
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.

Note:

- In the case of the static mechanical analysis, one assigns the sequence number 0 (moment 0) to the field solution.
- The use of "reuse" is very restricted. The only authorized use that is described with the §3.4.

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

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 `AFPE_CHAR_MECA` or `AFPE_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 `AFPE_CHAR_CINE` and `AFPE_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.

3.3 Keywords 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. ,...)
```

3.4 Keyword reuse

The use of the keyword `reuse` is very restricted for this order.

The only authorized use that is described in the paragraph above:

- The list of the moments (`LIST_INST`) is obligatory must be the same concept for all the calls.
- The order is satisfied not to recompute the already calculated previous moments.

3.5 Keyword factor SOLVEUR

See [U4.50.01].

3.6 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.

3.7 Operand INFORMATION

◇ `INFORMATION = 1,`

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

3.8 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].