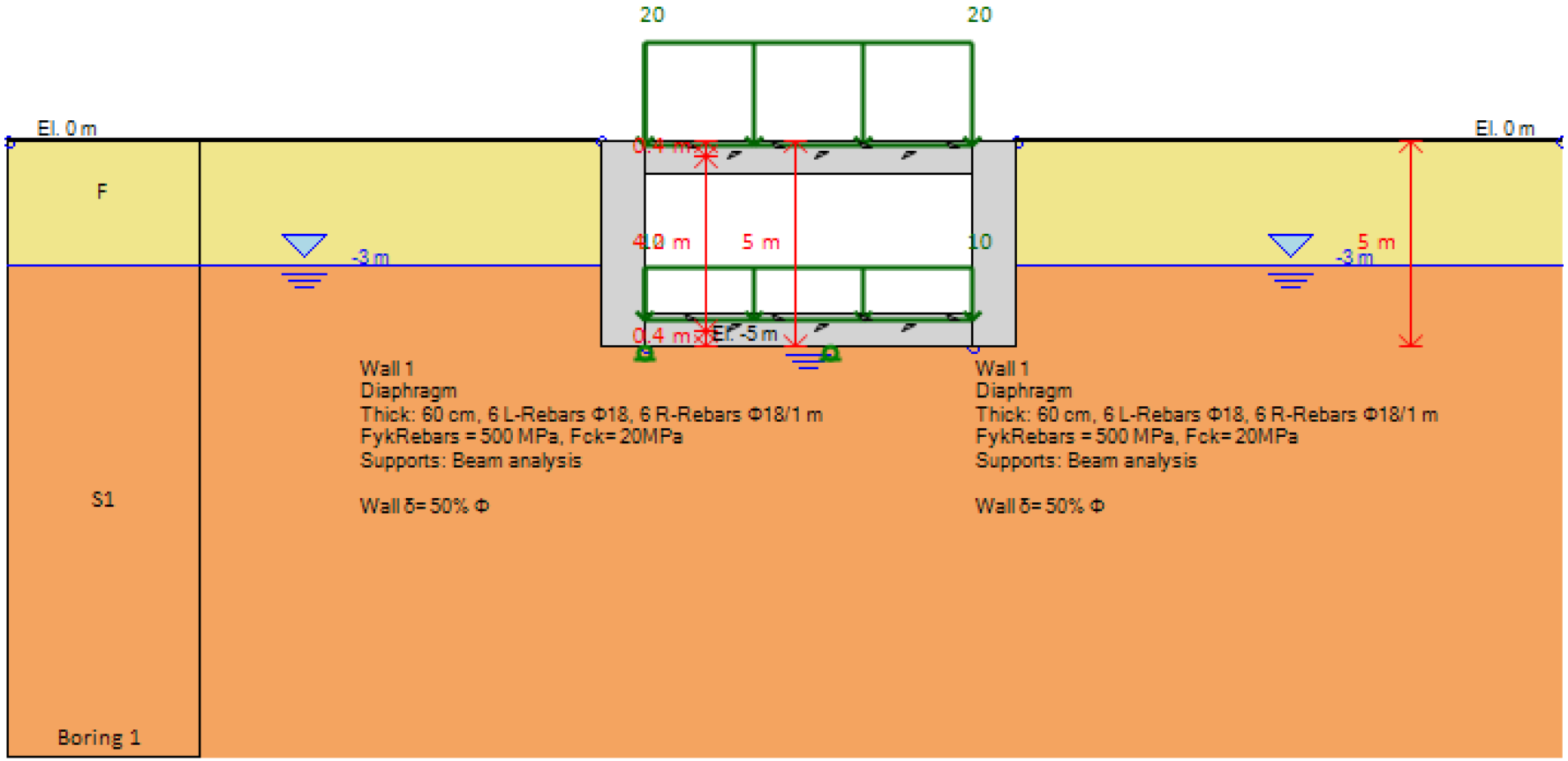
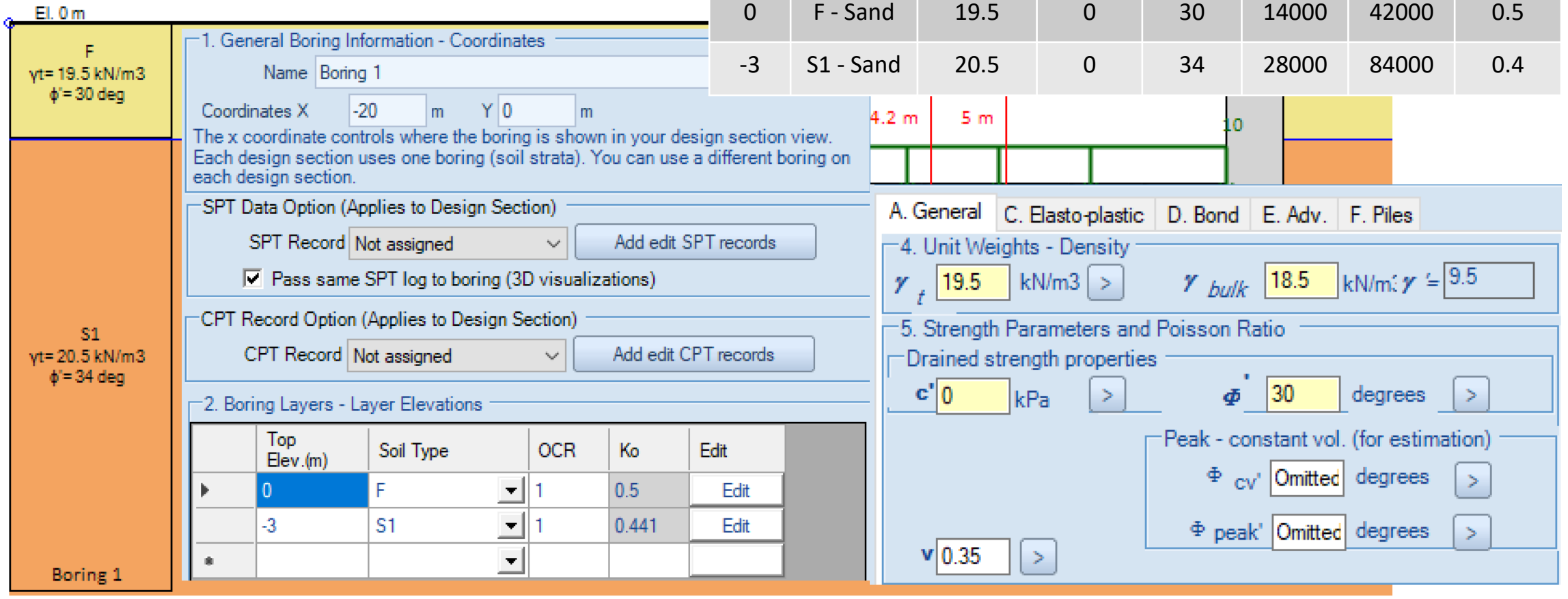
Example 6: Concrete Drain Box
Limit Equilibrium – Non-Linear – Finite Element Analysis



