SSNV169 - Coupling creep – damage

Summary:

It is about an elementary test of not-regression making it possible to validate the coupling between the clean model of creep BETON_UMLV_FP and models of damage ENDO_ISOT_BETON and MAZARS. The test consists in maintaining an effort constant on an element and letting it creep.

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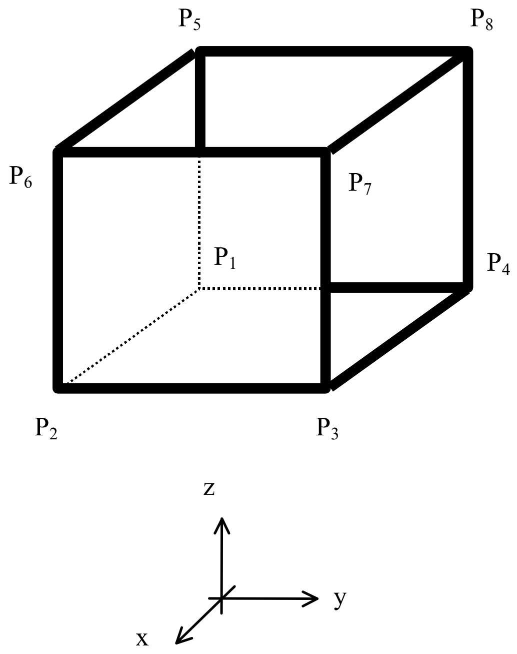
1 Problem of reference

1.1 Geometry and boundary conditions



Blocages
P1P2P3P4 : dz=0
P1P4P8P7 : dx=0
P1P2P6P5 : dy=0
P2P3P7P6 : liaison uniforme suivant x
P3P4P8P7 : liaison uniforme suivant y

Traction
P5P6P7P8 : effort imposé

{dx, dy, dz} sont les déplacements des noeuds suivant les trois directions.

1.2 Properties of material

Two sets of different parameters are used for the coupling with the model ENDO_ISOT_BETON (modeling A, B and C) and for the model of MAZARS (modeling D with I). They are synthesized in the two following tables.

Data materials used for the coupling BETON_UMLV_FP/ENDO_ISOT_BETON

Elastic parameters	
E	$31\,GPa$
NAKED	0.2
Parameters of creep	
K_RS	$1.2\,10^{5}\,MPa$
ETA_RS	$2.21\,10^{10}\,MPa.s$
K_IS	$6.22\,10^{4}\,MPa$
ETA_IS	$4.16\,10^{10}\,MPa.s$
K_RD	$3.86\,10^{4}\,MPa$
ETA_RD	$6.19\,10^{10}\,MPa.s$
ETA_ID	$1.64\,10^{12}\,MPa.s$
Parameters of damage	
SYT	$3\,MPa$
D_SIGM_EPSI	$-6\,GPa$
SYC	$30\,MPa$

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Data materials used for the coupling BETON_UMLV_FP/MAZARS

Elastic parameters	
E	$31\ GPa$
NAKED	0.2
Parameters of creep	
K_RS	$6.0\,10^{4}\ MPa$
ETA_RS	$1.0\,10^{10}\ MPa.s$
K_IS	$3.0\,10^{4}\ MPa$
ETA_IS	$2.4\,10^{10}\ MPa.s$
K_RD	$3.4\,10^{4}\ MPa$
ETA_RD	$4.08\,10^{11}\ MPa.s$
ETA_ID	$5.44\,10^{12}\ MPa.s$
Parameters of damage	
EPSD0	$5.6\,10^{-5}$
AT	0.831
BT	$21\,330.$
AC	1.15
BC	$1390.$
K	0.7
CHI	0.6
Parameter not-room	
LONG_CARA	0 (100 for the test I)

It is supposed that drying does not evolve in the course of time, the function of sorption is thus arbitrarily selected.

1.3 Boundary conditions and loadings

In this test, drying and the temperature are supposed to be uniform and invariants. Moisture is worth 100% and the temperature $20°C$.

