

Operator POST_LIQUEFACTION

1 Goal

This order allows to calculate the value of a criterion r_u evaluating the zones of liquefaction in a geotechnical work, modelled by a saturated porous environment. Four formulas are available to calculate this criterion:

- **DP_SIGV_REF** : LE criterion is based on the values in any material point of the pore water pressure at the moment considered, of the pore water pressure at the moment of reference and of the component of the effective stress field at the moment of reference, according to the direction of the gravity, associated with the weight of the grounds. He allowed that when the value of the criterion exceeds 0.8, one is deduced from it a risk from local liquefaction.
- **DP_SIGM_REF** : the criterion is calculated starting from the values in any material point of the pore water pressure at the moment considered, pore water pressure at the moment of reference and of the effective average constraint at the moment of reference.
- **DP** : C is a difference in pore water pressure between one moment t and a moment of reference.
- **P_SIGM** : the criterion calculationE starting from the pore water pressure and of the effective average constraint at the moment t .

This calculation of postprocessing is independent of the mechanical model of behavior of the porous environment considered.

As starter, one gives:

- the concept result **EVOL_NOLI** simulation of the work at the moment considered;
- the axis according to which gravity applies;
- For the criteria **DP_SIGV_REF/DP_SIGM_REF/DP** :
 - a concept result **EVOL_NOLI** of "reference" of simulation of the work;
 - the moment of reference.

At exit, a concept result is obtained **EVOL_NOLI** who contains in a field at the points of Gauss of the type 'ELGA_SIEF_R' the value of the criterion, in the variable **SIPXX** or **SIPYY** or **SIPZZ** according to the direction of gravity in the grid.

2 Syntax

```
POST_LIQ = POST_LIQUEFACTION (
    ♦ CRITERION = / 'DP_SIGV_REF',
                  / 'DP_SIGM_REF',
                  / 'DP',
                  / 'P_SIGM',
    ♦ RESULT = resu , [evol_noli]
    ♦ AXIS = / 'X',
             / 'Y',
             / 'Z',
```

For criteria DP_SIGV_REF/DP_SIGM_REF/DP

```
    ♦ RESU_REF = resu_ref , [ evol_noli]
    ♦ INST_REF = inst_ref, [R]
);
```

3 Description

Order has POST_LIQUEFACTION allows to calculate the value of a criterion evaluating the zones of liquefaction in a geotechnical work, modelled by a saturated porous environment. Four formulas are available to calculate this criterion:

- DP_SIGV_REF : the criterion is based on the values in any material point of the pore water pressure p_h at the moment t , pore water pressure at the moment of reference $t_{réf}$, component of the effective stress field σ_v^{eff} at the moment of reference, according to the direction of the gravity, associated with the weight of the grounds. It is allowed that when the value of the criterion exceeds 0.8, one from of deduced a risk from local liquefaction: to consult for example the document DGPR, "seismic Risk and security of the hydraulic works", final version of October 2014. Its expression is the following one, at the moment t and at the point \mathbf{x} :

$$r_u(t, \mathbf{x}) = \frac{p_h(t, \mathbf{x}) - p_h(t_{réf}, \mathbf{x})}{\sigma_v^{eff}(t_{réf}, \mathbf{x})}$$

- DP_SIGM_REF : the criterion is calculated starting from the values in any material point of the pore water pressure p_h at the moment t , pore water pressure at the moment of reference $t_{réf}$ and of the effective average constraint σ_m^{eff} at the moment of reference. Its expression is the following one, at the moment t and at the point \mathbf{x} :

$$r_u(t, \mathbf{x}) = \frac{p_h(t, \mathbf{x}) - p_h(t_{réf}, \mathbf{x})}{\sigma_m^{eff}(t_{réf}, \mathbf{x})}$$

with the average constraint defined by

$$\sigma_m^{eff}(t_{réf}, \mathbf{x}) = \frac{(\sigma_{xx}^{eff}(t_{réf}, \mathbf{x}) + \sigma_{yy}^{eff}(t_{réf}, \mathbf{x}) + \sigma_{zz}^{eff}(t_{réf}, \mathbf{x}))}{3}$$

- DP : it is a difference in pore water pressure p_h between one moment t and a moment of reference $t_{réf}$. Its expression is the following one, at the moment t and at the point \mathbf{x} :

$$r_u(t, \mathbf{x}) = p_h(t, \mathbf{x}) - p_h(t_{réf}, \mathbf{x})$$

- P_SIGM : the criterion is calculated starting from the pore water pressure p_h and the effective average constraint at the moment t . Its expression is the following one, at the moment t and at the point \mathbf{x} :

$$r_u(t, \mathbf{x}) = \frac{p_h(t, \mathbf{x})}{\sigma_m^{eff}(t, \mathbf{x})}$$

with the average constraint defined by

$$\sigma_m^{eff}(t, \mathbf{x}) = \frac{(\sigma_{xx}^{eff}(t, \mathbf{x}) + \sigma_{yy}^{eff}(t, \mathbf{x}) + \sigma_{zz}^{eff}(t, \mathbf{x}))}{3}$$

This calculation of postprocessing is independent of the model of mechanical behavior of the porous environment considered. Let us specify that only one formula can be associated with the order. If the user wants to calculate several criteria, it must use several times the order. LE CAS-test zzzz403a [V1.01.403] illustrate an implementation of the order on a fictitious case and documentation [U2.04.09] present calculations of liquefaction.

4 Keywords

4.1 Concept created by the order

This order creates at exit a concept of the type `result EVOL_NOLI`, in which one will extract the field 'SIEF_ELGA', then the component `SIPXX`, or `SIPYY` or `SIPZZ` according to the direction of gravity in the grid (see § 4.4).

4.2 Keyword CRITERION

It keyword allows to choose the formula of computation of the criterion.

◆ `CRITERION = ' DP_SIGV_REF ' or ' DP_SIGM_REF ' or ' DP ' or ' P_SIGM`
,

4.3 Keywords RESU_REF and RESULT

◆ `RESULT = resu`

It keyword obligatory allows to inform the name of the concept of the type `Resultat`, for which the calculation of the work was carried out, in which one recovers the pore water pressure at the moment considered, in the form of a field 'SIEF_ELGA'.

For the criteria ' DP_SIGV_REF ' / ' DP_SIGM_REF ' / ' DP ' :

◆ `RESU_REF = resu_ref`

This obligatory operand for the criteria 'DP_SIGV_REF'/'DP_SIGM_REF'/'DP' allows to inform the name of the concept of the type `result`, for which the calculation of the work was carried out, in which one recovers the pore water pressure at the moment of reference, in the form of a field ' SIEF_ELGA '.

Note:

| Only a structure result of the type `evol_noli` can be well informed in these keywords.

4.4 Keyword INST_REF

For the criteria ' DP_SIGV_REF ' / ' DP_SIGM_REF ' / ' DP ' .

◆ `INST_REF = inst_ref`

This keyword is obligatory for the criteria 'DP_SIGV_REF'/'DP_SIGM_REF'/'DP'. It allows to inform the moment of reference where the value of the component of the effective stress field is taken σ_v^{eff} and of the pore water pressure p_h .

4.5 Keyword AXIS

◆ `AXIS = / 'X'`
/ 'Y'
/ 'Z'

This keyword obligatory allows to inform the direction `x` , `y` or `z` grid according to which gravity is exerted.