Macro-command MACR_SPECTRE

1 Drank

This macro-command allows computation of a fast and effective postprocessing to determine the floor spectrums of any building after a seismic dynamic analysis.

It can for example be used after a transient dynamic computation of a building to the seisme, where connections between the soil and to erase it are simulated by a soil stiffness (DYNA_TRAN_MODAL [U4.53.21], transient dynamic computation on a reduced modal base, calculated in relative reference, product concept: resu_gene) or after computations resulting from the coupling *Code_Aster* - *ProMiss3D* (LIRE_ MISS3D [U7.02.31], product concept: dyna_trans) or following a nonlinear transient dynamics resolution (DYNA_NON_LINE, concept evol_noli, or on an array of observation resulting from a computation of this type).

This macro-command carries out successively:
1) the extraction of relative acceleration in one or more nodes of the mesh as a result concept (RECU_FONCTION [U4.32.03]);
2) combination with the acceleration of soil to obtain absolute acceleration (CALC_FONCTION [U4.32.04]);
3) the computation of the response sprectrum of acceleration with several damping coefficients (CALC_FONCTION [U4.32.04]);
4) the function wraps relative displacement corresponding to a bottom given to obtain the floor spectrum (optional).

For practical examples of implementation, the reader can refer to the cases tests sdll138a (postprocessing of an analysis dyna_tran_modal), or to the tests miss01, miss05 with computation of coupling *Code_Aster* - *ProMiss3D*.

The macro-command produces a concept of the table_sdaster type .

2 Syntax

```
table_sdaster =MACR_SPECTER        (
   ##calcul    of the response sprectrum, seismic postprocessing of analysis
      ♦MAILLAGE=ma                                                      [mesh]
      ♦PLANCHER  = _F   (
                         ♦NOM                = floor                [kN]
                         ◊/NOEUD               = l_no
[l_noeud]
                            /GROUP_NO      = l_gno              [l_gr_noeud]
                          )
      ♦CALCUL    =     /  "ABSOLU"
                        / "RELATIF"
      ♦NOM_CHAM  = /   "ACCE"
                        / "DEPL"
   ##si    NOM_CHAM = ' ACCE':
         ♦AMOR_SPEC       =   l_amor                          [l_R]
         ◊LISTE_INST      =   linst                           [listr8]
         ◊/FREQ          =    l_fr                            [l_R]
            /LIST_FREQ    =   lfreq                           [listr8]
          ♦ NORM        =       R                            [R]
          ♦ RESU = _F  (
                          ♦ /   "RESU_GENE"   = tg          [tran_gene]
                            /   "ARRAY"       =        [table_sdaster]
                            /   "RESULTAT"       = resu       [dyna_trans]
                                                              [evol_noli]
      ##si    CALCUL = ' RELATIF':
                         ♦  ACCE_X =         ac_x                 [function]
                         ♦  ACCE_Y =         ac_y                 [function]
                         ♦ACCE_Z    =        ac_z                  [function]
                         )
          ◊ PRINTING = _F (
                            ◊TRI    =     /  "AMOR_SPEC"          [DEFAULT]
                                          /  "DIRECTION"
                            ◊FORMAT    = /  "TABLEAU"             [DEFAULT]
                                          /  "XMGRACE"
   logical      ##unity indicating the print file of the results  :
                            ◊UNITE  = /29                       [DEFAULT]
                                        /u                         [I]
            ##SI    FORMAT = ' XMGRACE':
                            ◊PILOTE    = /  "POSTSCRIPT"
                                         /  "EPS"
                                         /  "MIF"
                                         /  "SVG"
                                         /  "PNM"
                                          / "PNG"
                                          / "JPEG"
                                         /  "PDF"
                                         /  "INTERACTIF"
                             ◊  TOUT =        "NON"                [DEFAULT]
```

```
                                          /   "OUI'
                                  )
        ##SI    NOM_CHAM = ' DEPL':
             ◊LISTE_INST      =   linst                         [listr8]
              ♦ RESU = _F  (
                         ♦ /   "RESU_GENE" = tg            [tran_gene]
                           /   "RESULTAT"  = resu              [dyna_trans,
                                                               [evol_noli]
           ##si    CALCUL = ' ABSOLU':
                         ♦ DEPL_X =         de_x             [function]
                         ♦ DEPL_Y =         de_y             [function]
                         ♦ DEPL_Z =         de_z             [function]
                       )
        );
```

