SSNV237 - Law of behavior KIT_RGI : Clean creep tests with taking into account of the damage

Summary:

This document presents a test making it possible to validate the capacities of the model of behavior KIT_RGI to couple creep and the damage. 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. Creep tests specific to various levels of loading are simulated. The results of simulation are compared with the experimental tests of work of Rolls [bib1].

1 Problem of Reference

This case test supports on the creep tests carried out by [Roll, 1969]. Four level of loading are studied: 0.2σ_{fc}, 0.35σ_{fc}, 0.5σ_{fc} and 0.65σ_{fc}. Where σ_{fc} is the limit in compression of the concrete.

1.1 Geometry

The test is pressed on a unit cubic finite element with 8 nodes. 1 mesh HEXA8

1.2 Property of materials

The studied material is a concrete whose properties are defined in work of [bib1].

Young modulus: $E=41838\,MPa$
Poisson's ratio: $\nu=0.17$
Tensile strength: $\sigma_{ft}=4\,MPa$
Compressive strength: $\sigma_{fc}=42\,MPa$
Deformation with the peak of compression: $\varepsilon_{fc}=2.10^{-3}$
Deformation with the peak of traction: $\varepsilon_{ft}=1.10^{-4}$

Table 1.2-1 : Values of the parameters of clean creep, identified starting from the experimental results. (Unit of time in the D-day and the lengths are in mm)

$CBIO=0,3$	$MU=0$
$MSAT=0$	$DT80=0,3$
$SFLD=12$	$STMP=1,0$
$MG=0$	$KTMP=4,5$
$VG0=0$	$YISY=3$
$PORO=0,12$	$TAU1=1$
$TKVP=0,1$	$TAU2=7$
$NRJA=36500$	$EKFL=1,2E-3$
$MSHR=0$	$DFMX=1$
$KD=0$	$TREF=0,00139$

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 creep is employed by using in STAT_NON_LINE law FLUA_PORO_BETON.

1.3 Boundary conditions and loadings

Perpendicular displacements according to three faces of the cubes are blocked in order to model an unconfined compression test. On another face, a surface pressure is applied in $t=0.1\,jour$ and maintained for one duration of $t=210\,jours$
The value of the pressure is successively of: 0.2 σ_{fc} , 0.35 σ_{fc} , 0.5 σ_{fc} and 0.65 σ_{fc} . Four calculation are thus carried out. The boundary conditions and the loading are schematized on the following figure:

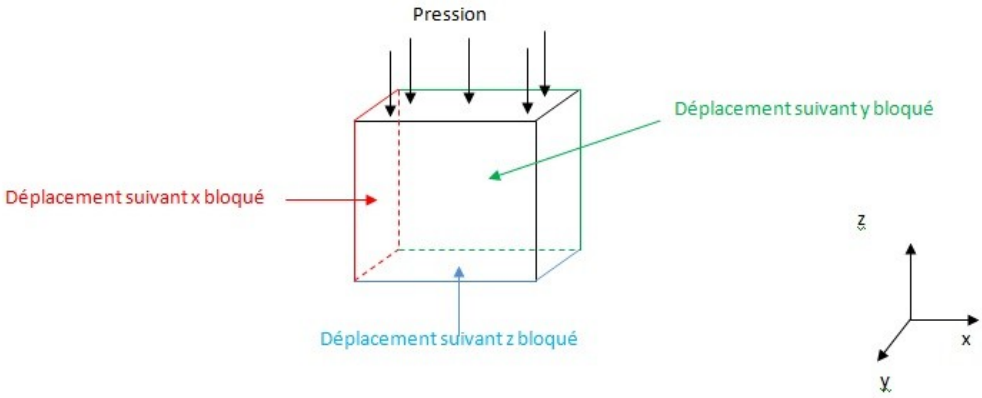

Figure 1.3-1 : Boundary conditions and mechanical loading on a cube of 1 mm of with dimensions.

1.4 Initial conditions

Nothing

2 Reference solution

2.1 Method of calculation

A method of nonregression is applied.

2.2 Sizes and results of reference

The sizes tested are thus the total deflections $EPZZ(N7)$. The values of reference according to the pressure applied are provided in the following tables:
For 0.2 σ_{fc}, 0.35 σ_{fc}, 0.5 σ_{fc}, 0.6 σ_{fc}.

It appears clearly that more the load is strong plus the deformations related to clean creep are important. The model makes it possible to find results close to the article to Rolls [bib1] .

2.3 Uncertainties on the solution

Without object

2.4 Bibliographical references

[1] F.Rools, “Long Time Creep Recoveryof Highly Stressed Concrete Cylinders”, Symponium one Creep, 1969

3 Modeling A

3.1 Characteristic of modeling

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

3.2 Characteristic of the grid

1 mesh HEXA8

3.3 Sizes tested and results

$\boxed{EPZZ(N3)}$ on the node $N3$ for moments 24,55,71,82 and 94 for 0.2 $\boxed{\sigma_{fc}}$, 0.35 $\boxed{\sigma_{fc}}$, 0.5 $\boxed{\sigma_{fc}}$, 0.6 $\boxed{\sigma_{fc}}$.

4 Summary of the results

Results calculated by *Code_Aster* check the not-regression. It appears well that the model makes it possible to couple the damage and creep. Without this coupling, it will be impossible to find the results of work of Rolls [bib1].