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## Macro-order CALC\_SPECTRE\_IPM

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### 1 Goal

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This macro-order allows calculation of a fast and effective postprocessing to determine the spectra of floor of any building after a seismic dynamic analysis by taking of account the interaction of the floor with the masses of the equipment (*cf.* documentation [R4.05.08]).

It can for example be used after a transitory dynamic calculation of a building to the earthquake, transitory dynamic calculation on a reduced modal basis, calculated in relative reference mark, or following a nonlinear transitory dynamic resolution.

This macro-order carries out successively:

- 1) the extraction of relative acceleration in one or more nodes of the grid in the concept result (RECU\_FONCTION [U4.32.03]);
- 2) combination with the acceleration of ground to obtain absolute acceleration (CALC\_FONCTION [U4.32.04]);
- 3) calculation of the transfer transfer function which takes into account the interaction of the floor and the masses
- 4) the calculation of the spectrum of answer of acceleration with several damping coefficients (CALC\_FONCTION [U4.32.04]);
- 5) impression of the spectra of floor.

For practical examples of implementation, the reader can refer to the case test sldd 109 [ V2.01.109 ] .

The macro-order produces a concept of the type `table_sdaster` .

## 2 Syntax

```
table_sdaster = CALC_SPECTRE_IPM (  
  ◊ GRID = my [grid]  
  ◆ EQUIPMENT = _F (  
    ◆ NAME = floor [KN]  
    ## if Well informed GRID :  
    ◆ GROUP_NO = l_gno [l_gr_noeud]  
    ## if Nonwell informed GRID :  
    ◆ NODE = l_no [l_noeud]  
  
    ◆ RAPPORT_MASSE_TOTALE = r_mass [R],  
    ◆ COEF_MASS_EQUIP = coef_rap_mas [l_R],  
    ◆ FREQ_EQUIP = modes_equip [l_R],  
    ◆ FREQ_SUPPORT = freq_support [R],  
    ◆ AMOR_EQUIP = amor_equip [l_R],  
    ◆ AMOR_SUPPORT = amor_support [R],  
  )  
  ◆ CALCULATION = / 'ABSOLUTE'  
  / 'RELATIVE'  
  ◆ AMOR_SPEC = l_amor [l_R]  
  ◊ LIST_INST = linst [listr8]  
  ◊ / FREQ = l_fr [l_R]  
  / LIST_FREQ = lfreq [listr8]  
  ◆ NORMALIZES = R [R]  
  ◆ RESU = _F (  
    ◆ 'TABLE' = [table_sdaster]  
  
  ## if CALCULATION = 'RELATIF':  
  ◆ ACCE_Z = ac_z [function]  
  
  ◊ TOLE_INIT = 1e-3 [R]  
  ◊ CORR_INIT = / 'NOT' [DEFECT]  
  / 'YES'  
  )  
)
```

## 3 Operands

The classical postprocessing of a seismic analysis in transitory dynamics consists in carrying out following calculations:

- The spectrum of floor obtained starting from absolute accelerations, for the direction  $Z$ , calculated in a specified node of the grid (for example in the case of model "a skewer");
- Three operators of *Code\_Aster* can produce concepts `result` correspondent with transitory dynamic calculations:
  - `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 ground to obtain accelerations absolute, necessary to the calculation of the spectrum of floor.
  - `CALC_MISS` [U7.03.12] produced a concept `dyna_trans`, including the fields of acceleration and absolute displacements. In this case, accelerations are directly employed for the calculation of the spectrum of floor; conversely, the deduction of displacements of ground is obligatory (with being read with the order `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 treatment is then the same one as for the preceding point.

