SSNV215 - Law of behavior BETON_RAG: test of rotation of the principal directions

Summary:

This document presents a test making it possible to validate the capacities of the model of behavior BETON_RAG, used to consider the behavior long-term of the structures affected by the reaction alkali-aggregate. One simulates here the behavior of a test-tube subjected to a way of specific loading which creates a continual rotation of the directions of the principal constraints.

1 Problem of Reference

In this test [Willam and al., 1987], the test-tube is subjected to a way of specific loading which creates a continual rotation of the directions of the principal constraints: this determines the capacity of the model to converge in spite of such changes.

1.1 Geometry

The test is pressed on a unit cubic finite element.

1.2 Property of materials

- Young modulus: $E=32000\,MPa$
- Poisson's ratio: $\nu=0.2$
- Tensile strength: $\sigma_{ft}=3.0\,MPa$
- Compressive strength: $\sigma_{fc}=38.3\,MPa$
- Deformation with the peak of compression: $\epsilon_{fc}=2.0.10^{-3}$
- Deformation with the peak of traction: $\epsilon_{ft}=2.0.10^{-4}$

1.3 Boundary conditions and loadings

It is here about a cube subjected to a uniform loading nonproportional, consisting into cubes displacements imposed in the plan (Ox,Oy) .

The material is subjected in the first time to a uniaxial traction in the direction xx to the peak of stress-strain curve, in the second time a shearing xy and an orthogonal traction yy come to superimpose itself on the uniaxial loading xx (which continues), it results from this way of being translated loading a rotation of the principal directions of the constraints, by the appearance of a shear stress σ_{xy} .

That results in deformations imposed which evolve in a way closely connected per pieces according to time, with:

- with $t=0.01\;jour$, $\epsilon=10^{-4}\begin{pmatrix}0.84 & 0\\ 0 & -0.105\end{pmatrix}$
- with $t=0.05\;jour$, $\epsilon=10^{-4}\begin{pmatrix}5.6 & 4.76\\ 4.76 & 7.035\end{pmatrix}$

2 Reference solution

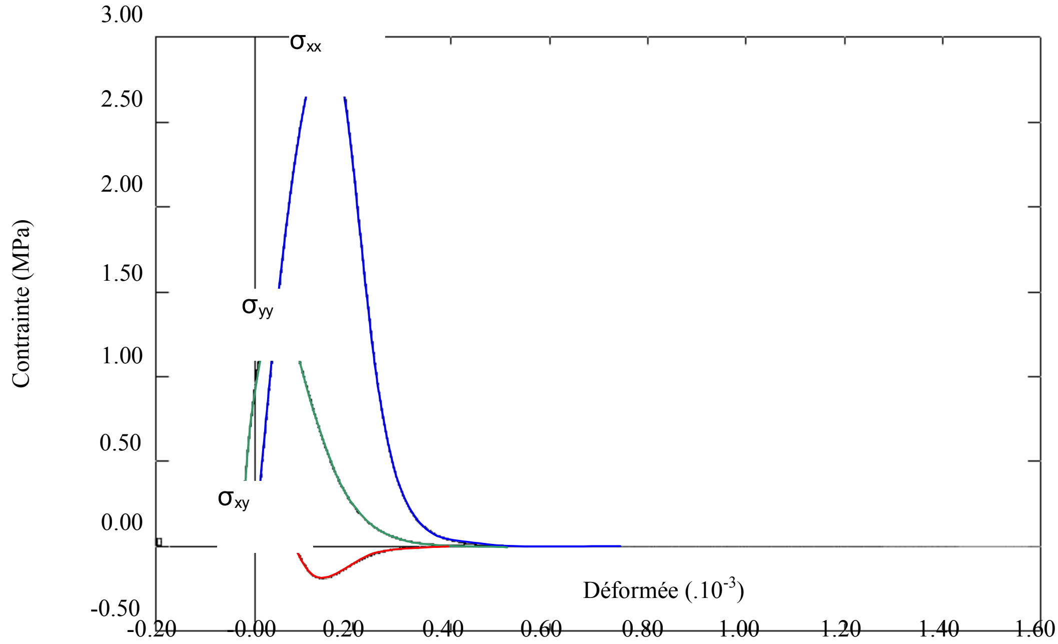

Figure 2-a : Simulation of the test of Willam

On Figure 2-a, it is noted that the constraint σ_{yy} is weak, because of an effect of initial cracking in the direction xx . One also notices, a change of sign for the constraint σ_{xy} characteristic of the anisotropic models [Ghavamian and al., 2003]. This test confirms the capacity of the model to converge when a rotation of the principal directions of the constraints is applied.

2.1 Bibliographical references

[Willam and al., 1987] K. Willam, E. Pramono, S. Sture, “Fundamental exits of smeared ace models”, Proc. Of the SEM-RILEM Int. conf. One fractures of concrete and rock'n'roll, Shah S.P., Swartz S.E. (eds), Society of Engineering Mechanics, p. 192-207, 1987.

3 Modeling A

3.1 Characteristic of modeling

The problem is modelled in 3D.

3.2 Characteristic of the grid

1 mesh HEXA8

3.3 Sizes tested and results

All the sizes are calculated with the node $N1$.

Identification	Moments	Reference	Aster	Tolerance
$EPXX$	0.01	not-regression	8.4 E-5	0.1%
$EPYY$	0.01	not-regression	-1.05 E-5	0.1%
$EPXY$	0.01	not-regression	0	1.E-8
$SIXX$	0.01	not-regression	2.114073	0.1%
$SIYY$	0.01	not-regression	8.572651 E-2	0.1%
$SIXY$	0.01	not-regression	0	1.E-8
$V15$	0.01	not-regression	0.217816	0.01%
$EPXX$	0,012	not-regression	1,078 E-4	0.1%
$EPYY$	0,012	not-regression	2.52 E-5	0.1%
$EPXY$	0,012	not-regression	2.38 E-5	0.1%
$SIXX$	0,012	not-regression	2.439871	0.1%
$SIYY$	0,012	not-regression	1.1612722	0.1%
$SIXY$	0,012	not-regression	0.380011	0.1%
$V15$	0,012	not-regression	0.337548	0.1%
$EPXX$	0.05	not-regression	5.6 E-4	0.1%
$EPYY$	0.05	not-regression	7,035 E-4	0.1%
$EPXY$	0.05	not-regression	4.76 E-4	0.1%
$SIXX$	0.05	not-regression	0.23002	0.1%
$SIYY$	0.05	not-regression	0.2925271	0.1%
$SIXY$	0.05	not-regression	-0.25573	0.1%
$V15$	0.05	not-regression	0.9592491	0.1%

4 Summary of the results

Results calculated by *Code_Aster* check the not-regression.