Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version default

Date : 03/12/2017 *Page : 1/12*
Clé : U4.66.11   *Révision :*
               bab598d4bb25

Macro-order `MACRO_MATR_AJOU`

1   Goal

To calculate in a way more condensed than with `CALC_MATR_AJOU` matrices of mass, damping or rigidity added [R4.07.03]. The matrices are induced by a fluid true, incompressible, at rest or in potential flow, on a structure in 2D, 2D axisymmetric or in 3D.

The terms of these matrices are calculated on the basis of modal structure in the vacuum.

One can also calculate by the launching of `CALC_FORC_AJOU` [U4.66.03] vectors of the added forces induced by a seismic movement of training also calculated on the basis of modal structure in the vacuum.

The interest of this macro-order is primarily to mask the calls to the operators of linear thermics who calculate the hydrodynamic pressures caused by the vibration of the structure in the fluid. The user should from now on inform only the characteristics of his fluid field and the clean modes in air of the structure, the operator undertaking to calculate the added matrices.

The possibilities of the order preserve those of the operator `CALC_MATR_AJOU` [U4.66.01].

Examples of use of the macro-order `MACRO_MATR_AJOU` are presented in the CAS-test:
- FDLV101 [V8.01.101],
- FDLV102 [V8.01.102],
- FDLV106 [V8.01.106],
- FDLV108 [V8.01.108],
- FDLV109 [V8.01.109],
- FDLV112 [V8.01.112].

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version default

Date : 03/12/2017 Page : 2/12
Clé : U4.66.11 Révision :
bab598d4bb25

2   Syntax

```
MACRO_MATR_AJOU

    (   ♦   GRID            = netted                    [grid]
        ♦   GROUP_MA_FLUIDE   = fluid                   [gr_ma]
        ♦   GROUP_MA_INTERF   = interf                  [gr_ma]
        ♦   MODELING =   / '3D'
                         / 'PLAN'
                         / 'AXIS'
        ♦   FLUID =      _F (      ♦   RHO      = rho         [R]
                                   ◊   ALL      = 'YES'
                                   ◊   GROUP_MA  = grma        [group_ma]
                         )

        ♦   DDL_IMPO =   _F (  ♦  /  PRES_FLUIDE = pfluide     [R]
                                  /  PRES_SORTIE = psortie     [R]
                               ♦  GROUP_NO    = grno           [group_no]
                         )

        ◊   FLOW = _F (      ♦   VNOR_1        = vnor1      [R]
                             ◊   VNOR_2        = vnor2      [R]
                             ♦   GROUP_MA_1    = grma1      [group_ma]
                             ♦   GROUP_MA_2    = grma2      [group_ma]
                             ◊   POTENTIAL     = phi        [evol_ther]
                         )

        ♦   /   MODE_MECA    = modes                      [mode_meca]
            /   DEPL_IMPO    = chamno                     [cham_no_DEPL_R]
            /   MODELE_GENE  = modgen                     [modele_gene]

         If MODE_MECA or MODELE_GENE
            ♦   NUME_DDL_GENE   = numgen                  [nume_ddl_gene]

         If DEPL_IMPO
            ◊   NUME_DDL_GENE   = numgen                  [nume_ddl_gene]

        ◊   DIST_REFE = /  distance                   [R]
                        /  1.0 D-2                     [DEFECT]

        ♦   |   MATR_MASS_AJOU  = massaj               [matr_asse_gene_R]
            |   MATR_RIGI_AJOU  = rigiaj               [matr_asse_gene_R]
            |   MATR_AMOR_AJOU  = amoraj               [matr_asse_gene_R]

        ◊   /   MONO_APPUI    = 'YES'
            /   MODE_STAT    = mode                    [mode_meca]

        ◊   FORC_AJOU = _F ( ◊  GROUP_NO  = grno       [l_group_no]
                             ♦  DIRECTION = direction  [l_R]
                             ♦  VECTOR = vector   [vect_asse_gene]
                           .

        ◊   SOLVEUR = to see [U4.50.01]
        ◊   INFORMATION =    /  1                          [DEFECT]
                    /  2

        ◊   NOEUD_DOUBLE =   /  'YES'
                             /  'NOT'                       [DEFECT]
```

