SLOPE STABILIZATION USING DRIVEN PILES

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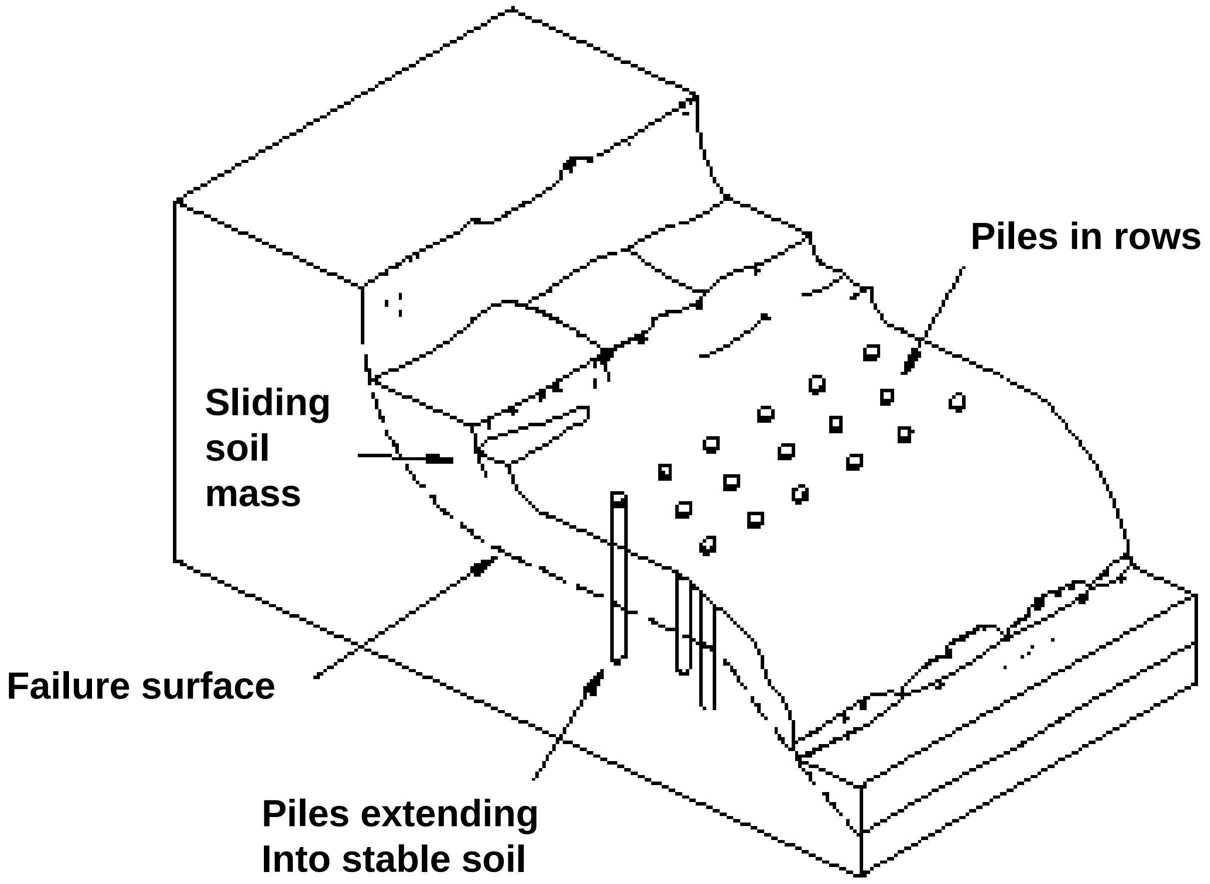
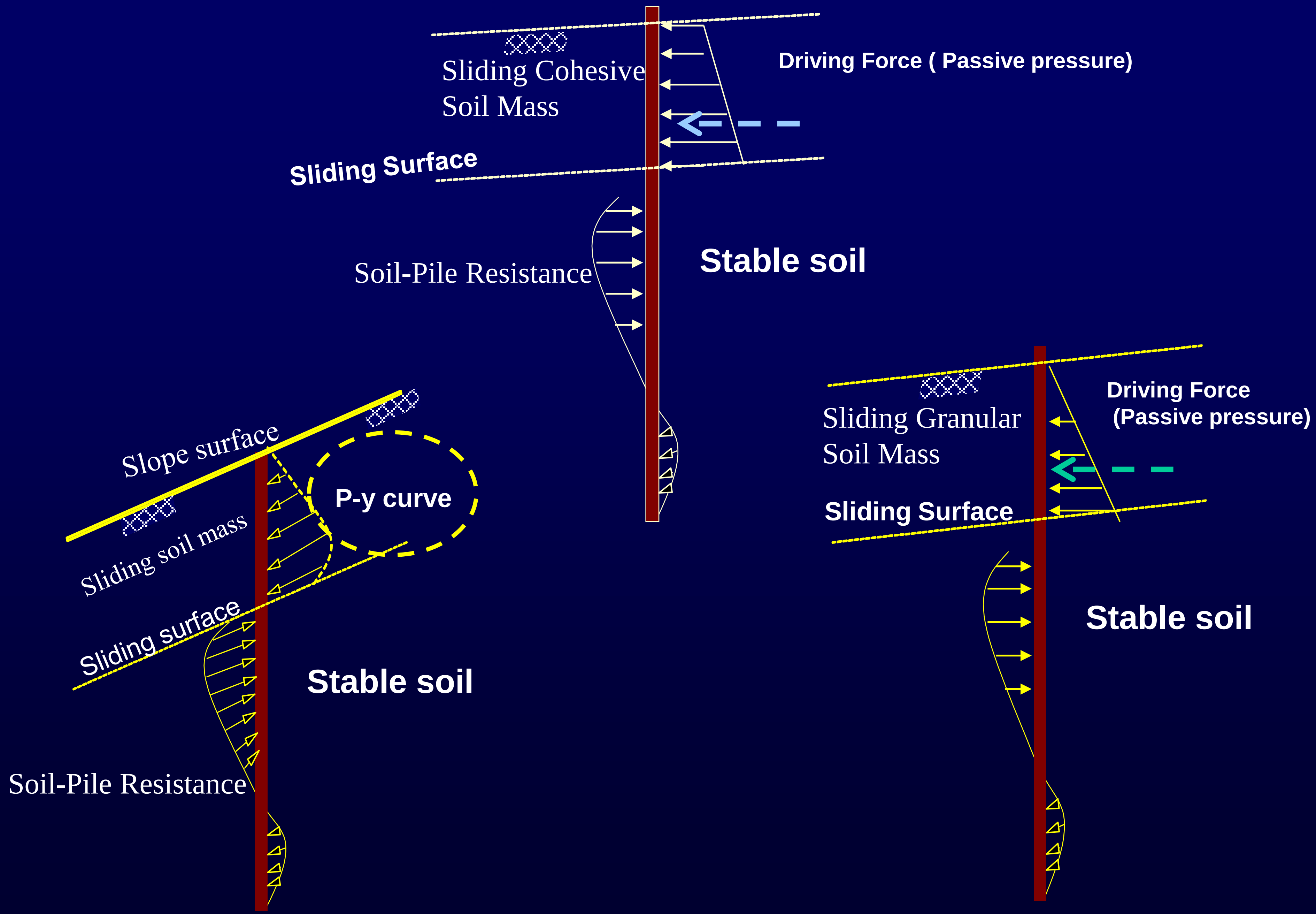
Slope Stabilizing Piles/Shafts Effectively Act as Shear Dowels across the Slip Plane



Pile Rows for Slope Stabilization (Thomson et al. 2005)

Current Practice

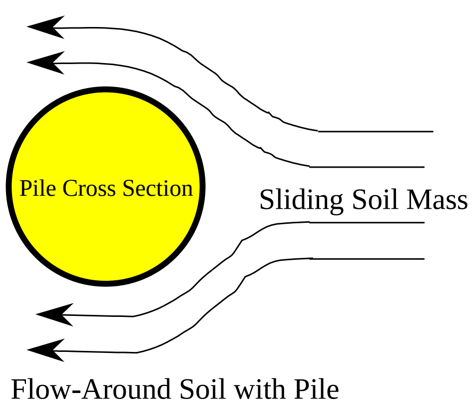


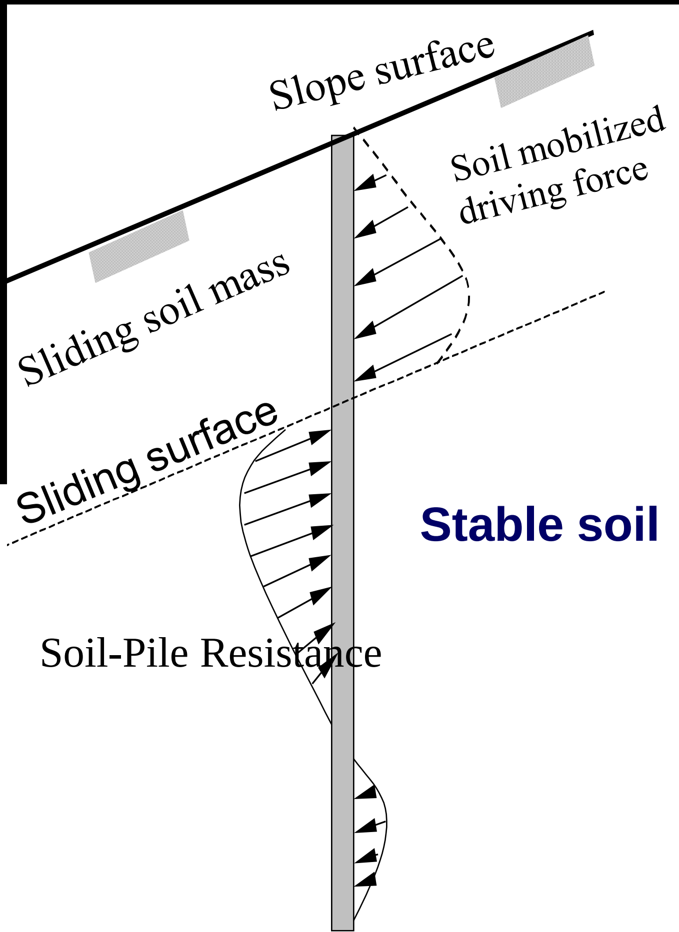
CHALLENGES:

- Characterization and Evaluation of the Mobilized Lateral Pressure Induced by the Moving Soil Mass on the Pile

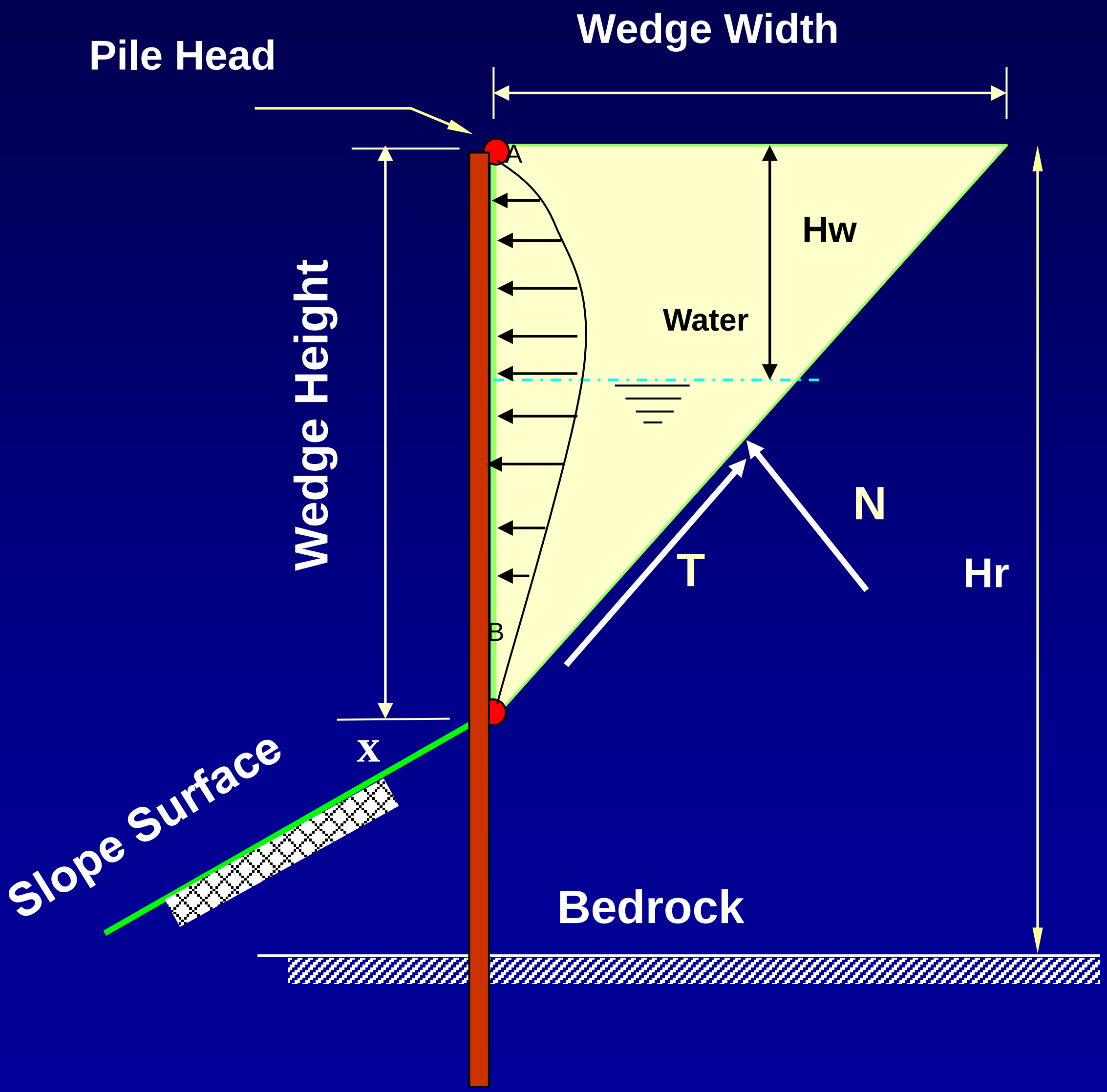
- Interaction between Stabilizing Piles and Soil Arching Effect