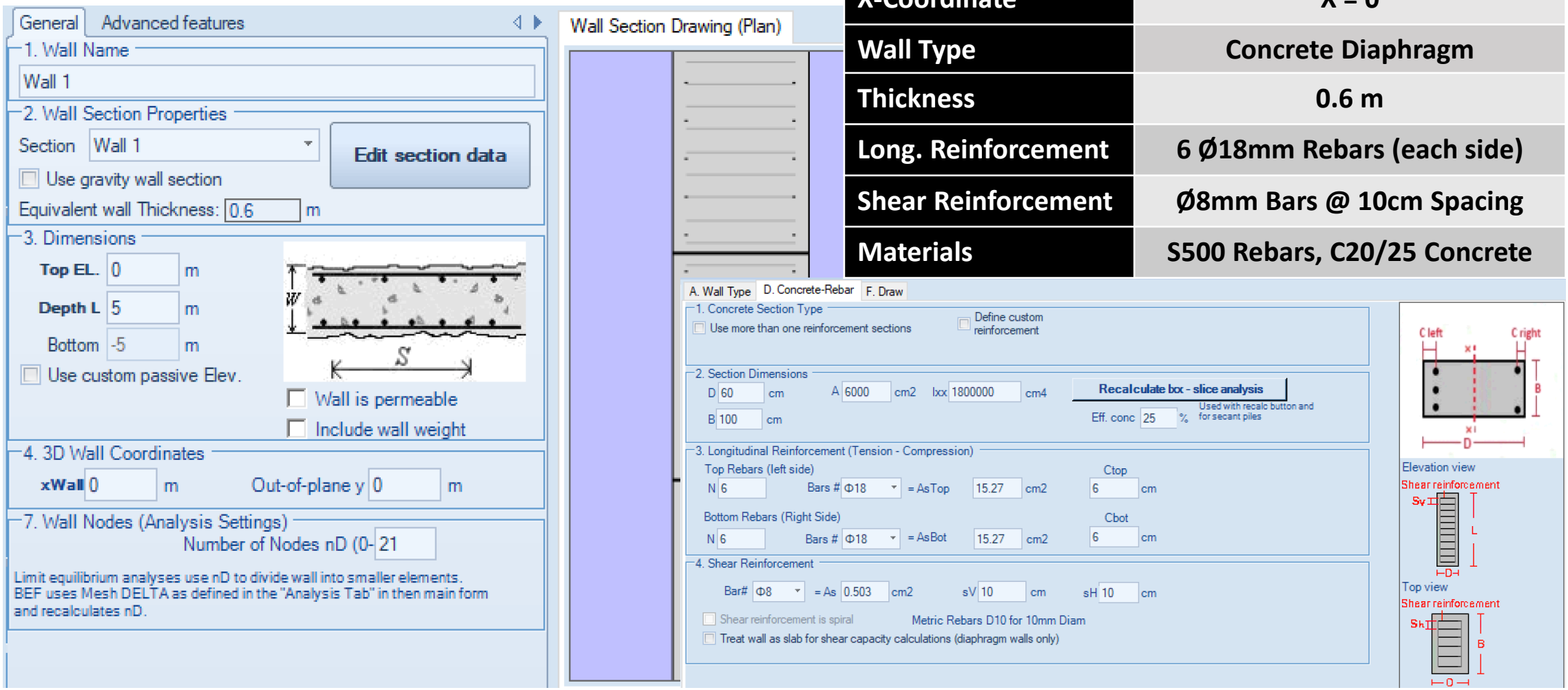
A. Soil Properties and Stratigraphy (Soil Layers)

