
Macro command MACR_ASCOUF_MAIL

1 Drank

To generate the mesh of a healthy elbow or comprising a crack or one or more under-thickness.

The lengths must be given in millimetres and the angles in degrees.

The product concept by this macro-command is of mesh type, containing the topological entities making it possible to apply boundary conditions and loadings. The mesh product can be used only or associated with macro-command MACR_ASCOUF_CALC.

MACR_ASCOUF_MAIL rests on parametric procedures GIBI of mesh of plates with defaults. This mesh is then transformed into mesh of tube or elbow per call to command MODI_MAILLAGE.

To use MACR_ASCOUF_MAIL, it is thus necessary to be able to reach to GIBI on the same object computer of *the Code_Aster* (either all locally, or on the central machine *Aster*).

Product a concept of mesh type .

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Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

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2 Syntax

```
netted [mesh] = MACR_ASCOUF_MAIL

(
  ◆EXEC_MAILLAGE =_F ( ◆LOGICIEL=/ "GIBI2000",
[DEFAULT]
                        / "GIBI98" ,
                        ◇ UNITE_DATG=/ unit_d , [I]
                        /70 ,
[DEFAULT]
                        ◇ UNITE_MGIB=/ unit_s , [I]
                        /19 ,
[DEFAULT]
                        ◇ NIVE_GIBI=/ 10 ,
[DEFAULT]
                        /3,4,5,6,7,8,9,11 [I]
  )

  ◇ TYPE_ELEM = "CU20" ,
[DEFAULT]
  / "CUB8" ,

  ◆ COUDE =_F ( ◆ ANGLE=alpha , [R]
                ◆ R_CINTR=Rc , [R]
                ◆ L_TUBE_P1=l_tube_p1 , [R]
                ◇ L_TUBE_P2=/ l_tube_p2, [R]
                /0. ,
[DEFAULT]
                ◇ NB_ELEM_EPAIS=/nbel , [I]
                /3 ,
[DEFAULT]
                ◇SYME=/ "QUART" , [TXM]
                / "DEMI" , [TXM]
                / "WHOLE" ,
[DEFAULT]
                ◇TRANSFORMEE=/ "TUBE" , [TXM]
                / "COUDE" ,
[DEFAULT]

# If TRANSFORMEE = "COUDE"
  ◆DEXT=De , [R]
  ◆ EPAIS=e , [R]
  ◇SUR_EPAIS=/ surep, [R]
  /0. ,
[DEFAULT]
  ◇ BOL_P2=/ "ASP_MPP" , [TXM]
  / "CUVE" ,
  / "GV" ,

# Finsi
```

```

# If TRANSFORMEE = "TUBE"
    ◊TRAN_EPAIS=/          "NON",          [DEFAULT]
                          /"OUI",        [TXM]

#Si      TRAN_EPAIS = "OUI"

    ◆DEXT_T1=De_t1          ,          [R]
    ◆ EPAIS_T1=e_t1          ,          [R]
    ◆ EPAIS_T2=e_t2          ,          [R]
    ◆ ANGL_TETA1=teta1      ,          [R]
    ◊ ANGL_TETA2=teta2      ,          [R]
    ◊ EPAIS_TI=e_ti         ,          [R]
    ◆ /ABSC_CURV_TRAN=ltran ,          [R]
    /POSI_ANGU_TRAN=phi     ,          [R]

#Finsi

#Si      TRAN_EPAIS = "NON"

    ◆DEXT=De                ,          [R]
    ◆EPAIS=e                ,          [R]
    ◊SUR_EPAIS=/           surep,      [R]
                                /0. ,

[DEFAULT]
    ◊ BOL_P2=/              "ASP_MPP" , [TXM]
                                / "CUVE" ,
                                / "GV"  ,

#Finsi

# Finsi

)

◊/SOUS_EPAIS_COUDE =_F ( ◆TYPE=/          "ELLI",
                          ◆AXE_CIRC=2a     , [R]
                          / "AXIS",
    ◆AXE_LONGI=2b          ,          [R]
    ◆PROFONDEUR=c         ,          [R]
    ◆/ POSI_CURV_LONGI=s1  ,          [R]
    /POSI_ANGUL=beta      ,          [R]
    ◆/ POSI_CURV_CIRC=sc   ,          [R]
    /AZIMUT=phi           ,          [R]
    ◆SOUS_EPAIS=          /"INTERN",     [TXM]
                                /"EXTERNAL",
    ◆ NB_ELEM_LONGI=n1     ,          [I]
    ◆ NB_ELEM_CIRC=nc      ,          [I]
    ◊EMPREINTE=/          "NON",        [TXM]
                                /"OUI",   [DEFAULT]
    ◊ NB_ELEM_RADI=/      NR ,          [I]
                                /3 ,

[DEFAULT]

)

```

```

/SOUS_EPAIS_MULTII =_F ( ◆TYPE=/ "ELLI",
                          ◆AXE_CIRC = 2a , [R]
                          / "AXIS",
                          ◆AXE_LONGI= 2b , [R]
                          ◆PROFONDEUR= C , [R]
                          ◆/ POSI_CURV_LONGI= s1 , [R]
                          /POSI_ANGUL=beta , [R]
                          ◆/ POSI_CURV_CIRC=sc , [R]
                          /AZIMUT=phi , [R]
                          ◆ SOUS_EPAIS=/ "INTERN", [TXM]
                          /"EXTERNAL",
                          ◆ NB_ELEM_LONGI=n1 , [I]
                          ◆ NB_ELEM_CIRC=nc , [I]
                          ◇ EMPREINTE=/ "NON", [TXM]
                          /"OUI",
[DEFAULT]
)

/ FISS_COUDE =_F ( ◆PROFONDEUR=a , [R]
                  ◇AXIS=/ "OUI",
                  /"NON",
[DEFAULT]
# If AXIS = "NON"
◆LONGUEUR=2c , [R]
# Finsi

◆/ ABSC_CURV = sf , [R]
  /POSI_ANGUL=beta , [R]
◇AZIMUT = phi , [R]
  /90. ,

[DEFAULT]
◆ORIEN=/ xsi , [R]
  /+45. ,
  /-45. ,
  / 90. ,
  / 0. ,
◆ FISSURE=/ "DEB_INT", [TXM]
  /"DEB_EXT",
◆ NB_TRANCHE=nt , [I]
◆NB_SECTEUR=ns , [I]
◆NB_COURONNE=nc , [I]
◇ RAYON_TORE=rc0 , [R]
◇ COEF_MULT_RC2=/ rc2 , [R]
  /1. ,

[DEFAULT]
◇COEF_MULT_RC3=rc3 ,
[R]
◇ANGL_OUVERTURE=/ eps , [R]
  /0.5 ,
[DEFAULT]
)

```

Code Aster

Version
default

Titre : Macro commande MACR_ASCOUF_MAIL
Responsable : Samuel GENIAUT

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Clé : U4.CF.10 Révision : 1122

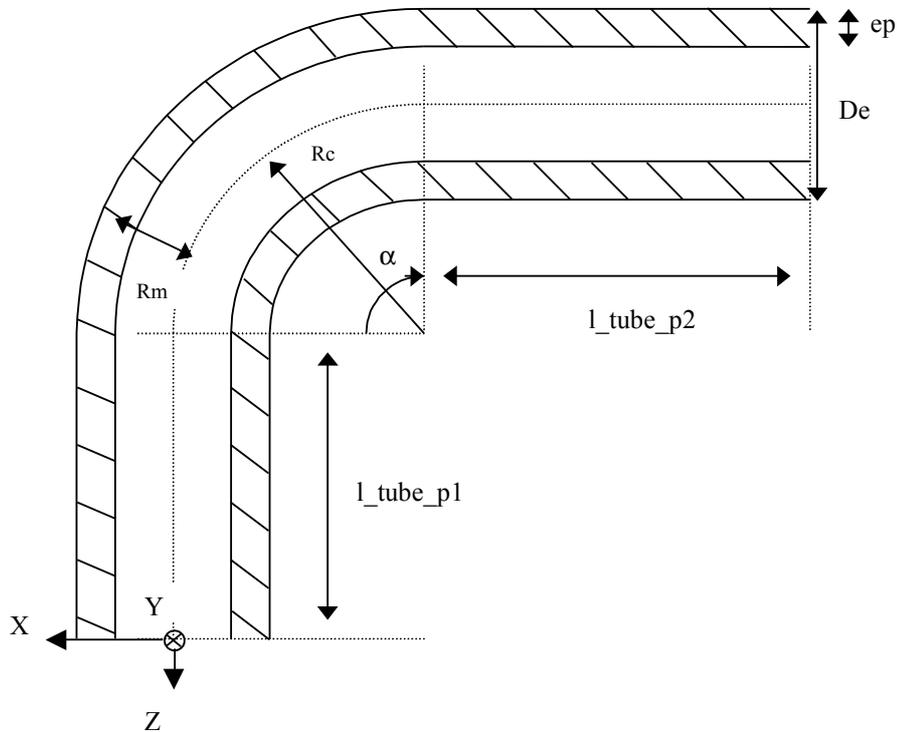
```

    ◇IMPRESSION      =_F ( ◇FICHER=      nom_fichier ,           [TXM]
                          ◇ UNITE      = unit ,                 [I]
                          ◇/FORMAT=/    "ASTER",
[DEFAULT]
                          /FORMAT      = "IDEAS",
                          ◇ VERSION=/   4 ,                   [I]
                          /5 ,
[DEFAULT]
                          /FORMAT      = ' CASTEM' ,
                          ◇ NIVE_GIBI=/ 3 ,                   [I]
                                          /10 ,                 [DEFAULT]
    )

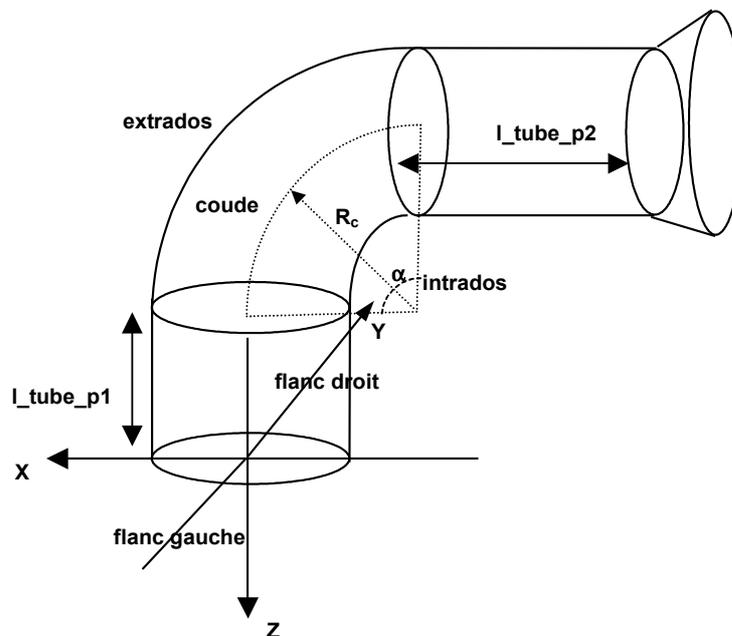
    ◇INFO=/1
[DEFAULT]
    /2 ,

)
```