- Soil Flow-around Failure

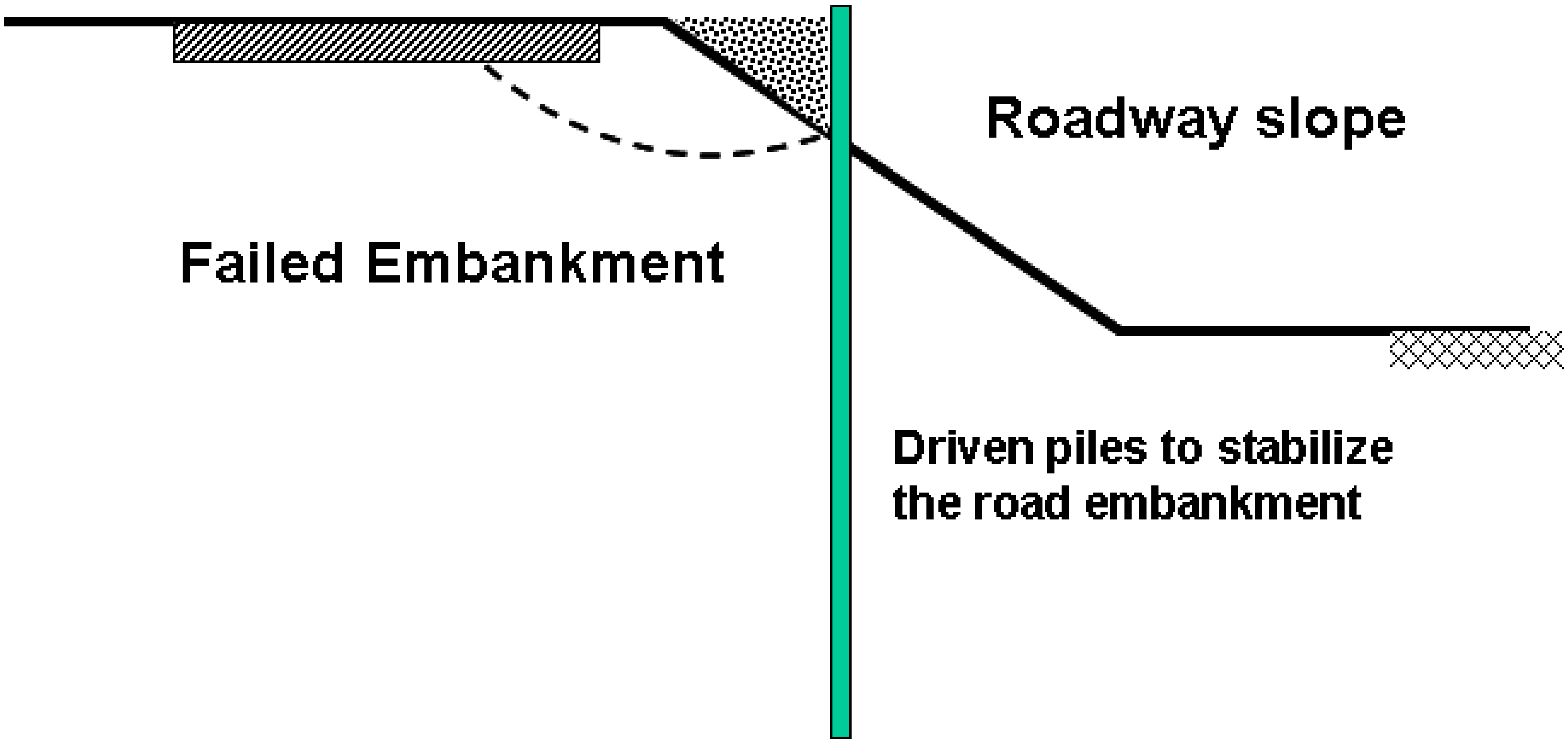




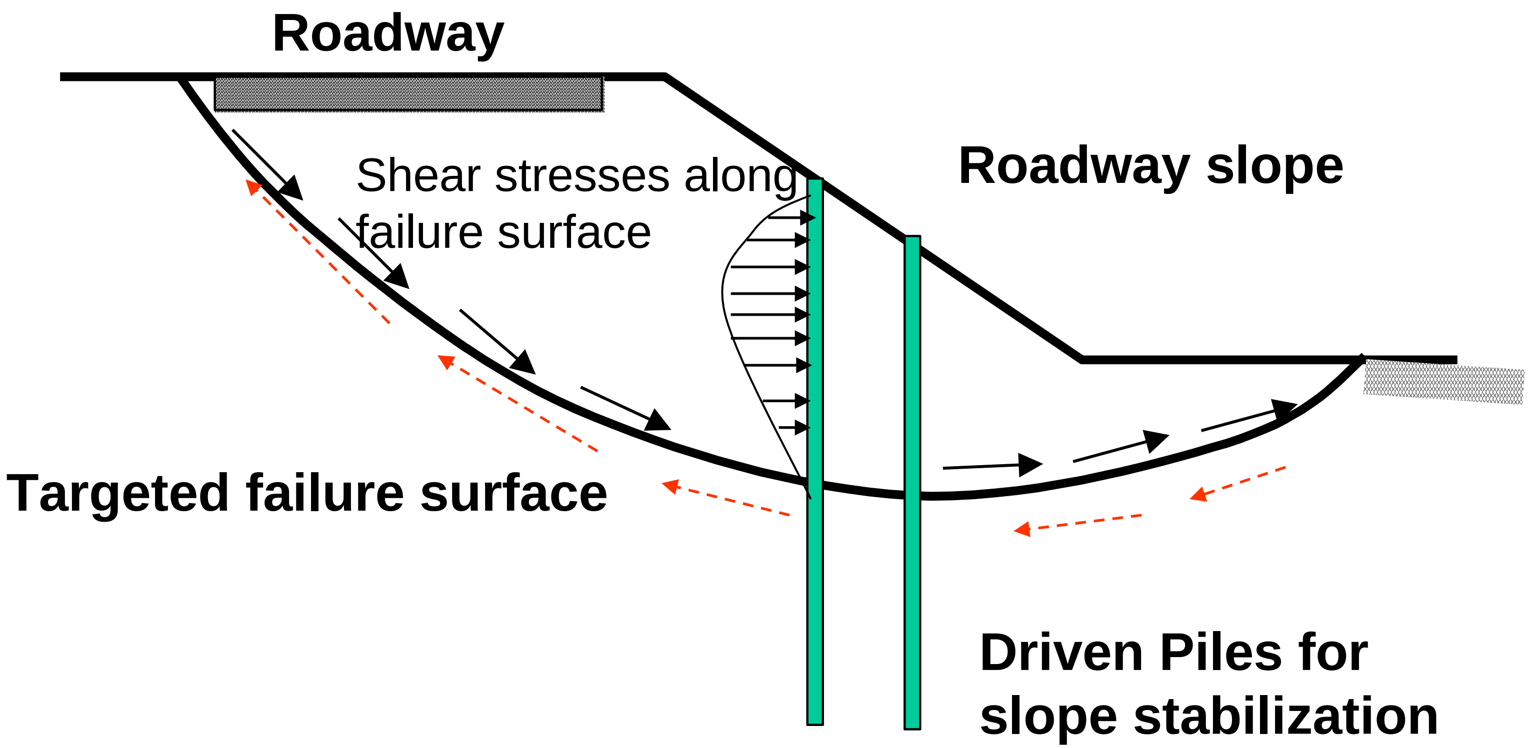
A. SIMPLE WEDGE FAILURE



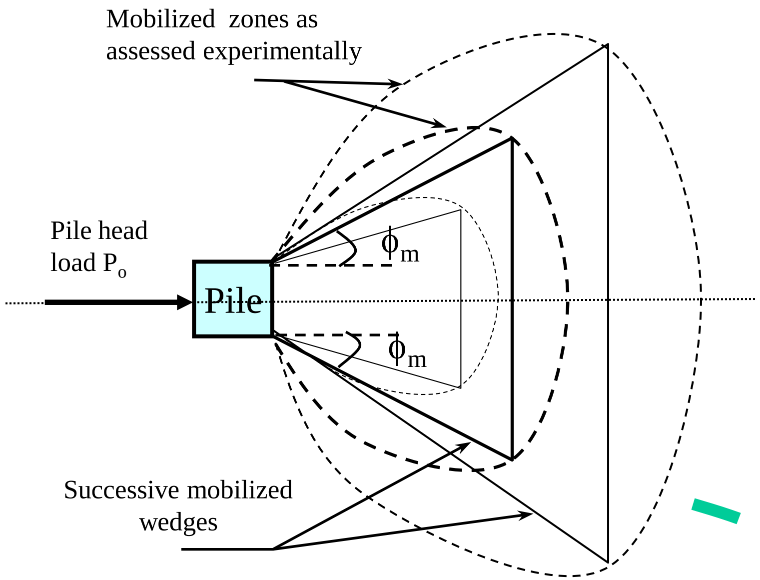
B. Pre-existing Failure Surface

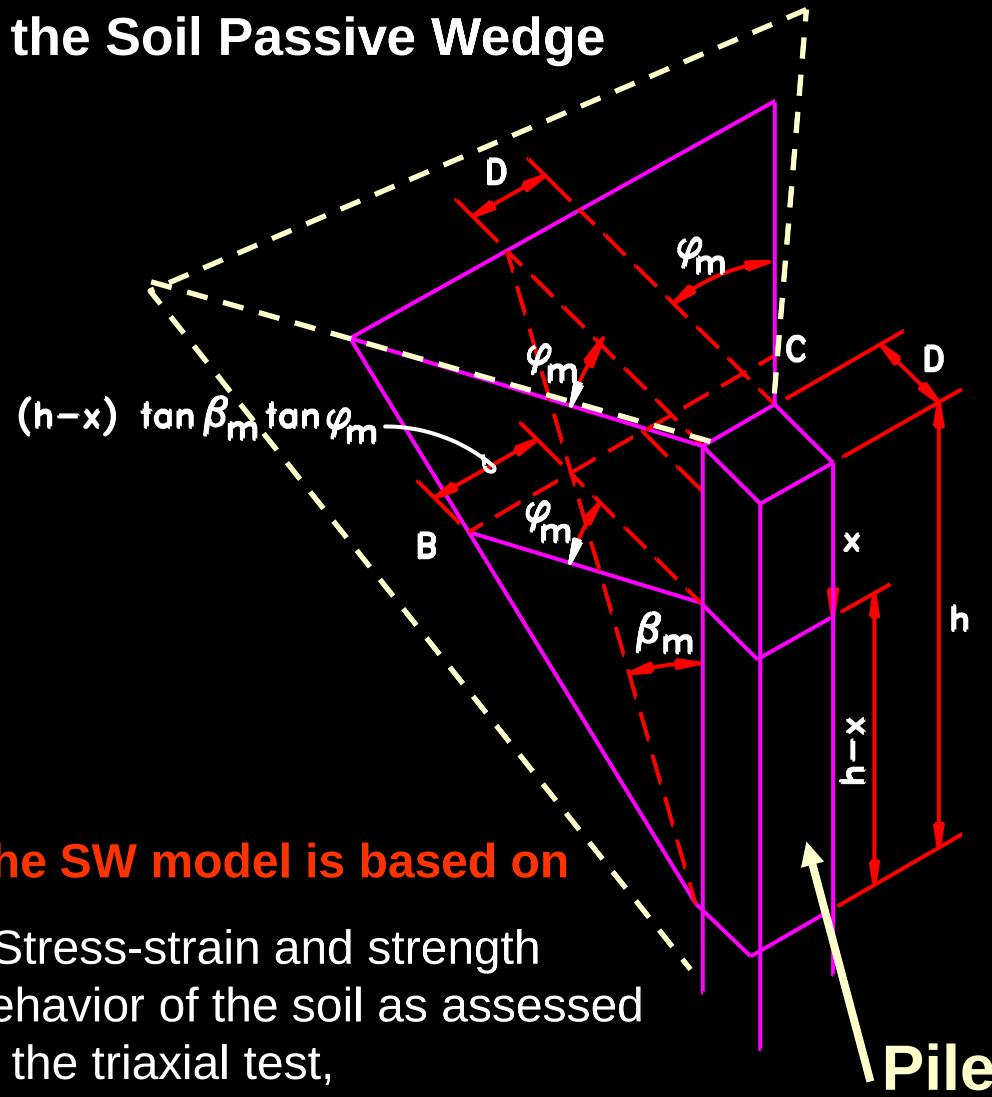


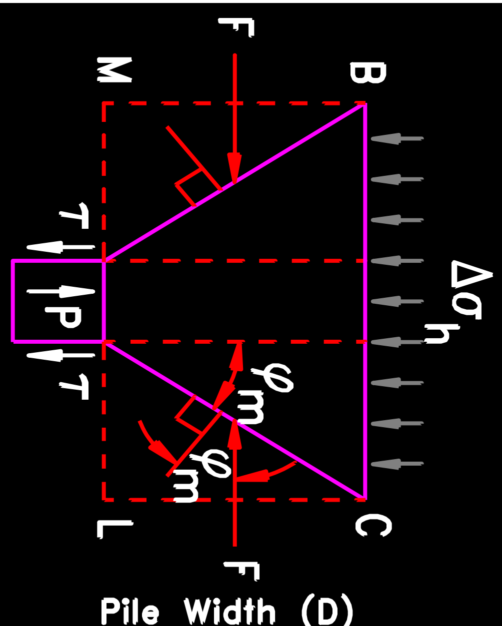
C. Anticipated Failure Surface



Horizontal and Vertical Growth in the Soil Passive Wedge



