Operator DEFI_GLRC

1 Goal

The operator `DEFI_GLRC` permet to define the parameters of the models of reinforced concrete behavior `GLRC_DAMAGE` [R7.01.31] and `GLRC_DM` [R7.01.32].

It makes it possible to determine the characteristics of the reinforced concrete homogenized starting from the properties of the concrete and several types of reinforcement (passive reinforcements, cables of prestressing, liner metal).

In this order, one informs the physical properties (coefficients elastic, yield stress) and geometrical (steel section and positions) of the reinforced concrete, and also the choice of an option for the method of identification (case `GLRC_DM`). At exit, one lays out of a concept “material”, which one can then assign to the various meshs of plates with the order `AFFE_MATERIAU`.

It is important to note that before calling on `DEFI_GLRC`, it is necessary to use `DEFI_MATERIAU` to inform the whole of the parameters material concerning the concrete and steel components.

Product a Structure of data of the type `to subdue`.

Contents

2 General syntax

```
my [to subdue] = DEFI_GLRC (

reuse     =   chechmate,                                    [to subdue]
♦   RELATION =    /   GLRC_DM
# Definition of the parameters concrete
   ♦   CONCRETE =    (   _F  (♦  MATER =   mat_beton,        [to subdue]
                         ♦   THICK     = ep,             [R]
                 ),
# Definition of the parameters of the reinforcements
   ♦   TABLECLOTH = (   _F  (♦  MATER  = mat_acier,        [to subdue]
                         ♦   OMX    = Wx,               [R]
                         ♦   OMY    = Wy,               [R]
                         ♦   X-ray     = X-ray,                [R]
                         ♦   RY     = ry,               [R]
                 ),
   ◊   RHO          =   rho                             [R]
   ◊   AMOR_ALPHA   =   amor_alpha                      [R]
   ◊   AMOR_BETA    =   amor_beta                       [R]
   ◊   AMOR_HYST    =   amor_hyst                       [R]
   ♦   COMPR  =   /   GAMMA                             [DEFECT]
                ♦   GAMMA_C   = gc,                     [R]
                /   THRESHOLD
                ♦   NRYC   = Nyc,                          [R]
   ♦   SLOPE  =   /   RIGI_ACIER                        [DEFECT]
                /   PLAS_ACIER
                /   UTIL
                ♦   EPSI_MEMB = EM,                     [R]
                ♦   KAPP_FLEX = KF,                     [R]
   ♦   CISAIL =   /   YES
                /   NOT                                 [DEFECT]
   ♦   METHODE_ENDO =   /   ENDO_INTER                  [DEFECT]
                      /   ENDO_NAISS
                      /   ENDO_LIM
   ◊   INFO=  /   1                                     [DEFECT]
              /   2

♦RELATION =   /   GLRC_DAMAGE
# Definition of the parameters concrete
   ♦   CONCRETE =    (   _F  (♦  MATER  =  mat_beton,        [to subdue]
                         ♦   THICK  =   ep,             [R]
                         ♦   GAMMA  =   gamma,          [R]
                         ♦   QP1    =   qp1             [R]
                         ♦   QP2    =   qp2,            [R]

                         ♦   C1N1   =   c1n1,           [R]
                         ♦   C1N2   =   c1n2,           [R]
                         ♦   C1N3   =   c1n3,           [R]
                         ♦   C2N1   =   c2n1,           [R]
                         ♦   C2N2   =   c2n2,           [R]
                         ♦   C2N3   =   c2n3,           [R]
                         ♦   C1M1   =   c1m1,           [R]
                         ♦   C1M2   =   c1m2,           [R]
                         ♦   C1M3   =   c1m3,           [R]
                         ♦   C2M1   =   c2m1,           [R]
                         ♦   C2M2   =   c2m2,           [R]
                         ♦   C2M3   =   c2m3,           [R]
```

```
                         ◊  BT1      =  bt1,             [R]
                         ◊  BT2    =  bt2,            [R]

                         ◊  EAT    =  eat,            [R]
                         ◊  OMT    =  omt,            [R]

                         ◊  MP1X   =  mp1x,           [l_R]
                         ◊  MP1Y   =  mp1y,           [l_R]
                         ◊  MP2X   =  mp2x,           [l_R]
                         ◊  MP2Y   =  mp2y,           [l_R]

                         ◊  MP1X_FO   =  mp1x_fo,     [l_R]
                         ◊  MP1Y_FO   =  mp1y_fo,     [l_R]
                         ◊  MP2X_FO   =  mp2x_fo,     [l_R]
                         ◊  MP2Y_FO   =  mp2y_fo,     [l_R]
          ),

    # Definition of the parameters passive reinforcements
      ♦  TABLECLOTH = (   _F (♦  MATER  = mat_acier,        [to subdue]
                         ♦  OMX    = Wxa,             [R]
                         ♦  OMY    = Wya,             [R]
                         ♦  X-ray     = rxa,             [R]
                         ♦  RY     = rya,             [R]
              ),

    # Definition of the parameters cables of prestressing
      ♦  CABLE_PREC = (   _F (   ♦  MATER  =  mat_cable,    [to subdue]
                           ♦  OMX    =  Wxp,          [R]
                            ♦ OMY    =  Wyp,          [R]
                           ♦  X-ray     =  rxp,          [R]
                           ♦  RY     =  ryp,          [R]
                           ♦  PREX   =  precx,        [R]
                           ♦  PREY   =  precy,        [R]
                ),

    # Definition of the parameters liner metal
      ♦  LINER =   (  _F (   ♦  MATER  =  mat_liner,       [to subdue]
                         ♦  OML    =  W L,            [R]
                         ♦  RLR    =  rlr,            [R]
          ),

    # Definition of the thermal dilation coefficient "average":
      ◊  ALPHA =   alpha,                             [R]

      ◊  INFORMATION =/  1                                  [DEFECT]
              /  2
                         )
```

