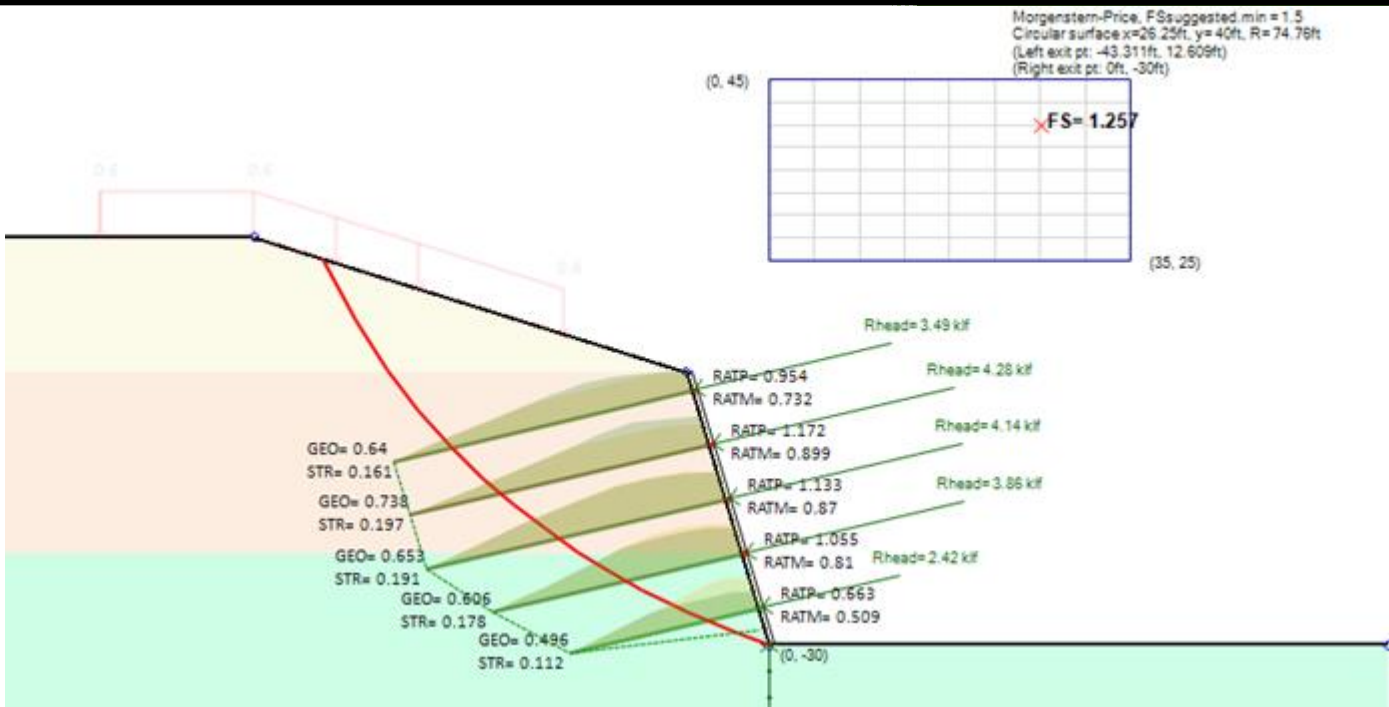




DEEP EXCAVATION
GEOTECHNICAL SOFTWARE & ENGINEERING

Soil Nail Wall Design Example - SnailPlus

Circular Failure Surface – Bishop and Morgenstern-Price Methods



SnailPlus
Soil Nail Wall Design
Software

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INTRODUCTION: SNAILPLUS – SOIL NAIL WALL DESIGN SOFTWARE

SnailPlus is a powerful software program for the slope stability analysis, and the design and evaluation of soil nail wall systems.

SnailPlus can be used for the calculation of the global stability safety factor, and it can also design all soil nail wall structural members (soil nails, shotcrete facing, head plates)

Slope Stability Methods: Bishop, Morgenstern-Price (General Limit Equilibrium), Spencer.

Shotcrete Facing: Temporary, Permanent, Two-Stage (Temporary and Permanent in different construction stages).

