7 Circular Footing on an Associated Mohr-Coulomb Material

7.1 Problem Description

The bearing capacity of a circular footing on a Mohr-Coulomb medium is determined numerically in this section. The footing, represented by a circle of radius *a*, is located on an associated material with the following properties.

Young's modulus = 250 *MPa*
Poisson's ratio = 0.2
Cohesion (c) = 0.1 *MPa*
Friction angle (ϕ) = 20°
Dilation angle (ψ) = 20°

7.2 Semi-Analytical Solution

Cox et al. (1961) have solved numerically the slip-line equations for this axisymmetric-footing problem. The semi-analytical value of the average pressure over the footing at failure for a friction angle of 20° is found to be:

$$q = 20.1c$$

where q is the bearing capacity and c is the cohesion of the material.

7.3 Model Information

The model for this problem is built in ***RS3*** (Figure 7-1). A system of coordinate axes is selected with the x- and y-axes in the plane of the cylinder and the z-axis pointing downward along the cylinder axis. The slab is represented by a disk segment with radius *a*. The radius of the domain is 15 m and its height is 30 m. The parameters are:

- Graded mesh
- 10 noded-tetrahedron elements
- Excavation radius = 3 m
- 40 segments (discretizations) around the circular opening
- Fixed external boundary, located 15 m from the center

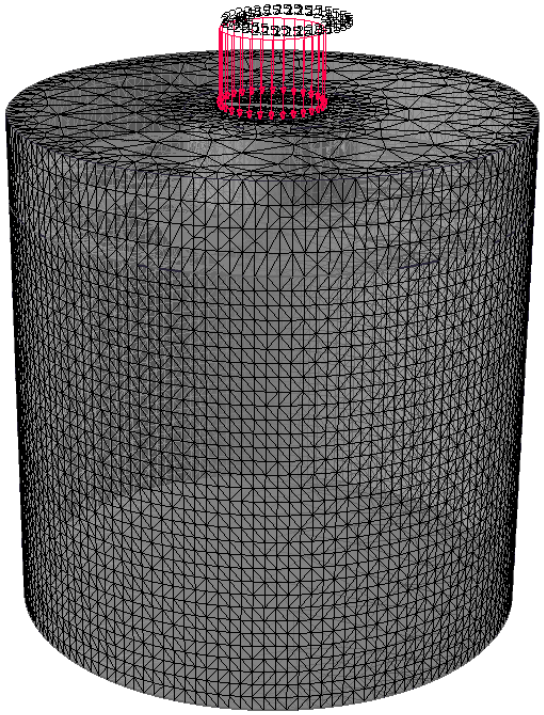

Figure 7-1: Model of circular footing on an associated Mohr-Coulomb material

The displacement of the circular boundary and that of the cylinder base is restricted in all directions. Downward loads are applied in successive stages to represent the footing in the positive z-direction. The magnitudes of the staged loads are summarized in Table 7-1.

Table 7-1: Loads at different stages

Stage Number	*Load [kPa]*
1	50
2	250
3	500
4	750
5	1000
6	1250
7	1500
8	1700
9	1800
10	1900
11	2000
12	2025
13	2050
14	2075
15	2100
16	2125
17	2150

7.4 Results and Discussions

The load-displacement curve produced by the ***RS3*** numerical simulation is presented in Figure 7-2. The analytical value of the bearing capacity, *q*, is 2010 kPa. ***RS3*** results begin to plateau at about 2025 kPa. The graph shows that ***RS3*** results are in close agreement with the analytical solution.

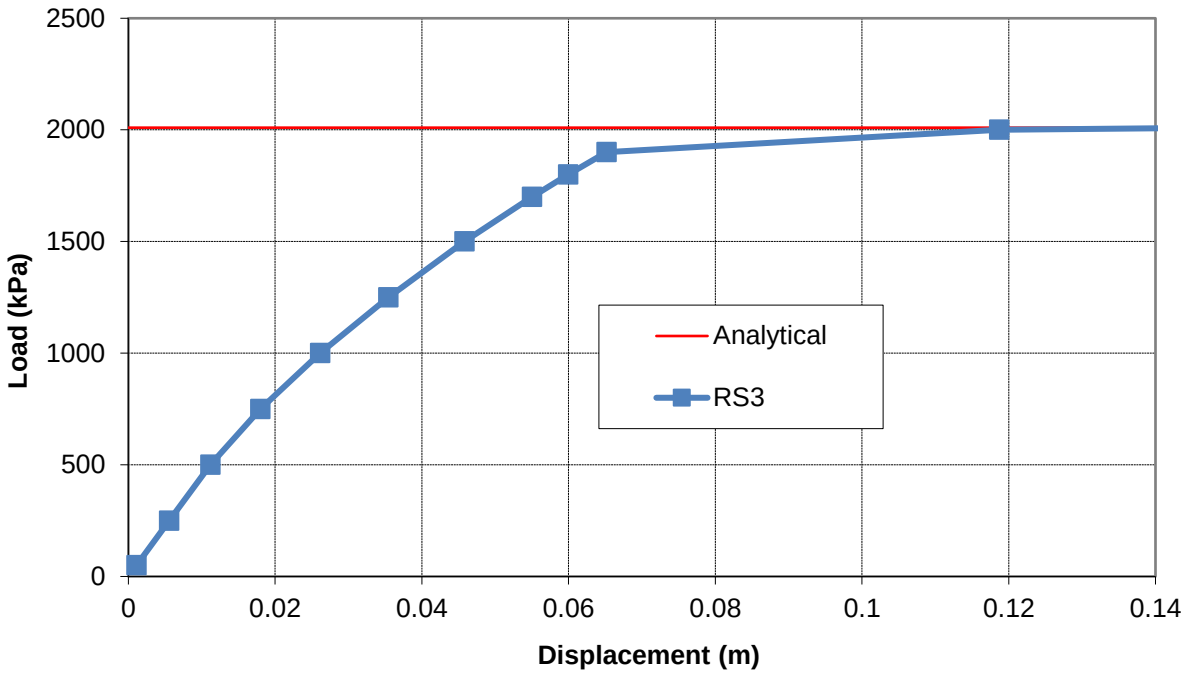

Figure 7-2: Load-displacement curve for a circular footing on a Mohr-Coulomb material

7.5 References

1. Cox, A. D., G. Eason and H. G. Hopkins. (1961) "Axially Symmetric Plastic Deformation in Soils," Phys. Trans. Royal Soc. London, Series A, 254(1036), 1-45.

7.6 Data Files

The input data file **V007.rs3model** can be found in the ***RS3*** installation folder.