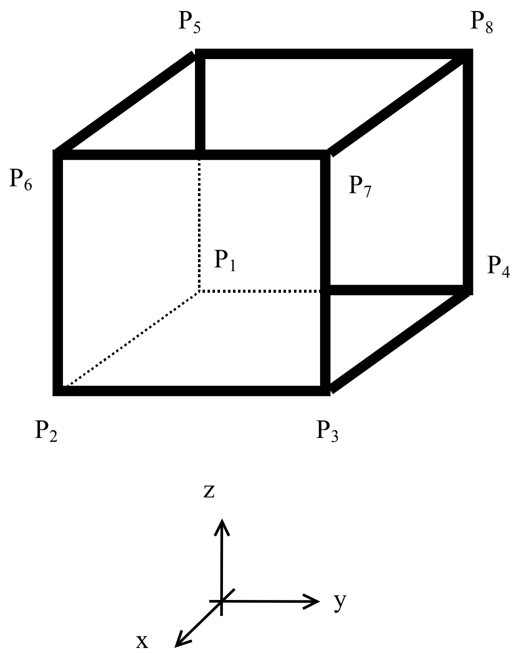
SSNV169 - Coupling creep – Summarized

damage:

It is about an elementary test of NON-regression making it possible to validate the coupling enters the model of clean creep BETON_UMLV_FP and the model of damage ENDO_ISOT_BETON and MAZARS. The test consists in maintaining a force constant on an element and letting it creep.

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 the material

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

Data materials used for coupling BETON_UMLV_FP/ENDO_ISOT_BETON

elastic Parameters	
E	$31\,GPa$
NU	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	$30\,MPa$

Given materials used for elastic coupling

BETON_UMLV_FP/MAZARS	
Parameters	
E	$31\,GPa$
NU	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 NON-room	
LONG_CARA	0 (100 for the test I)

One supposes 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 tension on the upper face of the test-tube ($P5P6P7P8$) imposed into 1 second then maintained constant until reaching (almost) the failure of the 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 NON-regression.

3 Modelization A

3.1 Characteristic of the modelization

The modelization is 3D.

3.2 Characteristics of the mesh

Many nodes: 8

Number of meshes and types: 1 HEXA8

3.3 Quantities tested and results

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

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

One tests in addition the weight of Gauss point 1.

Fields	Component	Not	Standard Value of reference	of reference	Tolerance
COOR_ELGA	W	Gauss point 1	0.25	ANALYTIQUE	1e-7%

4 Modelization B

4.1 Characteristic of the modelization

The modelization is axisymmetric (AXIS).

4.2 Characteristics of the mesh

Many nodes: 4

Number of meshes and types: 1 QUAD4

4.3 Quantities tested and results

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

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

One finds the same results as in 3 dimensions.

5 Modelization C

5.1 Characteristic of the modelization

The modelization is in plane stresses (C_PLAN).

5.2 Characteristics of the mesh

Many nodes: 4

Number of meshes and types: 1 QUAD4

5.3 Quantities tested and results

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

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

One tests in addition the weight of Gauss point 1.

Fields	Component	Not	Standard Value of reference	of reference	Tolerance
COOR_ELGA	W	Gauss point 1	0.25	ANALYTIQUE	1e-7%

One finds the same results as in 3 dimensions.

6 Modelization D

6.1 Characteristic of the modelization

The modelization is 3D.

6.2 Characteristics of the mesh

Many nodes: 8

Number of meshes and types: 1 HEXA8

6.3 Quantities tested and results

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

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

7 Modelization E

7.1 Characteristic of the modelization

The modelization is $2D$ in plane strains D_PLAN.

7.2 Characteristics of the mesh

Many nodes: 4
Number of meshes: 1 QUAD4

7.3 Quantities tested and results

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

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

8 Modelization F

8.1 Characteristic of the modelization

Modelization in plane stresses C_PLAN.

8.2 Characteristics of the mesh

Many nodes: 4
Number of meshes: 1 QUAD4

8.3 Quantities tested and results

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

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

9 Modelization G

9.1 Characteristic of the modelization

NON-local Modelization 3D_GRAD_EPSI.

9.2 Characteristics of the mesh

Many nodes: 20
Number of meshes: 1 mesh HEXA20

9.3 Quantities tested and results

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

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

10 Modelization H

10.1 Characteristic of the plane

modelization NON-local $2D$ Modelization in strain D_PLAN_GRAD_EPSI.

10.2 Characteristics of the mesh

Many nodes: 8

Number of meshes: 1 QUAD 8

10.3 Quantities tested and results

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

Fields	Component	Not	Standard Value of reference	of reference	Tolerance
SIEF_ELGA	SIXX	Gauss point 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DX	$N1$	3.2017E-03	NON_REGRESSION	0.01%
VARI_ELGA	V22	Gauss point 1.0.0		NON_REGRESSION	0.01%
VARI_ELGA	V3	Gauss point 1	1.0653E-05	NON_REGRESSION	0.01%

11 Modelization I

11.1 Characteristic of the modelization

NON-local Modelization in plane stresses C_PLAN_GRAD_EPSI.

11.2 Characteristics of the mesh

Many nodes: 8

Number of meshes: 1 QUAD 8

11.3 Quantities tested and results

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

Fields	Component	Not	Standard Value of reference	of reference	Tolerance
SIEF_ELGA	SIXX	Gauss point 1	1.38880E +00	NON_REGRESSION	0.01%
DEPL	DX	$N2$	3.1603E-03	NON_REGRESSION	0.01%
VARI_ELGA	V22	Gauss point 1.0.0		NON_REGRESSION	0.01%
VARI_ELGA	V3	Gauss point 1	9.1621E-06	NON_REGRESSION	0.01%

12 Synthesis

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

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