Realization of the calculation of an assembly pin-attaches

1 Goal

This note concerns, the realization of the grid and of the total calculation of an assembly pin-attaches with *Code_Aster*.

Calculations themselves as well as the macro-orders evoked in this document are available in the command files of cast-test ZZZZ120A and ZZZZ120B.

The production of the grid requires the use of the function MACR_GOUJ2E_MAIL who must be defined at the beginning of the command file. On the other hand, calculation is carried out only with the orders of *Code_Aster*. The macro-order POST_GOUJ the presentation of the results in a format allows which facilitates their reading. Like the function MACR_GOUJ2E_MAIL, this macro-order must be defined at the beginning of the command file. Calculation also requires the use of the database containing the geometrical and mechanical characteristics assemblies.

We give the contents of the base in its version 1.00 of the 9/16/1999 which was produced by the Department MN starting from the old base ("gouj2ech.base_v1_11" version 1.09 of the 6/9/1997) qualified by the UTO, and we briefly point out the manner of feeding this new database.

This base is conceived so that the contribution of new data, characterizing new local situations, can be carried out easily.

2 Introduction

This note concerns, the use of the function macr_gouj2e_mail and of the macro-order POST_GOUJ who allow, respectively, to carry out the grid of an assembly pin-attaches and post-to treat the results of a mechanical calculation carried out with the classical orders of *Code_Aster*. Calculation also requires the use of the database containing the geometrical and mechanical characteristics assemblies.

Initially we describe the function macr_gouj2e_mail and the macro-order POST_GOUJ. The text of these macro-orders as their catalogues are available in the command files of CAS-tests ZZZZ120A and ZZZZ120B.

In the second part we detail the contents of the profile of study and the command file. We continue by specifying the manner of using the function macr_gouj2e_mail, the macro-order POST_GOUJ and the classical orders to carry out the grid and the total calculation of an assembly pin-attaches. To finish, we describe the contents of the file of results (.resu) before quickly approaching the contents of the file of message (.mess).

The last part is devoted to the database of the geometrical and mechanical characteristics of the pins. We follow the curves of behavior of the nets as well as the organization of the various data. We give the contents of the base in its version 1.00 of the 9/16/1999 which was produced by the Department MN. Lastly, we briefly point out the manner of feeding this database.

3 Description of the function macr_gouj2e_mail

3.1 Goal of macr_gouj2e_mail

To create the command files GIBI in units UNITD and UNITP.

3.2 Syntax

```
Macr_gouj2e_mail
 (
    ♦ TYPE      =  / 'M33',                                   [TXM]
                   / 'M64',
                   / 'M90',
                   / 'M115',
                   / 'M155',
                   / 'M180',
                   / 'M186',

    ♦ ALTERNATIVE  =  / 'With',
   [TXM]
                   / 'B',
                    / 'It,
                   / 'Of,
                   / 'E',
                    / 'F',
                   / 'G',
                   / 'H',
                   / 'I',
                   / 'I,
                   / 'K',
                   / 'It,
                    / 'Me,
                   / ',
                   / 'O',
                   / 'P',
                   / 'Q',
                   / 'R',
                   / ',
                   / 'You,
                   / 'U',
                    / 'V',
                   / 'W',
                   / 'X',
                    / 'Y',
                   / 'Z',

    ♦ NB_FILET     =  Nf,                                    [I]
    ♦ H_CORP_BRID  =  H_corps_bride,                         [R]
    ♦ R_EXT_BRID   =  Reb,                                   [R]
    ◊ H_HAUT_BRID  =  / H_haut_bride,                        [R]
                      / 0.0D0,                               [DEFECT]
    ◊ H_BAS_BRID   =  / H_bas_bride,                         [R]
                      / 0.0D0,                               [DEFECT]
    ◊ FILET_ABST   =  Numero_filet,                          [L_I]
```

```
        ♦ UNITD  =  70,                                          [I]

        ♦ UNITP  =  71,                                          [I]
    )
```

3.3 Geometrical definition of the assembly pin-attaches

The assemblies pin-supports which are concerned here are those which maintain the lid of tank or the plate of the inspection pit closed.

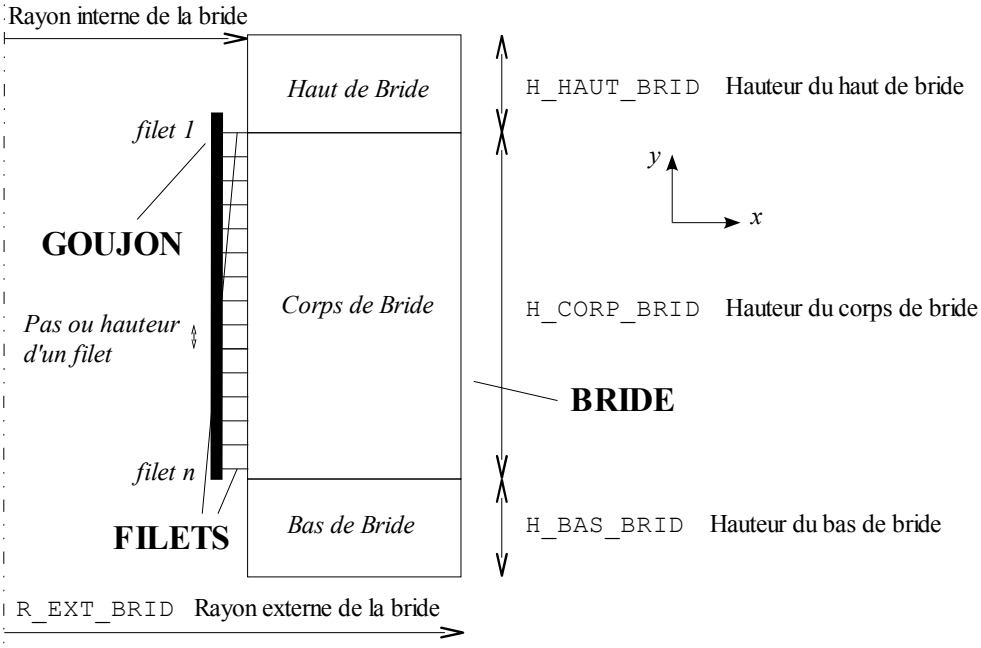


Figure 3.3-a: description of the various geometrical parameters assembly pin-attaches

The ray interns support, the external ray of the pin as well as the step or the height of a net is sizes characteristic of a given assembly. These three last sizes are thus not accessible to the user.

All dimensions (lengths) must be given in **millimetres**. If the user gives values to the heights from the top of support and of the bottom of support, those cannot be lower than a millimetre.

3.4 Operands

3.4.1 Operand TYPE

♦ TYPE = / 'M33', [TXM]
/ 'M64',
/ 'M90',
/ 'M115',
/ 'M155',
/ 'M180',
/ 'M186',

This operand makes it possible to indicate the type of characteristics which one wants to include, for example the type 'M186' corresponds to the pin of lid of tank of the N4 stage.

3.4.2 Operand ALTERNATIVE

♦ ALTERNATIVE = / 'With',
[TXM]
/ 'B',
/ 'It,
/ 'Of,
/ 'E',
/ 'F',
/ 'G',
/ 'H',
/ 'I',
/ 'I,
/ 'K',
/ 'It,
/ 'Me,
/ ',
/ 'O',
/ 'P',
/ 'Q',
/ 'R',
/ ',
/ 'You,
/ 'U',
/ 'V',
/ 'W',
/ 'X',
/ 'Y',
/ 'Z',

This operand makes it possible to specify the alternative in the type of characteristic which one wants to include.