3 Definition geometrical of the elbow



Appears 3-a: Description of the various geometrical parameters of the elbow



Appears 3-b: Sight 3D of the elbow and its nozzles

4 Operands

4.1 Key word factor EXEC_MAILLAGE

4.1.1 Operand LOGICIEL

◆ LOGICIEL= / "GIBI2000", [DEFAULT]
/ "GIBI98" ,

Version of software GIBI carried out for the realization of the mesh of structure.

◇ UNITE_DATG= unit_d

logical Number of unit where data GIBI are written making it possible to generate the mesh of plate. The value by default is 70.

◇ UNITE_MGIB= unit_s

logical Number of unit where the mesh of plate to format GIBI is written. This mesh is generated by GIBI. The value by default is 19.

◇ NIVE_GIBI=/ 3, [I]
/ 4,
/ 5,
/ 6,
/ 7,
/ 8,
/ 9,
/10, [DEFAULT]
/11,

Level of the software GIBI in which the mesh is generated.

4.2 Operand TYPE_ELEM

Makes it possible to choose the type of element (linear or quadratic) which will constitute the mesh.

◇ TYPE_ELEM = "CU20" , [DEFAULT]
/ "CUB8" , [TXM]

4.3 Key word factor COUDE

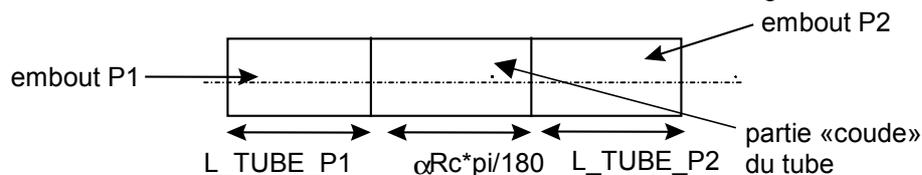
4.3.1 Operand ANGLE

◆ ANGLE= alpha

Value of the angle of the elbow in degrees. If one wishes to model only one tube without bending it (by means of option "TUBE" of operand TRANSFORMEE), the length of this one in its part

"elbow" will be $\alpha \frac{\pi}{180} R_c$ où est R_c the bend radius (see operand R_CINTR). It is necessary

thus choisir de αR_c such way that the part "elbow" has the desired length. The deauthorized values α lie between 20 and 90 degrees.



Appar 4.3.1-a: longitudinal distances from the structure

4.3.2 Operand R_CINTR

♦ R_CINTR= Rc

Valeur of the bend radius of the elbow. The bend radius must be such as: $Rc \leq De/2$.

4.3.3 Operand L_TUBE_P1

♦ L_TUBE_P1= l_tube_p1

Value length of the nozzle P1 at the end of which the loadings will be applied. The length of this nozzle must be higher than the damping length of the bending wave being propagated since the

part bends and being worth $L_{amor} = \frac{3}{2} \sqrt{\frac{R_m^3}{e}}$. If this dimension is not reached for the nozzle an alarm message not blocking is transmitted.

4.3.4 Operand L_TUBE_P2

♦ L_TUBE_P2= l_tube_p2

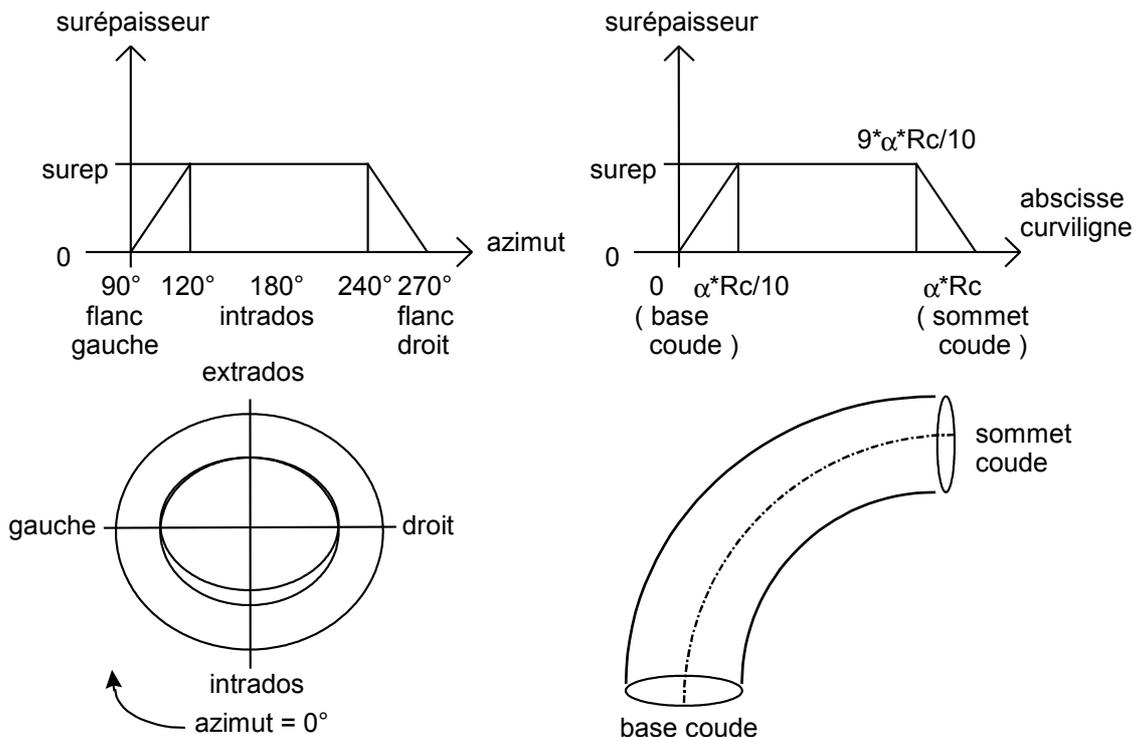
Value length of the nozzle P2 at the end of which the boundary conditions will be applied. The length of this nozzle must be higher than the damping length of the bending wave being

propagated since the part bends and being worth $L_{amor} = \frac{3}{2} \sqrt{\frac{R_m^3}{e}}$. If this dimension is not reached for the nozzle an alarm message not blocking is transmitted (except in the event of presence of a bowl).

4.3.5 Operand SUR_EPAIS

♦ SUR_EPAIS= surep

Value of the extra thickness presents in intern skin to the underside of the elbow. It is distributed thus on the elbow:



Appear 4.3.5-a: Extra thickness

Note:

It is possible to generate the mesh of elbows or tubes comprising simultaneously one or more under - thickness and an extra thickness.

4.3.6 Operand BOL_P2

◇ BOL_P2

Makes it possible to prolong the cylindrical nozzle length `1_tube_p2` by a bowl [bib1] on which one applies the boundary conditions. The possibilities are:

"CUVE" bowl of type pipe of entry of tank,
"ASP_MPP" bowl of type pipe of primary aspiration of pump,
"GV" bowl of type pipe of GV.

Caution:

This option is not valid for the elbows or tubes with under-thickness.

The bowl of type pipe GV has a conical end where the condition of type connection 3D - beam is not used but is not replaced by a blocking of the section by conditions of type beam (cf [U4.CF.20]).

4.3.7 Operand NB_ELEM_EPAIS

◇NB_ELEM_EPAIS= nbel

Makes it possible to give the number of layers of elements present in the thickness of the elbow and of its nozzles.

Caution:

This option is not valid for the elbows or tubes with crack (factor key word `FISS_COUDE`) or one under-thickness (factor key word `SOUS_EPAIS_COUDE`). The number of elements in the thickness of the elbow part is then fixed at three (except the zone of the default which presents a specific refinement) and at for the zones nozzles.

4.3.8 Operand SYME

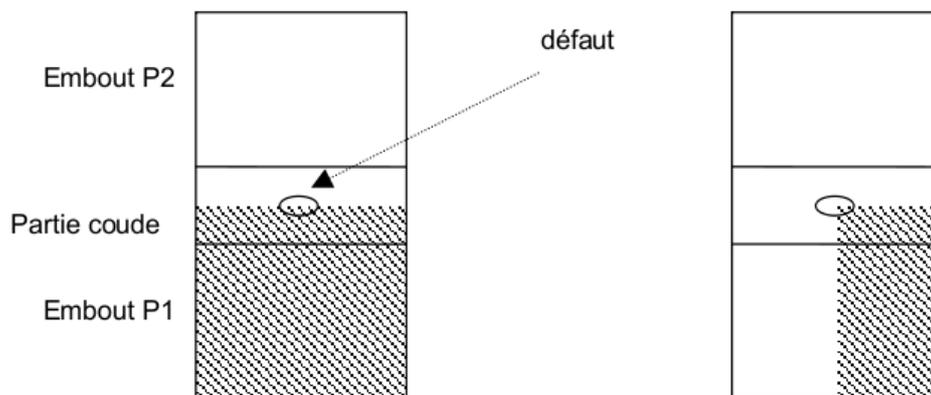
◇SYME= / "QUART" ,
/ "DEMI" ;
/ "WHOLE" , [DEFAULT]

Makes it possible to net all structure or only one quarter or a half-structure and to thus treat elbows presenting of symmetries. The geometry represented is then the following one:

- for SYME=' DEMI ' : the part of structure going of the median section of the elbow (forming the transverse symmetry plane) at the end of the nozzle P1,
- for SYME=' QUART ' : the representation of the quarter of structure is made on the same support but for a value angle $\theta \in [\Phi, \Phi + \pi]$ to leave the position azimuthale du Φ center of the default. The tubular structure is then not closed and presents a longitudinal symmetry plane represented by two free edges.

