Non-homogeneous Slope Stability

Keywords

2D, Plane Strain, Mohr-Coulomb, phi-c.

Problem Description

This example examines the stability of an embankment comprising three different soils layers.

Discretisation

The model is a meshed using plane strain elements with quadrilateral shape and quadratic interpolation order (QPN8 elements). The bottom surface is fully restrained whilst the sides are allowed to displace vertically. Figure 1 shows the problem geometry and Figure 2 the mesh and boundary conditions.

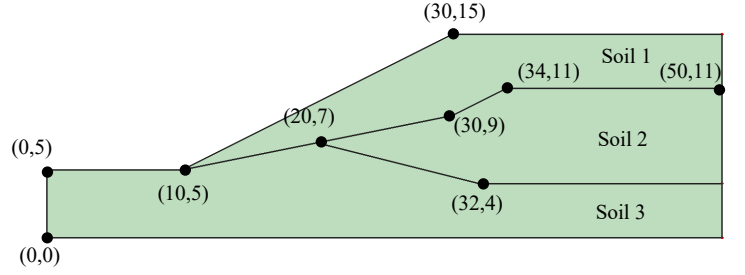

Figure 1: Problem geometry

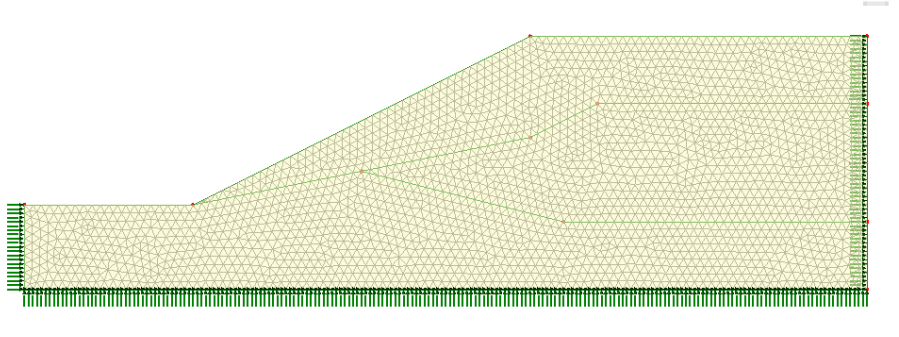

Figure 2: Mesh and boundary conditions

Material Properties

The elastic properties for the three soil layers are the same and are listed in table 1. Table 2 details the plastic properties for the Mohr-Coulomb and Modified Mohr-Coulomb material models.

Table 1: Elastic material properties for all layers

Mass density	Young's modulus, E	Poisson's ratio, ν
1.988 t/m^3	50E3 kPa	0.4

Table 2: Plastic properties

	Friction angle, φ^o	Dilation angle, ψ^o	Cohesion, c
Soil 1	38.0	0.0	0 kPa
Soil 2	23.0	0.0	5.3 kPa
Soil 3	20.0	0.0	7.2 kPa

Loading Conditions

Gravity loading is applied.

Modelling Hints

The number of iterations allowed in an increment increased from 12 to 20 to allow for slow convergence during the phi-c analysis.

Fine integration of the element stiffness matrices was used.

Comparison

The safety factor is compared to results obtained using other methods [1] in table 3

Method	Factor of safety
Bishop	1.405
Spencer	1.375
GLE	1.374
Janbu corrected	1.357
LUSAS MC	1.339

Figure 3 shows the effective strain at failure. Two failure planes are visible, one starting from the toe and running along the interface between layer 1 and 2 and a second plane starts at the surface and runs deeper to the bottom of the model.

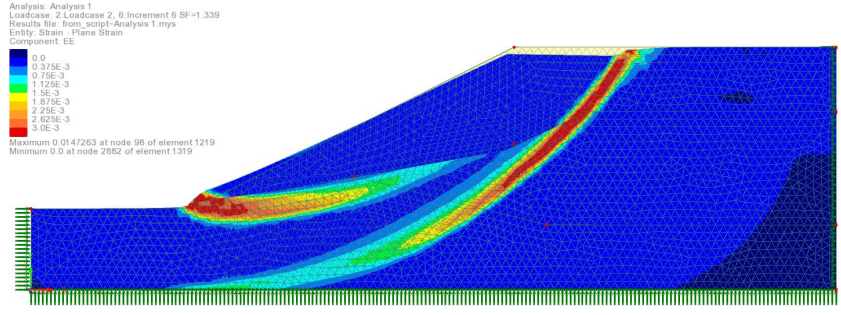

Figure 3: Effective strain at failure

References

[1] Giam and Donald, ACADS, 1989.

Input Data

non_homogeneous_slope.lvb