UMAT001 – Test of the interface *Code_Aster*-Umat in linear thermoelasticity

Summary:

One carries out, on a linear thermoelastic problem, a comparison enters *Code_Aster*-Umat and *Code-aster* with the behavior ELAS. This test makes it possible to validate the interface Aster-Umat, in particular the good taking into account of thermal dilations.

Modeling A validate the interface in AXIS.

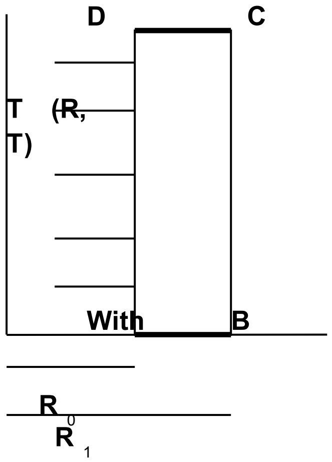
Modeling B validate the interface in great deformations (DEFORMATION = ' GDEF_LOG')

Valid modeling C validates the interface in AXIS. with variables of orders.

1 Problem of reference

1.1 Geometry

It is about a hollow roll, similar to that treated in SSNA106.



R_0 $1\,m$
R_1 $2\,m$

1.2 Properties of materials

1.2.1 Umat data

Elasticity is translated, for the Umat behavior present by way of an example in the sources of Code_Aster, by:

$$C1=\lambda=\frac{E\nu}{(1+\nu)(1-2\nu)}$$
$$C2=\mu=\frac{E}{2(1+\nu)}$$
$$C3=C4=C5=0$$

1.2.2 Data Aster

Young modulus: $E=1\,MPa$
Poisson's ratio: $\nu=0.3$
Dilation coefficient: $\alpha=0.7$

1.3 Boundary conditions and loadings

Boundary conditions:
The cylinder is blocked in DY on the sides $[AB]$ and $[CD]$.

Loading:
The cylinder is subjected to a field of temperature $T(r,t)=t\,r^2$

2 Reference solution

One makes an intercomparison between the results got with the behavior ELAS and those obtained with the Umat behavior.

3 Modeling A

3.1 Characteristics of modeling

The problem is modelled in axisymetry: AXIS.

3.2 Characteristics of the grid

The grid comprises 200 meshs of the type QUAD4.

3.3 Sizes tested and results

Comparison between the results got and the law ELAS with those obtained with the law UMAT.

Identification	***Type of reference***	***reference (Code_Aster, law ELAS)***	**Tolerance (%)**
σ_{yy} of SIEF_ELGA	'ANALYTICAL'	-0.3658	0.10
$DX(B)$	'ANALYTICAL'	1,092	0.10

4 Modeling B

4.1 Characteristics of modeling

The loadings and material are identical to those of modeling A .

Only exchange the model of great deformations: one compares here SIMO_MIEHE with a behavior VMIS_ISOT_LINE (simulating an elastic behavior, via a high elastic limit) and a behavior UMAT (rubber band also) with GDEF_LOG.

4.2 Characteristics of the grid

The grid is identical to that of modeling A : 200 elements of the type QUAD4.

4.3 Sizes tested and results

Comparison between the results got and the law SIMO_MIEHE with those obtained with GDEF_LOG.

Identification	***Type of reference***	***reference (Code_Aster, SIMO_MIEHE)***	**Tolerance (%)**
σ_{yy} of SIEF_ELGA	'AUTRE_ASTER'	-0,029	10.0
$DX(B)$	'AUTRE_ASTER'	0,103	7.9

5 Modeling C

The loadings and material are identical to those of modeling A .

Only the variables of order change: one uses here SECH besides the temperature and one chooses for dilation coefficient half of that used in modeling A. One assigns also this value to the dilation coefficient due to drying.

"Thermal" dilation will be thus made up of half of pure thermal dilation and another half of deformation due to drying. The results must be identical to those of modeling A.

5.1 Characteristics of modeling

The problem is modelled in axisymetry: AXIS.

5.2 Characteristics of the grid

The grid comprises 200 meshs of the type QUAD4.

5.3 Sizes tested and results

Comparison between the results got and the law ELAS with those obtained with the law UMAT.

Identification	*Type of reference*	*reference (Code_Aster, law ELAS)*	Tolerance ($\%$)
σ_{yy} of SIEF_ELGA	'ANALYTICAL'	-0.3658	0.10
$DX(B)$	'ANALYTICAL'	1,092	0.10

5.4 Remarks

Results resulting from the two models of great deformations (SIMO_MIEHE and GDEF_LOG) are also tested in NON_REGRESSION with 0.1% .

6 Summary of the results

The got results are in perfect agreement enters *Code_Aster*- Umat and *Code_Aster.*

Two models of great deformations (SIMO_MIEHE and GDEF_LOG give different results (8 to 9% of difference) what is explained by the difference in formulation in elasticity (one being very-rubber band and the other hypo-rubber band). This test shows in fact the possibility of using UMAT in great deformations.