

SSNV158 - Triaxial compression test drained with the model of Laigle

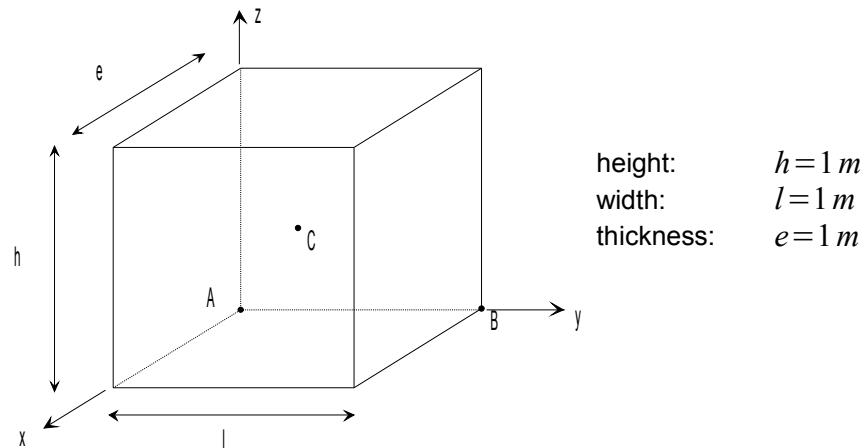
Summarized

This test makes it possible to validate the model of Laigle in rock mechanics (formalism CIH). 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. Four levels of containment are applied (8 MPa - 4 MPa - 2 MPa - 1 MPa). By reason of symmetry, one is interested only in the eighth of a sample subjected to a triaxial compression test. The modelization is axisymmetric.

It is about a test of non regression. Nevertheless, the results got with *Code_Aster* were post-treated with Excel and compared with those obtained with a private version of software FLAC-2D.

1 Problem of reference

1.1 Geometry



Coordinates of the points (in meters):

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

1.2 Material property

$$E = 1500,00 \cdot 10^3 \text{ kPa}$$

$$\nu = 0,27$$

$$\gamma_{ult} = 0.132;$$

$$\gamma_e = 0.005;$$

$$m_{ult} = 2.0;$$

$$m_e = 7.0;$$

$$a_e = 0.65;$$

$$m_{pic} = 15.0;$$

$$a_{pic} = 0.5;$$

$$\eta = 0.45;$$

$$\xi = 0.25;$$

$$\gamma_{cjs} = 0.7;$$

$$\sigma_{p1} = 9.09 \cdot 10^6 \text{ Pa};$$

$$\sigma_{p2} = 23.05 \cdot 10^6 \text{ Pa};$$

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 obtain $\varepsilon_{zz} = -20\%$ a strain (counted starting from the beginning of the phase).