Example for the quarter of structure: if the default is in azimuth 90° (located left side) then the sector of the quarter of structure modelled is located between left side and right side via the underside.

Here an illustration of the representation on the structure developed on a plate:



Appear 4.3.8-a: Representation of half and quarter of structure

Attention:

This option is valid only for the elbows or tubes comprising a default.

The use of this operand requires four essential conditions:

- 1) *One and only one default are modelled.*
- 2) *This one is placed on the median section of the elbow.*
- 3) *If it is about a crack, this one must be directed circonférentiellement. Moreover the elbow does not have to comprise of zone of transition thickness.*
- 4) *The lengths of each nozzle must be given equal.*

Computations with the mesh thus produced could not be realized with the macro command of computation `MACR_ASCOUF_CALC` insofar as the nozzle `P2` does not exist: in a general way the loadings of the standard basic effect related to the internal pressure, moment and force in `P2` cannot be applied. One will refer to the paragraphs [§5.3] and [§5.4] for details on the conditions of symmetry to apply.

4.3.9 Operand TRANSFORMEE

◇ TRANSFORMEE

Makes it possible to choose the type of transformation applied to the mesh resulting from the procedure `gibi` carried out by the macro-command (see command `MODI_MAILLAGE`).

◇TRANSFORMEE = "TUBE", transformation out of tube,
/ "COUDE", transformation in elbow.

4.3.10 Operand TRAN_EPAIS

◆TRAN_EPAIS= / "OUI", [DEFAULT]
/ "NON",

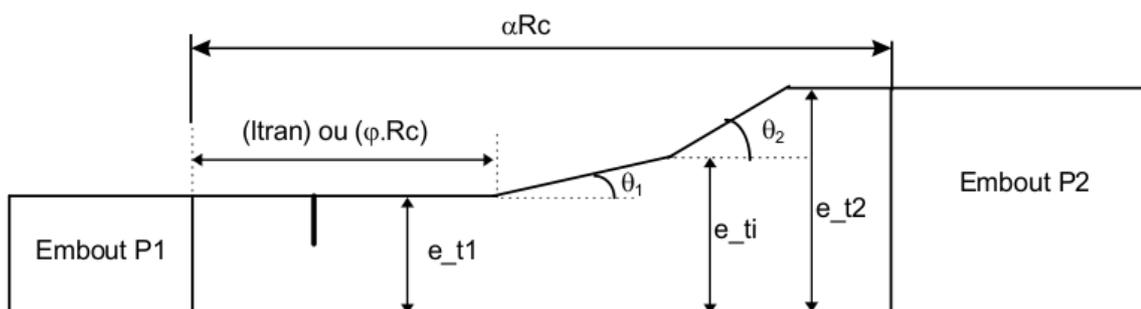
optional Key word indicating the presence or not transition thickness.

The transitions thickness relate to only the RIGHT **tubes**. The internal radius remains constant and only the external radius varies. These transitions can be with one or two slopes. For these two types of transition, a default must be present. The default is either a circumferential crack, or one under-thickness which can emerge in external skin or in intern skin. The default is always perpendicular to the longitudinal axis of the right pipe. The crack or under-thickness can be axisymmetric. The site of the default must be imposed so that it is located between the interface: nozzle P1/zone length αR_c (α in radian) and the beginning of the transition thickness. In all the mesh, the number of elements in the thickness remains identical.

The transition thickness should not be entirely understood in the block of incrustation of crack, including the block and the fissures zones of coarsening to be connected to the structured mesh of the plate. In the event of transition to two slopes, it can include the first but in no case the totality of the transition.

In order to have lines of the mesh confused with the beginning, the end (and possibly break of slope) of the transition, the zone length αR_c and the nozzle P2 are dissociated in several parts to which homotheties are applied. In the case fissured, if the transition thickness begins in the block from incrustation, this one is not modified (except if the transition begins outside the block fissures) and the beginning of the transition thickness is not in this not positioned case in an exact and rectilinear way.

The longitudinal size of the elements in the zone length αR_c can vary in a rather important way following homotheties. It is in this case advised to modify the value of \square and to recompute the value of R_c so that the length αR_c remains unchanged while modifying the longitudinal cutting of this zone. It is thus possible to change the longitudinal size of the elements of the plate which decreases when \square increases. The limits of the transition thickness then are lucky more to coincide or to approach the initial position of the nodes to the mesh.



Appear 4.3.10-a: Cut thickness of the tube with transition thickness to two slopes

4.3.11 Operand DEXT

◆DEXT= Of

compulsory Key word if there is no transition thickness. Value of the external diameter of the elbow and the right nozzles.

4.3.12 Operand EPAIS

◆EPAIS= E

Key word compulsory if there is no transition thickness. Value of the thickness of the elbow and the nozzles.

Note:

The beaches of use for this parameter are different according to the type of default considered:

- 1) *bypass with one under-thickness single: the Rm/e ratio must be ranging between 5 and 50, where Rm indicates the average radius;*
- 2) *bypass fissured or with under-thickness multiple: the Rm/e ratio must be ranging between 5 and 21.*

In this last case, it is possible to generate a mesh for ratios going up to 50. An alarm is however emitted to announce that the quality of the mesh obtained is not guaranteed (possibility of meshes too stretched,...).

4.3.13 Operand DEXT_T1

◆DEXT_T1= compulsory

De_t1 Operand if there is a transition thickness. Value of the external diameter of the elbow before the transition thickness. It must respect $112\text{ mm} \leq De_{t1} \leq 880\text{ mm}$ if the transition thickness is to a slope and $77\text{ mm} \leq De_{t1} \leq 355\text{ mm}$ if the transition thickness is with two slopes.

4.3.14 Compulsory operand

EPAIS_T1 ◆EPAIS_T1=

e_t1 Operand if there is a transition thickness. Value of the thickness of the elbow before the transition thickness. It must respect $12\text{ mm} \leq e_{t1} \leq 80\text{ mm}$ if the transition thickness is with a slope and $7\text{ mm} \leq e_{t1} \leq 35\text{ mm}$ if the transition thickness is with two slopes.

4.3.15 Operand EPAIS_T2

◆EPAIS_T2= e_t2

compulsory Operand if there is a transition thickness. Value of the thickness of the elbow after the transition thickness. It must respect $20\text{ mm} \leq e_{t2} \leq 110\text{ mm}$ if the transition thickness is with a slope and $15\text{ mm} \leq e_{t2} \leq 40\text{ mm}$ if the transition thickness is with two slopes.

4.3.16 Compulsory operand

ANGL_TETA1 ◆ANGL_TETA1=

teta1 Operand if there is a transition thickness. Value of the angle of inclination of the transition thickness (first slope if there are two of them). It must respect $0^\circ \leq \text{teta1} \leq 30^\circ$.

4.3.17 Optional operand

ANGL_TETA2 ◆ANGL_TETA2=

teta2 Operand, indicating if it is present a transition thickness at two slopes. Value of the angle of inclination of the second slope of the transition thickness. It must respect $0^\circ \leq \text{teta2} \leq 45^\circ$.

4.3.18 Operand EPAIS_TI

◇EPAIS_TI= e_ti

compulsory Operand if there is a transition thickness to two slopes. Value of the thickness of the intermediate elbow during break of slope. It must respect $15\text{ mm} \leq e_{ii} \leq 40\text{ mm}$ and $e_{i1} \leq e_{ii} \leq e_{i2}$.

4.3.19 Operands ABSC_CURV_TRAN and POSI_ANGU_TRAN

◆/ ABSC_CURV_TRAN= ltran
/POSI_ANGU_TRAN= phi

One (and only one) of these operands is compulsory if there is a transition thickness. Value of the longitudinal position of the beginning of the transition thickness given respectively by the curvilinear abscisse or the angular position, counted positively from the interface with the nozzle P1. The curvilinear abscisse is defined along the axis of the elbow on the external skin of this one, and there is then $ltran = \Phi R_c$.

If the default is a circumferential crack located at a curvilinear distance sf of the interface with the nozzle P1, $ltran$ or Φ must respect: $0 \leq sf \leq ltran \leq \alpha R_c$.

If the default is one under-thickness whose center is located at a distance sf interface with the nozzle P1 and whose width (AXE_LONGI) is worth $2b$, $ltran$ or Φ must respect:

$$0 \leq sf + b \leq ltran \leq \alpha R_c .$$

4.4 Key key factor SOUS_EPAIS_COUDE or SOUS_EPAIS_MULTII

These two factor keyword make it possible to model an elbow or a tube comprising only one under-thickness (key word SOUS_EPAIS_COUDE) thanks to a procedure of mesh equipped with automatic coarsening, or to model one or more under-thickness (key word SOUS_EPAIS_MULTII) by a procedure of structured mesh uniformly. One repeats key word SOUS_EPAIS_MULTII for each under-thickness to define.

4.4.1 Operand TYPE

◆TYPE

Makes it possible to define the type of under-thickness in modelling:

"ELLI" : under thickness of the elliptic type defined by its axes circumferential and longitudinal.

"AXIS" : under axisymmetric thickness defined by its longitudinal axis.