3.4.3 Operand NB_FILET

♦ NB_FILET = Nf [I]

Theoretical full number of nets of an assembly pin-attaches.

3.4.4 Operand H_CORP_BRID

♦ H_CORP_BRID = H_corps_bride [R]

Height of the body of support in millimetres. The body of support is the part of the support which is in catch with the nets.

3.4.5 Operand R_EXT_BRID

♦ R_EXT_BRID = Reb [R]

Value of the ray external of the support in millimetres.

3.4.6 Operand H_HAUT_BRID

◊ H_HAUT_BRID = H_haut_bride [R]

Height from the top of support in millimetres.

3.4.7 Operand H_BAS_BRID

◊ H_BAS_BRID = H_bas_bride [R]

Height of the bottom of support in millimetres.

3.4.8 Operand FILET_ABST

◊ FILET_ABST = Numero_filet [L_I]

This keyword makes it possible to indicate the list of the nets absent, if it is necessary (see [Figure 3.3-a]).

3.4.9 Operand UNITD

♦ UNITD = 70 [I]

Number of the logical unit which contains the parameters user and the beginning of the file containing the instructions of grid (gouj1.datg).

3.4.10 Operand UNITP

♦ UNITP = 71 [I]

Number of the logical unit which contains the instructions of elimination of the possible nets absent and the end of the file containing the instructions of grid (gouj2.datg).

Note:

*Files fort.70 (UNITD = 70) and fort.71 (UNITP = 71) are carried out in a way connected by GIBI by the means of instruction GIBI: "OPTI GIFT '. /fort.71'; " which is at the end of the file gouj1.datg, therefore file fort.70. **Two keywords UNITD and UNITP are well informed at the time of the definition of the function macr_gouj2e_mail**.*

3.5 Example

```
INCLUDE (UNIT = 38,)

TYPE        = 'M155'
ALTERNATIVE    = 'with'
NB_FILET    = 56
H_CORP_BRID = 225.0
R_EXT_BRID  = 140.0
H_HAUT_BRID = 200.0
H_BAS_BRID  = 0.0
FILET_ABST  = (3, 4,)

macr_gouj2e_mail (STANDARD, ALTERNATIVE, NB_FILET, H_CORPS_BRID, R_EXT_BRID,
                  H_HAUT_BRID, H_BAS_BRID, FILET_ABST,)

loc_outils=aster.repout ()

EXEC_LOGICIEL (LOGICIEL=loc_outils+' gibi',
               ARGUMENT= (_F (NOM_PARA=' fort.70'),
                          _F (NOM_PARA=' fort.19')),);

PRE_GIBI ()

MAIL=LIRE_MAILLAGE ()

MAIL=DEFI_GROUP (reuse = E-MAIL,
                 MAILLAGE=MAIL,
                 CREA_GROUP_NO= (_F (NOM=' NDFILETS',
                                     GROUP_MA=' CORPSGOU',
                                     CRIT_NOEUD=' TOUS')),)
```

Note:

The order INCLUDE *allows to include the orders which define all the assemblies pin-attaches. The data necessary to construction of the grid are recovered by the function* macr_gouj2e_mail *starting from the information indicated in the operands:* TYPE *and* ALTERNATIVE *.*
Operands UNITD *and* UNITP *are not well informed during the use of the function* macr_gouj2e_mail because they are it at the time of the definition of the latter.
In the order EXEC_LOGICIEL, 'gibi' *and* 'gibi2000' *correspond to version 2000 of Gibi on the machine Aster (Alpha Serveur).*

4 Description of the macro order POST_GOUJ

4.1 Goal of POST_GOUJ

To carry out the post treatment in a specific format.

To transform a table created by POST_RELEVE_T in a table of a specific format of type table_sdaster. The table of the type table_sdaster contains the parameters 'NUMÉRIQUE_FILET', 'NODES' (number of node corresponding to the number of net), 'NUMÉRIQUE_ORDRE' (corresponding to the increment of load), 'REACTION' (reaction of the nets) and 'REACTION_CUM' (cumulated reaction of the nets in %).

Product a structure of data of the type table_sdaster.

4.2 Syntax

```
ntab   [table_sdaster]  = POST_GOUJ

(

   ♦  TABLE  = tabl_post_rele ,                                    [TXM]

)
```

4.3 Operand

4.3.1 Operand TABLE

♦ TABLE = [TXM]

This operand makes it possible to indicate the name of the table of the type tabl_post_rele that one wants to modify.

4.4 Example

```
TFORC = POST_RELEVE_T (
                         ACTION =_F (
                                     ENTITLE   = 'RESU_T1',
                                     GROUP_NO   = 'NDFILETS',
                                     RESULT   = CALC,
                                     NOM_CHAM   = 'FORC_NODA',
                                     TOUT_ORDRE = 'YES',
                                     NOM_CMP    = 'DY',
                                     OPERATION  = 'EXTRACTION'
                                   )
                       )

NTFORC = POST_GOUJ (
                      TABLE  = TFORC,
                    )

IMPR_TABLE (TABLE    = NTFORC,
             NOM_PARA = ('NUMÉRIQUE_FILET', 'NODES'),
             FILTER   =_F (
                           NOM_PARA  = 'NODES',
                           CRIT_COMP = 'NON_VIDE'
                         ),
             FORMAT   = 'AGRAF'
           )

IMPR_TABLE (TABLE    = NTFORC,
             NOM_PARA = (
                         'NUMÉRIQUE_ORDRE', 'NUMÉRIQUE_FILET',
                         'REACTION', 'REACTION_CUMU'
                        ),
             FILTER   =_F (
                           NOM_PARA  = 'NUMÉRIQUE_ORDRE',
                           CRIT_COMP = 'EQ',
                           VALE_I    = 1
                          ),
             FORMAT   = 'AGRAF'
           )
```

5 Realization of the calculation of an assembly pin-attaches

In this part one indicates the manner of using the function `macr_gouj2e_mail`, the macro-order `POST_GOUJ` and orders of *Code_Aster* to do a total calculation of an assembly pin-attaches. One will start by describing the profile of study (file `.astk`), one will continue by clarifying the contents of the command files (file `.comm`), results (file `.resu`) and of messages (file `.mess`). Contents of the database (unit logical `38` free format) is described in [§6].

5.1 Profile of study

In the profile of study, only two files are obligatory in data: the command file (file `.comm`) and the file containing the database (unit logical `38` free format). The file containing the grid (file `.mail`) is automatically produced and is not visible by the user. Nevertheless, this last can visualize the grid produces by putting as a result the file "Gibi grid, (`mgib`) "corresponding to the logical unit `53`, and by using in the command file the order `IMPR_RESU` as indicated in the paragraph [§ 5.2.2].
The file of results (file `.resu`) allows to exploit the results.

