

## WTNV129 - Triaxial compression test not drained with the model of Hoek-Brown modified in total constraints

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### Summary

This test makes it possible to validate the elastoplastic law of behavior of Hoek-Brown modified in total constraints is `HOEK_BROWN_TOT` with hydraulic coupling. It is about a triaxial compression test in not drained condition. The aspect not drained is modelled by a worthless voluminal deformation of the skeleton and the hydraulic coupling is taken into account. The sample is completely saturated, the incompressible skeleton and the fluid being supposed.

For reasons of symmetry, one is interested only in the eighth of a sample subjected to a triaxial compression test.

The level of containment applied is of  $5\text{ MPa}$ .

It is about a test of nonregression.

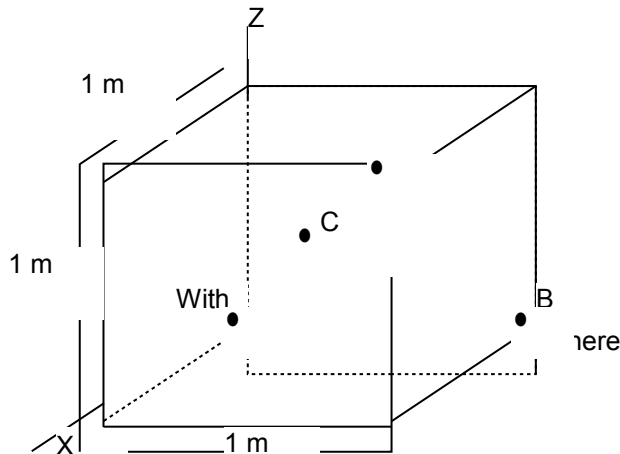
Modeling A is a modeling of the type `3D_HM` with integration at the points of Gauss.

Modeling B is a modeling of the type `3D_HMS` with integration at the points of Gauss or the nodes (see Doc. [R7.01.10]).

## 1 Problem of reference

### 1.1 Geometry

A cube of dimension here is considered  $1\text{ m} \times 1\text{ m} \times 1\text{ m}$ .



Coordinates of the points (in  $m$ ):

	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>
<i>x</i>	0	0	0.5	1
<i>y</i>	0	1	0.5	1
<i>z</i>	0	0	0.5	1

### 1.2 Properties of material

Parameters of the elastic law of behavior:

$$E = 4500 \text{ MPa}$$

$$\nu = 0.3$$

Parameters of the law of Hoek-Brown modified:

$$\gamma^{rup} = 0.005$$

$$\gamma^{res} = 0.017$$

$$(S \sigma_c^2)^{end} = 225 \text{ MPa}^2$$

$$(S \sigma_c^2)^{rup} = 482.5675 \text{ MPa}^2$$

$$(m \sigma_c^2)^{end} = 13.5 \text{ MPa}$$

$$(m \sigma_c^2)^{rup} = 83.75 \text{ MPa}$$

$$\beta = 3 \text{ MPa}$$

$$\phi^{rup} = 15^\circ$$

$$\phi^{res} = 30^\circ$$

$$\alpha = 3.3$$

## 1.3 Initial conditions, with the limits and loading

The test breaks up into two phases:

- 1) Initially, one brings the sample in a homogeneous state  $\sigma_{xx}^0 = \sigma_{yy}^0 = \sigma_{zz}^0$ . For that, the corresponding confining pressure is imposed on the front faces ( $x = 1$ ), side right-hand side ( $y = 1$ ) and higher ( $z = 1$ ), the water pressures are taken worthless everywhere and displacements are taken worthless on the faces postpones ( $u_x|_{x=0} = 0$ ), side left ( $u_y|_{y=0} = 0$ ) and lower ( $u_z|_{z=0} = 0$ ).
- 2) Once the homogeneous state obtained, displacements are maintained blocked on the faces postpones, side left and lower. Hydraulic flows are worthless on all the faces. A displacement is imposed on the higher face ( $u_z(t)$ ) in order to obtain a deformation  $\varepsilon_{zz}$  equalize with  $-25\%$  starting from the beginning of the second phase, by constant increments of deformation  $\Delta\varepsilon_{zz} = -2.5E - 4$ . On the front faces and side right-hand side, one imposes boundary conditions in total constraint:  $\sigma \cdot n = \sigma^0 = -5MPa$ .