Design Conditions: Temporary Structure, Permanent Structure, Extreme Events (Seismic and High Water).

Seismic Pressures Methods: Semirigid, Mononobe-Okabe, Wood, User-Defined.

Water Pressures Methods: Hydrostatic, Simplified Flow, Full 2D Flownet Analysis.

Soil Properties: User-Defined, Estimation Tools (Test Data), SPT and CPT logs.

Structural Design: ACI, FHWA (ASD), FHWA (LRFD).

Analysis - Combinations: Allowable Design (ASD), LRFD GEC-7, EUROCODE 7 (ULS).

Printed Reports: Reports Exported in PDF and Word.

Model Creation: Graphical (Interactive Interface), Model Wizard.

SnailPlus – Software Capabilities and Examples

SnailPlus is a robust software for the design of soil nail wall systems. It can locate the most critical slope surfaces, the slope stability FS and it can fully design all structural items (soil nails, head plates, shotcrete facings).

[Click here to learn more: SnailPlus: Features and Examples](#)

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A. PROJECT DESCRIPTION – MODEL DATA

In this example we will design a 75 deg slope surface, supported by a soil nail wall (5 rows of #9 bar soil nails, with a 6in permanent shotcrete facing).

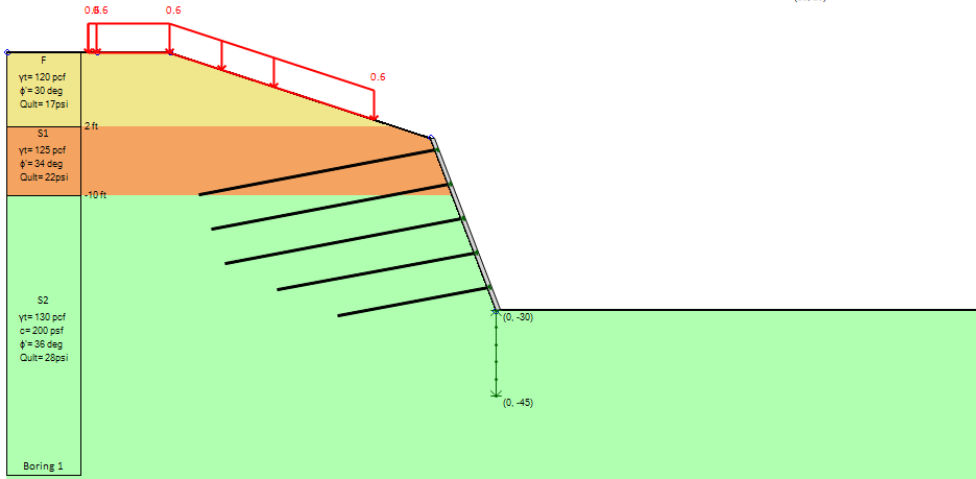


Figure: 2D Section Model

Table: Soil Properties and Soil Layer Elevations

Soil Layer Elev. (ft)	Soil (-)	Soil Type (-)	Friction Angle (deg)	Cohesion (psf)	Total Unit Weight (pcf)	Skin Friction (psi)
15	F	Sand (Fill)	30	10	120	17
0	S1	Medium Sand	34	20	125	22
-20	S2	Dense Sand	36	200	130	28

Table: Shotcrete Facing Properties

Wall Type	Shotcrete Wall
Wall Thickness	6 in
Reinforcement	2 rows / #6 Bars Horizontal And Vertical
Steel Grade	Grade 60
Concrete	3 ksi

Table: Soil Nails and Head Plates Properties

Elevation	Varies (5 rows)
Support Type	1#9 Rebar Soil Nails
Grout Diameter	4 in
Head Plate Section	Rectangular – 10in x 10in
Head Plate Thickness	1.5 in
Steel Grade	Grade 60
Concrete	5 ksi
Horizontal Spacing	6 ft
Vertical Spacing	6 ft