3 General description of the reinforced concrete hull

One describes in this paragraph the geometry of the hull considered.

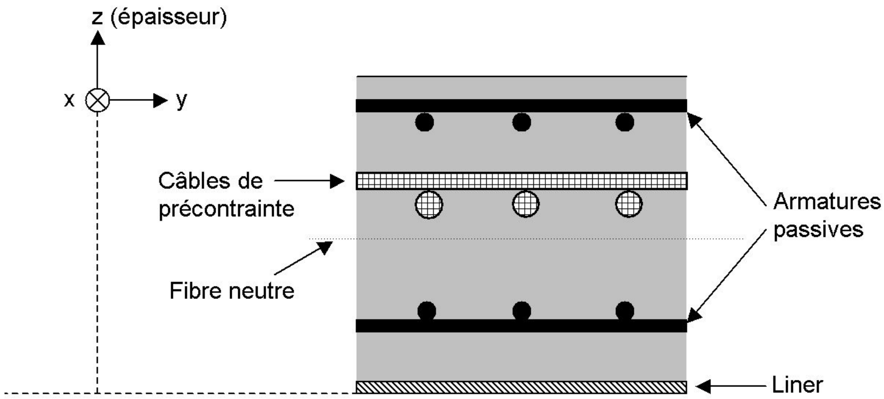

Figure 3-a: Current section of the reinforced concrete hull.

The basic section of a reinforced concrete flagstone (Figure 3-a) is made up:

- concrete hull
- passive reinforcements

and in the case of `GLRC_DAMAGE`, the section can contain moreover:

- cables of prestressing
- a metal liner

The liner is a steel plate placed in internal skin of the enclosure guaranteeing the sealing in the event of accidental escape in particular.

Prestressing makes it possible to compress the structural concrete of civil engineer. This prestressing is applied using cables of prestressed out of steel energized.

4 Operands RELATION = GLRC_DM

The documentation of the model will be consulted GLRC_DM [R7.01.32].

4.1 Keyword CONCRETE

The keyword factor CONCRETE allows to define the geometrical characteristics and material of the concrete.

4.1.1 Operand MATER

```
MATER = mat_beton
```

The name of material produced defines by DEFI_MATERIAU used for the concrete. This operand makes it possible to check that the parameters associated with the behaviors concrete exist well in material. One waits to find the properties: ELAS and BETON_ECRO_LINE.

4.1.2 Operand THICK

```
THICK = ep
```

The thickness of the concrete plate defines. It is checked that $ep \geq 0$.

Note:
The value this thickness must be identical to that given in AFFE_CARA_ELEM for the elements of hull using material mat_beton (defined by DEFI_GLRC).

