WTNA101 – Triaxial compression test NON-drained with a softening behavior DRUCK_PRAGER

Summarized:

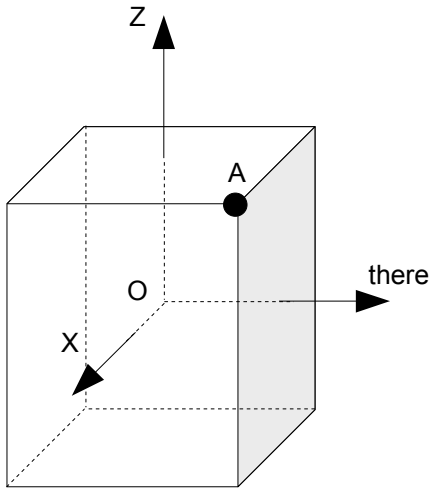
This benchmark makes it possible to during implement a triaxial compression test NON-drained on two different modelizations a nonlinear computation. That makes it possible to propose the effect of negative, parabolic or linear hardening, in the case of model 3D_HM.

Modelization a:
•Models of type " DRUCK_PRAGER " with linear negative hardening for a containment of $2\,MPa$.
•Modelization 3D_HM with meshes HEXA20 .

Modelization b:
•Models of type " DRUCK_PRAGER " with parabolic negative hardening for a containment of $2\,MPa$.
•Modelization 3D_HM with meshes HEXA20 .

1 Problem of reference

1.1 Geometry



Geometry of the cube:

Do not center $O(0.,0.,0.)$
$A(0.5,0.5,0.5)$
Cubes of with dimensions $1\,m$

1.2 Properties of the Elastic

•material
• $E=5800.0\,E6\,Pa$ Young Modulus
• $\rho=2500\,kg.m^{-3}$ Density
• $\nu=0.3$ Poisson's ratio

•DRUCK_PRAGER with negative hardening linear
• $\alpha=0.33$ Coefficient of dependence in pressure
• $p_{ultm}=0.01$ cumulated Plastic strain ultimate
• $\sigma^{Y}=2.57\,E6\,Pa$ plastic Stress
• $h=-2.00\,E8\,Pa$ Hardening modulus

•DRUCK_PRAGER with negative hardening parabolic
• $\alpha=0.33$ Coefficient of dependence in pressure
• $p_{ultm}=0.01$ cumulated Plastic strain ultimate
• $\sigma^{Y}=2.57\,E6\,Pa$ ultimate Forced
• $\sigma^{Y}_{ultm}=0.57\,E6\,Pa$ plastic Stress

•Behavior hydraulic: liquidates saturated

- $Pre1=1\ Pa$ Pressure with fluid of reference
- $\rho_{pre1}=1000\,kg.m^{-3}$ Density of water
- $Poro=0.14$ initial Porosity
- $\rho_{vh}=2400\,kg.m^{-3}$ Density homogenized
- $bio=1$ Coefficient of intrinsic
- $K_{intrinsèque}=1\,E-18\ m^2$ Biot Permeability
- $\frac{1}{K_l}=0$ Liquidates incompressible
- $vi=1.0\,E-3\ Pa.s$ Viscosity

1.3 Boundary conditions and loadings

the boundary conditions and the loadings are applied in two stages:

•Stage $A\ :\ t\in[0,1.]$

Boundary conditions

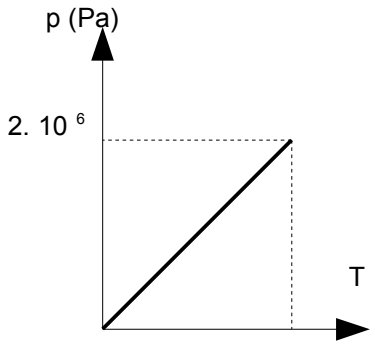
•Pressure with the nodes $PRE1=0.$

•Displacements imposed, of symmetry, on the sides of the cube pertaining to the Loadings

$X=-0.5 \quad DX=0$
$Y=-0.5 \quad DY=0$
$Z=-0.5 \quad DZ=0$

planes

•One gradually applies a compression $p=2.10^6\,Pa$ to the sides of the cube pertaining to the planes: $X=0.5$, $Y=0.5$ and $Z=0.5$



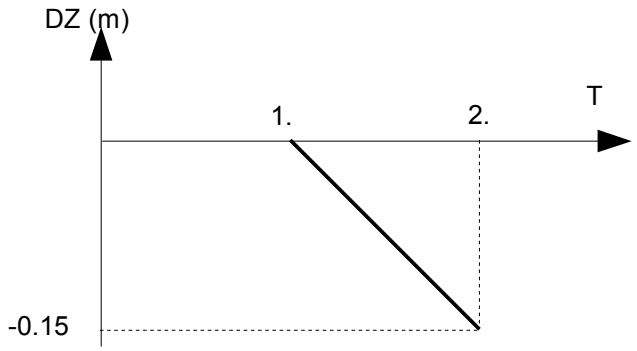
1.

•Stage b: $t \in]1,2.]$

From the stress state obtained at time $t=1.s$, one applies to the sides of the cube the following conditions:

Displacements

•For the face belonging to plane $Z=0.5$ one gradually applies displacement DZ , according to a slope:



•For the sides belonging to the planes $X=-0.5, Y=-0.5, Z=-0.5$ one applies conditions of symmetry.

