Operator MACR_ELEM_DYNA

1 Drank

To define a dynamic macro-element of substructuring.

In the frame of a transient analysis, modal or harmonic, with dynamic substructuring operator MACR_ELEM_DYNA carries out the projection of the stiffness matrixes, mass and possibly of damping (harmonic analysis) on the modal base of the substructure defined by DEFI_BASE_MODALE [U4.64.02], and the extraction of the matrixes of connection of the interfaces. Result is consisted by the projected matrixes and of the matrixes of connection. He can be used several times with different directional senses in the same model (cf DEFI_MODELE_GENE [U4.65.02]). He can be printed on file by the command IMPR_MACR_ELEM [U7.04.33].

Product a concept of the macr_elem_dyna type.

Contents

2 Syntax

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macro_dyna [macr_elem_dyna] = MACR_ELEM_DYNA

    (      ♦BASE_MODALE=bamo              ,                  [mode_meca]

           # Given matrixes :

           ◊/MATR_RIGI=mr                    ,
[matr_asse_DEPL_R]
                                                         [matr_asse_DEPL_C]

              /MATR_MASS              =mm   ,
[matr_asse_DEPL_R]

              /MATR_IMPE              =mi   ,
[matr_asse_gene_C]

                 # If MATR_IMPE well informed:
                 ♦FREQ_EXTR=freq            ,               [R]
                 ◊AMOR_SOL=/0.0                ,            [DEFAULT]
                                /amosol    ,         [R]
                 ◊MATR_IMPE_INIT=mi0        ,            [matr_asse_gene_C]
              /  |  MATR_IMPE_RIGI  = Mr.,              [matr_asse_gene_C]
                 |  MATR_IMPE_AMOR  = my,               [matr_asse_gene_C]
                 |  MATR_IMPE_MASS  = mm,               [matr_asse_gene_C]


           ◊/MATR_AMOR=ma                 ,
[matr_asse_DEPL_R]
              /AMOR_REDUIT      =la   ,                  [l_R]

           ◊SANS_GROUP_NO=grno            ,                  [group_no]

        # Substructuring static:

           ◊CAS_CHARGE    =_F    (
              ♦NOM_CAS=nocas                ,               [k8]
              ♦VECT_ASSE_GENE=vgen          ,               [vect_asse_gene]
                         ),
        # manual Filling of the reduced matrixes (given experimental):

           ◊MODELE_MESURE    = _F (
              ♦FREQ=freq                 ,                  [l_R]
              ♦MASS_GENE=mgen            ,                  [l_R]
              ◊AMOR_REDUIT=xsi           ,                  [l_R]
                                ),