4.2 Keyword TABLECLOTH

The keyword factor TABLECLOTH allows to define the geometrical characteristics and material of the passive reinforcements. This keyword can be defined only once. Indeed, under the assumption of isotropy in elasticity of the law of behavior GLRC_DM, all the reinforcements are necessarily identical and to equidistance of neutral fibre.

4.2.1 Operand MATER

```
MATER = mat_acier
```

The name of material produced defines by DEFI_MATERIAU used for the passive reinforcements.
This operand makes it possible to recover the parameters material used for the passive reinforcements (Young modulus E_a , Poisson's ratio ν_a and yield stress σ_{ya}) that one finds in the properties: ELAS and ECRO_LINE.

4.2.2 Operands OMX and OMY

```
OMX = Wx
OMY = Wy
```

Define the steel sections Ω_x and Ω_y of any of the two beds of reinforcements given according to the directions x and y (in m^2/m linear if the thickness is given in m). It is pointed out that the formulation of the model GLRC_DM impose that the two tablecloths of reinforcements are identical.
It is checked that $\Omega_x > 0$ ET $\Omega_x = \Omega_y$. With the two tablecloths of reinforcements in the reinforced concrete section, there will be thus a rate of total reinforcement equal to $2\Omega_x = 2\Omega_y$.

4.2.3 Operands `X-ray` and `RY`

```
X-ray = X-ray
RY = ry
```

Define the position adimensionnée of a bed of reinforcements compared to the thickness of the concrete hull, given in the directions x and y ($-1 \leq rx \leq 1$, $-1 \leq ry \leq 1$, Figure 4.2.3-a).
It is checked that $rx = ry$.

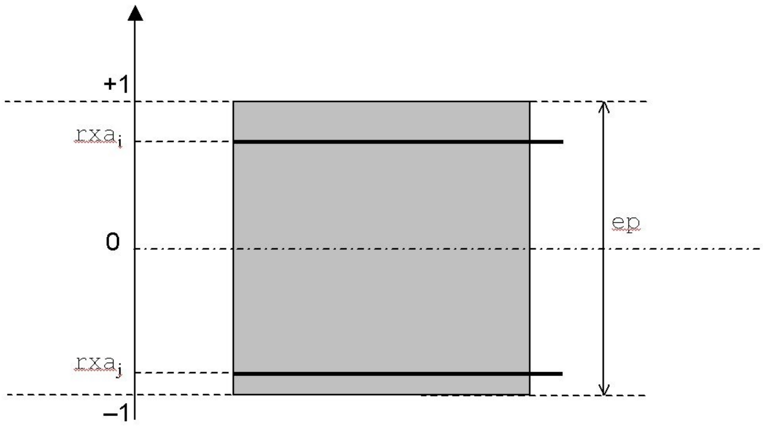

Figure 4.2.3-a: Définition of the adimensionnée position of the beds of reinforcements.

4.3 Operand `RHO`

```
RHO = rho
```

Operand optional allowing the user to define the equivalent density of the reinforced concrete flagstone. If the operand is not defined, the density is calculated in the following way:

$$\rho_{eq} = \rho_b + \frac{\rho_a}{h} (\Omega_x^{sup} + \Omega_x^{inf} + \Omega_y^{sup} + \Omega_y^{inf})$$

Where ρ_a indicate the density of steel and is recovered in the concept `mat_acier` provided by the operand `MATER` keyword `TABLECLOTH`.
Where ρ_b indicate the density of the concrete and is recovered in the concept `mat_beton` provided by the operand `MATER` keyword `CONCRETE` .
Where h is the thickness provided by the keyword `THICK`.

4.4 Operands `AMOR_ALPHA`, `AMOR_BETA` and `AMOR_HYST`

```
AMOR_ALPHA    = amor_alpha
AMOR_BETA     = amor_beta
AMOR_HYST     = amor_hyst
```

Operand optional allowing the user to define the coefficients α and β who are used to build the matrix of the damping of Rayleigh and η for damping hysteretic.

$$\mathbf{C} = \alpha \mathbf{K} + \beta \mathbf{M}$$

One will refer to the documents of modeling of the mechanical cushioning [U2.06.03] and [R5.05.04].

If the operands are not indicated in the order, they take the values defined in the concept `mat_beton` provided by the operand `MATER` keyword `CONCRETE`.