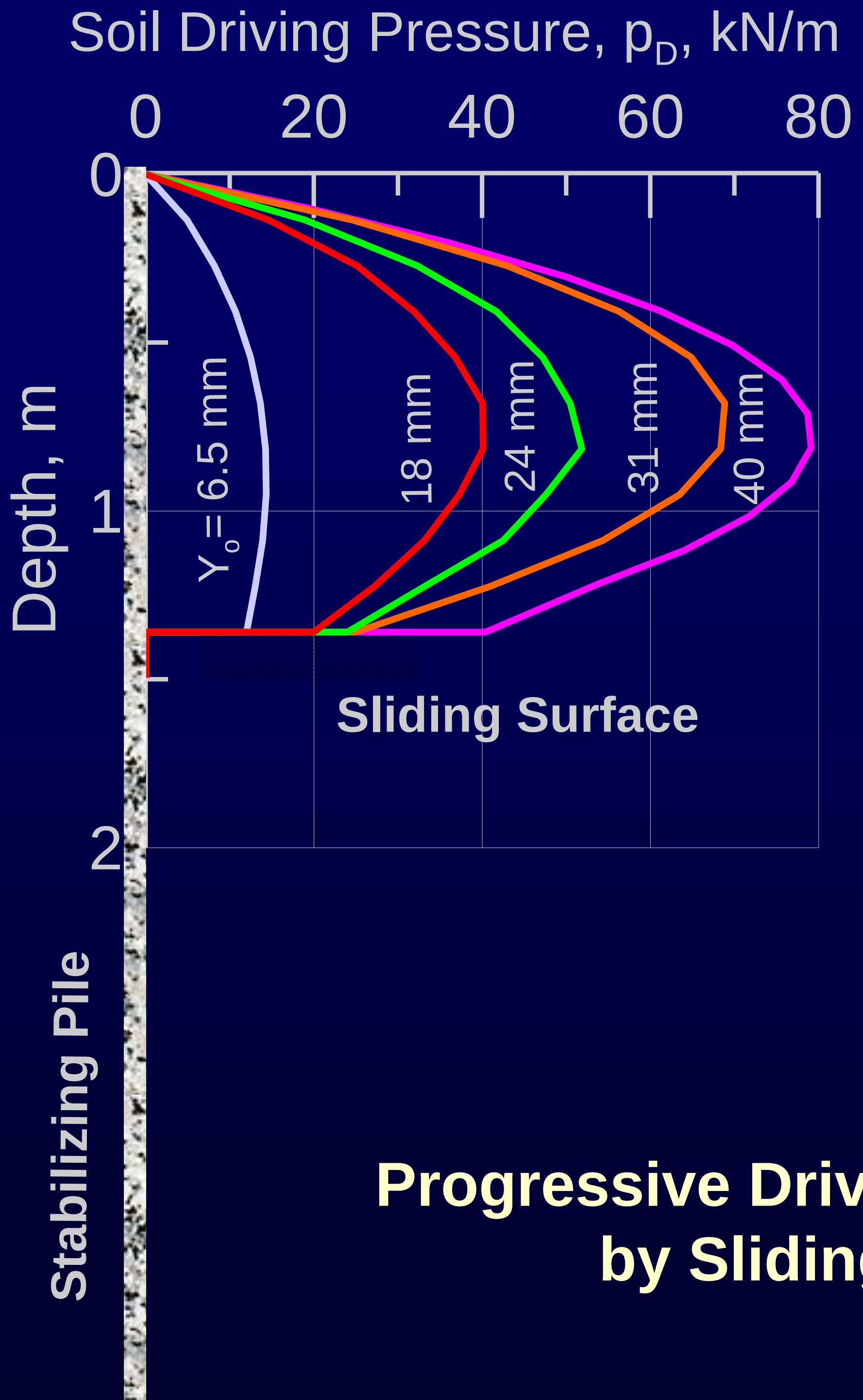


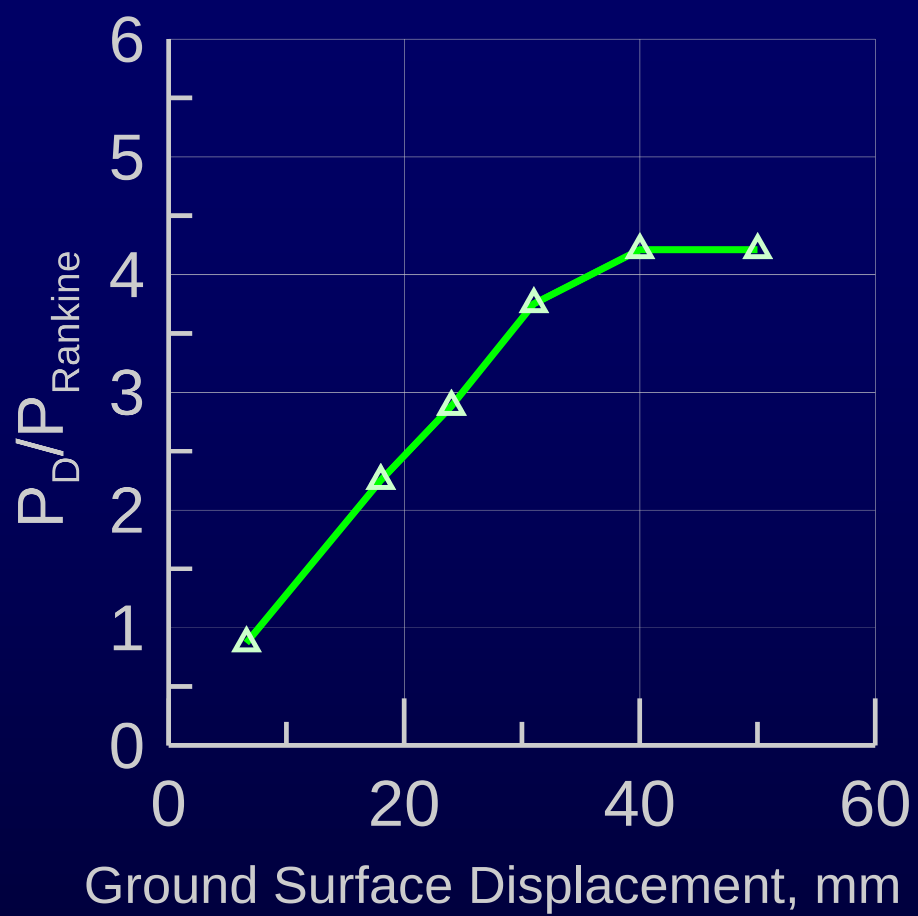


SLICE OF WEDGE AT DEPTH x

The SW model is based on

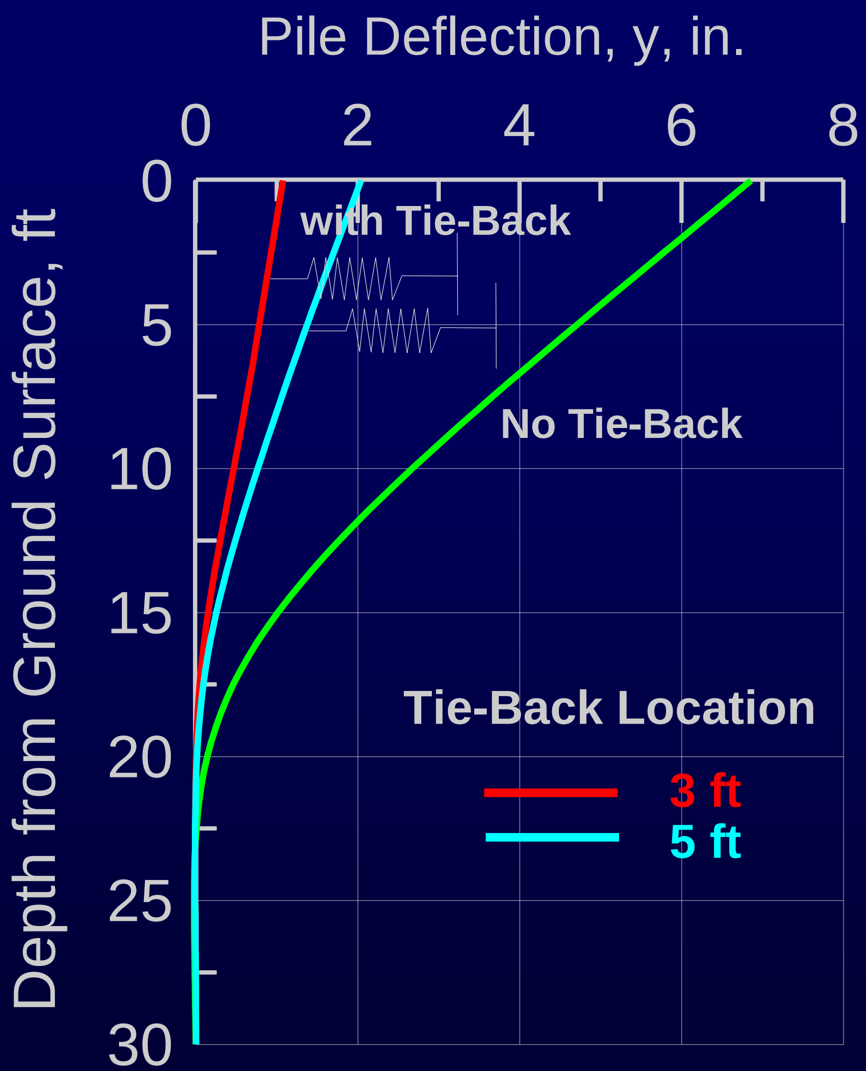
- Stress-strain and strength behavior of the soil as assessed in the triaxial test,
- Soil effective stress analysis
- Plane strain problem
- Beam on Elastic Foundation