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B. SNAILPLUS SOFTWARE – SOIL TYPES AND BORINGS

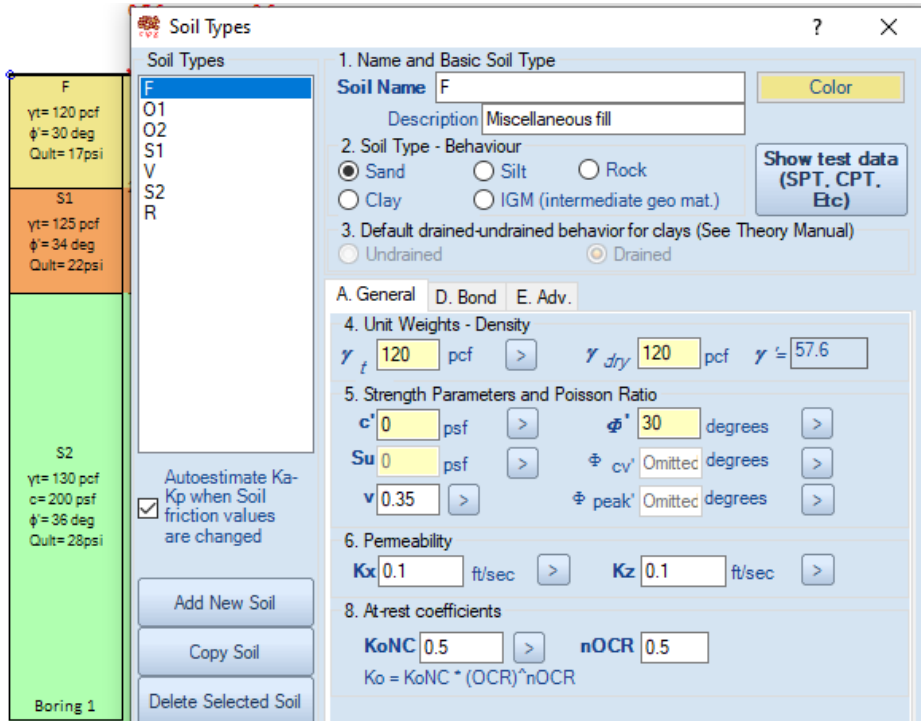


Figure: General soil properties – Fill Layer (Soil F)