The mechanical loading corresponds to an one-way traction on the higher face of the test-tube ($P5P6P7P8$) imposed into 1 second then maintained constant until reaching (almost) the ruin of material by tertiary creep. The intensity of the loading is equal to 0.6 times the instantaneous load of peak in the case of the coupling with ENDO_ISOT_BETON and 0.8 times the instantaneous load of peak for the coupling with MAZARS.

2 Reference solution

This test is a test of not-regression.

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3 Modeling A

3.1 Characteristics of modeling

Modeling is 3D.

3.2 Characteristics of the grid

Many nodes: 8

Many meshs and types: 1 HEXA8

3.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 104), the constraint SIZZ, clean deformation of creep EPZZ like 2 internal variables V7 and V22 corresponding respectively to the reversible deviatoric deformation according to zz and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform).

Fields	Component	Not	Value of reference	Type of reference
SIEF_ELGA	SIZZ	Not Gauss 1	1.80000E+00	NON_REGRESSION
VARI_ELGA	V5	Not Gauss 1	3.10881E-05	NON_REGRESSION
VARI_ELGA	V22	Not Gauss 1	1.54698E-05	NON_REGRESSION
EPSP_ELGA	EPYY	Not Gauss 1	5.57153E-05	NON_REGRESSION

One in addition tests the weight of the point of Gauss 1.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
COOR_ELGA	W	Not Gauss 1	0.25	ANALYTICAL	1e-7%

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4 Modeling B

4.1 Characteristics of modeling

Modeling is axisymmetric (AXIS).

4.2 Characteristics of the grid

Many nodes: 4

Many meshs and types: 1 QUAD4

4.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 104), the constraint SIYY, clean deformation of creep EPYY like 2 internal variables V5 and V22 corresponding respectively to the reversible deviatoric deformation according to yy and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform).

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIZZ	Not Gauss 1	1.80000E+00	NON_REGRESSION	0.01%
VARI_ELGA	V5	Not Gauss 1	3.10881E-05	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	1.54698E-05	NON_REGRESSION	0.01%
EPSP_ELGA	EPYY	Not Gauss 1	5.57153E-05	NON_REGRESSION	0.01%

One finds the same results as in 3 dimensions.

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5 Modeling C

5.1 Characteristics of modeling

Modeling is in plane constraints (C_PLAN).

5.2 Characteristics of the grid

Many nodes: 4

Many meshs and types: 1 QUAD4

5.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 104), the constraint SIYY, clean deformation of creep EPYY like 2 internal variables V5 and V22 corresponding respectively to the reversible deviatoric deformation according to yy and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform).

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIZZ	Not Gauss 1	1.80000E+00	NON_REGRESSION	0.01%
VARI_ELGA	V5	Not Gauss 1	3.10881E-05	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	1.54698E-05	NON_REGRESSION	0.01%
EPSP_ELGA	EPYY	Not Gauss 1	5.57153E-05	NON_REGRESSION	0.01%

One in addition tests the weight of the point of Gauss 1.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
COOR_ELGA	W	Not Gauss 1	0.25	ANALYTICAL	1e-7%

One finds the same results as in 3 dimensions.

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6 Modeling D

6.1 Characteristics of modeling

Modeling is 3D.

6.2 Characteristics of the grid

Many nodes: 8

Many meshs and types: 1 HEXA8

6.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 202), the constraint SIZZ, like 2 internal variables V7 and V22 corresponding respectively to the reversible deviatoric deformation according to zz and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform). One also tests the value of displacement to the node $N5$.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIXX	Not Gauss 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DX	$N5$	6.635E-5	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	5.607E-2	NON_REGRESSION	0.01%
VARI_ELGA	V7	Not Gauss 1	1.0145E-5	NON_REGRESSION	0.01%

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7 Modeling E

7.1 Characteristics of modeling

Modeling is $2D$ in plane deformations D_PLAN.

