LE11: Solid cylinder/taper/sphere —temperature loading

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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.

This page discusses:

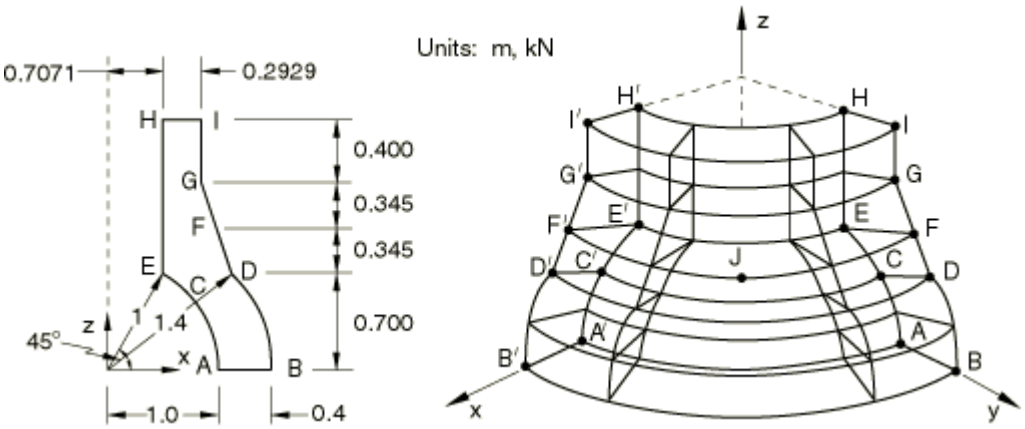
ProductsAbaqus/Standard

Elements tested

C3D20

C3D20R

Problem description



Mesh:

A coarse and a fine mesh are tested.

Material:

Linear elastic, Young's modulus = 210 GPa, Poisson's ratio = 0.3, coefficient of thermal expansion = 2.3E−4/°C.

Boundary conditions:

uy= 0 on the plane y= 0. ux= 0 on the plane x= 0. uz= 0 on the plane z= 0 and the face HIH′I′.

Loading:

Linear temperature gradient in the radial and axial directions is given by

Δθ=(x2+y2)+z.

This is applied using user subroutine UTEMP.

Reference solution

This is a test recommended by the National Agency for Finite Element Methods and Standards (U.K.): Test LE11 from NAFEMS Publication TNSB, Rev. 3, “The Standard NAFEMS Benchmarks,” October 1990.

Target solution: Direct stress, σzz = −105 MPa at point A.

Results and discussion

The results are shown in the following table. The values enclosed in parentheses are percentage differences with respect to the reference solution.

Element	σzz, Coarse Mesh	σzz, Fine Mesh
C3D20	−96.71 MPa (−7.9%)	−103.26 MPa (−1.7%)
C3D20R	−93.04 MPa (−11.4%)	−99.60 MPa (−5.1%)

Input files

Coarse mesh tests:

nle11fkc.inp

C3D20 elements.

nle11fkc.f

User subroutine used in nle11fkc.inp.

nle11rkc.inp

C3D20R elements.

nle11rkc.f

User subroutine used in nle11rkc.inp.

Fine mesh tests:

nle11fkf.inp

C3D20 elements.

nle11fkf.f

User subroutine used in nle11fkf.inp.

nle11rkf.inp

C3D20R elements.

nle11rkf.f

User subroutine used in nle11rkf.inp.