5.2 The command file

The command file (file .comm) **must obligatorily contain the following lines before the order BEGINNING ()** :

```
importation aster
importation bone

#######################################################################
# Generation of the name of the file for L unit logical unit
def name_file (unit):
    to cur_dir = os.getcwd ()
    nomFichier = cur_dir+'/extremely. '+str (unit)
    return nomFichier
#######################################################################

#######################################################################
# creation of the command files GIBI in units UNITD and UNITP
def macr_gouj2e_mail (STANDARD, ALTERNATIVE, NB_FILET, H_CORPS_BRID, R_EXT_BRID,
                      H_HAUT_BRID, H_BAS_BRID, FILET_ABST,
                      UNITD=70, UNITP=71):
   text =          '************************************************************ \
   text = text + '*                                                              \
   text = text + '* CREATION OF the GRID OF PIN, NETS AND ATTACHES 2D AXIS  \
   text = text + '* ------------------------------------------------------------\
   text = text + '*********************************************          \
   text = text + '*                VERSION 1.0                    *          \
   text = text + '*            VERSION OF THE 7/15/1999              *          \
   text = text + '*********************************************          \
   text = text + '*                                                              \
   text = text + 'OPTI NIVE 10;                                                 \
   text = text + 'OPTI ECHO 0  ;                                                \
   text = text + '************************************************************ \
   text = text + '****              PROGRAM  The MAIN THING                  **** \
   text = text + '************************************************************ \
   text = text + '*                                                              \
   text = text + '   OPTION TITHE 2 ELEM QUA4 ECHO 0;                           \
   text = text + '* BEGINNING PARAMETERS USER                                \
   text = text + '*                                                              \
   text = text + '* GENERAL PARAMETERS                                         \
   text = text + '*                                                              \
   text = text + 'RI_BRI       = '+str (eval ('RIB'+TYPE+VARIANTE)) +'; '+'      \
   text = text + 'RE_GOUJ      = '+str (eval ('REG'+TYPE+VARIANTE)) +'; '+'      \
   text = text + 'NOT          = '+str (eval ('HF' +TYPE+VARIANTE)) +'; '+'      \
   text = text + 'RE_BRI       = '+str (R_EXT_BRID) +';                         \
   text = text + 'HTE_BRI      = '+str (H_CORP_BRID) +';                         \
   text = text + 'NFIL         = '+str (NB_FILET   ) + ';                        \
   text = text + 'H_MINFI      = '+str (H_BAS_BRID) +';                         \
   text = text + 'H_HTBRI      = '+str (H_HAUT_BRID) +';                         \
   text = text + '* FINE PARAMETERS USER                                \
   textp = ''
   yew FILET_ABST! =None:
      for num in FILET_ABST:
          textp = textp + 'NETS = DIFF NETS FIL00'+str (num) +';             \
   loc_datg = aster.repdex ()
   textp = textp + """ OPTI GIFT '""" +loc_datg+ """ gouj2.datg';                \
N """
```

```
   text = text + """ OPTI GIFT '""" +loc_datg+ """ gouj1.datg';                \ N
"""

   # Name of the command file for GIBI
   nomFichierDATG = name_file (UNITD)
   nomFichierDATP = name_file (UNITP)

   # Opening of the file D entered of orders gibi
   fdgib=open (nomFichierDATG, 'W')
   fdgip=open (nomFichierDATP, 'W')
   fdgib.write (text)
   fdgip.write (textp)
   fdgib.close ()
   fdgip.close ()

   return
#########################################################################

#########################################################################
# macro orders postprocessing (ex POST_GOUJ2E)
# calculation of the reactions cumulees according to the nets

def POST_GOUJ_ops (coil, TABLE):
  ier=0
  ### One imports the definitions of the orders has to use in the macro one
  CREA_TABLE  =self.get_cmd ('CRÉA_TABLE')

  aa1=TABLE.EXTR_TABLE ()
  aaa=aa1.values ()

  v_DY=aaa ['DY']
  v_NU=aaa ['NUMÉRIQUE_ORDRE']
  NBVAL=len (v_DY)
  nbv=0
  for num in v_NU:
    yew num==v_NU [0]: nbv=nbv+1
  yew nbv>0: ninch=NBVAL/nbv
  else: print "error"

  v_F1= [v_DY [i*nbv: (i+1) *nbv] for I in arranges (ninch)]
  v_FO= []
  v_CU= []
  def add (X, there): return x+y
  for list in v_F1:
    liste.reverse ()
    v_FO.append (list)
    ftot=reduce (add, list)
     v_CU.append ([reduce (add, list [: i+1]) *100. /ftot for I in arranges (len
(list))])

  v_NF= []
  for I in arranges (ninch)    : v_NF=v_NF+range (1, nbv+1)
  v_RE= []
  for list in v_FO: v_RE=v_RE+list
  v_RC= []
  for list in v_CU: v_RC=v_RC+list

  self.DeclareOut ('tab3', self.sd)
  tab3=CRÉA_TABLE (LISTE= (_F (PARA    = 'NUMÉRIQUE_ORDRE',
```

```
                                LISTE_I = v_NU),
                             _F (PARA    = 'NUMÉRIQUE_FILET',
                                 LISTE_I = v_NF),
                            _F (PARA    = 'REACTION',
                                 LISTE_R = v_RE),
                            _F (PARA    = 'REACTION_CUMU',
                                 LISTE_R = v_RC),
                    ))
  return 0

POST_GOUJ=MACRO  (nom=  "  POST_GOUJ",  op=POST_GOUJ_ops,  sd_prod=table_sdaster,
reentrant=', fr= "",
                  TABLE=SIMP (statut=' o', typ=tabl_post_rele),)
########################################################################
```

Note:

The preceding lines are present in the cases tests ZZZZ120A and ZZZZ120B, they will thus have to be recopied at the beginning of all new command file.

Then the command file will have to contain the orders and the whole of orders in the order indicated below:

- BEGINNING ()
- INCLUDE ()
- e-mail = {Together of orders which produce the grid. }
- calc = {Together of orders which carry out calculation. }
- END ()

5.2.1 Detail of the order INCLUDE

The syntax of the order INCLUDE is the following one:

```
INCLUDE (UNIT = 38,)
```

The Logical number of Unit (38) corresponds to the file containing the database, cf [§5.1].

5.2.2 Production of the grid

The function macr_gouj2e_mail, cf [[§3] and the whole of orders described low ensure the production of the grid of an assembly pin-attaches such as that which is presented on [Figure 3.3 - has]. **Except the order IMPR_RESU, They all are necessary.**

- the function macr_gouj2e_mail ;
- The line loc_outils=aster.repout () ;
- the order EXEC_LOGICIEL ;
- the order PRE_GIBI ;
- the order MAIL=LIRE_MAILLAGE ;
- the order MAIL=DEFI_GROUP ;
- the optional order IMPR_RESU.

The order EXEC_LOGICIEL launch the Gibi software which generates the file of grid to the format Gibi (file .mgib) starting from the data files Gibi (file .datg) to which the user does not have access.

The function macr_gouj2e_mail in the database the ray is used to recover interns support, the external ray of the pin and the step of the nets of the pin characterized by its type and its alternative, cf [§3]. Moreover this function prepares the data files Gibi (.datg). The geometrical characteristics of the support and the nets are specified by the means of the operands H_CORP_BRID (Height of the Body of Support, part of the support in catch with the nets) and R_EXT_BRID (Ray External of the Support) which is obligatory. Operands H_HAUT_BRID (Height from the top of Support) and H_BAS_BRID (Height of Bas de Bride) are optional, they are worth zero by default. All dimensions must be given in **millimetres**. If the user gives values to the heights from the top of support and of the bottom of support, those cannot be lower than 1 millimetre. The ray interns support, the external ray of the pin as well as the step or the height of a net is sizes characteristic of a given assembly which are stored in the base; they are not, consequently, to inform by the user.
One indicates the full number and theoretical of nets with the obligatory simple keyword NB_FILET. So some of the nets are absent or missing, the simple keyword FILET_ABST allows to indicate the list of it. The nets absent are not with a grid.

Notice 5.2.2-1:

The name of the concept grid (here e-mail) must be different from the names of concepts defined in the database, which one presents the list in [Table 5.2.2-1]. In [Table 5.2.2-1], prefixes SGM , REGM , etc are reserved for concepts of the database (which can be enriched later), the symbol " xx " can be equal to 33 , 64 , 90 , 115 , 155 , 180 or 186 . The symbol " there " can be equal to the one of the twenty-six letters of the alphabet.