3 Operands

the classical postprocessing of a seismic analysis in transient dynamics consists in carrying out following computations:

- The floor spectrum obtained starting from absolute accelerations, for each direction X, Y, Z, calculated in a specified node of the mesh (for example in the case of model “a skewer”);
- The envelope of the floor spectrum, calculated in some nodes of the same bottom, for each direction X Y, Z and H (maximum enters X and Y), (for example in the case of a structure of building 3D);
- Envelopes displacements of structure compared to motions of soil.

Three operators of *Code_Aster* can produce result concepts corresponding to transient dynamic computations:

- DYNA_TRAN_MODAL [U4.53.21] produced a concept resu_gene, including the fields of acceleration and relative displacements. In this case, one must add accelerations of soil to obtain absolute accelerations, necessary to the computation of the floor spectrum.
- LIRE_ MISS3D [U7.02.31] produced a concept dyna_trans, including the fields of acceleration and absolute displacements. In this case, accelerations are directly employed for the computation of the floor spectrum; conversely, the deduction of displacements of soil is compulsory (with being read with command LIRE_FONCTION [U4.32.02] since a specific file given by its logical unit) to obtain relative displacements.
- DYNA_NON_LINE [U4.53.01]. The processing is then the same one as for the preceding point.

Here a general diagram of the calculation algorithm:

Buckle #1 on bottoms
Buckles #2 on the nodes of bottom
Buckles #3 on the 3 directions (X, Y, Z)
Buckles #4 on the Recovery
results of functions: relative accelerations with the nodes… (RECU_FONCTION)
If computation of accelerations:
Combination or not with the function of acceleration of soil (CALC_FONCTION COMB)
Computation of the response sprectrum, with specified values of frequencies and damping (CALC_FONCTION SPEC_OSCI)
If computation of displacements (absolute displacements):
Displacements of soil are deduced to obtain relative displacements (CALC_FONCTION COMB)
Fine of the loop #4
in the case of the computation of accelerations:
computation of the mean value for a node and a direction given (CALC_FONCTION COMB)
in the case of the computation of displacements:
recovery of the maximum
End of the loop #3
Impression of the spectrum of acceleration for each node and each direction X, Y, Z *(IMPR_FONCTION)*
Fine of the loop #2
Enveloppes of the spectrum of acceleration for a given bottom, or maximum displacements (CALC_FONCTION ENVELOPPE)
Envelopes of the spectrum of acceleration for each bottom, each direction X, Y, Z, H *(IMPR_FONCTION)*
Fine of the loop #1

3.1 Key word MESH

This key word is compulsory to define the mesh read by the operator LIRE_MAILLAGE [U4.21.01].

3.2 Key word BOTTOM

This key word is compulsory to define the names of bottoms, where the spectrums will be calculated. These names will be employed to select or filter the parameters of display in structure of array produced by the macro-command table_sdaster.

3.2.1 Operand NOM

This operand compulsory makes it possible to name bottom considered.

3.2.2 Operand NOEUD / GROUP_NO

This operand makes it possible to define the nodes (individually or by groups) component bottom where the spectrums will be calculated.

3.3 Key word CALCUL

This a key word is compulsory makes it possible to define the nature of the transient dynamic computation employed for postprocessing: in the absolute coordinate system ("ABSOLU") or the relative reference ("RELATIF").

3.4 Key word NOM_CHAM

This a key word is compulsory makes it possible to define the nature of the field used: accelerations ("ACCE") or displacements ("DEPL").

3.5 Case NOM_CHAM = ' ACCE'

In this case, the user must provide the following data necessary for computation of the response sprectrum of acceleration: in the 3 directions X Y, Z (vertical) and H (maximum horizontal value enters the values according to X and Y).