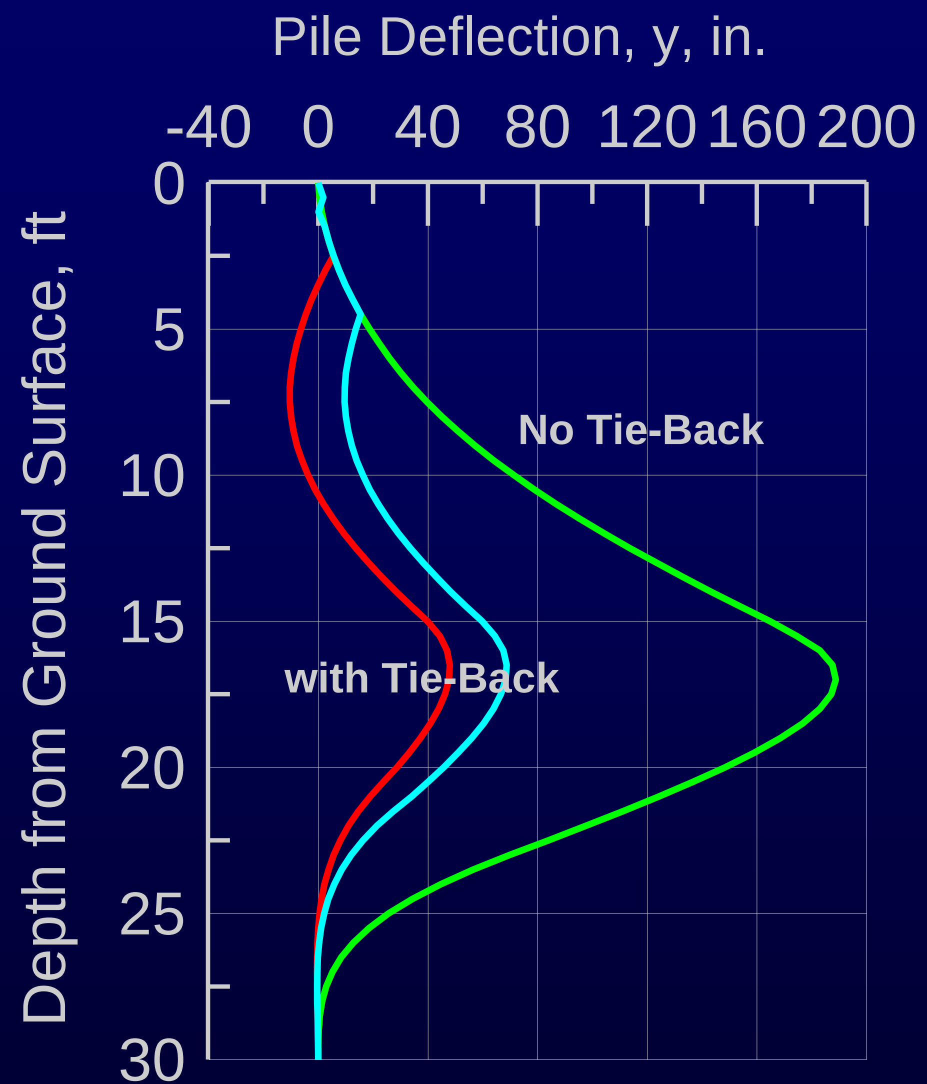




Progressive Driving Force Induced by Sliding Soil Mass

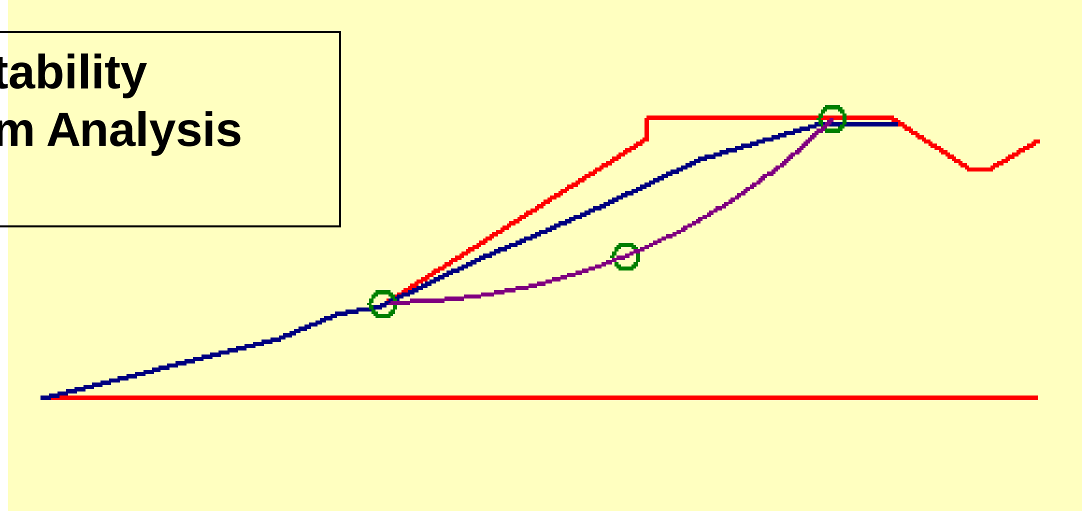
TIE-BACK IN PSSLOPE

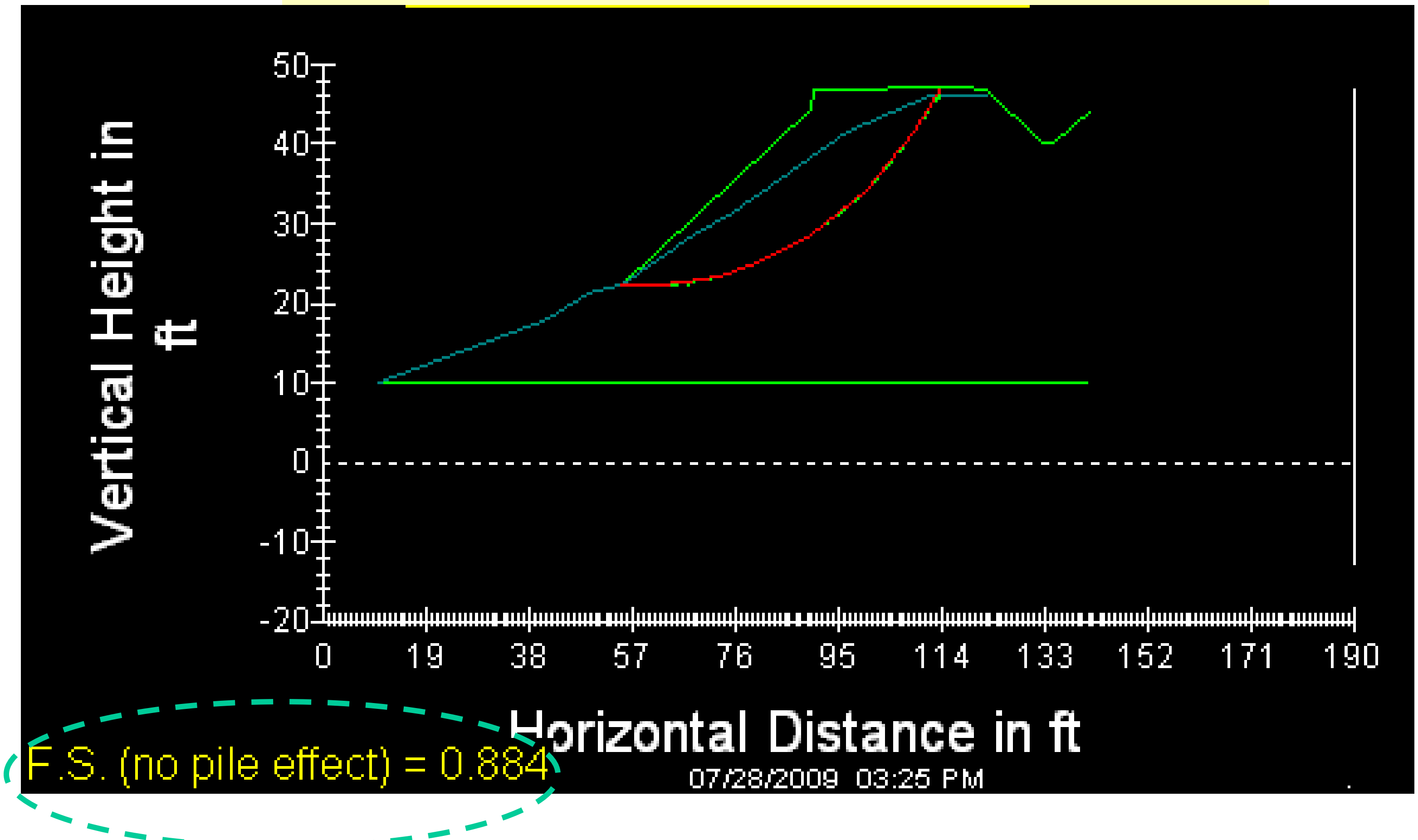


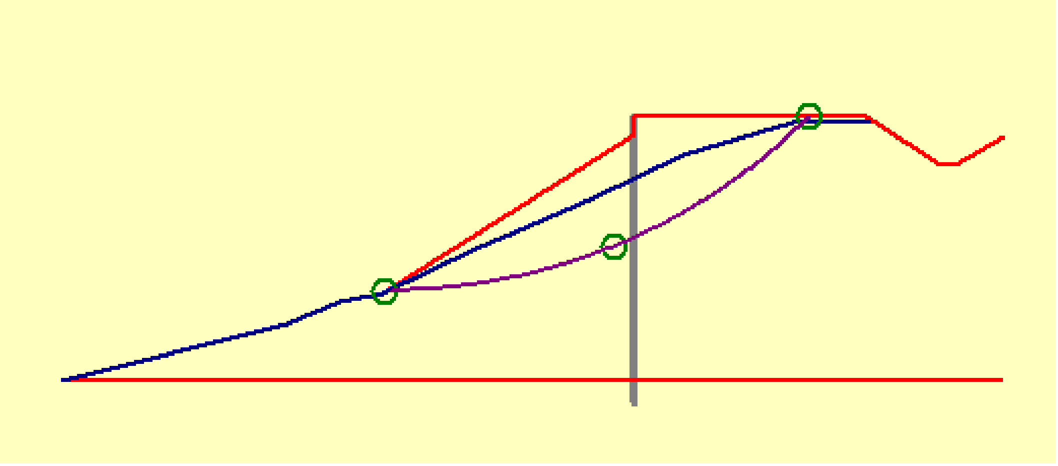