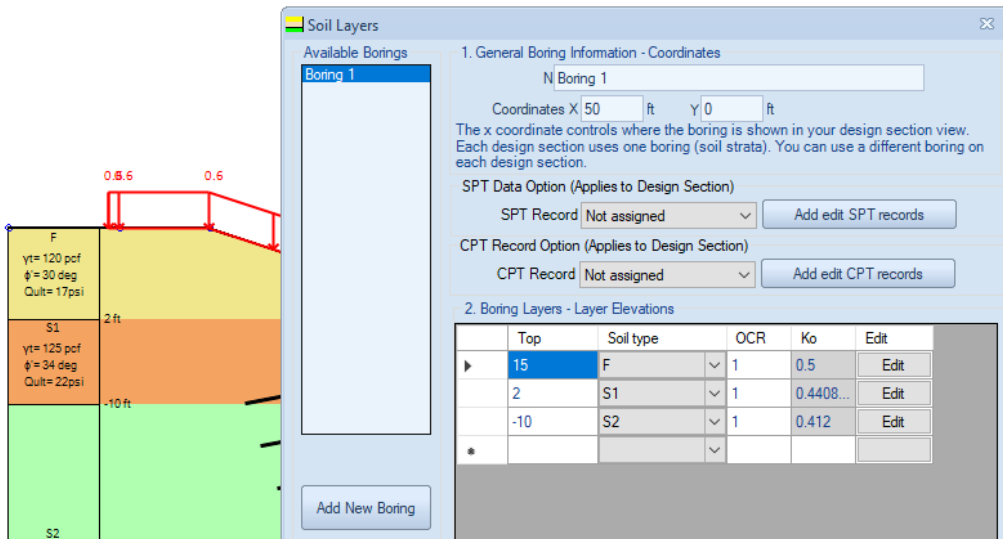


Figure: Soil Layers

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C. SNAILPLUS SOFTWARE – SOIL NAILS AND FACING PROPERTIES

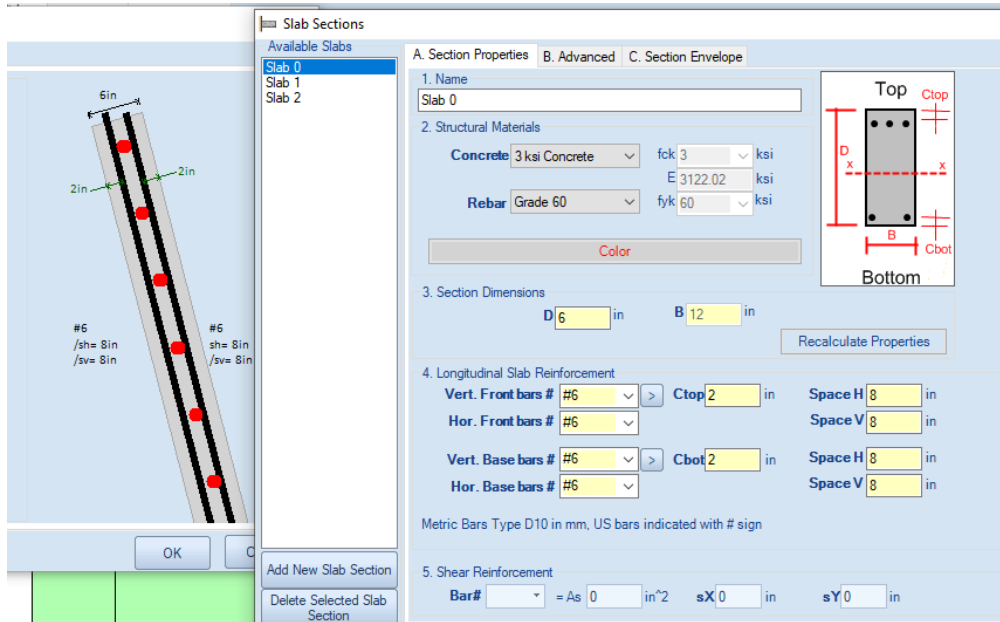


Figure: SnailPlus – Shotcrete Facing – Section Properties

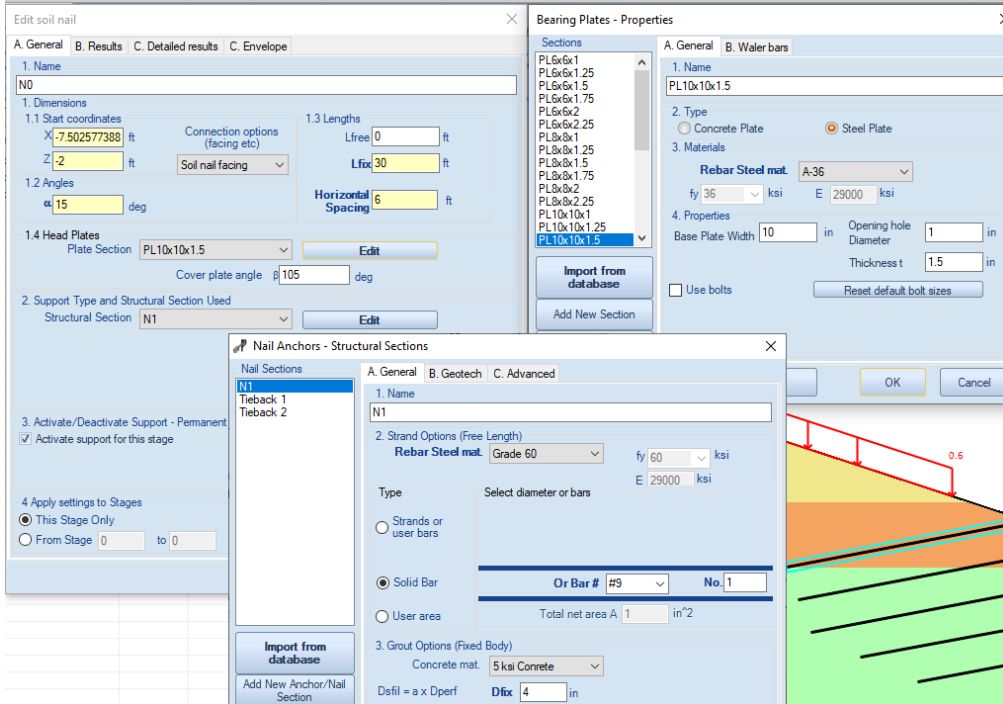


Figure: SnailPlus – Soil Nail and Head Plate Properties

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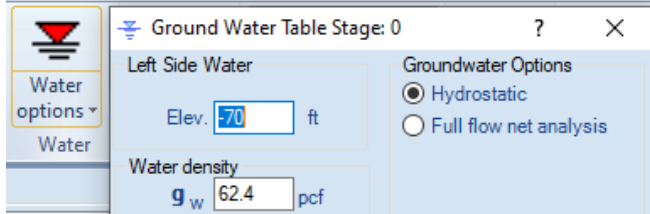
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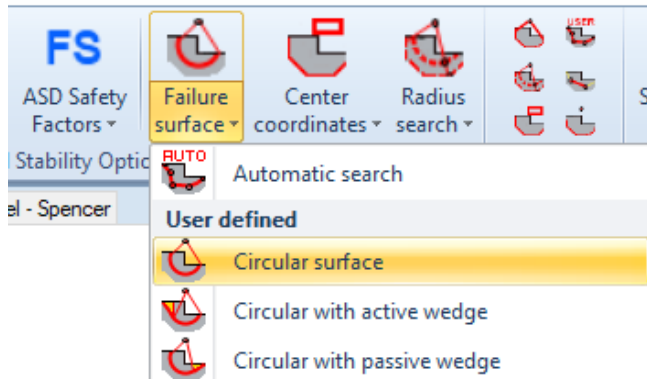
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D. SNAILPLUS – ANALYSIS SETTINGS

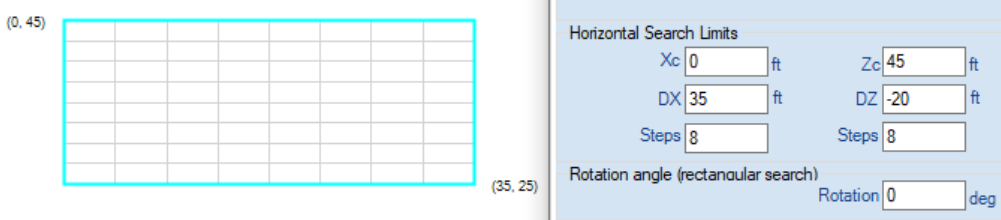
1. Water Pressures -> Hydrostatic