3.5.1 Operand AMOR_SPEC

This operand compulsory makes it possible to define the values of the damping coefficient reduces employed in the computation of the spectral response. See also CALC_FONCTION [U4.32.04], key word SPEC_OSCI .

3.5.2 Operand LIST_INST

This operand optional makes it possible to specify the list, produced by DEFI_LIST_REEL [U4.34.01], defining all time step for the computation of transient dynamics.

3.5.3 Operand FREQ / LIST_FREQ

/ ◊ FREQ = l_fr
l_fr = f1,…, fi. List frequencies.
/ ◊ LIST_FREQ = lfreq
List of frequencies defined beforehand by a concept listr8.

This operand optional makes it possible to define the values of frequencies, to also see CALC_FONCTION [U4.32.04], key word SPEC_OSCI .

3.5.4 Operand NORMALIZES

♦ NORM = R

the response sprectrum will be standardized by the value r (value of pseudo-acceleration). The calculations are done in most case in Units of the International System (USI) and the historical of accelerations are often given in unit m/s^2. The response sprectrums are generally given with $g=9.81 \mathrm{m}/s^2$.
Thus, this compulsory operand NORM can be used like conversion factor of units between calculated accelerations and the response sprectrum, to also see CALC_FONCTION [U4.32.04], key word SPEC_OSCI .

3.5.5 Key word RESU

This a key word is compulsory makes it possible to specify the names of the result concepts where nodal accelerations are considered. The possible values are:

♦ / "RESU_GENE" = tg [tran_gene]

if postprocessing is carried out from a concept DYNA_TRAN_MODAL [U4.53.21] (transient dynamics on a reduced modal base). However, this result must be calculated in the relative reference.

or:

/ "RESULTAT" = resu [dyna_trans], [evol_noli]

if postprocessing is carried out from result transient dynamics (coming for example from LIRE_MISS3D [U7.02.31], product concept: dyna_trans or of DYNA_NON_LINE, product concept: evol_noli).

or:

/ "ARRAY" = [table_sdaster]

if postprocessing is carried out from an array containing the results to read. Typically, an array of observation deduced from a computation of transient dynamics.

3.5.6 Case CALCUL = ' RELATIF'

♦ ACCE_X = /ac_x [function]
♦ ACCE_Y = /ac_y [function]
♦ ACCE_Z = /ac_z [function]

In this case, the user must provide the function of acceleration of soil, definite on the same list of times, in each direction of space, in order to compute: combine them with relative accelerations absolute accelerations.

3.6 Key word PRINTING

This optional key word makes it possible to specify the nature of the results to print (spectrums, envelopes).

3.6.1 TRI operand

This optional key word makes it possible to specify the nature of the curves to print sorted selom: the value of the damping coefficient ("AMOR_SPEC") or spatial direction ("DIRECTION").

3.6.2 Operand FORMAT

This key word optional makes it possible to specify the format of printing of the curves: by printing with the format table ("TABLEAU") or in form readable by the Xmgrace software ("XMGRACE"). The scale of the X-coordinates (frequencies) is logarithmic curve.

3.6.3 Logical operand

UNITE ◊UNITE

=u Unit of the file in which the results are written (whole ranging between 10 and 90). The unit by default is 29. This number of unit must be coherent with the statement made in the interface astk for the file in question.

3.6.4 Case FORMAT = ' XMGRACE'

For more details, to see of the command documentation IMPR_FONCTION [U4.33.01].

3.6.5 Operand TOUT

This operand optional TOUT=' OUI' can be used to print all the spectrum calculated) the exit of the loop #4: mean values with each node, for all the directions and all the values of damping.

3.7 Case NOM_CHAM = ' DEPL'

In this case, the user must give the following data necessary for computation of the envelope of displacement: in the 3 directions X Y, Z (vertical) and H (maximum horizontal value according to X and Y).

3.7.1 Operand LIST_INST

This operand makes it possible to specify the list, resulting from DEFI_LIST_REEL [U4.34.01], defining all time step dynamic transient for the computation of displacement wraps.