Depth from Pile Head (ft)	Horizontal Spacing (ft)	Vertical Inclination Angle with Horiz. (deg)	Tie-Back Length ft	Tie-Back Section Area (in2)	Factored Resistance (Kips)
3	4	0	30	3	10

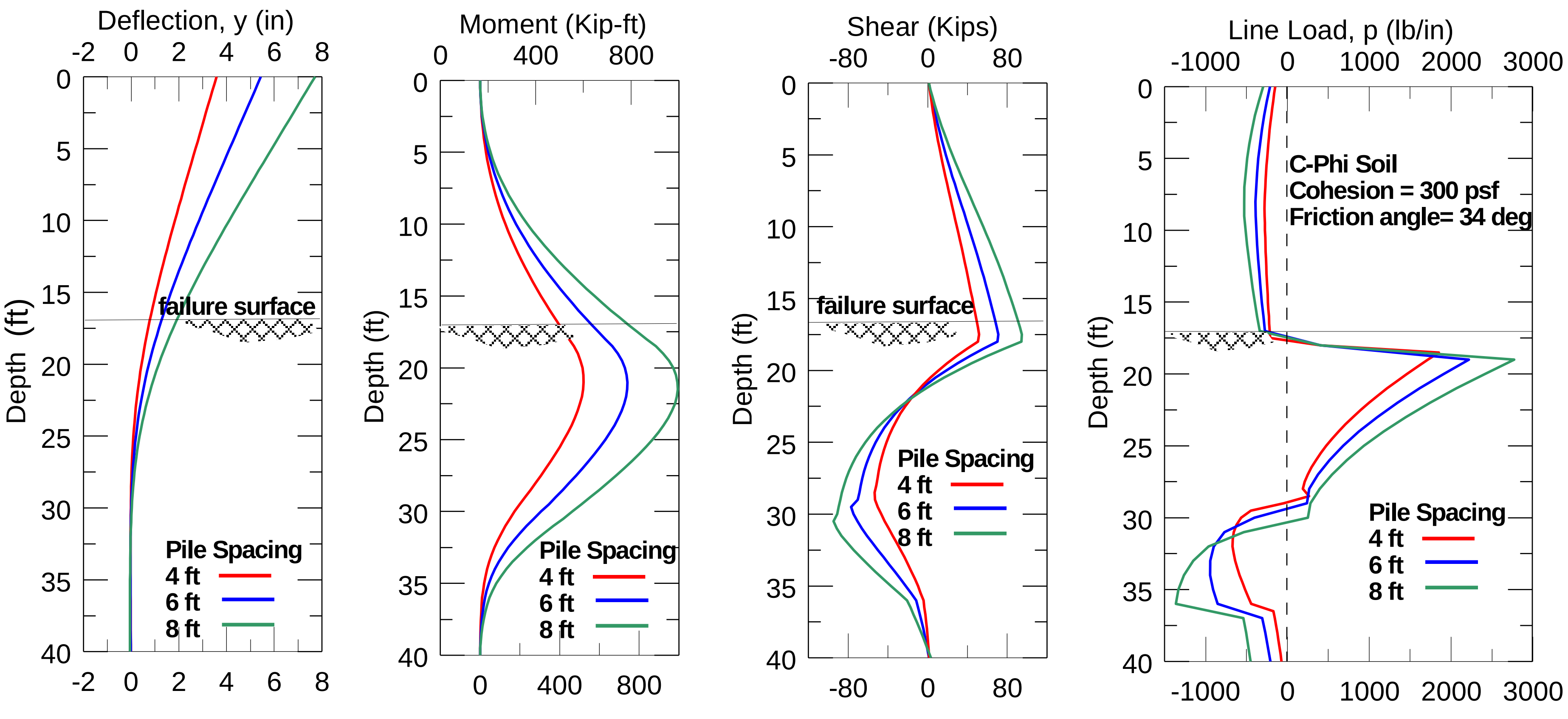
Slope Stability
Limit Equilibrium Analysis