Elev. (m)	Soil (-)	γt (kN/m3)	C' (kPa)	ϕ' (deg)	Eoed (kPa)	Eur (ksf)	m (-)
0	F - Sand	19.5	0	30	14000	42000	0.5
-3	S1 - Sand	20.5	0	34	28000	84000	0.4

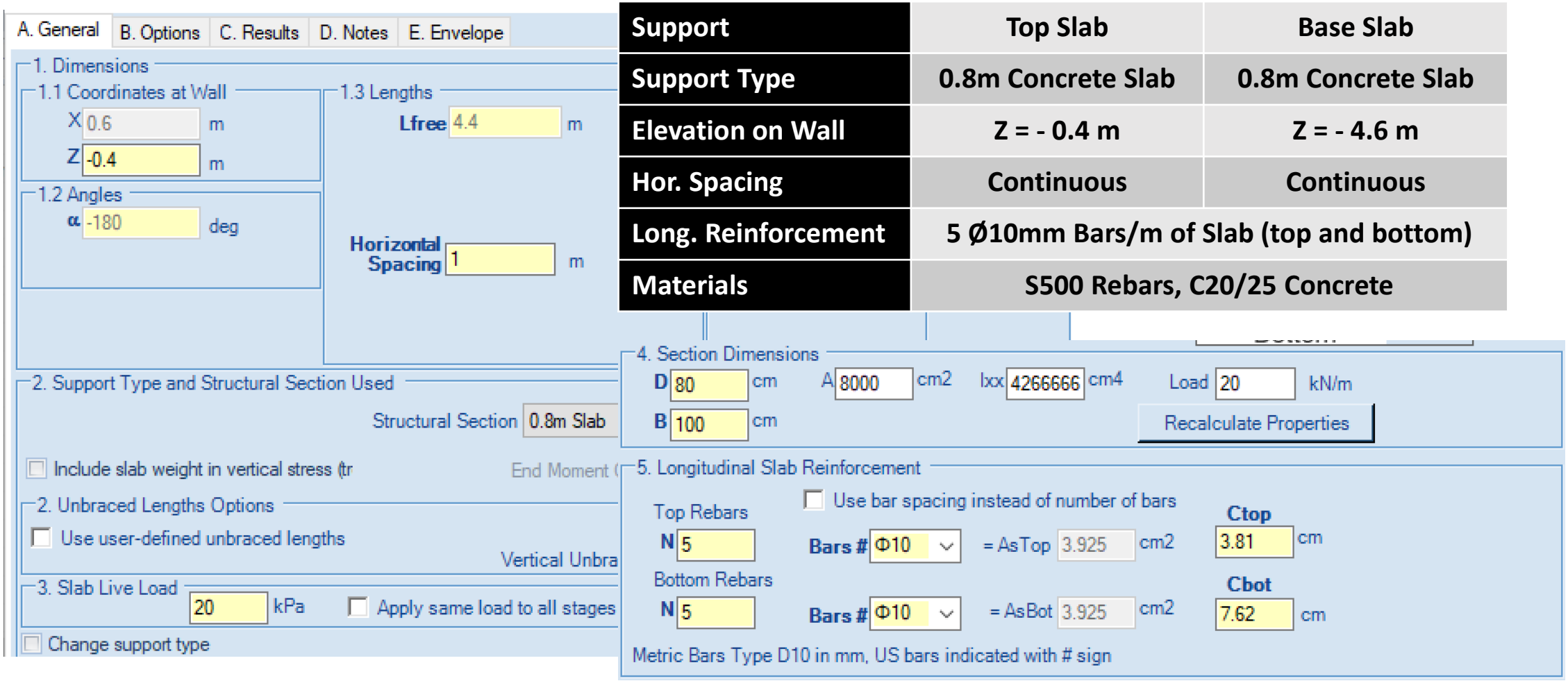


B. Wall Section Properties, Wall Position and Depth

X-Coordinate	X = 0
Wall Type	Concrete Diaphragm
Thickness	0.6 m
Long. Reinforcement	6 Ø18mm Rebars (each side)
Shear Reinforcement	Ø8mm Bars @ 10cm Spacing
Materials	S500 Rebars, C20/25 Concrete