4.5 Keyword COMPR

The simple keyword `COMPR` allows to define two options to calculate the various parameters of the law in membrane compression:
if `COMPR=' GAMMA`'the parameter of damage in compression is directly used γ_c or
if `COMPR=' THRESHOLD`'the threshold of damage in compression of the concrete `NYC`.

There exists a strong relation between these two sizes which is clarified in the reference material [R7.01.32].

4.5.1 Operands GAMMA_C

```
GAMMA_C = gc
```

The value of the parameter of damage in compression defines γ_c. It is checked that $0 \leq gc \leq 1$.

4.5.2 Operands NYC

```
NYC = nyc
```

The absolute value of the threshold of appearance of the damage in compression of the reinforced concrete flagstone defines (force by length).

4.6 Keyword SLOPE

The keyword factor `SLOPE` allows to define the method of calculating of the slope post-rubber band. Indeed, it is possible to carry out this calculation according to three methods called `RIGI_ACIER`, `PLAS_ACIER` and `UTIL`. These three calculations of slopes make it possible to set up three different methods of retiming according to the well informed properties materials. If the yield stress of steels is not known, methods of retiming `RIGI_ACIER`, i.e slope post-rubber band equalizes with the slope of resumption of stiffness of steels, and `UTIL`, i.e slope post-rubber band cuts the slope of resumption of stiffness of steels to a maximum deformation whose value is imposed by the user, are accessible (cettE method is not adapted for maximum deformations weaker than the hollow of the curve of reference, to see Figure 4.6-b). If the elastic limit of steels is known, it is possible to use the method of retiming to the plastic limit of steels (`PLAS_ACIER`). The various methods of retiming are illustrated by the figures which follow.

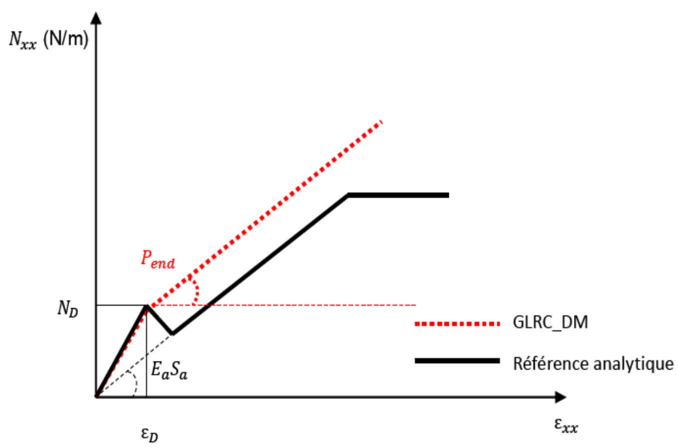

Figure 4.6-a: Traction diagram (`GLRC_DM` vs Référence) Retiming `SLOPE = RIGI_ACIER`

