

MFRON04 – Test of the interface Code_Aster-MFront for laws with metallurgy

Summary:

This test validates behaviors with metallurgy defined using *MFront* by comparison with similar behaviors of *Code_Aster*.

Modeling a: this modeling makes it possible to validate the Mfront model which corresponds to META_LEMA_ANI in AXIS by comparison with test HSNV134A

Modeling b: this modeling makes it possible to validate the Mfront model which corresponds to META_LEMA_ANI in 3D by comparison with test HSNV134B

Modeling C: this modeling makes it possible to validate the model Mfront which corresponds to META_LEMA_ANI in AXIS by comparison with test HSNV135A

Modeling D: this modeling makes it possible to validate the Mfront model which corresponds to META_LEMA_ANI in AXIS with GDEF_LOG by comparison with test HSNV136C

Modeling E: this modeling makes it possible to validate LE models Mfront which corresponds to META_LEMA_ANI on a material point subjected to various loadings.

1 Modeling A

1.1 Characteristics modeling AXIS

- Behavior tested: AnisotropicLemaitreViscoplasticBehaviour.mfront. Viscoplastic law orthotropic with effect of metallurgy, similar to the law META_LEMA_ANI [cf R4.04.05].
- Modeling and data similar to those of test HSNV134A [V7.22.134]

The coefficients materials are

	Coefficients provided with keyword UMAT/LISTE_COEF	Name of the parameter are equivalent in DEFI_MATERIAU/META_LEMA_ANI
1	8,0000E+04	E
2	3,5000E-01	Naked
3	1,4277E+04	F1_A
4	2,2000E-01	F2_A
5	1,3394E+04	C_A
6	0,0000E+00	F1_M
7	7,7000E-05	F2_M
8	9,9000E-05	C_M
9	1,4336E+04	F1_N
10	2,9600E+00	F2_N
11	4,2314E+04	C_N
12	1,9923E+04	F1_Q
13	2,1024E+04	F2_Q
14	6,2190E+03	C_Q
15	4,4140E-01	F_MRR_RR
16	1,0000E+00	F_MTT_TT
17	7,1400E-01	F_MZZ_ZZ
18	7,5000E-01	F_MRT_RT
19	7,5000E-01	F_MTZ_TZ
20	7,5000E-01	F_MRZ_RZ
21	1,0000E+00	C_MRR_RR
22	1,0000E+00	C_MTT_TT
23	1,0000E+00	C_MZZ_ZZ
24	7,5000E-01	C_MRT_RT
25	7,5000E-01	C_MRZ_RZ
26	7,5000E-01	C_MTZ_TZ

1.2 Sizes tested and results

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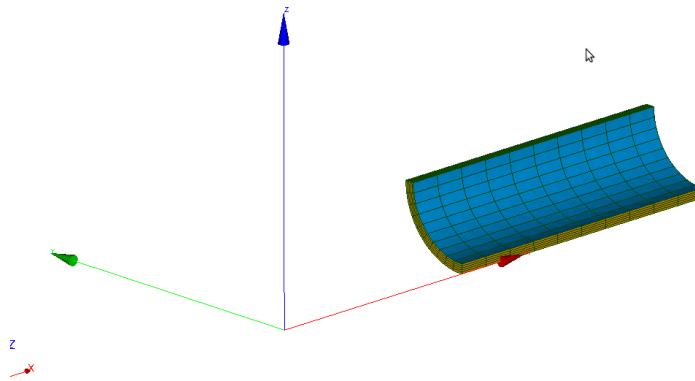
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Identification	Size	Reference
t=100s NA	SIXX	-9,442
t=100s NA	SIZZ	60,226
t=100s NA	SIYY	26,795
t=100s NA	EPXX	-9.49597E-03
t=100s NA	EPZZ	1.35633E-02
t=100s NA	EPYY	-3.7769E-03
t=100s NB	SIXX	3.28215E-02
t=100s NB	SIZZ	64,199
t=100s NB	SIYY	30,771
t=100s NB	EPXX	-6.58609E-03
t=100s NB	EPZZ	1.07189E-02
t=100s NB	EPYY	-3.7769E-03

