

Verification - Example 2: Stress variation around underground sphere cavity (Hydrostatic stress field)

Problem Description

This verification example compares normalized radial and tangential and angular stresses with analytical solution. It assumes the sphere cavity exists in an infinite domain.

Model Information

- The sphere radius is $a = 1.0$ m.
- A constant 30MPa in all directions for field stress is assumed.
- Host rock material property:
 - $E = 2000$ MPa, $\nu = 0.3$

Analytical Solution

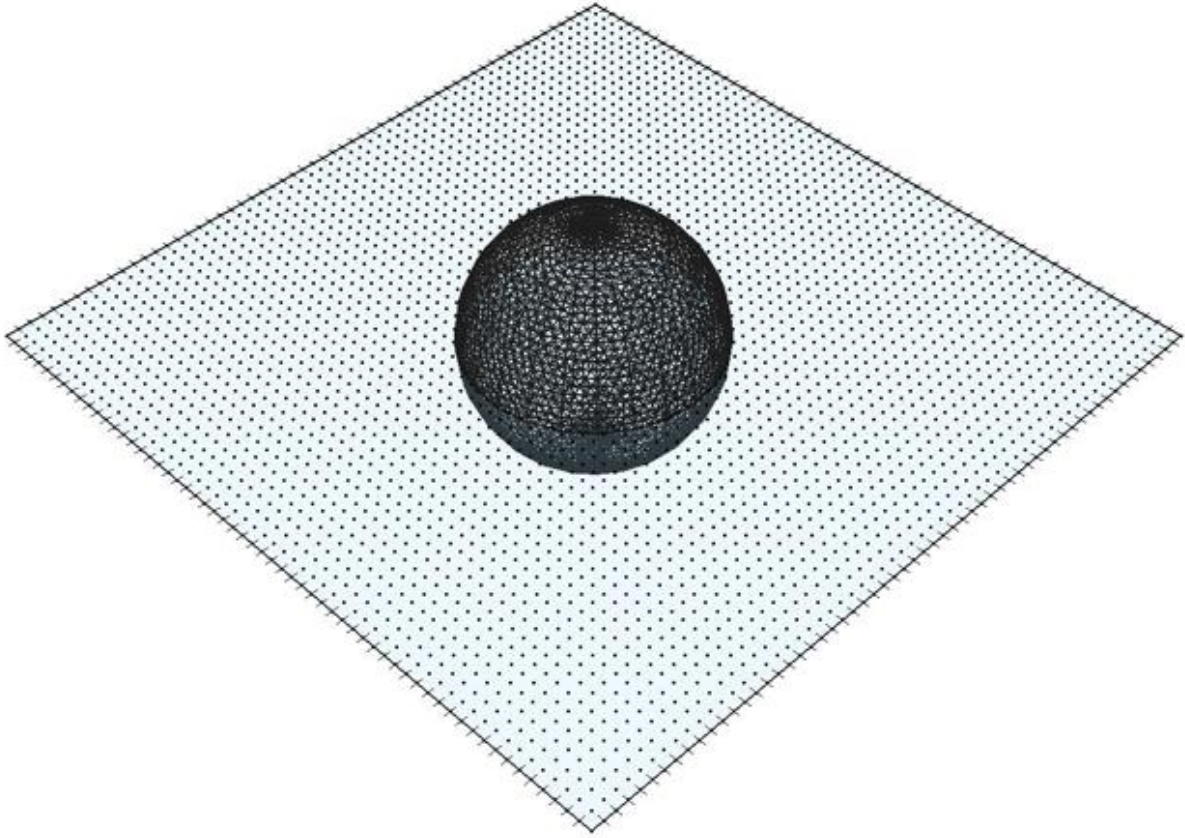
The external radial and tangential stress along any direction can be determined by:

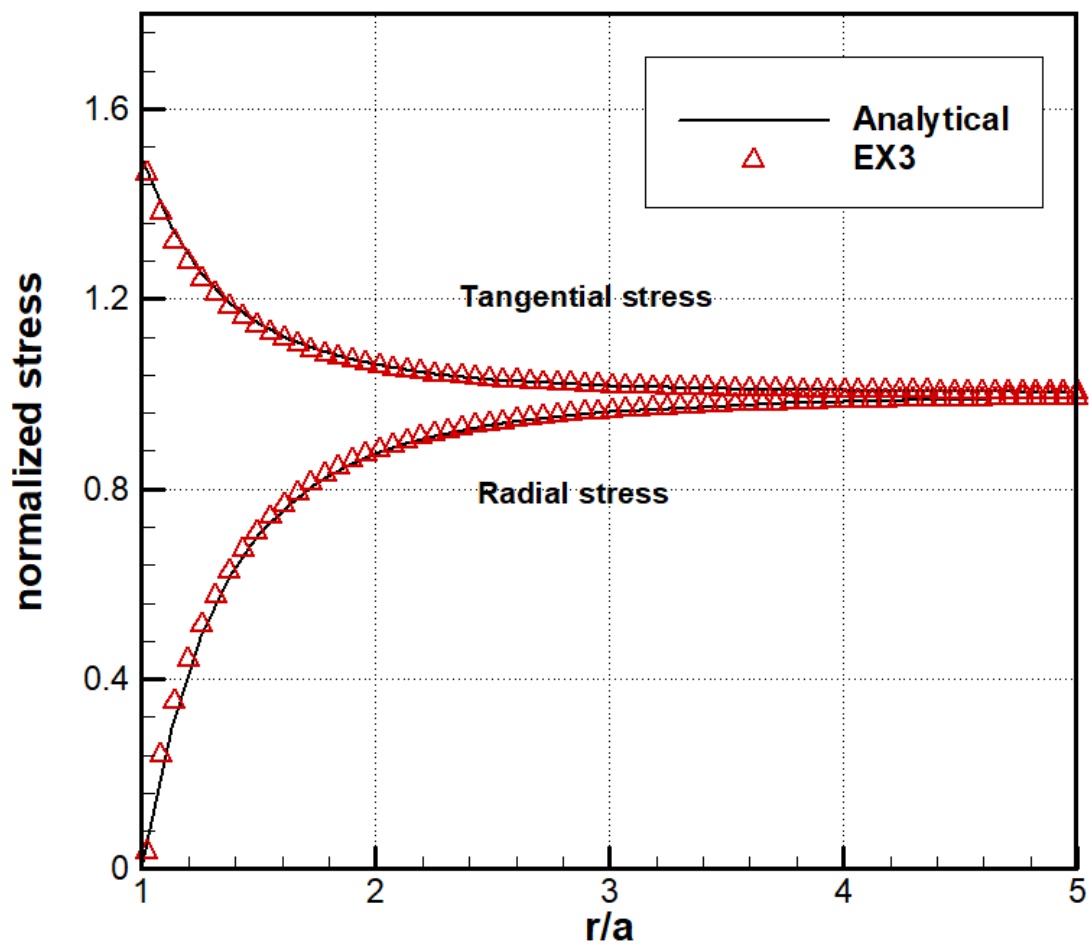
$$\sigma_{rr} = P[1 - \beta^3]$$
$$\sigma_{\theta\theta} = \sigma_{\phi\phi} = P \left[1 + \frac{1}{2}\beta^3 \right]$$

