Operator DEFI_MATER_GC

1 Drank

operator DEFI_MATER_GC allows to define the parameters of materials used for studies of civil engineer.

The purpose is to help the user to define materials parameters from more physical quantity.

In this command, the physical properties are informed (elastic coefficients, yield stresses, strength characteristic,…), in output one has a concept material, which one can meshes assign then to different with the command AFFE_MATERIAU.

Product a data structure of the type MATER

Contents

2 general Syntax

```
MATER [to subdue] = DEFI_MATER_GC (
     ◊ INFO=       /1                                          [Default]
                    /2
     ◊ REGLE=       "BAEL91"                                   [Default]
     ♦/MAZARS=      _F (
          ♦                   UNITE_LONGUEUR= ("M" | "MM")
      [Text]
          ♦ F CJ=             fcj                                 [Real]
          ◊ EIJ=              eij                                 [Real]
          ◊                   EPSI_C= epsi_c                      [Real]
          ◊ FTJ=              ftj                                 [Real]
          ◊ NU=               nu                                  [Real]
          ◊ EPSD0=            epsid0                              [Real]
          ◊ K=                K                                   [Real]
          ◊ AC=               ac                                  [Real]
          ◊ BC=               bc                                  [Real]
          ◊ AT=               At                                  [Real]
          ◊ BT=               BT                               [Reality]
           # For postprocessing
          ◊                   SIGM_LIM= sigmlim                   [Real]
          ◊                   EPSI_LIM= epsilim                   [Real]
          )

     ♦/ACIER=       _F (
          ♦ E=                Young                               [Real]
          ♦ SY=               sigy                                [Real]
          ◊ NU=               nu                                  [Real]
          ◊                   D_SIGM_EPSI= dsde                   [Real]
           # For postprocessing
          ◊                   SIGM_LIM= sigmlim                   [Real]
          ◊ EPSI_LIM=         epsilim                            [Real]
          )

     ◊ RHO=         rho                                           [Real]
     ◊ ALPHA=       appha                                         [Real]
     ◊              AMOR_ALPHA= will amora                        [Real]
     ◊              AMOR_BETA= amorb               of the command [Real
     ]              ◊ AMOR_HYST=                            amorh [Real
]
```

3) Objective

3.1 Command DEFI_MATER_GC

command DEFI_MATER_GC aims to simplify the entry of the coefficients materials for the concrete mazars model and the steel ecro_line model , for an application to the civil engineer.

In this command, the physical properties are informed (elastic coefficients, yield stresses, strength characteristic,…), in output one lays out of a concept “material”, which one can meshes assign then to different with the command AFFE_MATERIAU.

3.2 Operand INFO

Allows, in the file of message, the echo of the command DEFI_MATERIAU to have used by DEFI_MATER_GC at the time of the definition of the material.

The command DEFI_MATER_GC always prints the parameters of the material which are transmitted to the command DEFI_MATERIAU (confer the paragraph “example of use”).

3.3 Operand REGLE

the command DEFI_MATER_GC can use code of practice or advice resulting from payment to determine a certain number of parameters.
For example for concrete material knowing its characteristic strength in compression FCJ , its strength in tension can be estimated by: $FTJ = 0.6 + 0.06\, FCJ$ where FTJ and FCJ are in $[MPa]$.

The key key RULE makes it possible to indicate what is used for the estimate of the parameters resulting from the payments or of the rules of Article

◊ REGLE = “BAEL91”
“BAEL91” indicates that the rules used result from THE BAEL 1991. It is currently the only possibility.

3.4 Other operands

operands RHO, ALPHA, AMOR_ALPHA, AMOR_BETA, AMOR_HYST correspond and have the same meaning as those which one of the command finds under the key key FACTOR elas DEFI_MATERIAU [U4.43.01]

4 Key key factor MAZARS

The model of behavior of Mazars is an elastic model of behavior endommageable making it possible to describe the softening behavior of the concrete. It distinguishes behavior in tension and compression.

4.1 Operands

the operands presented in table DEFI_MATERIAU

EPSD0	Threshold of damage in strain
HAS C , B C	Coefficients making it possible to fix the pace of the curved post-peak in compression.
HAS T , B T	Coefficients allowing to fix the pace of the curved post-peak in tension.
K	Parameter of correction for the shears.

Table Materials parameters of model MAZARS.

♦ UNITE_LONGUOR
Unit of length of the problem [“M”|' ME]: measure or millimetre. Seizure of the operand is compulsory, because the formulas used in the continuation requires to know if materials parameters are in [Pa] or [MPa] .

- “M”: if the unit of length of the problem is in meter, materials parameters are homogeneous with [PA].
- “MM”: if the unit of length of the problem is in millimetre, materials parameters are homogeneous with [MPA].