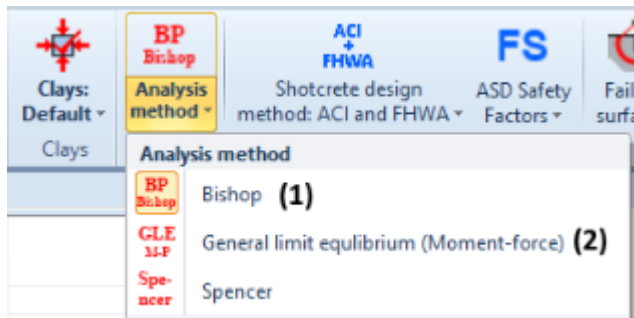
2. Failure Surface Type -> Circular



3. Circular Failure Surface Center -> Rectangular Search



4. Analysis Methods -> (1) Bishop and (2) Morgenstern-Price (GLE Method)



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E. ANALYSIS METHODS CONCEPT – BISHOP AND GLE METHODS

The simplified **Bishop method** uses the method of slices to discretize the soil mass and determine the Factor of Safety. This method satisfies vertical force equilibrium for each slice and overall moment equilibrium about the center of the circular trial surface. The horizontal forces are not considered at each slice with the simplified Bishop method, so zero interslice shear forces are assumed in this case.

