Macro-command CALC_ESSAI_GEOMECA

1 Drank

This macro-command makes it possible to simulate for a material point various ways of loading characteristic of tests géomechanics, and post-to treat the got results. The user provides as starter the behavior, the material, as of the lists of loading parameters which correspond to several occurrences of the same test. The tests available are the following:

•monotonous triaxial compression test drained
•monotonous triaxial compression test not drained
•cyclic test shear drained
•cyclic triaxial compression test not drained

Produces curves with the format xmgrace and/or data structures counts.

Contents

2 Syntax

```
CALC_ESSAI_GEOMECA (

♦    MATER       = mat ,                                          [ to subdue
]
♦    COMP_INCR   = _F (see the document [U4.51.11]),
◊    CONVERGENCE = _F (see the document [U4.51. 03 ]),
```

triaxial Compression test monotonous drained (TD)

```
♦   |    ESSAI_TD = _F (

              ♦PRES_CONF      = l_pconf,                          [l_R]
              ♦   EPSI_IMPOSE = l_eps I mpo,                      [l_R]
              ◊   NB_INST     =/100,                            [DEFAULT]
                               /nbinst,                           [I]
              ◊   TABLE_RESU  = l_tabres,                        [l_CO]
              ◊   GRAPHIQUE   =/("P-Q", "EPS_AXI-Q",
                                 "EPS_AXI-EPS_VOL"),             [DEFAULT]
                               /l_typgraph,                     [l_Kn]
              ◊   TABLE_REF   = l_tabre F,                        [l_ array ]

                   ),
```

triaxial Compression test monotonous not drained (TND)

```
    |   ESSAI_T N D = _F (

              ♦PRES_CONF      = l_pconf,                          [l_R]
              ♦   EPSI_IMPOSE = l_eps I mpo,                      [l_R]
              ◊   BIOT_COEF   =/1. ,                            [DEFAULT]
                               / biot,                            [R]
              ◊   NB_INST     =/100,                            [DEFAULT]
                               /nbinst,                           [I]
              ◊   TABLE_RESU  = l_tabres,                        [l_CO]
              ◊   GRAPHIQUE   =/("P-Q", "EPS_AXI-Q",
                                 "EPS_AXI-PRE_EAU"),             [DEFAULT]
                               /l_typgraph,                     [l_Kn]
              ◊   TABLE_REF   = l_tabre F,                        [l_ array ]

                   ),
```

drained cyclic Test shear (CISA_C)

```
    |   ESSAI_ CISA_C = _F (

              ♦PRES_CONF      = l_pconf,                          [l_R]
              ♦   EPSI_IMPOSE = l_epsimpo,                        [l_R]
              ♦   NB_CYCLE    = nbcyc,                           [I]
              ◊   EPSI_ELAS   =/1.E-7 ,                         [DEFAULT]
                               / epselas,                         [R]
              ◊   NB_INST     =/25 ,                            [DEFAULT]
                               /nbinst,                           [I]
              ◊   TABLE_RESU  = l_tabres,                        [l_CO]
              ◊   GRAPHIQUE   =/(" EPSXY-SIGXY ",
                                 "EPSXY-G", "EPSXY-D"),          [DEFAULT]
                              /l_typgraph,                       [l_Kn]
              ◊   TABLE_REF   = l_tabre F,                        [l_ array ]
```

```
                    ),
```

triaxial Compression test cyclic not drained (TND _C)

```
    |   ESSAI_ TND_C = _F (

              ♦PRES_CONF      = l_pconf,                          [l_R]
              ♦   SIGM_IMPOSE = l_ sig impo,                      [l_R]
              ♦   NB_CYCLE    = nbcyc,                           [I]
              ♦   UN_SUR_K    = unsurk ,                         [R]
              ◊   BIOT_COEF   =/1. ,                           [DEFAULT]
                               / biot,                           [R]
              ◊   NB_INST     =/25 ,                          [DEFAULT]
                               /nbinst,                          [I]
              ◊   TABLE_RESU  = l_tabres,                       [l_CO]
              ◊   GRAPHIQUE   =/(" SIG_AXI-PRE_EAU ", "P-Q",
                                  "NCYCL-DSIGM"),               [DEFAULT]
                               /l_typgraph,                    [l_Kn]
              ◊   TABLE_REF   = l_tabre F,                      [l_ array ]

                    ),

◊    INFO =/1 ,                                                 [DEFAULT]
           / 2, );
```

3 Operands

3.1 Operand MATER

```
♦MATER  = mat,                      [to subdue]
```

This key word makes it possible to inform the name of the material defined by DEFI_MATERIAU [U4.43.01], where are provided the parameters necessary to the selected behavior.

3.2 Key word COMP_INCR

the syntax of this key word is described in the document [U4.51.11].
In the frame of this macro-command, the use of the operand RELATION of key word COMP_INCR is limited to the elastoplastic models of soil following:

- "CAM_CLAY"
- "CJS"
- "DRUCK_PRAGER"
- "DRUCK_PRAG_N_A"
- "HUJEUX"

3.3 Key word CONVERGENCE

the syntax of this key word is described in the document [U4.51.03]. It makes it possible to modify the values by default of the parameters of convergence.