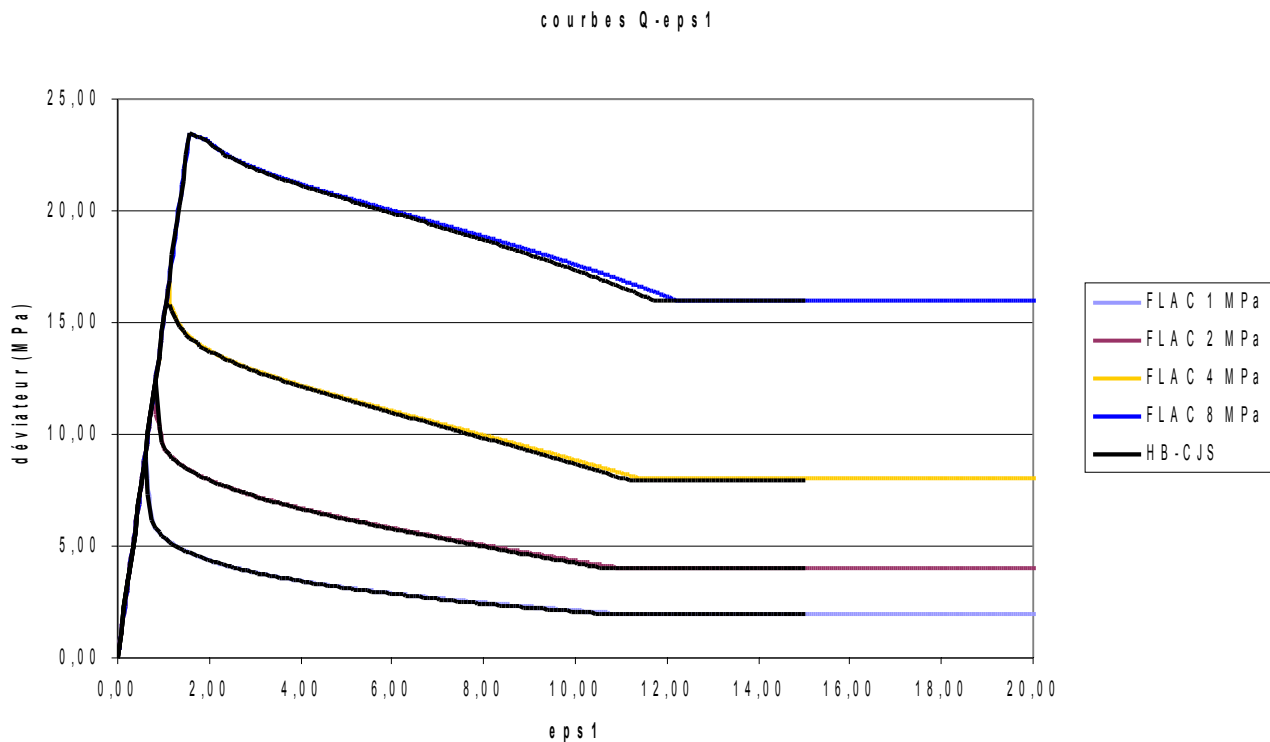
2 Reference solution

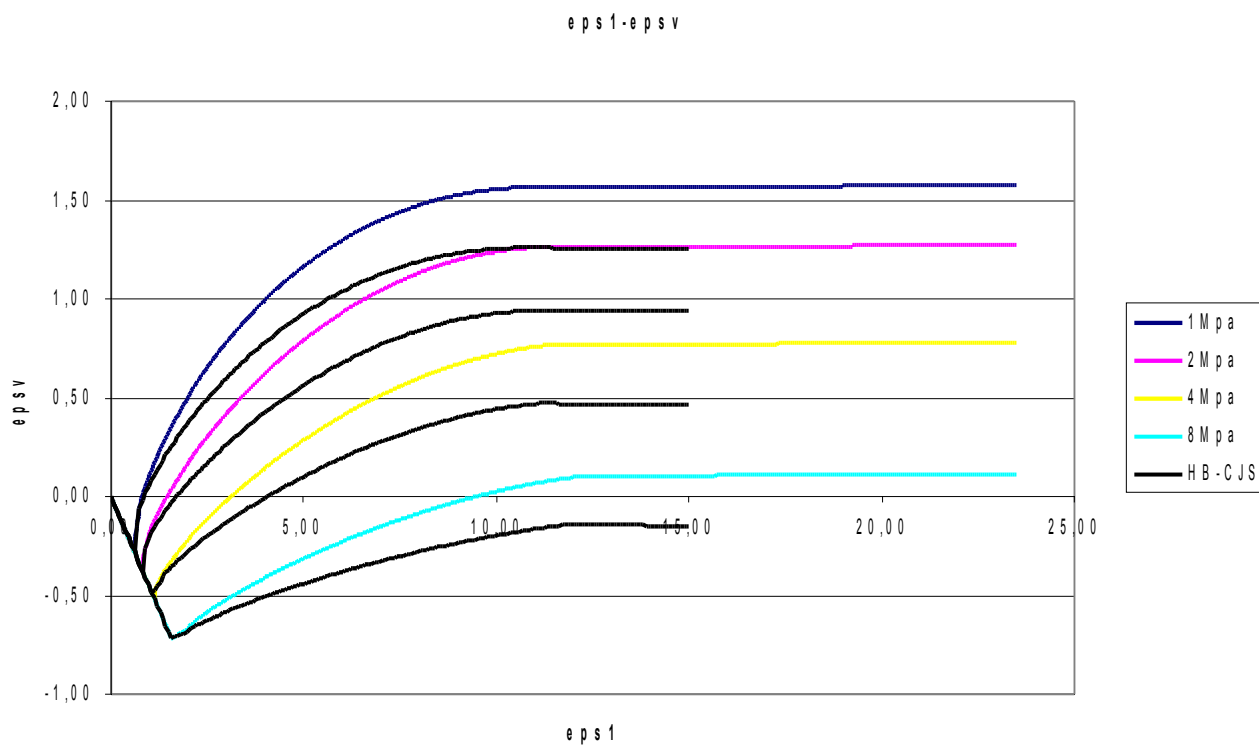
2.1 Forced Results of

reference σ_{xx} , σ_{yy} and σ_{zz} at the point D .

Displacements ε_{xx} , ε_{yy} at the point D .