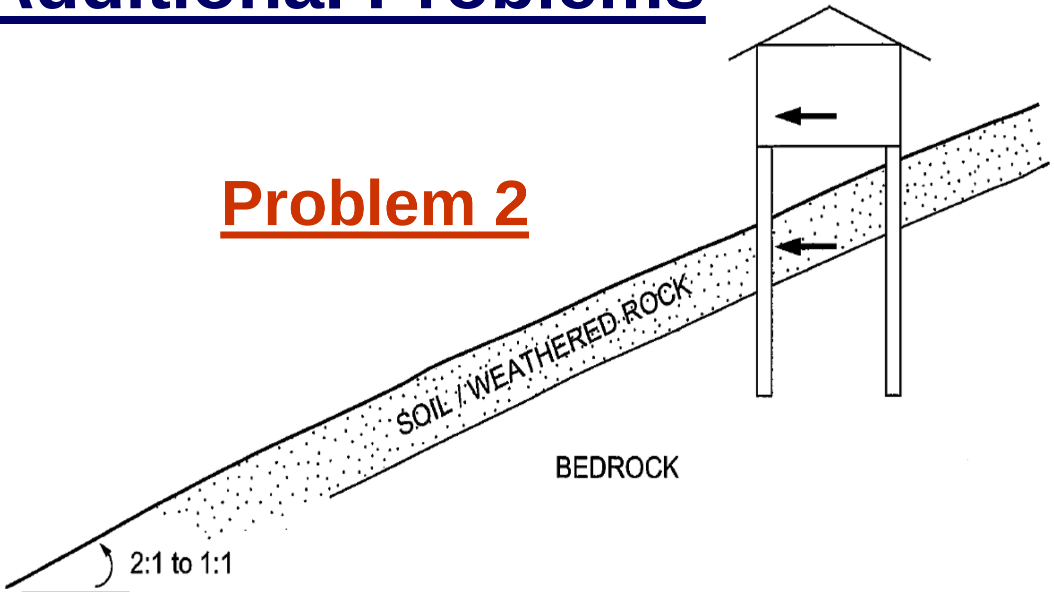


Pile
W 14 x 211
Mp = 1625 kip-ft
Desired FS of Supported Slope = 1.3

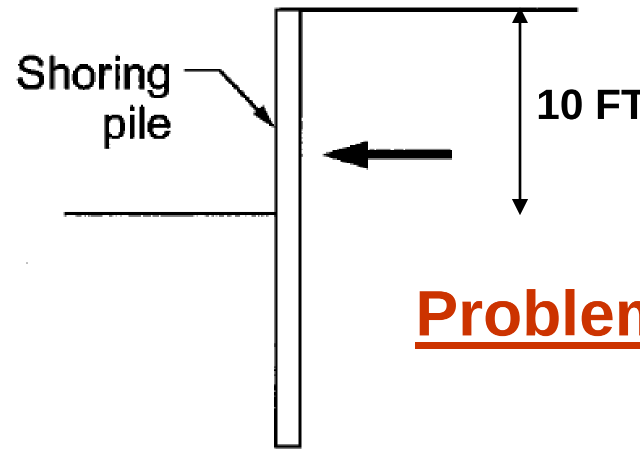


Additional Problems

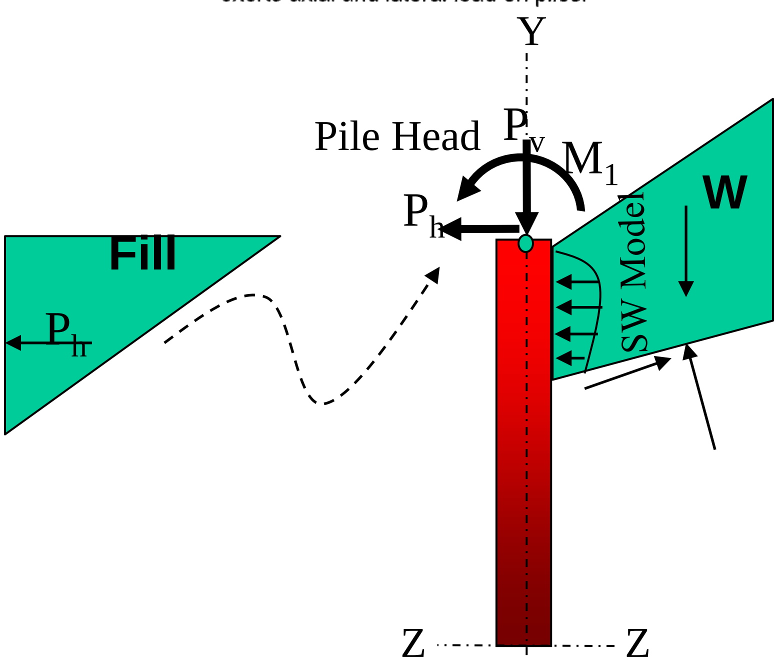
Problem 2



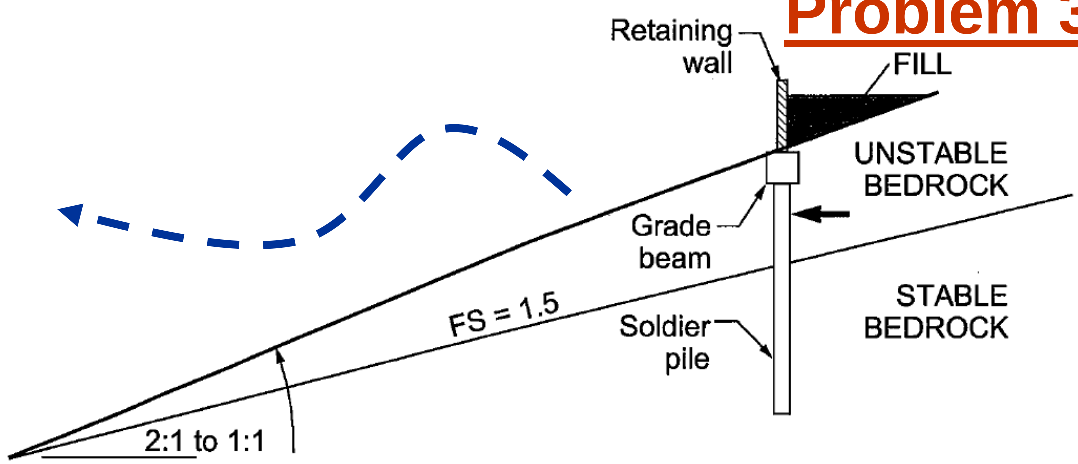
Problem 1



Bedrock is stable, but soil/weathered rock exerts a lat
exerts axial and lateral load on piles.

