SSNV238 - Law of behavior KIT_RGI : cyclic loading of a concrete test-tube

Summary:

This document presents a test making it possible to validate the capacities of the model of behavior KIT_RGI and more precisely the module PORO_ENDO_BETON. Let us specify that KIT_RGI is a set of three modules allowing to take into account the deformation differed from the concrete with FLUA_PORO_BETON, the damage of the concrete with ENDO_PORO_BETON and the reaction alkali-aggregate with RGI_BETON. The behavior of a test-tube under cyclic loading in simple traction is simulated.

1 Problem of Reference

The loading consists of the application of two cycles of loading in traction then of two cycles of loading in compression.

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: $\sigma_{ft}=4.0\,MPa$
Compressive strength: $\sigma_{fc}=40\,MPa$
Deformation with the peak of compression: $\varepsilon_{fc}=4{,}0.10^{-3}$
Deformation with the peak of traction: $\varepsilon_{ft}=5{,}0.10^{-4}$
Let us recall that KIT_RGI is a model in KIT which makes it possible either to couple the models of creep (FLUA_PORO_BETON), of damage (ENDO_PORO_BETON) and of RAG-RSI (RGI_BETON) or or to use the models separately. In all the cases, the properties materials are specified in DEFI_MATERIAU with name PORO_BETON. For this case test, only the model of damage is employed by using in STAT_NON_LINE law ENDO_PORO_BETON.

1.3 Boundary conditions and loadings

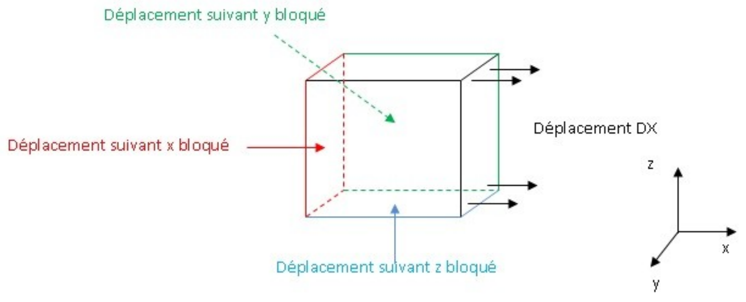

Figure 1.3-1 : Boundary conditions and mechanical loading on a cube of 1 mm of with dimensions.

Perpendicular displacements according to three faces of the cubes are blocked in order to model an unconfined compression test. On another face, a displacement DX (equivalent to a deformation $EPXX$ because the dimension of the structure is unit) is applied. The boundary conditions and the loading are schematized on the preceding figure. The imposed values of displacement are the following one:

1. traction $\epsilon_{xx}=1{,}0.10^{-3}$
2. relaxation (with $\sigma_{xx}=0$)
3. traction $\epsilon_{xx}=5{,}0.10^{-3}$
4. compression $\epsilon_{xx}=-4{,}0.10^{-3}$
5. relaxation (with $\sigma_{xx}=0$)
6. compression $\epsilon_{xx}=-1{,}0.10^{-2}$
7. traction $\epsilon_{xx}=0$

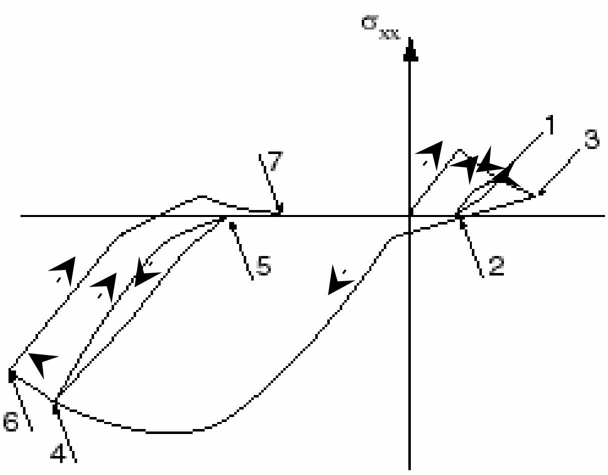

Figure 1.3-2 : Illustration on a stress-strain curve of the imposed loading.

1.4 Initial conditions

Nothing

2 Reference solution

2.1 Method of calculating

A calculation of nonregression east realizes.

2.2 Sizes and results of reference

The stress-strain curves obtained is the following one:

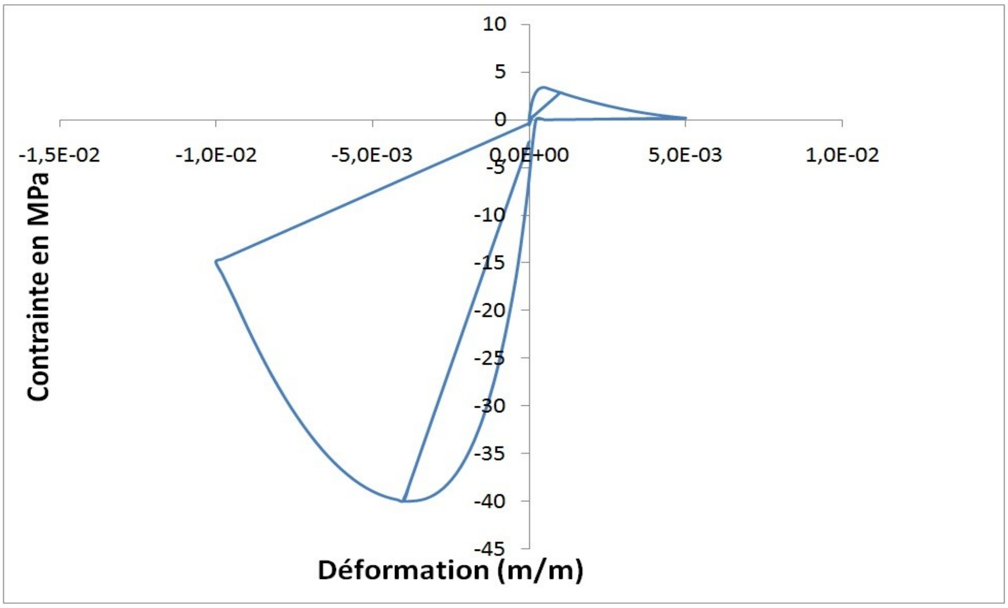

Figure 2.2-1 : Simulation of the behavior of the concrete under uniaxial cyclic loading with ENDO_PORO_BETON (Module of damage of KIT_RGI)

The value of the constraint $SIXX$ with the node $N6$ is tested for several moments (0.5 1.0.3.0.4.0 6.0 and 7.0).
The constraints are in MPa.

2.3 Uncertainties on the solution

Without object

3 Modeling A

3.1 Characteristic of modeling

The problem is modelled in 3D. The model employed is ENDO_PORO_BETON of KIT_RGI.

3.2 Characteristic of the grid

1 mesh HEXA8

3.3 Sizes tested and results

The value of the constraint $SIXX$ with the node $N6$ is tested for several moments (0.5 1.0.3.0.4.0 6.0 and 7.0).

The constraints are in MPa.

4 Summary of the results

Results calculated by *Code_Aster* check the not-regression. The model takes well into account the dissymmetrical behavior of the concrete in traction and compression. Moreover, the refermeture of the cracks is taken into account by the almost total restitution of the stiffness of the concrete at the time of the passage traction and compression.