Operator CALC_CHAR_SEISME

1 Drank

To establish the seismic loading for a computation of response moving relative motion compared to the bearings. For a better theoretical comprehension of this loading, one will refer to the document [R4.05.01].

The product concept is directly usable during a direct transient analysis with DYNA_LINE_TRAN [U4.53.02] or by modal synthesis with DYNA_TRAN_MODAL [U4.53.21]. On the other hand for a nonlinear direct transient analysis with DYNA_NON_LINE [U4.53.01], it is necessary to transform this concept charges some from operator AFFE_CHAR_MECA [U4.44.01].

Product a field at nodes of quantity DEPL_R .

2 Syntax

```
S    [cham_no_sdaster] = CALC_CHAR_SEISME

          (  ♦MATR_MASS     = m
[matr_asse_DEPL_R]

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

             ♦/MONO_APPUI      = "/MODE_STAT
                OUI'    = mode                          [mode_meca]

                      ♦  /  NOEUD = noeu                  [l_noeud]
                         /  GROUP_NO = g_noeu             [l_gr_noeud]

             ◊TITER  = title                              [l_Kn]

          )
```

3 Operands

3.1 Operand MATR_MASS

♦MATR_MASS = m

Mass matrix of the system.

3.2 Operand DIRECTION

♦DIRECTION = (d1, d2, d3, r1, r2, r3)

Component of a vector giving the direction of the seisme in the total reference. It is a list of three realities if the imposed accelerograms are only translations. If accelerations of rotations are also imposed, a list of six realities is expected (valid for modelizations with discrete elements).

3.3 Description of the motion of training

3.3.1 Operand MONO_APPUI

♦/MONO_APPUI = ' OUI'

the structure is uniformly excited in all the bearings (motion of training of solid body).

3.3.2 Excitation multi-bearings

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

3.3.2.1 Operand MODE_STAT

/MODE_STAT =mode

static Modes of structure: concept of the mode_meca type by the operator produces MODE_STATIQUE [U4.52.14] with option MODE_STAT. They correspond to $6 \times nb_{supports}$ the static modes where $nb_{supports}$ is the number of different accelerograms undergone by structure.

Note:

If the structure is requested only by translations, there is then formula $3\,nb_{supports}$ modes.

3.3.2.2 Operands NOEUD / GROUP_NO

♦/NOEUD =noeu
/GROUP_NO =g_noeu

Nodes list (noeu) or nodes groups (g_noeu) of structure subjected to the seismic excitation: these nodes support the degrees of freedom of bearings of structure to which are applied imposed motions.

3.4 Operand TITER

◊TITER =titer

Title attached to the product concept by this operator [U4.03.01].

4 Examples

the two examples which follow illustrate the employment of operator CALC_CHAR_SEISME in the cases of a seismic excitation mono bearing and in the case multi-bearings (identical acceleration then different on each bearing).

4.1 Computation of a second member in mono bearing

One considers the seismic modelization beam of the building represented in test SDLL109B, as presented in the documentation of operator POST_ELEM [U4.81.22].

One wishes to determine forces at the time of the response transient dynamics of structure with a seisme in the direction X. The computation of transient response is carried out here by modal recombination by DYNA_TRAN_MODAL [U4.53.21].

One calculates the modes of vibrations of structure of the model resting on only one elastic bearing (come out from soil):

```
# --- search eigen modes of vibration -------------------------

MODES = MODE_ITER_SIMULT (MATR_RIGI = STIFFNESS,  MATR_MASS = MASSE,
                          CALC_FREQ =_F (OPTION = "PLUS_PETITE",
                                         NMAX_FREQ = 33         )  )
```

One defines the accelerogram of the seisme:

```
# --- excitation ----------------------------------------------------

LBNSNL1 = DEFI_FONCTION (NOM_RESU = "ACCE",   NOM_PARA = "INST",
                         PROL_GAUCHE = "EXCLUDED",  PROL_DROIT =
"EXCLUDED",
                         VALE = (

      0.00000E+00   9.98700E-02   1.00000E-02   6.60700E-02
      2.00000E-02  -5.65000E-03   3.00000E-02  -9.46800E-02
-----------------------------------------------------
      1.19800E+01   1.68110E-01   1.19900E+01   8.80300E-02
      1.20000E+01   0.00000E+00   9.98700E-02   0.00000E+00   )

                          );

ACCELERO = CALC_FONCTION (COMB =_F (FONCTION= LBNSNL1,  COEF= 1.47));
```

One calculates the second member (field at nodes of the inertia forces of training) and one defines the direction of the seisme

```
DIRSEISM = CALC_CHAR_SEISME (MATR_MASS = MASSE,
                             MONO_APPUI = "OUI',
                             DIRECTION = (-1. , 0. , 0. ));
```