4.4.2 Operand AXE_CIRC

◆AXE_CIRC = 2a

Longueur of the circumferential axis of the under-thickness measured in curvilinear abscisse in external skin on the elbow, even if the under-thickness is located in intern skin. Is used only if TYPE = "ELLI".

4.4.3 Operand AXE_LONGI

◆AXE_LONGI = 2b

Longueur of the longitudinal axis of the under-thickness measured in curvilinear abscisse in external skin on the elbow, even if the under-thickness is located in intern skin.

4.4.4 Operand PROFONDEUR

◆PROFONDEUR= C

Value maximum depth measured in the center of the under-thickness.

4.4.5 Operands POSI_CURV_LONGI and POSI_ANGUL

◆/POSI_CURV_LONGI= s1
/POSI_ANGUL = beta

Value of the longitudinal position of the center of the under-thickness, definite compared to the interface of the nozzle P1. The position can be given either by the curvilinear abscisse s_1 along the axis of the elbow on the external skin of this one, or by the angle β in degrees formed by the section containing this one and nozzle P1 interfaces it.

This value must be ranging between 0 and αR_c (for s_1) or 0 and α (for β).

4.4.6 Operands POSI_CURV_CIRC and AZIMUT

◆/POSI_CURV_CIRC= s_c
/AZIMUT = ϕ

Value of the circumferential position of the center of the under-thickness given either by the curvilinear abscisse s_c on the external skin of this one, or by the angle in ϕ degrees. The angle and the curvilinear abscisse are counted positively from the suction face to the underside via the left side. This value must be ranging between 0 and πD_e (for s_c) or between 0 and 360 degrees (for ϕ).

If under-thickness is of the axisymmetric type, the center by convention is positioned in underside (180 °) and must be indicated as tel.

4.4.7 Operand SOUS_EPAIS

◆SOUS_EPAIS

Makes it possible to define the position of the under-thickness on the skin of the elbow:

"INTERN" under-thickness in intern skin of the elbow,
"EXTERNAL" under-thickness in external skin of the elbow.
"

4.4.8 Operand NB_ELEM_LONGI

◆ NB_ELEM_LONGI= n1

Permet to define the number of elements present on the longitudinal axis of the under-thickness.

Note:

- The stage of processing of the macro-command which transforms successively the initial mesh of plate into elbow with for effect to compress longitudinally meshes zones underside of them and to dilate them in zone suction face. In the event of default positioned in these zones, the number of elements defined on the longitudinal axis (which is used to create the initial mesh of plate) will be able to be seen slightly reduced or increased. Thus for an axisymmetric under-thickness, the number of elements present longitudinally can vary from two units on an elbow with 90°. Generally, one will advise with the user sufficiently to discretize the axes of the default. The elliptic profile of the under-thickness will be only better.
- The case of a default located shared between elbow and nozzle can cause a representation of the under-thickness which is not perfectly symmetric in the longitudinal meaning. This is due to the same phenomenon as previously added to the fact that the part of the under-thickness presents in the nozzle does not undergo geometrical transformation. There still, one can advise with the user to refine the longitudinal axis to correct this light dissymetry.

4.4.9 Operand NB_ELEM_CIRC

◆ NB_ELEM_CIRC= nc

Permet to define the number of elements present on the circumferential axis of the under-thickness.

Note:

CAUTION to coherence enters the circumferential number of elements, the longitudinal number of elements and the geometry of the under-thickness. In particular, when this one is circumferential, the circumferential number of elements must be about 20.

4.4.10 Operand EMPREINTE

◇EMPREINTE=
/ "OUI", [DEFAULT]

the under-thickness is dug: the points belonging to the half-ellipsoid defining under - thickness undergo a geometrical transformation proportional in the thickness.

/ "NON",

the under-thickness is not dug: the geometrical transformation of the points defining it is not activated. The mesh does not comprise a under-thickness.

4.4.11 Operand NB_ELEM_RADI

◇ NB_ELEM_RADI=nr

Makes it possible to radially define the number of elements present (in the meaning of the thickness of the elbow) towards the under-thickened zone. By default, this value is of three as for the current part of the elbow.

Caution:

|This option N `is valid that for key word SOUS_EPAIS_COUDE (single under-thickness).

4.5 Key word factor FISS_COUDE

Three cases are possible to distinguish cracks short and the cracks long. The distinction is done according to the a_p/c_p ratio (a_p being depth and c_p the half-length of crack on the plate before transformation out of tube or elbow):

- the cracks are short elliptic if $a_p/c_p \geq 0.2$,
- the cracks are long with the rectilinear bottom and the round ends if $0.1 \leq a_p/c_p < 0.2$ or if the directional sense is longitudinal,
- the cracks are long with the rectilinear bottom if $a_p/c_p < 0.1$ and if the directional sense is circumferential (it is the case in particular for axisymmetric cracks).

4.5.1 Operand PROFONDEUR

◆PROFONDEUR=a

Half length of the small axis of crack.

4.5.2 Operand LONGUEUR

◆LONGUEUR=2c

Length of the large axis of crack measured on the elbow in intern skin or external according to the skin on which the crack is. This length is compulsory if the crack is not axisymmetric. She is on the other hand ignored if she is provided and that the crack is axisymmetric.

4.5.3 Operand AXIS

◇AXIS=/ "OUI",
/ "NON", [DEFAULT]

optional Key word indicating if the crack is axisymmetric or not.

4.5.4 Operand AZIMUT

◇AZIMUT= phi

Value of the circumferential position of the center of crack counted positively in degrees from the suction face to the underside via the left side. The definite position by default is on the left side (azimuth equal to 90 degrees). The azimuth must be understood between 0° and 180°.

4.5.5 Operands ABSC_CURV and POSI_ANGUL

◆/ABSC_CURV = sf
/POSI_ANGUL = beta

Value of the longitudinal position of the center of crack, definite compared to the interface of the nozzle P1. The position can be given either by the curvilinear abscisse sf along the axis of the elbow on the internal or external skin (according to the position of crack), or by the angle $beta$ in degrees formed by the section containing this one and nozzle P1 interfaces it.

This value must be understood:

- for sf : between 0 and $\alpha [Rc + (Rm + \eta e/2) \cos(\phi)]$, where $\eta = 1$ is worth if the default is in external skin and -1 if not;

- for $beta$: between 0 and α .

4.5.6 Operand ORIEN

◆ORIEN= xsi

Value of the angle in degrees formed by the large axis of crack and the generator of the elbow giving the directional sense of the default thus.

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

Caution:

- Only three types of directional sense are possible:
- longitudinal crack ($x_{si} = 0$ degree),
 - circumferential crack ($x_{si} = + 90$ degrees),
 - tilted crack ($x_{si} = +45$ or -45 degrees), only for short cracks.

A longitudinal crack cannot encroach on one of the two right nozzles, or the two right nozzles at the same time. On the other hand, the block fissures can it. In other words, the crack must inevitably be in the elbow, the block crack can overflow on the right nozzles.

4.5.7 Operand FISSURES

◆FISSURE

Makes it possible to define the position of crack on the skin of the elbow:

- "DEB_INT" fissures emerging in intern skin of the elbow,
- "DEB_EXT" fissures emerging in external skin of the elbow.

4.5.8 Operand NB_TRANCHE

◆NB_TRANCHE=nt

For short cracks, many slices along the crack tip **on a quarter of ellipse**. The total number of slices is then this data multiplied by two (see [Figure 4.5.9-a]). This value must be a power of 2 and must be worth 8 at least.

For long cracks with round ends, NT is the nombre total of slices, ranging between 20 and 186 on the totality of the crack tip, with 8 slices for each round end and between 4 and 170 slices on the rectilinear part.

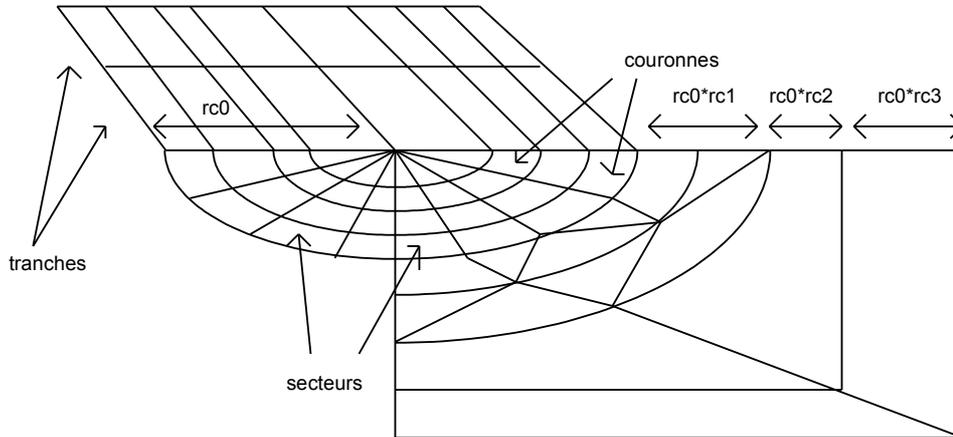
For long cracks with rectilinear bottom only, the number of slices must be ranging between 8 and 40.

In the case of the circumferential cracks, the following table provides a reasonable estimate amongst slices for the rectilinear part of long cracks according to the $2c$ ratio / $2 \square R_m$ (length of crack over width of the plate) for two levels of refinement. For long cracks with round ends, it is thus necessary to add 16 slices.

C / \square R _m	0	0.02	0.04	0.06	0.08	0.1	0.12	0.14	0.16	0.18	0.2	0.22	0.24	0.26	0.28	0.32	0.34	0.36	
>																			
C / \square R _m	0.02	0.04	0.06	0.08	0.1	0.12	0.14	0.16	0.18	0.2	0.22	0.24	0.26	0.28	0.32	0.34	0.36	1	
<																			
at the end of NT	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	40	
large NT	4	4	6	6	8	8	10	10	12	12	14	14	16	16	18	18	20	20	

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

In the case of longitudinal cracks or cracks having a rapportel a/c that $0.1 \leq a/c < 0.2$, the number of slices can vary between 20 and 186, included. One needs a ratio of stretching of meshes from approximately 10 (large side/small side), a ratio of stretching of about 20 being acceptable.



