Operator CALC_MATR_ELEM

1 Drank

Compute of the elementary matrixes which one will be able to assemble by the command ASSE_MATRICE.

The possible computation options are:

"AMOR_ACOU", "MASS_MECA", "RIGI_FLUI_STRU", "RIGI_ROTA", "AMOR_MECA",
"AMOR_MECA_ABSO", "MECA_GYRO", "MASS_MECA_DIAG", "RIGI_GEOM", "RIGI_THER",
"IMPE_MECA", "MASS_THER", "RIGI_MECA", "MASS_ACOU", "ONDE_FLUI",
"RIGI_MECA_HYST", "MASS_FLUI_STRU", "RIGI_ACOU", "RIGI_GYRO"

Produce a data structure of the matr_elem_* type.

2 Syntax

```
mel     [matr_elem_*] = CALC_MATR_ELEM

          (      /♦OPTION      = "RIGI_MECA",
                    ♦MODELE    = Mo,                          [model]
                    ♦CHAM_MATER    =     chmat,               [cham_mater]
                       ◊CARA_ELEM    =caract        ,          [cara_elem]
                    ◊MODE_FOURIER =/nh         ,             [I]
                                  /0     ,                    [DEFAULT]
                    ◊CHARGE    =l_char         ,                [l_char_meca]

                 /♦OPTION      =      "MASS_MECA",
                                /   "MASS_MECA_DIAG",
                    ♦MODELE    = Mo,                          [model]
                    ◊CHAM_MATER   = chmat,                    [cham_mater]
                    ◊CHARGE    = tank   ,                        [char_meca]
                    ◊CARA_ELEM    =caract,                    [cara_elem]

                 /♦OPTION      = "RIGI_GEOM",
                    ♦MODELE    = Mo,                  [model]
                    ◊CARA_ELEM    = carac,                    [cara_elem]
                    ♦SIEF_ELGA    = sig ,                     [cham_elem]
                    ◊MODE_FOURIER =/nh         ,              [I]
                                  /0     ,                    [DEFAULT]

                 /♦OPTION      = "RIGI_ROTA",
                    ♦MODELE    = Mo,                          [model]
                    ♦CHAM_MATER   = chmat,                    [cham_mater]
                    ♦CHARGE    = l_char,                         [l_char_meca]

                 /♦OPTION      = "AMOR_MECA",
                    ♦MODELE    = Mo,                          [model]
                    ♦   |      CARA_ELEM = carac   ,          [cara_elem]
                        |   ♦RIGI_MECA    = rigiel ,          [matr_elem_DEPL_R]
                            ♦MASS_MECA    = massel ,          [matr_elem_DEPL_R]
                    ♦CHAM_MATER   = chmat,                    [cham_mater]
                    ◊CHARGE    = tank,                        [char_meca]

                 /♦OPTION      = "MECA_GYRO",
                    ♦MODELE    = Mo,                          [model]
                    ♦CARA_ELEM    = carac  ,                  [cara_elem]
                    ♦CHAM_MATER   = chmat,                    [cham_mater]

                 /♦OPTION      = "RIGI_GYRO" ,
                    ♦MODELE    = Mo,                          [model]
                    ♦CARA_ELEM    = carac  ,                  [cara_elem]
                    ♦CHAM_MATER   = chmat,                    [cham_mater]

                 /♦OPTION      = "RIGI_MECA_HYST",
                    ♦MODELE    = Mo,                            [model]
                    ♦CHAM_MATER   = chmat,                    [cham_mater]
                    ♦CHARGE    = l_char,                         [l_char_meca]
                    ♦RIGI_MECA    = rigiel ,                  [matr_elem_DEPL_R]

                 /♦OPTION      = "RIGI_THER",
                    ♦MODELE    = Mo,                          [model]
                    ♦CHAM_MATER   = chmat,                    [cham_mater]
```

```
                    ◊CARA_ELEM     = carac,                [cara_elem]
                    ◊MODE_FOURIER =/nh         ,           [I]
                                   /0          ,           [DEFAULT]
                    ◊CHARGE=lchar              ,           [l_char_ther]

                  /♦OPTION       = "MASS_THER",
                    ♦MODELE      = Mo,                     [model]
                    ♦CHAM_MATER    = chmat  ,              [cham_mater]
                    ◊CARA_ELEM     = carac  ,              [cara_elem]

                  /♦OPTION       = "RIGI_ACOU",
                    ♦MODELE      = Mo,                     [model]
                    ♦CHAM_MATER    = chmat,                [cham_mater]
                    ◊CHARGE      =lchar   ,                   [l_char_acou]

                  /♦OPTION       =      "MASS_ACOU",
                                   /   "AMOR_ACOU",
                    ♦MODELE      = Mo,                     [model]
                    ♦CHAM_MATER    = chmat,                [cham_mater]

                  /♦OPTION       = "RIGI_FLUI_STRU",
                    ♦MODELE      = Mo,                     [model]
                    ♦CARA_ELEM     = carac  ,              [cara_elem]
                    ♦CHAM_MATER    = chmat  ,              [cham_mater]
                    ◊CHARGE      = l_char,                   [l_char_meca]

                  /♦OPTION       = "MASS_FLUI_STRU",
                    ♦MODELE      = Mo,                     [model]
                    ♦CARA_ELEM     = carac  ,              [cara_elem]
                    ♦CHAM_MATER    = chmat  ,              [cham_mater]

                  /♦OPTION       =          "IMPE_MECA",
                                        /   "ONDE_FLUI",
                    ♦MODELE      = Mo,                     [model]
                    ♦CHARGE      = lchar,                  [l_char_meca]
                    ♦CHAM_MATER    = chmat  ,              [cham_mater]

                  ◊INST   =/tps              ,             [R]
                                 /0.0        ,             [DEFAULT]

          )


If          OPTION'AMOR_ACOU'alors     [*]            PRES_C
            '                             AMOR_MECA'DEPL_R
            '                             MECA_GYRO'DEPL_R
            '                             RIGI_GYRO'DEPL_R
            '                             IMPE_MECA'DEPL_R
            '                             MASS_ACOU'PRES_C
            '                          MASS_FLUI_STRU'DEPL_R
            "                             MASS_MECA'DEPL_R
            "                          MASS_MECA_DIAG'DEPL_R
            "                             MASS_THER'TEMP_R
            "                             ONDE_FLUI'DEPL_R
            "                             RIGI_ACOU'PRES_C
            "                          RIGI_FLUI_STRU'DEPL_R
            "                             RIGI_GEOM'DEPL_R
            "                             RIGI_MECA'DEPL_R
            "                          RIGI_MECA_HYST'DEPL_C
```