Here a general diagram of the calculation algorithm of this macro-order:

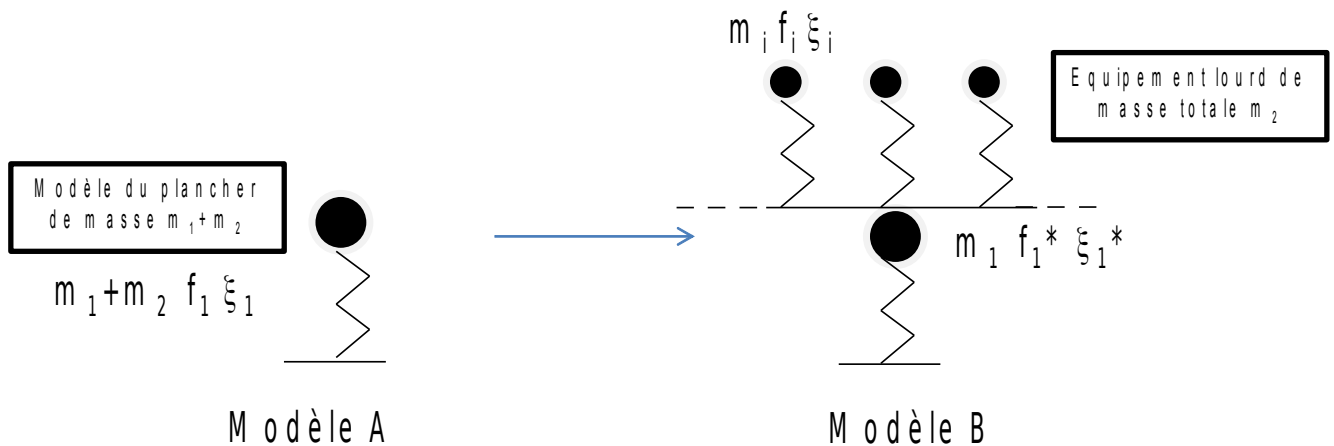
**Buckle #1 on the floors**

- *Recovery of the properties support and equipment*
  - Buckle #2 on the nodes of floor**
    - *Recovery of the functions accelerations relating to the nodes: `RECU_FONCTION`*
    - *If relative calculation*
      - Combination or not with the function of acceleration of the ground:*  
`CALC_FONCTION/COMB`
      - *Calculation `DE` the transfer transfer function*
      - *Calculation of the spectrum of answer, with specified values of frequencies and of damping with `CALC_FONCTION/SPEC_OSCI`*
      - *Impression of the spectrum of acceleration for each node : `IMPR_FONCTION`*

**End of the loop #2**

**End of the loop #1**

The taking into account of interaction floor-mass is done thanks to the transformation of acceleration measured to the node NR by a transfer transfer function. This transfer transfer function converts the response of a model A to a model B, as illustrated on the figure below. Documentation R4.07.05 give more complete explanations of the method and assumptions.



## 3.1 Keyword GRID

This keyword corresponds to the grid read by the operator `LIRE_MAILLAGE` [U4.21.01]. This key word is optional. The knowledge of the grid is necessary only if the user uses the single-ended spanner word `GROUP_NO` key word factor `FLOOR`. Indeed as described in the preceding algorithm, the treatment is carried out on the nodes and if the user directly gives the name of the nodes present in the table the grid is not necessary.

## 3.2 Keyword FLOOR

This keyword is obligatory to define the names of the floors, where the spectra will be calculated. These names will be employés to select or filter the parameters of posting in the structure of table produced by the macro-order `table_sdaster`.

### 3.2.1 Operand NAME

This obligatory operand makes it possible to name the floor considered.

### 3.2.2 OperandS NODE / GROUP\_NO

ItS operandS allowstent to define the nodes (individually or by groups) component the floor where the spectra will be calculated. It is possible to inform `GROUP_NO` if the grid were indicated.

### 3.2.3 Keyword RAP\_MASS

It is the report of the masses of the equipment compared to the mass of the floor  $\lambda = \frac{m_2}{m_1}$ . It is understood between 0 and 1.

### 3.2.4 Keyword RAP\_MASS\_COEFF

It is the list of the reports of the individual masses  $\alpha_i$  of each equipment compared to the total mass of equipment  $m_i = \alpha_i m_2$ . The sum of the coefficients must be equal to 1.

### 3.2.5 Keyword FREQ\_SUPP

This keyword defines the frequency of the support  $f_1$  model A.