Appar 4.5.9-a: Parameters of the basic crack mesh radiating

4.5.9 Operand NB_SECTEUR

◆NB_SECTEUR=ns

Many sectors on 90 degrees in a contour of the torus modelling the crack tip. The nombre total of sectors on a contour is then this data multiplied by four (see [Figure 4.5.9-a]).

For long cracks, this value must be worth 2,3 or 4. For the other types of crack this value should not exceed 8.

4.5.10 Operand NB_COURONNE

◆NB_COURONNE=nc

Many contours of the mesh radiating around the crack tip, including the formed central contour by prisms (see [Figure 4.5.9-a]).

For long cracks, this value must be worth 3 or 4.

4.5.11 Operand RAYON_TORE

◇RAYON_TORE=rc0

Makes it possible to define the value of the radius of the torus of the zone in imposed mesh of type radiating around the crack tip (see [Figure 4.5.9-a]). Are a the depth of the crack et' e thickness of the pipe, by default, the radius is worth:

$$rc_0 = \frac{rc_0^{ref} a}{0.2 e} \quad \text{where} \quad rc_0^{ref} = 2 \text{ mm} \quad \text{if the number of slices is equal to or higher than 16,}$$

$$rc_0 = 1,5 \text{ mm} \quad \text{if not.}$$

4.5.12 Operand COEF_MULT_RC2

◇ COEF_MULT_RC2=rc2

Value of the multiplying coefficient of rc0 allowing to define the thickness of the first contour of coarsening of the slices (see [Figure 4.5.9-a]). By default this coefficient is worth 1.

4.5.13 Operand COEF_MULT_RC3

◇ COEF_MULT_RC3=rc3

Value of the multiplying coefficient of rc0 allowing to define the thickness of the second contour of coarsening of the slices (see [Figure 4.5.9-a]). By default, this coefficient is worth 1 if the number of slices is lower than 16 and 1.4 if not.

4.5.14 Operand ANGL_OUVERTURE

◇ANGL_OUVERTURE =eps

Value in degrees of the half angle of opening of crack. By default, eps is worth 0.5.

4.6 Factor key word PRINTING

4.6.1 Operand FICHIER

◇FICHIER=nom_fichier

Name given to the print file. By default, the print file is the file of the standard Aster mesh (.mast). It is thus important to put this kind of file in the profile of study if one uses the default options PRINTING of the key word.

4.6.2 Operand UNITE

◇UNITE=unite

logical Number of unit associated with the print file.

4.6.3 Operand FORMAT

◇FORMAT

Makes it possible to specify the format of printing of the mesh. By default the format is "ASTER".

4.6.4 Operand VERSION

◇VERSION

If and only if operand FORMAT is worth "IDEAS", this operand makes it possible to specify the version of the Ideas software. By default VERSION is worth 5. Only versions 4 and 5 are supported.

4.6.5 Operand NIVE_GIBI

◇NIVE_GIBI

If and only if operand FORMAT is worth "CASTEM", this operand makes it possible to specify the level of the software GIBI in which mesh will be printed. By default VERSION is worth 10. Only levels 3 and 10 are supported.

4.7 Operand INFO

◇INFO =

Indicates the level of printing of the results of the operator,

- 1: no printing,
- 2: printing of the relative information to the mesh.

The printings are made in the file "MESSAGE".

To have the detail of the operators called by the macro-command in the message file, it is necessary to specify IMPR_MACRO=' OUI ' in the command debut.

5 Topological mesh and groups

5.1 Mesh of plate

The mesh of plate 3D produced by the procedure of mesh GIBI before geometrical transformation out of tube or elbow is defined as follows:

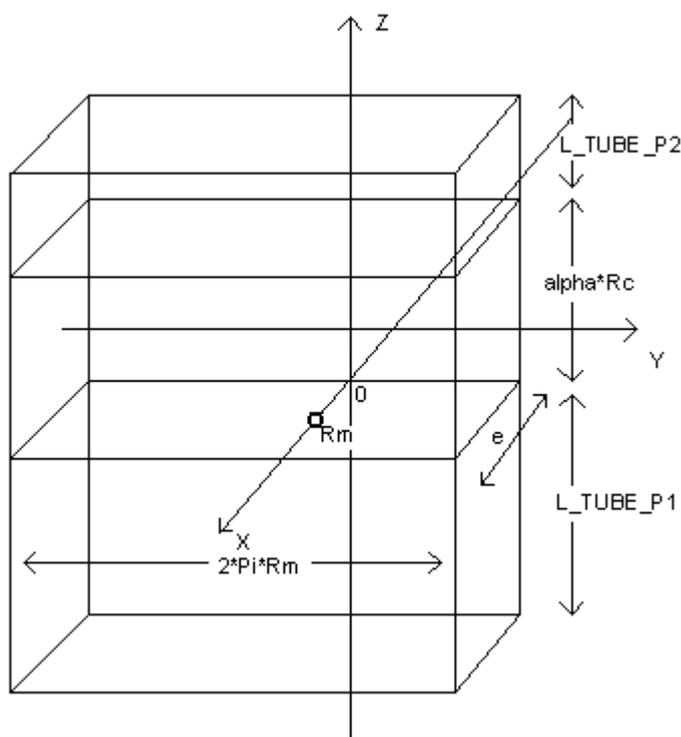


Plate generated by procedure GIBI

Rm : average radius,
alpha : angle of the elbow in radians,
E : thickness,
Rc : bend radius,
L_TUBE_P1 : length of the nozzle P1,
L_TUBE_P2 : length of the nozzle P2.

The reference of the mesh plate is at the base of the part bends (interface between the zone bends and the nozzle P1), the plate occupies the following fields: $X \in [R_m - e/2, R_m + e/2]$

$$Y \in [-\pi * R_m, \pi * R_m] \quad Z \in [-L_TUBE_P1, \alpha * R_c + L_TUBE_P2] \quad .$$

- P2 : node located at the center section CLGV.

Groups of points defining the generators of the elbow:

- GAUCHE: nodes group constituting all the nodes located in external skin on the left side of the elbow and the nozzles ($X = R_m + e/2, Y = 0$),
- DROIT: nodes group constituting all the nodes located in external skin on the right side of the elbow and the nozzles ($X = R_m + e/2, Y = -\pi * R_m$),
- INTRA: nodes group constituting all the nodes located in external skin on the underside of the elbow and the nozzles ($X = R_m + e/2, Y = +\pi * R_m/2$),
- EXTRA: nodes group constituting all the nodes located in external skin on the suction face of the elbow and the nozzles ($X = R_m + e/2, Y = -\pi * R_m/2$).

Mesh group linear:

- BORDTU: contour interns section at the end of the nozzle P1 ($Z = -l_tube_p1$).

Mesh group surface:

- PEAUEXT: external skin of the elbow and the nozzles ($X = R_m + e/2$),
- PEAUINT: skin interns elbow and nozzles ($X = R_m - e/2$),
- EXTUBE: section at the end of the nozzle P1 ($Z = -l_tube_p1$),
- CLGV: section at the end of the nozzle P2 ($Z = \alpha * R_c + l_tube_p2$).

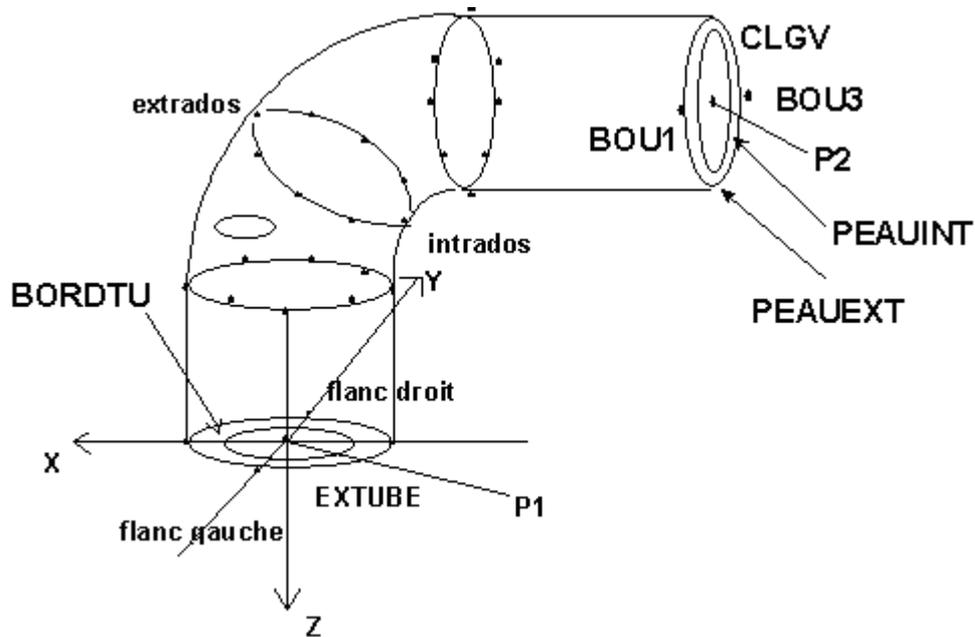
Very Important :

The elements of skin described above have an external outgoing norm in external skin and an outgoing norm interns in intern skin.

Mesh group voluminal:

- COUDE: mesh group voluminal constituting the elbow, the nozzle P1 and the nozzle P2 representing the part of structure made up out of stainless,
- PACOUDE: mesh group voluminal constituting the elbow ($0 \leq Z \leq \alpha * R_c$),
- EMBOUITTU: mesh group voluminal constituting the nozzle P1 ($-l_tube_p1 \leq Z \leq 0$),
- EMBOUITGV: mesh group voluminal constituting the nozzle P2 ($\alpha * R_c \leq Z \leq \alpha * R_c + l_tube_p2$),
- MY: mesh group containing all meshes voluminal and surface definite, as well as the meshes discrete ones.