Code_Aster

Version default

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Date : 03/12/2017 Page : 3/12
Clé : U4.66.11 Révision :
bab598d4bb25

```
      ◊   AVEC_MODE_STAT=  /   'YES'                    [DEFECT]
                           /   'NOT'
    );
```

Contents

Contents

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version default

Date : 03/12/2017 Page : 4/12
Clé : U4.66.11   Révision :
bab598d4bb25

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version
default

Date : 03/12/2017 *Page : 5/12*
Clé : U4.66.11 *Révision :*
bab598d4bb25

3 Operands

3.1 Operand GRID

Name of the grid containing the fluid field and the fluid interface/structure. This grid can also include the structure.

3.2 Operand GROUP_MA_FLUIDE

♦ GROUP_MA_FLUIDE = fluid

Groups of meshs (plane meshs in 2D and 2D axisymmetric, voluminal meshs in 3D) representing the fluid field acting on the studied structure.

3.3 Operand GROUP_MA_INTERF

♦ GROUP_MA_INTERF = interf

Groups of meshs representing the interface enters the fluid and the structure (plane or telegraphic meshs). It should be stressed that this group of meshs can be one of those used to model the surface of the structure, in particular if this one is modelled by elements of hull. It is not always necessary to create a group of meshs of specific interface with meshs except for whole.

3.4 Operand MODELING

Type of modeling to be assigned to the fluid field and the fluid interface/structure. Currently, modelings 'PLAN'(fluid field 2D),'3D'(voluminal fluid field) and'AXIS'(axisymmetric fluid field) are only authorized.

3.5 Keyword FLUID

Keyword factor where one affects the fluid material characteristics. If the density of the fluid varies on the fluid field, it is necessary to specify these various densities by several occurrences of the keyword factor FLUID.

3.5.1 Operand RHO

♦ RHO = rho

Value of the density of the fluid to be affected on the below definite topological entities.

3.5.2 Operands ALL / GROUP_MA

Groupe of meshs or totality of the fluid field where one affects the density RHO.

3.6 Keyword DDL_IMPO

Keyword factor by which one specifies the boundary conditions of the fluid (of Dirichlet type).

3.6.1 Operand GROUP_NO

Groupes of nodes where one imposes the boundary conditions on the fluid field.

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version default

Date : 03/12/2017 Page : 6/12
Clé : U4.66.11   Révision :
bab598d4bb25

3.6.2 Operand PRES_FLUIDE

Keyword under which one specifies the value that one imposes on the hydrodynamic pressure (i.e. the disturbance of pressure created by the vibration of the structure) on topological entity given Ci - above. This keyword must appear at least once because it makes it possible to calculate the generating non stationary fields of pressure of the added mechanical magnitudes.

3.6.3 Operand PRES_SORTIE

Pressure of exit to be imposed on a steady flow. Keyword to be used (in an occurrence different from the keyword factor DDL_IMPO where one used PRES_FLUIDE) to specify the boundary conditions on the permanent sizes to calculate (like the potential permanent fluid speeds characterizing a steady flow disturbed by the vibrations). This keyword is to be used only if one wants to calculate the matrices of added damping and rigidity which require the calculation of a presumedly potential steady flow.

3.7 Keyword FLOW

This keyword factor makes it possible to determine the boundary conditions of the Neumann type when one wants to calculate a presumedly potential steady flow, to be able to calculate added damping and rigidity.

3.7.1 Operands GROUP_MA_1 / GROUP_MA_2

Names of the groups of meshs respectively of entry and exit of the fluid field where one imposes conditions normal speed of entry or exit of the fluid.

3.7.2 Operands VNOR_1 / VNOR_2

Actual values normal speeds of the fluid respectively at the entry and the exit of the fluid field.