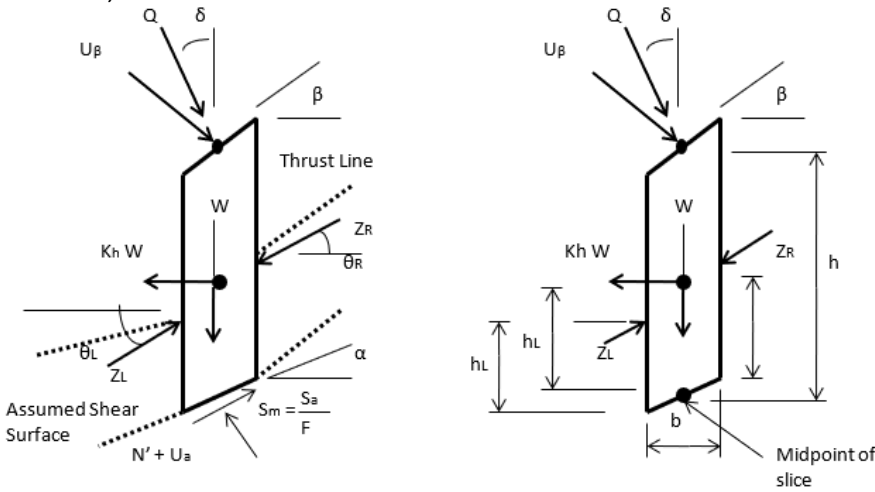
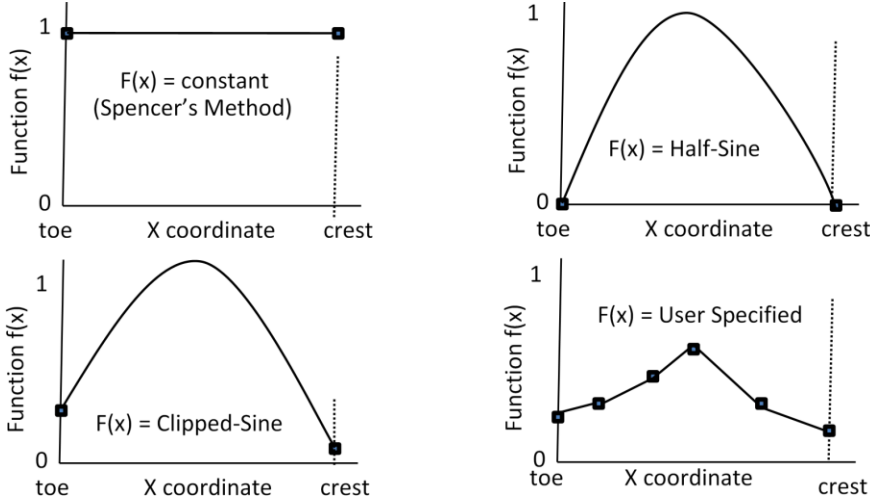


Figure: Forces Acting on a Typical Slice

The **GLE method** is an extension of Spencer’s (1973) method, which has been generalized by Chugh (1986). The GLE method adopts a function to assign the interslice force angle on the right-hand side of the slice i , as shown in Figure above. The GLE Method, takes into consideration both the horizontal and the vertical interslice forces, and performs the Equilibrium of Forces and Moments calculations for each slice. Morgenstern-Price method calculates the total normal, vertical and shear stresses at the base of each slice to allow the user to evaluate the reasonableness of the reported FS.



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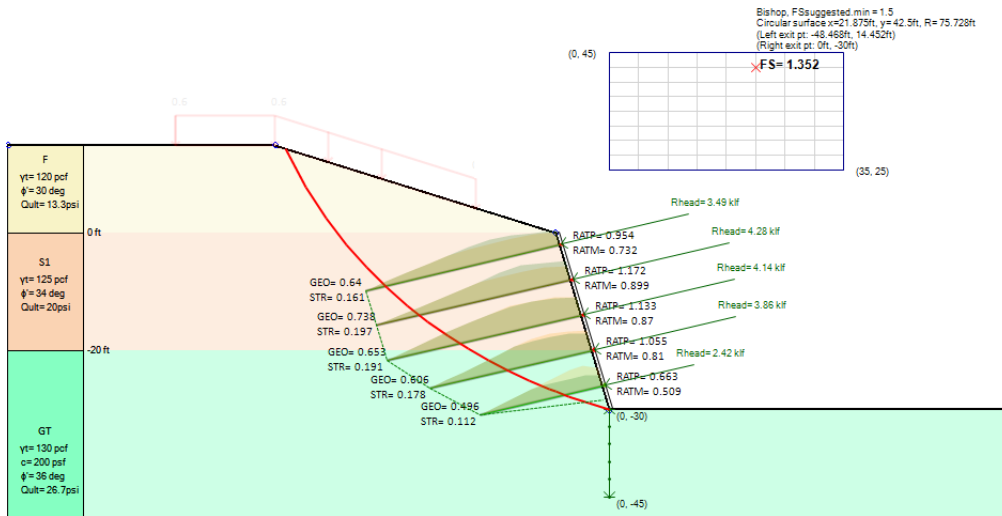
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F.1. SNAIL PLUS ANALYSIS RESULTS – BISHOP METHOD