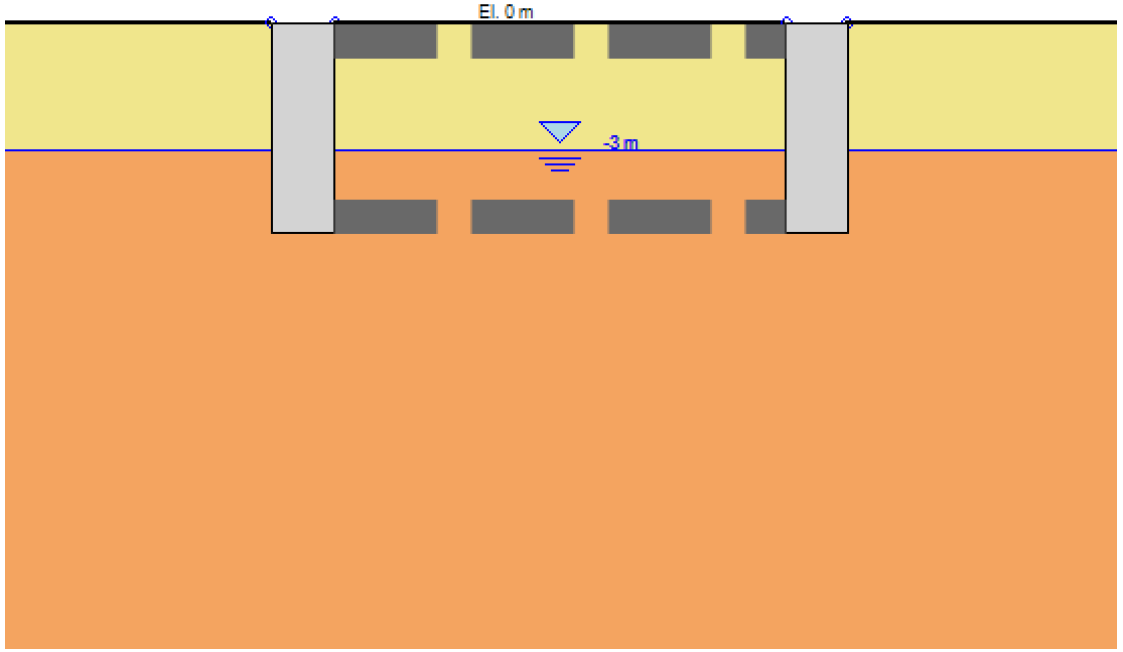


C. Support Section Properties and Elevation

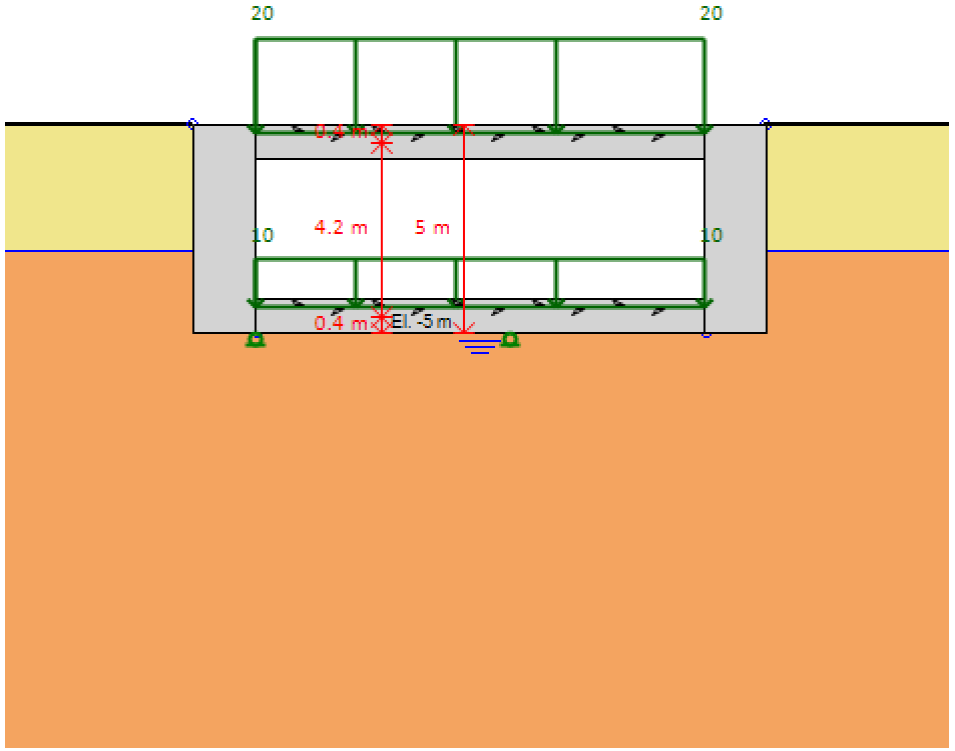


Support	Top Slab	Base Slab
Support Type	0.8m Concrete Slab	0.8m Concrete Slab
Elevation on Wall	Z = - 0.4 m	Z = - 4.6 m
Hor. Spacing	Continuous	Continuous
Long. Reinforcement	5 Ø10mm Bars/m of Slab (top and bottom)	
Materials	S500 Rebars, C20/25 Concrete	

D. Model in Construction Stages



Stage 0: At-rest Conditions

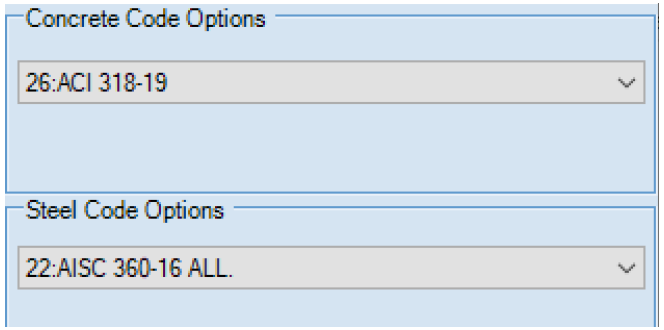


Stage 1: Drain Box Installation

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: At-Rest (All Stages)

