SSNP104 – Rigid test of sole with the law of Mohr-Coulomb

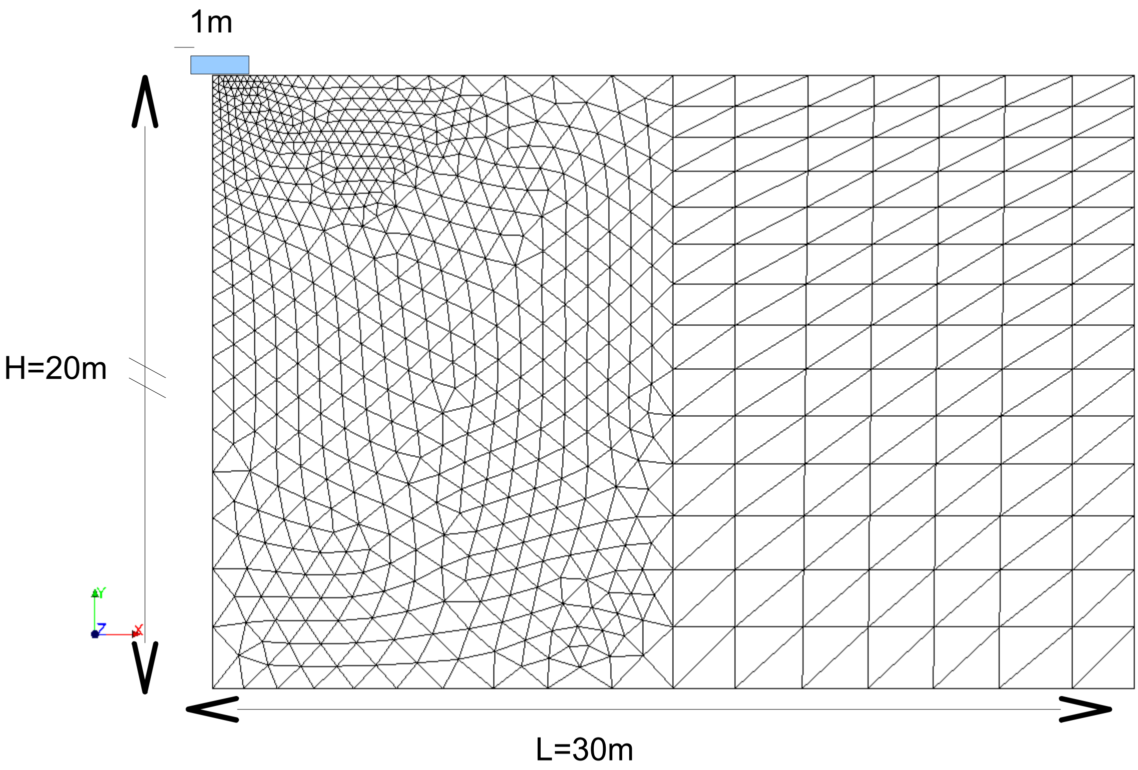
Summary

One is carried out *rigid test of sole* posed on a ground modelled with *the law of Mohr-Coulomb*. This test comprises two modelings:

- a modeling 2D;
- a modeling 3D;

1 Problem of reference

1.1 Geometry



The grid above represents a rigid sole resting on a half space of ground. The foundation has a width of $2m$. It is subjected to a depression linear vertical according to time. By exploiting the vertical symmetry of the problem, only a half of the ground is represented. The model of ground represented is a rectangular geometry height $H=20m$ and of width $L=30m$. The grid, refined around the foundation, comprises 1297 elements TRIA3.

1.2 Material properties

The elastic properties are:

- Young modulus: $E=9GPa$
- modulus of rigidity: $\nu=0,25$
- density: $\rho=2000\,kg.m^{-3}$

The parameters of the law of Mohr-Coulomb are:

- angle of friction: $\varphi=32°$
- angle of dilatancy: $\psi=32°$
- cohesion: $c_0=4,21\,MPa$

1.3 Boundary conditions and loadings

The test consists in imposing a vertical displacement on the interface ground/foundation represented by the group of meshs $APPUI$.

The limiting conditions are thus the following ones:

- Conditions of symmetry:

    - $u_x=0$ on the groups of side meshs Left and Right
- Conditions of adherence ground/foundation:
    - $u_x=0$ on the group of meshs $APPUI$
- Conditions of free surface:
    - $P_n=0$ on the group of mesh $Freesurf$

The ground is subjected to gravity.

The loading is carried out in two phases:
- Initialization :

The model is purely elastic linear and is subjected to its actual weight (condition geostatics). The coefficient of pushed grounds is $K_0=1$
- loading of the foundation :

vertical displacement u_y imposed on the group of mesh $APPUI$ and varying linearly enters $t\in[0-200]$ seconds of $0\,cm$ with $-20\,cm$ (depression). The number of steps of time is of $N=100$

1.4 Results

One compares the vertical resultant of the nodal force FORC_NODA_Y on the foundation (group of meshs $APPUI$) with $t=200\mathrm{s}$. At this moment, one reaches the limiting load of the rigid foundation [**1**].

Calculation 2D (modeling **With**) is used as reference.

2 Modeling A

2.1 Characteristics of modeling

Modeling **With** beT two-dimensional.

The grid, refined around the foundation, comprises 1297 elements TRIA3.

The step of time is of $\Delta t=2\,sec$, that is to say 100 temporal increments. The recutting of the step of time is activated in the event of nonconvergence.

The total convergence criteria are RESI_GLOB_RELA = 10^{-6} .

2.2 Sizes tested and results

2.2.1 Values tested

One compares the vertical resultant of the nodal force FORC_NODA_Y on the foundation (group of meshs $APPUI$) with $t=200\text{s}$. This modeling is used as reference. The results are recapitulated in the following table:

$t=200\,sec$	Reference solution
F_y	$-2{,}022757350693E+8$

Table 2.2.1-1 : Validation of the results for modeling A

3 Modeling B

3.1 Characteristics of modeling

Modeling **B** beT tridimensionnelle.
It is built starting from an extrusion of the grid of modeling **With** in the direction (Oz) . The thickness in this direction is of $1\,m$ and consists of only one element. The grid, refined around the foundation, comprises 1297 elements TRIA3.

The step of time is of $\Delta t=2\,sec$, that is to say 100 temporal increments. The recutting of the step of time is activated in the event of nonconvergence.

The total convergence criteria are `RESI_GLOB_RELA` = 10^{-6} .

3.2 Sizes tested and results

3.2.1 Values tested

One compares the vertical resultant of the nodal force `FORC_NODA_Y` on the foundation (group of meshs $APPUI$) with $t=200\mathrm{s}$. Modeling **With** is used as reference. The results are recapitulated in the following table:

$t=200\,sec$	Reference solution	Acceptable relative error [%]
F_y	$-2{,}022757350693\mathrm{E}{+}8$	6,E-3

Table 3.2.1-1 : Validation of the results for modeling B

4 References

1 **E.S. Sorensen**, *Elasto-plastic strain hardening Mohr-Coulomb Model. Derivation and Implementation into the Finite Element Method using principal stress space*. Master degree thesis, Aalborg University, 2012.