♦ FCJ
Forced with the peak in compression, in [PA] if UNITE_LONGUEUR=' ME, in [MPA] if UNITE_LONGUEUR=' ME.

◊ EIJ
Modulus Young in [P has] if UNITE_LONGUOR = ' ME , in [MP has] if UNITE_LONGUEUR=' ME.

◊ EPSI_C
Strain with the peak in compression.

◊ FTJ
Forced with the peak in tension, in [PA] if UNITE_LONGUEUR=' ME, in [MPA] if UNITE_LONGUEUR=' ME.

◊ NU
Poisson's ratio.

ULTIMATE ◊
SIGM_LIM Stress, in [PA] if UNITE_LONGUEUR=' ME, in [MPA] if UNITE_LONGUEUR=' ME.

LIMITING ◊
EPSI_LIM Strain.

4.2 Operation

Two operands are compulsory: UNITE_LONGUOR , FCJ . So operands optional are indicated, they are taken into account by the command and the values S er did not modify. It is thus necessary to make sure of the coherence of the provided quantities.

If operands optional are not indicated, the command determines the missing quantities by formulas resulting from the code of practice and/or BAEL 1991.

$E_{ij}=11000.0\sqrt[3]{f_{cj}}$ in the unit of the problem

$f_{tj}=0.6+0.06\,f_{cj}$ in the unit of the problem

$\varepsilon_c=0.620\text{E-}3\sqrt[3]{f_{cj}}$ $\nu=0.200$ $\varepsilon_0=f_{tj}/E_{ij}$ $\beta=1.10$

$B_T=E_{ij}/f_{tj}$ $A_T=0.70$

$$B_c=\frac{1}{\varepsilon_c\nu\sqrt{2}}\quad A_c=\frac{\left(\frac{f_{cj}\nu\sqrt{2}}{E_{ij}}-\varepsilon_0\right)}{\varepsilon_c\nu\sqrt{2}\,exp\left(B_c(\varepsilon_0-\varepsilon_c\nu\sqrt{2})\right)-\varepsilon_0}$$

Note: A_c and B_c are given by solving the equations resulting from the writing 1D behavior from MAZARS. B_c is obtained while solving $f'(\varepsilon_c)=0$ and A_c while solving $f_{cj}=f(\varepsilon_c)$. If the user gives B_c the equation $f'(\varepsilon_c)=0$ can not be checked, in this case the behavior will pass by the point f_{cj} but f_{cj},ε_c will not be any more a extrema.
If the user gives A_c the equation $f_{cj}=f(\varepsilon_c)$ can not be checked, in this case the behavior will not pass by the point f_{cj} and ε_c .

$\sigma_{ELS}=0.6\,f_{cj}$ in the unit of the problem, $\varepsilon_{ELU}=3.5‰$

4.3 Example of use

to define a concrete which has a behavior of MAZARS with a strength characteristic of $40.0\,MPa$, the command is used in the following way:

```
BETONM = DEFI_MATER_GC (
   MAZARS = _F (FCJ=40.0E+06, UNITE_LONGUEUR= " M”,),
)
```

the command prints in the file of message all the values which are used to define the material.

```
== PARAMÈTRES OF MODEL MAZARS [PA] ==
PARTIE ELASTICITY:
  E =  3.76194246E+10, NU =  2.00000000E-01,
LEFT NONLINEAR:
  BT =  1.25398082E+04, K =  0.70000000E+00,
  AT =  7.00000000E-01, EPSI_LIM =  3.50000000E-03,
  BC =  1.66741558E+03, SIGM_LIM =  2.40000000E+07,
  AC =  1.28292129E+00, EPSD0 =  7.97460364E-05,
FOR INFORMATION:
 FCJ =  4.000E+07, FTJ =  3.0000E+06, EPSI_C =  2.12036757E-03,
```

table 4.3-a gives sets of parameters obtained with the rules previously described.

Fcj [MPa]	30.0	35.0	40.0	45.0	50.0
Ftj [MPa]	2.4	2.7	3.0	3.3	3.6
$Young$ [MPa]	34180.0	35982.0	37619.0	39126.0	40524.0
Nu	0.2	0.2	0.2	0.2	0.2
$Epsi\,c$	1.93E-03	2.03E-03	2.12E-03	2.21E-03	2.28E-03
At	0.7	0.7	0.7	0.7	0.7
Bt	14241.0	13327.0	125 39. 8	11856.0	11257.0
$Epsi0$	7.02E-05	7.50E-05	7.9 7 E-05	8.43E-05	8.88E-05
Bc	1835.2	1743.3	1667.4	1603.2	1547.9
Ac	1.128	1.209	1.283	1.351	1.415

Table 4.3-a

The figure 4.3-a presents the various curves obtained with the values of table 4.3-a .

