

PERF002 - Thermoelastic calculation of a hollow ring subjected to a thermal loading

Summary:

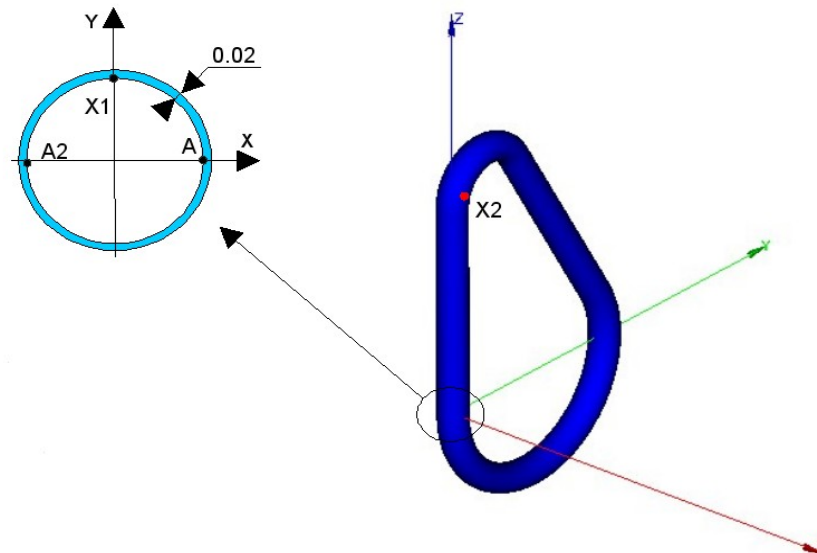
The objective of this CAS-test is to measure the performances of a thermoelastic calculation 3D with several steps of time.

Three modelings carried out are the following ones:

- Modeling a: grid HEXA8, $2.5 E5$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling b: grid HEXA8, $5.0 E5$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling C: grid HEXA8, $1.0 E6$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')

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 meshes: $P1$ internal surface

1.2 Properties of material

- $E = 5.0 \text{ E11 Pa}$
- $\nu = 0.3$
- $\rho = 9800 \text{ kg.m}^{-3}$
- $\alpha = 2.0 \text{ E-5 } ^\circ\text{C}^{-1}$

1.3 Boundary conditions and loadings

- Imposed displacements:
 - A : $DX = DY = DZ = 0.$
 - $A2$: $DY = DZ = 0.$
 - $X1$: $DZ = 0.$

- Thermal loading:

The thermal loading transient evolves according to the axis Z , on the interval $[0. 10.]$ in the following way:

- $t = 0.s$: the temperature is constant with 20°C for $Z = -20m$ with $Z = 30m$
- $t = 10.s$: the temperature varies 20°C for $Z = -20m$ with 220°C for $Z = 30m$

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 as of modelings A and B at the moment $t=9.s$.

2.2 Results of reference

Displacement at the point $X2$: $DZ=3.57 E-2 m$ with $t=9.s$.

2.3 Uncertainties

Digital solution.

3 Modeling A

3.1 Characteristics of modeling A

Modeling 3D:

Many nodes	83 760	
Many meshes	112 928	That is to say:
		SEG2 3 320
		QUAD4 46 788
		HEXA8 62820

3.2 Results

Points	Size	Reference (<i>m</i>)	Tolerance (%)
<i>X2</i>	<i>DZ</i>	3.57 E-2	1.000E-5

4 Modeling B

4.1 Characteristics of modeling B

Modeling 3D:

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

4.2 Results

Points	Size	Reference (<i>m</i>)	Tolerance (%)
<i>X2</i>	<i>DZ</i>	$3.57 E-2$	1.000E-5

5 Modeling C

5.1 Characteristics of modeling C

Modeling 3D:

Many nodes	336 000	
Many meshes	405 472	That is to say:

SEG2	6 192
QUAD4	105 280
HEXA8	294 000

5.2 Results

Points	Size	Reference (<i>m</i>)	Tolerance (%)
<i>X2</i>	<i>DZ</i>	$3.57 E-2$	1.000E-5

6 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	251,292	387	292	207.05	53.72	260.77	263.36
		B	504,012	807	578	413.38	72.54	485.92	489.48
		C	1,008,012	1796	1263	1284.55	235.61	1520.16	1525.72