Name concept	Definition
SGMxxy	section of the pin
REGMxxy	ray external of the pin
HFMxxy	height or not of the net
RIBMxxy	interior ray of the support
CFMxxy	configuration net
HBMxxy	high of support
COMxxy	mechanical behavior
MABMxxy	name of material of the support
MAGMxxy	name of material of the pin
PFMxxy	behavior of the first net (diagram traction)
DFMxxy	behavior of the second net (diagram traction)
FCMxxy	behavior of the current nets (diagram traction)
MGMxxy	definition of material of the pin (E and NAKED)
MBMxxy	definition of material of the support (E and NAKED)
FTMxxy	behavior of a truncated net (diagram traction)
FTAMxxy	behavior of a truncated net of type A (diagram traction)
FTBMxxy	behavior of a truncated net of type B (diagram traction)
JHTMxxy	behavior of a net whose game is except tolerance (diagram traction)
HTAMxxy	behavior of a net whose game is except tolerance of the type A (diagram traction)
HTBMxxy	behavior of a net whose game is except tolerance of the type B (diagram traction)

Table 5.2.2-1: List of the names of concepts which are prohibited to the user

Below we indicate a typical example of command file allowing to produce the grid of an assembly pin-attaches.

```
# user datum
# it is necessary to satisfy the constraints:
#
# height of support lower than the number of nets by the step:
# NB_FILET * HFM155A < H_CORP_BRID
#
# interior ray of support lower than the external ray:
# RIBM155A < R_EXT_BRID
#
# ray external of the pin lower than the interior ray of support:
# REGM155A < RIBM155A
#
TYPE         = 'M155'
ALTERNATIVE     = 'with'
NB_FILET     =  56
H_CORP_BRID  = 225.0
R_EXT_BRID   = 140.0
H_HAUT_BRID  = 200.0
H_BAS_BRID   =   0.0
FILET_ABST   = (3.4,)
```

```
macr_gouj2e_mail (STANDARD, ALTERNATIVE, NB_FILET, H_CORPS_BRID, R_EXT_BRID,
                  H_HAUT_BRID, H_BAS_BRID, FILET_ABST,)

loc_outils=aster.repout ()

EXEC_LOGICIEL (LOGICIEL=loc_outils+' gibi',
               ARGUMENT= (_F (NOM_PARA=' fort.70'),
                          _F (NOM_PARA=' fort.19')),);

PRE_GIBI ()

MAIL=LIRE_MAILLAGE ()

MAIL=DEFI_GROUP (reuse = E-MAIL,
                 MAILLAGE=MAIL,
                 CREA_GROUP_NO= (_F (NOM=' NDFILETS',
                                     GROUP_MA=' CORPSGOU',
                                     CRIT_NOEUD=' TOUS')),)
```

Lastly, all the entities of the grid which can be affected of a particular behavior or a loading are named:

```
  THE PILE NUMBER   1 CONTAINS      73 OBJECT (S) GRID
  IT THERE WITH       66  OBJECT (S) NAMES (S):
  CORPSGOU    5  HAUTGOUJ    6  PIN      7  FIL001      8  NETS      9
  FIL002     10  FIL005     11  FIL006     12  FIL007     13  FIL008     14
  FIL009     15  FIL010     16  FIL011     17  FIL012     18  FIL013     19
  FIL014     20  FIL015     21  FIL016     22  FIL017     23  FIL018     24
  FIL019     25  FIL020     26  FIL021     27  FIL022     28  FIL023     29
  FIL024     30  FIL025     31  FIL026     32  FIL027     33  FIL028     34
  FIL029     35  FIL030     36  FIL031     37  FIL032     38  FIL033     39
  FIL034     40  FIL035     41  FIL036     42  FIL037     43  FIL038     44
  FIL039     45  FIL040     46  FIL041     47  FIL042     48  FIL043     49
  FIL044     50  FIL045     51  FIL046     52  FIL047     53  FIL048     54
  FIL049     55  FIL050     56  FIL051     57  FIL052     58  FIL053     59
  FIL054     60  FIL055     61  FIL056     62  BASGBRID   63  GBRIDE     64
  ATTACH      65  HBRIDE     68  BBRIDE     69  DBRIDE     70  E-MAIL        1
  SHBRI      71

  THE PILE NUMBER  32 CONTAINS    2453 OBJECT (S) NOT
  IT THERE WITH        8  OBJECT (S) NAMES (S):
  PBFIL    2397  PHFIL    2452  PHGOUJ   2453  PBGBRID   262  PBGFBRID  361
  PHGFBRID  636  PCFIL    2397  PCBRID    361
```

5.2.3 Realization of calculation

Before writing the part "calculation" of the command file, it is advised to consult the database in order to know the types of nets, the materials and the diagrams traction which is associated with a kind of assembly pin-attaches given.

The realization of calculation requires the sequence of the orders of *Code_Aster* following:

- the order DEFI_GROUP who enriches the grid by creating groups by nodes;
- the order AFFE_MODELE who assigns the mechanical phenomena to the various groups of meshs;
- the order AFFE_CARA_ELEM who allows to define the section of the beam which models the pin and the characteristics of discrete which model the nets;
- the order DEFI_MATERIAU who allows to define materials of the nets of the pin;
- the order AFFE_MATERIAU who affects materials defined in the groups of adequate meshs;
- the order AFFE_CHAR_MECA who affects the boundary conditions and the loading;

- the order DEFI_FONCTION who defines the multiplying function to apply to the loading;
- the order DEFI_LIST_REEL who defines the list of moments;
- the order STAT_NON_LINE who carries out calculation;
- the order CALC_CHAMP who calculates the nodal forces;
- the order POST_RELEVE_T who recovers the relevant results;
- the macro-order POST_GOUJ who reorganizes the results in the adapted format;
- the order IMPR_TABLE who allows to print the results.

Concretely that results in the following orders:

```
MAIL=DEFI_GROUP (reuse =MAIL,
                 MAILLAGE=MAIL,
                 CREA_GROUP_NO= (_F (GROUP_MA=' GOUJON',
                                     NOM=' GOUJ_NO',
                                     CRIT_NOEUD=' TOUS',),
                                  _F (GROUP_MA=' FILETS',
                                     NOM=' FILET_NO',
                                     CRIT_NOEUD=' TOUS',),
                                  _F (GROUP_MA=' BRIDE',
                                     NOM=' BRIDE_NO',
                                     CRIT_NOEUD=' TOUS',),),);

modele=AFFE_MODELE (MAILLAGE=MAIL,
                    AFFE= (_F (GROUP_MA=' GOUJON',
                               PHENOMENE=' MECANIQUE',
                               MODELISATION=' POU_D_E',),
                           _F (GROUP_MA=' FILETS',
                               PHENOMENE=' MECANIQUE',
                               MODELISATION=' 2D_DIS_T',),
                           _F (GROUP_MA=' BRIDE',
                               PHENOMENE=' MECANIQUE',
                               MODELISATION=' AXIS',),),);
```

REGM155A is the ray external of the pin of the type M155 alternative With.

```
carael=AFFE_CARA_ELEM (MODELE=modele,
                       POUTRE=_F (GROUP_MA=' GOUJON',
                                  SECTION=' CERCLE',
                                  CARA=' R',
                                  VALE=REGM155A,),
                       DISCRET_2D=_F (GROUP_MA=' FILETS',
                                      CARA=' K_T_D_L',
                                      VALE= (10000000.0, 10000000.0,),),);
```

One can apply to the ordinary nets three behaviors, to see it [Table 5.2.2-1]:

- behavior of the first net (diagram traction);
- behavior of the second net (diagram traction);
- behavior of the current nets (diagram traction).

