

Operator DEFI_GLRC

1 Goal

The operator `DEFI_GLRC` allows to define the parameters of the models `GLRC_DAMAGE` and `GLRC_DM`.

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 (elastic, yield stress coefficients) and geometrical (steel section and positions) of the reinforced concrete. At exit, one lays out of a concept "material", which one can then assign to the various meshes 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

1 Goal.....	1
2 General syntax.....	4
3 General description of the reinforced concrete hull.....	6
4 Operands RELATION = GLRC_DM.....	7
4.1 Keyword CONCRETE.....	7
4.1.1 Operand MATER.....	7
4.1.2 Operand THICK.....	7
4.2 Keyword TABLECLOTH.....	7
4.2.1 Operand MATER.....	7
4.2.2 Operands OMX and OMY.....	7
4.2.3 Operands X-ray and RY.....	7
4.3 Operand RHO.....	8
4.4 Operands AMOR_ALPHA, AMOR_BETA and AMOR_HYST.....	8
4.5 Keyword COMPR.....	9
4.5.1 Operands GAMMA_C.....	9
4.5.2 Operands NYC.....	9
4.6 Keyword SLOPE.....	9
4.6.1 Operand EPSI_MEMB.....	10
4.6.2 Operand KAPP_FLEX.....	10
4.7 Keyword CISAIL.....	10
4.8 Keyword METHODE_ENDO.....	11
4.9 Keyword INFORMATION.....	11
5 Operands RELATION = GLRC_DAMAGE.....	12
5.1 Keyword CONCRETE.....	12
5.1.1 Operand MATER.....	12
5.1.2 Operand THICK.....	12
5.1.3 Operand GAMMA.....	12
5.1.4 Operands QP1 and QP2.....	14
5.1.5 Operands C1N1/C1N2/C1N3/C2N1/C2N2/C2N3.....	14
5.1.6 Operands C1M1/C1M2/C1M3/C2M1/C2M2/C2M3.....	14
5.1.7 Operands BT1/BT2 and EAT/OMT.....	15
5.1.8 Operands MP1X/MP1Y/MP2X/MP2Y and MP1X_FO/MP1Y_FO/MP2X_FO/MP2Y_FO...16	
5.2 Keyword ARMED.....	16
5.2.1 Operand MATER.....	16
5.2.2 Operands OMX and OMY.....	16
5.2.3 Operands X-ray and RY.....	16
5.3 Keyword CABLE_PREC.....	17
5.3.1 Operand MATER.....	17

5.3.2 Operands OMX and OMY.....	17
5.3.3 Operands X-ray and RY.....	17
5.3.4 Operands PREX and PREY.....	17
5.4 Keyword LINER.....	18
5.4.1 Operand MATER.....	18
5.4.2 Operand OML.....	18
5.4.3 Operand RLR.....	18
5.5 Keyword ALPHA.....	18
5.6 Keyword INFORMATION.....	18
6 Example of use.....	19

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_HIST  = amor_hist                              [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                                    [DEFECT]
                  / NOT
  ◆ 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,         [1_R]
        ◇ MP1Y     = mp1y,         [1_R]
        ◇ MP2X     = mp2x,         [1_R]
        ◇ MP2Y     = mp2y,         [1_R]

        ◇ MP1X_FO  = mp1x_fo,     [1_R]
        ◇ MP1Y_FO  = mp1y_fo,     [1_R]
        ◇ MP2X_FO  = mp2x_fo,     [1_R]
        ◇ MP2Y_FO  = mp2y_fo,     [1_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.

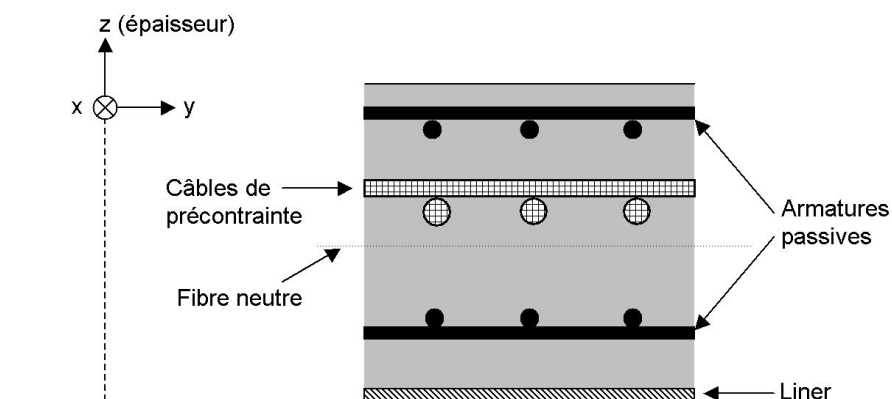


Figure 3-a: Current section of the reinforced concrete hull.