"	RIGI_ROTA'DEPL_R
"	RIGI_THER'TEMP_R

3 Operands

3.1 Operand OPTION

♦OPTION =

the table which follows gives the list of the matrixes calculated by an option as well as the type of element to which the option applies.

This kind of element is given either by the name of the phenomenon having made it possible to define the model, or by the name of the operator having produced the concept charges.

Option	Phenomenon or operator	Stamps
"AMOR_MECA"	MECHANICS	Damping of the elements calculated by linear combination of the stiffness and the mass [U2.06.03] or by direct assignment for the discrete elements. Damping of the elements of absorbing border pertaining to the modelizations spécifiques' 3D_ABSO'ou' DP_ABSO' of the model Mo and calculated starting from the mechanical characteristics E, □ and □ of the affected material.
"MECA_GYRO"	gyroscopic	MECANIQUE Damping [R5.05.17]
"RIGI_GYRO"	MECHANICAL	gyroscopic Stiffness [R5.05.17]
"IMPE_MECA"	acoustic	MECANIQUE Impedance of the surface elements belonging to the modélisations' 3D_FLUIDE'ou' 2D_FLUIDE' of the model Mo [U4.53.11].
"Mechanical	MASS_FLUI_STRU '*	Masses elements of the model Mo with taking into external account of the fluids and intern with structure and of the coefficient of containment.
"MASS_MECA"	MECHANICS	Masses elements of the model Mo.
"MASS_MECA_DIAG"	MECHANICS	Masses (diagonal) elements of the model Mo.
"ONDE_FLUI"	ACOUSTIC	MECANIQUE Impedance of the surface elements of the model Mo pertaining to the modélisations' 3D_FLUIDE'et' 2D_FLUIDE". This impedance corresponds to the harmonic influence of one incident wave of pressure [U4.53.11].
"Mechanical	RIGI_FLUI_STRU '*	Stiffness of the elements of the model Mo with taking into external account of the fluids and intern with structure and of the coefficient of containment.
"RIGI_GEOM"	GEOMETRICAL	Mechanics Stiffness of the elements of the model Mo.
"RIGI_MECA"	MECHANICS	Stiffness of the elements of the model Mo.
	AFFE_CHAR_MECA	Stamps associated with the LAGRANGE multipliers with lchar.
"RIGI_MECA_HYST"	MECHANICS	Hysteretic rigidity (complex) calculated by the multiplication by a complex number of the simple stiffness [U2.06.03].
	AFFE_CHAR_MECA	Stamps associated with the LAGRANGE multipliers with lchar.
"RIGI_ROTA"	MECANIQUE	Stiffness of rotation of the elements of the model THERMAL

Mo "MASS_THER	"	Masses elements of the model Mo.
"RIGI_THER"	THERMAL	Stiffness of the elements of the model Mo.
	AFFE_CHAR_THER	Stiffness coming from the conditions of exchange of lchar.
	AFFE_CHAR_THER	Stamps associated with the LAGRANGE multipliers with lchar.
"AMOR_ACOU"	ACOUSTICS	Damping of the elements of the model Mo.
"MASS_ACOU"	ACOUSTICS	Masses elements of the model Mo.
"RIGI_ACOU"	ACOUSTICS	Stiffness of the elements of the model Mo.
	AFFE_CHAR_ACOU	Stamps associated with the LAGRANGE multipliers with lchar.

