
Operator POST_FATI_ALEA

1 Drank

Compute the damage of fatigue undergone by a structure subjected to a request of the random type.

With this intention `POST_FATI_ALEA` allows 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 stresses peaks or method of goings beyond of a given level) the number of elementary cycles of loading undergone by structure,
- to determine the elementary damage associated with each elementary cycle using the curve with Wöhler with the 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 ϵ_{elasto} .

The average damage is stored in an array of the `table_sdaster` type.

2 Syntax

```
tabl_post_f_alea [table_sdaster] = POST_FATI_ALEA (
    %Introduction of random loading
    ♦/♦MOMENT_SPEC_0=                λ 0                ,                [R]
        ♦MOMENT_SPEC_2=                λ 2                ,                [R]
        ◇MOMENT_SPEC_4=                λ 4                ,                [R]
    /TABL_POST_ALEA =table            ,
[tabl_post_alea]
    %Méthode of counting of cycles
    ♦COMPTAGE=/                        "PIC"            ,
        / "NIVEAU"                    ,
    ◇ DUREE=/duree                    ,                [R]
        /1 .                            ,                [DEFAULT]
    %Coefficient of elastoplastic correction That
    ◇ CORR_KE=' RCCM'                ,
    %Calcul of the elementary damage
    ♦ DOMMAGE=' WOHLER'                ,
    ♦MATER=mater                        ,                [to subdue]
    ◇TITER=titer                        ,                [l_Kn]
    )
```

3 Operands

3.1 Operands TABL_POST_ALEA / MOMENT_SPEC_0 / MOMENT_SPEC_2 / MOMENT_SPEC_4

These operands makes it possible to introduce the three spectral moments value of order 0,2 and 4 which can have been given by the command 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 stresses peaks, which uses λ_0 , λ_2 and λ_4 ,
- method of counting of going beyond a given level, which requires only the data of λ_0 and λ_2 .

```
◆/◆MOMENT_SPEC_0=            $\lambda_0$  , [R]  
  ◆MOMENT_SPEC_2=            $\lambda_2$  , [R]  
  ◇MOMENT_SPEC_4=            $\lambda_4$  , [R]
```

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

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

Makes it possible to specify the name of an array created by POST_DYNA_ALEA [U4.84.04], in which values of spectral moments are stored (λ_0 , λ_2 , λ_4), 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 array.

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

3.2 Operand COMPTAGE

◆COMPTAGE=

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

```
/ "PIC" ,
```

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

```
/ "NIVEAU" ,
```

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 DUREE

```
◇ DUREE=/duree , [R]  
/1 . , [DEFAULT]
```

Allows to introduce the data of the period of the signal which intervenes in the statement 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 strain and the amplitude of strain determined by an elastic analysis.

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

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

The values of S_m , n and m are introduced into operator `DEFI_MATERIAU` [U4.43.01] under the key word `TIRES` and the operands `SM_KE_RCCM`, `N_KE_RCCM`, and `M_KE_RCCM`.

3.5 Operand DOMMAGE

◇DOMMAGE = "WOHLER" ,

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

To compute: the damage, the user must introduce into 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 (key word `TIRES`, operand `WOHLER`),
- analytical form of Basquin (key word `TIRES`, operands `A_BASQUIN` and `BETA_BASQUIN`),
- form "zones current" (key word `TIRES`, operands `E_REFE`, `A0`, `A1`, `A2`, `A3` and `SL` and key word `ELAS` operand `E`).

Notice on the curves of fatigue:

For the small amplitudes, the difficulty of the prolongation of the curve of fatigue can arise: for example, for the curves of fatigue of the RCC-M beyond 106 cycles, the corresponding stress, 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 notion of limit of endurance: if the amplitude of stress is lower than the first X-coordinate of the curve of fatigue, then one takes a factor of null use i.e. an infinite number of cycles acceptable.

3.6 Operand MATER

◇MATER = to subdue,

Makes it possible to specify the name of the `MATER` material created by `DEFI_MATERIAU` [U4.43.01].

The `MATER` material 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 material characteristics (`N`, `M` and `SM`) necessary to the computation of K_e .

3.7 Operand TITER

◇TITER = title,

Title associated with the array.

3.8 Count produced

operator POST_FATI_ALEA creates an array, tabl_post_f_alea, which understands 1 parameter:
DOMMAGE : value of the average damage over the period of the signal.

Note:

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

Command IMPR_TABLE [U4.91.03] makes it possible to print the produced array.

4 Example

```
subdues = DEFI_MATERIAU (
    FATIGUE = _F (A_BASQUIN= 1.001730939 E-14,
                 BETA_BASQUIN= 4.065 )
)

counts = POST_FATI_ALEA (
    MOMENT_SPEC_0=182.5984664 ,
    MOMENT_SPEC_2=96098024.76 ,
    MOMENT_SPEC_4=6.346193569E+13 ,
    COMPTAGE='PIC' ,
    DOMMAGE='WOHLER' ,
    MATER=mate ,
)
```