3.4 Key word ESSAI_TD

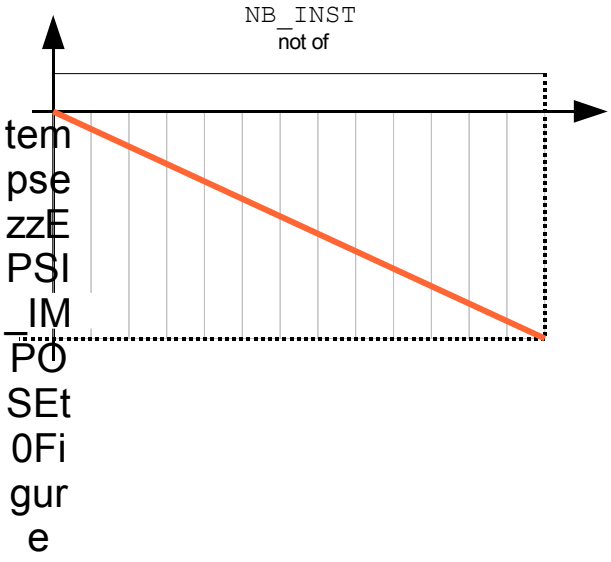
This factor key word (répétable) makes it possible to carry out a series of simulations of the same drained triaxial compression test for which one varies the loading parameters (confining pressure and imposed axial strain), post-to treat the got results and to write them in the form of graphs (with the format xmgrace) and/or of arrays.

3.4.1 Operands PRES_CONF, EPSI_IMPOSE, NB_INST

```
♦PRES_CONF      = l_pconf,          [l_R]
♦    EPSI_IMPOSE = l_eps I mpo,        [l_R]
◊    NB_INST     =/100,         [DEFAULT]
                  /nbinst,           [I]
```

operand PRES_CONF make it possible to define the list of the confining pressures which will be kept during each test. In the same way operand EPSI_IMPOSE makes it possible to define the list of the end values of the loading of compression (slope of imposed axial strain).
For this test, one makes correspond to each confining pressure an end value for the slope of axial strain (see figure 3.4.1-a) : lists PRES_CONF and EPSI_IMPOSE must thus have even cardinal. C E cardinal corresponds to the number of simulations which will be carried out under this factor key word.
The stresses and the strains being counted negatively in compression, the values indicated for PRES_CONF and EPSI_IMPOSE must be strictly negative.

Operand NB_INST makes it possible to define the temporal discretization of the loading (see figure 3.4.1-a) , with a value by default of 100 steps of loading during the slope.



3.4.1-a: discretization and pace of the loading for key words ESSAI_TD and ESSAI_TND

3.4.2 Operand TABLE_RESU

◊ TABLE_RESU = l_tabres , [l_ CO]

This operand optional makes it possible to give the list of the names of the product concepts by the macro-command which will be then of type [array] . Each produced array contains the gross profits and post-treaties of a simulation of test: list TABLE_RESU must thus have even cardinal that lists PRES_CONF and EPSI_IMPOSE .
The title of each produced array is supplemented by the macro-command, it understands:

- the name of factor key word (here ESSAI_TD) and its number of occurrence (this one being répétable)
- the couple of values (PRES_CONF, EPSI_IMPOSE) characterizing the loading of the test

Example:

```
TABRES1 =CO ("TRES1")
TABRES2 =CO ("TRES2")
TABRES3 =CO ("TRES3")

CALC _ ESSAI_GEOMECA (
    …
    ESSAI_TD = _F ( PRES_CONF    = (- 1.0E4, - 1.5E4, - 2.0E4) ,
                    EPSI_IMPOSE = (- 1.0E-2, - 1.0E-2, - 1.0E-2) ,
                    TABLE_RESU  = ( TABRES1, TABRES2, TABRES3 ), ),
    …
                     );
```

TABRES1 , TABRES 2 , and TABRES 3 are successively filled according to the order of lists PRES_CONF and EPSI_IMPOSE , the table below specify the test results contained in each array.

EPSI_IMPOSE ® / PRES_ CONF ¯	-1.0E-2	-1.0E-2	-1.0E-2
-1.0E4	TABRES1		
-1.5E4		TABRES2	
-2. 0 E4			TABRES3

3.4.3 Operand GRAPHIQUE

```
◊   GRAPHIQUE =/("P-Q", "EPS_AXI-Q", "EPS_AXI-EPS_VOL"),
[DEFAULT]
                /l_typgraph,                                    [l_Kn]
```

This operand makes it possible to specify the types of the graphs produced by the macro-command. These graphs recapitulate the results of the simulations carried out under factor key word running. The value by default is the list of all the types of graphs available for factor key word, but it is possible to exclude some from them by informing a list containing only the types desired among those which appear in the list of values by default.
The files satisfying these graphs are written with the format xmgrace in the same directory specified by the user (standard repe as a result in astk), and its named in the following way:

" *name of factor key word* " the _ standard *"number of* occurrence " _ *"of graph "* .dat

For example:

```
ESSAI_TD = ( _F ( … GRAPHIQUE = ( " P-Q ", " EPS_AXI-Q " ),… ),
             _F ( … GRAPHIQUE = ( " P-Q " ),              … ),),
```

produces the following files:

Essai_TD_1_P-Q.dat, Essai_TD_1_EPS_AXI-Q.dat, Test _TD_2_P-Q.dat… Operand

3.4.4 TABLE_REF ◊TABLE

_REF = l_tabref , [l_table] This operand

makes it possible to inform curves of reference (for example, experimental) tabulated and stored in the form of arrays, in order to superimpose them on the curves resulting from the simulations carried out under factor key word running. These curves of reference are then included in files produced by the key word GRAPHIQUE . Each array
contained in list TABLE_REF must be created as a preliminary using operator CREA_TABLE [U4.33.02], and formatted in the following way: tabref =

```
CREA_TABLE (LISTE= (_F
   (PARA=' TYPE', LISTE_    K= [typgraph,]), _F (PARA=
          "LEGENDE", LISTE_K= [malegend,]), _F (PARA=
          "ABSCISSE", LISTE_R=l_absc), _F ("
          ORDERED" PARA=, LISTE_R=l_ordo),),); with:
```

typgraph

- a character string whose value belongs obligatorily to the list of default values of key word GRAPHIQUE . This value makes it possible to identify the type of graph (and thus the file) to which the curve of reference must be added. malegend
- a character string which contains the legend associated with the curve with reference l_absc and
- l_ordo are python lists of realities respectively containing the X-coordinates and the ordered of the points of the curve of reference. These lists must thus factor key word have even cardinal

3.5 Key word TEST _TND This

(répétable) makes it possible to carry out a series of simulations of the same triaxial compression test not drained (total saturation is supposed) for which one varies the loading parameters (confining pressure and imposed axial strain), post-to treat the got results and to write them in the form of graphs (with the format xmgrace) and/or of arrays. Operands

3.5.1 PRES_CONF , EPSI_IMPOSE , NB_INST ♦PRES_

```
CONF    = L_PCONF   , [l_R]           ♦EPSI_
IMPOSE  = L_EPSIMPO , [l_R] ◊      NB_INST
    =/100,     [DEFAULT]         /nbinst
                 , [I] These operands
```

have the same meaning as for factor key word the ESSAI_TD (§ 3.4.1). 3.4.1

3.5.2 BIOT_COEF ◊ BIOT

```
_COEF  =/1. [DEFAULT]                /biot [R
               ] Value            of
```

the coefficient of Biot. Operand

3.5.3 TABLE_RESU ◊ ARRAY

```
_RESU  = L_TABRES , [l_CO] This              operand
```

has the same meaning as for factor key word the ESSAI_TD (§ 3.4.2). 3.4.2

3.5.4 GRAPHIQUE ◊ GRAPHIQUE

```
    =/("P-Q", "EPS_AXI-Q", "EPS_AXI - PRE_EAU"), [DEFAULT]
   /l_typgraph
              , [l_Kn] This                                    operand
```

has the same meaning as for factor key word the ESSAI_TD (§ 3.4.3), 3.4.3 the list of the default values (and thus of the types of graph available) differs. Operand

3.5.5 TABLE_REF ◊TABLE

```
_REF    = l_tabref , [l_table]           This operand
```

has the same meaning as for factor key word the ESSAI_TD (§ 3.4.4). 3.4.4

3.6 TEST _CISA _C This factor key word

(répétable) makes it possible to carry out a series of simulations of the same drained cyclic shear test for which one varies the loading parameters (confining pressure, amplitude of shear strain and many cycles), post-to treat the got results and to write them in the form of graphs (with the format xmgrace) and/or of arrays. Operands

3.6.1 PRES_CONF , EPSI_IMPOSE , NB_CYCLE , NB_INST ♦PRES_

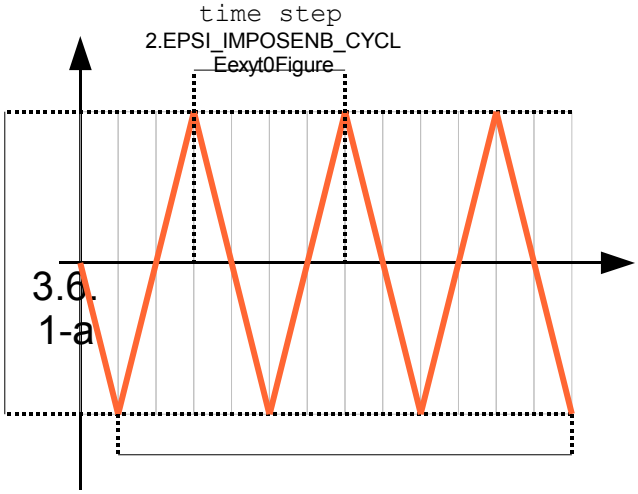
```
CONF    = L_PCONF   , [l_R]              ♦EPSI_
IMPOSE  = L_EPSIMPO , [l_R] ♦         NB_CYCLE
    = nbcyc,    [I] ◊              NB_INST
    =/25,     [DEFAULT]                 /nbinst
                 , [I] These operands
```

make it possible to define the loading of each simulation to be carried out under factor key word running, like its discretization. Their meaning is summarized with the figure 3.6.1-a 3.6.1-a below: PRES_CONF

•makes it possible to define the list of the confining pressures (strictly negative) which will be kept during each test. EPSI_IMPOSE

- makes it possible to define the list of the amplitudes (strictly positive) of shear strain of the imposed cyclic loading. NB_CYCLE
- corresponds to the number of cycles, fixed for all simulations. NB_INST
- MAKES IT POSSIBLE to define the temporal discretization of the loading, and corresponds to the number of steps of loading per quarter of cycle For each

confining pressure PRES_CONF , ONE CARRIES OUT as many simulations as there are elements in list EPSI_IMPOSE . Contrary to tests TD and TND (see respectively §3.4 and §3.55), these7 are not in bijection and there are on the whole simulations $card(\text{PRES\_CONF}).card(\text{EPSI\_IMPOSE})$ carried out. 4.NB_INST