    )
```

3 Operands

3.1 Operand BASE_MODALE

♦BASE_MODALE = bamo

Name of the concept mode_meca produces DEFI_BASE_MODALE [U4.64.02] by the operator.

3.2 Operand MATR_RIGI

◊MATR_RIGI = Mr.

Nom of the concept stamps assembled of type matr_asse_DEPL_R or matr_asse_DEPL_C by the operator produces ASSE_MATRICE [U4.61.22] or the macro-command ASSEMBLY [U4.61.21] corresponding to the stiffness matrix of the substructure.

3.3 Operand MATR_MASS

◊MATR_MASS = mm

Name of the concept stamps assembled of matr_asse_DEPL_R type produced by the operator ASSE_MATRICE [U4.61.22] or the macro-command ASSEMBLY [U4.61.21] corresponding to the mass matrix.

These two operands are to be employed if one uses modal base bamo is of type "RITZ".

3.4 Operand MATR_AMOR / AMOR_REDUIT

◊/MATR_AMOR = my

Name of the concept stamps assembled of matr_asse_DEPL_R type produced by the operator ASSE_MATRICE [U4.61.22] or the macro-command ASSEMBLY [U4.61.21] corresponding to the damping matrix viscous, specific to the macro-element. This damping must be of type RAYLEIGH by element (linear combination of the stiffness and the mass on the level of the element) and is thus defined by the properties of the material (operator: DEFI_MATERIAU [U4.43.01], operands AMOR_ALPHA and AMOR_BETA).

/AMOR_REDUIT =

the List of reduced dampings (percentage of critical damping) the corresponding to each mode of vibration of the macro-element. The length of the list is (with more) equal to the number of eigen modes of modal base; if it is lower, one supplements the list with the reduced dampings equal ones to the last term of the list entered by the user. No damping is associated with the static modes. The generalized damping matrix of the macro-element k is thus diagonal incomplete (j index of the eigen mode):

$$\overline{C}^k=\begin{pmatrix}\xi_j & 0\\ 0 & 0\end{pmatrix}$$

3.5 Operands MATR_IMPE / FREQ_EXTR / AMOR_SOL

◊ MATR_IMPE = semi

Name of the concept stamps assembled of matr_asse_gene_C type produced by the operator LIRE_IMPE_MISS [U7.02.32] corresponding to the matrix of impedance of soil constitutive of the macro-element.

♦ FREQ_EXTR = freq

Frequency of extraction of the matrix of impedance of soil necessary for the radiative computation of the damping matrix of soil from the imaginary part of the matrix mi .

◊AMOR_SOL = amosol

Value of material reduced damping of the soil. It serves to distinguish in damping as the soil the properly material part and the radiative part. If it is non-zero, the radiative part C is expressed then such as:

$$2\pi \, freq \, C = Imag(mi(freq)) - 2\,amsol\,Reel(mi(freq))$$

3.6 Operand MATR_IMPE_INIT

◊ MATR_IMPE_INIT = mi0

Name of the concept stamps assembled of matr_asse_gene_C type produced by the operator LIRE_IMPE_MISS [U7.02.32] corresponding with a matrix of impedance of soil constitutive of the macro-element extracted with a frequency quasi-nulle. In particular in the cases of interaction soil-structure-fluid with key word ISSF=' OUI' in the call to LIRE_IMPE_MISS, that allows to extract a contribution from mass M such as:

$$(2\pi \, freq)^2 M = Reel(mi0) - Reel(mi(freq))$$

3.7 Operands MATR_IMPE_RIGI/MATR_IMPE_AMOR/MATR_IMPE_MASS

| MATR_IMPE_RIGI = Mr.
| MATR_IMPE_AMOR = my
| MATR_IMPE_MASS = mm

Name of the concepts of assembled matrix of matr_asse_gene_C type produced by successive calls to operator LIRE_IMPE_MISS [U7.02.32] in order to extract the respective contributions constitutive of the macro-element in stiffness, damping or mass of a matrix of temporal impedance of soil. If at least of the operands is indicated, without others being present, then the contributions of the latter under the macro-element are filled and put at 0.
An example of use is provided by test MISS03B [V1.10.122] .

3.8 Operand SANS_GROUP_NO

♦ SANS_GROUP_NO = grno

Name of the nodes group including the list of the nodes of the physical interface of the part of model on which one calculates the dynamic macro-element. Its data is necessary only if this macro-element is used as substructure super-mesh defined by key word AFFE_SOUS_STRUC in a mixed model including also of the finite elements classical, and in this case, only when the nodes of the interfaces physics and dynamics (the latter defined by DEFI_INTERF_DYNA) do not coincide. For example in the case of the dynamic interface reduced to a node connected by a solid connection to the physical interface.

3.9 Key word CAS_CHARGE.

◊CAS_CHARGE

This key word factor makes it possible to define a set of named **loading cases** (key word NOM_CAS). These loading cases are used to apply generalized load vectors applied to the part of model on which one calculates the dynamic macro-element so then this macro-element is used as substructure super-mesh in a mixed model including also of the finite elements classical.

3.9.1 Operand NOM_CAS

♦NOM_CAS = nocas

the loading condensed under the name nocas (between “quotes”) corresponds to the loading defined by argument VECT_ASSE_GENE on the part of model on which one calculates the dynamic macro-element.

3.9.2 Operand VECT_ASSE_GENE

♦VECT_ASSE_GENE = vgen

the loading condensed under the name nocas (between “quotes”) corresponds to the loading defined by argument VECT_ASSE_GENE. It is obtained by the projection of a load, applied to the part of model on which one calculates the dynamic macro-element, on higher definite bamo modal base.

3.10 Operand MODELE_MESURE

◊MODELE_MESURE

This key word factor makes it possible to manually fill the reduced matrixes of the macro-element, by means of, for example, of the data resulting from measurements (and imported with LIRE_RESU). One must, has minimum, and to return the generalized mass eigenfrequencies. One can also inform the list of reduced dampings.

The well informed number of data must be equal to number of modes of the base modal on which the macro-element is built.

Not methodological: this kind of use of MACR_ELEM_DYNA is justified for the use of the method of structural modification from an experimental model. A presentation of the method is given in U2.07.03. **Modal base used to build the macro-element should be made up only of the eigen modes of measured structure**, and does not have to comprise the static statements with the interface, because those are false (because not measured and, in the actual position of knowledge, nonmeasurable).

The sdll137e benchmark is an example of the implementation of methodology.

3.10.1 Operand FREQ

♦FREQ = freq

List of the identified eigenfrequencies.

3.10.2 Operand MASS_GENE

♦MASS_GENE = farmhouse

Lists identified generalized masses.

3.10.3 Operand AMOR_REDUIT

♦AMOR_REDUIT = xsi

List of reduced dampings identified.

4 Example

an example of use of this operator is given in the documentation of operator DEFI_SQUELETTE [U4.24.01].