## 2 Modeling A

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### 2.1 Characteristics of modeling

Modeling 3D

Cutting: 1m in height, 1m in width

Loading of phase 1:  $\sigma_{xx}^0 = \sigma_{yy}^0 = \sigma_{zz}^0 = -5$  MPa (confining pressure)

Boundary conditions:  $u_x|_{x=0} = u_y|_{y=0} = u_z|_{z=0} = 0$

Coefficient of Biot: 1

UN\_SUR\_K water: 0 (coefficient of incompressibility of water)

Modeling: 3D\_HM

### 2.2 Characteristics of the grid

Many nodes: 20

Many meshes and types: 6 QUAD8 and 1 HEXA20

## 2.3 Sizes tested and results

Localization	Sequence number	Constraint ( MPa )	Code_Aster
Not D	16	$\sigma'_{xx}$	1.14121
	28	$\sigma'_{xx}$	1.94894
	36	$\sigma'_{xx}$	1.49781
	44	$\sigma'_{xx}$	-2.69068
	52	$\sigma'_{xx}$	-1.24045 10 <sup>1</sup>
	80	$\sigma'_{xx}$	-3.72255 10 <sup>1</sup>
	16	$\sigma'_{yy}$	1.14121
	28	$\sigma'_{yy}$	1.94894
	36	$\sigma'_{yy}$	1.49781
	44	$\sigma'_{yy}$	-2.69068
	52	$\sigma'_{yy}$	-1.24045 10 <sup>1</sup>
	80	$\sigma'_{yy}$	-3.72255 10 <sup>1</sup>
	16	$\sigma'_{zz}$	-1.74245 10 <sup>1</sup>
	28	$\sigma'_{zz}$	-2.23066 10 <sup>1</sup>
	36	$\sigma'_{zz}$	-2.6216810 <sup>1</sup>
	44	$\sigma'_{zz}$	-2.95247 10 <sup>1</sup>
	52	$\sigma'_{zz}$	-3.24666 10 <sup>1</sup>
	80	$\sigma'_{zz}$	-5.2947 10 <sup>1</sup>
	16	Pressure water	6.14121
	44	Pressure water	2.30931
	80	Pressure water	-3.2225 10 <sup>1</sup>

## 3 Modeling B

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### 3.1 Characteristics of modeling

Modeling 3D

Cutting: 1m in height, 1m in width

Loading of phase 1:  $\sigma_{xx}^0 = \sigma_{yy}^0 = \sigma_{zz}^0 = -5$  MPa (confining pressure)

Boundary conditions:  $u_x|_{x=0} = u_y|_{y=0} = u_z|_{z=0} = 0$

Coefficient of Biot: 1

UN\_SUR\_K water: 0 (coefficient of incompressibility of water)

Modeling: 3D\_HMS

### 3.2 Characteristics of the grid

Many nodes: 20

Many meshes and types: 6 QUAD8 and 1 HEXA20

## 3.3 Sizes tested and results

Localization	Sequence number	Constraint ( MPa )	Code_Aster
Not D	16	$\sigma'_{xx}$	1.14121
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	80	$\sigma'_{zz}$	-5.2947 10 <sup>1</sup>
	16	Pressure water	6.14121
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	80	Pressure water	-3.2225 10 <sup>1</sup>

## 4 Summary of the results

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This case test is a test of not-regression developed to validate the model of Hoek-Brown modified in total constraints, HOEK\_BROWN\_TOT with hydraulic coupling.

One finds the same results with two modelings 3D\_HM and 3D\_HMS.