: 3.6.1-a and pace of the loading for key word ESSAI_CISA _C, for 3 cycles Operand

3.6.2 EPSI_ELAS ◊ EPSI

```
_ELAS   =/1.E-   7, [DEFAULT]        /epselas
                 , [R] For    each
```

confining pressure, the maximum secant shear modulus (i.e. of the operational material) is given by simulating a slope of imposed shear strain whose end value is EPSI_ELAS . THIS VALUE must be such as the material remains in its field of elasticity (linear or not, according to the behavior model used). EPSI_ELAS IS WORTH 1. E-7 by default , and any value indicated by the user must be lower to him. If the well informed value does not make it possible to remain in the field of elasticity, the code stops in fatal error. Operand

3.6.3 TABLE_RESU ◊ ARRAY

```
_RESU  = L_TABRES , [l_CO] This          operand
```

optional makes it possible to give the list of the names of the product concepts by the macro-command which will be then of type [array] . The size of this list must check: formulate

$$card(\text{TABLE\_RESU}) = card(\text{PRES\_CONF}) + 1$$

, each produced array gathers the rough results of all the simulations carried out for the same confining pressure (PRES_CONF), IN which each simulation corresponds to a package of contiguous columns whose titles all are indexed by the same integer (index of the value considered in list EPSI_IMPOSE). An additional array recapitulating the postprocessings carried out at the conclusion of all simulations is also produced. This array contains for each confining pressure (PRES_CONF) THE VALUES of the standardized secant shear modulus and the rate of depreciation

G/G_{max} in with respect to D the imposed amplitudes of strain (EPSI_IMPOSE). THIS array corresponds in the name of concept given in last position in list TABLE_RESU . EXTRACTS of these arrays are presented in the example below. Example:

TABRES1=

```
CO ("TRES1") TABRES2
=CO ("VERY 2") BILA
=CO ("T BILA ") CALC_ TEST
```

```
_GEOMECA (… TEST
    _CISA
    _C = _F (NEAR _CONF = (- 1.0   E5 , - 2.05E5,), EPSI_IMPOSE
                      = (1.0E-5, 5.0E-5, 1.0E-4, 1.0E-3), NB_CYCLE
                      = 3, ARRAY     _RESU
                      = (TABRES  1, TABRES2, BILA ), ),… ) ;
    The table
```

below specifies for this example the results of simulations contained in arrays TABRES1 and TABRES 2 , as well as the order in which these arrays are filled out. EPSI_IMPOSE

® 1.0E- 5.5.0 ¯ -1.0E 5 TABRES	E-5 1.0	E-4 1.0	E-3 NEAR	_CONF
1	TABRES1	TABRES1	TABRES1	-2.05E5
TABRES2	TABRES2	TABRES2	TABRES2	One present