5.3 Bend with under-thickness

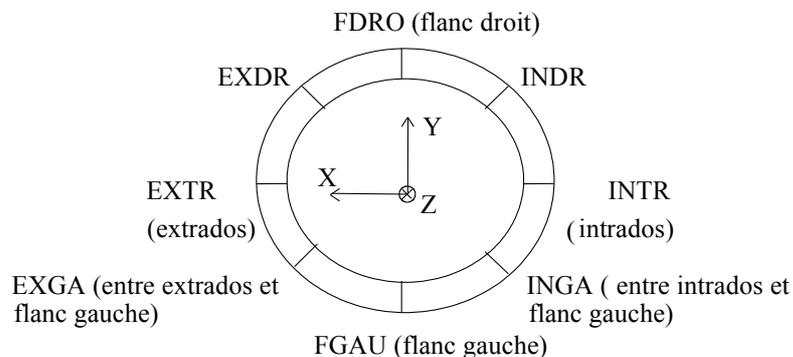


Bends with under-thickness (COUDE)

At the conclusion of the execution of the procedure, the mesh will mention following topological entities in order to facilitate visualization, the application of the loadings, the assignment of the boundary conditions and the mechanical analysis:

- **COUDE** : together voluminal elements of the mesh bends and nozzles,
- **CLGV** : elements of membrane located at the end of the nozzle P2,
- **EXTUBE** : elements of membrane located at the end of the nozzle P1,
- **PEAUINT** : elements of membrane located in intern skin of structure
- **PEAUEXT** : elements of membrane located in external skin of structure,
- **BOU1** : node located at the end of the nozzle P2 in external skin and left side,
- **BOU3** : node diametrically opposed to BOU1 on the section of the tube, located at the end of the nozzle P2 in external skin and right side,
- **P1** : node located at the center of the section EXTUBE,
- **P2** : node located at the center of section CLGV,
- **internal** : BORDTU contour of the section at the end of the nozzle P1 ($Z = 0$).

Points BOU1 and BOU3 are located left side and right side for an azimuth of the default $\phi = 90^\circ$, they "turn" if this one is different. The eight nodes groups formed by the ligaments in the thickness taken all the 45 degrees (or closest to these positions) on a section are prefixed in the following way:



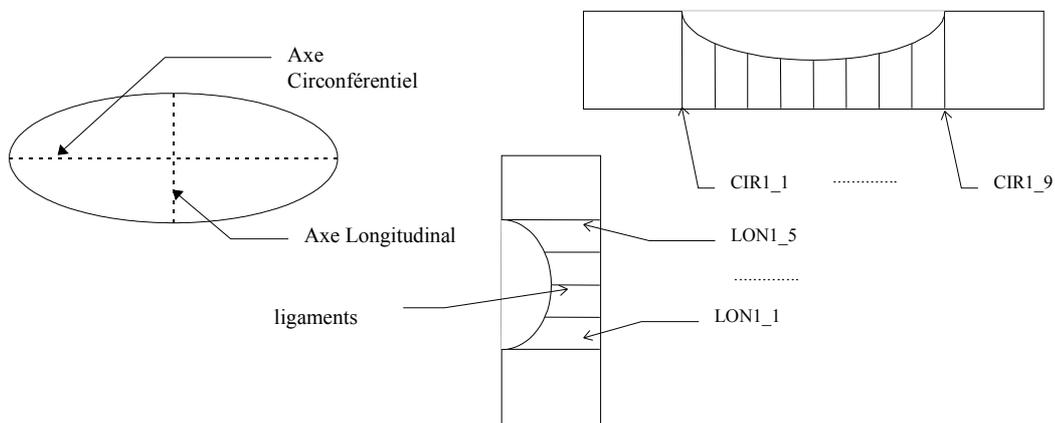
- **EXGAMI, FGAUMI, INGAMI, INTRMI, INDRMI, FDRMI, EXDRMI, EXTRMI** : nodes groups formed by the ligaments in the thickness all 45 degrees on the median section of the elbow (or nearest).
- **EXGATU, FGAUTU, INGATU, INTRTU, INDRTU, FDROTU, EXDRTU, EXTRTU** : nodes groups formed by the ligaments in the thickness all the 45 degrees on the section interfaces between the nozzle tubes and the elbow.
- **EXGAGV, FGAUGV, INGAGV, INTRGV, INDRGV, FDROGV, EXDRGV, EXTRGV** : nodes groups formed by the ligaments in the thickness all the 45 degrees on the section interfaces between the nozzle GV and bends it.
- **EXGAX, FGAUX, INGAX, INTRX, INDRX, FDROX, EXDRX, EXTRX** : nodes groups formed by the ligaments in the thickness all 45 degrees on the section corresponding to the minimal thickness of the N°x under-thickness.

For the nonaxisymmetric under-thickness:

- **CIRx_y** : nodes group representing the circumferential ligament n°y under-thickness n°x. The ligaments are sorted according to Y growing on the mesh plates.
- **LONx_z** : nodes group representing the longitudinal ligament n°z under-thickness n°x. The ligaments are sorted according to Z growing on the mesh plates.
- **PCIRCx** : together nodes of the N°x under-thickness located on the circumferential axis and at the right of this one on all the thickness,
- **PLONGx** : together nodes of the N°x under-thickness located on the longitudinal axis and at the right of this one on all the thickness,
- **PCENTx** : together nodes of the N°x under-thickness located at the center of the ellipse and the right of this one on all the thickness (intersection of the groups PLONGx and PCIRCx),

Important :

|For each ligament, the nodes are ordered external skin with the internal skin.



5.3.1 Cases of half-structure

the following entities present but are associated with places different from whole structure:

- **CLGV** : elements of membrane located in median section forming the transverse symmetry plane of the elbow,
- **BOU1** : node located on the median section in external skin on the left side for an azimuth of the default of 90° ,
- **BOU3** : node diametrically opposed to BOU1 on the median section, located in external skin on the right side,
- **P2** : node located at the center section CLGV.

Ligaments **EXGAGV**, **FGAUGV**, **INGAGV**, **INTRGV**, **INDRGV**, **FDROGV**, **EXDRGV**, **EXTRGV** do not exist.

The boundary conditions for a half-structure in order to block displacements of rigid body and simulating the conditions of symmetry are the following ones (α is the angle of the elbow and ϕ the azimuth of the default):

- Blocking of normal displacement to the median section (CLGV):
 $DZ=0$ for a tube,
 $DNOR=0$ an elbow.
- A point on the aforementioned section blocked in the plane of this one:
 $DX=DY=0$ for a tube,
 $DY=0 \quad \cos(\alpha)DX - \sin(\alpha)DZ=0$ an elbow.
- The point opposed symmetrically (located at the azimuth Φ_1) to the precedent in the section, blocked in tangent displacement with the aforementioned section:
 $\sin(\Phi_1)DX + \cos(\Phi_1)DY=0$ for a tube,
 $\sin(\Phi_1)\cos(\alpha)DX + \cos(\Phi_1)DY - \sin(\Phi_1)\sin(\alpha)DZ=0$ an elbow.

Note:

One can also for half-structure plan to preserve the principle of the connection 3D-beam (used with the whole modelization in the *MACR_ASCOUF_CALC*) with a node in the middle of the median section (in the occurrence P2).

5.3.2 Cases of the quarter of structure

the modifications are similar to the preceding paragraph. Moreover, the two edges forming the longitudinal symmetry plane of the elbow are available:

- **BORD1** : elements of membrane located left side for an azimuth of default $\phi=90^\circ$,
- **BORD2** : elements of membrane located right side for an azimuth of default $\phi=90^\circ$.

The boundary conditions for a quarter of structure in order to block displacements of rigid body and simulating the conditions of symmetry are the following ones (α is the angle of the elbow and ϕ the azimuth of the default):

- Blocking of normal displacement to the median section (CLGV):
 $DZ=0$ for a tube,
 $DNOR=0$ an elbow.
- Blocking of the longitudinal symmetry plane of tubular structure:
 $DNOR=0$ on BORD1 and BORD2.

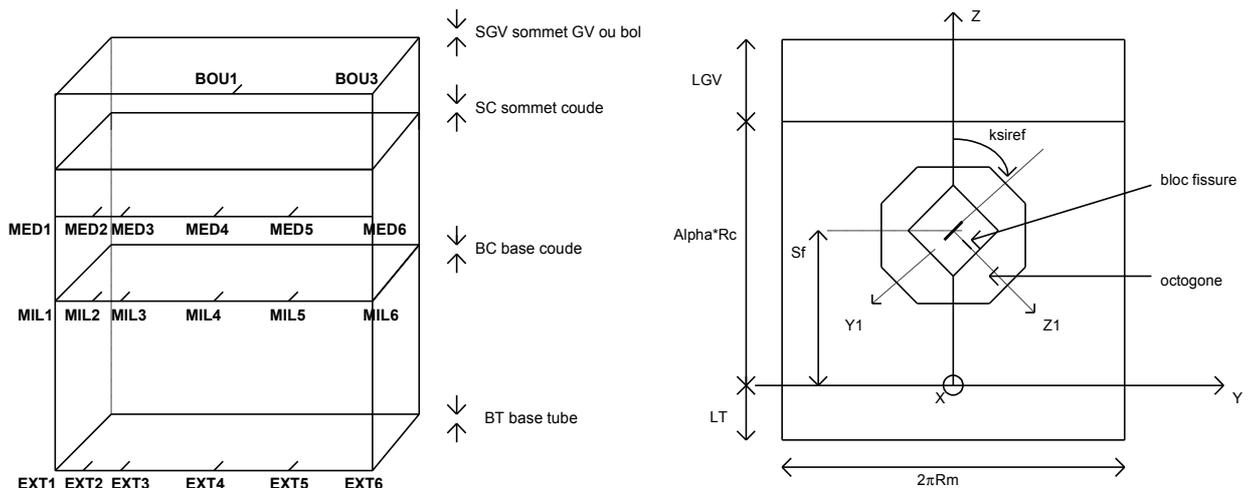
- Blocking of displacement perpendicular to the longitudinal symmetry plane of one of points (BOU3 to avoid taking the point located in the zone of the default which is BOU1) located at the intersection of the two planes previously quoted:

$$\cos(\Phi)DX + \sin(\Phi)DY = 0 \quad \text{for a tube,}$$

$$\cos(\Phi)\cos(\alpha)DX + \sin(\Phi)DY - \cos(\Phi)\sin(\alpha)DZ = 0 \quad \text{an elbow.}$$

