Operator POST_FATI_ALEA

1 Goal

To calculate the damage of tiredness undergone by a structure subjected to a request of the random type.

With this intention POST_FATI_ALEA allows starting from the data of the spectral moments entirely characterizing the random signal:

- to extract by a statistical method of counting of cycles (method of counting of peaks of constraints or method of goings beyond of a given level) the number of elementary cycles of loading undergone by the structure,
- to determine the elementary damage associated with each elementary cycle using the curve with Wöhler with material,
- to determine the average damage throughout signal.

In addition, it is possible to take account of the influence of the plastic coefficient of concentration élasto -.

The average damage is stored in a table of the type table_sdaster.

2 Syntax

```
Tabl_post_f_alea    [table_sdaster] = POST_FATI_ALEA (

          %   Introduction of the random loading

          ♦   /  ♦   MOMENT_SPEC_0    =  λ0     ,                    [R]
                 ♦   MOMENT_SPEC_2    =  λ2     ,                    [R]
                 ◊   MOMENT_SPEC_4    =  λ4     ,                    [R]

              /  TABL_POST_ALEA   =  table  ,                 [tabl_post_alea]

          %   Method of counting of cycles

          ♦   COUNTING      =  /  'PEAK'    ,
                               /  'LEVEL'   ,

          ◊   DURATION         =  /  duration  ,                        [R]
                               /  1.     ,                     [DEFECT]

          %   Elastoplastic coefficient of correction That

          ◊   CORR_KE       =  'RCCM' ,

          %   Calculation of the elementary damage

          ♦   TOO BAD       =  'WOHLER'  ,
          ♦   MATER         =  to subdue    ,                       [to subdue]

          ◊   TITLE         =  title     ,                     [l_Kn]

                                                  )
```

3 Operands

3.1 Operands TABL_POST_ALEA / MOMENT_SPEC_0 / MOMENT_SPEC_2 / MOMENT_SPEC_4

These operands make it possible to introduce the three spectral moments value of order 0.2 and 4 which can be determined by the order POST_DYNA_ALEA [U4.84.04].

These values completely characterize the random signal for the statistical methods of counting of the cycles:

- method of counting of peaks of constraints, which uses λ0, λ2 and λ4,
- method of counting of going beyond a given level, which requires only the data of λ0 and λ2.

```
♦ / ♦ MOMENT_SPEC_0 = λ0 ,             [R]
    ♦ MOMENT_SPEC_2 = λ2 ,             [R]
    ◊ MOMENT_SPEC_4 = λ4 ,             [R]
```

One provides the value of the spectral moment following the operand corresponding.

```
♦ /   TABL_POST_ALEA = table ,         [tabl_post_alea]
```

Allows to specify the name of a table created by POST_DYNA_ALEA [U4.84.04], in which values of spectral moments are stored λ0, λ2, λ4), for various modes or various nodes.

The values are read again and one calculates a value of average damage for each triplet of spectral moments met in the table.

However, the method of calculating of the average damage being valid only for homogeneous loadings with constraints, one emits an alarm when the calculation of the average damage does not correspond to spectral concentrations of power homogeneous to constraints (DSP_CONT).

3.2 Operand COUNTING

```
♦ COUNTING =
```

To be able to calculate the damage undergone by a structure, it is necessary beforehand to extract the elementary cycles from the history of loading.

```
/ 'PEAK' ,
```

Allows to choose the method of counting of the peaks of constraints to determine the elementary cycles of the random loading [R7.04.02].

```
/ 'LEVEL' ,
```

Allows to choose the method of counting of the goings beyond a level given to determine the elementary cycles of the random loading [R7.04.02].

3.3 Operand DURATION

```
◊ DURATION = / duration ,         [R]
             / 1. ,               [DEFECT]
```

Allows to introduce the data of the duration of the signal which intervenes in the expression of the average damage [R7.04.02].

3.4 Operand CORR_KE

◊ CORR_KE = 'RCCM' ,

This operand makes it possible to take account of an elastoplastic coefficient of concentration K_e, which is defined by the RCC-M as being the relationship between the amplitude of real deformation and the amplitude of deformation determined by an elastic analysis.

$$\begin{cases} K_e = 1 & \text{si} \quad \Delta\sigma < 3S_m \\ K_e = 1+\dfrac{(1-n)(\Delta\sigma/3S_m-1)}{n(m-1)} & \text{si} \quad 3S_m < \Delta\sigma < 3mS_m \\ K_e = 1 & \text{si} \quad 3mS_m < \Delta\sigma \end{cases}$$

where S_m is the acceptable maximum constraint, n and m are two constants depending on material.

Values of S_m, n and m are introduced into the operator DEFI_MATERIAU [U4.43.01] under the keyword TIREDNESS and operands SM_KE_RCCM, N_KE_RCCM, and M_KE_RCCM.

3.5 Operand TOO BAD

♦ DAMAGE = 'WOHLER' ,

This operand makes it possible to specify the method of calculating of the damage, which in the case of request of a random type is the method of Wöhler.

To calculate the damage, the user must introduce into the operator DEFI_MATERIAU [U4.43.01], the curve of Wöhler of the material which can be given in three distinct mathematical forms [R7.04.02]:

- point by point discretized function (keyword TIREDNESS, operand WOHLER),
- analytical form of Basquin (keyword TIREDNESS, operands A_BASQUIN and BETA_BASQUIN),
- form "zones current" (keyword TIREDNESS, operands E_REFE, A0, A1, A2, A3 and SL and keyword ELAS operand E).

Notice on the curves of tiredness:

For the small amplitudes, the difficulty of the prolongation of the curve of tiredness can arise: for example, for the curves of tiredness of the RCC-M beyond 10^6 cycles, the corresponding constraint, 180 MPa is regarded as limit of endurance, i.e. very forced lower than 180 MPa must produce a factor of null use or an infinite number of cycles acceptable.
The method adopted here corresponds to this concept of limit of endurance: if the amplitude of constraint is lower than the first X-coordinate of the curve of tiredness, then one takes a factor of null use i.e. an infinite number of cycles acceptable.

3.6 Operand MATER

♦ MATER = to subdue,

Allows to specify the name of material to subdue created by DEFI_MATERIAU [U4.43.01].

The material to subdue must at least contain the definition of the curve of Wöhler of the material [R7.04.02].

If one wishes to take account of an elastoplastic coefficient of concentration K_e, it is necessary moreover have specified the data material (NR, M and SM) necessary to the calculation of K_e.

3.7 Operand `TITLE`

◊ `TITLE = title,`

Title associated with the table.

3.8 Produced table

The operator `POST_FATI_ALEA` create a table, `Tabl_post_f_alea`, which understands 1 parameter: `TOO BAD` : value of the average damage over the duration of the signal.

Note:

If the operand were used `TABL_POST_ALEA` to introduce the values of the spectral moments, one stores in the table, the value of the average damage over the duration of the signal, for each triplet of spectral moments present in the table.

The order `IMPR_TABLE` [U4.91.03] allows to print the produced table.

4 Example

```
= DEFI_MATERIAU subdue (
          TIREDNESS = _F   (A_BASQUIN       = 1.001730939 E-14,
                        BETA_BASQUIN    = 4,065                )
                       )

table = POST_FATI_ALEA (
          MOMENT_SPEC_0=  182.5984664      ,
          MOMENT_SPEC_2=  96098024.76      ,
          MOMENT_SPEC_4=  6.346193569E+13  ,
          COUNTING     =  'PEAK'           ,
          TOO BAD      =  'WOHLER'         ,
          MATER        =  matt             ,
                       )
```