below an extract of array TABRES1 containing the rough results of the simulations carried out for the first value of PRES_CONF (TABRES 2 being built same way, for the second value of PRES_CONF). #
#----------

```
# #Resultats

rough: ESSAI_CISA_C number 1/PRES_CONF = -1.000000E+05 # EPSI_IMPOSE

 _1 INST_1 EPS_XY_1       SIG_XY_1     EPSI_IMPOSE      _2 INST_2 EPS_XY_2       SIG_XY_2     … 1.00000     E
   - 05 0.00000E  +00 0.00000E  +00 0.00000E  +00 5.00000E   - 05 0.00000E  +00 0.00000E  +00 0.00000E  +00… - 4.00000
  E             - 01 -4.00000E-07 -7.58633E+01 - 4.00000  E             - 01 -2.00000E-06 -3.79317E+02… - 8.00000
  E             - 01 -8.00000E-07 -1.51727E+02 - 8.00000  E             - 01 -4.00000E-06 -7.19696E+02… - 1.20000
  E             +00 -1.20000E-06 -2.27590E+02 - 1.20000  E            +00 -6.00000E-06 -1.05778E+03… - 1.60000
  E             +00 -1.60000E-06 -3.03453E+02 - 1.60000  E            +00 -8.00000E-06 -1.39554E+03… - 2.00000
  E             +00 -2.00000E-06 -3.79317E+02 - 2.00000  E            +00 -1.00000E-05 -1.73297E+03… - 2.40000
  E             +00 -2.40000E-06 -4.49001E+02 - 2.40000  E            +00 -1.20000E-05 -2.07008E+03… - 2.80000
  E             +00 -2.80000E-06 -5.16693E+02 - 2.80000  E            +00 -1.40000E-05 -2.40685E+03… - 3.20000
  E             +00 -3.20000E-06 -5.84374E+02 - 3.20000  E            +00 -1.60000E-05 -2.74328E+03… - 3.60000
  E             +00 -3.60000E-06 -6.52041E+02 - 3.60000  E            +00 -1.80000E-05 -3.07937E+03… - 4.00000
  E             +00 -4.00000E-06 -7.19696E+02 - 4.00000  E            +00 -2.00000E-05 -3.41512E+03… - 4.40000
  E             +00 -4.40000E-06 -7.87338E+02 - 4.40000  E            +00 -2.20000E-05 -3.75052E+03… - 4.80000
  E             +00 -4.80000E-06 -8.54966E+02 - 4.80000  E            +00 -2.40000E-05 -4.08454E+03… - 5.20000
  E             +00 -5.20000E-06 -9.22582E+02 - 5.20000  E            +00 -2.60000E-05 -4.40512E+03… - 5.60000
  E             +00 -5.60000E-06 -9.90185E+02 - 5.60000  E            +00 -2.80000E-05 -4.71365E+03… - 6.00000
  E             +00 -6.00000E-06 -1.05778E+03 - 6.00000  E            +00 -3.00000E-05 -5.01024E+03 … - 6.40000
  E             +00 -6.40000E-06 -1.12535E+03 - 6.40000  E            +00 -3.20000E-05 -5.29602E+03… - 6.80000
  E             +00 -6.80000E-06 -1.19292E+03 - 6.80000  E            +00 -3.40000E-05 -5.57200E+03… - 7.20000
  E             +00 -7.20000E-06 -1.26047E+03 - 7.20000  E            +00 -3.60000E-05 -5.83838E+03… - 7.60000
  E             +00 -7.60000E-06 -1.32801E+03 - 7.60000  E            +00 -3.80000E-05 -6.09653E+03… - 8.00000
  E             +00 -8.00000E-06 -1.39553E+03 - 8.00000  E            +00 -4.00000E-05 -6.34707E+03… - 8.40000
  E             +00 -8.40000E-06 -1.46304E+03 - 8.40000  E            +00 -4.20000E-05 -6.59055E+03… - 8.80000
  E             +00 -8.80000E-06 -1.53054E+03 - 8.80000  E            +00 -4.40000E-05 -6.82744E+03… - 9.20000
  E             +00 -9.20000E-06 -1.59803E+03 - 9.20000  E            +00 -4.60000E-05 -7.05818E+03… - 9.60000
  E             +00 -9.60000E-06 -1.66550E+03 - 9.60000  E            +00 -4.80000E-05 -7.28316E+03… - 1.00000
  E             +01 -1.00000E-05 -1.73296E+03 - 1.00000  E            +01 -5.00000E-05 -7.50271E+03… - 1.04000
  E             +01 -9.60000E-06 -1.65710E+03 - 1.04000  E            +01 -4.80000E-05 -7.12340E+03… - 1.08000
```

```
 E            +01 -9.20000E-06 -1.58123E+03 - 1.08000  E            +01 -4.60000E-05 -6.74408E+03… - 1.12000
 E            +01 -8.80000E-06 -1.50537E+03 - 1.12000  E            +01 -4.40000E-05 -6.40166E+03… - 1.16000
 E            +01 -8.40000E-06 -1.42951E+03 - 1.16000  E            +01 -4.20000E-05 -6.06333E+03… - 1.20000
 E            +01 -8.00000E-06 -1.35364E+03 - 1.20000  E            +01 -4.00000E-05 -5.72517E+03… - 1.24000
 E            +01 -7.60000E-06 -1.27778E+03 - 1.24000  E            +01 -3.80000E-05 -5.38716E+03… - 1.28000
 E            +01 -7.20000E-06 -1.20192E+03 - 1.28000  E            +01 -3.60000E-05 -5.04931E+03… - 1.32000
 E            +01 -6.80000E-06 -1.12605E+03 - 1.32000  E            +01 -3.40000E-05 -4.71162E+03… - 1.36000
 E            +01 -6.40000E-06 -1.05019E+03 - 1.36000  E            +01 -3.20000E-05 -4.37409E+03… - 1.40000
 E            +01 -6.00000E-06 -9.74325E+02 - 1.40000  E            +01 -3.00000E-05 -4.03672E+03… - 1.44000
 E            +01 -5.60000E-06 -9.02660E+02 - 1.44000  E            +01 -2.80000E-05 -3.69951E+03… - 1.48000
 E            +01 -5.20000E-06 -8.34957E+02 - 1.48000  E            +01 -2.60000E-05 -3.36246E+03… - 1.52000
 E            +01 -4.80000E-06 -7.67260E+02 - 1.52000  E            +01 -2.40000E-05 -3.02558E+03… - 1.56000
 E            +01 -4.40000E-06 -6.99570E+02 - 1.56000  E            +01 -2.20000E-05 -2.68889E+03… - 1.60000
 E            +01 -4.00000E-06 -6.31886E+02 - 1.60000  E            +01 -2.00000E-05 -2.35236E+03… - 1.64000
 E            +01 -3.60000E-06 -5.64209E+02 - 1.64000  E            +01 -1.80000E-05 -2.01599E+03… - 1.68000
 E            +01 -3.20000E-06 -4.96537E+02 - 1.68000  E            +01 -1.60000E-05 -1.67980E+03… - 1.72000
 E            +01 -2.80000E-06 -4.28873E+02 - 1.72000  E            +01 -1.40000E-05 -1.34377E+03… - 1.76000
 E            +01 -2.40000E-06 -3.61214E+02 - 1.76000  E            +01 -1.20000E-05 -1.00789E+03… - 1.80000
 E            +01 -2.00000E-06 -2.93562E+02 - 1.80000  E            +01 -1.00000E-05 -6.72187E+02… - 1.84000
 E            +01 -1.60000E-06 -2.25916E+02 - 1.84000  E            +01 -8.00000E-06 -3.36652E+02……
 …          …          …          …          …          …          Ci          below
```

