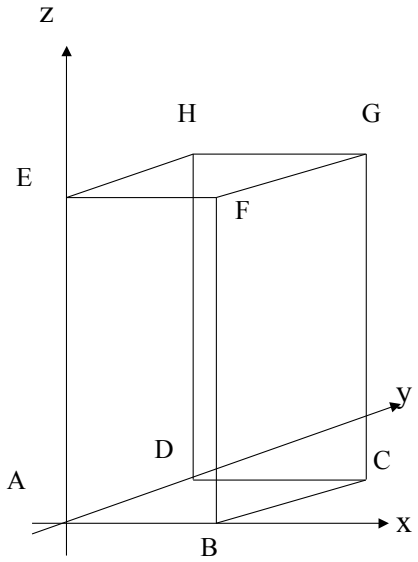
WTNV121- Damping of the concrete with a damage model

Summarized:

This test makes it possible to validate the connection of damage models ENDO_ISOT_BETON and MAZARS with modelizations HHM. The intrinsic permeability under key word PERM_END is an user datum in the form of formula, function of the variable of damage. It is a case test of non regression.

1 Problem of reference

1.1 Geometry



height: $h=10\text{m}$
width: $l=1\,m$
thickness: $e=1\,m$

1.2 Properties of the material

$E=39.5\,E+9\,Pa$
$\nu=0{,}245$
$\rho=2370\,kg/m^3$
$\alpha=1.\,E-5$

For the model ENDO_ISOT_BETON and under key word BETON_ECRO_LINE :

$\sigma_y=6.10^6\,Pa$; $E_T=-6.10^5\,Pa$

For the model MAZARS:

$k=0.7$; $\varepsilon_{d0}=1.510^{-4}$; $A_c=1.15$; $A_t=1.0$; $B_c=1391.3$; $B_t=10000.$

Some characteristics related to the Thermohydraulic problem are summarized in the following table:

Liquid water	Density ($kg.m^{-3}$) Heat capacity ($J\,kg^{-1}K^{-1}$) thermal Coefficient of thermal expansion of the fluid (K^{-1})	1.103 4180 0.6619310-4
Vapor	Heat capacity Molar mass ($kg\,mole^{-1}$)	1870 28,96 10-3
initial State	Porosity capillary Pressure (Pa) Pressure of gas (Pa) initial Saturation out of fluids	0,149 0. 1.013 E5 0,74
Constant	Constant of perfect gases	8,315
homogenized Coefficients	homogenized Density capillary Curve Coefficient of Biot	2265 $S(P_c)=(1+(p_c*2{,}1433*10^{-8})^{1{,}825})^{-0{,}57609}$ 1

1.3 Boundary conditions and loadings

the mechanical boundary conditions are such as displacements perpendicular to each facet are prevented. Damping consists of the application of a capillary pressure on the upper face of the structure which decreases in time.

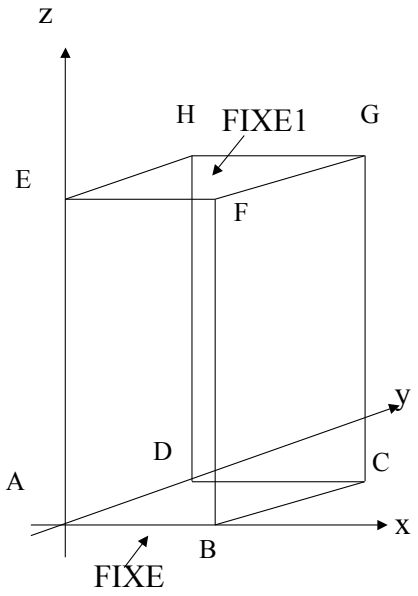
2 Reference solution

This test is a test of NON-regression.