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Figure: Slope Stability FS, Critical Slope Surface, Soil Nail and Head Plates Check Ratios (Bishop Method)

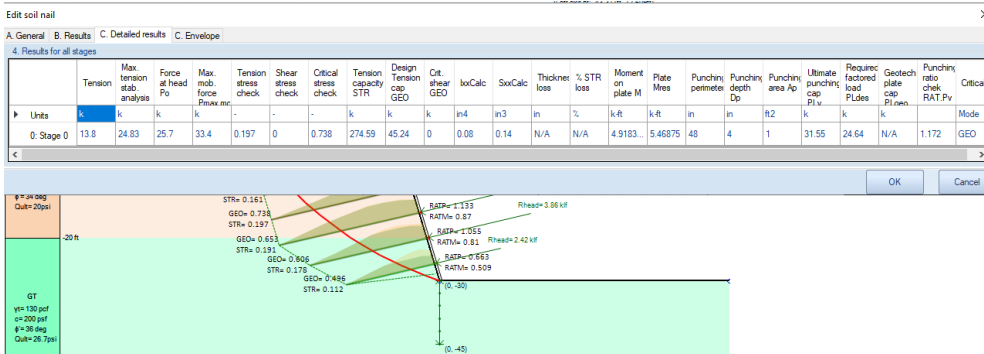


Figure: Soil Nail and Head Plates Results Table (Bishop Method)

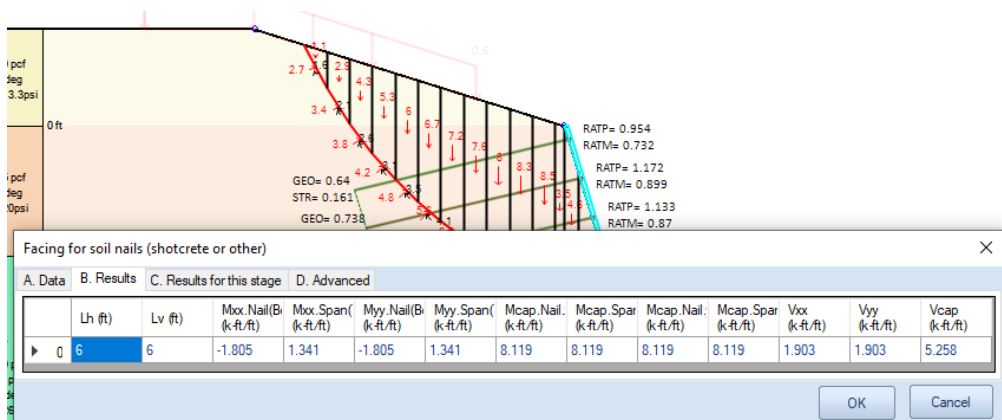
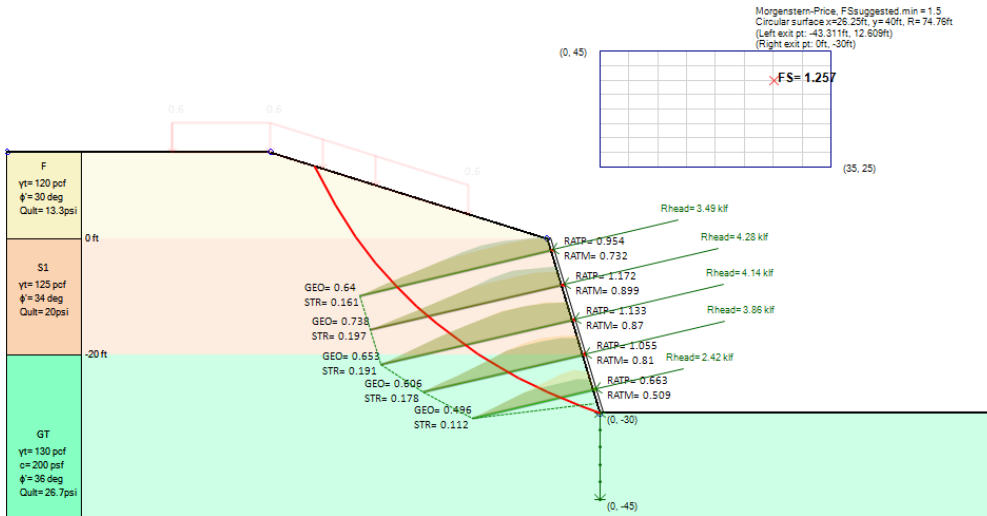


