MAP3D VERIFICATION EXAMPLE 4

Strip Loading on an Elastic Infinite Mass

Description

This example involves the analysis of a uniformly distributed strip loading on an elastic isotropic rockmass (Figure 1).

The strip footing has a width of 2b (b = 1m so a 2m width is considered).
The initial stress in the rockmass is also set to zero.

The model uses a Young's modulus of 20 GPa and a Poisson's ratio of 0.2.

The strip loading on the surface is 1 MPa/area.

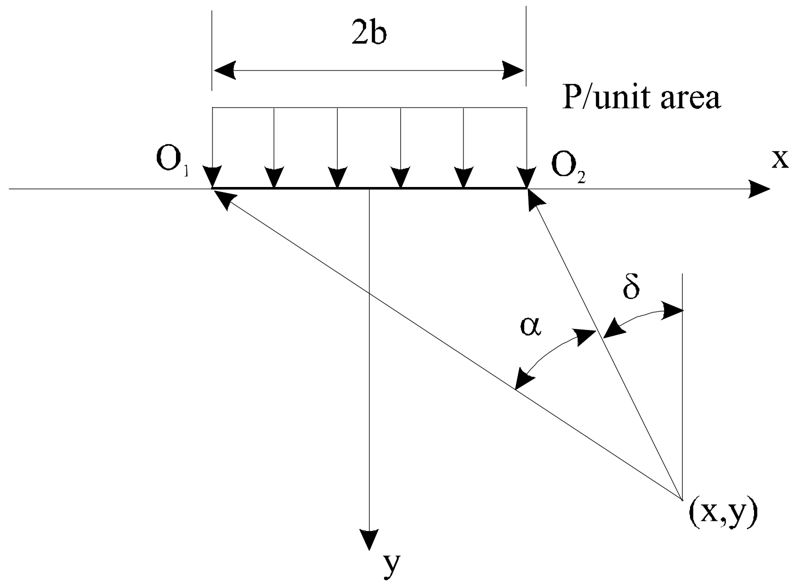

Figure 1 Vertical strip loading on an elastic rockmass

Analytical Solution

The closed-form solution for this problem can be found in the book "Elastic Solutions for Soil and Rock Mechanics" by H.G. Poulos and E.H. Davis (1974). The stress tensor at Cartesian coordinates (x,y) (Figure 1) under the surface is given by:

$$\sigma_x = \frac{P}{\pi}[\alpha - \sin\alpha\cos(\alpha + 2\delta)]$$

$$\sigma_y = \frac{P}{\pi}[\alpha + \sin\alpha\cos(\alpha + 2\delta)]$$

$$\tau_{xy} = \frac{P}{\pi}\sin\alpha\sin(\alpha + 2\delta)$$

and the principal stresses are:

$$\sigma_1 = \frac{P}{\pi}(\alpha + \sin\alpha)$$

$$\sigma_3 = \frac{P}{\pi}(\alpha - \sin\alpha)$$

$$\tau_{max} = \frac{P}{\pi}\sin\alpha$$

Results and Discussion

Figure 2 shows the calculated principal stresses σ_1 and σ_3 under the centre line of the strip loading compared to the analytical solutions. The small error in the stress comparisons are simply a by product of the number of elements specified in the model. A greater number of elements would produce a perfect match

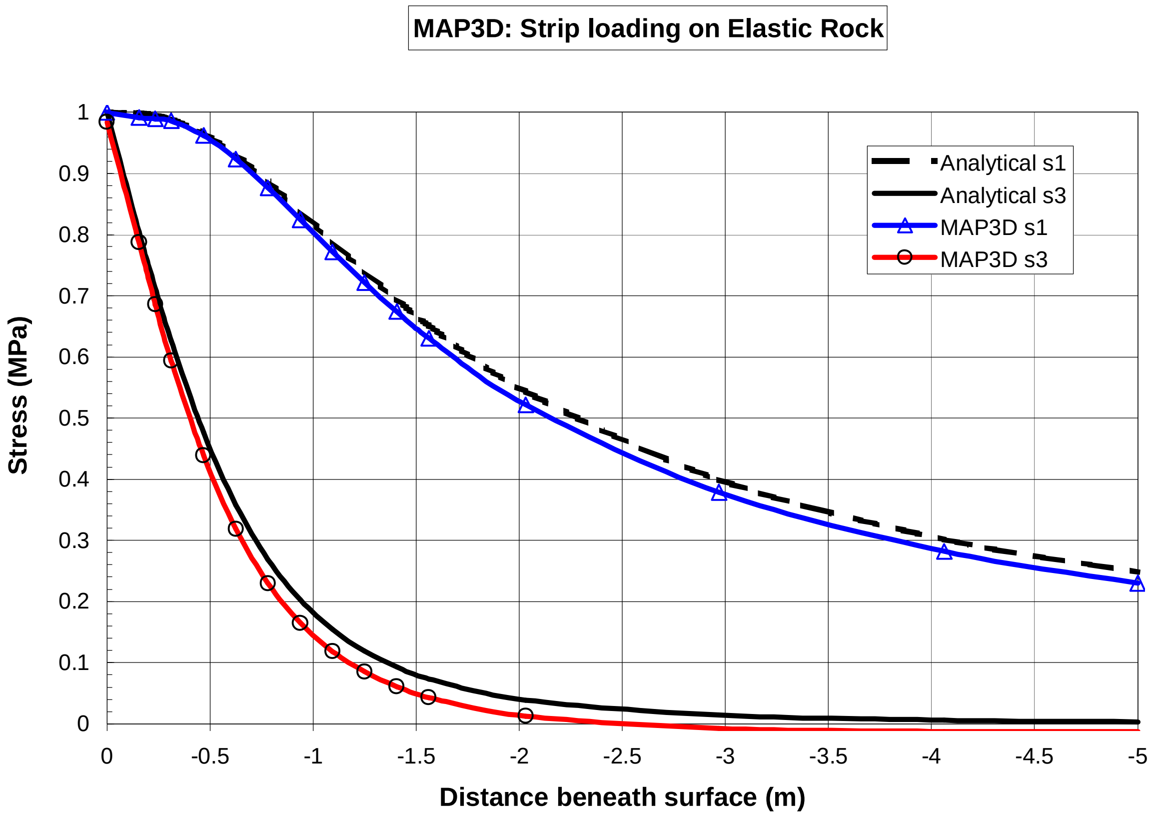

Figure 2. Principal stresses σ_1, σ_3 beneath the center line of a strip loading compared to the analytical solutions.

Reference

H.G. Poulos and E.H. Davis, (1974), Elastic Solutions for Soil and Rock Mechanics, John Wiley & Sons, Inc., New York. London.Toronto