

HSLV304 - Cylinder under thermal loading

Summary:

The goal of the test is to validate a decomposable thermal loading in 2 harmonics, applied to an axisymmetric structure (cylinder in fact).

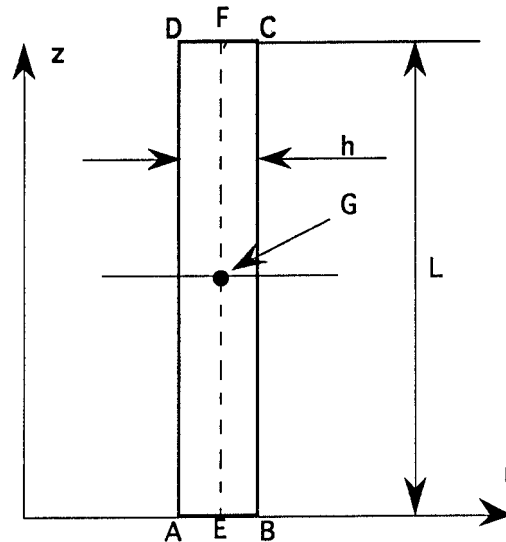
The harmonies considered are harmonies 1 and 2.

The comparison is carried out compared to a model hull, with a software finite elements.

In modeling B , a field of deformations is imposed ε_0 defined by `AFFE_CHAR_MECA`, corresponding to the field of deformations resulting from the model A . The goal is to compare the results compared to those obtained for the model A .

1 Problem of reference

1.1 Geometry



Length	: $L=4\text{ m}$	Position of the points E, F, G
Thickness	: $H=0,1\text{ m}$	• E, F, G remotely R_0 axis
Average radius	: $R_0=1\text{ m}$	• G with middle height

1.2 Material properties

$$E=2.1 \times 10^{11} \text{ Pa}$$
$$\nu=0.3$$
$$\alpha=0.12 \times 10^{-4} / ^\circ \text{C}$$

1.3 Boundary conditions and loadings

- Sections AB and CD embedded
- Field of temperature $T=\cos \theta + \sin 2 \theta$

1.4 Initial conditions

Without object for the static analysis.

2 Reference solution

2.1 Method of calculating used for the reference solution

Comparison of the results compared to the software finite elements CASTOR-SD of CETIM.

The element of BEAVER used is an isoparametric element of hull with 8 nodes, based on the formulation of Ahmad. It is about a degenerated three-dimensional element, whose scope of application is that of the thick hulls.

2.2 Results of reference

- Displacement and constraints at the points E, F, G for each harmonic.
- Displacement and constraints at the points E, F, G for the total loading.

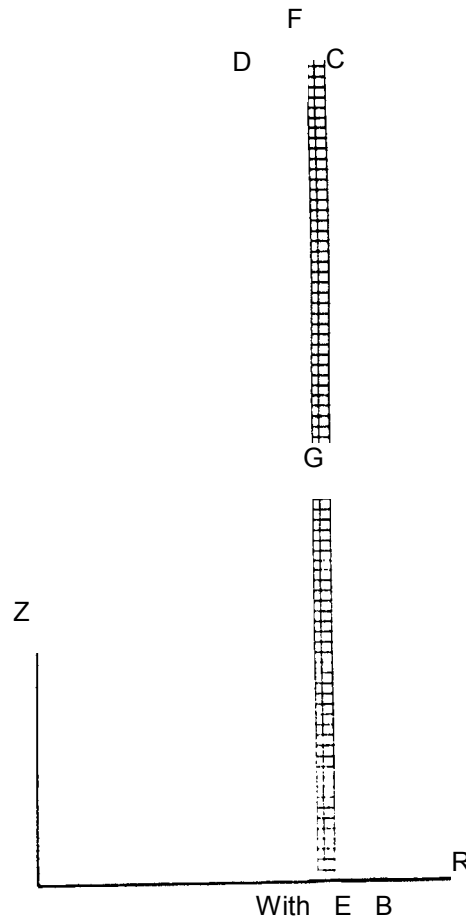
2.3 Uncertainty on the solution

Comparison of software.