Figure: Shotcrete Facing Results Table (Bishop Method)

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F.2. SNAIL PLUS ANALYSIS RESULTS – GLE (MORGENSTERN-PRICE) METHOD



SnaillPlus – Software Capabilities and Examples

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Figure: Slope Stability FS, Critical Slope Surface, Soil Nail and Head Plates Check Ratios (GLE Method)

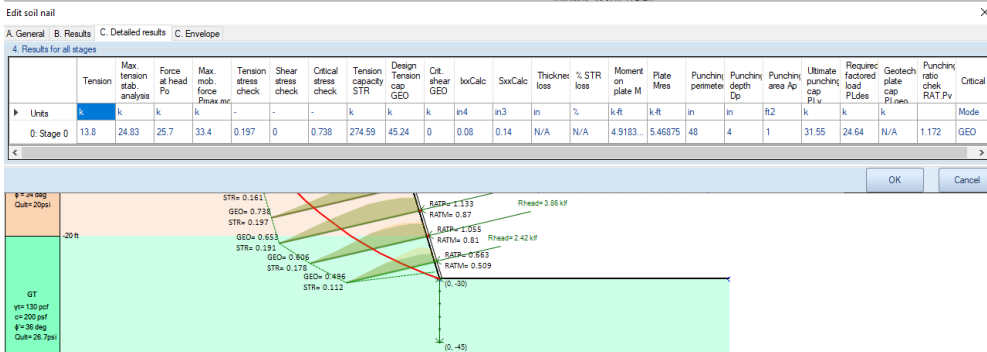


Figure: Soil Nail and Head Plates Results Table (GLE Method)

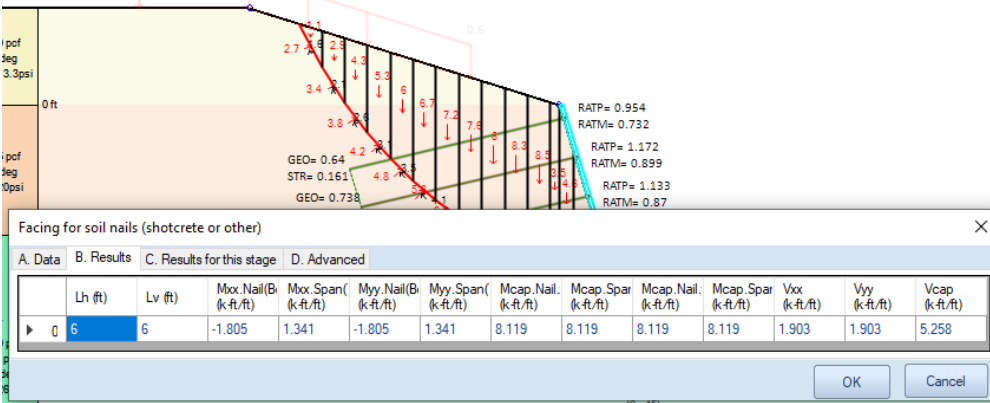


Figure: Shotcrete Facing Results Table (GLE Method)

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