Structure of data `sd_macr_elem_dyna`

Summary:

The structure of data `sd_macr_elem_dyna` contains the projection of the matrices of rigidity, mass and possibly of damping of a substructure on a beforehand definite basis.
It also contains the projection of the loading if one applies a loading to the substructure.

That structure of data is used for calculations of dynamic under-structuring. The dynamic macronutrient creates can also be used as super-mesh in a mixed model.

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1 General information

The structure of data `sd_macr_elem_dyna` contains the projection of the matrices of rigidity, mass and possibly of damping of a substructure on a beforehand selected basis.
It also contains the projection of the loading if one applies a loading to the substructure.
A structure of data `sd_nume_ddl` is attached to the structure of data `sd_macr_elem_dyna`. One referred there for the fictitious classification of the basic vectors of projection.
In order to ensure compatibility with `sd_macr_elem_stat`, data are repeated in various objects of the structure of data.

This structure of data is used in calculations of dynamic under-structuring or calculations with a mixed modeling. In this case, the dynamic macronutrient is used as super-mesh of the model.

2 Tree structure of the Structure of Data

```
sd_macr_elem_dyna (K8):: = record

   % description of the dynamic substructure
      ♦      '.DESM'            :  OJB    S   V   I
      ♦      '.REFM'            :  OJB    S   V   K8
      ♦      '.CONX'            :  OJB    S   V   I
      ♦      '.LINO'            :  OJB    S   V   I
      ♦      '.MAEL_DESC'       :  OJB    S   V   I
      ♦      '.MAEL_REFE'       :  OJB    S   V   K24
   % description of the loadings
      ◊      '.LICH'            :  OJB    XC  V   K8  NO
      ◊      '.LICA'            :  OJB    XD  V   R   NO
   % projected rigidity
      ♦      '.MAEL_RAID_DESC'  :  OJB    S   V   I
      ♦      '.MAEL_RAID_REFE'  :  OJB    S   V   K24
      ♦      '.MAEL_RAID_VALE'  :  OJB    S   V   R or C
   % masses projected
      ♦      '.MAEL_MASS_DESC'  :  OJB    S   V   I
      ♦      '.MAEL_MASS_REFE'  :  OJB    S   V   K24
      ♦      '.MAEL_MASS_VALE'  :  OJB    S   V   R
   % damping project
      ◊      '.MAEL_AMOR_DESC'  :  OJB    S   V   I
      ◊      '.MAEL_AMOR_REFE'  :  OJB    S   V   K24
      ◊      '.MAEL_AMOR_VALE'  :  OJB    S   V   R
   % inertias following DX, DY and DZ
      ◊      '.MAEL_INER_REFE'  :  OJB    S   V   K24
      ◊      '.MAEL_INER_VALE'  :  OJB    S   V   R
   % classification of the basic vectors
      ♦      '$VIDE'            :  sd_nume_ddl
```

3 Contents of the objects

3.1 Object .DESM

`'.DESM'             :  OJB    S   V   I      length = 10`

- `DESM (1)` : 0
- `DESM (2)` : `nbnstc` (many nodes used for the classification of the basic vectors)
- `DESM (3)` : many internal nodes of the substructure

DESM (4) : nbvect (many basic vectors)
DESM (5) : 0
DESM (6) : 0
DESM (7) : many loadings
DESM (8) with DESM (10) : 0

3.2 Object .REFM

```
'.REFM'            :  OJB   S  V  K8    length = 8
```

REFM (1) : name of the model
REFM (2) : name of the grid
REFM (3) : field material
REFM (4) : elementary characteristics
REFM (5) : name of the dynamic macronutrient
REFM (6) : 'OUI_RIGI'
REFM (7) : 'OUI_MASS'
REFM (8) : 'OUI_AMOR' / 'NON_AMOR'

3.3 Object .LINO

```
'.LINO'            :  OJB   S  V  I     length = nbnstc
```

List of the numbers of the nodes used for the classification of the basic vectors

3.4 Object .CONX

```
'.CONX'            :  OJB   S  V  I     length = 3*nbnstc
```

For I varying 1 with nbnstc :
CONX (3* (i-1) +1) : 1
CONX (3* (i-1) +2) : LINO (I)
CONX (3* (i-1) +3) : 0
…

3.5 Object .MAEL_DESC

```
'.MAEL_DESC'       :  OJB   S  V  I     length = 3
```

MAEL_DESC (1) : many coded entireties necessary to the size DEPL_R
MAEL_DESC (2) : component count maximum for the size DEPL_R
MAEL_DESC (3) : number of the size DEPL_R in the catalogue of the sizes

3.6 Object .MAEL_REFE

```
'.MAEL_REFE'       :  OJB   S  V  K24   length = 2
```

MAEL_REFE (1) : name of the base of projection Φ
MAEL_REFE (2) : name of the grid

3.7 Object .LICH

This object is created only if one applies a loading to the substructure.

```
'.LICH'            :  OJB   XC V  K8 NO
```

This collection contains the names of the loadings.

`LICH (I)` is of dimension `2`.

In the case of load number `I`, one a:
`LICH (I) (1)` : `'NON_SUIV'`
`LICH (I) (2)` : name of the generalized loading F_i

3.8 Object `.LICA`

This object is created only if one applies a loading to the substructure.

```
'.LICA'             :  OJB    XD  V   R   NO
```

This collection contains the generalized coordinates of the loadings.

