4 Strip Footing on Surface of Mohr-Coulomb Material

4.1 Problem Description

The prediction of collapse loads under steady plastic-flow conditions is one that can be difficult model to simulate accurately (Sloan and Randolph, 1982). A classic problem involving steady flow is the determination of the bearing capacity of a strip footing on a rigid-plastic half space. The bearing capacity is dependent on the steady plastic flow beneath the footing, and is practically significant for footing type problems in foundation engineering. The classic solution for the collapse load derived by Prandtl is a worthy problem for comparison purposes.

The strip footing with a half-width 3 m is located on an elasto-plastic Mohr-Coulomb material with the following properties:

Young's modulus = 250 *MPa*
Poisson's ratio = 0.2
Cohesion (c) = 0.1 *MPa*
Friction angle (ϕ) = 0

4.2 Closed Form Solution

The collapse load from Prandtl's Wedge solution can be found in Terzaghi and Peck (1967):

$$q = (2+\pi)c \cong 5.14c$$

where c is the cohesion of the material and q is the collapse load. The plastic flow region is shown in Figure 4-1.

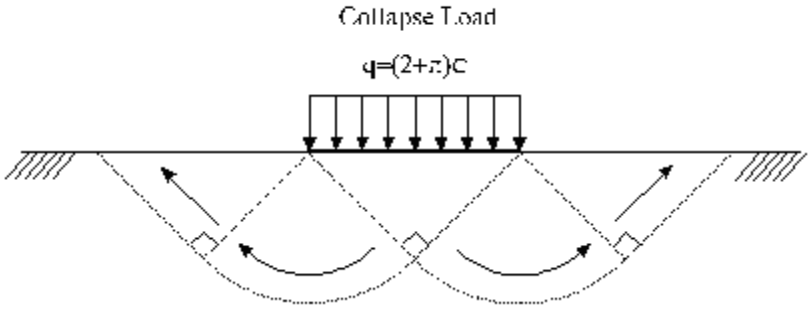

Figure 4-1: Prandtl's wedge problem of a strip load on a frictionless soil

4.3 Model Information

The model for this problem is built with 10-noded tetrahedron elements in ***RS3*** as shown in Figure 4-2. Half-symmetry is used and the strip load is increased with each stage. This model is extruded 1 m to create a prismatic shape. The boundary conditions are set according to Figure 4-3.

