PERF001 - Elastic design of a hollow ring subjected to an internal pressure

Summary:

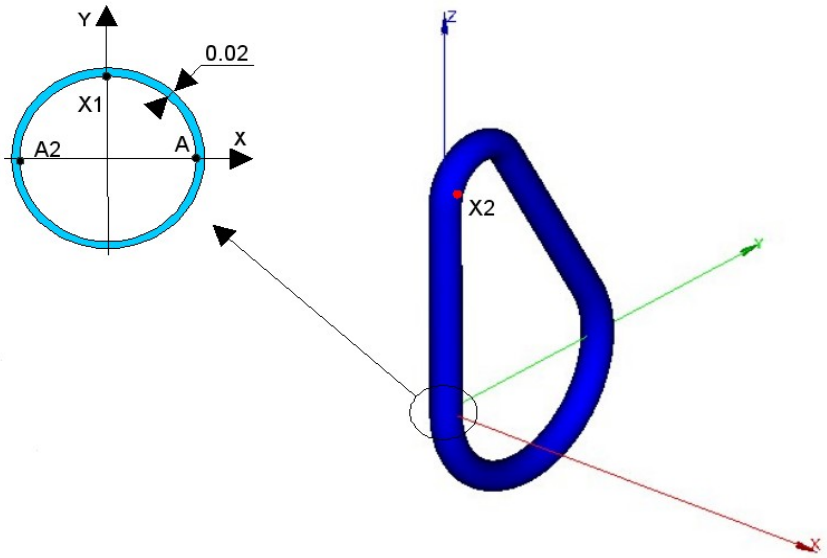
The objective of this CAS-test is to measure the performances of an elastic design 3D.

Five modelings carried out are the following ones:

- Modeling a: grid HEXA8, $5.0\,E5$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling b: grid HEXA20, $5.2\,E5$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling C: grid HEXA8, $1.0\,E6$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling D: grid HEXA8, $2.0\,E6$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling E: grid HEXA8, $5.0\,E5$ degrees of freedom, MECA_STATIQUE ('MUMPS')

1 Problem of reference

1.1 Geometry



Coordinates of the points (m) :

$A:(1.,0.,0.)$
$A2:(-1.,0.,0.)$
$X1:(0.,1.,0.)$
$X2:(1.,0.,15.)$

Group of meshs: $P1$ internal surface

1.2 Properties of material

- $E=5.0\ E11\ \ Pa$
- $\nu=0.3$
- $\rho=9800\ \ kg.m^{-3}$

1.3 Boundary conditions and loadings

- Imposed displacements:
  - $A \quad : \quad DX=DY=DZ=0.$
  - $A2 \quad : \quad DY=DZ=0.$
  - $X1 \quad : \quad DZ=0.$
- Internal pressure:
  - $p=2.0\,E6\ Pa$

2 Reference solution

2.1 Method of calculating

The result of reference (displacement following the axis Z point $X2$) was obtained by making the average of the displacements calculated at the time of modelings A , B and C .

2.2 Results of reference

Displacement at the point $X2$: $DZ=5.87\mathrm{E}-4\,m$

2.3 Uncertainties

Digital solution.

3 Modeling A

3.1 Characteristics of modeling A

Modeling 3D:

Many nodes	168 000			
Many meshs	225 248	That is to say:		
			SEG2	6 128
			QUAD4	93 120
			HEXA8	126000

3.2 Results

Points	Size	Reference (m)	Tolerance (%)
$X2$	DZ	$5.870\mathrm{E}-4$	3.000E-3

4 Modeling B

4.1 Characteristics of modeling B

Modeling 3D:

Many nodes	172 800			
Many meshs	62 408	That is to say:		
			SEG3	2 352
			QUAD8	26 496
			HEXA20	34 560

4.2 Results

Points	Size	Reference (m)	Tolerance (%)
$X2$	DZ	$5.870\mathrm{E}-4$	3.000E-3

5 Modeling C

5.1 Characteristics of modeling C

Modeling 3D:

Many nodes	336 000			
Many meshs	405 472	That is to say:		
			SEG2	6 192
			QUAD4	105 280
			HEXA8	294 000

5.2 Results

Points	Size	Reference (m)	Tolerance (%)
$X2$	DZ	$5.870\mathrm{E}-4$	3.000E-3

6 Modeling D

6.1 Characteristics of modeling D

Modeling 3D:

Many nodes	672000			
Many meshs	785 632	That is to say:		
			SEG2	6 672
			QUAD4	190 960
			HEXA8	588 000

6.2 Results

Points	Size	Reference (m)	Tolerance (%)
$X2$	DZ	$5.870\mathrm{E}-4$	3.000E-3

7 Modeling E

7.1 Characteristics of modeling E

Modeling 3D:

Many nodes	168 000			
Many meshs	225248	That is to say:		
			SEG2	6128
			QUAD4	93120
			HEXA8	126000

7.2 Results

Points	Size	Reference (m)	Tolerance (%)
$X2$	DZ	$5.870\mathrm{E}-4$	3.000E-3

8 Summary of the results

Machine	Aster	MOD.	Nb DDL	Memory (Mo)		Time execution (MECA_STATIQUE) (dryness)			
				Allocated	Used	USERS	SYSTEM	USERS+SYS	ELAPSED
Linux 64 bits (ia64) “Bull”	10.1	With	504,012	763	758	138.22	18.73	156.37	157.49
		B	518,412	1,348	1,221	406.03	50.93	456.96	462.52
		C	1 008,012	1,690	1,263	707.14	97.74	804.88	807.53
		D	2 016,012	3,961	2,486	2256.55	225.42	2481.97	2633.52
		E	504,012	624	570	132.98	35.57	168.55	169.16