HSLV304 - Roll under thermal loading

Abstract:

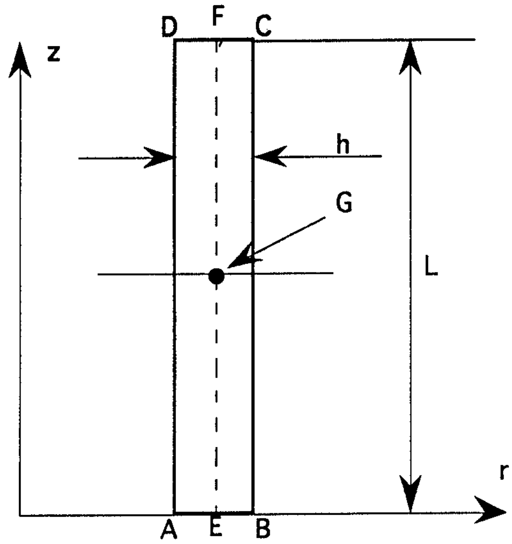
The goal of the test is to validate a decomposable thermal loading in 2 harmonics, applied to an axisymmetric structure (cylinder in fact).

The harmonies considered are harmonies 1 and 2.
The comparison is carried out compared to a model shell, with a software finite elements.

In the modelization B , one imposes a strain field ε_0 defined by AFFE_CHAR_MECA, corresponding to the strain field 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	:	$L=4m$	Position of the points E, F, G
Thickness	:	$H=0,1m$	• E, F, G remotely R_0 of the axis
Average radius	:	$R_0=1m$	• G with middle height

1.2 Material properties

$E=2.1\times10^{11} Pa$
$\nu=0.3$
$\alpha=0.12\times10^{-4}/°C$

1.3 Boundary conditions and loadings

- Sections AB and CD clamped
- Field of temperature $T=\cos\theta+\sin2\theta$

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 shell element 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 shells.

2.2 Results of reference

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

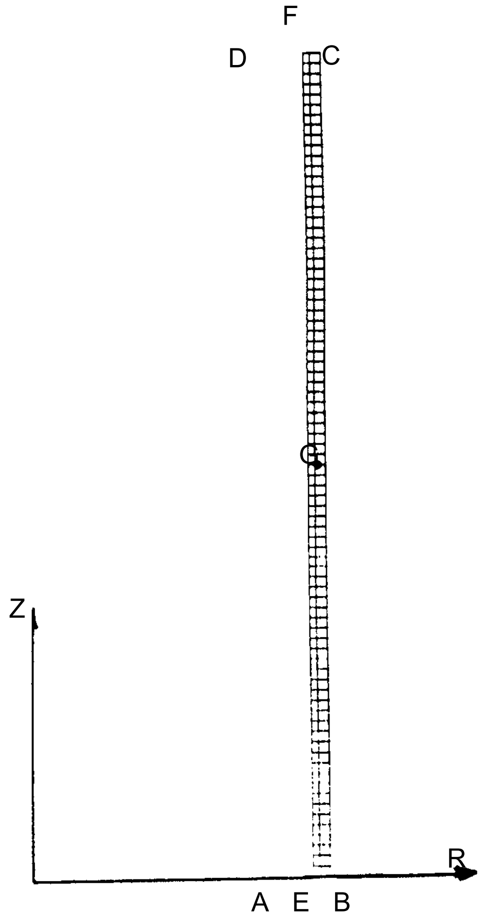
2.3 Uncertainty on the solution

Comparison of software.

3 Modelization A

3.1 Characteristic of the modelization

Modelization AXIS_FOURIER, meshes QUAD8



uniform

Loading Field of temperatures $T_0=1$.

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

Name of the nodes:

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

3.2 Characteristics of the mesh

Many nodes: 645
Number of meshes and types: 160 QUAD8

3.3 Quantities tested and Standard

	Localization	results of Standard	value of Reference	Values of reference	% Tolerance
Charge in $\cos\theta$	Point G	$u_r(m)$	SOURCE EXTERNE	0.96 X 10-5	0.10
		$u_\theta(m)$		0.15 X 10-5	0.10
Load in $\sin 2\theta$	Point G	$u_r(m)$	SOURCE EXTERNE	0.544426 X 10-5	0.10
Load total	Point G	$u_r(m)$	SOURCE EXTERNE	1.50748 10-5	0.10
		$u_\theta(m)$		1.52412 10-5	0.10

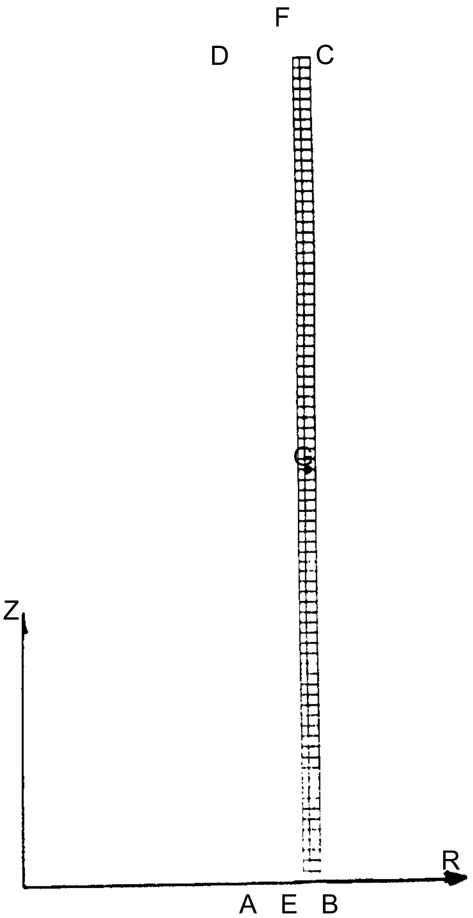
3.4 Remark

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

4 Modelization B

4.1 Characteristic of the modelization

Modelization `AXIS_FOURIER`, meshes `QUAD8`



Loading

Field of pre strains $\varepsilon_0 constant=\alpha T_0 \quad T_0=1$.
($\varepsilon_{rr}=\varepsilon_{zz}=\varepsilon_{\theta\theta}=0.12\times10^{-4}$)

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

Name of the nodes:

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

4.2 Characteristics of the mesh

Many nodes: 645
Number of meshes and types: 160 `QUAD8`

4.3 Quantities tested and Standard

	Localization	results of Standard	value of Reference	Values of reference	% Tolerance
Charge in $\cos\theta$	Point G	$u_r(m)$	SOURCE EXTERNE	0.96 X 10-5	0.10
		$u_\theta(m)$		0.15 X 10-5	0.10
Load in $\sin 2\theta$	Point G	$u_r(m)$	SOURCE EXTERNE	0.544426 X 10-5	0.10
Load total	Point G	$u_r(m)$	SOURCE EXTERNE	1.50748 10-5	0.10
		$u_\theta(m)$		1.52412 10-5	0.10

5 Summary of the results

the results got for the modelization B in which one imposes like predeformations the strains resulting from the modelization A , are identical to those of the modelization A .