5.4 Bend with crack

The mesh thus carried out comprises the following geometrical groups (the fields are given in the reference mesh plates):



The following points are located for an azimuth of the default $\square = 90^\circ$, they "turn" if this one is different:

- EXT6: nodes group made up of the node located in external skin on the right side at the base of the nozzle tubes ($X = R_m + e/2, Y = \pi * R_m, Z = -1_tube_p1$),
- EXT5: nodes group made up of the node located in external skin on the underside at the base of the nozzle tubes ($X = R_m + e/2, Y = \pi * R_m/2, Z = -1_tube_p1$),
- EXT4: nodes group made up of the node located in external skin on the left side at the base of the nozzle tubes ($X = R_m + e/2, Y = 0, Z = -1_tube_p1$),
- EXT3: nodes group made up of the node located in external skin on the suction face at the base of the nozzle tubes ($X = R_m + e/2, Y = -\pi * R_m/2, Z = -1_tube_p1$),
- EXT2: nodes group made up of the node located in external skin at the base of the nozzle tubes ($X = R_m + e/2, Y = -4 * \pi * R_m/5, Z = -1_tube_p1$),
- EXT1 (= EXT6 on the elbow): nodes group made up of the node located in external skin on the right side at the base of the nozzle tubes ($X = R_m + e/2, Y = -\pi * R_m, Z = -1_tube_p1$),
- MIL6: nodes group made up of the node located in external skin on the right side at the interface nozzle tubes and bends ($X = R_m + e/2, Y = \pi * R_m, Z = 0$),
- MIL5: nodes group made up of the node located in external skin on the underside at the interface nozzle tubes and bends ($X = R_m + e/2, Y = \pi * R_m/2, Z = 0$),
- MIL4: nodes group made up of the node located in external skin on the side at the interface nozzle tubes and bends ($X = R_m + e/2, Y = 0, Z = 0$),
- MIL3: nodes group made up of the node located in external skin on the suction face at the interface nozzle tubes and bends ($X = R_m + e/2, Y = -\pi * R_m/2, Z = 0$),
- MIL2: nodes group made up of the node located in external skin at the interface nozzle tubes and bends ($X = R_m + e/2, Y = -4 * \pi * R_m/5, Z = 0$),

- MIL1 (= MIL6 on the elbow): nodes group made up of the node located in external skin on the right side at the interface nozzle tubes and bends ($X = R_m + e/2, Y = -\pi * R_m, Z = 0$),

- MED6: nodes group made up of the node located in external skin on the right side more close to the median section of the part bends ($X = R_m + e/2, Y = \pi * R_m, Z = \alpha * R_c/2$),
- MED5: nodes group made up of the node located in external skin on the underside more close to the median section of the part bends ($X = R_m + e/2, Y = \pi * R_m/2, Z = \alpha * R_c/2$),
- MED4: nodes group made up of the node located in external skin on the left side more close to the median section of the part bends ($X = R_m + e/2, Y = 0, Z = \alpha * R_c/2$),
- MED3: nodes group made up of the node located in external skin on the suction face more close to the median section of the part bends ($X = R_m + e/2, Y = -\pi * R_m/2, Z = \alpha * R_c/2$),
- MED2: nodes group made up of the node located in external skin more close to the median section of the part bends ($X = R_m + e/2, Y = -4 * \pi * R_m/5, Z = \alpha * R_c/2$),
- MED1 (=MED6 on the elbow): nodes group made up of the node located in external skin on the right side more close to the median section of the part bends ($X = R_m + e/2, Y = -\pi * R_m, Z = \alpha * R_c/2$),
- BORDTU: contour interns section at the end of the nozzle tubes ($Z = -1_tube_p1$).

Groups of points useful for the boundary conditions of the type beam:

- BOU1: nodes group made up of the node located in external skin on the left side at the top of the nozzle P2 or of the bowl ($X = R_m - e/2, Y = 0, Z = \alpha * R_c + 1_tube_p2 + \text{longueur bol}$),
- BOU3: nodes group made up of the node located in external skin on the right side at the top of the nozzle P2 or of the bowl ($X = R_m - e/2, Y = +\pi * R_m, Z = \alpha * R_c + 1_tube_p2 + \text{longueur bol}$),
- P1 : node located at the center of the section EXTUBE,
- P2: node located at the center of section CLGV.

Mesh group surface:

- PEAUEXT: mesh group containing all meshes surface constituting the external skin of the elbow and the nozzles ($X = R_m + e/2$),
- PEAUINT: mesh group containing all meshes surface constituting the skin interns elbow and nozzles ($X = R_m - e/2$),
- FACE1: mesh group containing the upper lip of crack (Z1=0- plane) whose directional sense of the norm is positive towards Z1 positive,
- FACE2: mesh group containing the lower lip of crack (Z1=0+ plane) whose directional sense of the norm is positive towards Z1 negative,
- EXTUBE: mesh group surface constituting the end of the nozzle tubes ($Z = -1_tube_p1$).

Very Important:

The elements of skin described above have an external outgoing norm in external skin and an outgoing norm interns in intern skin.

Mesh group voluminal for short cracks:

- BLOCFISS: mesh group constituting the block fissures symmetrized,
- QUARBLOC: mesh group constituting the quarter of initial block (Y1>0 and Z1<0),
- BLOCOCTO: mesh group constituting the block fissures symmetrized and the octagone of incrustation,
- TORE1: half torus (Z1=0-) containing the crack tip and part of FACE1,
- TORE2: half torus (Z1=0+) containing the crack tip and part of FACE2 (complement of TORE1),
- COUDE: mesh group constituting all meshes voluminal and surface definite on the mesh,
- BOWL: mesh group constituting the mesh of nozzle of type bowl.

Mesh group voluminal for long cracks (a/c \square 0.2):

- BLOCFISS: mesh group constituting the block fissures symmetrized,
- BLOFISS1: mesh group constituting the half-block fissures symmetrized ($Z \leq 0$),
- BLOFISS2: mesh group constituting the half-block fissures symmetrized ($Z \geq 0$),
- TORE1: half torus ($Z1=0-$) containing the crack tip and part of FACE1,
- TORE2: half torus ($Z1=0+$) containing the crack tip and part of FACE2 (complement of TORE1),
- COUDE: mesh group constituting all meshes voluminal definite on the mesh,
- BOWL: mesh group constituting the mesh of nozzle of type bowl.

Nodes group:

- FONDFISS: nodes group constituting the crack tip describes in the order of Y1 negative in Y1 positive,
- CLGV: nodes group constituting the end of the nozzle P2 ($Z = \alpha * R_c + 1_tube_p2$),
- P_AXE_1: nodes group constituting the small axis of the crack ($Z1 = 0$) ordered in the meaning crack tip - > emerging face,
- P_AXE_2: nodes group constituting the small axis of the crack ($Z1 = 0+$) ordered in the meaning crack tip - > emerging face,
- G_AXE_1: nodes group constituting the main roads of the crack ($Z1 = 0$) ordered in the Y<0 meaning in Y>0 for a circumferential crack and in meaning Z<0 in Z>0 for the other crack directional senses,
- G_AXE_2: nodes group constituting the main roads of the crack ($Z1 = 0+$) ordered in the Y<0 meaning in Y>0 for a circumferential crack and in meaning Z<0 in Z>0 for the other crack directional senses,
- NOLIG1: nodes group made up of all the points of P_AXE_1 and the ligament located in the prolongation of this one in the thickness.
- NOLIG2: nodes group made up of all the points of P_AXE_2 and the ligament located in the prolongation of this one in the thickness.

5.4.1 Cases of half-structure

the following entities present but are associated with places different from whole structure:

- **CLGV** : elements of membrane located in median section forming the transverse symmetry plane of the elbow. In the case of a circumferential crack, one will be able to deduce there the lip (entity FACE2) thanks to operator `DEFI_GROUP (DIFFE)`,
- **BOU1** : node located on the median section in external skin on the left side for an azimuth of the default of 90° (this point also coincides with point MED4),
- **BOU3** : node diametrically opposed to BOU1 on the median section, located in external skin on the right side (this point also coincides with point MED6),
- **P2** : node located at the center section CLGV.

Entities FACE1, TORE1, BLOFISS1, P_AXE_1, G_AXE_1, NOLIG1, BOWL do not exist.

The boundary conditions for a half-structure in order to block displacements of rigid body and simulating the conditions of symmetry are the following ones (α is the angle of the elbow and ϕ the azimuth of the default):

- Blocking of normal displacement to the median section (CLGV from which one will have withdrawn the lip of default LEVRE2):
DZ = 0 for a tube,
DNOR = 0 for an elbow.

- A point on the aforementioned section blocked in the plane of this one:
 $DX = DY = 0$ for a tube,
 $DY = 0$ and $\cos(\alpha)DX - \sin(\alpha)DZ = 0$ for an elbow.
- The point opposed symmetrically (located at the azimuth Φ_1) to the precedent in the section, blocked in tangent displacement with the aforementioned section:
 $\sin(\Phi_1)DX + \cos(\Phi_1)DY = 0$ for a tube,
 $\sin(\Phi_1)\cos(\alpha)DX + \cos(\Phi_1)DY - \sin(\Phi_1)\sin(\alpha)DZ = 0$ an elbow.

Note:

One can also for half-structure plan to preserve the principle of the connection 3D-beam (used with the whole modelization in the MACR_ASCOUF_CALC) with a node in the middle of the median section (in the occurrence P2).