One can apply to the nets six particular behaviors, to see it [Table 5.2.2-1]:

[1] behavior of a truncated current net, (traction diagram), cf [§6.1] Notices 6.1-1;
[2] behavior of a truncated net of type A, (traction diagram);
[3] behavior of a truncated net of type B, (traction diagram);
[4] behavior of a current net whose game is except tolerance, (traction diagram);
[5] behavior of the first net whose game is except tolerance of the type A (diagram traction);
[6] behavior of the second net whose game is except tolerance of the type B (diagram traction).

The user will have to check in the database, that the behaviors which it intends to use are well defined, cf [§6].

For example, for the M155 assembly there are no traction diagrams for truncated nets or having a game except tolerance, contrary to the M90 assembly.

PFM155A is the traction diagram of the First net of the pin of the type M155 alternative With.
```
MF_1=DEFI_MATERIAU (TRACTION=_F (SIGM=PFM155A,),);
```

DFM155A is the traction diagram of the Second net of the pin of the type M155 alternative With.
```
MF_2=DEFI_MATERIAU (TRACTION=_F (SIGM=DFM155A,),);
```

FCM155A is the traction diagram of the current nets (other nets) of the pin of the type M155 alternative With.
```
MF_C=DEFI_MATERIAU (TRACTION=_F (SIGM=FCM155A,),);
```

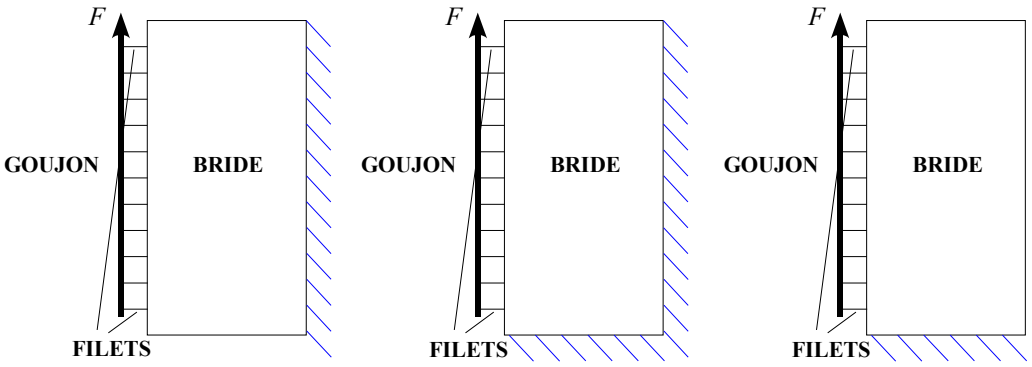
One assigns in the last particular materials to the nets which have a particular behavior.

```
chmat=AFFE_MATERIAU (MAILLAGE=MAIL,
                     AFFE= (_F (GROUP_MA=' GOUJON',
                                MATER=MGM155A,),
                            _F (GROUP_MA=' FILETS',
                                MATER=MF_C,),
                            _F (GROUP_MA=' BRIDE',
                                MATER=MBM155A,),
                            _F (GROUP_MA=' FIL001',
                                MATER=MF_1,),
                            _F (GROUP_MA=' FIL002',
                                MATER=MF_2,),),);
```

There are three types of boundary conditions on the support:

- dimensioned side there following outside of the support blocked;
- dimensioned side outside and support bases blocked following there;
- base support blocked according to Y.

One also specifies the value, in **Newton**, force of traction applied at the top of the pin.



Conditions aux limites 1 *Conditions aux limites 2* *Conditions aux limites 3*

```
charme=AFFE_CHAR_MECA (MODELE=modele,
                       DDL_IMPO=_F (GROUP_NO= ('GOUJ_NO', 'FILET_NO',
'BRIDE_NO',),
                                    DX=0.0,),
                       FACE_IMPO= (_F (GROUP_MA= ('DBRIDE', 'BBRIDE',),
                                       DY=0.0,),
                                   _F (GROUP_MA=' GOUJON',
                                       DZ=0.0,
                                       DRY=0.0,),),
```

```
                FORCE_NODALE=_F (GROUP_NO=' PHGOUJ',
                                FY=1.0,),);
```

FORCE_NODALE will be multiplied by the following function during calculation (order STAT_NON_LINE, keyword EXCIT):

```
fonc=DEFI_FONCTION (NOM_PARA=' INST',
                    NOM_RESU=' TOUTRESU',
                    VALE= (0.0, 0.0, 5.0, 5000000.0,),);
```

The order DEFI_LIST_REEL is used to define the list of moments necessary to incremental calculation (order STAT_NON_LINE, keyword BEHAVIOR).

```
liste=DEFI_LISTE_REEL (DEBUT=0.0,
                       INTERVALLE= (_F (JUSQU_A=1.0,
                                        NOMBRE=1,),
                                    _F (JUSQU_A=2.0,
                                        NOMBRE=1,),
                                    _F (JUSQU_A=3.0,
                                        NOMBRE=1,),
                                    _F (JUSQU_A=4.0,
                                        NOMBRE=1,),
                                    _F (JUSQU_A=5.0,
                                        NOMBRE=1,),),);
```

Two types of calculation can be selected:

- **ELASTOPLASTIC**, one uses **the behavior of the nets** given in the form of traction diagram in the base, one uses the incremental behavior then:

```
                                _F (RELATION=' DIS_GOUJ2E_ PLAS ',
                                    DEFORMATION=' PETIT',
                                    GROUP_MA=' FILETS',),),
```

- **RUBBER BAND**, that amounts plotting a straight line with the origin and the first point of the traction diagram **nets**, which makes it possible to do a linear elastic design, the incremental behavior is used:

```
                                _F (RELATION=' DIS_GOUJ2E_ ELAS ',
                                    DEFORMATION=' PETIT',
                                    GROUP_MA=' FILETS',),),
```

In the example below we carry out a calculation **ELASTOPLASTIC**.

```
CALC=STAT_NON_LINE (MODELE=modele,
                    CHAM_MATER=chmat,
                    CARA_ELEM=carael,
                    EXCIT=_F (CHARGE=charme,
                              FONC_MULT=fonc,
                              TYPE_CHARGE=' FIXE_CSTE',),
                    COMPORTEMENT= (_F (RELATION=' ELAS',
                                       DEFORMATION=' PETIT',
                                       GROUP_MA=' GOUJON',),
                                   _F (RELATION=' ELAS',
                                       DEFORMATION=' PETIT',
                                       GROUP_MA=' BRIDE',),
                                   _F (RELATION=' DIS_GOUJ2E_PLAS',
                                       DEFORMATION=' PETIT',
                                       GROUP_MA=' FILETS',),),
                    INCREMENT=_F (LIST_INST=liste,),
                    NEWTON=_F (REAC_ITER=3,),
                    CONVERGENCE=_F (ITER_GLOB_MAXI=20,),);
```

The order CALC_CHAMP calculate the nodal forces exerted on the nets.

```
CALC=CALC_CHAMP (reuse =CALC,
             RESULTAT=CALC,
             PRECISION=0.001,
             CRITERE=' RELATIF',
             FORCE=' FORC_NODA',
             GROUP_MA=' FILETS',);
```

The keyword factor IMPRESSION is used to choose the format of presentation of the results.

```
tab1=POST_RELEVE_T (ACTION=_F (INTITULE=' RESU_T1',
                               GROUP_NO=' NDFILETS',
                               FORMAT_C=' MODULE',
                               RESULTAT=CALC,
                               NOM_CHAM=' FORC_NODA',
                               TOUT_ORDRE=' OUI',
                               PRECISION=1e-06,
                               CRITERE=' RELATIF',
                               NOM_CMP=' DY',
                               REPERE=' GLOBAL',
                               MOYE_NOEUD=' OUI',
                               OPERATION=' EXTRACTION',),);
```

In addition to the classical formats of impression of *Code_Aster* there exists the format TABLE specific to the total calculation of an assembly pin-attaches, cf [§3.3].

```
tab2=POST_GOUJ (TABLE=tab1,);

IMPR_TABLE (
         TABLE=tab2,
         UNITE=8,
         FORMAT=' AGRAF',
         FILTRE=_F (NOM_PARA=' NUMÉRIQUE_ORDRE',
                    VALE_I=1,),
              NOM_PARA=  ('NUMÉRIQUE_ORDRE',  'NUMÉRIQUE_FILET',  'REACTION',
'REACTION_CUMU',),);
```

Notice 5.2.3-1:

Cf Notices 5.2.2-1.