, one also presents the contents of additional array TABBILA , recapitulating the postprocessings (formula G/G_{max} D at the conclusion of all simulations. Each package of contiguous columns whose titles are indexed by the same integer (index of the value considered in list PRES_CONF) corresponds to the postprocessings carried out for the same confining pressure. # #----------

```
# #Resultats

total: ESSAI_CISA_C number 1 # PRES_
CONF
 _1 EPSI_IMPOSE  _1 G_SUR_GMAX_1 DAMPING_1 PRES_CONF    _2 EPSI_IMPOSE  _2 G_SUR_GMAX_2 DAMPING_2 -1.00000
 E+05 1.00000E   - 05 9.13742E  - 01 5.96577E  - 03 -2.05000E+05 1.00000E   - 05 9.42753E  - 01 5.33399E  - 03 - 5.00000
 E             - 05 7.91603E  - 01 2.53274E  - 02 - 5.00000E             - 05 8.85544E  - 01 8.53707E  - 03 - 1.00000
 E             - 04 6.23819E  - 01 5.40243E  - 02 - 1.00000E             - 04 7.48746E  - 01 3.51910E  - 02 - 1.00000
 E             - 03 1.85414E  - 01 1.28612E  - 01 - 1.00000E             - 03 2.50446E  - 01 1.17804E  - 01 # Operand
```

3.6.4 GRAPHIQUE ◊ GRAPHIQUE

```
=/("EPSXY-SIGXY", "EPSXY-G", "EPSXY-D"), [DEFAULT ]          /l_typgraph
          , [l_Kn] This                                       operand
```

has the same meaning as for factor key word the ESSAI_TD (§ 3.4.3), 3.4.3 the list of the values by default (and thus of the types of graph available) differs. Note:

Curves "EPSXY-G " and "EPSXY_- D " have well_as a X-coordinate and not ε_{xy} formula $\gamma = 2\ \varepsilon_{xy}$

3.6.5 TABLE_REF ◊TABLE

```
_REF    = l_tabref , [l_table]          This operand
```

has the same meaning as for factor key word the ESSAI_TD (§3.4.4). Key word3.4.4

3.7 TEST _TND _C This factor key word

(répétable) makes it possible to carry out a series of simulations of the same triaxial compression test not drained (total saturation is supposed) cyclic for which one varies the loading parameters (confining pressure, amplitude of imposed axial effective stress, and many cycles), post-to treat the got results and to write them in the form of graphs (with the format xmgrace) and/or of arrays. Operands

3.7.1 PRES_CONF , SIGM_IMPOSE , NB_CYCLE , NB_INST ♦PRES_

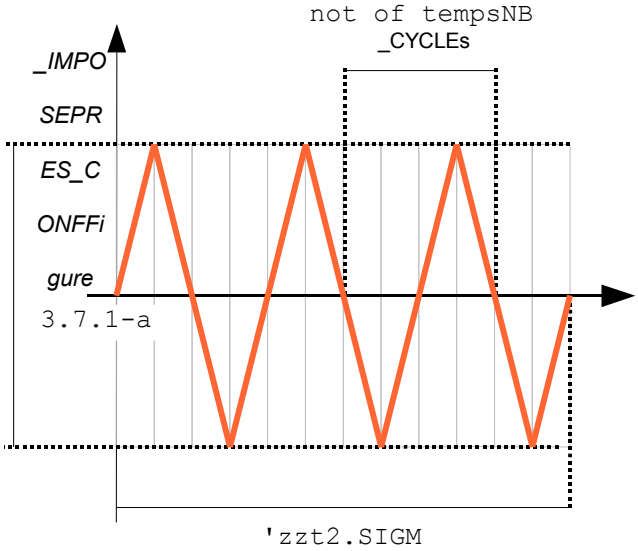
```
CONF    = L_PCONF   , [l_R]              ♦SIGM_
IMPOSE  = L_SIGIMPO , [l_R] ♦          NB_CYCLE
    = nbcyc,     [I] ◊ NB_INST
    =/25,      [DEFAULT]              /nbinst
```

, [I] These operands

make it possible to define the loading of each simulation to be carried out under factor key word running, like its discretization. Their meaning is summarized with the figure 3.7.1-a 3.7.1-a below: PRES_CONF

- makes it possible to define the list of the confining pressures (strictly negative) which will be kept during each test. SIGM_IMPOSE
- MAKES IT POSSIBLE to define the list of the amplitudes (strictly positive) of axial effective stress of the imposed cyclic loading (with PRES_CONF the average constraint). NB_CYCLE
- corresponds to the number of cycles, fixed for all simulations. NB_INST
- MAKES IT POSSIBLE to define the temporal discretization of the loading, and corresponds to the number of steps of loading per quarter of cycle For each

confining pressure PRES_CONF , ONE CARRIES OUT as many simulations as there are elements in list SIGM_IMPOSE . Contrary to tests TD and TND (see respectively §3.4 and §3.55), these7 are not in bijection and there is on the whole formula simulations $card(\text{PRES\_CONF}).card(\text{SIGM\_IMPOSE})$. 4.NB_INST



