

LE7: Axisymmetric cylinder/sphere under pressure

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This problem provides evidence that Abaqus can reproduce the result from the benchmark defined by NAFEMS and cited as the reference solution.

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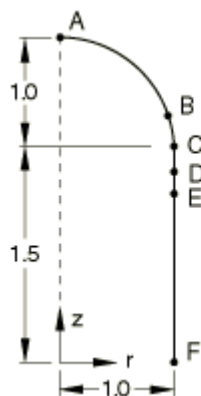
ProductsAbaqus/StandardAbaqus/Explicit

Elements tested

SAX1

SAX2

Problem description



Units: m, kN

Thickness = 0.025

Point	r	z
B	0.9814	1.6920
D	1.0	1.4034
E	1.0	1.1136

Model:

Thin-walled pressure vessel.

Mesh:

A coarse and a fine mesh are tested.

Material:

Linear elastic, Young's modulus = 210 GPa, Poisson's ratio = 0.3, density = 7800 kg/m³.

Boundary conditions:

$u_r = \phi = 0$ at point A. $u_z = 0$ at point F.

Loading:

Uniform internal pressure of 1.0 MPa. In the explicit dynamic analysis the loading is applied such that a quasi-static solution is obtained.

Reference solution

This is a test recommended by the National Agency for Finite Element Methods and Standards (U.K.): Test LE7 from NAFEMS Publication TNSB, Rev. 3, "The Standard NAFEMS Benchmarks," October 1990.

Target solution: Axial stress, $\sigma_{zz} = 25.9$ MPa on the outer surface at point D.

Results and discussion

The results are shown in the following table. The values enclosed in parentheses are percentage differences from the target solution.

Element	σ_{zz} , Coarse Mesh	σ_{zz} , Fine Mesh
SAX1 (Abaqus/Explicit)	25.6 MPa (−1%)	25.7 MPa (−0.5%)
SAX2 (Abaqus/Standard)	26.034 MPa (+0.67%)	25.878 MPa (+0.07%)

Input files

Coarse mesh tests:

[le7_c.inp](#)

SAX1 elements.

[nle7xa3c.inp](#)

SAX2 elements.

Fine mesh tests:

[le7_f.inp](#)

SAX1 elements.

[nle7xa3f.inp](#)

SAX2 elements.