### 3.2.6 Keyword FREQ\_EQUI

This keyword defines the list of the frequencies of the equipment.  $f_i$ .

### 3.2.7 Keyword AMOR\_SUPP

This keyword defines the damping of the support  $\xi_1$ .

### 3.2.8 Keyword AMOR\_EQUI

This keyword defines the list of depreciation of the equipment  $\xi_i$ .

## 3.3 Keyword CALCULATION

This obligatory keyword makes it possible to define the nature of the transitory dynamic calculation employed for postprocessing: in the absolute reference mark ( 'ABSOLUTE' ) or the relative reference mark ( 'RELATIVE' ).

## 3.4 Operand AMOR\_SPEC

This obligatory operand makes it possible to define the values of the damping coefficient reduces employed in the calculation of the spectral response. See also CALC\_FONCTION [U4.32.04], keyword SPEC\_OSCI.

## 3.5 Operand LIST\_INST

This operand optional makes it possible to specify the list, produced by DEFI\_LIST\_REEL [U4.34.01], defining all the steps of time for the transitory calculation of dynamics.

## 3.6 Operand FREQ / LIST\_FREQ

```
/ ◇ FREQ = L_FR  
/ ◇ 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 see too CALC\_FONCTION [U4.32.04], keyword SPEC\_OSCI.

## 3.7 Operand NORMALIZES

◆ = R NORMALIZES

The spectrum of answer 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 histories of accelerations are often given in unit  $m/s^2$ . The spectra of answers are generally given with  $g=9.81m/s^2$ .

Thus, this obligatory operand NORMALIZES can be used as conversion ratio of units between calculated accelerations and the spectrum of answer, see too CALC\_FONCTION [U4.32.04], keyword SPEC\_OSCI.

## 3.8 Keyword RESU

This obligatory keyword makes it possible to specify them data input where nodal accelerations are extracted.

◆ 'TABLE' = [TABLE\_SDASTER]

LE postprocessing is carried out starting from a table containing the results to read. Typically, a table of observation deduced from a transitory calculation of dynamics.

### 3.8.1 Keyword ACCE\_Z

◆ ACCE\_Z = /AC\_Z [FUNCTION]

In this case CALCULATION = ' RELATIVE ', the user must provide the function of acceleration of ground, definite on the same list of moments, in each direction of space, in order to combine them with relative accelerations to calculate absolute accelerations.

## 3.9 Operand TOLE\_INIT

◇ TOLE\_INIT = 1e-3

This operand optional makes it possible to specify a limiting criterion for the initial value of initial accelerations of the signals. It is checked that the ratio between the initial value of the signal is the maximum of the signal is lower than the definite tolerance.

## 3.10 Operand CORR\_INIT

```
◇ CORR_INIT = / 'NOT' [DEFECT]
               / 'YES'
```

This operand optional makes it possible to correct the initial value of the signal if this one is larger than the tolerance given.

## 4 Examples

The following example is extracted case test sdd109 [V2.01.109] :

```
tabl_spe = CALC_SPECTRE_IPM (GRID = GRID,
                             AMOR_SPEC = 0.05,
                             EQUIPMENT = (_F (NOM=' NOEUD2',
                                               GROUP_NO=' N02',
                                               RAPPORT_MASSE_TOTALE = lbd,
                                               COEF_MASS_EQUIP = (m2_1/m2, m2_2/m2,
m2_3/m2),
                                               FREQ_EQUIP = (f2_1, f2_2, f2_3),
                                               FREQ_SUPPORT = f1,
                                               AMOR_SUPPORT = amor_supp,
                                               AMOR_EQUIP = (amor_equip, amor_equip,
amor_equip)
                                               ),),
                             LIST_INST = L_INST,
                             CALCULATION = ' RELATIF',
                             LIST_FREQ = L_FREQ,
                             = 1 NORMALIZES. ,
                             RESU = (_F (TABLE =,
                                           ACCE_Z = ACCE,)),
                             )
```

In this CAS-test, one uses as starter a result got in relative reference mark (mono-support), one must thus give the signal of training named here ACCE .