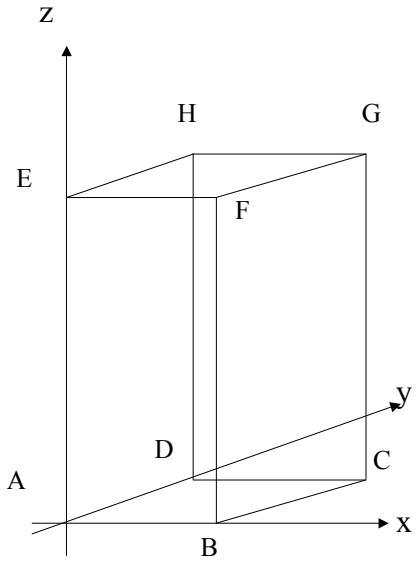
WTNV121- Damping of the concrete with a law of damage

Summary:

This test makes it possible to validate the connection of the laws of damage ENDO_ISOT_BETON and MAZARS with modelings HHM. The intrinsic permeability under the keyword PERM_END is an user datum in the form of formula, function of the variable of damage. It is a case test of nonregression.

1 Problem of reference

1.1 Geometry



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

1.2 Properties of 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 the keyword 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-storage capacity ($J\ kg^{-1}\ K^{-1}$) Thermal dilation coefficient of the liquid (K^{-1})	1.10^3 4180 0.6619310^{-4}
Vapor	Heat-storage capacity Molar mass ($kg\ mole^{-1}$)	1870 $28.96\ 10^{-3}$
Initial state	Porosity Capillary pressure (Pa) Gas pressure (Pa) Initial saturation in liquid	0.149 0. 1,013 E5 0.74
Constants	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 boundary conditions mechanical are such as displacements perpendicular to each facet are prevented. Damping consists of the application of a capillary pressure on the higher face of the structure which decreases in time.

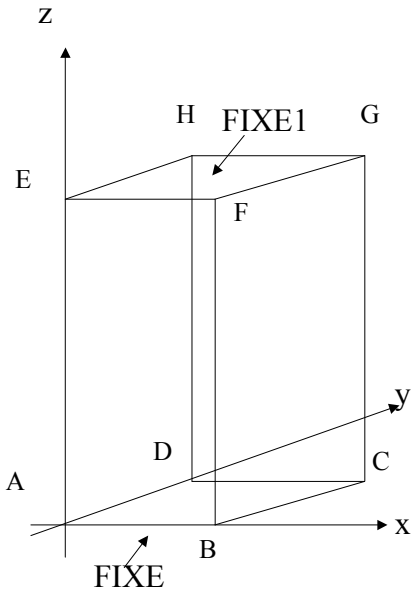
2 Reference solution

This test is a test of not-regression.

3 Modeling A

3.1 Characteristics of modeling

Modeling 3D - ENDO_ISOT_BETON like law of damage



3.2 Characteristics of the grid

Many nodes: 209
Many meshs: 10 of type HEXA20
42 of type QUAD8

One imposes the boundary conditions mechanical following:

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

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

3.3 Sizes tested and results

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

Identification	Type of reference	Value	Tolerance
σ_{zz} at the moment 0.5	'NON_REGRESSION'	5.77301E+6	0,10%
σ_{zz} at the moment 1.	'NON_REGRESSION'	5.59655E+6	0,10%
$PRE1$ at moment 0.5	'NON_REGRESSION'	3.714495E+7	0,10%
$PRE1$ at moment 1.	'NON_REGRESSION'	3.714495E+7	0,10%
$PRE2$ at moment 0.5	'NON_REGRESSION'	5.94425E+4	0,10%
$PRE2$ at moment 1.	'NON_REGRESSION'	6.2749E+4	0,10%
D at moment 0.5	'NON_REGRESSION'	7.78955E-4	0,10%
D at moment 1.	'NON_REGRESSION'	7.78955E-4	0,10%

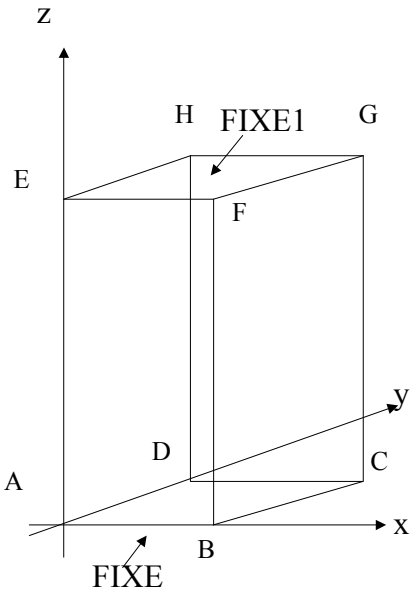
One tests the extraction of an internal variable:

Identification	Type of reference	Value	Tolerance
$X1$ with the node N_{90} mesh M_{10} with the sequence number 1	'NON_REGRESSION'	3.89478E-4	0,001%

4 Modeling B

4.1 Characteristics of modeling

Modeling 3D - MAZARS like law of damage



4.2 Characteristics of the grid

Many nodes: 209
Many meshs: 10 of type HEXA20
42 of type QUAD8

One imposes the boundary conditions mechanical following:

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

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

4.3 Sizes tested and results

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

Values of σ_{zz} :

Moment	Type of Reference	Reference	Tolerance (%)
1.	NON_REGRESSION	2531.90497	0,001

Values of $PRE1$:

Moment	Type 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 not-regression of which the goal is to test the connection of the laws of damage MAZARS and ENDO_ISOT_BETON with modeling HHM. This case test does not have the ambition to compare the results of the two models of damage.