7.2 Characteristics of the grid

Many nodes: 4
Many meshs: 1 QUAD 4

7.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 85), the constraint SIXX, like 2 internal variables V3 and V22 corresponding respectively to the reversible deviatoric deformation according to XX and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform). One also tests the value of displacement to the node $N1$.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIXX	Not Gauss 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DX	$N1$	-6.813E-3	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	7.466E-2	NON_REGRESSION	0.01%
VARI_ELGA	V3	Not Gauss 1	1.015E-5	NON_REGRESSION	0.01%

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8 Modeling F

8.1 Characteristics of modeling

Modeling in plane constraints C_PLAN.

8.2 Characteristics of the grid

Many nodes: 4
Many meshs: 1 QUAD 4

8.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 85), the constraint SIXX, like 2 internal variables V3 and V22 corresponding respectively to the reversible deviatoric deformation according to XX and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform). One also tests the value of displacement to the node $N1$.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIXX	Not Gauss 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DX	$N1$	-6.5657E-3	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	4.2817E-2	NON_REGRESSION	0.01%
VARI_ELGA	V3	Not Gauss 1	9.4824E-6	NON_REGRESSION	0.01%

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9 Modeling G

9.1 Characteristics of modeling

Not-local modeling 3D_GRAD_EPSI.

9.2 Characteristics of the grid

Many nodes: 20
Many meshs: 1 mesh HEXA 20

9.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 202), the constraint SIZZ, like 2 internal variables V7 and V22 corresponding respectively to the reversible deviatoric deformation according to zz and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform). One also tests the value of displacement to the node $N5$.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIXX	Not Gauss 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DZ	$N5$	6.633E-05	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	5.5810E-2	NON_REGRESSION	0.01%
VARI_ELGA	V7	Not Gauss 1	1.0145E-05	NON_REGRESSION	0.01%

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10 Modeling H

10.1 Characteristics of modeling

Not-local modeling $2D$ in deformation plane D_PLAN_GRAD_EPSI.

10.2 Characteristics of the grid

Many nodes: 8

Many meshs: 1 QUAD 8

10.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 85), the constraint SIXX, like 2 internal variables V3 and V22 corresponding respectively to the reversible deviatoric deformation according to XX and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform). One also tests the value of displacement to the node $N1$.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIXX	Not Gauss 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DX	$N1$	3.2017E-03	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	0.0	NON_REGRESSION	0.01%
VARI_ELGA	V3	Not Gauss 1	1.0653E-05	NON_REGRESSION	0.01%

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11 Modeling I

11.1 Characteristics of modeling

Not-local modeling in plane constraints C_PLAN_GRAD_EPSI.

11.2 Characteristics of the grid

Many nodes: 8

Many meshs: 1 QUAD 8

11.3 Sizes tested and results

One tests with the last step of time (NUME_ORDRE 85), the constraint SIXX, like 2 internal variables V3 and V22 corresponding respectively to the reversible deviatoric deformation according to XX and the value of the damage. These sizes are observed on the first point of Gauss (all fields being uniform). One also tests the value of displacement to the node $N2$.

Fields	Component	Not	Value of reference	Type of reference	Tolerance
SIEF_ELGA	SIXX	Not Gauss 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DX	$N2$	3.1603E-03	NON_REGRESSION	0.01%
VARI_ELGA	V22	Not Gauss 1	0.0	NON_REGRESSION	0.01%
VARI_ELGA	V3	Not Gauss 1	9.1621E-06	NON_REGRESSION	0.01%

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12 Synthesis

All these tests are tests of not-regression, which validate the establishment of the models from a point of view data-processing and not physical. Thus, on tests of enclosure, it was noticed that the coupling of the model ENDO_ISOT_BETON with BETON_UMLV_FP in the current version much the damage over-estimated.

In addition, one holds to inform the user, that the current coupling of the model of MAZARS with BETON_UMLV_FP is explicit and is thus sensitive in keeping with step of time used. A study of convergence is thus essential.

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