3.7.3 Operand POTENTIAL

Name given by the user to the potential permanent fluid speeds if he wants possibly post-to treat it.

3.8 Operands MODE_MECA / DEPL_IMPO / MODELE_GENE

♦ / MODE_MECA = modes

Dynamic modes calculated on the model structure. If there are several nonrelated structures immersed in the same fluid, for which one wants to determine the added matrices including the terms of coupling by the fluid, the model structure which one defines gathers the totality of the immersed structures. The modes used by the operator are the modes calculated for the total structure.

/ DEPL_IMPO = chamno

Fields with the nodes of displacements affected on groups of nodes defining the fluid interface/structure. By affecting such a field of displacement on (S) the group (S) of nodes of interface thanks to the operator CREA_CHAMP, one can for example easily simulate modes of rigid body of the structures. This operand is to be used if one wants to estimate the terms of the added matrices and coupling for a plane geometry **without doing modal calculation as a preliminary** structure in the vacuum, and which one wants to affect these terms in discrete elements (modeling DIS_T). The operand INFORMATION must imperatively be active to visualize the calculated terms.

Code_Aster

Version default

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Date : 03/12/2017   Page : 7/12
Clé : U4.66.11   Révision   :
bab598d4bb25

Caution:

*The use of this operand **excludes** that of the operand NUME_DDL_GENE . One cannot thus do modal, transitory calculation or harmonic by using the operand CHAM_NO .*

Indeed, to do calculation of modes out of water, it is necessary to have a matrix of generalized mass and a matrix of rigidity generalized of the structure. This supposes to have done a modal calculation on the structure in the vacuum (what one wants precisely to avoid).

*This operand is used ultimately only for **to evaluate the matrix of mass, rigidity and damping added** , and to use them to couple structures of type beam by discrete elements of mass, for example.*

/   MODELE_GENE = modgen

Generalized model built by the operator DEFI_MODELE_GENE [U4.65.02]. This keyword is to be used when one does a calculation by dynamic under-structuring, and that one wants to calculate the matrix of added mass coupling the whole of under - structures. In this case, the substructures can be in different files of grid, these files being able to be themselves distinct from the fluid file of grid. The substructures which have a repetitivity within the fluid are to be netted only once, but one will take care on the level it fluid grid to net all the interfaces fluid/structure. Moreover, it is necessary to take care that the nodes of fluid interface coincide as well as possible with the nodes of interface of structure, in order to be able to recopy, on the basis of geometrical criterion of proximity, the values of the fields of displacement of structure on the nodes of fluid interface (see operand DIST_REFE).

3.9   Operands `MATR_MASS_AJOU`/`MATR_AMOR_AJOU`/`MATR_RIGI_AJOU`

These keywords specify the name user of the matrices of mass, rigidity or added damping (E) that one wants to calculate. One needs at least one of these keywords to operate calculation. The 3 keywords can be used simultaneously, but in the case of the use of MATR_AMOR_AJOU or MATR_RIGI_AJOU, the keywords should be informed FLOW and DDL_IMPO with PRES_SORTIE.

3.10   Operand `DIST_REFE`

Distance from reference to be informed when one does a calculation of **added mass** on a generalized model. This distance is a geometrical absolute criterion of proximity intended to recopy values of structural displacements in a fluid field, in order to solve there the equation of Laplace of the field of non stationary pressure. By default, it is equal to 10^{-2}.

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version
default

Date : 03/12/2017 Page : 8/12
Clé : U4.66.11   Révision   :
*   bab598d4bb25*

3.11 Operand NOEUD_DOUBLE

◊   NOEUD_DOUBLE = 'YES'