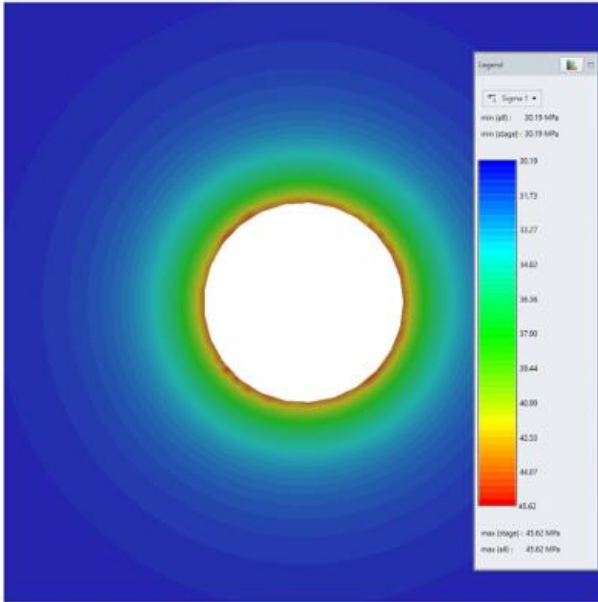
Here $\beta = \frac{a}{r}$

Results

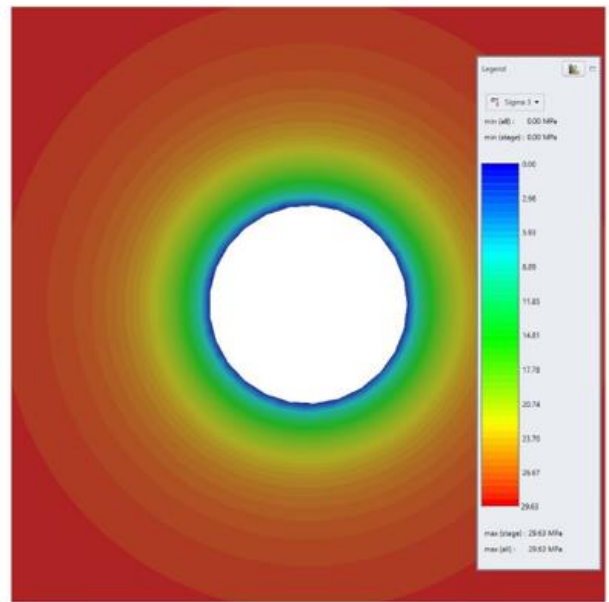
Results are calculated from the surface of tunnel to the distance of 5.0m ($a < r < 5.0\text{m}$):



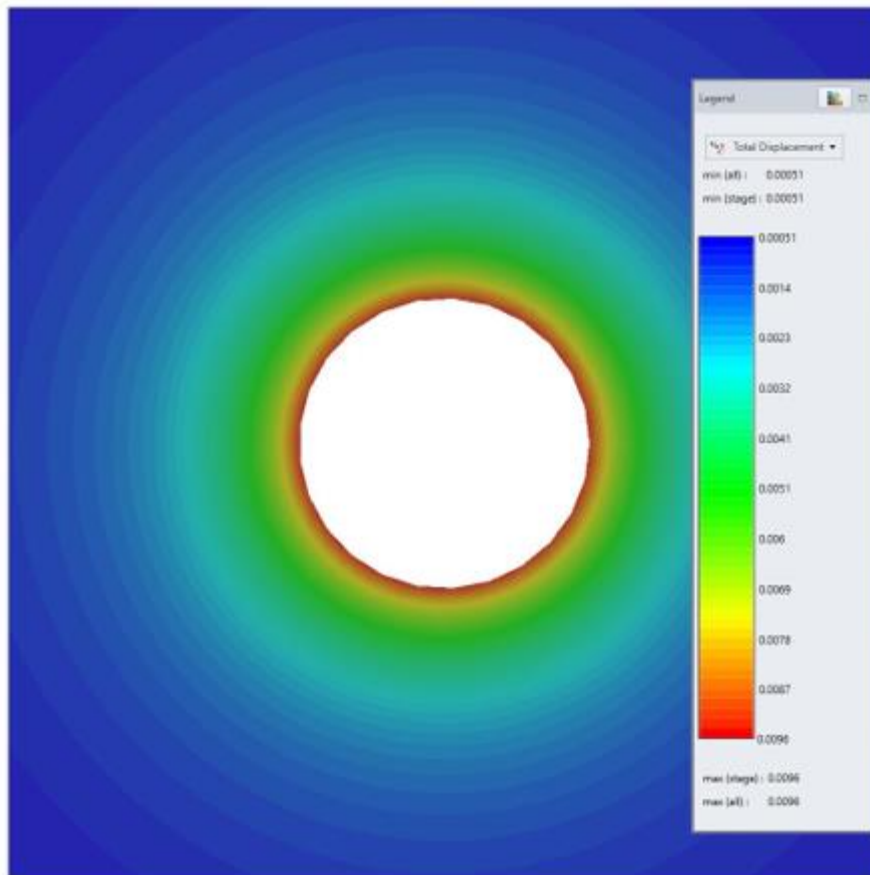




Tangential Stress



Radial Stress



Total Displacement

References

Timoshenko, S.P. and Goodier, J.N. (1970) theory of Elasticity, McGraw Hill, New York.

Data Files

The data input file(s) and file for the finished model can be found in the EX3 installation folder.