Loadings: the loadings applied are constant:

•Face belonging to plane $X=0.5$ $p=2.10^6 Pa$
•Face belonging to plane $Z=0.5$ $p=2.10^6 Pa$

2 Reference solution

2.1 Variables reference

the reference variables are the following ones:

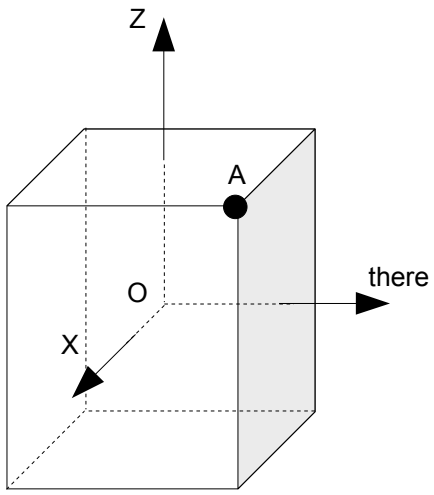
- Forced $SIXX$ with the node A
- Forced $SIZZ$ with the node A
- Pressure $Pre1$ with the node A

2.2 Result of reference

the reference variables correspond to those of the modelization A obtained with version 7.2.6 of Code_Aster. They are values of NON-regression.

3 Modelization A

3.1 Characteristic of the modelization A



Modelization 3D_HM,

Constitutive law of type DRUCK_PRAGER with a linear negative hardening:

Many nodes 20
Number of meshes 7 Are:

QUAD8	6
HEXA20	1

Mesh groups:

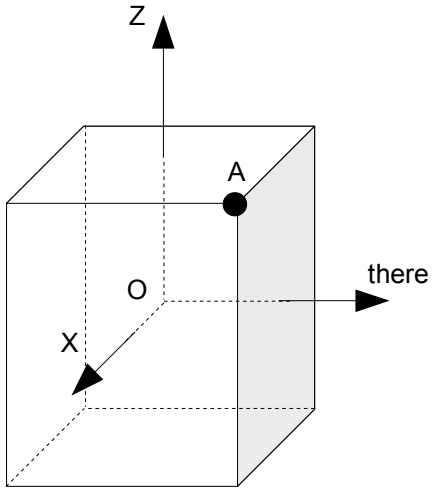
BAS :	surface cube belonging to plane	$Z=-0.5$
HAUT :	surface cube belonging to plane	$Z=+0.5$
DROITE :	surface cube belonging to plane	$Y=+0.5$
GAUCHE :	surface cube belonging to plane	$Y=-0.5$
DERRIERE :	surface cube belonging to plane	$X=-0.5$
DEVANT :	surface cube belonging to plane	$X=+0.5$

3.2 Quantity

Results	Not	$Inst$	Reference	Tolerance (%)
$SIXX\ (Pa)$	A	1.004	$-9.69\,E5$	0.01
		1.16	$-4.52\,E7$	0.01
		1.34	$-9.59\,E7$	0.01
		1.60	$-1.69\,E8$	0.01
$SIZZ\ (Pa)$	A	1.004	$-4.06\,E6$	0.01
		1.16	$-1.13\,E8$	0.01
		1.34	$-2.38\,E8$	0.01
		1.60	$-4.20\,E8$	0.01
$Pre1\ (Pa)$	A	1.004	$1.03\,E6$	0.01
		1.16	$-4.32\,E7$	0.01
		1.34	$-9.39\,E7$	0.01
		1.60	$-1.67\,E8$	0.01

4 Modelization B

4.1 Characteristic of the modelization B



Modelization 3D_HM,

Constitutive law of type DRUCK_PRAGER with a parabolic negative hardening:

Many nodes 20
Number of meshes 7 Are:

QUAD8	6
HEXA20	1

Mesh groups:

BAS :	surface cube belonging to plane	$Z=-0.5$
HAUT :	surface cube belonging to plane	$Z=+0.5$
DROITE :	surface cube belonging to plane	$Y=+0.5$
GAUCHE :	surface cube belonging to plane	$Y=-0.5$
DERRIERE :	surface cube belonging to plane	$X=-0.5$
DEVANT :	surface cube belonging to plane	$X=+0.5$

4.2 Results

the got results are identical to those of modelization A.

Grandeur	Not	$Inst$	Reference	Tolerance (%)
$SIXX\ (Pa)$	A	1.004	$-9.69\,E5$	0.01
		1.16	$-4.52\,E7$	0.01
		1.34	$-9.59\,E7$	0.01
		1.60	$-1.69\,E8$	0.01
$SIZZ\ (Pa)$	A	1.004	$-4.06\,E6$	0.01
		1.16	$-1.13\,E8$	0.01
		1.34	$-2.38\,E8$	0.01
		1.60	$-4.20\,E8$	0.01
$Pre1\ (Pa)$	A	1.004	$1.03\,E6$	0.01
		1.16	$-4.32\,E7$	0.01
		1.34	$-9.39\,E7$	0.01
		1.60	$-1.67\,E8$	0.01

5 Summary of the results

all the results got with this benchmark are satisfactory.