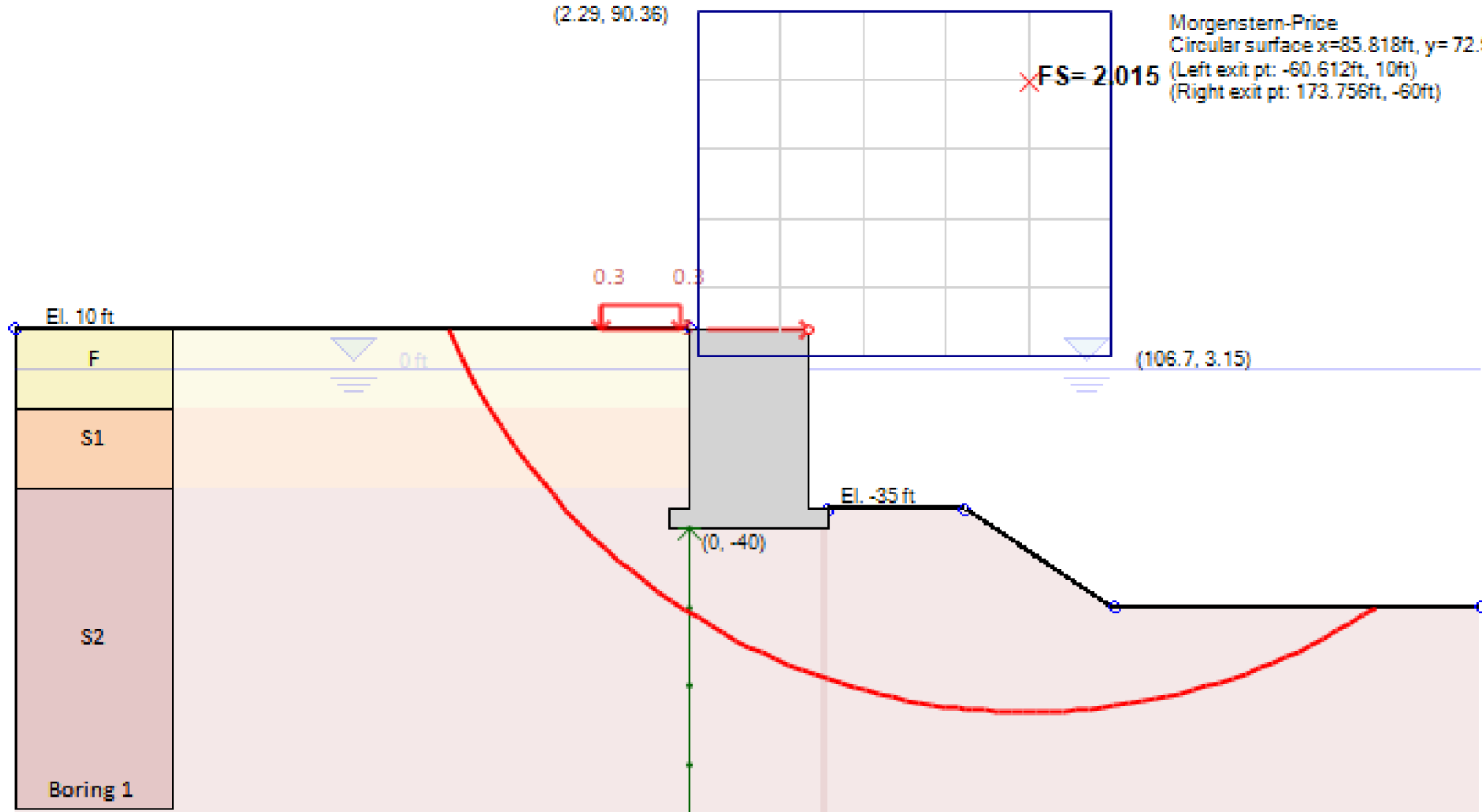
Wall Moment & Displacement Diagrams - Operating Conditions

G2. FEM Analysis Results



Generated FEM Mesh & Soil Displacement Shadings - Low Wave Conditions

H. Slope Stability Analysis Results



Critical Slope Surface (Circular) & Slope Stability Safety Factor

Thank You!

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