2 Modeling B

2.1 Characteristics modeling

- Behavior tested: AnisotropicLemaitreViscoplasticBehaviour.mfront. Viscoplastic law orthotropic with effect of metallurgy, similar to the law META_LEMA_ANI [cf R4.04.05].
- Modeling 3D. The data are similar to those of the test HSNV134B [v7.22.134]. However, the center of the tube is relocated in (34,746, 0, , 4,746) and its axis is turned along axis X, in order to validate the change of reference mark implemented in the command file of the test (procedure python ANGLE_CYL). Thus the coefficients material are defined under DEFI_MATERIAU/UMAT in the reference mark related to the tube, and the procedure ANGLE_CYL provides the occurrences of the keyword SOLID MASS of the operator AFFE_CARA ELEM allowing to define the local reference mark of each mesh.



2.2 Sizes tested and results

Identification	Size	Reference	Tolerance
t=100s NA	SIXX	-9.4420	0.5 (absolute)
t=100s NA	SIZZ	60,226	0.5 (absolute)
t=100s NA	SIYY	26,795	0.5 (absolute)
t=100s NA	EPXX	-9.49597E-03	7th-4 (absolute)
t=100s NA	EPZZ	1.35633E-02	7th-4 (absolute)
t=100s NA	EPYY	-3.7769E-03	7th-4 (absolute)

t=100s NB	SIXX	3.28215E-02	0.5 (absolute)
t=100s NB	SIZZ	64,199	0.5 (absolute)
t=100s NB	SIYY	30,771	0.5 (absolute)
t=100s NB	EPXX	-6.58609E-03	6th-4 (absolute)
t=100s NB	EPZZ	1.07189E-02	6th-4 (absolute)
t=100s NB	EPYY	-3.7769E-03	1e-4 (absolute)

3 Modeling C

3.1 Characteristics of modeling

This modeling makes it possible to validate the model in axisymetry with variable temperature (thus evolution of the metallurgical phases).

- Behavior tested: AnistropicLemaitreViscoplasticBehaviour.mfront. Viscoplastic law orthotropic with effect of metallurgy, similar to the law META_LEMA_ANI [cf R4.04.05].
- Modeling and data similar to those of test HSNV135A [V7.22.135]

3.2 Sizes tested and results

Identification	Size	Aster
t=49.2s NA	SIXX	-6.61
t=49.2s NA	SIZZ	43,449
t=49.2s NA	SIYY	19.30
t=49.2s NA	EPXX	-1.72E-02
t=49.2s NA	EPZZ	4.055E-02
t=49.2s NA	EPYY	-2.106E-03

4 Modeling D

4.1 Characteristics of modeling

- Behavior tested: AnistropicLemaitreViscoplasticBehaviour.mfront. Viscoplastic law orthotropic with effect of metallurgy, similar to the law META_LEMA_ANI [cf R4.04.05].
- Modeling and data similar to those of test HSNV136C [V7.22.136], using in particular great deformations (GDEF_LOG)

4.2 Sizes tested and results

Comparison with test HSNV136C

Identification	Reference	Tolerance
t=1.03 Deformation EPYY (PGI)	0,105	0.01
t=1.03 Constraints SIGYY (PGI)	337.24	0.01
t=1.03 Variable p VARI (PGI)	0.10078	0.015

5 Modeling E

5.1 Characteristics of modeling

This modeling makes it possible to validate the model META_LEMA_ANI on a material point subjected to various loadings. The matrix of orthotropy is provided in Cartesian reference mark.

- Behavior tested: AnisotropicLemaitreViscoplasticBehaviour.mfront. Viscoplastic law orthotropic with effect of metallurgy, similar to the law META_LEMA_ANI [cf R4.04.05].
- Modeling similar to that of tests COMP002 [V6.07.102]

The coefficients materials are identical to those of modeling A.

5.2 Sizes tested and results

One checks the invariance of the results compared to a change of units, a rotation, and convergence compared to the discretization.

6 Summary of the results

The results are satisfactory and validate the interface enters *Code_Aster* and MFRONT for behaviors with metallurgy.