

MFRON06 – Test of the interface *Code_Aster-MFront* for laws with metallurgy for the digital simulation of welding

Summary:

This test validates behaviors with metallurgy defined using *MFront* by comparison with similar behaviors of *Code_Aster*. One is interested in the laws of type `META_**_**_**` for the which criterion of plasticity and the parameters materials depend on the metallurgical phases.

Modeling a: this modeling makes it possible to validate the Mfront-Official model which corresponds to `META_P_IL_PT` in `AXIS` by comparison with test HSNV102B.

Modeling b: this modeling makes it possible to validate the Mfront-Official model which corresponds to `META_P_IL_PT` in `AXIS` by comparison with test HSNV101B.

Modeling C: this modeling makes it possible to validate the model Mfront-User which corresponds to `META_P_IL_PT` in `AXIS` by comparison with test HSNV102B.

1 Modeling A

1.1 Characteristics modeling

- Behavior tested: MetaAcierEPIL_PT.mfront. Law elastoplastic of vonMises with effect of metallurgy and plasticity of transformation, similar to the law META_P_IL_PT [cf R4.04.02].
- Modeling and data similar to those of test HSNV102B [V7.22.102]

The parameters materials of the law *Mfront* MetaAcierEPIL_PT are well informed in the keyword factor MetaAcierEPIL_PT_FO order DEFI_MATERIAU. One points out the name here of each one of these parameters by specifying the name of the corresponding parameter used during a calculation with the law *Aster* META_P_IL_PT:

MetaAcierEPIL_PT		META_P_IL_PT	
Parameters provided in DEFI_MATERIAU :		Parameters provided in DEFI_MATERIAU :	
Keyword factor	Name	Name	Keyword factor
MetaAcierEPIL_PT_FO	YoungModulus	E	ELAS_META_FO
	PoissonRatio	NAKED	
	SYY_0	F1_SY	
	SYY_1	F2_SY	
	SYY_2	F3_SY	
	SYY_3	F4_SY	
	SYY_4	C_SY	
	metaF1	SY_MELANGE	
	ETT_0	F1_D_SIGM_EPSI	META_ECRO_LINE
	ETT_1	F2_D_SIGM_EPSI	
	ETT_2	F3_D_SIGM_EPSI	
	ETT_3	F4_D_SIGM_EPSI	
	ETT_4	C_D_SIGM_EPSI	
	FK_0	F1_K	META_PT
	FK_1	F2_K	
	FK_2	F3_K	
	FK_3	F4_K	
	metaFDF_0	F1_D_F_META	
	metaFDF_1	F2_D_F_META	
	metaFDF_2	F3_D_F_META	
metaFDF_3	F4_D_F_META		

1.2 Sizes tested and results

Moments	Identification	Reference	Test	Tolerance	
t=24 S	Vari. Intern (p)	V10	0	AUTRE_ASTER	1.0E-6 (absolute)
t=24 S	Vari. Intern (χ)	V11	0	AUTRE_ASTER	1.0E-6 (absolute)
t=24 S	Constraint	SIYY	359.99983273579 E+06	AUTRE_ASTER	0.1 %
t=24 S	Total deflection	EPYY	-3.840000491808E-03	AUTRE_ASTER	0.1 %
t=26 S	Vari. Intern (p)	V9	0.037217300451586	AUTRE_ASTER	0.1 %
t=26 S	Vari. Intern (χ)	V11	1	AUTRE_ASTER	0.1 %
t=26 S	Constraint	SIYY	389.99985521818E+06	AUTRE_ASTER	0.1 %
t=26 S	Total deflection	EPYY	0.050984312806764	AUTRE_ASTER	0.1 %
t=40 S	Vari. Intern (p)	V9	0.062523435331006	AUTRE_ASTER	0.1 %
t=40 S	Vari. Intern (χ)	V11	1	AUTRE_ASTER	0.1 %
t=40 S	Constraint	SIYY	599.9996756526E+06	AUTRE_ASTER	0.1 %
t=40 S	Total deflection	EPYY	0.10091527725955	AUTRE_ASTER	0.1 %
t=90 S	Vari. Intern (p)	V9	0.074146128182812	AUTRE_ASTER	0.1 %
t=90 S	Vari. Intern (χ)	V11	1	AUTRE_ASTER	0.1 %
t=90 S	Constraint	SIYY	1349.9990964823E+06	AUTRE_ASTER	0.1 %
t=90 S	Total deflection	EPYY	0.10879630937905	AUTRE_ASTER	0.1 %