5.3 The file of results

In this part one presents only the format TABLE dedicated to the total calculation of an assembly pin - attaches. In this last case the results are presented in two parts. The first gives the correspondence number of net-number of node. The second part is organized in the shape of a table having four columns. First is relating to the sequence number or of increment, the second indicates the number of the nets, the third the reaction in **Newton** nets and the fourth cumulated reaction of the nets expressed in **%**. The format TABLE simply allows to plot the curves: reaction of the nets according to their number and cumulated reaction of the nets according to their number, using the software of layout of curves xmgrace.
An outline of the format below is given TABLE.

Part giving the correspondence number of net-number of node:

```
NUME_FILET    NODES
            1 \ N1954
            2 \ N1953
            3 \ N1952
```

```
 4 \ N1951
 5 \ N1950
.     .
.     .
.     .
.     .
.     .
52 \ N1903
53 \ N1902
54 \ N1901
55 \ N1900
56 \ N1899
```

Part giving the sequence number, the number of net, the reaction (in NR) and the cumulated reaction (in % of the total), example for the sequence number five:

NUME_ORDRE	NUME_FILET	REACTION	REACTION_CUMU
5	1	3.75966E+05	7.51932E+00
5	2	3.63799E+05	1.47953E+01
5	3	0.00000E+00	1.47953E+01
5	4	0.00000E+00	1.47953E+01
5	5	3.09596E+05	2.09872E+01
5	6	2.84261E+05	2.66724E+01
	.		
	.		
	.		
5	52	3.35943E+04	9.66590E+01
5	53	3.59525E+04	9.73780E+01
5	54	3.90373E+04	9.81588E+01
5	55	4.31747E+04	9.90223E+01
5	56	4.88871E+04	1.00000E+02

Notice 5.3-1:

The sequence number corresponds to the increment of load.

5.4 The file of messages

This file contains the whole of the orders *Code_Aster*, database and the whole of the orders produced by the macro-orders. We do not give here an outline of the file of messages (`.mess`), the eager reader of more than details will be able to consult the files of messages of the cases tests ZZZZ120A and ZZZZ120B.

6 Presentation and use of the database

6.1 General information

A threaded assembly leads to a modeling beam for the pin (element of beam) and 2D for the nets (discrete elements with two nodes) and attaches it (axisymmetric elements 2D). The three elements of an assembly are schematized on [Figure 6.1-a].

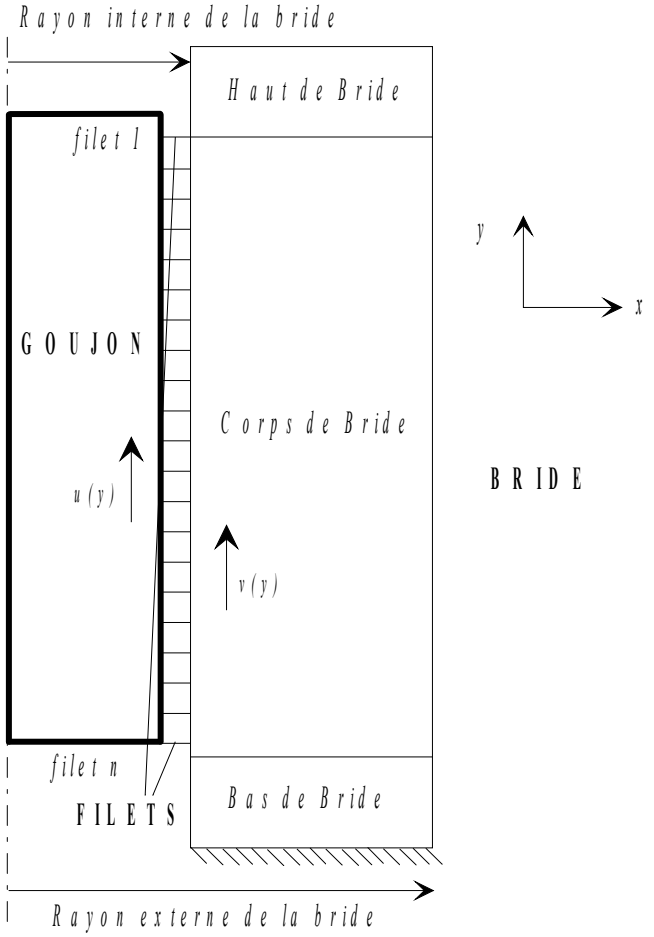


Figure 6.1-a: Schematized representation of an assembly

The pin and the support have a linear elastic behavior. The nonlinear behavior is localised in the nets. It applies to the discrete elements and is given in an independent way by a local calculation 2D axisymmetric whose one exploited the results. This behavior appears in the form of a relation, indexed by the position of the net in the structure, between a difference in displacement $(u-v)$ and shearing forces it $\tau=q=f(u-v)$ who is associated for him. Knowing the behavior of the elements constituting an assembly, the total problem is solved of which displacements of the pin $u(y)$ and of the support $v(y)$ are solutions.

These are the various relations which are described, in the form of functions given point by point, in the base presented in this note. These curves were obtained for **the tractions exerted at the top of the pin and not of compressions**.

Within the framework of the summary above, certain parameters characteristic of a given assembly intervene only during the integration of the total problem.

It is the case, for example, amongst nets, of the total effort exerted at the top of the pin, the conditions of blocking of the support (side surface and/or bases blocked (S)). These parameters thus do not appear in the specifications of a curve characteristic of a net.
The parameters which, on the other hand, determine the behavior of the nets are listed below:

- Designation of the standardized form of the geometry of the pin, example: M33, M155 ;
- Type of the assembly pin-attaches, example: NOMINAL or HELICOIL ;
- Stiffener top of support, example: WITH or WITHOUT ;
- Geometrical characteristics of game, example: MINIS or MAXIMUM ;
- Behavior of the nets and condition of contact pin/tapping, example: RUBBER BAND (linear rubber band) or ELASTOPLASTIC nonlinear traction diagram).

Each combination of these various parameters thus leads a priori to a specific relation shearing-jump of displacement. One locates each one of these combinations by a letter, for example: for the standardized form of the geometry of the pin M33, if the assembly pin-attaches is NOMINAL, the stiffener top of support present (WITH), game MAXIMUM and the behavior of the nets ELASTOPLASTIC one will speak about the pin M33 of alternative With, noted: M33_A, cf [Table 6.2-3] association forms standardized geometry of the pin (M33) and alternative (With) identify in a single way the card of an assembly gathering the whole of the data relating to it (geometry of the assembly, characteristic of the assembly, curved of behavior of the files $\tau = q = f(u - v)$ ts, definition of materials of the support and the pin) in the base, cf [Table 6.3-1] and [Table 6.3-2].