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

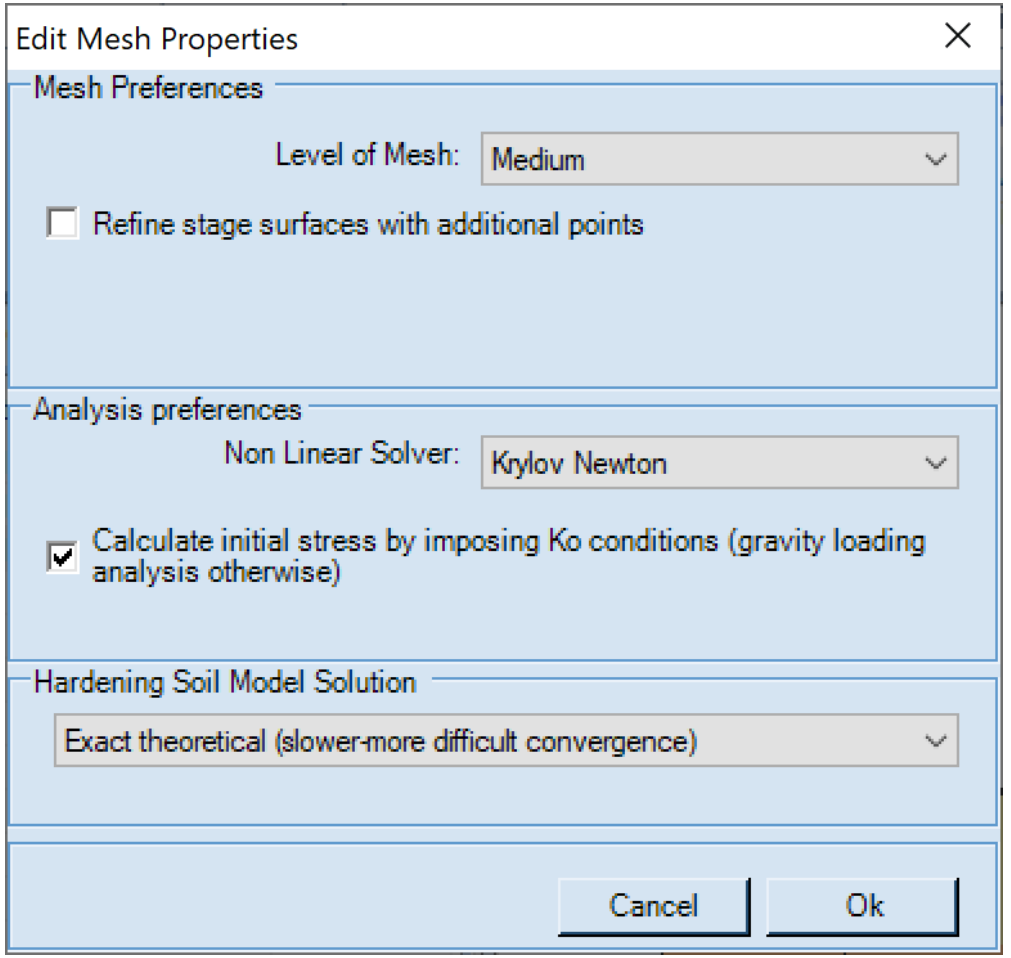


E2. Additional FEM Analysis Settings & Tips

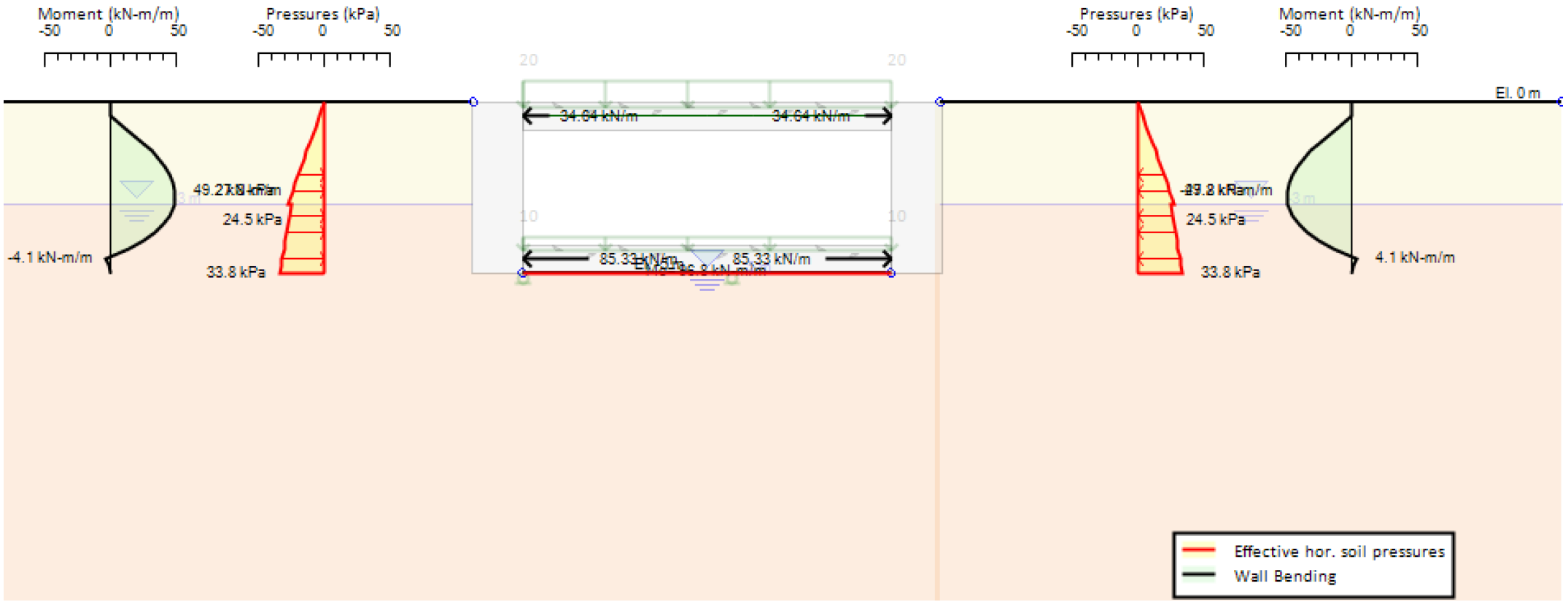
- Generated Mesh Density: Medium
- Non-Linear Solver: Krylov Newton Method
- Hardening Soil Model: Exact Theoretical

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)

