

PERF004 - Elastoplastic calculation of a hollow ring subjected to an internal pressure

Summary:

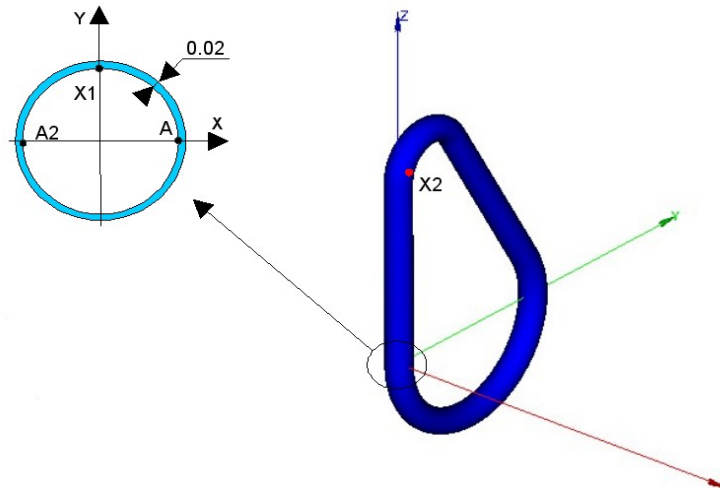
The objective of this CAS-test is to measure the performances of an elastoplastic calculation 3D.

Five modelings carried out are the following ones:

- Modeling a: grid HEXA8, $5.3 E4$ degrees of freedom, STAT_NON_LINE ('MULT_FRONT')
- Modeling b: grid HEXA8, $1.0 E5$ degrees of freedom, STAT_NON_LINE ('MULT_FRONT')
- Modeling C: grid HEXA8, $2.5 E5$ degrees of freedom, STAT_NON_LINE ('MULT_FRONT')
- Modeling D: grid HEXA8, $5.0 E5$ degrees of freedom, STAT_NON_LINE ('MULT_FRONT')
- Modeling E: grid HEXA8, $5.0 E5$ degrees of freedom, STAT_NON_LINE ('NEWTON_KRYLOV' + 'GCPC')

1 Problem of reference

1.1 Geometry



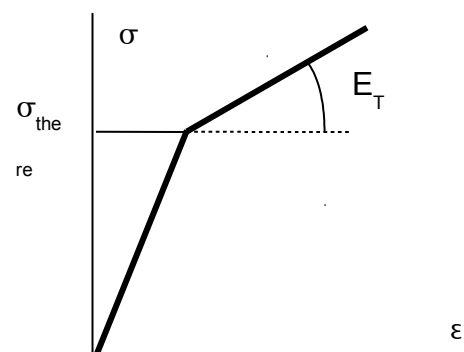
Coordinates of the points (m) :

$$\begin{aligned} A &: (1., 0., 0.) \\ A2 &: (-1., 0., 0.) \\ X1 &: (0., 1., 0.) \\ X2 &: (1., 0., 15.) \end{aligned}$$

Group of meshes: *PI* internal surface

1.2 Properties of material

- $E = 5.0 \text{ E11 Pa}$
- $\nu = 0.3$
- $\rho = 9800 \text{ kg.m}^{-3}$
- $\sigma_y = 1.0\text{E9 Pa}$
- $E_T = 1.0\text{E4 Pa}$



1.3 Boundary conditions and loadings

- Imposed displacements:
 - $A : DX = DY = DZ = 0.$
 - $A2 : DY = DZ = 0.$
 - $X1 : DZ = 0.$
- Internal pressure:
 - $P = 2.0\text{E6 Pa}$

2 Reference solution

2.1 Method of calculating

The result of reference (displacement DZ point $X2$) is obtained by making the average of displacements calculated for four modelings A , B , C and D .

2.2 Results of reference

Displacement at the point $X2$: $DZ = 5.5E-3 m$ at the moment $t = 9.5 s$, corresponding to a pressure interns $2.E6 Pa$.

2.3 Uncertainties

Digital solution

3 Modeling A

3.1 Characteristics of modeling A

Modeling 3D:

Many nodes	17920	
Many meshes	25888	That is to say:
		SEG2 1424
		QUAD4 11024
		HEXA8 13440

3.2 Results

Moment	Points	Size	Reference (<i>m</i>)	Tolerance (%)
9.5	<i>X2</i>	<i>DZ</i>	5.5E-3	0.02

4 Modeling B

4.1 Characteristics of modeling B

Modeling 3D:

Many nodes	33 200	That is to say:	SEG2	1 712
Many meshes	44 848		QUAD4	16 576
			HEXA8	26 560

4.2 Results

Moment	Points	Size	Reference (<i>m</i>)	Tolerance (%)
9.5	<i>X2</i>	<i>DZ</i>	5.5E-3	0.02

5 Modeling C

5.1 Characteristics of modeling C

Modeling 3D:

Many nodes	83 760	
Many meshes	112 928	That is to say:
		SEG2 3 320
		QUAD4 46 788
		HEXA8 62 820

5.2 Results

Moment	Points	Size	Reference (<i>m</i>)	Tolerance (%)
9.5	<i>X2</i>	<i>DZ</i>	5.5E-3	0.02

6 Modeling D

6.1 Characteristics of modeling D

Modeling 3D:

Many nodes	168 000	
Many meshes	225 248	That is to say:
		SEG2 6 128
		QUAD4 93 120
		HEXA8 126 000

6.2 Results

Moment	Points	Size	Reference (<i>m</i>)	Tolerance (%)
9.5	<i>X2</i>	<i>DZ</i>	5.5E-3	0.02

7 Modeling E

7.1 Characteristics of modeling E

Modeling 3D:

Many nodes	168 000	
Many meshes	225 248	That is to say:
		SEG2 6 128
		QUAD4 93 120
		HEXA8 126 000

7.2 Results

Moment	Points	Size	Reference (<i>m</i>)	Tolerance (%)
9.5	<i>X2</i>	<i>DZ</i>	5.5E-3	0.02