

PERF008 – Elastic design of a full elastic twin wheel subjected to a thermal loading

Summary:

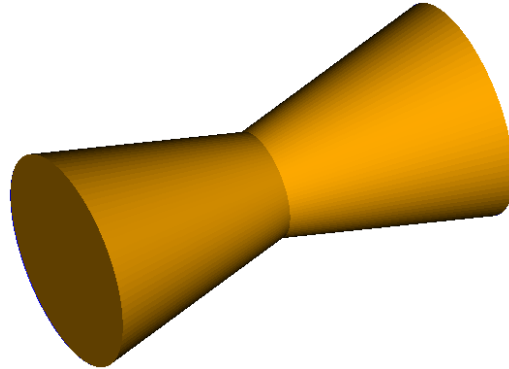
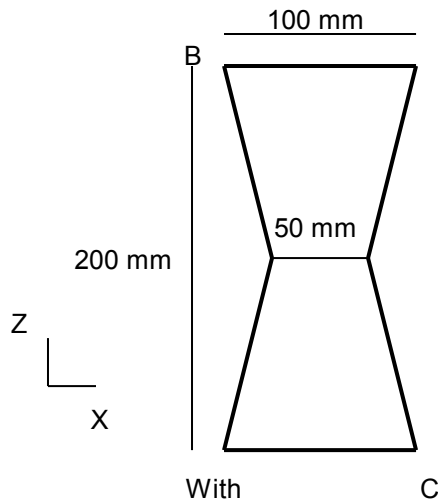
The objective of this CAS-test is to measure the performances of an elastic design of a massive structure 3D subjected to a sinusoidal thermal loading.

Four modelings carried out are the following ones:

- 1) Modeling a: grid HEXA8, $4.9 \cdot 10^5$ degrees of freedom
- 2) Modeling b: grid HEXA20, $4.9 \cdot 10^5$ degrees of freedom
- 3) Modeling C: grid HEXA8, $1.0 \cdot 10^6$ degrees of freedom
- 4) Modeling D: grid HEXA8, $1.9 \cdot 10^6$ degrees of freedom

1 Problem of reference

1.1 Geometry



1.2 Properties of material

- $E = 5.10^{11} Pa$
- $\nu = 0.3$
- $\rho = 9800. kg/m^3$

1.3 Boundary conditions and loadings

Imposed displacements:

A	:	$DX = DY = DZ = 0.$
B	:	$DX = DY = 0.$
C	:	$DY = 0.$

Imposed thermal field:

$$T = \cos(z/\pi)$$

2 Reference solution

2.1 Method of calculating

The result of reference (displacement maximum following the axis X and Y) was obtained by making the average of the displacements calculated during several calculations.

2.2 Uncertainties

Digital solution

3 Modeling A

3.1 Characteristics of modeling A

Modeling 3D:

Many nodes	166,397	That is to say:	SEG2	1,376
Many meshes	187,680		QUAD4	25,792
			HEXA8	160,512

3.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	DDL IMPO
AFFE MATERIAU	AFFE_VARC NOM_VARC
MECA_STATIQUE	
SOLVEUR	MULT_FRONT

3.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MAX DX	5.2E-5	5.19E-5	-0,186
DEPL MAX DY	2.6E-5	2.595E-5	-0,186

3.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		USERS	SYSTE M	USERS +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	9.4.1	3500	3496.6	499,203	1481.5	103.93	1585.4	1587.6

4 Modeling B

4.1 Characteristics of modeling B

Modeling 3D:

Many nodes	165,021	That is to say:	SEG3	836
Many meshes	50,348		QUAD8	9,768
			HEXA20	39,744

4.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	DDL IMPO
AFFE MATERIAU	AFFE_VARC NOM_VARC
MECA STATIQUE	
SOLVEUR	MULT_FRONT

4.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MAX DX	6.5E-5	6.44E-5	-0,009
DEPL MAX DY	3.25E-5	3.249E-5	-0,009

4.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocated	Used		USERS	SYSTEM	USERS +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	9.4.1	6500	6440.9	495,075	2912.9	129.17	3042.08	3357.3

5 Modeling C

5.1 Characteristics of modeling C

Modeling 3D:

Many nodes	333,805	That is to say:	SEG2	1,736
Many meshes	367,480		QUAD4	40,944
			HEXA8	324,800

5.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	DDL_IMPO
AFFE MATERIAU	AFFE_VARC NOM_VARC
MECA STATIQUE	
SOLVEUR	MULT_FRONT

5.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MAX DX	5.8E-5	5.813E-5	-0,229
DEPL MAX DY	2.9E-5	2.906E-5	-0,229

5.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		USERS	SYSTE M	USER S +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	9.4.1	8500	8346.8	1,001,427	5891.1	229.11	6120.2 6	6166.6

6 Modeling D

6.1 Characteristics of modeling D

Modeling 3D:

Many nodes	664,323	That is to say:	SEG2	2,176
Many meshs	716,976		QUAD4	64,784
			HEXA8	650,016

6.2 Features tested

Order	Option
AFFE MODELE	MODELING 3D
AFFE CHAR MECA	DDL IMPO
AFFE MATERIAU	AFFE_VARC NOM_VARC
MECA STATIQUE	
SOLVEUR	GCPC

6.3 Results

Size	Reference	Code_Aster	Relative error (%)
DEPL MAX DX	6.1E-5	6.1011E-5	0.18
DEPL MAX DY	3.05E-5	3.0505E-5	0.18

6.4 Environment of execution

Machine	Version	Memory (Mo)		Number DDL	Time execution (MECA_STATIQUE) (dryness)			
		Allocat ed	Used		USERS	SYSTE M	USERS +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	9.4.1	3000	2998.6	1,992,981	3492.4	34.98	3527.37	3531.9

7 Summary of the results

Machine	Aster	MO D.	Nb DDL	Memory (Mo)		Time execution (MECA_STATIQUE) (dryness)			
				Allocat ed	Used	USERS	SYSTEM	USERS +SYS	ELAPSED
Linux 64 bits (ia64) "Bull"	9.4.1	With	499,203	3500	3496.6	1481.5	103.93	1585.4	1587.67
		B	495,075	6500	6440.9	2912.9	129.17	3042.08	3357.33
		C	1,001,427	8500	8346.8	5891.1	229.11	6120.26	6166.59
		D	1,992,981	3000	2998.6	3492.4	34.98	3527.37	3531.93