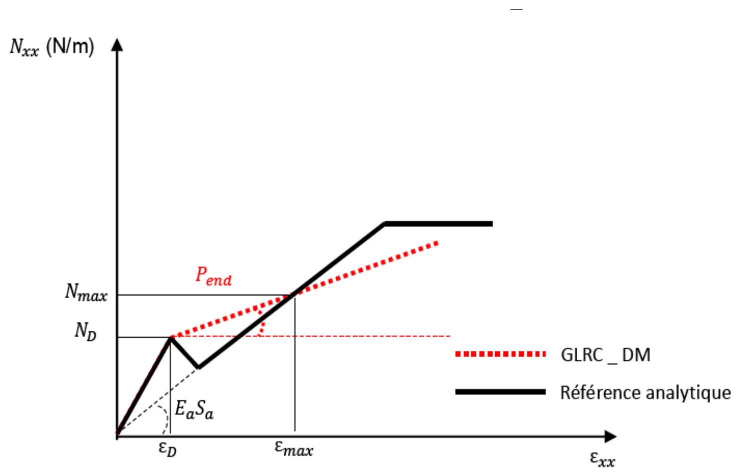

Figure 4.6-b: Traction diagram (`GLRC_DM` vs Référence) Retiming `SLOPE = UTIL`

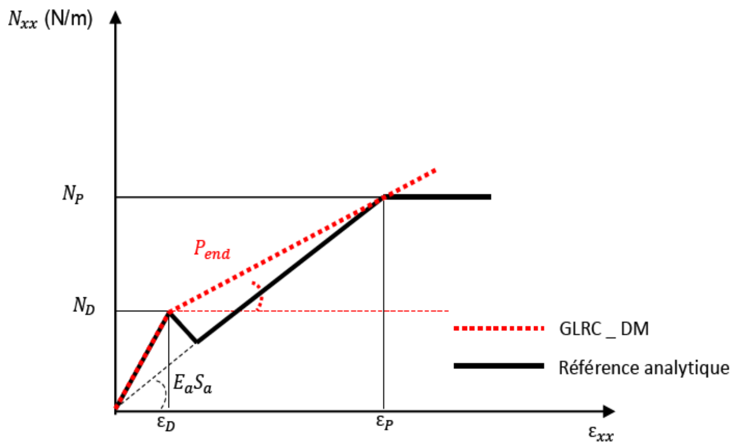

Figure 4.6-c: Traction diagram (`GLRC_DM` vs Référence) Retiming `SLOPE = PLAS_ACIER`

In the case of retiming with the maximum deformation (`PENTE=UTIL`), it is necessary to inform the maximum deformation out of membrane (`EPSI_MEMB`) and maximum curve in inflection (`KAPP_FLEX`).

4.6.1 Operand `EPSI_MEMB`

`EPSI_MEMB = EM`

The value of the maximum deformation out of membrane in the case defines `PENTE=UTIL` .

4.6.2 Operand `KAPP_FLEX`

`KAPP_FLEX = KF`

Defines the value of the maximum curve in inflection (opposite a length) in the case `PENTE=UTIL` .

4.7 Keyword `CISAIL`

The simple keyword CISAIL allows to determine whether the homogenized elastic parameters are those calculated by homogenisation for a standard application of the model of behavior (CISAIL=NON) or those calculated for a particular application in order to respect the fact when one is in shearing pure plan the rigidity of steels does not intervene in the elastic behavior (CISAIL=OUI).

4.8 Keyword METHODE_ENDO

From the knowledge of the slopes post-rubber bands, several methods are available to go back to the values of the parameters of damage γ_t, γ_c and γ_f, according to the range of loadings aimed in terms of generalized deformations reached. The detail of the various methods can be found in [R7.01.32]:

- ENDO_INTER is the method by default (and advised) and corresponds to a report of slope
- ENDO_NAISS corresponds to the case of the assumption of the incipient damage, by considering the infinitesimal evolution just after the appearance of the first damage,
- ENDO_LIM corresponds to the case of the assumption of infinite values of damage, for important generalized deformations.

4.9 Keyword INFORMATION

With INFORMATION = 2, one obtains the Impression with the format RESULT list of the homogenized parameters used as starter of the model of behavior GLRC_DM : elasticity, thresholds and damaging behavior.

4.10 Example of use

One will be able to consult the example of use deferred in the test SSNS106A, in situation of traction and compression, and in the test SSNS106B, in situation of alternating bending, cf [V6.05.106]. It can be used in order to check on the case to study the consequences in terms of answer for elementary loadings in alternate statics of the choice of the parameters and methods of identification.

5 Operands RELATION = GLRC_DAMAGE

The documentation of the model will be consulted GLRC_DAMAGE [R7.01.31].

5.1 Keyword CONCRETE

The keyword factor CONCRETE allows to define the geometrical characteristics and material of the concrete.

5.1.1 Operand MATER

```
MATER = mat_beton
```

The name of material produced defines by DEFI_MATERIAU used for the concrete. This operand makes it possible to check that the parameters associated with the behaviors chosen under the keywords FLOW, ECRO_ISOT, ECRO_CINE and ELAS exist well in material.

5.1.2 Operand THICK

```
THICK = ep
```

The thickness of the concrete plate defines. It is checked that $ep \geq 0$.

Note:
The value this thickness must be identical to that given in AFFE_CARA_ELEM for the elements of hull using material mat_beton (defined by DEFI_GLRC).

