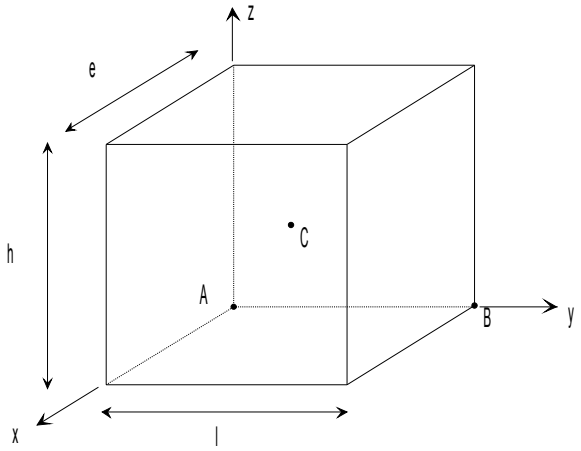
SSNV154 - Triaxial compression test drained with the model CJS (level 3)

Summarized

This test makes it possible to validate level 3 of model CJS. It is about a triaxial compression test in drained condition. Computations are carried out only on the solid part of the soil without hydraulic coupling. The level of containment is of $400\,KPa$.
By reason of symmetry, one is interested only in the eighth of a sample subjected to a triaxial compression test. Two modelizations are presented. The modelization A is axisymmetric. In the modelization B $3\mathrm{D}$, the sample tested is turned of an angle from $-\pi/6$ ratio with the axis x . Consequently, the directions x, y, z are not any more principal directions. That makes it possible to validate the operations of numerical integration of the model which act on the nondiagonal terms of the tensors of the strains and the stresses.
It is about a test of non regression. Nevertheless, the results got with *Code_Aster* for the model CJS3 are compared with those obtained with a private version of software FLAC-2D.

1 Problem of reference

1.1 Geometry



height: $h=1\,m$
width: $l=1\,m$
thickness: $e=1\,m$

Coordinates of the points (in meters):

	A	B	C
x	0.	0.	0.5
y	0.	1.	0.5
z	0.	0.	0.5

1.2 Material property

$E=35{,}6616541\,10^{3}\,kPa$
$\nu=0{,}15037594$

Parameters CJS3: $\beta=-0{,}55$ $\gamma=0{,}82$ $R_m=0{,}05$ $R_c=0{,}265$ $n=0{,}6$
$K_o^p=25{,}5\,10^{3}\,kPa$ $b=7.0\,kPa$ $\mu=0.021$ $p_{co}=-600\,kPa$
$c=30.0$ $P_a=-100\,kPa$

1.3 Initial conditions, boundary conditions, and loading

Phase 1:

One brings the sample in a homogeneous state: $\sigma_{xx}^0=\sigma_{yy}^0=\sigma_{zz}^0$, by imposing the corresponding confining pressure on the front, side right and higher sides. Displacements are blocked on the sides postpones ($u_x=0$), side left ($u_y=0$) and lower ($u_z=0$).

Phase 2:

One maintains displacements blocked on the sides postpones ($u_x=0$), side left ($u_y=0$) and lower ($u_z=0$), as well as the confining pressure on the front sides and side right. One applies a displacement imposed to the upper face: $u_z(t)$, in order to 2) obtain $\varepsilon_{zz}=-20\,\%$ a strain (counted starting from the beginning of the phase.

2 Reference solution

2.1 Méthode de calcul used for the reference solution

the results got with a private version of software FLAC 2D are used as reference.

2.2 Forced results of

reference σ_{xx} , σ_{yy} and σ_{zz} with the point A .

2.3 Bibliographical references

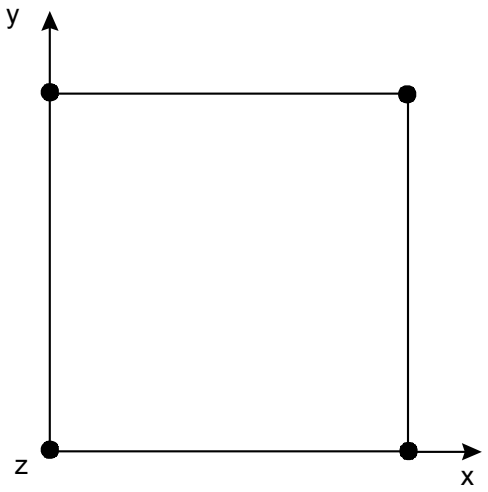
•Board, “SPLASH (Fast Lagrangian Analysis of Continua) Version 2.20. U.S. NRC”, NUREG/CR-5430, October 1989.

•“Splash Fast Lagrangian Analysis of Continua. Theory and Background.” Itasca Consulting Group.

3 Modelization A

3.1 Characteristic of the modelization

3D :



Cutting: 1 in height, 1 in width.