3.7.2 Key word RESU

This a key word is compulsory makes it possible to specify the names of the result concept in which nodal accelerations are extracted. The operand associated can be:

♦ / "RESU_GENE" = tg [tran_gene]

if postprocessing is carried out from a concept DYNA_TRAN_MODAL [U4.53.21] (transient dynamics on a reduced modal base). However, this result must be calculated in the relative reference.

/ "RESULTAT" = resu
[dyna_trans],
[evol_noli]

if postprocessing is carried out from result transient dynamics (coming for example from LIRE_MISS3D [U7.02.31], product concept: dyna_trans or of DYNA_NON_LINE, product concept: evol_noli).

or:

/ "ARRAY" = [table_sdaster]

if postprocessing is carried out from an array containing the results to read. Typically, an array of observation deduced from a computation of transient dynamics.

3.7.3 Case CALCUL = ' ABSOLU'

♦ DEPL_X = /de_x [function]
♦ DEPL_Y = /de_y [function]
♦ DEPL_Z = /de_z [function]

In this case, it is necessary to introduce the functions of displacement of the soil, definite on the same list of times, in each direction of space, in front of being deduced from absolute displacements in order to obtain relative displacements.

4 Examples

the following examples are extracted from the case test sdll138a, initially to show the computation of a spectrum of acceleration, then to show the computation of the envelope of displacements:

```
TAB=MACR_SPECTER (
        MAILLAGE  = MA1,
        BOTTOM  = (_F (NOM = "NIV1",
                        GROUP_NO  = ("N4_NIV1",),),
                     _F (NOM  = "NIV8",
                        GROUP_NO  = ("N4_NIV8", "N5_NIV8",),),
                      ),
        NOM_CHAM = "ACCE",
        CALCUL = "RELATIF",
        AMOR_SPEC = L_AMOR_S,
          LIST_FREQ = L_FREQ,
          LIST_INST = LISTE,
          RESU= (_F (RESU_GENE = TRAN_GE1,
                   ACCE_X    = acceH1,
                   ACCE_Y    = acceH2,
                   ACCE_Z    = acceV3,),
                _F (RESU_GENE = TRAN_GE2,
                   ACCE_X    = acceH2,
                   ACCE_Y    = acceH3,
                   ACCE_Z    = acceV1,),
                _F(RESU_GENE = TRAN_GE3,
                   ACCE_X    = acceH3,
                   ACCE_Y    = acceH1,
                   ACCE_Z    = acceV2,),),
         PRINTING =_F (
                  FORMAT = ' TABLEAU',
                  UNITE = 16,)
                ),

TAB2=MACR_SPECTER (
        MAILLAGE  = MA1,
        BOTTOM  = (_F (NOM = "NIV1",
                      GROUP_NO  = ("N4_NIV1", "N5_NIV1", "N6_NIV1", "N7_NIV1",),
                          ),
                     _F (NOM  = "NIV8",
                      GROUP_NO  = ("N4_NIV8", "N5_NIV8", "N6_NIV8", "N7_NIV8",),
                         ),
                      ),
        NOM_CHAM = "DEPL",
        CALCUL = "RELATIF",
        LIST_INST = LISTE,
        RESU= (_F (RESU_GENE = TRAN_GE1,),
              _F (RESU_GENE = TRAN_GE2,),
              _F (RESU_GENE = TRAN_GE3,),
             ),
                ),

TAB3=MACR_SPECTER (
        MAILLAGE  = MA1,
        BOTTOM  = (_F (NOM = "NIV1", GROUP_NO  = ("N4_NIV1",),),
                     _F (NOM = "NIV8", GROUP_NO  = ("N4_NIV8", "N5_NIV8",),), ),
        NOM_CHAM = "ACCE",
        CALCUL = "ABSOLU",
        AMOR_SPEC = L_AMOR_S,
          LIST_FREQ = L_FREQ,
          RESU= (_F (RESULTAT = DYNAT_K1,),
                _F (RESULTAT = DYNAT_K2,),
                _F (RESULTAT = DYNAT_K3,),),
         PRINTING =_F (
                  FORMAT = ' TABLEAU',
```

```
UNITE = 16,), )
```