SSNV240 - Law of behavior KIT_RGI : free swelling on test-tube

Summary:

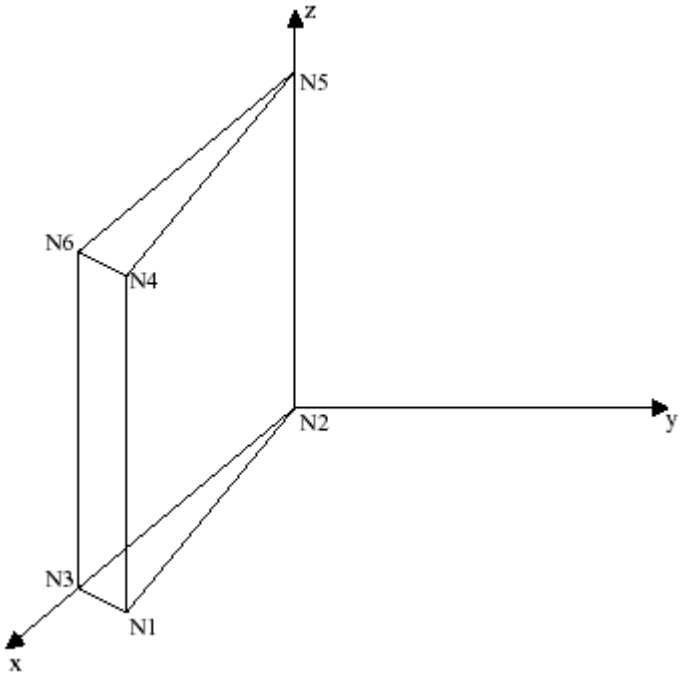
This document presents a test making it possible to validate the capacities of the model of behavior KIT_RGI and more precisely the module RGI_BETON. Let us specify that KIT_RGI is a set of three modules allowing to take into account the deformation differed from the concrete with FLUA_PORO_BETON, the damage of the concrete with ENDO_PORO_BETON and the reaction alkali-aggregate with RGI_BETON. A free test of swelling under the effect of the reaction alkali-aggregate on a test-tube is simulated. Let us specify that the properties materials do not correspond to a real concrete.

1 Problem of Reference

The digital simulations carried out here aim to check the capacity of the model to reproduce the evolution of swellings of a test-tube in free swelling.

1.1 Geometry

The test is based on the representation of a test-tube $13 \times 24\, cm$.



1.2 Property of materials

Young modulus: $E = 38000\, MPa$
Poisson's ratio: $\nu = 0.13$
Tensile strength: $\sigma_{ft} = 3.7\, MPa$
Compressive strength: $\sigma_{fc} = 38.3\, MPa$
Deformation with the peak of compression: $\varepsilon_{fc} = 2{,}0 . 10^{-3}$
Deformation with the peak of traction: $\varepsilon_{ft} = 2{,}0 . 10^{-4}$
The properties materials of the RAG are the following ones:

- ALUC = $ALUC = 500\, mol/(mm^3)$,
- SULC = $SULC = 177\, mol/(mm^3)$,
- SILC = $SILC = 1354\, mol/(mm^3)$,
- TDEF = $TDEF = 20\,°C$,
- TAAR = $TAAR = 120\, s^{-1}$ ¿ ,
- SSDE = $SSDE = 0{,}95$,
- SSAR = $SAAR = 0{,}2$,
- VAAR = $VAAR = 0{,}0055\, mm^3$,
- VETT = $VETT = 715\text{e-}6\, mm^3$,
- VVAR = $VVAR = 0{,}15 * VAAR\, mm^3$,

- VVDE = $VVDE=0{,}0001\,mm^3$,
- BAAR = $BAAR=0{,}23$,
- BDEF = $BDEF=1$,
- MAAR = $MAAR=27700.0\,MPa$,
- MDEF = $MDEF=0\,MPa$,
- COTH = $\coth=0$,
- CORG = $CORG=0$,
- ID0 = $ID0=0$,
- ID1 = $ID1=6{,}2$,
- ID2 = $ID2=11$,

Only asymptotic swellings are taken into account for the identification of the parameters " RAG ". For each test-tube, simulation takes into account the degree of saturation as well as stresses axial and radial.
The parameters of creep are identified in order to represent the following curves of creep:

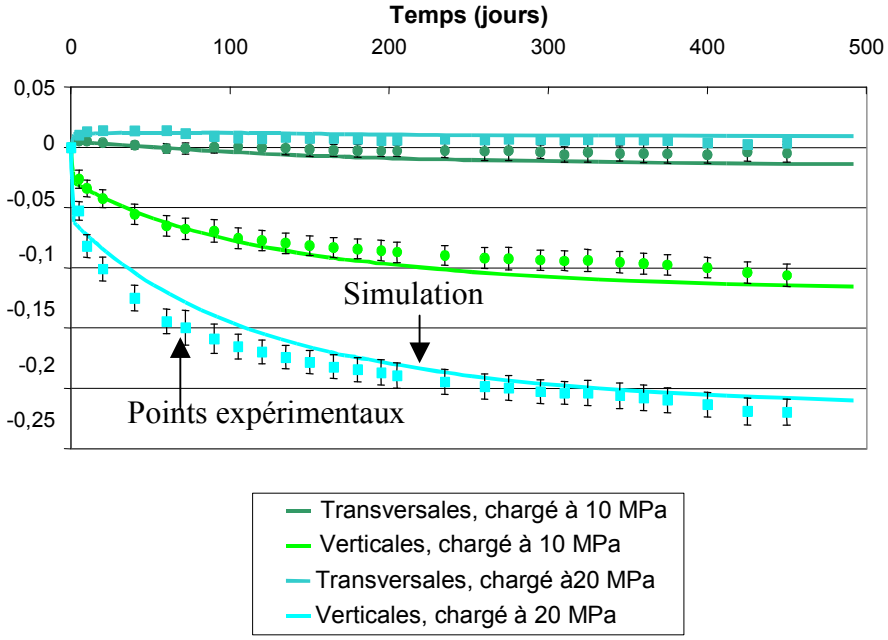


Figure 1.2-1 : Identification of the parameters of creep (FLUA_PORO_BETON) on a creep test