References provided by software FLAC-2D:

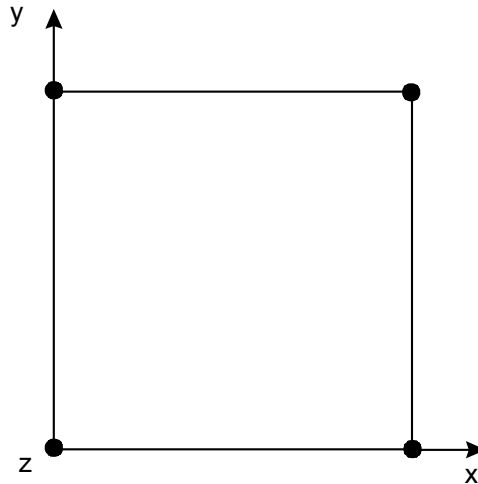




3 Modelization A

3.1 Characteristic of the modelization

2D :



Cutting: 1 in height, 1 in width.

Loading of phase 1:

Confining pressure: $\sigma_{xx}^0 = \sigma_{zz}^0 = -8 \text{ MPa}$.

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 $\sigma_{xx}^0 = \sigma_{zz}^0 = -8 \text{ MPa}$

Localization	Sequence number	Forced (MPa)	Aster
Point <i>D</i>	5	σ_{xx}	- 8.000
	49	σ_{xx}	- 8.000
	5	σ_{zz}	- 8.000
	49	σ_{zz}	- 8.000
	5	σ_{yy}	- 31.5966
	10	σ_{yy}	- 31.1055
	16	σ_{yy}	- 29.9622
	25	σ_{yy}	- 26.3670
	30	σ_{yy}	- 24.3922

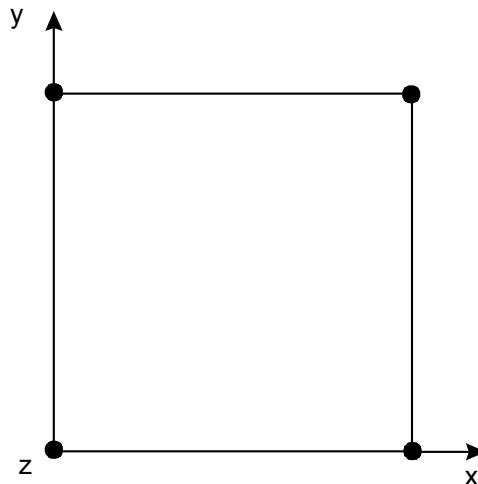
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	40	σ_{yy}	- 24.0000
	49	σ_{yy}	- 24.0000
Localization	Sequence number	Strain	Aster * E-02
Point <i>D</i>	1	ϵ_{xx}	0.324
	10	ϵ_{xx}	0.692805
	40	ϵ_{xx}	7.140
	1	ϵ_{yy}	- 1.200
	5	ϵ_{yy}	- 1.580
	10	ϵ_{yy}	- 2.053
	25	ϵ_{yy}	- 8.000
	48	ϵ_{yy}	- 19.04

4 Modelization B

4.1 Characteristic of the modelization

2D :



Cutting: 1 in height, 1 in width.

Loading of phase 1:

Confining pressure: $\sigma_{xx}^0 = \sigma_{zz}^0 = -4 \text{ MPa}$.

4.2 Characteristic of the mesh

Many nodes: 4

Number of meshes and types: 1 QUAD4 and 4 SEG2

4.3 Quantities tested and results

For $\sigma_{xx}^0 = \sigma_{zz}^0 = -4 \text{ MPa}$

Localization	Sequence number	Forced (MPa)	Aster
Point <i>D</i>	5	σ_{xx}	- 4.000
	49	σ_{xx}	- 4.000
	5	σ_{zz}	- 4.000
	49	σ_{zz}	- 4.000
	5	σ_{yy}	- 19.6729
	10	σ_{yy}	- 17.9207
	16	σ_{yy}	- 16.9627
	25	σ_{yy}	- 14.1850

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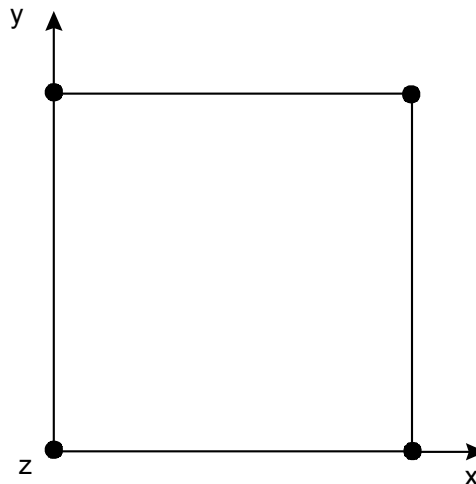
	30	σ_{yy}	- 12.4257
	40	σ_{yy}	- 12.0000
	49	σ_{yy}	- 12.0000