One carries out the computation of the transient response in modal space

```
# --- projection of the matrixes and vector assembled on the modes

PROJ_BASE (  BASE=MODE,
                  NB_VECT=33, MATR_ASSE_GENE= (
                  _F (
                                 MATRICE = CO ("MASSGENE"),
                                 MATR_ASSE = MASSE),
```

```
                        _F (
                                        MATRICE = CO ("RIGIGENE"),
                                        MATR_ASSE = STIFFNESS)),
                        VECT_ASSE_GENE=_F (
                                        VECTEUR = CO ("VECTGENE"),
                                        VECT_ASSE = SEISME)
                                   );

# --- computation by modal combination ----------------------------------

LISTAMOR= (


           0.055,0.055,0.070,0.070,0.071,0.072,0.157,0.085,0.086,0.070,0.076
,0.074,0.071,0.072,0.115,0.073,0.076,0.086,0.081,0.070,0.072,0.075,0.074,0.0
70,0.152,0.148,0.074,0.297,0.074,0.075,0.089,0.138,0.118,)


TRANGENE=DYNA_TRAN_MODAL (  MASS_GENE=MASSGENE,  RIGI_GENE=RIGIGENE,
                            METHODE=METHODE,
                            AMOR_REDUIT=LISTAMOR,
                            INCREMENT=_F (  INST_INIT = 0. ,
                                            INST_FIN = 4. ,  NOT = 0.002,
                                            VERI_PAS = "NON"),
                         EXCIT=_F (  VECT_GENE = VECTGENE,
                                     FONC_MULT = ACCELERO),
                                           ))
```

One used here the accelerogram of imposed motion.

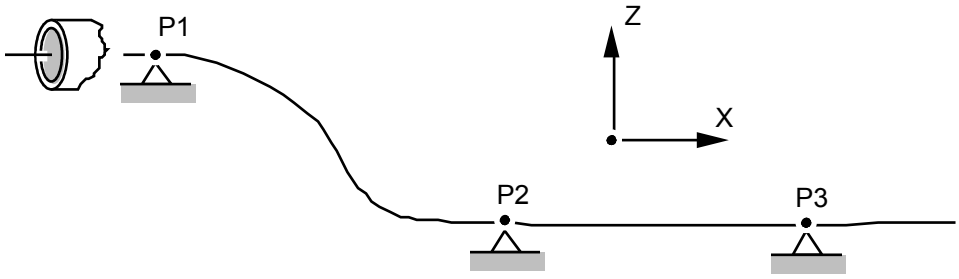
One passes by again in physical space:

```
# --- restitution in physical base ---------------------------------

LISTINST=DEFI_LISTE_REEL (DEBUT=1.334,
                          INTERVALLE=_F (JUSQU_A = 3.154, NOMBRE = 1))

TRANPHYS=REST_GENE_PHYS (  RESU_GENE=TRANGENE,
                           CRITERE=' RELATIF',   PRECISION=1.E-06,
                           LIST_INST=LISTINST,   TOUT_CHAM=' OUI')
```

4.2 Computation of a second member out of multi-bearings

the example which follows watch the computation of the second members when the seismes are different on the bearings.

One considers the modelization in beam elements of line of following pipework to which a seisme is applied in the direction X :



One calculates the static modes to express the vector of training like a linear combination of those.

```
MODST   = MODE_STATIQUE (MATR_RIGI = RG,
                         MATR_MASS = MS,
                         MODE_STAT =_F (NOEUD = ("P1", "P2", "P3"),)
                                       (AVEC_CMP = "DX"),));
```

One must calculate three second different members (field at nodes of the inertia forces of training) for each node or nodes group subjected to the same seismic signal.

```
SMP1   = CALC_CHAR_SEISME (MATR_MASS = MS,
                           DIRECTION = (1. , 0. , 0.),
                           MODE_STAT = MODST,
                           NOEUD = "P1");

SMP2   = CALC_CHAR_SEISME (MATR_MASS = MS,
                           DIRECTION = (1. , 0. , 0.),
                           MODE_STAT = MODST,
                           NOEUD = "P2");

SMP3   = CALC_CHAR_SEISME (MATR_MASS = MS,
                           DIRECTION = (1. , 0. , 0.),
                           MODE_STAT = MODST,
                           NOEUD = "P3");
```

In accordance with what is explained in the reference document [R4.05.01] operator CALC_CHAR_SEISME calculates the following statement:

$$-\boldsymbol{M}\left(\Psi_{P1,X}+\Psi_{P2,X}+\Psi_{P3,X}\right)\boldsymbol{s}$$

with $\boldsymbol{s}=(1,0,0)$, direction of the seisme.

Computation of the transient response (without damping) with three seismic signals various ACCELP1, ACCELP2 and ACCELP3:

```
TRANGENE = DYNA_LINE_TRAN (MATR_MASS = MS,
                           MATR_RIGI = RG,
                           NEWMARK =_F (),
                           LIST_INST = LI,
                           EXCIT = (
                          _F (VECT_ASSE = SMP1, FONC_MULT = ACCELP1),
                          _F (VECT_ASSE = SMP2, FONC_MULT = ACCELP2),
                          _F (VECT_ASSE = SMP3, FONC_MULT = ACCELP3),
                                       )
                          );
```

One will be able to find other examples of multimedia structures subjected to seismic requests by consulting tests SDLD103 and SDND102.