: 3.7.1-a and pace of the loading for key word ESSAI_TND _C, 3 cycles Operand

3.7.2 BIOT_COEF ◊ BIOT

_COEF =/1. [DEFAULT] /biot [R
] Value of

the coefficient of Biot. Operand

3.7.3 UN_SUR_K ♦ UN_SUR_K

= UNSURK [R] Value of

the reverse of the modulus of compressibility of water. Operand

3.7.4 TABLE_RESU ◊ ARRAY

_RESU = L_TABRES , [l_CO] This operand

optional makes it possible to give the list of the names of the product concepts by the macro-command which will be then of type [array] . The size of this list must check: formulate

$$card(\text{TABLE\_RESU}) = card(\text{PRES\_CONF}) + 1$$

, each produced array gathers the rough results of all the simulations carried out for the same confining pressure (PRES_CONF), IN which each simulation corresponds to a package of contiguous columns whose titles all are indexed by the same integer (index of the value considered in list SIGM_IMPOSE). An additional array recapitulating the postprocessings carried out at the conclusion of all simulations is also produced. This array contains for each confining pressure (PRES_CONF) THE NUMBER of cycles to the end of which the criterion of liquefaction of the soil was reached, in with respect to the amplitudes of imposed effective stress (SIGM_IMPOSE). THE CRITERION of liquefaction is regarded as reached if, with $r_u \geq 0.8$: formulate

$$r_u = \left| \frac{u}{P_0} \right|$$

u the pore water pressure and formulates P_0 . This array corresponds in the name of concept given in last position in list TABLE_RESU . EXTRACTS of these arrays are presented in the example below. Example:

TABRES1=

```
CO ("TRES1") TABRES2=
CO ("TRES2") TABRES3=
CO ("TRES3") TABBILA=
CO ("TBILA") CALC_ESSAI

_GEOMECA (… TEST
    _TND
    _C = _F (NEAR _CONF = (- 3.E4   , - 3.25E4, - 3.5E4,), SIGM_IMPOSE
                    = (1.E4,1.1E4,1.2E4,1.3E4,1.6E4,), NB_CYCLE
                     = 25, UN_SUR_K
                    = 1.E-12    ,  TABLE_RESU
                     = (TABRES  1 , TABRES2, TABRES3, TABBILA),),…) ;
    The table
```

below specifies for this example the results of simulations contained in arrays TABRES1, TABRES2 and TABRES 3, as well as the order in which these arrays are filled out. SIGM_IMPOSE

® 1.E4 1.1 ¯ -3.E4 TABRES	E4 1.2	E4 1.3	E4 1.6	E4 NEAR	_CONF
1	TABRES1	TABRES1	TABRES1	TABRES1	-3.25E4
TABRES2	TABRES2	TABRES2	TABRES2	TABRES2	-3.5E4 TABRES
3	TABRES3	TABRES3	TABRES3	TABRES3	One present