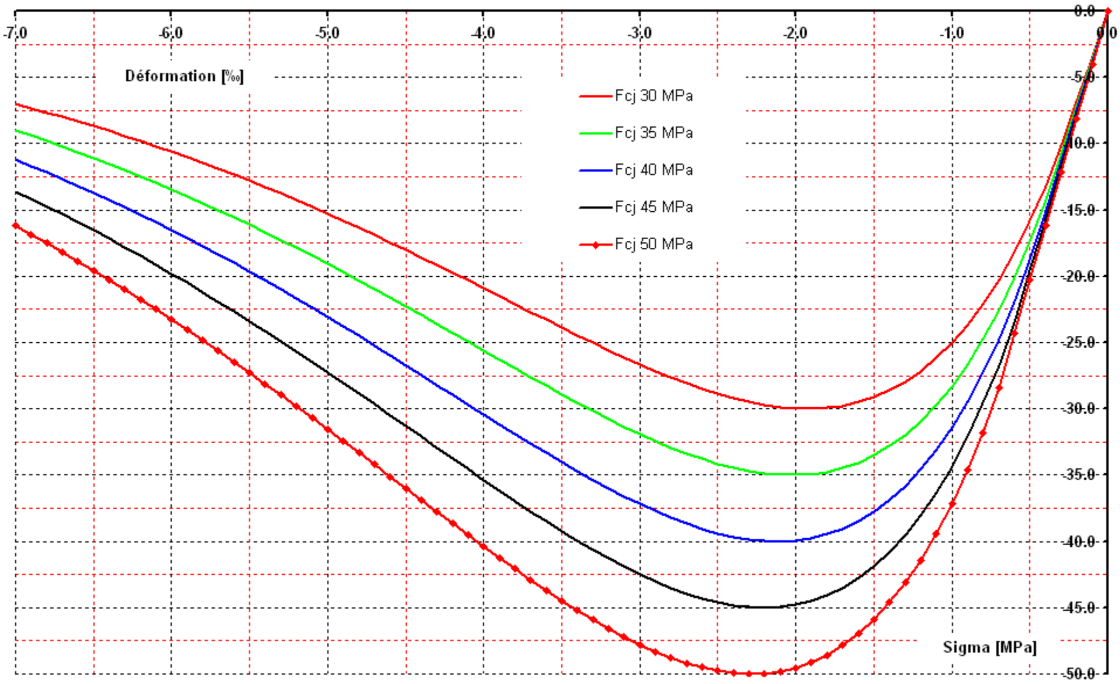

Figure 4.3-a :Model of MAZARS curves .

5 Key key factor ACIER

The model of behavior is elastoplastic with a linear kinematic hardening.

5.1 Operands

the operands factor ELAS of the command DEFI_MATERIAU .

♦ E
Young, elastic slope Modulus of the curve $\sigma = f(\varepsilon)$

♦ SY
Elastic limit.

◊ NU
Poisson's ratio

◊ D_SIGM_EPSI = dsde
Slope of hardening on the curve $\sigma = f(\varepsilon)$. (cf ECRO_LINE).

◊ SIGM_LIM
Stress ultimate.

LIMITING ◊
EPSI_LIM Strain.

5.2 Operation

Two operands are compulsory: E, SY. So operands optional are indicated, they are taken into account by the command and the values will not be modified. It is thus necessary to make sure of the coherence of the provided quantities.

If operands optional are not indicated, the command determines the missing quantities by D are formulas resulting from the code of practice and/or the BAEL 1991.

$\nu = 0.3$ $dsde = E/10000.0$ $\sigma_{ELS} = \sigma_y/1.1$, $\varepsilon_{ELU} = 10.0‰$

5.3 Examples of use

to define a steel with an yield stress of $400.0\,MPa$, the command is used in the following way:

```
ACIER = DEFI_MATER_GC (
   ACIER =_F (E=2.0E+11, SY=400.0E+06,),
)
```

the command prints in the file of message all the values which are used to define the material.

```
== PARAMÈTRES OF MODEL ECRO_LINE ==
PARTIE ELASTICITY:
   E =  2.000E+11, NU =  3.00000000E-01,
LEFT NONLINEAR:
   SY =  4.00000000E+08, EPSI_LIM =  1.00000000E-02,
   D_SIGM_EPSI =  2.00000000E+07, SIGM_LIM =  3.63636364E+08,
FOR INFORMATION:
   EPSI_ELAS =  2.00000000E-03,
```