`LICA (I)` is of dimension `2*nbvect`

Each object is made of two end to end stored identical segments.
In each segment, one finds the loadings generalized: $f_i = \Phi^T F_i$

3.9 Object `.MAEL_RAID_DESC`

```
'.MAEL_RAID_DESC'   :  OJB    S   V   I      length = 3
MAEL_RAID_DESC (1) : 2
MAEL_RAID_DESC (2) : nbvect
MAEL_RAID_DESC (3) : 2
```

3.10 Object `.MAEL_RAID_REFE`

```
'.MAEL_RAID_REFE'   :  OJB    S   V   K24    length = 2
```
`MAEL_RAID_REFE (1)` : name of the base of projection Φ
`MAEL_RAID_REFE (2)` : vacuum if one exploits the matrix of impedance of the ground, or the name of the matrix of rigidity K to project

3.11 Object `.MAEL_RAID_VALE`

```
'.MAEL_RAID_VALE'   :  OJB    S   V   R or C    length = nbvect* (nbvect+1)/2
```

This object contains the matrix of projected rigidity $\tilde{K} = \Phi^T K \Phi$

This matrix is symmetrical, one stores only the higher triangular block.

3.12 Object `.MAEL_MASS_DESC`

```
'.MAEL_MASS_DESC'   :  OJB    S   V   I      length = 3
MAEL_MASS_DESC (1) : 2
MAEL_MASS_DESC (2) : nbvect
MAEL_MASS_DESC (3) : 2
```

3.13 Object `.MAEL_MASS_REFE`

```
'.MAEL_MASS_REFE'   :  OJB    S   V   K24    length = 2
```
`MAEL_MASS_REFE (1)` : name of the base of projection Φ

MAEL_MASS_REFE (2) : vacuum or name of the matrix of mass M to project

3.14 Object .MAEL_MASS_VALE

```
'.MAEL_MASS_VALE'   :  OJB   S  V  R     length = nbvect* (nbvect+1)/2
```

This object contains the matrix of projected mass $\tilde{M}=\Phi^T M \Phi$

Only the higher triangular block is stored.

3.15 Object .MAEL_AMOR_DESC

```
'.MAEL_AMOR_DESC'   :  OJB   S  V  I     length = 3
MAEL_AMOR_DESC (1) : 2
MAEL_AMOR_DESC (2) : nbvect
MAEL_AMOR_DESC (3) : 2
```

3.16 Object .MAEL_AMOR_REFE

```
'.MAEL_AMOR_REFE'   :  OJB   S  V  K24   length = 2
```

MAEL_AMOR_REFE (1) : name of the base of projection Φ
MAEL_AMOR_REFE (2) : vacuum or the name of the matrix of damping C to project

3.17 Object .MAEL_AMOR_VALE

```
'.MAEL_AMOR_VALE'   :  OJB   S  V  R     length = nbvect* (nbvect+1)/2
```

This object contains the terms of the matrix of damping projected (triangular higher)

$$\tilde{C}=\Phi^T C \Phi$$

If the user provides the generalized depreciation associated with the dynamic modes, the diagonal terms of this matrix contain provided depreciation.

3.18 Object .MAEL_INER_REFE

This object is not creates if the matrix of impedance of the ground is exploited.

```
'.MAEL_INER_REFE'   :  OJB   S  V  K24   length = 2
```

MAEL_INER_REFE (1) : name of the base of projection Φ
MAEL_INER_REFE (2) : name of the matrix of inertia M used for the calculation of inertias

3.19 Object .MAEL_INER_VALE

This object is not creates if the matrix of impedance of the ground is exploited.

```
'.MAEL_INER_VALE'   :  OJB   S  V  R     length = 3*nbvect
```

This object contains inertias along the axes DX, DY and DZ

MAEL_INER_VALE (1) with MAEL_INER_VALE (nbvect) : inertia according to DX
where: MAEL_INER_VALE (I) : $(L_x \Phi_i)^T M (L_x \Phi_i)$

MAEL_INER_VALE (nbvect+1) with MAEL_INER_VALE (2*nbvect) : inertia according to DY where: `MAEL_INER_VALE (nbvect+i) :` $(L_y \Phi_i)^T M (L_y \Phi_i)$

`MAEL_INER_VALE (2*nbvect+1)` with `MAEL_INER_VALE (3*nbvect)` : inertia according to `DZ`
where: `MAEL_INER_VALE (2*nbvect+i) :` $(L_z \Phi_i)^T M (L_z \Phi_i)$

L_x indicate a matrix of localization of which the columns are made up of `1` on the ddl `DX` and `0` elsewhere.

L_y indicate a matrix of localization of which the columns are made up of `1` on the ddl `DY` and `0` elsewhere.

L_z indicate a matrix of localization of which the columns are made up of `1` on the ddl `DZ` and `0` elsewhere.

Φ_i indicate the 2rd vector of the base of projection.

3.20 Classification of the basic vectors

A structure of data `sd_nume_ddl` is attached to the structure of data `sd_macr_elem_dyna`. One refers to it for the classification of the basic vectors.