WTNV140 - Drained elastic triaxial compression test anisotropic

Summary:

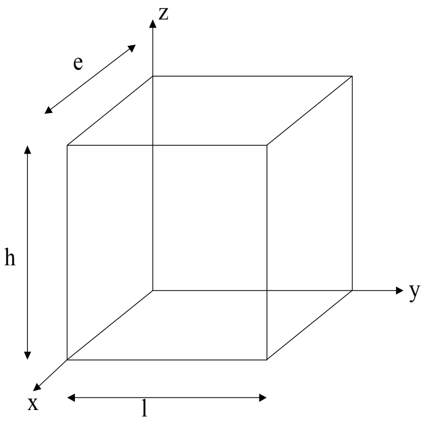
This test makes it possible to validate the mechanical part of the transverse anisotropy in THM. It is about a triaxial compression test with worthless pressure. This test can thus be compared with a case of pure mechanics.

The reference mark of anisotropy will be different from the principal reference mark. One tests various geometries (3D, 2D, AXI).

Modeling A is an elastic case in transverse 3D isotropy treated in pure mechanics then in HM.
Modeling B is an elastic case in 2D orthotropic treaty in pure mechanics then in HM.
Modeling C is an elastic case in axisymetry treaty in pure mechanics then in HM.

1 Problem of reference

1.1 Geometry



height: $h = 1\text{m}$
width: $l = 1\,m$
thickness: $e = 1\,m$
One will also distinguish for modelings C and D, a geometry 2D of $1\text{m} \times 1\text{m}$.

1.2 Properties of material

- Case general 3D (transverse isotropy)

Parameters specific to ELAS_ISTR :

$\%E_L = 9\,GPa \quad \%E_N = 18\,GPa \quad N_{LT} = 0.24 \quad N_{LN} = 0.48 \quad G_{LN} = 8.88\,GPa$

The transverse reference mark of anisotropy is defined by the nautical angles $\alpha = 30°$ and $\beta = -60°$.

- Case general 2D (orthotropism)

Parameters specific to ELAS_ORTH :

One will make for modelings C and D which are D_PLAN, an alternative by considering that the 2D plan corresponds to the plan of anisotropy. In this case:

$\%E_L = 9\,GPa \quad \%E_T = 18\,GPa$ and $\%E_N = 9\,GPa$

$N_{LT} = 0.48 \quad N_{LN} = 0.24 \quad \text{N}_{\%TN} = 0.48 \quad G_{LN} = 8.88\,GPa$

The transverse reference mark of anisotropy is defined by the nautical angle $\alpha = 40°$.

- Parameters related to the THM (here without impact since the pressure is kept worthless: $\text{PORO} = 0.14$, coefficients of Biot $B_L = 0.3$ and $B_N = 0.6$.

1.3 Boundary conditions and loadings

On the edge plan $x=1\text{m}$: application of containment $P=25\text{MPa}$
On the edge plan $z=1\text{m}$: application of containment $P=29\text{MPa}$ (case 3D)
On the edge plan $y=1\text{m}$: application of a displacement of $0{,}01\,m$ according to a slope of 1s .
Conditions of symmetry are applied to the other edges and the pressure is kept worthless everywhere (total drainage).

1.4 Initial conditions

The initial constraints are anisotropic (in the global level), that is to say:
$\sigma_{xx}=-25\text{MPa}$; $\sigma_{yy}=-22\text{MPa}$; $\sigma_{zz}=-29\text{MPa}$

2 Reference solution

For each modeling, a calculation in pure mechanics is used as reference to calculation THM.

3 Modeling A

Modeling A is a case of pure mechanics in transverse isotropy 3D (modeling already validated in addition) followed by same in modeling HM (elastic saturated modeling).

3.1 Characteristics of modeling

Modeling 3D_SI then Modeling 3D_HMS

3.2 Characteristics of the grid

Many meshs: $5\times5\times5$ of type HEXA20 and 150 QUAD8

3.3 Sizes tested and results

Displacements will be observed DX and DZ at the point of coordinates $(1,1,1)$, that is to say $N7$ and displacement in DY at the point of coordinate $(0.8, 0.2, 0.8)$ that is to say $N216$

It is checked that the results in HM are the same ones as in pure mechanics, which is used as reference:

Node	Moment	Size	Reference	Aster
$N7$	1	DX	Pure mechanical modeling	– 5.98E-3
$N7$	1	DY	Pure mechanical modeling	– 3.569E-3
$N216$	1	DY	Pure mechanical modeling	– 1.965E-3

4 Modeling B

Modeling B is a case of pure mechanics orthotropic 2D (modeling already validated in addition) followed by the same modeling in HM (elastic saturated modeling).

4.1 Characteristics of modeling

Modeling D_PLAN then D_PLAN_HMS.

4.2 Characteristics of the grid

Many meshs: 90 of type TRIA6 and 24 SEG2

4.3 Sizes tested and results

Displacements will be observed DX and DY at the central point of coordinates $(5.38, 4.85)$, that is to say $N32$.

It is checked that the results in HM are the same ones as in pure mechanics, which is used as reference:

Node	Moment	Size	Reference	Aster

$N32$	1	DX	Pure mechanical modeling	3.68E-3
$N32$	1	DY	Pure mechanical modeling	-4.98E-3

5 Modeling C

Even thing that modeling B but in axisymetry.

5.1 Characteristics of modeling

Modeling `AXIS` then `AXIS_HMS`.

5.2 Characteristics of the grid

Many meshs: 90 of type `TRIA6` and 24 `SEG2`

5.3 Sizes tested and results

Displacements will be observed DX and DY at the central point of coordinates $(5.38, 4.85)$, that is to say $N32$.

It is checked that the results in HM are the same ones as in pure mechanics, which is used as reference:

Node	Moment	Size	Reference	*Aster*
$N32$	1	DX	Pure mechanical modeling	2.997E-3
$N32$	1	DY	Pure mechanical modeling	-4.886E-3

6 Conclusion

Anisotropic modelings THM are coherent with anisotropic mechanical modelings.