HSLL100 – Bi--embedded multifibre beam subjected to a field of temperature

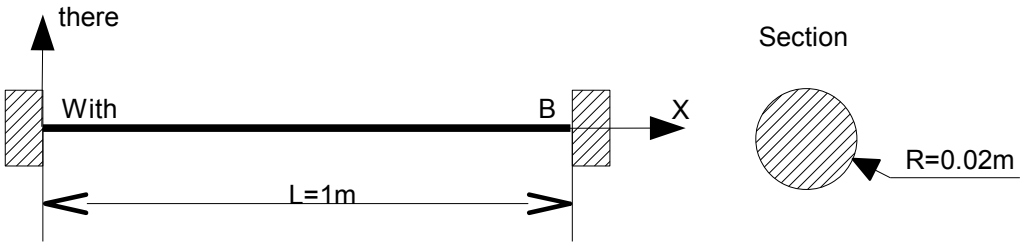
Summary

This test makes it possible to validate the good taking into account of the temperature for the law of behavior ELAS in the case of a beam multifibre. This test makes it possible to check that thermal dilation is well calculated.

1 General characteristics

1.1 Geometry

It is about a beam fixed at its two ends.



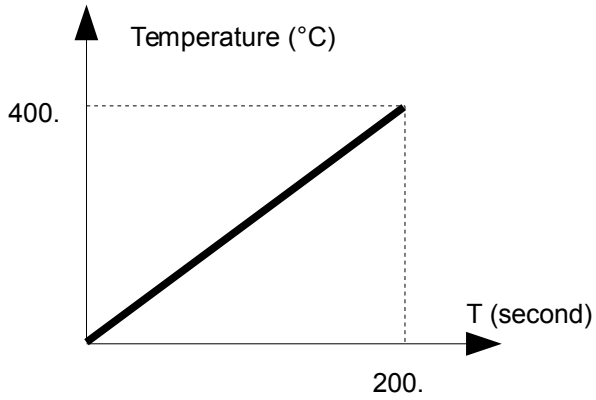
1.2 Properties of materials

$E=2.0\,\mathrm{E+11}\ Pa$	Young modulus
$\nu=0.3$	Poisson's ratio
$\alpha=15.0\,\mathrm{E-06}/°C$	Dilation coefficient
$D\_SIGM\_EPSI=2.0\,\mathrm{E+09}\ Pa$	Slope of the traction diagram
$SY=150.0\,\mathrm{E+10}\ Pa$	Elastic limit

1.3 Boundary conditions and loadings

Embedding at the points A and B : $DX=DY=DZ=DRX=DRY=DRZ=0$
Imposed temperature: $T=400\,°C$

The imposed temperature is increasing linearly according to time.



1.4 Initial conditions

Temperature of reference: $0\,°C$

2 Reference solution

2.1 Method of calculating used for the reference solution

Embedding at the points A and B allows to block the deformations according to x : $\varepsilon_{xx}=0$.
This blocking associated with Lhas imposed temperature creates an axial stress of compression along the axis x . This constraint has as an expression:

$$\sigma_{xx}=E\alpha(T_{reference}-T)$$

2.2 Reference variables

Constraint $SIXX$

2.3 Result of reference

For $T=200\,°C$ one obtains $SIXX=-0.6\,\mathrm{E}{+}09\,Pa$
For $T=400\,°C$ one obtains $SIXX=-1.20\,\mathrm{E}{+}09\,Pa$

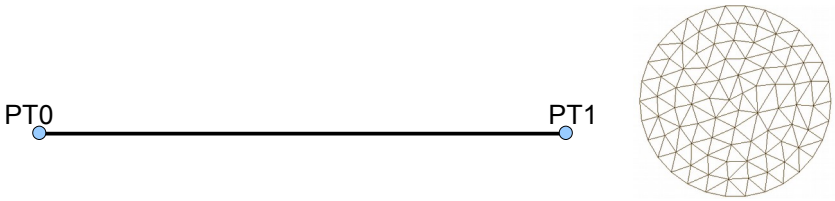
2.4 Uncertainty on the solution

Analytical solution

3 Modeling A

3.1 Characteristics of modeling

Modeling POU_D_EM
Relation of behavior of ELAS



Grid of the beam
Many nodes 11
Many meshs 10
That is to say:SEG2 10

Grid of the section of the beam
Many nodes 96
Many meshs 160
That is to say:TRIA3 160

3.2 Results

Behavior ELAS.

Size	Mesh	Not	Under-point	moment	Reference	Tolerance (%)
SIXX	*M4*	1	120	50.	0.60 E+09 *Pa*	0.1
SIXX	*M9*	2	40	100.	1.2 E+09 *Pa*	0.1

Behavior VMIS_ISOT_LINE.

Size	Mesh	Not	Under-point	moment	Reference	Tolerance (%)
SIXX	*M4*	1	120	50.	0.60 E+09 *Pa*	0.1
SIXX	*M9*	2	40	100.	1.20 E+09 *Pa*	0.1

The behavior of the beam during calculations with the law of behavior VMIS_ISOT_LINE Reste rubber band.

4 Summary of the results

The results are in conformity with the analytical solution.