Remarks 6.1-1:

- *All configurations other than those with thread inserts (HELICOIL), cf [bib3], [bib4], were calculated in plasticity. If it is wanted nevertheless that the nets have a linear elastic behavior it will be necessary to use* RELATION=' DIS_GOUJ2E_ELAS' *keyword* BEHAVIOR *order* STAT_NON_LINE*, cf [§ 5.2.3].*
- *The curves representative of anomalies are also specific place of the nets carrying these anomalies,* With *and* B *respectively locating in the card of an assembly that of the first and second net.*
- ***The user will have to ensure himself** that the types of behavior of the nets which it chose correspond or not to a configuration calculated in the base.*

6.2 Presentation of the curves introduced into the database

One presents, here version 1.0 of the database at the date of the 9/16/1999.
The complete base can be obtained from EDF/BPI/UTO.
[Table 6.2-1] gathers the geometries available with their characteristics of assembly.

Geometry	Section of the pin (in mm ^{2})	Ray external of the pin (in mm)	Thickness of the net (in mm)	Interior ray of the support (in mm)
M33	6.45E+02	14.3286E+00	3.5	16.5
M64	2.715E+03	29.3975E+00	6.0	34.0
M90	5.845E+03	43.1338E+00	3.0	45.0
M115	9.724E+03	55.6349E+00	3.0	57.5
M155	1.704E+04	73.6478E+00	4.0	80.0
M180	2.337E+04	86.2491E+00	4.0	90.0
M186	2.487E+04	88.9740E+00	6.0	93.0

Table 6.2-1: List of the geometries of assemblies threaded available in the database

[Table 6.2-2] presents materials available as well for the support as the pin. Some of these materials are not used that for the support or that for the pin, cf [Table 6.2-3].

Material	YOUNG modulus for the pin (in MPa)	YOUNG modulus for the support (in MPa)	Poisson's ratio
16MND5	1.90000E+05	11.93800E+05	0.3
40NCDV	1.91139E+05	12.00962E+05	0.3
Z3CN_20_09_M (300_C)	1.76500E+05	11.08982E+05	0.3
40NCD (300_C)	1.85000E+05	11.62389E+05	0.3
20MND5 (316_C)	1.95000E+05	12.25200E+05	0.3
42CDV4 (316_p3)	1.90220E+05	11.95188E+05	0.3
16MND5 (343_C)	1.90000E+05	11.93800E+05	0.3
40NCDV (343_C)	1.90000E+05	11.93800E+05	0.3

Table 6.2-2: List of materials available in the database.

In [Table 6.2-3] the list of the configurations of assemblies threaded in the database of the nets was gathered.

Notice 6.2-1:

The Young modulus of the support is multiplied by 2π because it is treated in 2D axisymmetric, whereas the pin is in beam.

Type of pin and Alternative	WITH or WITHOUT high of attach	Game MINIS MAXIMUM	Configured tion of the net	Material attach	Material pin	Behavior
M33_A	WITH	MAXIMUM	NOMINAL	20MND5 (316_C)	42CDV4 (316_p3)	ELASTOPLASTIC
M33_B	WITHOUT	MAXIMUM	NOMINAL	20MND5 (316_C)	42CDV4 (316_p3)	ELASTOPLASTIC
M33_C	WITH	MINIS	NOMINAL	20MND5 (316_C)	42CDV4 (316_p3)	ELASTOPLASTIC
M33_D	WITHOUT	MINIS	NOMINAL	20MND5 (316_C)	42CDV4 (316_p3)	ELASTOPLASTIC
M33_E	WITH	MAXIMUM	NOMINAL	20MND5 (316_C)	42CDV4 (316_p3)	ELASTOPLASTIC
M64_A	WITH	MAXIMUM	NOMINAL	16MND5	40NCDV	ELASTOPLASTIC
M90_A	WITH	MAXIMUM	NOMINAL	Z3CN_20_ 09_M (300_C)	40NCD (300_C)	ELASTOPLASTIC
M90_B	WITH	MINIS	NOMINAL	Z3CN_20_09_M (300_C)	40NCD (300_C)	ELASTOPLASTIC
M115_A	WITH	MAXIMUM	NOMINAL	Z3CN_20_ 09_M (300_C)	40NCD (300_C)	ELASTOPLASTIC
M115_B	WITHOUT	MAXIMUM	NOMINAL	Z3CN_20_09_M (300_C)	40NCD (300_C)	ELASTOPLASTIC
M115_C	WITHOUT	MINIS	NOMINAL	Z3CN_20_ 09_M (300_C)	40NCD (300_C)	ELASTOPLASTIC
M115_D	WITH	MAXIMUM	NOMINAL	Z3CN_20_09_M (300_C)	40NCD (300_C)	ELASTOPLASTIC
M115_E	WITH	MAXIMUM	NOMINAL	Z3CN_20_ 09_M (300_C)	40NCD (300_C)	ELASTOPLASTIC
M155_A	WITH	MAXIMUM	NOMINAL	16MND5	40NCDV	ELASTOPLASTIC
M155_B	WITHOUT	MAXIMUM	NOMINAL	16MND5	40NCDV	ELASTOPLASTIC
M155_C	WITH	MINIS	NOMINAL	16MND5	40NCDV	ELASTOPLASTIC
M155_D	WITHOUT	MAXIMUM	HELICOIL	16MND5	40NCDV	ELASTOPLASTIC
M180_A	WITH	MAXIMUM	NOMINAL	16MND5	40NCDV	ELASTOPLASTIC
M180_B	WITHOUT	MAXIMUM	NOMINAL	16MND5	40NCDV	ELASTOPLASTIC
M180_C	WITH	MINIS	NOMINAL	16MND5	40NCDV	ELASTOPLASTIC
M186_A	WITH	MAXIMUM	NOMINAL	16MND5 (343_C)	40NCDV (343_C)	ELASTOPLASTIC
M186_B	WITH	MINIS	NOMINAL	16MND5 (343_C)	40NCDV (343_C)	ELASTOPLASTIC

Table 6.2-3: List of the configurations of assemblies threaded available in the database version 1.00 of the 9/16/1999

The curves of behavior (force of shearing - game) which are in the database are form presented in [Table 6.2-4]. Sizes $u-v$ and q are respectively expressed in mm and Newton.

$u-v$	q
1.4454D-03	5960.40
7.8791D-03	32289.00
1.4830D-02	57528.00
2.4101D-02	75876.00
3.1714D-02	82719.00
3.9722D-02	88368.00
4.7951D-02	93345.00
5.6338D-02	97836.00
6.4836D-02	102012.00
10.8080D-02	120678.00
15.1800D-02	136881.00
19.5490D-02	151413.00
23.8870D-02	164658.00
28.1710D-02	176835.00
32.3800D-02	188022.00
36.4850D-02	198210.00
40.4850D-02	207417.00

Table 6.2-4: Pin M115 alternative A

6.3 Presentation of the database

The database is the object of a specific data processing; certain rules are essential to observe in order to supplement it in a rigorous way.

The file of the base is divided into three parts: the references dates and version, the framework makes dizzy, the cards of the assemblies. These three parts are taken again and detailed below:

- The first line contains the date and the number of version of the base. This line is regarded as being a comment.
- The framework of the heading makes it possible to note the successive evolutions of the base: author (S), date version and object.
- The third part contains the cards of the assemblies. Those are in the following way made up:
  - ha s **The type of the pin as well as the alternative**.
  - B **Geometry of the assembly**, left in which one finds: the section of the pin, the ray external of the pin, the height or the step of the net and the interior ray of the support.
  - C **Characteristics of the assembly**, one finds there: the configuration net, the characteristic high of support, the type of game, the mechanical behavior, the material attaches and the material pin.
  - D **Curves describing the behavior of the nets** (FIRST NET, SECOND NET, CURRENT NET, …).
  - E **Materials of the support and the pin** : the Young modulus and the Poisson's ratio.