The marked options * relate to the resorption of software FLUSTRU:

These two options: "RIGI_FLUI_STRU'et'MASS_FLUI_STRU' make it possible to calculate the mass matrixes and stiffness (and thus a modal base) for a structure of beam (SEG2) bathed by an external fluid. The behavior model of the material must be ELAS_FLU.

3.2 Operands MODELS / CHAM_MATER / CARA_ELEM

♦MODELE = Mo

This operand is used to indicate the elements for which must be carried out elementary computations: it is pointed out that the finite elements for the majority are defined in the model.

There are two exceptions:

1) Elements of dualisation of the conditions of DIRICHLET, i.e. elements allowing to impose conditions on the degrees of freedom of displacement in mechanics, degrees of freedom of temperature in thermal and the degrees of freedom of pressure in acoustics.
2) Nodal loading elements.

These elements are defined in the concepts of the char_meca type, char_ther or char_acou.

One must thus provide the argument l_char for the computation of the elementary matrixes of stiffness: RIGI_MECA, RIGI_THER, RIGI_ACOU, RIGI_MECA_HYST.

◊CHAM_MATER = chmat

Name of the material field where the characteristics of the materials of the elements are defined.

This argument is **almost always necessary**.

In practice, one can do some:

- for the discrete elements whose elementary matrixes are defined in the concept cara_elem. See AFFE_CARA_ELEM [U4.42.01],
- for the computation of the stiffness due to the dualisation of the boundary conditions.

◊INST = tps

the argument tps is used when the material characteristics or the loadings depend on time. A rather frequent case is that of a mechanical material depend on the temperature which it even depends on time.

◊CARA_ELEM = carac

the elementary characteristics carac are necessary if there exists in the model beam elements, shell or discrete elements or if a reference D" anisotropy were defined on solid elements (key word MASSIF of the command AFFE_CARA_ELEM).

3.3 Operand CHARGE

◊CHARGE = tank

This operand has several distinct functions:

1) To allow the computation of the elemental stiffness matrixes corresponding to the dualisation of certain boundary conditions of DIRICHLET),
2) For the option'IMPE_MECA": to give the value of the acoustic impedance of meshes of edge,
3) For the option'ONDE_FLUI": to give the value of the pressure of L" incident wave,
4) For the option'RIGI_ROTA": to give the value of the rotation imposed on the model.

3.4 Operand MODE_FOURIER

◊MODE_FOURIER = nh

positive or null Entier indicating the harmonic of FOURIER on whom one calculates the elementary matrixes.

By default: nh = 0

3.5 Operand SIEF_ELGA (option'RIGI_GEOM")

♦SIEF_ELGA = sig

the stress field sig given for the computation of the option'RIGI_GEOM' must be calculated in theory with the option'SIEF_ELGA" (stress field with Gauss points of the elements) (cf commands CALC_CHAM_ELEM [U4.81.03] or CALC_CHAMP [U4.81.04]).
The theory of fambement linear indeed supposes a theory of small elastic displacements.

3.6 Operands RIGI_MECA and MASSE_MECA (options'AMOR_MECA'et'RIGI_MECA_HYST")

elementary ♦RIGI_MECA

= Matrixes of stiffness (option: "RIGI_MECA") necessary to the computation of the damping matrixes ("AMOR_MECA") or of hysteretic rigidity ("RIGI_MECA_HYST") to see "Note of use of damping and hysteretic rigidity" [U2.06.03].

Elementary ◊MASS_MECA

= Matrixes of mass (option: "MASS_MECA'ou'MASS_MECA_DIAG") necessary to the computation of the damping matrixes ("AMOR_MECA").

Note:

> *For L" option'RIGI_MECA_HYST", result of computation will contain besides the hysteretic rigidity of the elements of the model, the "stiffness" of the elements of Lagrange of the outputs.*

4 Examples of computations with CALC_MATR_ELEM

4.1 geometrical Stiffness matrix for the buckling of EULER

```
rigigeom = CALC_MATR_ELEM (   OPTION = ' RIGI_GEOM",  MODELS = Mo,
                              CARA_ELEM = carac   ,   SIEF_ELGA = chsig)
```

4.2 Stamps of "mass" in acoustics

```
massacou = CALC_MATR_ELEM (   OPTION = ' MASS_ACOU",  MODELS = Mo,
                              CHAM_MATER = chmat  )
```

4.3 Stiffness matrix of the elements of LAGRANGE in mechanics

```
rigibloc = CALC_MATR_ELEM (   OPTION = ' RIGI_MECA",  CHARGE = ch_bloc)
```