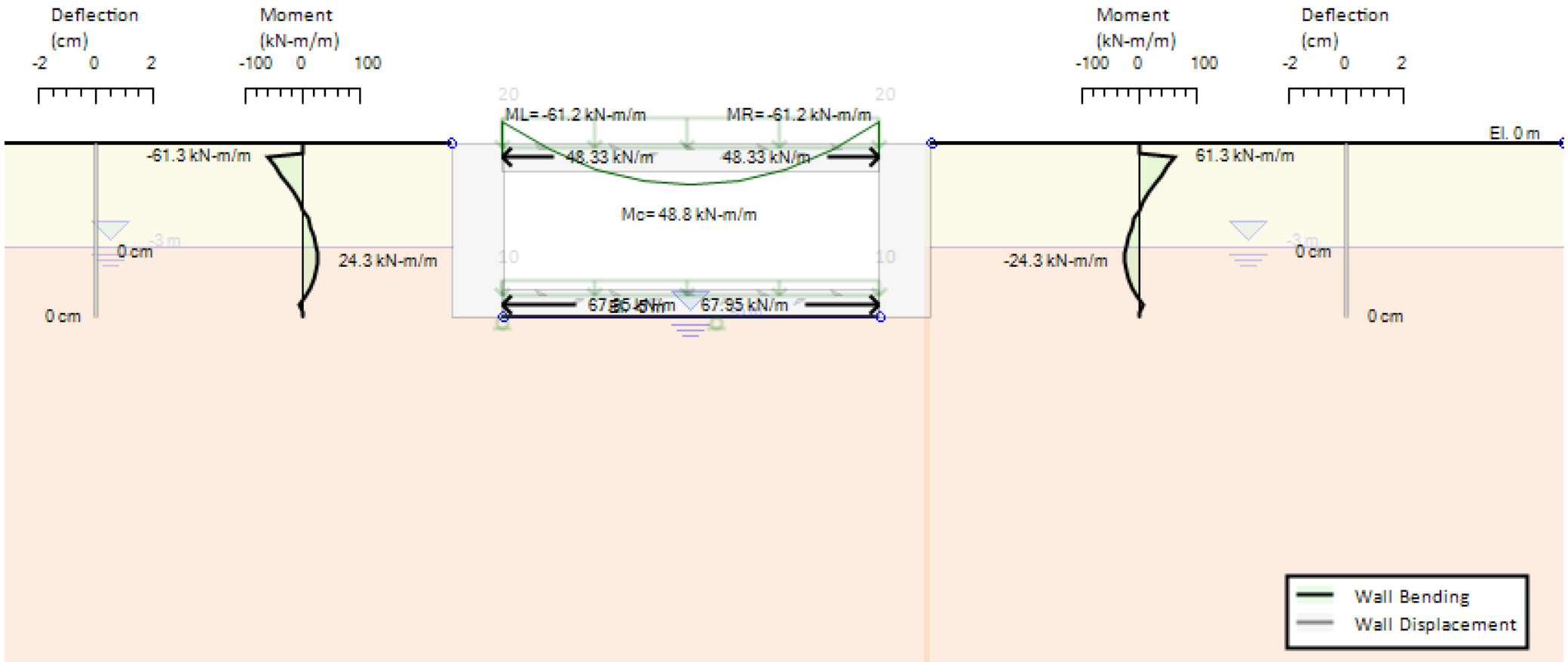


F. LEM Analysis Results



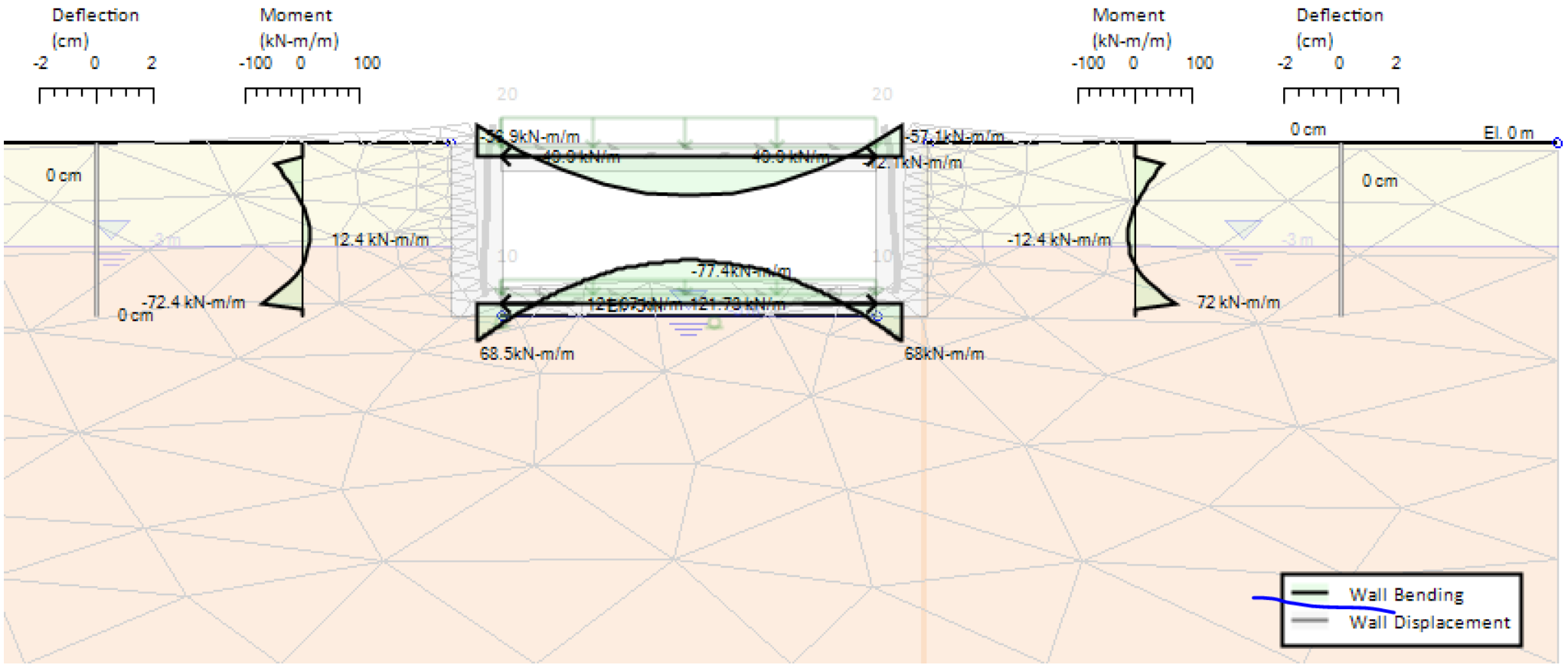
Wall Moments, Support Reactions & Soil Pressures - Stage 1

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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