This operand is to be used when one does a calculation of **added mass** starting from a generalized model which understands a substructure with a grid by a telegraphic or surface grid (*i.e.* without thickness like beam or hull) and surrounded by two fluids. One needs in this case for the level it grid to duplicate the nodes of the fluid interfaces of those of the structure, in order to be able to calculate the hydrodynamic jump of pressure on both sides of the structure (*cf.* figure Ci - below).
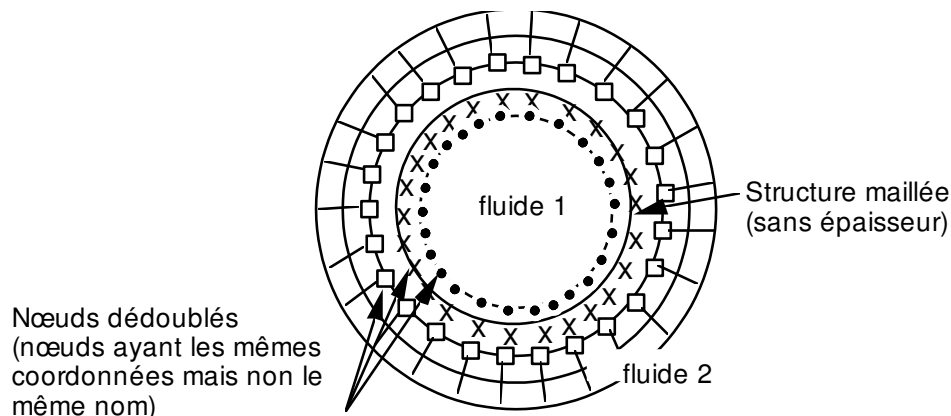
3.12 Operand AVEC_MODE_STAT

◊   AVEC_MODE_STAT = 'NOT'

This operand makes it possible to in the case of disconnect the calculation of the terms of mass added on the static modes contained in the modal base of the substructures a calculation with a generalized model (*cf.* [§3.8]).

3.13 Operand NUME_DDL_GENE

◊   NUME_DDL_GENE = numgen

Generalized classification based on the mechanical modes of the total structure. The presence of this operand makes it possible to calculate a matrix of added mass of type matr_asse_gene_R. It must be necessarily present if one wants to do modal, harmonic or transitory calculation thereafter.

3.14 Description of the seismic movement of training

3.14.1 Operand MONO_APPUI

♦   /   MONO_APPUI = 'YES'

The structure is uniformly excited in all the supports (movement of training of solid body).

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version
default

Date : 03/12/2017 Page : 9/12
Clé : U4.66.11   Révision :
*   bab598d4bb25*

3.14.2 Excitation multi supports: operand MODE_STAT

In this case, the accelerations undergone by the whole of the points of anchoring of the studied structure are not inevitably identical and in phase.

/   ♦   MODE_STAT = mode

Static modes of the structure: concept of the type mode_meca product by the operator MODE_STATIQUE [U4.52.14] with the option DDL_IMPO. They correspond to the 3 or 6·nb_supports static modes where nb_supports is the number of accélérogrammes different undergone by the structure.

Note:

If the structure is requested only by translations, there are then 3 nb_supports static modes.

3.15 Added forces due to the seismic movement of training: keyword FORC_AJOU

3.15.1 Operand GROUP_NO

♦   GROUP_NO = g_noeu

Groupes of nodes (g_noeu) structure subjected to the seismic excitation: these nodes support them ddl supports of the structure to which are applied the imposed movements.

3.15.2 Operand DIRECTION

♦   DIRECTION = (d1, d2, d3, r1, r2, r3)

Components of a vector giving the direction of the earthquake of training in the total reference mark. It is a list of three realities if the imposed accélérogrammes are only translations. If accelerations of rotations are also imposed, a list of six realities is expected (valid for modelings with discrete elements).

3.15.3 Operand VECTOR

♦   VECTOR = vector   [vect_asse_gene]
Name of the vector forces added created by the launching of the operator CALC_FORC_AJOU [U4.66.03]. It there as many vectors created of occurrences of the keyword FORC_AJOU.

3.16 Keyword SOLVEUR

Keyword factor specifying the technique of resolution of system linear appearing here in the calculation of the non stationary fields of pressure. See [U4.50.01].

3.17 Operand INFORMATION

◊   INFORMATION =

Indicate the level of impression of the results of the operator,

1:     no impression,
2:     impression of the higher triangular part of the matrices of added mass, added damping or rigidity.