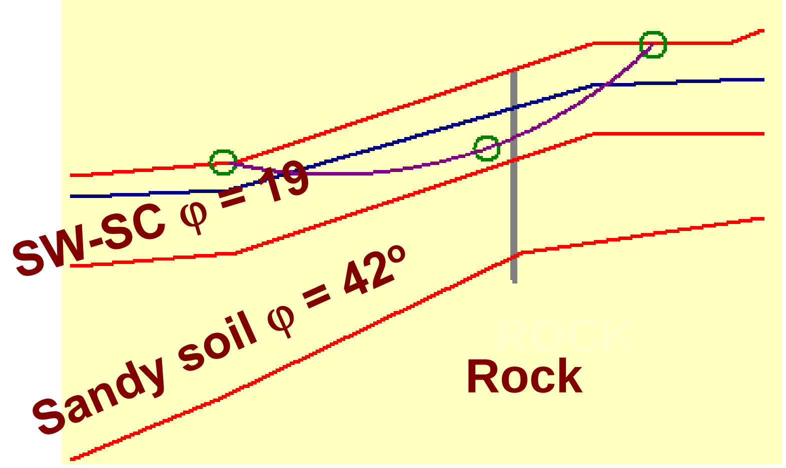


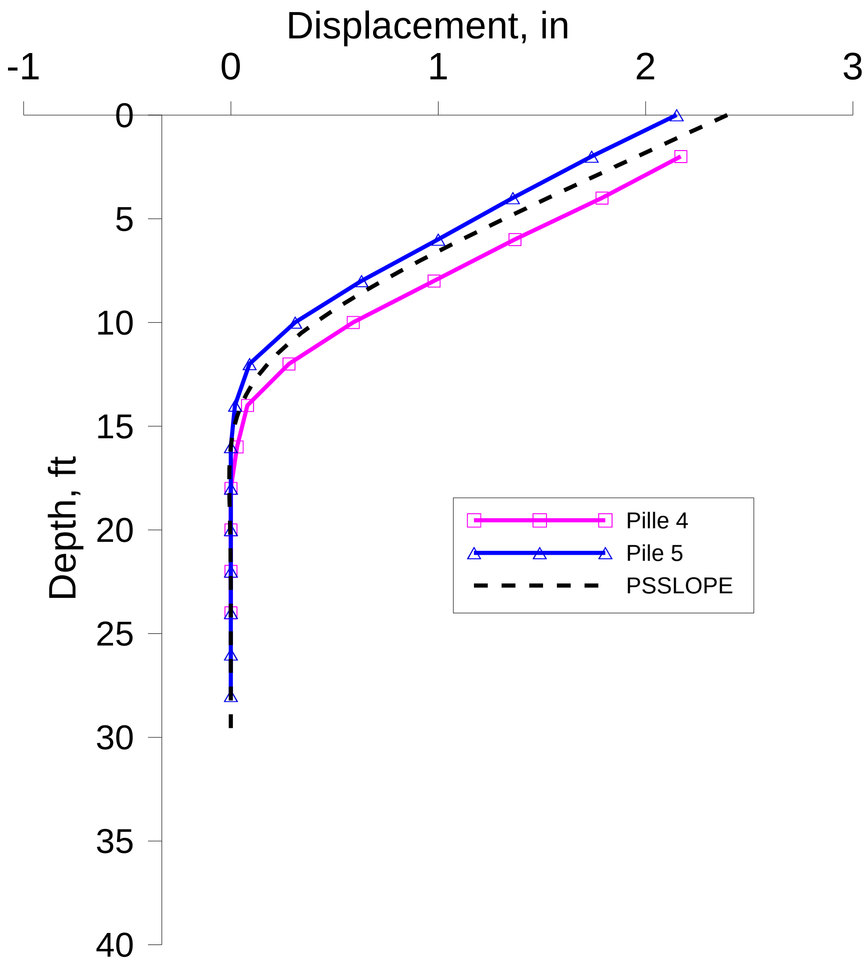
Problem 3

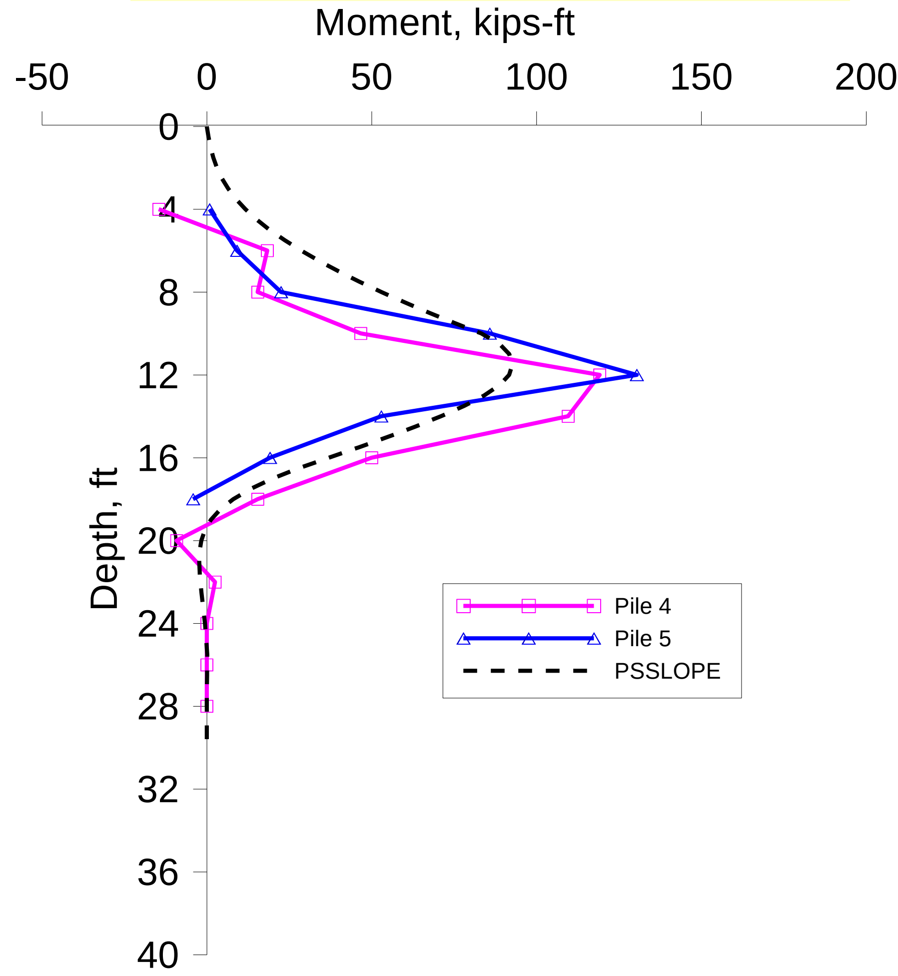


Unstable bedrock exerts a load on the pile above a plane/circle above the 1.5 factor of safety line. Analyze the loads on the pile from the earth loading and the loading from a retaining wall above.

Tygart Lake Test Site, WV
(After Richardson 2005)

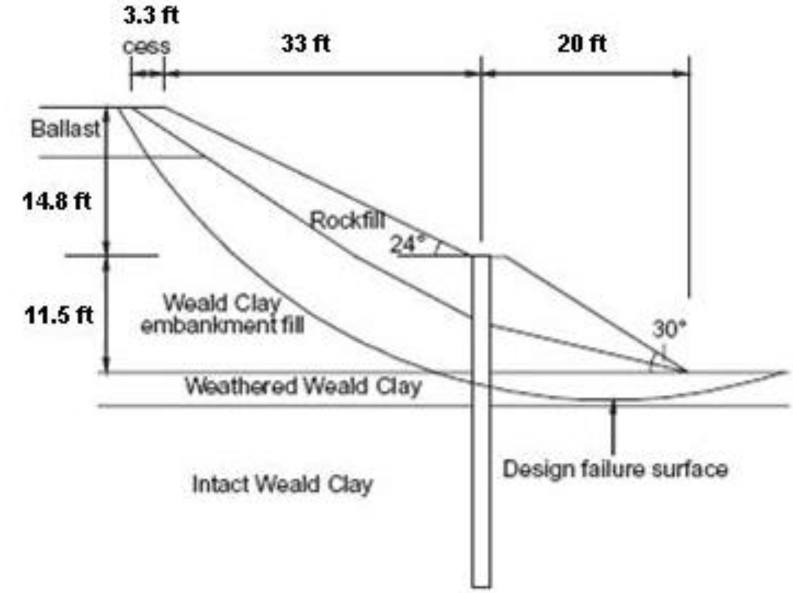


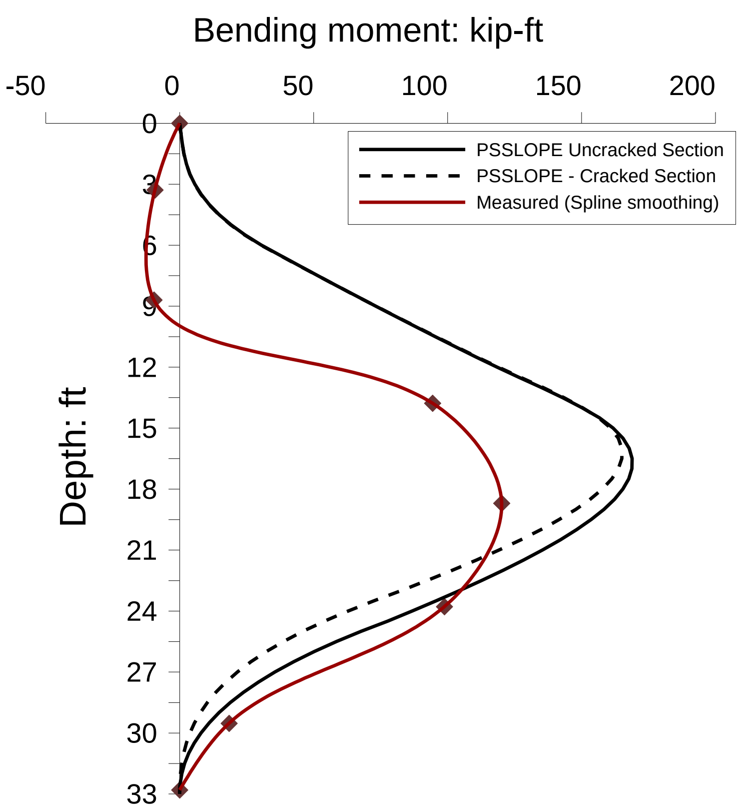


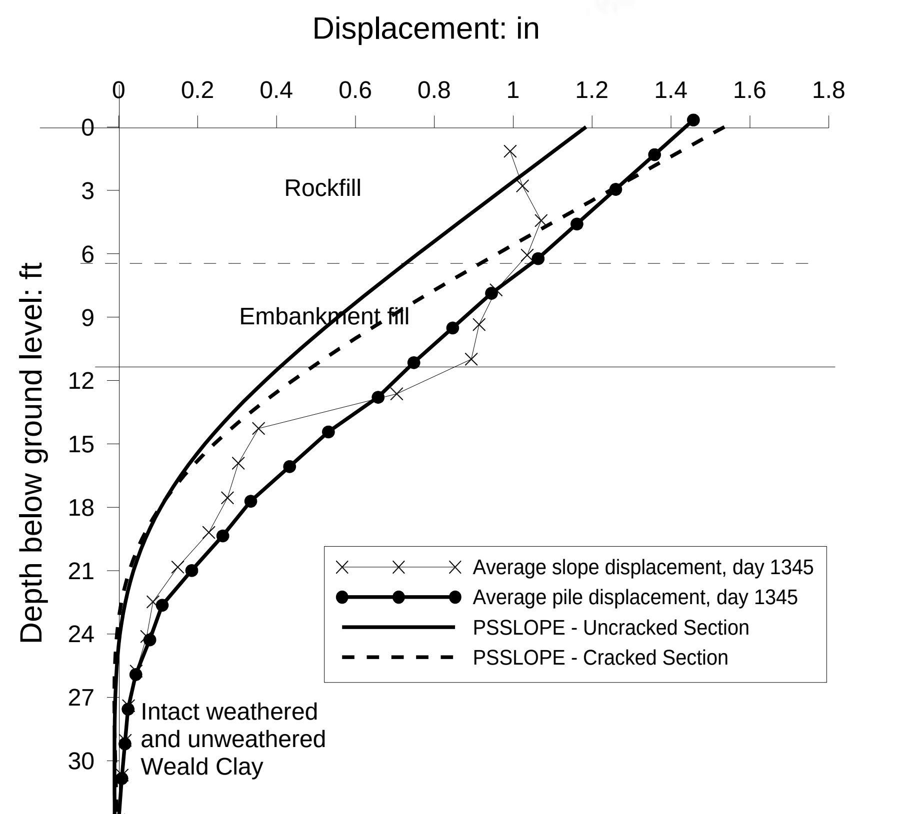


Embankment Profile, UK (Smethurst and Powerie 2007)

Soil type	Unit weight, γ : lb/ft^3	Friction angle, ϕ' : degrees	Effective cohesion c' : lb/ft3
Weald Clay embankment fill	121	25	20.9
Softened Weald Clay embankment fill	121	19	20.9
Weathered Weald Clay	121	25	20.9
Weald Clay	127	30	104.4
Rockfill	121	35	0







SUMMARY:

The current analysis/program provides the following:

- Limit equilibrium analysis for existing or anticipated failure surface
- Evaluation of the progressive driving pressure of sliding mass as a function of soil-pile displacement with varying safety factors
- Consideration of the flow-around failure of soil which limits the soil mass interaction with the pile
- The effect of pile properties and spacing
- LRFD recommendations
- Implementation of tie-back as an elastic support