1.3 Boundary conditions and loadings

It is here about a test-tube in free swelling.

The loading is done by the variables of ordering of temperature and saturation:
- The coefficient of saturation varies linearly from 0.83 with $t=0\ jours$ to 0.54 with $t=500\ jours$.
- The temperature is constant equal to $20\,°C$ of $t=0\ jours$ with $t=28\ jours$.
- The temperature varies linearly $20\,°C$ with $t=28\ jours$ with 38 °C with $t=29\ jours$.
- The temperature is constant equal to $38\,°C$ of $t=29\ jours$ with $t=500\ jours$.

Boundary conditions:
- $DY=0$ on the face $N2N3N6N5$
- $DNOR=0$ on the face $N2N1N4N5$

- $DZ=0$ on the lower face
- a pressure is applied to the upper surface and follows the following function:
  with $t=0.0\ jour\ ,\ P=0{,}00001\ MPa$
  with $t=28\ jours\ ,\ P=0{,}00001\ MPa$
  with $t=29\ jours\ ,\ P=0{,}00000001\ MPa$
  with $t=500\ jours\ ,\ P=0{,}00000001\ MPa$

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 answer of model KIT_RGI is illustrated by the following figure:

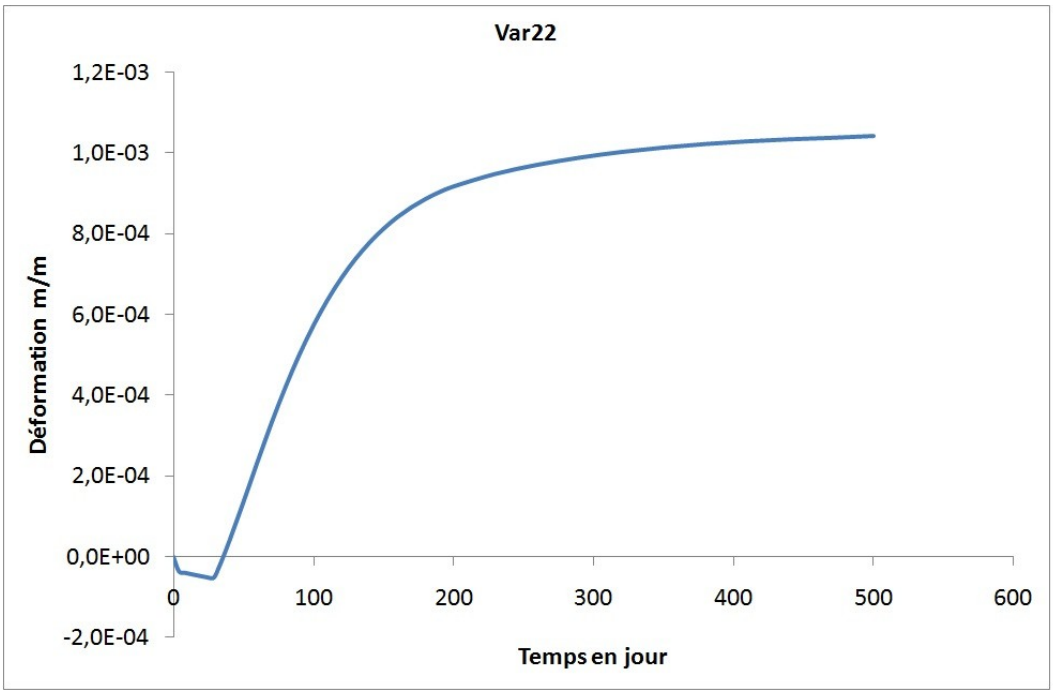


Figure 2-2: Vertical deformation of the test-tubes in free swelling

This curve does not characterize a real concrete. Only the general form is required. The values tested are displacements DZ, the volume of freezing induced by the RAG $V22$ and pressure of freezing $V18$ on the node $N5$ at several moments.

2.3 Uncertainties on the solution

Without object

2.4 Bibliographical references

Nothing

3 Modeling A

3.1 Characteristic of modeling

The problem is modelled in 3D.

3.2 Characteristic of the grid

1 mesh PENTA6

3.3 Sizes tested and results

Sizes tested with the node $N5$ afterwards the calculation of RGI_BETON are the volume of freezing of RAG $V22(N5)$ with the sequence number 8 and the deformation $DZ(N5)$ with the sequence number 39. At the end of the calculation of KIT_RGI, deformations $DZ(N6)$ with the node $N6$ and $DZ(N5)$ with the node $N5$ are tested respectively with the sequence numbers 8 and 39. Pressure of freezing $V18(N5)$ is tested with the node $N5$ and with the sequence number 39

4 Summary of the results

The results calculated by Code_Aster check the not-regression.