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
- of a metal liner

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

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

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 `AFPE_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 hyposthèse of isotropy 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 a bed of reinforcements given according to the directions x and y (in m^2/m linear).

It is checked that $\Omega_x > 0$ and $\Omega_x = \Omega_y$.

4.2.3 Operands X-ray and RY

```
X-ray = X-ray
```

$R_Y = r_y$

Define the position adimensionnée of a bed of reinforcements compared to the thickness of the concrete hull, given in the directions x and y ($-1 \leq r_x \leq 1$, $-1 \leq r_y \leq 1$, Figure 4.2.3-a).

It is checked that $r_x = r_y$.

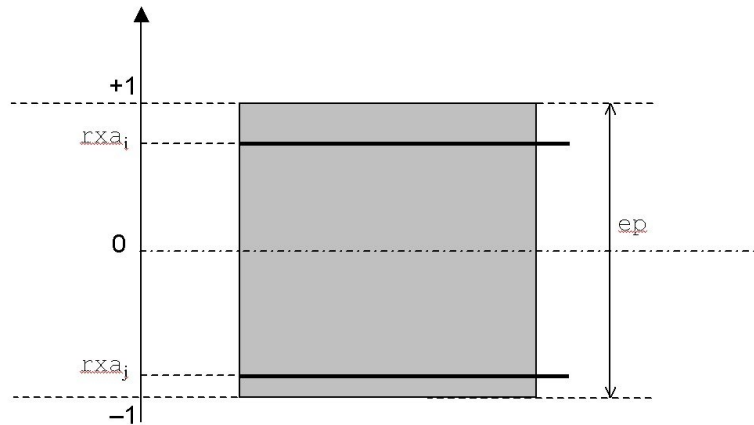


Figure 4.2.3-a: Définition of the adimensionnée position of the beds of reinforcements.

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 hysteretic matrix of the damping of Rayleigh and or damping.

$$C = \alpha K + \beta M$$

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 determine whether the parameter of damage in compression is used γ_c or the threshold of damage in compression of the concrete `NYC` to calculate the various parameters of the law. 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 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 of carried out this calculation following 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 an imposed maximum deformation, are accessible. 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 reclage are illustrated by the figures which follow.

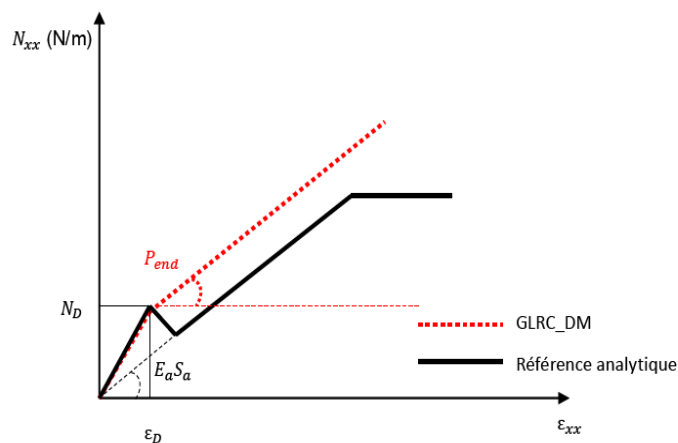


Figure 4.6-a: Traction diagram (GLRC_DM vs Référence) Retiming `SLOPE` = `RIGI_ACIER`