Each data is located by one **single name**, for example for the pin of the type M33 and of alternative With one a:

Name	Definition
SGM33A	section of the pin
REGM33A	ray external of the pin
HFM33A	height or not of the net
RIBM33A	interior ray of the support
CFM33A	configuration net
HBM33A	high of support
COM33A	mechanical behavior
MABM33A	name of material of the support
MAGM33A	name of material of the pin
PFM33A	behavior of the first net
DFM33A	behavior of the second net
FCM33A	behavior of the current nets
MGM33A	definition of material of the pin (E and NAKED)
MBM33A	definition of material of the support (E and NAKED)

Table 6.3-1: Definitions of the names

Each name must have with more the eight alphanumerics.
In addition, there exists for certain types of pin of the particular nets, for example for the pin of the type M180 and of alternative With :

Name	Definition
FTM180A	behavior of a truncated net
FTAM180A	behavior of a truncated net of type A
FTBM180A	behavior of a truncated net of type B
JHTM180A	behavior of a net whose game is except tolerance
HTAM180A	behavior of a net whose game is except tolerance of the type A
HTBM180A	behavior of a net whose game is except tolerance of the type B

Table 6.3-2: Definitions of the names of the particular nets

6.4 Food of the database in curves of behavior of the nets

A local calculation is necessary each time a new combination of parameters must be studied. These calculations are carried out by finite elements, and it is a specific postprocessing which provides to each step of load, the difference $u-v$ and the value of the axial load τ corresponding. That was described in former publications [bib4], [bib5] and [bib6]. The evolution of the database is on the initiative of the U.T.O.

6.5 Version 1.00 of the database

Hereafter an extract of the database concerning the behaviour of the threaded assemblies is presented in its version 1.00 the 9/16/1999:

```
# DATES: 9/16/1999   VERSION: 1.00
#
# MODIFICATION
#       AUTHOR  : J. ANGLES
#       DATE    : 9/16/1999
#       VERSION: 1.00
#       OBJECT   : CUTTING TO SIZE ASTER
#                  OLD DATABASE
#
#-------------------------------------------------------
#                 M33_REF_A.NOMI                        |
#-------------------------------------------------------
# DEPARTMENT: EPN
# DATES: 11/15/1995
#-------------------------------------------------------
#           GEOMETRY OF THE ASSEMBLY                   |
#-------------------------------------------------------
#-------------------------------------------------------
# SECTION OF THE PIN (IN MM)
#
SGM33A = 6.45E+02

#
# RAY EXTERNAL OF THE PIN (IN MM)
#
REGM33A = 14.328638337E+00

#
# HEIGHT OR NOT OF THE NET (IN MM)
#
HFM33A = 3.5

#
# INTERIOR RAY OF THE SUPPORT (IN MM)
#
RIBM33A = 16.5

#-------------------------------------------------------
#        CHARACTERISTICS OF THE ASSEMBLY               |
#-------------------------------------------------------
#-------------------------------------------------------
# CONFIGURATION NET
#
CFM33A = 'NOMINAL'

#
# HIGH OF SUPPORT
#
HBM33A = 'WITH'

#
# GAME
#
JEM33A = 'MAXIMUM'

#
# BEHAVIOR
#
COM33A = 'ELASTOPLASTIC'
```

```
#
# MATERIAL ATTACHES
#
MABM33A = '20MND5-316_C'
```

```
#
# MATERIAL PIN
#
MAGM33A = '42CDV4-316_P3'

#
#------------------------------------------------------
#     DATA OF CURVES OF AN ASSEMBLY  Q=F (UV)     |
#           OR UV IS IN MM AND Q IN NEWTON           |
#------------------------------------------------------
#------------------------------------------------------
# FIRST NET   CURVE OF 17 POINTS
PFM33A=DEFI_FONCTION (
                    NOM_PARA=' EPSI',
                 PROL_DROITE=' LINEAIRE',
                 PROL_GAUCHE=' EXCLU',
                        VALE= (
                              1.3213E-02,    24288.25,
                              2.3137E-02,    42441.00,
                              3.3313E-02,    59633.00,
                              4.3544E-02,    69713.00,
                              5.8073E-02,    77787.50,
                              9.8094E-02,    85445.50,
                             14.1580E-02,    90562.50,
                             18.6320E-02,    94640.00,
                             27.7720E-02,   101346.00,
                             46.3750E-02,   112297.50,
                             65.1530E-02,   121698.50,
                             83.9720E-02,   130354.00,
                            103.8600E-02,   138873.00,
                            118.9700E-02,   144711.00,
                            145.2500E-02,   152999.00,
                            174.0400E-02,   160786.50,
                            204.2200E-02,   168563.50,
                              )
                    )

#
# SECOND NET   CURVE OF 17 POINTS
DFM33A=DEFI_FONCTION (
                    NOM_PARA=' EPSI',
                 PROL_DROITE=' LINEAIRE',
                 PROL_GAUCHE=' EXCLU',
                        VALE= (
                              1.1883E-02,    20395.20,
                              2.0810E-02,    35716.71,
                              2.9999E-02,    51450.00,
                              3.9536E-02,    66048.50,
                              5.3593E-02,    75936.00,
                              9.3111E-02,    84672.00,
                             13.6240E-02,    89845.00,
                             18.0690E-02,    93961.00,
                             27.1580E-02,   100555.00,
                             45.6670E-02,   110901.00,
                             64.3630E-02,   119444.50,
                             83.0960E-02,   127176.00,
                            102.8600E-02,   134708.00,
                            117.5800E-02,   139947.50,
```

```
                141.6300E-02,   147542.50,
                167.2300E-02,   154434.00,
                193.7600E-02,   161066.50,
                )
            )
```

```
#
# CURRENT NET  CURVE OF 17 POINTS
FCM33A=DEFI_FONCTION (
                   NOM_PARA=' EPSI',
                PROL_DROITE=' LINEAIRE',
                PROL_GAUCHE=' EXCLU',
                       VALE= (
                              1.1879E-02,    21325.50,
                              2.0832E-02,    37397.96,
                              3.0330E-02,    54448.83,
                              4.0820E-02,    68953.50,
                              5.6362E-02,    78085.00,
                              9.7438E-02,    85711.50,
                             14.1160E-02,    90723.50,
                             18.6090E-02,    94713.50,
                             27.7600E-02,   101206.00,
                             46.3570E-02,   111513.50,
                             65.1280E-02,   120081.50,
                             83.7930E-02,   127792.00,
                            102.4000E-02,   134904.00,
                            116.9600E-02,   140143.50,
                            140.8600E-02,   147742.00,
                            166.2800E-02,   154665.00,
                            192.5700E-02,   161336.00,
                            )
                       )

#
# DEFINITION OF MATERIAL OF THE PIN (E AND NAKED)
MGM33A=DEFI_MATERIAU (
                          ELAS=_F (  E = 1.9022E+5,
                                     NAKED = 0.3E0)
                    )

#
# DEFINITION OF MATERIAL OF THE SUPPORT (E AND NAKED)
# the VALUE OF the MODULUS YOUNG EAST OF 1.95E+05 MPA.
# FOR REASONS SPECIFIC TO THE CODE_ASTER IT IS
# NECESSARY TO MULTIPLY THIS VALUE BY 2*PI,
# WHAT GIVES IN FACT: 12.252E+5 MPA.
MBM33A=DEFI_MATERIAU (
                          ELAS=_F (  E = 12.252E+5,
                                     NAKED = 0.3E0)
                    )
```