Presentation in column.

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version default

Date : 03/12/2017 Page : 10/12
Clé : U4.66.11   Révision :
bab598d4bb25

4   Production run

It is checked that the storage of the added matrices is done on a profile **full**.

It is checked that the coefficients of car masses added (diagonal terms of the matrix) are well all positive. In the contrary case, a message of alarm is transmitted so that the user checks the orientation of the normals.

In the case of a calculation of mass added on a generalized model, one informs the user on the recopies of fields of structural displacements in the fluid (many recopied values) and one indicates how to change the distance from reference (DIST_REFE).

5   Example

5.1   Example 1: Calculation of the matrix of mass added of a structure made up of two concentric cylinders separated by an incompressible fluid

The cylinders are supported each one by springs. The matrix of added mass is calculated for the first two modes of the structure, namely the modes of rigid body of each cylinder in direction OX (*cf.* diagram). One will present here only the stages of the command file, because this example is inspired by CAS-test FDLV101 [V8.01.101]. For the detail of the syntax of the other operators, the user will be able to thus refer to the command file of this CAS-test.
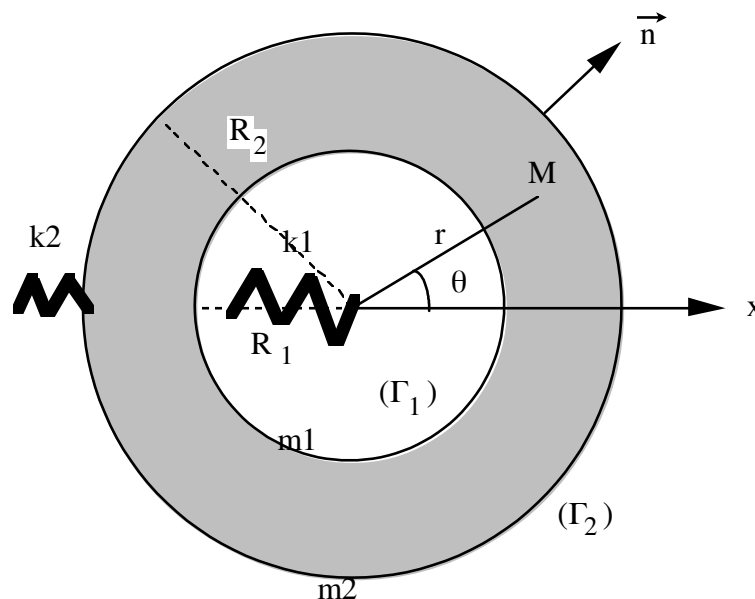
1)   Assignment of the model structure total (including the two cylinders and their springs of self-supporting quality).

2)   Calculation of the clean modes of the structure in the vacuum

3)   Generalized classification based on the calculated mechanical modes

Code_Aster

Version
default

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Date : 03/12/2017 Page : 11/12
Clé : U4.66.11   Révision   :
                      bab598d4bb25

4) Calculation of the matrix of added mass of type `matr_asse_gene_r` (operand `NUME_DDL_GENE` present). So one can then calculate the clean modes of the "wet" structure

```
MACRO_MATR_AJOU(GRID = Maya,
                GROUP_MA_FLUIDE = ' grfluide ',
                GROUP_MA_INTERF = grinter ,
                MODELING = 'PLAN' ,
                FLUID = _F (RHO = rho,
                            GROUP_MA = 'grtotal'),
                DDL_IMPO = _F (GROUP_NO = 'noflui',
                               PRES_FLUIDE = 0. ),
                MATR_MASS_AJOU = massaj,
                MODE_MECA = modes,
                NUME_DDL_GENE = numgen,
                INFORMATION =1)
```

5) Calculation of the matrices of mass and stiffness generalized on the generalized classification based on the calculated mechanical modes `numgen`. These matrices are of type [`matr_asse_gene_r`]

6) Calculation of the matrix of total mass of the structure (matrix of generalized mass more matrix of added mass)

7) Calculation of the modes of the immersed structure.

