Operator MECA_STATIQUE

1 Goal

To solve a problem of static mechanics linear.

This operator allows to solve is:

- a linear static mechanical problem with superposition of various boundary conditions and various loadings,
- a thermomechanical analysis for a given list of moments.
  - in this case the mechanical characteristics of materials can depend on the temperature: the concept of the type cham_mater must then be defined starting from functions (cf operator DEFI_MATERIAU [U4.43.01] operand ELAS_FO),
  - the loading of dilation can be given only if one defined the dilation coefficient and the temperature of reference (cf operators DEFI_MATERIAU [U4.43.01] and AFFE_MATERIAU [U4.43.03]).

The concept produced by this operator is of type evol_elas containing one or more fields of displacements at the various moments of calculation.

In the case of the static mechanical analysis, one assigns the sequence number 0 (moment 0) to the field solution.

2 Syntax

```
mestat [evol_elas] = MECA_STATIQUE   ,  reuse = mestat,
              (  ♦  MODEL =             Mo  ,                [model]
                 ♦  |  CHAM_MATER =     chmat  ,             [cham_mater]
                    |  CARA_ELEM =      carac  ,             [cara_elem]
                 ♦  EXCIT = (_F (♦  LOAD = tank   ,      /   [char_meca]
                                                         /   [char_cine_meca]
                                 ◊  FONC_MULT= fmult ,   /   [function]
                                                         /   [formula]
                             ),)
                 ◊  /  INST =           /  tps,              [R]
                                        /  0. ,              [DEFECT]
                    /  LIST_INST =      /  litps  ,          [listr8]
                       ◊  INST_FIN = tf,
                 ◊  SOLVEUR = ( … to see [U4.50.01]  ),
                 ◊  OPTION =  /  'SIEF_ELGA',        [DEFECT]
                              /  'WITHOUT',
                 ◊  INFORMATION =   /  1,                        [DEFECT]
                              /  2,
                 ◊  TITLE =   title,                          [l_K80]
              )
```

3 Operands

3.1 Operands MODEL / CHAM_MATER / CARA_ELEM

One provides the arguments allowing to calculate the matrix of rigidity (and the second member):

♦ MODEL = Mo,

Name of the model whose elements are the object of mechanical calculation.

♦ CHAM_MATER = chmat,

Name of the material field.

◊ CARA_ELEM = carac,

Name of the characteristics of the structural elements (beam, hull, discrete,…) if they are used in the model.

3.2 Keyword EXCIT and operands INST / LIST_INST

One defines here the boundary conditions and the loadings.

♦ EXCIT =

This keyword factor makes it possible to define several concepts of the type load, one by occurrence; the solution is calculated in **superimposing** effects of the various loads applied.

3.2.1 Operands LOAD / FONC_MULT

♦ LOAD = tank,

Name of a concept of the type char_meca product by AFFE_CHAR_MECA or AFFE_CHAR_MECA_F [U4.44.01] starting from the model Mo.

One can also give the name of a "kinematic load" (standard char_cine_meca) result of the operators AFFE_CHAR_CINE and AFFE_CHAR_CINE_F [U4.44.03].

◊ FONC_MULT = fmult,

Name of a concept of the type function (or formula) who allows to define for each moment of calculation a multiplying coefficient applied to the load tank.

fmult is a function of time: by default it is a constant function which is worth 1.

3.2.2 Operands INST / LIST_INST

◊ / INST = tps,

Keyword used to carry out calculation at only one moment tps with the temperature corresponding to this moment.

/ LIST_INST = litps,

◊ INST_FIN = tf,

The list litps produced by DEFI_LIST_REEL [U4.34.01] defines the moments for which one asks for the calculation of a thermomechanical evolution.
The keyword INST_FIN allows to calculate only the moments former or equal to tf.
This keyword (INST_FIN) compound with the keyword "reuse"(réentrante orders) allows to split a long thermomechanical transient.

One will make for example:

```
resu = MECA_STATIQUE (…   LIST_INST = linst, INST_FIN = 10. ,…)
MECA_STATIQUE (reuse = resu,  LIST_INST = linst, INST_FIN = 20. ,…)
MECA_STATIQUE (reuse = resu,  LIST_INST = linst, INST_FIN = 30. ,…)
```

3.3 Keyword factor SOLVEUR

See [U4.50.01].

3.4 Operand OPTION

◊ OPTION =/'WITHOUT' / 'SIEF_ELGA'

By default the order MECA_STATIQUE calculate the constraints at the points of Gauss (or efforts generalized for the elements of structure).
The other options of postprocessing will be calculated a posteriori by the order CALC_CHAMP [U4.81.04].
If the user indicates OPTION = 'WITHOUT', these constraints will not be calculated and the structure of data produced will be less bulky.

3.5 Operand INFORMATION

◊ INFORMATION = 1,

Print the main features of the linear systems to solve: number of unknown factors, size of the matrix.

3.6 Operand TITLE

◊ TITLE = titr,

Title which one wants to give to the result [U4.03.01].

4 Examples of calculations

4.1 Static calculation with superposition of 2 loading cases

```
mest1 = MECA_STATIQUE (    MODEL = Mo,  CHAM_MATER = chmat,
                 CARA_ELEM = carac,
                 EXCIT = (_F (LOAD = ch1, FONC_MULT = COS),
                           _F (LOAD = ch2),),  )
```

4.2 Thermoelastic calculation at various moments

```
chmat = AFFE_MATERIAU (    …, AFFE_VARC=_F (… EVOL=evoth…) );

mest2 = MECA_STATIQUE (    MODEL = Mo, CHAM_MATER = chmat,
                           EXCIT = _F (LOAD = bloq),
                           LIST_INST = litps)
```

5 Notice

For certain studies in linear elasticity for which the characteristics of rigidity of the structure are independent of the thermal history and the boundary conditions kinematics independent of the other loads, one can determine the deformations for several cases of loading while using MACRO_ELAS_MULT [U4.51.02].