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

Summarized:

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

The modelization A the interface in AXIS validates.

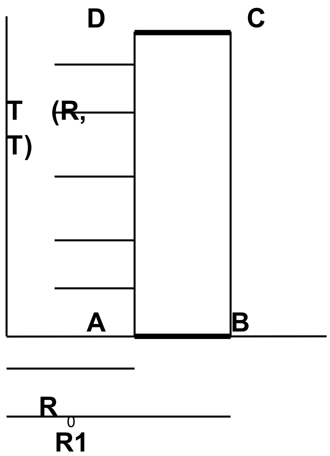
The modelization B the interface in large deformations validates (DEFORMATION = ' GDEF_LOG')

The modelization C validates validates the interface in AXIS. with command variables.

1 Problem of reference

1.1 Geometry

It acts of a hollow roll, similar to that treated in SSNA106.



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

1.2 Properties of the materials

1.2.1 Given Umat

elasticity is translated, for the Umat behavior present as 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 Aster data

Modulus Young: $E=1\,MPa$
Poisson's ratio: $\nu=0.3$
Coefficient of thermal expansion: $\alpha=0.7$

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 behavior ELAS and those obtained with the Umat behavior.

3 Modelization A

3.1 Characteristic of the modelization

the problem is modelled in axisymetry: AXIS.

3.2 Characteristics of the mesh

The mesh comprises 200 meshes type QUAD4.

3.3 Quantities tested and Comparison

results between the results got and model ELAS with those obtained with model UMAT.

Standard	***identification of reference***	***reference (Code_Aster, model ELAS)***	**Tolerance ($\%$)**
σ_{yy} of SIEF_ELGA	"ANALYTIQUE"	-0.3658	0.10
$DX(B)$	"ANALYTIQUE"	1.092	0.10

4 Modelization B

4.1 Characteristic of the modelization

the loadings and material are identical to those of the modelization A.

Only exchange the model of large 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 (elastic also) with GDEF_LOG.

4.2 Characteristics of the mesh

The mesh is identical to that of the modelization A : 200 elements of the type QUAD4.

4.3 Quantities tested and Comparison

results between the results got and model SIMO_MIEHE with those obtained with GDEF_LOG.

Standard	***identification 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 Modelization C

the loadings and material are identical to those of the modelization A .

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

"Thermal" thermal expansion will be thus made up of half of pure thermal thermal expansion and another half of strain due to drying. The results must be identical to those of modelization A.

5.1 Caractéristiques of the modelization

the problem is modelled in axisymetry: AXIS.

5.2 Characteristics of the mesh

The mesh comprises 200 meshes type QUAD4 .

5.3 Quantities tested and Comparison

results between the results got and model ELAS with those obtained with model UMAT.

Standard	***identification of reference***	***reference (Code_Aster, model ELAS)***	**Tolerance ($\%$)**
σ_{yy} SIEF_ELGA	"ANALYTIQUE"	-0.3658	0.10
$DX(B)$	"ANALYTIQUE"	1.092	0.10

5.4 Remarks

the results from the two models of large 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 between *Code_Aster-Umat* and *Code_Aster.*

The two models of large deformations (SIMO_MIEHE and GDEF_LOG give different results (8 with 9% difference) what is explained by the difference in formulation in elasticity (one being very-elastic and the other hypo-elastic). This test shows in fact the possibility of using UMAT in large deformations.