2 Modeling B

2.1 Characteristics modeling

- Behavior tested: MetaAcierEPIL_PT.mfront. Law elastoplastic of vonMises with effect of metallurgy and plasticity of transformation, similar to the law META_P_IL_PT [cf R4.04.02].
- Modeling and data similar to those of test HSNV101B [V7.22.101]

2.2 Sizes tested and results

Moments	Identification	Reference	Test	Tolerance
t=47 S	Vari. Intern (p)	V10	0	AUTRE_ASTER 1.0E-6 (absolute)
t=47 S	Vari. Intern (χ)	V11	0	AUTRE_ASTER 1.0E-6 (absolute)
t=47 S	Constraint	SIYY	281.99986897636E+06	AUTRE_ASTER 0.1 %
t=47 S	Total deflection	EPYY	-4.1125003852496E-03	AUTRE_ASTER 0.1 %
t=48 S	Vari. Intern (p)	V10	3.265354930413E-3	AUTRE_ASTER 0.1 %
t=48 S	Vari. Intern (χ)	V11	1	AUTRE_ASTER 0.1 %
t=48 S	Constraint	SIYY	287.99993609587E+06	AUTRE_ASTER 0.1 %
t=48 S	Total deflection	EPYY	-9.3464484572183E-4	AUTRE_ASTER 0.1 %
t=60 S	Vari. Intern (p)	V10	0.040000033462824	AUTRE_ASTER 0.1 %
t=64 S	Vari. Intern (p)	V10	0.040000033462824	AUTRE_ASTER 0.1 %
t=64 S	Vari. Intern (χ)	V11	0	AUTRE_ASTER 1.0E-6 (absolute)
t=64 S	Constraint	SIYY	359.99979662253E+06	AUTRE_ASTER 0.1 %
t=64 S	Total deflection	EPYY	0.040003778049952	AUTRE_ASTER 0.1 %
t=114 S	Vari. Intern (p)	V8	0.041071623444537	AUTRE_ASTER 0.1 %
t=114 S	Vari. Intern (χ)	V11	1	AUTRE_ASTER 0.1 %
t=114 S	Constraint	SIYY	360.000000E+06	AUTRE_ASTER 0.1 %
t=114 S	Total deflection	EPYY	0.071444235	AUTRE_ASTER 0.1 %
t=176 S	Vari. Intern (p)	V8	0.062068877	AUTRE_ASTER 0.1 %

3 Modeling C

3.1 Characteristics of modeling

This modeling is identical to modeling a:

- Behavior tested: MetaAcierEPIL_PT.mfront. Law elastoplastic of vonMises with effect of metallurgy and plasticity of transformation, similar to the law META_P_IL_PT [cf R4.04.02].
- Modeling and data similar to those of test HSNV102B [V7.22.102]

One uses the mode says "user" of implementation of the Mfront laws in Code_Aster. In this case, the parameters materials of the law Mfront MetaAcierEPIL_PT are informed by a list of functions in the keyword factor MFRONT_FO order DEFI_MATERIAU. The list of functions is form (fonc1, fonc2,..., fonc21) with the following correspondence with respect to the names of the parameters of the keyword MetaAcier_EPIL_PT :

Implementation of the law Mfront MetaAcierEPIL_PT	
as a mode user	in official mode
List of functions (fonc1,..., fonc21) provided in DEFI_MATERIAU : Keyword factor: MFRONT_FO	Names of the parameters provided in DEFI_MATERIAU : Keyword factor: MetaAcierEPIL_PT_FO
fonc1	YoungModulus
fonc2	PoissonRatio
fonc3	SYX_0
fonc4	SYX_1
fonc5	SYX_2
fonc6	SYX_3
fonc7	SYX_4
fonc8	ETT_0
fonc9	ETT_1
fonc10	ETT_2
fonc11	ETT_3
fonc12	ETT_4
fonc13	FK_0
fonc14	FK_1
fonc15	FK_2
fonc16	FK_3
fonc17	metaF1
fonc18	metaFDF_0
fonc19	metaFDF_1
fonc20	metaFDF_2
fonc21	metaFDF_3

3.2 Sizes tested and results

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Identical to modeling A.

4 Summary of the results

The results are satisfactory and validate, for the elastoplastic law of vonMises with metallurgy and plasticity of transformation, the interface enters *Code_Aster* and MFRONT, as an official mode and user.