5.1.3 Operand GAMMA

```
GAMMA = gamma
```

The parameter of damage defines which characterizes the slope of the curved moment – curve during the cracking of the concrete (figure 2). $gamma$ can be regarded as being the relationship between the slope lasting cracking on the elastic slope. If $gamma > 0$, the slope is positive. If $gamma < 0$, the slope decrease and stability is not guaranteed any more. In all the cases, we must have $gamma < QP1$ and $gamma < QP2$. The value by default is 0. This parameter is used only for the calculation of the damage:

$$\gamma = \frac{p_f}{p_{élas}}$$

with:

- γ : GAMMA
- $p_{élas}$: elastic slope
- p_f : slope during cracking

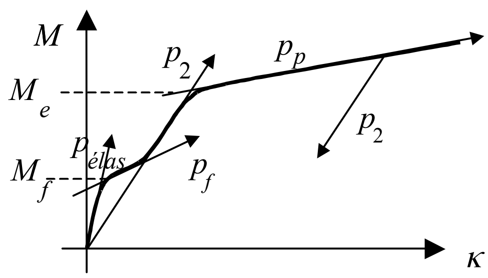

Figure 5.1.3-a: Curve moment – curve of the behavior of a reinforced concrete plate in inflection.

5.1.4 Operands QP1 and QP2

```
QP1 = qp1
QP2 = qp2
```

Ratios of slopes for a positive or negative inflection define. The ratio is supposed to be the report of the slope of the curved curve – moment after cracking on the elastic slope. They are used only for the calculation of the damage:

$$Q_P = \frac{p_2}{p_{élas}}$$

With:

- Q_p : ratio of the slopes
- $p_{élas}$: elastic slope
- p_2 : slope after cracking

It is checked that $0 < QPi < 1$.

5.1.5 Operands C1N1/C1N2/C1N3/C2N1/C2N2/C2N3

```
C1N1 = c1n1
C1N2 = c1n2
C1N3 = c1n3
C2N1 = c2n1
C2N2 = c2n2
C2N3 = c2n3
```

The components of the kinematic tensor of work hardening of Prager define binding the tensors of the membrane plastic deformations with the efforts of kinematic membrane of recall.

$$N = CN_1 \epsilon_1^p + CN_2 \epsilon_2^p$$

With:

- $CN_1 = \begin{pmatrix} C1N1 & 0 & 0 \\ 0 & C1N2 & 0 \\ 0 & 0 & C1N3 \end{pmatrix}$
- $CN_2 = \begin{pmatrix} C2N1 & 0 & 0 \\ 0 & C2N2 & 0 \\ 0 & 0 & C2N3 \end{pmatrix}$
- ϵ_1^p and ϵ_2^p are the tensors of membrane plastic deformation for the criterion of plasticity 1 and 2.

It is checked that $CiNj \geq 0$.

5.1.6 Operands C1M1/C1M2/C1M3/C2M1/C2M2/C2M3

```
C1M1 = c1m1
C1M2 = c1m2
C1M3 = c1m3
C2M1 = c2m1
C2M2 = c2m2
```

```
C2M3 = c2m3
```

The components of the kinematic tensor of work hardening of Prager define binding the tensors of the plastic curves with the moments of kinematic recall.

$$M = CM_1 \kappa_1^p + CM_2 \kappa_2^p$$

With:

- $CM_1 = \begin{pmatrix} C1M1 & 0 & 0 \\ 0 & C1M2 & 0 \\ 0 & 0 & C1M3 \end{pmatrix}$
- $CM_2 = \begin{pmatrix} C2M1 & 0 & 0 \\ 0 & C2M2 & 0 \\ 0 & 0 & C2M3 \end{pmatrix}$
- κ_1^p and κ_2^p are the tensors of plastic curve for the criteria of plasticity 1 and 2.

The calculation of $C_i M_j$ is carried out by using MOCO.

$$C_i M_j = \frac{p_{élas} p_p}{p_{élas} - p_p}$$

with:

- $p_{élas}$: elastic slope
- p_p : plastic slope

It is checked that $C_i M_j \geq 0$.

5.1.7 Operands **BT1/BT2** and **EAT/OMT**

```
BT1 = bt1
BT2 = bt2

EAT = eat
OMT = omt
```

If the finite elements support the calculation of the efforts cutting-edges, these operands are used to define the elastic matrix of rigidity of transverse shearing. The efforts cutting-edges V are connected to the distortions γ by:

$$V = \begin{bmatrix} BT1 & 0 \\ 0 & BT2 \end{bmatrix} : \gamma$$

If the user informs the Young modulus of transverse steels `EAT` as well as the steel section transverse per linear meter `OMT` then one deduces the coefficients from the matrix of rigidity by the following relation:

$$bt_i = \frac{5}{6} \frac{ep}{2} \left(\frac{eb}{1+nub} + eat \times omt \right)$$

The user cannot inform at the same time `BT1, BT2` and parameters `EAT, OMT`.