3 Modelization A

3.1 Characteristic of the modelization

Modelization 3D - ENDO_ISOT_BETON like damage model



3.2 Characteristics of the mesh

Many nodes: 209
Number of meshes: 10 of type HEXA20
42 of type QUAD8

the following mechanical boundary conditions are imposed:

$FIXE$	$DZ=0$
$FIXE1$	$DZ=0$
$ABFE$	$DY=0$
$CDHG$	$DY=0$
$DAEH$	$DX=0$
$BCGF$	$DX=0$

To simulate a damping, the loading is made up in the application of a capillary pressure on the face $FIXE1$ of value $PRE1=37.1\,MPa$ which decreases with time.

3.3 Quantities tested and results

the component σ_{zz} of the stress, the value of the capillarity $PRE1$, the gas pressure $PRE2$ and the variable of damage D are tested to times 0.5 and 1. with the nodes group E. The values tested are values with the nodes, this is why they largely exceed $6MPa$, the elastic limit of the concrete, at the first time of computation.

Standard	identification of reference	Value	Tolerance
σ_{zz} to time 0.5	"NON_REGRESSION"	5.77301E+6	0.10%
σ_{zz} at time 1.	"NON_REGRESSION"	5.59655E+6	0.10%
$PRE1$ at time 0.5	"NON_REGRESSION"	3.714495E+7	0.10%
$PRE1$ at time 1.	"NON_REGRESSION"	3.714495E+7	0.10%
$PRE2$ at time 0.5	"NON_REGRESSION"	5.94425E+4	0.10%
$PRE2$ at time 1.	"NON_REGRESSION"	6.2749E+4	0.10%
D at time 0.5	"NON_REGRESSION"	7.78955E-4	0.10%
D at time 1.	"NON_REGRESSION"	7.78955E-4	0.10%

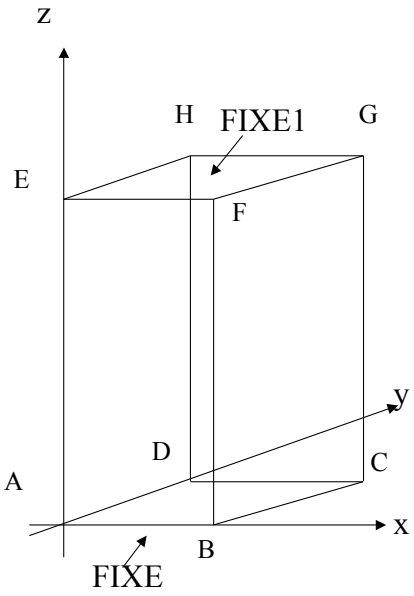
One tests the extraction of a local variable:

Standard	identification of reference	Value	Tolerance
$X1$ to the node N_{90} of the mesh M_{10} at the sequence number 1	"NON_REGRESSION"	3.89478E-4	0.001%

4 Modelization B

4.1 Characteristic of the modelization

Modelization 3D - MAZARS like damage model



4.2 Characteristics of the mesh

Many nodes: 209
Number of meshes: 10 of type HEXA20
42 of type QUAD8

the following mechanical boundary conditions are imposed:

$FIXE$	$DZ=0$
$FIXE1$	$DZ=0$
$ABFE$	$DY=0$
$CDHG$	$DY=0$
$DAEH$	$DX=0$
$BCGF$	$DX=0$

To simulate a damping, the loading is made up in the application of a capillary pressure on the face $FIXE1$ of value $PRE1=37.1\,MPa$ which decreases with time.

4.3 Quantities tested and results

the component σ_{zz} of the stress is tested with time 1 and the value of the capillarity $PRE1$ at time 1 with the nodes group E .

Values of σ_{zz} :

Standard	time of Reference	Reference	Tolerance (%)
1.	NON_REGRESSION	2531.90497	0.001

Values of $PRE1$:

Standard	time of Reference	Reference	Tolerance (%)
1.	NON_REGRESSION	$3.714495\,10^{7}$	0.001

5 Summary of the results

This case test is a case test of NON-regression of which the goal is to test the connection of damage models MAZARS and ENDO_ISOT_BETON with modelization HHM. This case test does not have the ambition to compare the results of the two models of damage.