

## WTNA111 - Axisymmetric modelization of a joint with hydro-mechanical coupling

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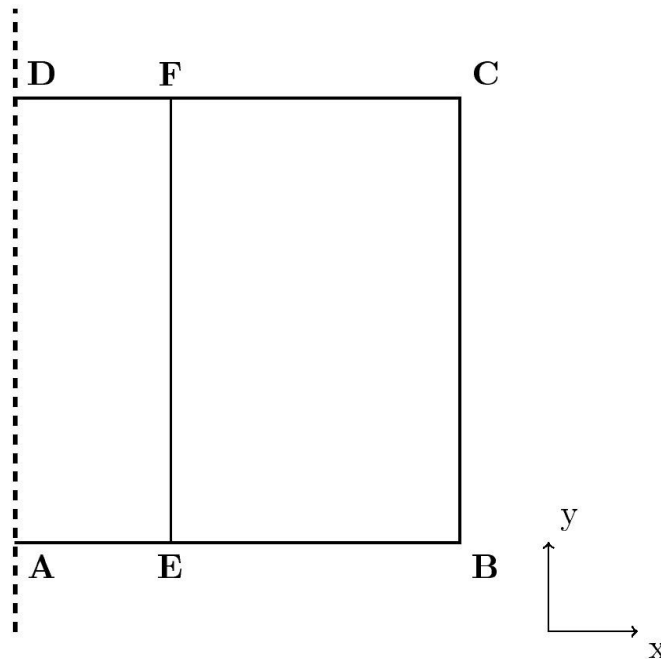
### Abstract:

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

## 1 Problem of reference

### 1.1 Geometry

One considers an axisymmetric rock solid mass. 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 the material

• Properties of the fluid intersticiel (liquid water):

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

• Properties of the solid mass:

The solid mass is elastic and has the following properties:

|                 |                   |
|-----------------|-------------------|
| Young modulus   | $200 \text{ MPa}$ |
| Poisson's ratio | $0,25$            |

|                       |                            |
|-----------------------|----------------------------|
| intrinsic             | 0,4055                     |
| Porosity Permeability | $1,688 \cdot 10^{-17} m^2$ |

•Properties of discontinuity:

The structural mechanics behavior of discontinuity is given the model of Bandis. Its statement is detailed in documentation of reference [R7.02.15].

Materials parameters used are:

|                                   |                       |
|-----------------------------------|-----------------------|
| Normal stiffness initial $K_{ni}$ | $1.10^9 Pa.m^{-1}$    |
| asymptotic Opening $U_{max}$      | 5,0mm                 |
| Coefficient $\gamma$              | 2                     |
| Tangencial stiffness $K_t$        | $1.10^{12} Pa.m^{-1}$ |

## 1.3 Initial conditions

the initial conditions are the following ones:

- initial opening of the joint  $\varepsilon_0 : 1,95 \cdot 10^{-5} m$
- initial water pressure in the solid mass: 0,0 MPa
- initial stress of radial compression and orthoradiale: 12,3 MPa

## 1.4 Boundary conditions

the mechanical and hydraulic boundary conditions are the following ones:

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

## 2 Modelization A

### 2.1 Characteristic of the modelization

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

Discretization in time:

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

### 2.2 Quantities tested and results

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

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

| $X(m)$ | $Y(m)$ | Time (seconds) | $PRE1(MPa)$ 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 times.

| $X(m)$  | $Y(m)$ | 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

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