8) Restitution of the modes "wet" on physical basis.

Code_Aster

Titre : Macro-commande MACRO_MATR_AJOU
Responsable : DEVESA Georges

Version default

Date : 03/12/2017 Page : 12/12
Clé : U4.66.11   Révision :
bab598d4bb25

5.2   Example 2: cylinder subjected to an annular flow

This case (very near to CAS-test FDLV106 [V8.01.106]) implements the calculation of mass, damping added, and rigidity added on a cylindrical structure subjected to an annular flow which one supposes potential. One calculates mass and damping initially added by the flow on the structure for various speeds upstream (4 m/s, 4.24 m/s and 6 m/s), this on a model 3D for the fluid and hull for the structure. The structure has a displacement of rotation around a pivot located at the downstream end of the cylinder compared to the flow.
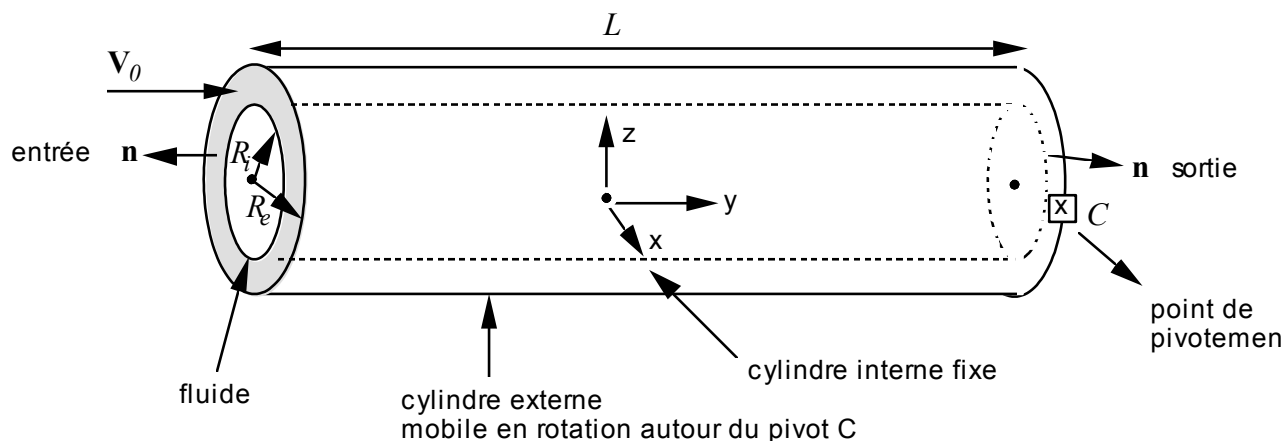
1)   After having modelled the cylindrical structure and having calculated its modes in air, the order MACRO_MATR_AJOU allows to calculate the mass, the rigidity and damping added by the fluid flow on this structure:

```
MACRO_MATR_AJOU (GRID = MAYA,
                GROUP_MA_FLUIDE = 'FLUID',
                GROUP_MA_INTERF = 'INTERFACE',
                FLUID = _F (RHO = 1000.),
                INFORMATION = 2,
                MODELING = '3D',
                DDL_IMPO = (
                        _F (GROUP_NO = 'TEMPIMPO', PRES_FLUIDE = 0.),
                        _F (GROUP_NO = 'NOSORT', PRES_SORTIE = 0.)),
                FLOW = _F (GROUP_MA_1 = 'ENTERED',
                        GROUP_MA_2 = 'LEFT',
                    VNOR_1 = -4. ,
                    VNOR_2 =  4.  ),
                MATR_MASS_AJOU = CO ("MASSAJ"),
                MATR_AMOR_AJOU = CO ("AMORAJ"),
                MATR_RIGI_AJOU = CO ("RIGIAJ"),
                MODE_MECA: = MODES,
                NUME_DDL_GENE = NUMGEN,
                )
```