WSLP100 - Test of desaturation by seepage in a porous sample unsaturated

Summary:

This test makes it possible to validate its conditions of hydraulic seepage. Modeling is carried out in 2D with a model D_PLAN_HHMS and a law of elastic behavior linear.

CE CAS-test contains only one modeling.
1 Problem of reference

1.1 Description

The test consists with désaturer a permeable porous sample with boundary conditions initially impermeable on the edges (outgoing water flow no one). At the moment $t = 0$, one imposes an "opening" of 50cm on the flat rim using the conditions of seepage, like magazine below. The height of water decreases gradually until being stabilized on the level of the lower edge of the opening.

Image 1.1-a: Description of the CAS-test

1.2 Geometry

Dimensions of the rectangular sample are:
- height: $h = 3\, m$
- width: $l = 1\, m$

The length of the section of seepage is of: $e = 50\, cm$. It is placed on the flat rim, between a height of 1m and 1.5m.

1.3 Properties of material

Lbe propriétés elastic are:
- $E = 515\, MPa$
- $\nu = 0.3$
- $\rho = 2670\, kg\cdot m^{-3}$

The law of behavior associated with hydraulic model HH2M is LIQU_GAZ: one thus considers 1 liquid phase without dissolved air and a phase gas without steam. The properties of the hydraulic model are presented in the table below:
1.4 **Boundary conditions and loadings**

The boundary conditions are:

- Blocking of the vertical displacement of the base: $DY = 0$
- Blocking of the horizontal displacement of the two edges: $DX = 0$
- Pressures of worthless water and air on the higher edge: $PRE1 = PRE2 = 0$
- Conditions of seepage on the section of the “opening”: $PRE1 \geq 0$

The loading imposed is the acceleration of gravity.

Calculation is carried out enters $t=0$ and $t=0.2$ s by step of 0.001 s until $t=0.02$ s, then by step of 0.01 s until $t=0.2$ s.

1.5 **Initial conditions**

The constraint effective initial in the sample is isotropic and geostatics, namely equalizes with:

$$\sigma'_{xx} = \sigma'_{yy} = \sigma'_{zz} = (\rho - 10^3) g z$$

Water pressure initial is geostatics:

$$PRE1 = 10^3 g z$$
$$PRE2 = 0$$
2 Reference solution

An analytical solution with a problem of flow with conditions of seepage not being easy to calculate, one proposes a sufficiently intuitive CAS-test here so that someS values intermediaries and expected finales can be tested.

Thus end values with  \( t = 0.2 \) s waited tested are:

- At the base:  \( PRE_1 = -10^3 \) g
- In top hole:  \( PRE_1 = +5.10^2 \) g
- In high flat rim:  \( PRE_1 = +2.10^3 \) g

At one intermediate moment where the height of water column did not reach the opening yet:  
\( PRE_1 = 0 \)
3 Modeling A

3.1 Characteristics of modeling

Modeling D_PLAN_HHMS

3.2 Characteristics of the grid

- Many nodes: 981
- Many meshes: 80 of type SEG3 and 300 of type QUAD8

They are defined nodes of postprocessing following:
- NBASE: at the base of the flat rim
- NTROU: in the middle of the opening
- NSUP: at the top of the flat rim

Lbe boundary conditions in displacement imposed are:

- On the face BAS: DY = 0 and PRE2 = 0
- On Lbe faceS GAUCHE and DROIT: DX = 0 and PRE2 = 0
- On the face HAUT: PRE1 = 0

3.3 Sizes tested and results

Values of water pressure PRE1 (knowing that PRE2 = 0 ∀ t on the flat rim):

<table>
<thead>
<tr>
<th>NRoeud</th>
<th>Moment [dryness]</th>
<th>Reference [Pa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTROU</td>
<td>5.10^-3</td>
<td>0.</td>
</tr>
<tr>
<td>NBASE</td>
<td>0.2</td>
<td>-9810.</td>
</tr>
<tr>
<td>NTROU</td>
<td>0.2</td>
<td>4905.</td>
</tr>
<tr>
<td>NSUP</td>
<td>0.2</td>
<td>19620.</td>
</tr>
</tbody>
</table>

Table 3.3-1: Synthesis of the values of reference
4 Summary of the results

The temporal evolution of the water pressure along the flat rim is presented on the following figure.

Image 4-a: Temporal evolution of the profiles of water pressure (PRE1) on the flat rim