Loading of phase 1:
Confining pressure: $\sigma_{xx}^{0} = \sigma_{yy}^{0} = -400\,kPa$.
Level 3 of model CJS

3.2 Characteristic of the mesh

Many nodes: 4
Number of meshes and types: 1 QUAD4 and 4 SEG2

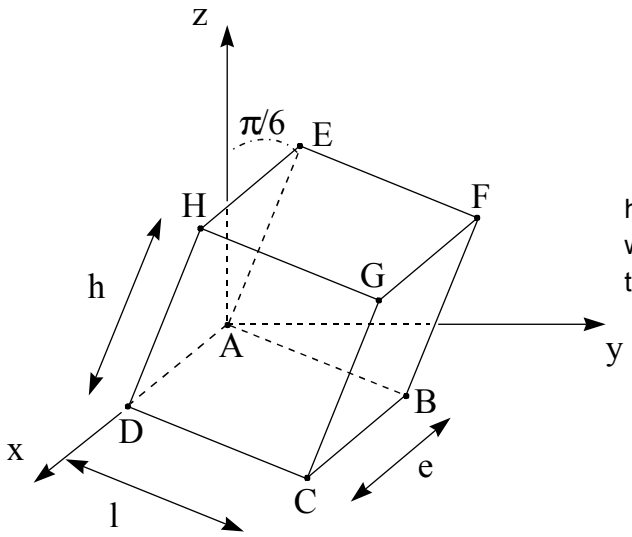
3.3 Quantities tested and results

For $\sigma_{xx}^0 = \sigma_{yy}^0 = -400\,kPa$

Localization	Sequence number	axial strain ε_{zz} (%)	Forced (kPa)	Reference FLAC 2D	*Aster*	% difference
Point A	10	– 4.0%	σ_{xx}	– 400.0	– 400.000	< 0.05
	50	– 20.0%	σ_{xx}	– 400.0	– 400.000	< 0.05
	10	– 4.0%	σ_{zz}	– 400.0	– 400.000	< 0.05
	50	– 20.0%	σ_{zz}	– 400.0	– 400.000	< 0.05
	2	– 0.8%	σ_{yy}	– 667.209	– 667.2087	< 0.05
	5	– 2.0%	σ_{yy}	– 917.634	– 917.6343	< 0.05
	10	– 4.0%	σ_{yy}	– 1184.57	– 1184.5705	< 0.05
	20	– 8.0%	σ_{yy}	– 1337.38	– 1337.3821	< 0.05
	34	– 12.0%	σ_{yy}	– 1351.76	– 1351.7551	< 0.05
	40	– 16.0%	σ_{yy}	– 1350.80	– 1350.8029	< 0.05
	50	–20.0%	σ_{yy}	– 1348.54	– 1348.5422	< 0.05

4 Modelization B

4.1 Geometry



height: $h=1\,m$
width: $l=1\,m$
thickness: $e=1\,m$

Coordinates of the points (in meters):

	A	B	C	D
x	0.	0.	1.	1.
y	0.	0.86602540378445	0.86602540378445	0.
z	0.	– 0.5	– 0.5	0.

4.2 Characteristic of the modelization

3D:

Cutting: 1 in height, in width and thickness.

Loading of phase 1:
Confining pressure: $-400\,kPa$.
Level 3 of model CJS

4.3 Characteristic of the mesh

Many nodes: 8
Number of meshes and types: 1 HEXA8 and 6 QUA4

4.4 Quantities tested and results

For containment: $-400\,kPa$

Localization	Sequence number	axial strain ε_{zz} (%)	forced (kPa)	Reference	*Aster*	% difference
Point A	10	– 2.0%	σ_{xx}	– 400.0	– 400.000	< 10-6
	50	– 10.0%	σ_{xx}	– 400.0	– 400.000	< 10-6
	100	– 20.0%	σ_{xx}	– 400.0	– 400.000	< 10-6
	10	– 2.0%	σ_{yy}	– 53.221	– 53.22098	< 10-6
	50	– 10.0%	σ_{yy}	– 63.7665	– 63.76653	< 10-6
	100	– 20.0%	σ_{yy}	– 63.7165	– 63.71645	< 10-6
	10	– 2.0%	σ_{zz}	– 79.6629	– 79.66294	< 10-6
	50	– 10 .0%	σ_{zz}	– 111.3	– 111.29959	< 10-6
	100	– 20.0%	σ_{zz}	– 111.149	– 111.14935	< 10-6
	10	– 2.0%	σ_{yz}	– 22.8994	– 22.89941	< 10-6
	50	– 10.0%	σ_{yz}	– 41.1648	– 41.16483	< 10-6
	100	– 20.0%	σ_{yz}	–41.0781	– 41.07809	< 10-6

5 Summary of the results

the results of *Aster* coincide with those of SPLASH with a lower deviation than $0,05\%$.