

WTNA111 - Axisymmetric modeling of a joint with hydro-mechanical coupling

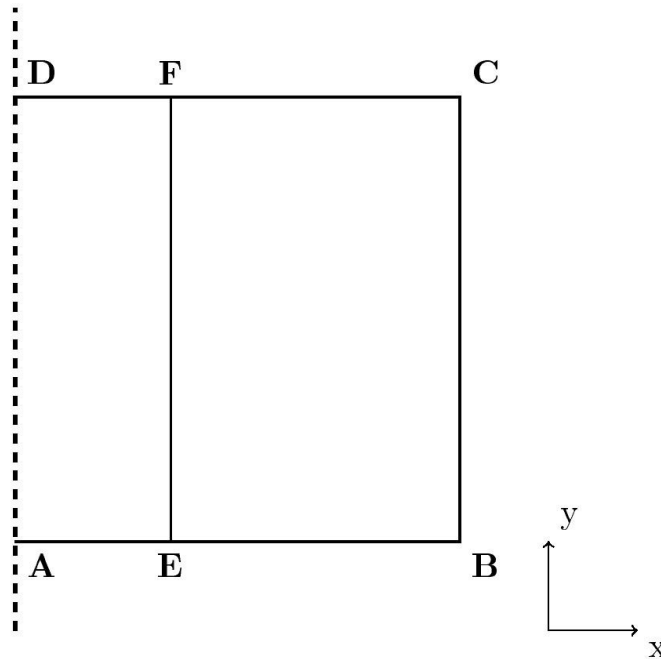
Summary:

The test presented here makes it possible to check the good performance of the elements of joints with hydraulic coupling in axisymmetric modeling.

1 Problem of reference

1.1 Geometry

An axisymmetric rock solid mass is considered. It is separate in two parts by a vertical discontinuity $[EF]$.



Coordinates of the points (in meters):

	x	y		x	y
A	0	0	D	0	1
B	1	0	E	0.35	0
C	1	1	F	0.35	1

1.2 Properties of material

- Properties of the fluid intersticiel (liquid water):

Density	1000 kg.m^{-3}
Viscosity	1.10^{-3} Pa.s
Compressibility	3.10^9 Pa

- Properties of the solid mass:

The solid mass is elastic and has the following properties:

Young modulus	200 MPa
Poisson's ratio	$0,25$

Porosity	0,4055
Intrinsic permeability	$1,688 \cdot 10^{-17} m^2$

- Properties of discontinuity:

The mechanical behavior of discontinuity is given the law of Bandis. Its expression is detailed in the reference material [R7 . 02 . 15].

The parameters materials used are:

Initial normal rigidity K_{ni}	$1 \cdot 10^9 Pa \cdot m^{-1}$
Asymptotic opening U_{max}	5,0 mm
Coefficient γ	2
Tangential rigidity K_t	$1 \cdot 10^{12} Pa \cdot m^{-1}$

1.3 Initial conditions

The initial conditions are the following ones:

- initial opening of the joint ε_0 : $1,95 \cdot 10^{-5} m$
- initial water pressure in the solid mass: 0,0 MPa
- initial constraint of radial compression and orthoradiale: 12,3 MPa

1.4 Boundary conditions

The boundary conditions mechanical and hydraulic are the following ones:

- On $[AB]$: water pressure imposed of 1,0 MPa
- On $[BC]$: mechanical pressure imposed of 12,3 MPa and hydraulic flow no one
- On $[CD]$: displacements blocked in y and hydraulic flow no one
- On $[DA]$: displacements blocked in x and hydraulic flow no one

2 Modeling A

2.1 Characteristics of modeling

Modeling is carried out into axisymmetric with 455 elements TRIA3 for the solid mass and 30 elements QUA4 for discontinuity.

Discretization in time:

- 25 pas de time for the 1000 first second
- 25 pas de time for 3000 the second following ones.

2.2 Sizes tested and results

In the absence of reference solution, one carries out only tests of nonregression.

One tests the pressure in the joint in two points at two different moments.

$X(m)$	$Y(m)$	Time (seconds)	$PREI(MPa)$ Aster
0.35	0.112	1000	0.948
0.35	0.483	1000	0.822
0.35	0.112	3000	0.968
0.35	0.483	3000	0.889

One also tests normal displacement on the lips of crack at two different moments.

$X(m)$	$Y(m)$	Time (seconds)	$DX(\mu m)$ Aster
0.35001	0.112	1000	292.5058
0.34999	0.112	1000	292.5197
0.35001	0.112	3000	478.6191
0.34999	0.112	3000	478.6331

3 Summary of the results

In the absence of reference solution, one carries out simply tests of nonregression. The results are in conformity so that one waits physically.