It is checked that these operands are strictly positive realities.

5.1.8 Operands MP1X/MP1Y/MP2X/MP2Y and MP1X_FO/MP1Y_FO/MP2X_FO/MP2Y_FO

```
MP1X = mp1x
MP1Y = mp1y
MP2X = mp2x
MP2Y = mp2y

MP1X_FO = mp1x_fo
MP1Y_FO = mp1y_fo
MP2X_FO = mp2x_fo
MP2Y_FO = mp2y_fo
```

The limiting plastic moments of the generalized criterion of Johansen used in the model of behavior define GLRC_DAMA. They can be defined are by constant values are by functions. It is not possible to mix functions and constants. Moreover as soon as one of the operands is indicated, it is obligatory of all to inform them. When those are not specified, they are calculated in an automatic way.

5.2 Keyword ARMED

The keyword factor ARMED allows to define the geometrical characteristics and material of the passive reinforcements.

5.2.1 Operand MATER

```
MATER= mat_acier
```

The name of material produced defines by DEFI_MATERIAU used for the passive reinforcements.
This operand makes it possible to recover the parameters material used for the passive reinforcements (Young modulus E_a , Poisson's ratio ν_a and yield stress σ_{ya}).

5.2.2 Operands OMX and OMY

```
OMX  = Wxa
OMY  = Wya
```

The steel sections of a bed of reinforcements define given according to the directions x and y (in m^2/m linear, the thickness being then given in m).
It is checked that $Wxa\geq 0$ and $Wya\geq 0$.

5.2.3 Operands X-ray and RY

```
X-ray = rxa
RY = rya
```

Define the position adimensionnée of a bed of reinforcements compared to the thickness of the concrete hull, given in the directions x and y ($-1\leq rxa\leq 1$, $-1\leq rya\leq 1$, figure 3).

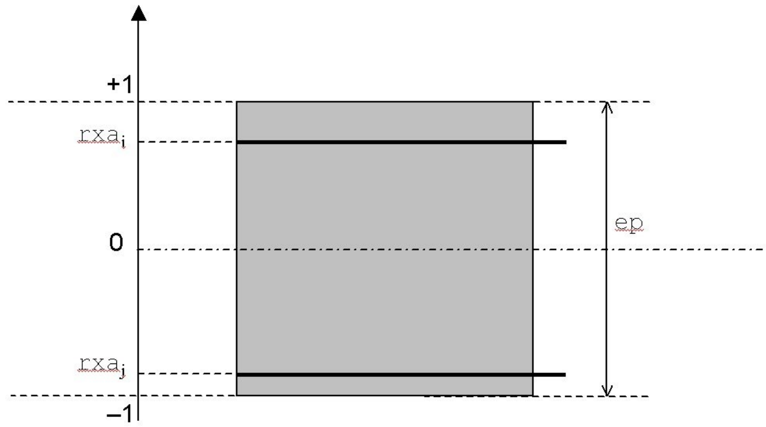

Figure 5.2.3-a: Définition of the adimensionnée position of the beds of reinforcements.

5.3 Keyword CABLE_PREC

The keyword factor `CABLE_PREC` allows to define the geometrical characteristics and material of the cables of prestressed as well as the prestressing force used.

5.3.1 Operand MATER

```
MATER = mat_cable
```

The name of material produced defines by `DEFI_MATERIAU` used for the cables of prestressing.
This operand makes it possible to recover the parameters material used for the cables of prestressing (Young modulus E_p, Poisson's ratio ν_p and yield stress σ_{yp}).

5.3.2 Operands OMX and OMY

```
OMX= W xp
OMY= W YP
```

The steel sections of a bed of cables of prestressing define given according to the directions x and y (in m^2/m linear, the thickness being then given in m).
It is checked that $Wxp \geq 0$ and $Wyp \geq 0$.

5.3.3 Operands X-ray and RY

```
X-ray = rxp
RY = ryp
```

Define the adimensionnée position of a bed of cables of prestressing compared to the thickness of the concrete hull, given in the directions x and y ($-1 \leq rxp \leq 1$, $-1 \leq ryp \leq 1$).

5.3.4 Operands PREX and PREY

```
PREX = precx,
PREY = precy,
```

The forces of prestressed (in Newton) in the directions define x and y (they must be normally negative because one applies a compressive force).