Localization	Sequence number	Strain	Aster * E-02
Point <i>D</i>	1	ϵ_{xx}	0.216
	10	ϵ_{xx}	0.757
	40	ϵ_{xx}	7.195
	1	ϵ_{yy}	- 0.800
	5	ϵ_{yy}	- 1.240
	10	ϵ_{yy}	- 1.789
	25	ϵ_{yy}	- 7.000
	48	ϵ_{yy}	- 16.000

5 Modelization C

5.1 Characteristic of the modelization

2D :



Cutting: 1 in height, 1 in width.

Loading of phase 1:

Confining pressure: $\sigma_{xx}^0 = \sigma_{zz}^0 = -2 \text{ MPa}$.

5.2 Characteristic of the mesh

Many nodes: 4

Number of meshes and types: 1 QUAD4 and 4 SEG2

5.3 Quantities tested and results

For $\sigma_{xx}^0 = \sigma_{zz}^0 = -2 \text{ MPa}$

Localization	Sequence number	Forced (MPa)	Aster
Point <i>D</i>	5	σ_{xx}	- 2.000
	5	σ_{zz}	- 2.000
	5	σ_{yy}	- 10.7188
	10	σ_{yy}	- 9.7927
	16	σ_{yy}	- 9.1268
	25	σ_{yy}	- 6.2033
	30	σ_{yy}	- 6.0968
	40	σ_{yy}	- 5.9965

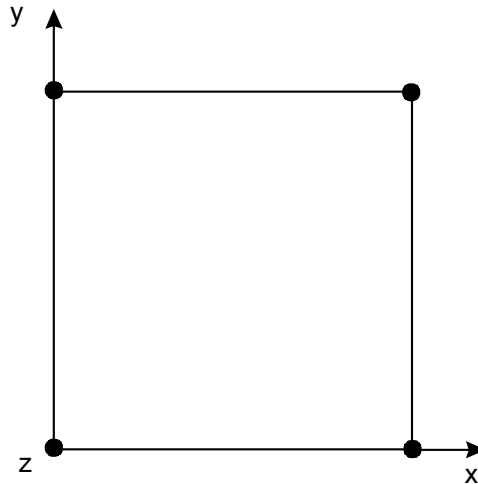
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	49	σ_{yy}	- 5.9942
Localization	Sequence number	Strain	Aster * E-02
Point <i>D</i>	1	ϵ_{xx}	0.216
	10	ϵ_{xx}	1.151
	40	ϵ_{xx}	8.048
	1	ϵ_{yy}	- 0.800
	5	ϵ_{yy}	- 1.387
	10	ϵ_{yy}	- 2.120
	25	ϵ_{yy}	- 12.000
	48	ϵ_{yy}	- 15.500

6 Modelization D

6.1 Characteristic of the modelization

2D :



Cutting: 1 in height, 1 in width.

Loading of phase 1:

Confining pressure: $\sigma_{xx}^0 = \sigma_{zz}^0 = -1 \text{ MPa}$.

6.2 Characteristic of the mesh

Many nodes: 4

Number of meshes and types: 1 QUAD4 and 4 SEG2

6.3 Quantities tested and results

For $\sigma_{xx}^0 = \sigma_{zz}^0 = -1 \text{ MPa}$

Localization	Sequence number	Forced (MPa)	Aster
Point <i>D</i>	296	σ_{xx}	- 1.000
	596	σ_{xx}	- 1.000
	296	σ_{zz}	- 1.000
	596	σ_{zz}	- 1.000
	196	σ_{yy}	- 4.7247
	296	σ_{yy}	- 4.1666
	312	σ_{yy}	- 4.0928
	496	σ_{yy}	- 3.4030
	596	σ_{yy}	- 3.1056

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Localization	Sequence number	Strain	Aster * E-02
Point <i>D</i>	196	ϵ_{xx}	2.4608
	396	ϵ_{xx}	4.7711
	596	ϵ_{xx}	6.8830
	196	ϵ_{yy}	- 3.9200
	296	ϵ_{yy}	- 5.9200
	396	ϵ_{yy}	- 7.9200
	496	ϵ_{yy}	- 9.9200
	596	ϵ_{yy}	- 11.9200