WTNV128 - Triaxial compression test not drained with the model of Hoek-Brown modified in effective stresses

Summarized

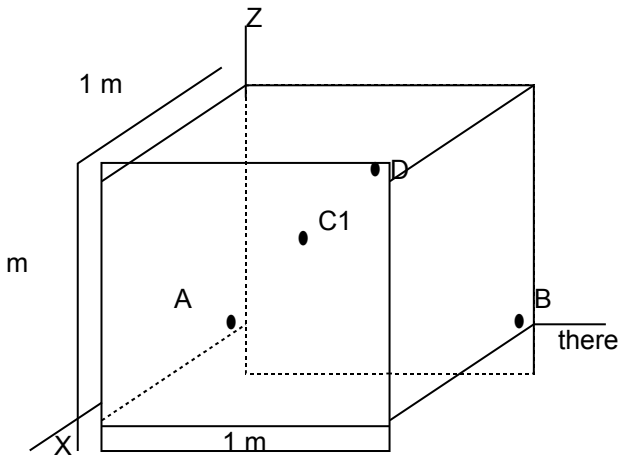
This test makes it possible to validate the elastoplastic constitutive law of Hoek-Brown modified in effective stresses, that is to say HOEK_BROWN_EFF with hydraulic coupling. It is about a triaxial compression test in not drained condition. The aspect not drained is modelled by a voluminal strain null squelette and the hydraulic coupling is taken into account. The sample is completely saturated, the incompressible squelette 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 $5 MPa$.
It is about a test of non regression.

The modelization A is a modelization of the type 3D_HM with integration with Gauss points.
The modelization B is a modelization of the type 3D_HMS with integration with Gauss points or the nodes (see Doc. [R7.01.10]).

1 Problem of reference

1.1 Geometry

One considers a cube of dimension here $1\mathrm{m}\times 1\mathrm{m}\times 1\mathrm{m}$.



Coordinates of the points (in m):

	A	B	C	D
x	0	0.0.5		1
y	0	1.0.5		1
z	0	0.0.5		1

1.2 Properties of the material

Parameters of the elastic constitutive law:

$E=4500\,MPa$
$\nu=0.3$

Parameters of the model of Hoek-Brown modified:

$\gamma^{rup}=0.005$
$\gamma^{res}=0.017$
$(S\sigma_c^2)^{end}=225\,MPa^2$
$(S\sigma_c^2)^{rup}=482.5675\,MPa^2$
$(m\sigma_c^2)^{end}=13.5\,MPa$
$(m\sigma_c^2)^{rup}=83.75\,MPa$
$\beta=3\,MPa$
$\phi^{rup}=15°$
$\phi^{res}=30°$
$\alpha=3.3$

1.3 Initial conditions, in extreme cases 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 sides ($x = 1$), side right ($y = 1$) and higher ($z = 1$), the water pressures are taken null everywhere and the displacements are taken null on the sides postpones ($u_x\big|_{x=0} = 0$), side left ($u_y\big|_{y=0} = 0$) and lower ($u_z\big|_{z=0} = 0$).
2) Once the homogeneous state obtained, displacements are maintained blocked on the sides postpones, side left and lower. The hydraulic flux are null on all the sides. A displacement is forced on the upper face ($u_z(t)$) in order to obtain a strain ε_{zz} equal to – 25% starting from the beginning of the second phase, by constant increments of strain $\Delta\varepsilon_{zz} = -2.5E-4$. On the front sides and side right, one imposes boundary conditions in total stress: $\sigma \cdot n = \sigma^0 = -5MPa$.

2 Modelization A

2.1 Characteristic of the modelization

Modelization 3D
Cutting: $1\mathrm{m}$ in height, $1\mathrm{m}$ width
Loading of phase 1: $\sigma_{xx}^{0} = \sigma_{yy}^{0} = \sigma_{zz}^{0} = -5\,\mathrm{MPa}$ (confining pressure)
Boundary conditions: $u_x\big|_{x=0} = u_y\big|_{y=0} = u_z\big|_{z=0} = 0$
Coefficient of Biot: 1
UN_SUR_K of water: 0 (coefficient of incompressibility of water)
Modelization: 3D_HM

2.2 Characteristic of the mesh

Many nodes: 20
Number of meshes and types: 6 QUAD8 and 1 HEXA20

2.3 Quantities tested and results

Localization	Sequence number	Forced (MPa)	*Code_Aster*
Point D	16	σ_{xx}	-0.239568
	28	σ_{xx}	-0.257851
	36	σ_{xx}	-1.10550
	44	σ_{xx}	-4.29762
	52	σ_{xx}	-7.28266
	80	σ_{xx}	-15.7587
	16	σ_{yy}	-0.239568
	28	σ_{yy}	-0.257851
	36	σ_{yy}	-1.10550
	44	σ_{yy}	-4.29762
	52	σ_{yy}	-7.28266
	80	σ_{yy}	-15.7587
	16	σ_{zz}	-16.0195
	28	σ_{zz}	-20.4913
	36	σ_{zz}	-24.7968
	44	σ_{zz}	-28.9045
	52	σ_{zz}	-33.7174
	80	σ_{zz}	-54.1101
	16	Pressure water	5.23957
	44	Pressure water	0.702380
	80	Pressure water	-10.7587

3 Modelization B

3.1 Characteristic of the modelization

Modelization 3D
Cutting: $1\mathrm{m}$ in height, $1\mathrm{m}$ width
Loading of phase 1: $\sigma_{xx}^{0} = \sigma_{yy}^{0} = \sigma_{zz}^{0} = -5\,\mathrm{MPa}$ (confining pressure)
Boundary conditions: $u_x\big|_{x=0} = u_y\big|_{y=0} = u_z\big|_{z=0} = 0$
Coefficient of Biot: 1
UN_SUR_K of water: 0 (coefficient of incompressibility of water)
Modelization: 3D_HMS

3.2 Characteristics of the mesh

Many nodes: 20
Number of meshes and types: 6 QUAD8 and 1 HEXA20

3.3 Quantities tested and results

Localization	Sequence number	Forced (MPa)	*Code_Aster*
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	52	σ_{zz}	-33.7174
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4 Summary of the results

This case test are a test of NON-regression developed to validate the model of Hoek-Brown modified in effective stresses, HOEK_BROWN_EFF, with hydraulic coupling.

One 3D_HM gets the same results with the two modelizations or 3D_HMS.