5.4.2 Cases of the quarter of structure

the modifications are similar to the preceding paragraph. Moreover, the two edges forming the longitudinal symmetry plane of the elbow are available:

- **BORD1** : elements of membrane located left side for an azimuth of default $\Phi = 90^\circ$,
- **BORD2** : elements of membrane located right side for an azimuth of default $\Phi = 90^\circ$.

The boundary conditions for a quarter of structure in order to block displacements of rigid body and simulating the conditions of symmetry are the following ones (α is the angle of the elbow and Φ the azimuth of the default):

- Blocking of normal displacement to the median section (CLGV from which one will have withdrawn the lip of default LEVRE2):
 $DZ = 0$ for a tube,
 $DNOR = 0$ for an elbow.
- Blocking of the longitudinal symmetry plane of tubular structure:
 $DNOR = 0$ on BORD1 and BORD2.
- Blocking of displacement perpendicular to the longitudinal symmetry plane of one of points (BOU3 to avoid taking the point located in the zone of the default which is BOU1) located at the intersection of the two planes previously quoted:
 $\cos(\Phi)DX + \sin(\Phi)DY = 0$ for a tube,
 $\cos(\Phi)\cos(\alpha)DX + \sin(\Phi)DY - \cos(\Phi)\sin(\alpha)DZ = 0$ an elbow.

6 Examples

the following table gives some examples of use of MACR_ASCOUF_MAIL.

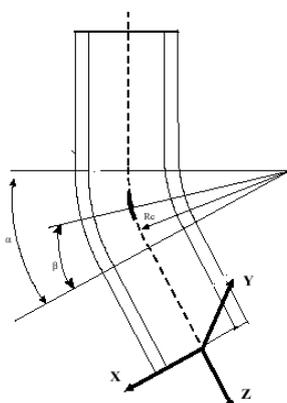
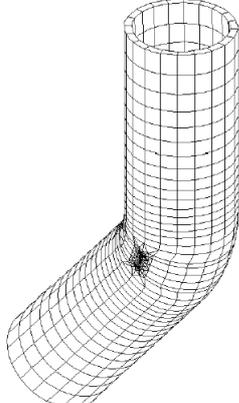
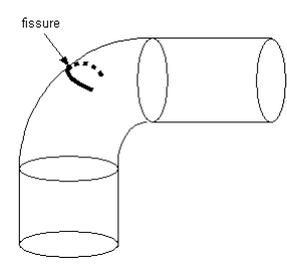
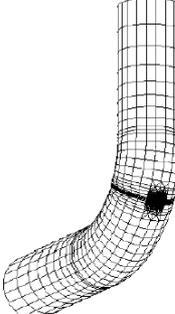
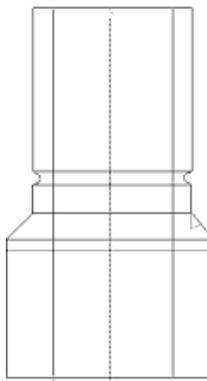
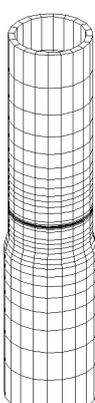
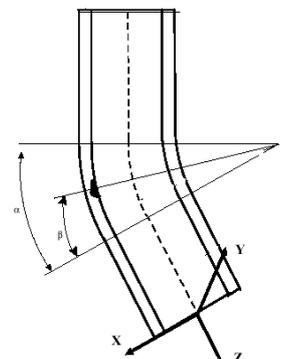
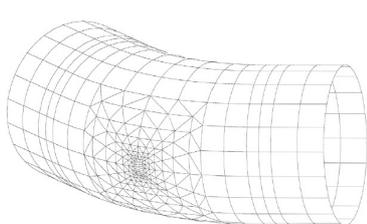
Type of default	Structure	Mesh
Bends with longitudinal short crack (ascou15a)		
Bends with circumferential long crack (ascou19a)		
Tubes with transition thickness and axisymmetric under-thickness (ascou06a)		
Elbow with elliptic under-thickness interns (ascou03a)		

Table: Examples of use of macro command MACR_ASCOUF_MAIL

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

Besides the examples described here one will be able to consult the command files (fichier.comm) of the cases tests. The latter are in the /aster/v9/STA9/astest directory and bear the names ascou *. Bend

6.1 with short crack MY

```
1 = MACR_ASCOUF_MAIL (EXEC
    _MAILLAGE=_F (LOGICIEL = "GIBI2000"), COUDE
    =_F (ANGLE = 40. , R_CINTR
        = 654. , DEXT
        = 912.4, EPAIS
        = 62.5, L_TUBE_P1
        = 1700. , L_TUBE_P2
        = 1700.), FISS
    _COUDE=_F (PROFONDEUR = 10. , LONGUEUR
        = 20. , POSI_ANGUL
        = 20. , AZIMUT
        = 90. , ORIEN
        = 0. , CRACK
        = "DEB_EXT", AXIS
        = "NON", NB_TRANCHE
        = 8, NB_SECTEUR
        = 3, NB_COURONNE
        = 2))
    Elbow
```

6.2 with elliptic under-thickness and extra thickness MY

```
2 = MACR_ASCOUF_MAIL (EXEC
    _MAILLAGE=_F (LOGICIEL = "GIBI2000"), COUDE
    =_F (ANGLE = 40. , R_CINTR
        = 1354. , DEXT
        = 912.4, EPAIS
        = 62.5, L_TUBE_P1
        = 1700. , L_TUBE_P2
        = 1700. , SUR_EPAIS
        = 8.), UNDER
    _EPAIS_COUDE=_F (TYPE = "ELLI", PROFONDEUR
        = 20. , AXE_LONGI
        = 50. , AXE_CIRC
        = 100. , POSI_ANGUL
        = 20. , AZIMUT
        = 0. , SOUS_EPAIS
        = "INTERN", NB_ELEM_LONGI
        = 4, NB_ELEM_CIRC
        = 8))
    Elbow
```

6.3 with under-ép. elliptic and under-ép. axisymmetric MY

```
3 = MACR_ASCOUF_MAIL (EXEC
    _MAILLAGE=_F (LOGICIEL = "GIBI2000"), COUDE
    =_F (ANGLE = 90. , R_CINTR
        = 1354. , DEXT
        = 912.4, EPAIS
        = 62.5, L_TUBE_P1
        = 1700. , L_TUBE_P2
        = 1700. ,), UNDER
    _EPAIS_MULTI= (_F
        (TYPE = "ELLI", PROFONDEUR
            = 20. , AXE_LONGI
            = 50. , AXE_CIRC
            = 100. , POSI_ANGUL
            = 45. , AZIMUT
            = 90. , SOUS_EPAIS
            = "INTERN", NB_ELEM_LONGI
            = 4, NB_ELEM_CIRC
            = 8), _F
        (TYPE = "AXIS", PROFONDEUR
            = 10. , AXE_LONGI
            = 10. , POSI_ANGUL
            = 45. , AZIMUT
            = 180. , SOUS_EPAIS
            = "EXTERNAL", NB_ELEM_LONGI
            = 4, NB_ELEM_CIRC
            = 20, EMPREINTE
            = "OUI')) PRINTING
    =_F (FICHIER = "MAIL.IDEAS" FORMAT
        = "IDEAS" UNITE
        = 38))
    Tube
```

6.4 with short crack and transition thickness MY

```
4 = MACR_ASCOUF_MAIL (EXEC _MAILLAGE=_F (LOGICIEL = "GIBI2000"), COUDE
    =_F (ANGLE =
        = 60. , R_CINTR
        = 654. , L_TUBE_P1
        = 1700. , L_TUBE_P2
        = 1700. , TRANSFORMEE
        = "TUBE", TRAN_EPAIS
        = "OUI", DEXT_T1
        = 250. , EPAIS_T1
        = 15. , EPAIS_TI
        = 25. , EPAIS_T2
        = 40. , ANGL_TETA1
        = 5. , ANGL_TETA2
        = 15. , ABSC_CURV_TRAN
        = 300.), FISS
```

```
_COUDE=_F (PROFONDEUR = 4. , LONGUEUR
           = 20. , POSI_ANGUL
           = 15. , AZIMUT
           = 90. , ORIEN
           = 90. , CRACK
           = "DEB_EXT", NB_TRANCHE
           = 8, NB_SECTEUR
           = 2, NB_COURONNE
           = 3, RAYON_TORE
           = 0.5), PRINTING
=_F (UNITE = 37 FORMAT
     = "CASTEM"))
Tube
```

6.5 with axisymmetric crack and transition thickness MY

5 = MACR_ASCOUF_MAIL (EXEC

```
_MAILLAGE=_F (LOGICIEL=' GIBI98',), COUDE
=_F (TRAN_EPAIS=' OUI', EPAIS
     _T1=60.0, EPAIS
     _T2=90.0, L_
     TUBE_P2=900.0, TRANSFORMEE
     = ' TUBE', L_
     TUBE_P1=1010.0, DEXT
     _T1=660.0, ABSC
     _CURV_TRAN=183.541, ANGL
     _TETA1=30.0, R_
     CINTR=340.0, ANGLE
     =90.0,), FISS
_COUDE=_F (NB_COURONNE=3, ABSC
           _CURV=150.0, PROFONDEUR
           =7.5, NB
           _TRANCHE=40, LONGUEUR
           =0., AXIS
           = ' OUI', AZIMUT
           =0.0, NB
           _SECTEUR=2, CRACK
           = ' DEB_EXT', RADIUS
           _TORE=1.8, ORIEN
           =90.0,), PRINTING
=_F (FORMAT=' IDEAS',),)
Bibliography
```

7 B.

- 1) MARTELET - S. IGNACCOLO. Tools ASCOUF: Specification for the modelization of the connections of the elbows to the components of the primary loops. Note SEPTEN ENT MS/96007A of the 2/15/96. I.
- 2) EYMARD - MR. BONNAMY: Preprocessor ASCOUF - User's manual - Version 5. Note EDF/DER HI-74/95/025/C S.
- 3) ANDRIEUX - I. EYMARD: Definition of the geometrical transformation plate-tube-elbow. Note EDF/DER HI-74/95/004/B of the 4/11/95