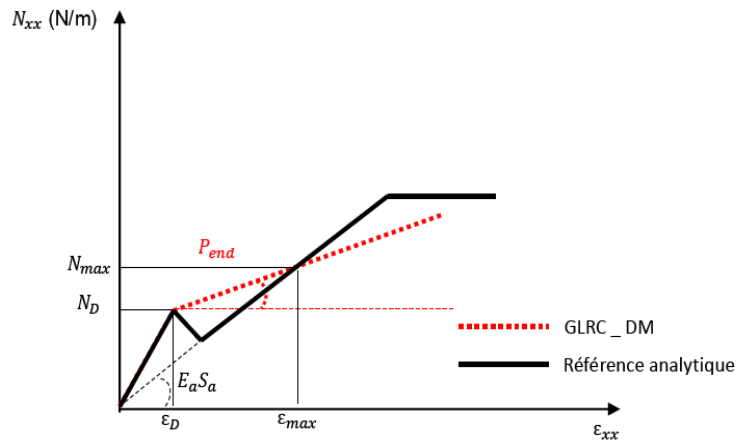


Figure 4.6-b: Traction diagram (GLRC_DM vs Référence) Retiming SLOPE = UTIL

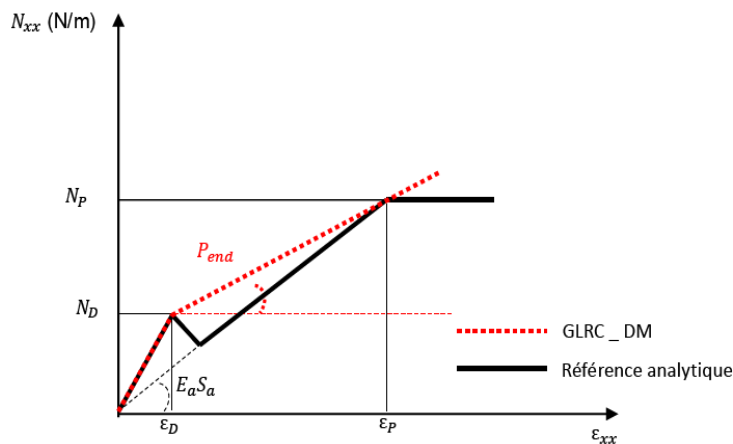


Figure 4.6-c: Traction diagram (GLRC_DM vs Référence) Retiming SLOPE = PLAS_ACIER

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

Defined T the value maximum deformation out of membrane in the case PENTE=UTIL .

4.6.2 Operand KAPP_FLEX

KAPP_FLEX = KF

Defined T the value 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 standard homogenisation (CISAIL=NON) or those calculated in order to respect the fact when pure shearing the rigidity of steels do not intervene (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_i , γ_c and γ_f . 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
- ENDO_LIM corresponds to the case of the assumption of the infinite damage

4.9 Keyword INFORMATION

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

5 Operands RELATION = GLRC_DAMAGE

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:

$$\gamma = \frac{p_f}{p_{\text{élas}}}$$

With:

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

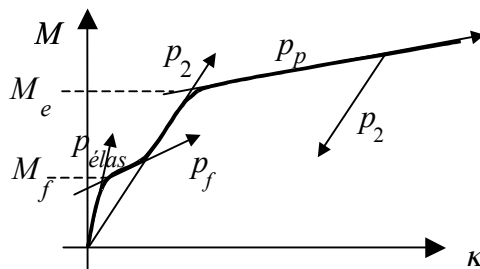


Figure 5.1.3-a: Curve moment – curve of the behavior of a reinforced concrete plate in inflection.

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:

$$Q_p = \frac{p_2}{p_{elas}}$$

With:

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

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

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:

$$\bullet CN_1 = \begin{pmatrix} CIN1 & 0 & 0 \\ 0 & CIN2 & 0 \\ 0 & 0 & CIN3 \end{pmatrix}$$
$$\bullet CN_2 = \begin{pmatrix} C2N1 & 0 & 0 \\ 0 & C2N2 & 0 \\ 0 & 0 & C2N3 \end{pmatrix}$$

- 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:

$$\bullet CM_1 = \begin{pmatrix} CIM1 & 0 & 0 \\ 0 & CIM2 & 0 \\ 0 & 0 & CIM3 \end{pmatrix}$$
$$\bullet CM_2 = \begin{pmatrix} C2M1 & 0 & 0 \\ 0 & C2M2 & 0 \\ 0 & 0 & C2M3 \end{pmatrix}$$

• κ_1^p and κ_2^p are the tensors of plastic curve for the criterion of plasticity 1 and 2.

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

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

With:

- $p_{\text{élas}}$: 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 by constant values or 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).

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).

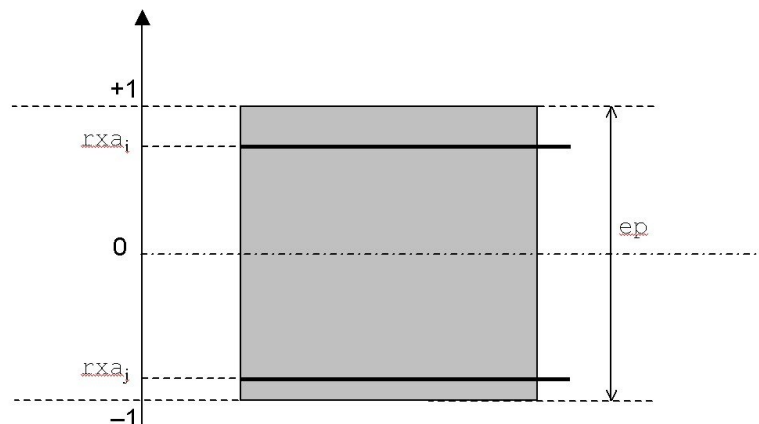


Figure 5.2.3-a: Définition of the adimensionnée position of the beds of reinforcements.

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).

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). 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.