3 Modeling A

3.1 Characteristics of modeling

Modeling AXIS_FOURIER, meshes QUAD8



Loading

Uniform field of temperatures $T_0=1$.

Cutting: 80 elements according to the length
2 elements according to the ray

Name of the nodes:

$A=N1$ $B=N2$ $C=N3$ $D=N4$ $E=N9$ $F=N171$ $G=N71$

3.2 Characteristics of the grid

Many nodes: 645

Many meshes and types: 160 QUAD8

3.3 Sizes tested and results

	Localization	Type of value	Type of Reference	Values of reference	% Tolerance
Load in $\cos \theta$	Not G	$u_r(m)$	EXTERNAL SOURCE	0.96×10^{-5}	0.10
		$u_\theta(m)$		0.15×10^{-5}	0.10
Load in $\sin 2\theta$	Not G	$u_r(m)$	EXTERNAL SOURCE	0.544426×10^{-5}	0.10
Total load	Not G	$u_r(m)$	EXTERNAL SOURCE	1.50748×10^{-5}	0.10
		$u_\theta(m)$		1.52412×10^{-5}	0.10

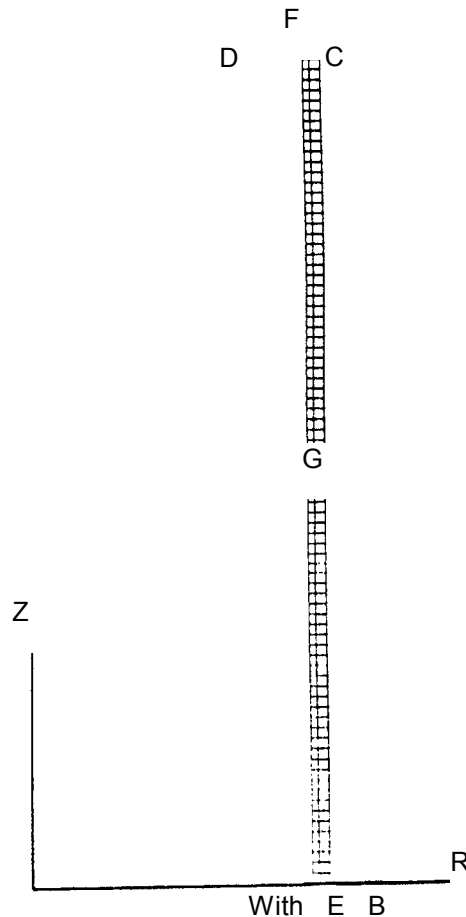
3.4 Notice

Model finite elements of reference: 640 elements of hull with 8 nodes (10 elements according to the length – 64 elements according to the circumference.

4 Modeling B

4.1 Characteristics of modeling

Modeling AXIS_FOURIER, meshes QUAD8



Loading

Field of pre deformations $\epsilon_0 \text{ constant} = \alpha T_0$, $T_0 = 1$.

($\epsilon_{rr} = \epsilon_{zz} = \epsilon_{\theta\theta} = 0.12 \times 10^{-4}$)

Cutting: 80 elements according to the length
2 elements according to the ray

Name of the nodes:

$A = N1$ $B = N2$ $C = N3$ $D = N4$ $E = N9$ $F = N171$ $G = N371$

4.2 Characteristics of the grid

Many nodes: 645

Many meshes and types: 160 QUAD8

4.3 Sizes tested and results

	Localization	Type of value	Type of Reference	Values of reference	% Tolerance
Load in $\cos \theta$	Not G	$u_r(m)$	EXTERNAL SOURCE	0.96×10^{-5}	0.10
		$u_\theta(m)$		0.15×10^{-5}	0.10
Load in $\sin 2\theta$	Not G	$u_r(m)$	EXTERNAL SOURCE	0.544426×10^{-5}	0.10
Total load	Not G	$u_r(m)$	EXTERNAL SOURCE	1.50748×10^{-5}	0.10
		$u_\theta(m)$		1.52412×10^{-5}	0.10

5 Summary of the results

Results got for modeling B in which one imposes like predeformations Lbe deformations resulting from modeling A , are identical to those of modeling A .