5.4 Keyword LINER

The keyword factor LINER allows to define the geometrical characteristics and material of the metal liner.

5.4.1 Operand MATER

```
MATER = mat_liner
```

The name of material produced defines by DEFI_MATERIAU used for the metal liner.
This operand makes it possible to recover the parameters material used for the metal liner (Young modulus E_l, Poisson's ratio ν_l and yield stress σ_{yl}).

5.4.2 Operand OML

```
OML = Wl
```

The thickness of the liner defines (in meters according to the choice operated for the other dimensioned parameters).
It is checked that $Wl \geq 0$.

5.4.3 Operand RLR

```
RLR= rlr,
```

The adimensionnée position of the liner compared to the thickness of the concrete hull defines (in practice, $rlr=-1$ or $rlr=1$, because the metal liner is laid out opposite lower or higher the concrete hull).

5.5 Keyword ALPHA

This keyword makes it possible to define a thermal dilation coefficient “average” (and isotropic) for the element of hull.

5.6 Keyword INFORMATION

Impression with the format RESULT list of the homogenized parameters used as starter of the model of behavior GLRC_DAMAGE.

6 Example of use

The following example is resulting from test SDNS106A:

```
CHECHMATE = DEFI_GLRC (RELATION = GLRC_DAMAGE,
                 CONCRETE = _F (
                   MATER = MAT_B,
                   THICK = EP,
                   GAMMA = 0.0,
                   QP1 = 0.15,
                   QP2 = 0.15,

                   C1N1 = 87.3E6, C1N2 = 87.3E6, C1N3 = 87.3E6,
                   C2N1 = 87.3E6, C2N2 = 87.3E6, C2N3 = 87.3E6,
                   C1M1 = 14.8E6, C1M2 = 14.8E6, C1M3 = 14.8E6,
                   C2M1 = 14.8E6, C2M2 = 14.8E6, C2M3 = 14.8E6,),

                 TABLECLOTH = (
                _F (MATER = MAT_A1,
                   OMX = 5.65E-4,
                   OMY = 5.65E-4,
                   X-ray = 0.95,
                   RY = 0.95,),

                _F (MATER = MAT_A1,
                   OMX = 5.65E-4,
                   OMY = 5.65E-4,
                   X-ray = -0.95,
                   RY = -0.95,),),

                 LINER = _F (
                  MATER = MAT_A2,
                  OML = 6.E-3,
                  RLR = -1. ,),

                 CABLE_PREC = _F (
                   MATER = MAT_A2,
                   OMX = 4.56E-3,
                   OMY = 1.35E-2,
                   X-ray = 0.0,
                   RY = 0.0,
                   PREX = -3.0E6,
                   PREY = -3.0E6,),

                  INFORMATION = 2,);
```

Note:
In this example, 3 different materials are used: `MAT_B` (concrete), `MAT_A1` (passive reinforcements) and `MAT_A2` (liner metal and cables of prestressed). Before defining the parameters of `DEFI_GLRC`, it is obligatory to use `DEFI_MATERIAU` to inform all the parameters concerning these materials:

```
MAT_B=DEFI_MATERIAU (
                    ELAS = _F (
                               E    =  30000.E6,
                               NAKED   =  0.2,
                               RHO    = 2500.0,),

                    BETON_ECRO_LINE = _F (
```

```
                                   D_SIGM_EPSI = 0.0,
                                   SYT   =  5E6,
                                   SYC    = -35.E6,),);
MAT_A1=DEFI_MATERIAU (
                    ELAS = _F (
                                   E    =  2.E11,
                                   NAKED   =  0.0,),
                    ECRO_LINE = _F (
                                   D_SIGM_EPSI = 0.0,
                                   SY   =  3.E9,),);

MAT_A2=DEFI_MATERIAU (
                    ELAS = _F (
                                   E    =  2.E11,
                                   NAKED   =  0.3,),
                    ECRO_LINE = _F (
                                   D_SIGM_EPSI = 0.0,
                                   SY   =  5.E8,),);
```

Although formulas of homogenisation used in DEFI_GLRC exploit only the threshold values SY for ECRO_LINE and SYT, SYC for BETON_ECRO_LINE of DEFI_MATERIAU, one is obliged to also inform the values D_SIGM_EPSI as indicated above, since they are obligatory keywords.