below an extract of array TABRES2 containing the rough results of the simulations carried out for the second value of PRES_CONF . # #----------

```
# #Resultats

rough: ESSAI_TND_C number 1/PRES_CONF = -3.250000E+04 # SIGM_IMPOSE

 _1 INST_1 EPS_AXI_        1 EPS_LAT_     1… PRE_      EAU_1 SIGM_IMPOSE     _2 INST_2… 1.00000         E
  +04 0.00000E  +00 0.00000E  +00 0.00000E  +00… -0.00000  E+00 1.10000E   +04 0.00000E  +00… - 4.00000
```

```
 E            - 01 2.37788E  - 06 -1.18887E-06… -1.33316  E+02 - 4.00000  E            - 01… - 8.00000
 E            - 01 5.27009E  - 06 -2.63491E-06… -2.66632  E+02 - 8.00000  E            - 01… - 1.20000
 E            +00 8.17434E  - 06 -4.08697E-06… -3.99948  E+02 - 1.20000  E           +00… - 1.60000
 E            +00 1.10910E  - 05 -5.54522E-06… -5.33263  E+02 - 1.60000  E           +00… - 2.00000
 E            +00 1.40203E  - 05 -7.00984E-06… -6.66579  E+02 - 2.00000  E           +00… - 2.40000
 E            +00 1.69628E  - 05 -8.48101E-06… -7.99895  E+02 - 2.40000  E           +00… - 2.80000
 E            +00 1.99187E  - 05 -9.95886E-06… -9.33211  E+02 - 2.80000  E           +00… - 3.20000
 E            +00 2.30002E  - 05 -1.14996E-05… -1.06631  E+03 - 3.20000  E           +00… - 3.60000
 E            +00 2.65689E  - 05 -1.32839E-05… -1.19796  E+03 - 3.60000  E           +00… - 4.00000
 E            +00 3.06705E  - 05 -1.53346E-05… -1.32706  E+03 - 4.00000  E           +00… - 4.40000
 E            +00 3.53282E  - 05 -1.76634E-05… -1.45247  E+03 - 4.40000  E           +00… - 4.80000
 E            +00 4.05684E  - 05 -2.02834E-05… -1.57305  E+03 - 4.80000  E           +00… - 5.20000
 E            +00 4.64193E  - 05 -2.32088E-05… -1.68756  E+03 - 5.20000  E           +00… - 5.60000
 E            +00 5.29170E  - 05 -2.64576E-05… -1.79469  E+03 - 5.60000  E           +00… - 6.00000
 E            +00 6.01011E  - 05 -3.00496E-05… -1.89303  E+03 - 6.00000  E           +00… - 6.40000
 E            +00 6.80160E  - 05 -3.40070E-05… -1.98113  E+03 - 6.40000  E           +00… - 6.80000
 E            +00 7.67173E  - 05 -3.83576E-05… -2.05731  E+03 - 6.80000  E           +00… - 7.20000
 E            +00 8.62682E  - 05 -4.31330E-05… -2.11975  E+03 - 7.20000  E           +00… - 7.60000
 E            +00 9.67455E  - 05 -4.83717E-05… -2.16636  E+03 - 7.60000  E           +00… - 8.00000
 E            +00 1.08244E  - 04 -5.41211E-05… -2.19469  E+03 - 8.00000  E           +00… - 8.40000
 E            +00 1.20878E  - 04 -6.04380E-05… -2.20193  E+03 - 8.40000  E           +00… - 8.80000
 E            +00 1.34791E  - 04 -6.73947E-05… -2.18477  E+03 - 8.80000  E           +00… - 9.20000
 E            +00 1.50170E  - 04 -7.50842E-05… -2.13899  E+03 - 9.20000  E           +00… - 9.60000
 E            +00 1.67253E  - 04 -8.36253E-05… -2.05939  E+03 - 9.60000  E           +00… - 1.00000
 E            +01 1.86360E  - 04 -9.31790E-05… -1.93918  E+03 - 1.00000  E           +01… - 1.04000
 E            +01 1.84117E  - 04 -9.20575E-05… -1.80586  E+03 - 1.04000  E           +01… - 1.08000
 E            +01 1.81336E  - 04 -9.06674E-05… -1.67255  E+03 - 1.08000  E           +01… - 1.12000
 E            +01 1.78318E  - 04 -8.91580E-05… -1.53923  E+03 - 1.12000  E           +01… - 1.16000
 E            +01 1.75296E  - 04 -8.76474E-05… -1.40592  E+03 - 1.16000  E           +01… - 1.20000
 E            +01 1.72272E  - 04 -8.61353E-05… -1.27260  E+03 - 1.20000  E           +01… - 1.24000
 E            +01 1.69244E  - 04 -8.46217E-05… -1.13928  E+03 - 1.24000  E           +01… - 1.28000
 E            +01 1.66214E  - 04 -8.31066E-05… -1.00597  E+03 - 1.28000  E           +01… - 1.32000
 E            +01 1.63181E  - 04 -8.15900E-05… -8.72652  E+02 - 1.32000  E           +01… - 1.36000
 E            +01 1.60145E  - 04 -8.00719E-05… -7.39335  E+02 - 1.36000  E           +01… - 1.40000
 E            +01 1.57105E  - 04 -7.85523E-05… -6.06019  E+02 - 1.40000  E           +01… - 1.44000
 E            +01 1.54063E  - 04 -7.70311E-05… -4.72703  E+02 - 1.44000  E           +01… - 1.48000
 E            +01 1.51017E  - 04 -7.55085E-05… -3.39387  E+02 - 1.48000  E           +01… - 1.52000
 E            +01 1.47969E  - 04 -7.39842E-05… -2.06071  E+02 - 1.52000  E           +01… - 1.56000
 E            +01 1.44857E  - 04 -7.24283E-05… -7.26273  E+01 - 1.56000  E           +01…… …
 …          …          …          …          …              Ci below
```

, one also presents the contents of additional array TABBILA, recapitulating the postprocessings (many cycles to liquefaction) carried out at the conclusion of all simulations. Each package of contiguous columns whose titles are indexed by the same integer (index of the value considered in list PRES_CONF) corresponds to the postprocessings carried out for the same confining pressure. # #----------

```
# #Resultats

total: ESSAI_TND_C number 1 # PRES_
CONF
 _1 NCYCL_1  SIGM_IMPOSE      _1 PRES_CONF_2 NCYCL_2  SIGM_IMPOSE      _2 PRES_CONF_3 NCYCL_3  SIGM_IMPOSE      _3 -3.00000
 E+04 1.10000E  +01 1.00000E   +04 -3.25000E+04 1.50000E  +01 1.00000E   +04 -3.50000E+04 2.10000E  +01 1.00000E   +04 - 7.00000
 E            +00 1.10000E   +04 - 1.10000E            +01 1.10000E   +04 - 1.50000E            +01 1.10000E   +04 - 6.00000
 E            +00 1.20000E   +04 - 8.00000E            +00 1.20000E   +04 - 1.10000E            +01 1.20000E   +04 - 4.00000
 E            +00 1.30000E   +04 - 6.00000E            +00 1.30000E   +04 - 8.00000E            +00 1.30000E   +04 - 3.00000
 E            +00 1.60000E   +04 - 3.00000E            +00 1.60000E   +04 - 4.00000E            +00 1.60000E   +04 # Operand
```

3.7.5 GRAPHIQUE ◊ GRAPHIQUE

```
 =/("NCYCL-DSIGM", "P-Q", "SIG_AXI-PRE_EAU",), [DEFAULT ]
/l_typgraph
            , [l_Kn] This                                          operand
```

has the same meaning as for factor key word the ESSAI_TD (§ 3.4.3), 3.4.3 the list of the values by default (and thus of the types of graph available) differs. Operand

3.7.6 TABLE_REF ◊TABLE

```
_REF    = l_tabref , [l_table]          This operand
```

has the same meaning as for factor key word the ESSAI_TD (§3.4.4). 3.4.4