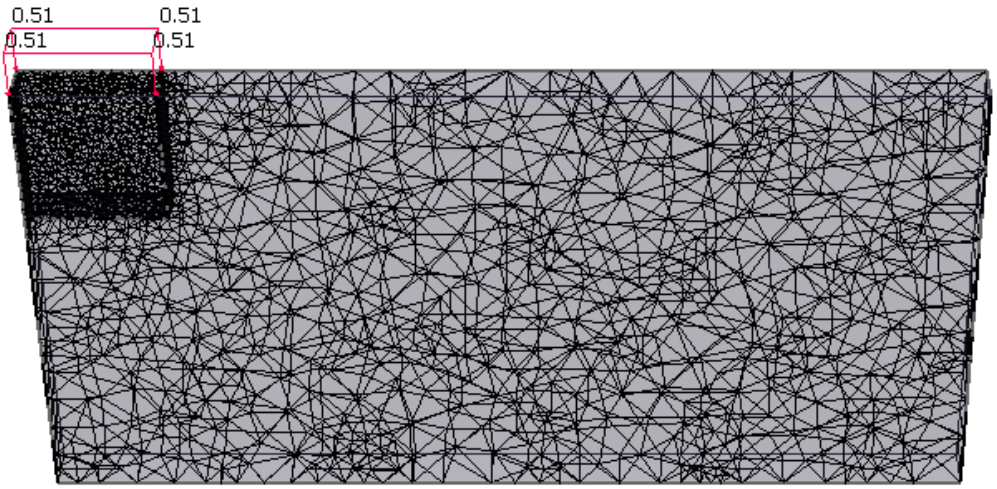

Figure 4-2: *RS3* model of strip load on frictionless soil at stage 15

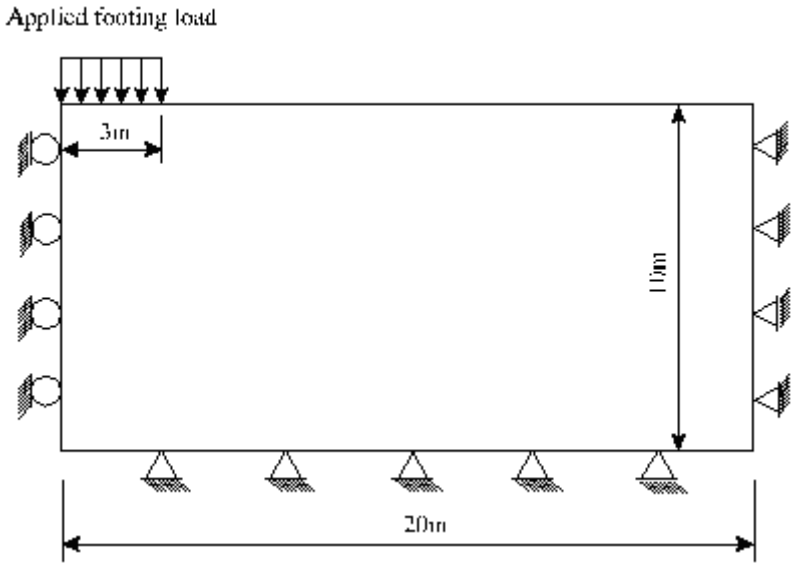

Figure 4-3: Model for *RS3* analysis

4.4 Results and Discussions

Figure 4-4 shows a history of bearing capacity versus applied footing load results from ***RS3*** were compared with ***Phase^2*** and the analytical solution. The pressure-displacement curve for ***RS3*** and ***Phase^2*** models accurately predicted the limit load of 514 kN.

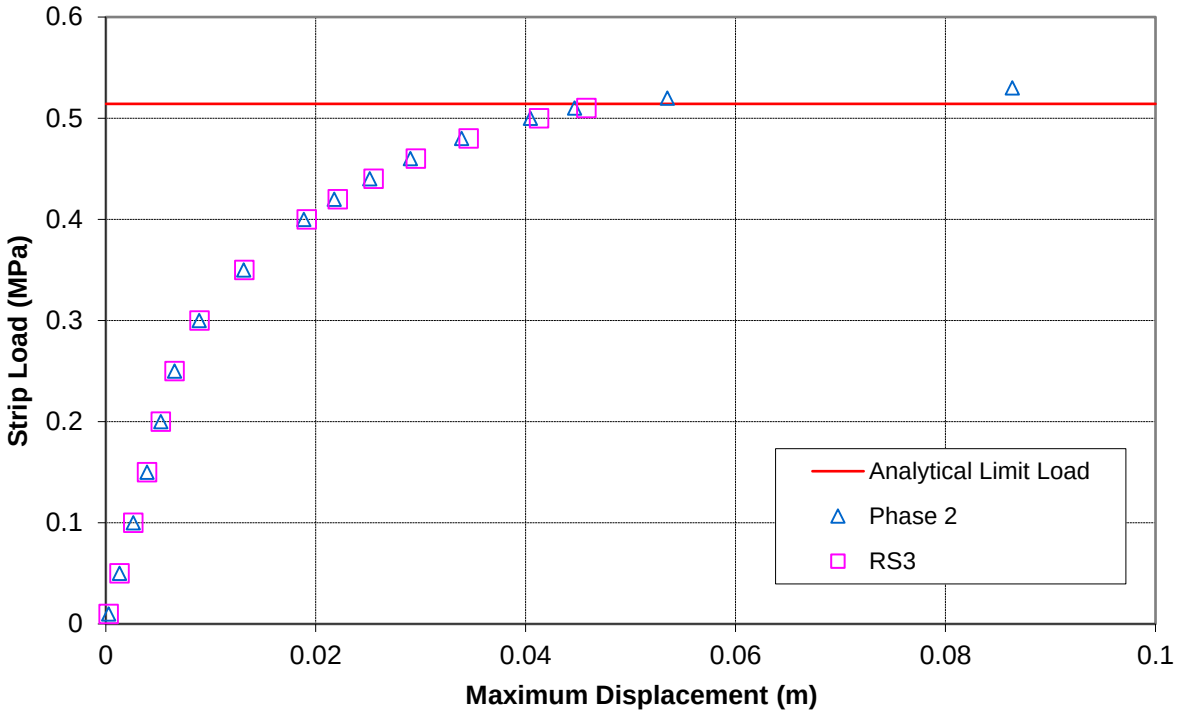

Figure 4-4: Pressure-displacement history of the bearing capacity

4.5 References

1. S. W. Sloan and M. F. Randolph (1982), Numerical Prediction of Collapse Loads Using Finite Element Methods, *Int. J. Num. & Anal. Methods in Geomech.*, Vol. 6, 47-76.
2. K. Terzaghi and R. B. Peck (1967), *Soil Mechanics in Engineering Practice*, 2nd Ed. New York, John Wiley and sons.

4.6 Data Files

The input data files **V004.rs3model** can be found in the ***RS3*** installation folder: