Macro command MACR_ASPIC_MAIL

1 Drank

To generate the mesh of an operational bypass or with long or short crack.

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 the macro MACR_ASPIC_CALC.

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

MACR_ASPIC_MAIL calls on command MODI_MAILLAGE to transform the mesh of the square into mesh of the bypass.

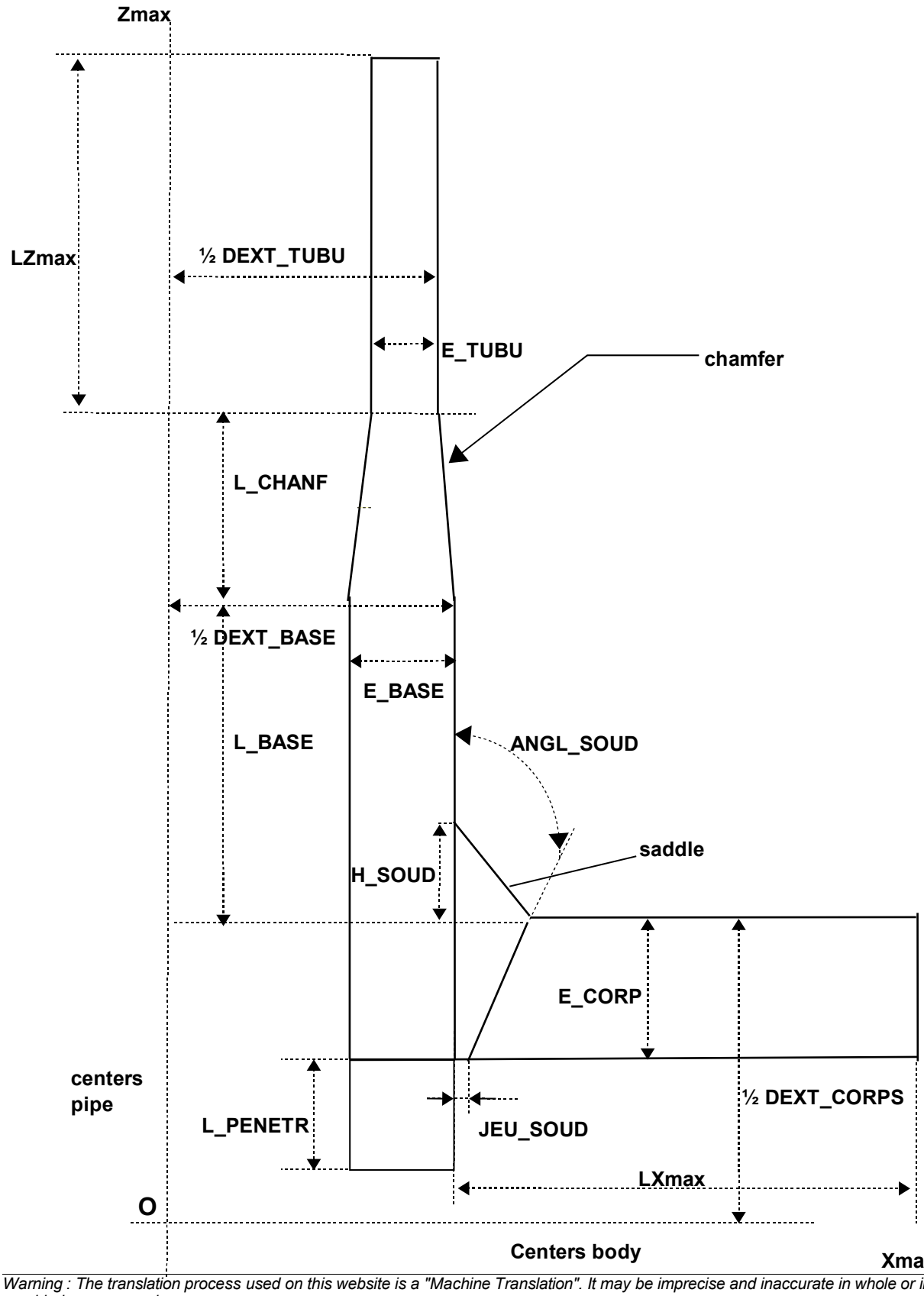
2 Syntax

```
mesh    [mesh] = MACR_ASPIC_MAIL      (

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

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

    ◊ RAFF_MAIL=/            "GROS" ,
[DEFAULT]
                         /   "FIN"  ,                                [TXM]

   ♦TUBULURE  =_F       ( ♦E_BASE=          thickness   ,             [R]
                             ♦DEXT_ BASE= diameter  ,              [R]
                           ♦L_BASE=          length   ,             [R]
                           ♦L_CHANF       = length ,             [R]
                           ♦E_TUBU=          thickness   ,             [R]
                           ♦   DEXT_TUBU=    diameter    ,             [R]
                           ♦Z_MAX=           length   ,             [R]
                           ♦TYPE=        /"TYPE_1" ,             [TXM]
                                           /"TYPE_2"  ,
                           ◊L_PENETR=       /0.          ,
[DEFAULT]
                                           /length ,             [R]
                         ),

   ♦SOUDURE   =_F       ( ♦H_SOUD=          height   ,                [R]
                           ♦ANGL_SOUD=       angle    ,                [R]
                           ♦JEU_SOUD=        clearance      ,
    [R]
                         ),

   ♦CORPS  =_F          ( ♦E_CORPS=         thickness   ,             [R]
                           ♦   DEXT_CORP=    diameter ,             [R]
                           ♦X_MAX=           length   ,             [R]
                         ),

   ◊FISS_SOUDURE  =_F    (              ♦/TYPE=' LONGUE' ,
                                ◊AXIS=/      "OUI'  ,
                                           /"NON" ,             [DEFAULT]
                               /TYPE     =   ' COURTE'    ,
                                 ◊  COEF_MULT_RC1=       rc1   ,       [R]
                                 ◊  COEF_MULT_RC2=       rc2   ,       [R]
                                 ◊  COEF_MULT_RC3=       rc3   ,       [R]
                           ◊NB_SECTEUR=      NS ,                 [I]
                           ◊NB_COURONNE=     nc ,                 [I]
```

```
◊  NB_TRANCHE=   NT,                [I]
◊  RAYON_TORE=   rc0   ,                [R]
♦PROFONDEUR=     has      ,                [R]
◊LONGUEUR=          2c    ,                [R]
♦  AZIMUT=          theta,                [R]
♦  POSITION=/            "DROIT"   ,       [TXM]
                    /  "INCLINE" ,
```

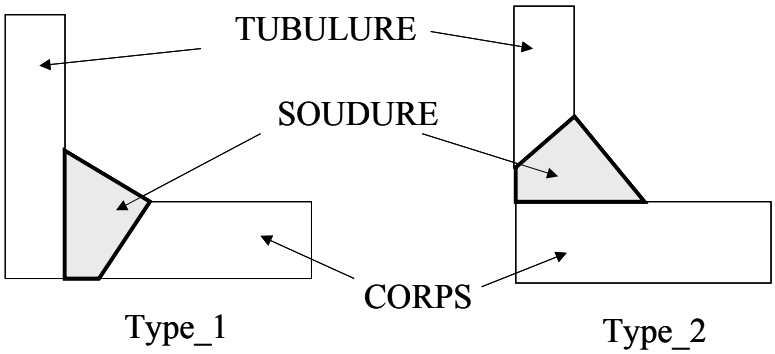
```
                              ♦  FISSURE=/           "DEB_INT" ,       [TXM]
                                                  /  "DEB_EXT" ,
                                                  /  "NON_DEB" ,
                                                  /  "TRAVERS" ,
      # If CRACK = "NON_DEB" then
                                    ◊LIGA_INT=                lig,      [R]
      # Finsi
                                    ◊ANGL_OUVERTURE=       /eps,      [R]
                                                           /0. ,
      [DEFAULT]
                           ),

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

         ◊INFO   =          1 ,
      [DEFAULT]
                         /2 ,

                                                 )
```

3 geometrical Definition of the bypass



Appears 3-a: description of the various parameters (weld of type_1)

There are two types of weld:



Determination of Xmax and Zmax

In a general way, the maximum dimension of a tube "Dmax" is defined from damping length "Ldmax". This length is calculated by the following formula: $Max(\frac{3}{2}\sqrt{\frac{R_m^3}{e}}, 3\sqrt{R_m e})$, where *Rm* is the average radius of the tube considered and *E* its thickness.

- *Computation of LXmax* (body): one applies the preceding formula with *Rm* average radius of the body (CORPS) and *E* his thickness.

- *Computation of LZmax* : the radius and the thickness of the pipe are not constant. It is thus necessary to successively twice apply the formula of the maximum, with the following data:
  - *Rm* average radius of pipe (TUBU) and *E* its thickness;
  - *Rm* average radius of the base of pipe (BASE) and *E* its thickness.

  Then one takes the maximum of the two preceding values.

These damping lengths are counted starting from edge external of the base of the pipe (according to X) and with the top of the chamfer (according to Z).

One thus obtains finally:

$$X_{max} = LX_{max} + 1/2\, DEXT\_BASE$$
$$Z_{max} = LZ_{max} + 1/2\, DEXT\_CORP + L\_BASE + L\_CHANF$$

These values constitute **the minimal values** for the length of the body and the pipe in order to respect the criterion over damping length: it is thus licit to do calculations with lengths larger than those.

It is possible to generate meshes with lengths of the bodies and pipe smaller than these damping lengths: an alarm message however is transmitted and the user is only judge of the relevance of his results.

4 Operands

4.1 Key word factor EXEC_MAILLAGE

4.1.1 Operand LOGICIEL

♦LOGICIEL=/ "GIBI98" ,
/ "GIBI2000",

Software GIBI carried out for the realization of the mesh of the square.

◊ UNITE_DATG= unit_d

Number of the logical unit where one can print data GIBI generated for the realization of the mesh of the square. By default, 70.

◊UNITE_MGIB= unit_s

logical Number of unit where one can print the mesh of the square generated by GIBI. By default, 19.

◊NIVE_GIBI=

Level of GIBI used, which is worth 10 per default.

4.2 Operand TYPE_ELEM

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

/ "CU20" , [DEFAULT]
/ "CUB8" , [TXM]

4.3 Operand RAFF_MAIL

This operand makes it possible to define the refinement of the mesh close to weld. It is Coarse by default, but it can be more FIN. [Table 4.3-1] the number of nodes indicates on the saddle and the interface (see [Figure 5-a]) when one uses operand RAFF_MAIL in the case of "healthy" meshes.

	Many nodes on the saddle	Many nodes on interface
GROS	2	3
FIN	3	7

Table 4.3-1: Topological definition of weld

For the cracked meshes, this parameter defines the refinement of the mesh around the crack tip and determines the values by default of the various optional parameters (cf [§4.10] and [§4.11]).

Notice 1:

In the case of a thermomechanical cal bottom on an operational bypass, the mesh with coarse refinement is not sufficient to make it possible to apply the simplified methods of the functions of influence which require to be able to collect the heat gradient correctly, it is thus not validated. An analysis of harmfulness of default on operational bypass in linear elasticity with ASPIC must be led on a mesh of fine refinement which allows a faithful representation of the field of temperature and stresses during the transient.

Notice 2:

In the case of one cal linear elastic bottom on a fissured bypass (short crack), the presence of a fissured block very refined around crack led, whatever the refinement of the mesh of the pipes on both sides of weld, with a faithful representation of rate of energy restitution G during the transient. The meshes of ASPIC with fine or coarse refinement are thus validated. From a practical point of view and in order to limit the computing times, one can be satisfied with a mesh with coarse refinement.

For the justification of the two remarks above, the reader will be able to consult the reference [1].

4.4 Key word factor TUBULURE

All the coasts of the mesh must be given in mm.

4.4.1 Operand E_BASE

♦E_BASE= thickness

Value of the thickness of the pipe in the zone of connection with the body.

4.4.2 Operand DEXT_BASE

♦DEXT_ BASE = diameter

Value of the diameter external of the pipe in the zone of connection with the body.

4.4.3 Operand L_BASE

♦L_BASE= length

Value length of the base of the pipe counted from surface external of the body.

4.4.4 Operand L_CHANF

♦L_CHANF = length

Value length of the chamfer.

4.4.5 Operand E_TUBU

♦E_TUBU= thickness

Value of the thickness of the pipe to the top of the chamfer.

4.4.6 Operand DEXT_TUBU

♦DEXT_TUBU= diameter

Value of the diameter external of the pipe with the top of the chamfer.

4.4.7 Operand Z_MAX

♦Z_MAX= length

Value of the maximum dimension in Z of the pipe specifying the localization of the load vector force, cf Appears 3-a.

This value must be higher than the value defined in the §3 and corresponding to the damping length of the bending wave. If this dimension is not reached, an alarm message not blocking is transmitted.

4.4.8 Operand TYPE

♦TYPE=

Defines the position of weld.

/"TYPE_1' the bevel of weld is located in the body
/"TYPE_2' the bevel of weld is located in pipe

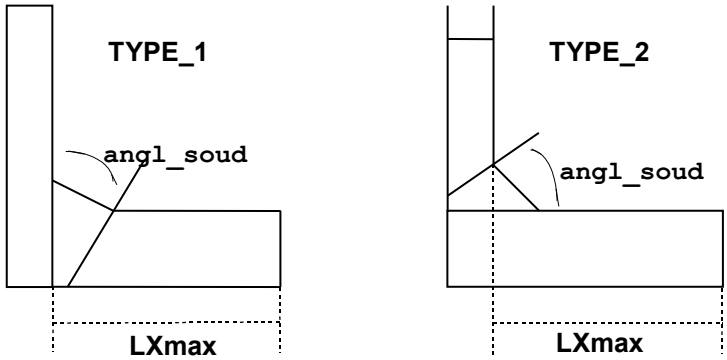


Figure 4.4.8-a: Definition of the position of the weld

4.4.9 Operand L_PENETR

◊L_PENETR= length

Value length of penetration of the pipe counted from the internal skin of the body in the case of a penetrating bypass. By default, bypass N" is not penetrating (the length of penetration is null).
A length of non-zero penetration N" is authorized that for welds of type 1.
The case of **tilted cracks emerging in intern skin with a non-zero clearance and a bypass penetrating is prohibited,** because in this case, one cannot net the corner of the penetrating part of the pipe. The user must then choose a null clearance (operand JEU_SOUD).

4.5 Key word factor SOUDURE

4.5.1 Operand H_SOUD

♦H_SOUD= height

Value height of weld counted from surface external of the body for welds of the type 1 and of the pipe for welds of the type 2.

4.5.2 Operand ANGL_SOUD

♦ANGL_SOUD= angle

Value of the angle of weld, in degrees.

4.5.3 Operand JEU_SOUD

♦JEU_SOUD= clearance

Value of the space located between the body and the pipe representing the clearance of weld.

4.6 Key word factor CORPS

4.6.1 Operand E_CORP

♦E_CORPS= thickness

Value of the thickness of the body.

4.6.2 Operand DEXT_CORP

♦DEXT_CORPS= diameter

Value of the diameter external of the body.

4.6.3 Operand X_MAX

♦X_MAX= length

Value of the maximum dimension in X of the body specifying the localization of the load vector force, cf Appears 3-a.

This value must be higher than the value defined in the §3 and corresponding to the damping length of the bending wave. If this dimension is not reached, an alarm message not blocking is transmitted.

4.7 Key word factor FISS_SOUDURE

Key word specific to the fissured bypasses.

4.7.1 Operand TYPE

♦TYPE=

Defines the type of crack: long crack or short crack.

/"LONGUE" one considers the case of long cracks but not very deep (1/8 or 1/4 of thickness)

/"COURTE" one considers the case of cracks of maximum depth equal to the half thickness of the bypass

4.7.2 Operand FISSURES

♦FISSURE=

Gives the position of crack

/"DEB_INT" emerging in intern skin

/"DEB_EXT" emerging in intern skin

/"NON_DEB" not emerging

/"TRAVERS" crossing

4.7.3 Operand AXIS

◊AXIS=

Power process the case of axisymmetric cracks ("OUI') or not axisymmetric ("NON") (if parameter fissures **long** exclusively).

Caution:

If the crack is axisymmetric (AXIS=' OUI') and if the crack is tilted (POSITION=' INCLINE'), the depth of crack will be corrected only if ANGL_SOUD lies between 8 and 26 degrees, this whatever the type of weld (TYPE_1 or TYPE_2). If the crack is axisymmetric and right (POSITION=' DROIT') the correction of depth is carried out whatever the authorized value of ANGL_SOUD .

4.7.4 Operand AZIMUT

♦AZIMUT= theta

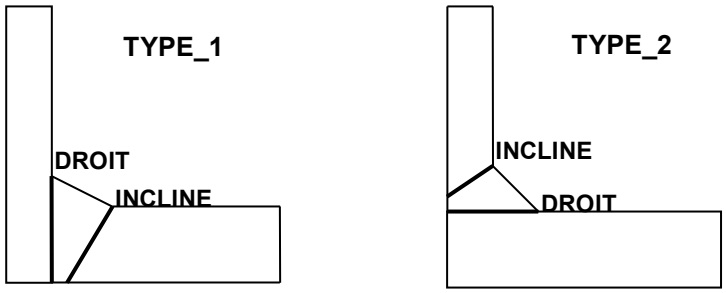
Position of the center of crack, counted positively from the axis X of the body, in degrees.

4.7.5 Operand POSITION

♦POSITION=

/"DROIT" the crack is at the interface between the pipe and weld for a weld of the type 1 and at the interface between the body and weld for a weld of the type 2.

/"INCLINE" the crack is located at the interface between the body and weld for a weld of the type 1 and at the interface between the pipe and weld for a weld of the type 2.



Appears 4.7.13-a: Definition of the position of a crack according to the type of the weld

4.7.6 Operand PROFONDEUR

♦PROFONDEUR= has

If TYPE = "LONGUE" has = depth of crack if the crack is emerging
= half - depth of crack if the crack is not emerging

If TYPE = "COURTE" has = size of **the small half centers** elliptic cracks
= depth of crack if the crack is emerging
= half-depth if the crack is not emerging

Note::

In the case of a crack of the type "COURTE" and emerging ("DEB_INT" or "DEB_EXT"), the real depth of crack in the generated mesh is calculated. That thus makes it possible to the user to check coherence between its data input and the mesh obtained. This information appears in the message file , at the end of the messages associated with macro-command MACR_ASPIC_MAIL:

```
<MACR_ASPIC_MAIL> PROFONDEUR OF CRACK IN THE MESH: 29.99
```

4.7.7 Operand LONGUEUR

◊LONGUEUR= 2c

If TYPE = "LONGUE" length of crack
If TYPE = "COURTE" cuts **large axis** of elliptic cracks

For short cracks (elliptic), a/c must be ranging between 1 and 0.2.

When the crack is axisymmetric (AXIS), it is useless to give a length, and this one is then not taken into account. This operand is on the other hand compulsory in the case of a nonaxisymmetric crack.

4.7.8 Operand LIGA_INT

◊LIGA_INT

Defines the length in mm of the interior ligament for a crack not emerging.

4.7.9 Operand ANGL_OUVERTURE

◊ANGL_OUVERTURE= eps

Defines the half angle of opening of crack in degrees (0 per default).

4.7.10 Operand RAYON_TORE

◊RAYON_TORE= rc0

Radius of the torus of the zone with imposed mesh of type radiating around the crack tip, cf Figure 4.7.10.
For long cracks, this parameter is calculated automatically.

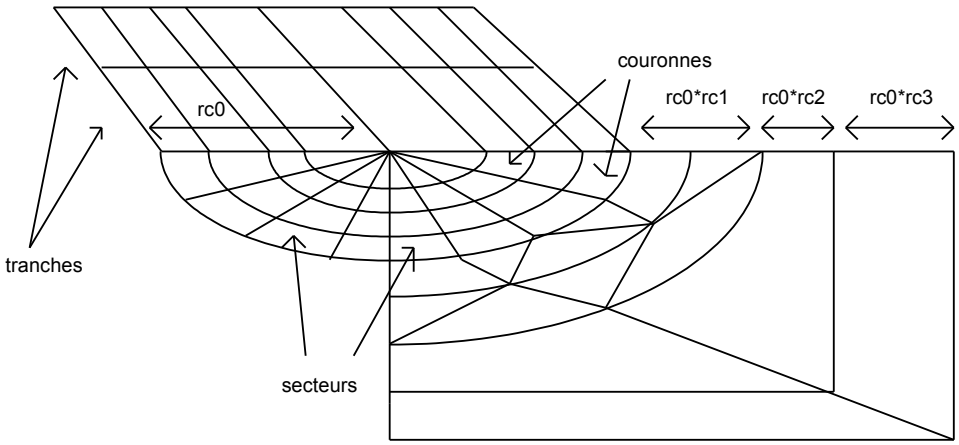


Figure 4.7.10: Parameters of crack the basic mesh radiating

4.7.11 Operand COEF_MULT_RC1

◊ COEF_MULT_RC1= rc1

multiplying Coefficient of the parameter rc0 allowing to define the thickness of the contour of coarsening of the sectors (if parameter fissures **short** exclusively, with two default values according to the refinement of the mesh).

4.7.12 Operand COEF_MULT_RC2

◊ COEF_MULT_RC2= rc2

multiplying Coefficient of the parameter rc0 allowing to define the thickness of the first contour of coarsening of the slices (if parameter fissures **short** exclusively, with two default values according to the refinement of the mesh).

4.7.13 Operand COEF_MULT_RC3

◊ COEF_MULT_RC3= rc3

multiplying Coefficient of the parameter rc0 allowing to define the thickness of the second contour of coarsening of the slices (if parameter fissures **short** exclusively, with two default values according to the refinement of the mesh).

4.7.14 Operand NB_SECTEUR

◊NB_SECTEUR= NS

Many sectors on **90°**, which is worth 2 or 4 in general.

4.7.15 Operand NB_COURONNE

◊NB_COURONNE = nc

Nombre of contours, which is worth 3 or 4 in general.

4.7.16 Operand NB_TRANCHE

◊NB_TRANCHE= NT

Many slices corresponding to **a quarter of elliptic crack**, which is worth 8 or 16 in general (16 or 32 for cracks with strong eccentricity).
For long cracks, the minimal value of 8 is imposed.

4.8 Key word factor PRINTING

4.8.1 Operand FICHIER

Name given to the print file. By default, the print file is file of mesh type ASTER (standard .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.

4.8.2 Operand UNITE

logical Number of unit associated with the file.

4.8.3 Operand FORMAT

Specifies the format of printing of the mesh of the bypass. By default, the format is ASTER.

4.8.4 Operand VERSION

the file IDEAS has a structure different according to the version from the software. This operand is thus licit only when operand FORMAT is worth IDEAS. By default, VERSION is worth 5. Only versions 4 and 5 are supported.

4.8.5 Operand NIVE_GIBI

file CASTEM has a structure different according to the level from output of the Gibi software. This operand is thus licit only when operand FORMAT is worth CASTEM. By default, VERSION is worth 10. Only levels 3 and 10 are supported.

4.9 Operand INFO

◊ INFO=/1 , [DEFAULT]
/2 , [I]

Level of information.
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.

4.10 Parameters by default for short cracks

- two values according to the refinement of the mesh,
- variable values according to the eccentricity of crack.

	a/c > 0.4999		a/c > 0.3499		a/c < 0.3499	
standard mesh	large	fine	large	fine	large	fine
NT	8	16	8	16	16	32
nc	3	4	3	4	3	4
NS	2	4	2	4	2	4
ndt (*)	1	2	1	2	2	2
nsdt (*)	2	4	2	4	4	4
rc0	a*0.12	a*0.10	a*0.12	a*0.10	a*0.08	a*0.08
rc1	1.2.1.0.1.2			1.0.1.2.1.0		
rc2	1.4.1.2.1.4			1.2.1.4.1.2		
rc3	*	2.2	*	2.0.2.5.2.0		
beta (*)	1	1	1	1	1	1
alpha (*)	0	0.0.4.0.4			0.8.0.8	

Table 4.10-1: Parameters by default of short cracks

(*) Parameters nonaccessible to the user

4.11 Parameters by default for long cracks

- two values according to refinement from the standard

mesh mesh	large	fine
nc	3	4
NS	2	4
ndt (*)	2	3
rc0	has (ndt+1)	has (ndt+1)
f_etir_f (*)	30*Léquerre/Lpiquage	15*Léquerre/Lpiquage
f_etir_p (*)	60*Léquerre/Lpiquage	30*Léquerre/Lpiquage

Table 4.11-1: Parameters by default of long cracks

(*) Parameters nonaccessible to the user

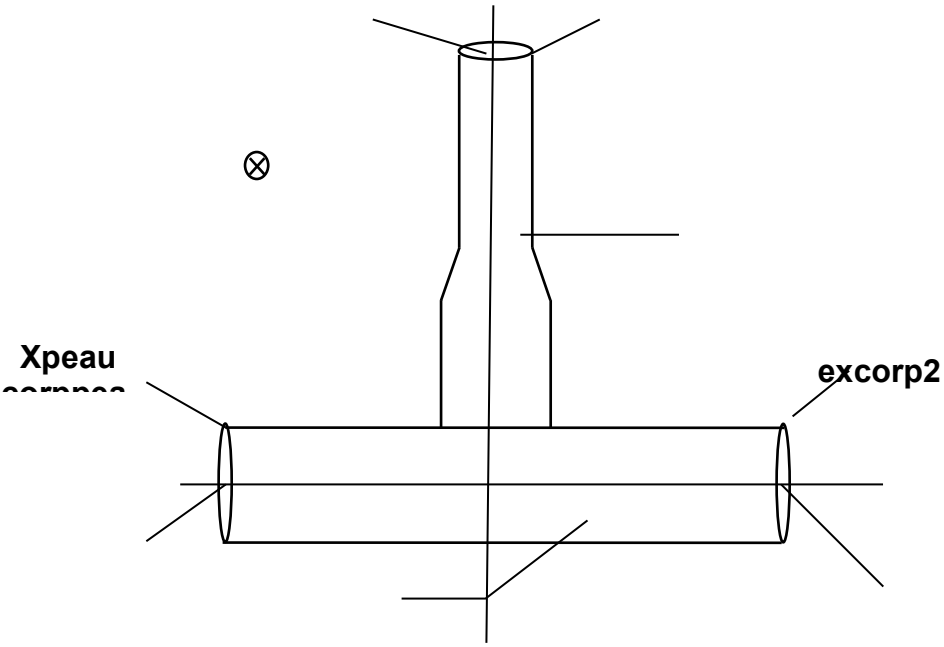
4.12 numerical Values for the geometrical parameters

the values from the geometrical parameters must be understood in the following ranges:

21 mm < epC <60 mm epC → E_CORP,
406 mm < DEC < 1500 mmDeC→DEXT_CORPS ,
141 mm < epT1<70 mm epT1 → E_BASE,
8 mm < epT2 < 56 mm epT2 → E_TUBU,
140 mm < DeT1 < 880 mmDeT1→DEXT_BASE ,
114 mm < DeT2 < 812.8 mm DeT2 → DEXT_TUBU,
41 mm < d1 < 825 mmd1→L_BASE ,
22 mm < d2 < 135 mm d2 → L_CHANF,
15 mm ≤ H ≤ 30 mm according to UTO/SISh→H_SOUD ,
0 mm < clearance < 20 mmjeu→JEU_SOUD ,
15° < alpha < 50°alpha→ANGL_SOUD .

5 Topological mesh and groups

macro command MACR_ASPIC_MAIL generates the mesh [Figure 5-a].



Appears 5-a: Mesh obtained

One notes:

- peautubu : interior skin of the pipe,
- peaucorp : interior skin of the body,
- excorp1 : the extreme section of the body, located at the dimension X = - Xmax,
- excorp2 : the extreme section of the body, located at the dimension X = +Xmax,
- P1_CORP : the node located at the center of excorp1,
- P2_CORP : the node located at the center of excorp2,
- extubu : the extreme section of the pipe, located at the dimension Z = Zmax,
- P_TUBU : the node located at the center of extubu.

Note:

Mesh groups TUBU, CORPS and SOUD are present only in the case of the operational bypass. They are replaced by TUBU and SOUDCORP or SOUDTUBU and CORPS, according to the type of weld and the position of crack (see the documentation of MACR_ASPIC_CALC, [§3.5.1]).

For postprocessings of the operational bypass, the nodes located at the ends of each segment, the various azimuths, whose group forms an interface between weld and the body, on the one hand, and between weld and the pipe, on the other hand, are created so that one can record there the normal stresses and tangential.

For the fissured bypasses, one notes also the following objects:

- levrtubu : the lip of crack, side pipe (meshes surface),
- levrcorp : the lip of crack, side body (meshes surface),
- fondfiss : crack tip (meshes SEG3), in the case of the unspecified emerging cracks or not emerging short which have one crack tip,
- fond_sup : crack tip (meshes SEG3) higher (external side skin) in the case of the long or axisymmetric cracks not emerging which have two crack tips,
- fond_inf : crack tip (meshes SEG3) lower (side skin interns) in the case of the long or axisymmetric cracks not emerging which have two crack tips.

Pfondfis, pfondsup and pfondinf are mesh groups POI1 respectively associated with the fondfiss groups, fond_sup and fond_inf.

The table below presents the mesh groups suitable for the fracture mechanics:

fissure	**not emerging**	**emerging**	**crack**
name of object Gibi	description	name of object Gibi	description
vfcos1	1/8 **block** volume **fissured body higher** side Y>0	vfco1	1/4 **block** volume **fissured body** on the side Y>0
vftus1	1/8 **block** volume **fissured pipe higher** side Y>0	vftu1	1/4 **block** volume **fissured pipe** on the side Y>0
torecos1	1/8 of torus pertaining to vfcos1	toreco1	1/4 of torus pertaining to vfco1
toretus1	1/8 of torus pertaining to vftus1	toretu1	1/4 of torus pertaining to vftu1
vfcos2	1/8 **block** volume **fissured body higher** side Y<0	vfco2	1/4 **block** volume **fissured body** on the side Y<0
vftus2	1/8 **block** volume **fissured pipe higher** side Y<0	vftu2	1/4 **block** volume **fissured pipe** on the side Y<0
torecos2	1/8 of pertaining torus with vfcos2	toreco2	1/4 of torus pertaining to vfco2
toretus2	1/8 of torus pertaining to vftus2	toretu2	1/4 of torus pertaining to vftu2
vfcoi1	1/8 **block** volume **fissured body lower** side Y>0		
vftui1	1/8 **block** volume **fissured pipe lower** side Y>0		
torecoi1	1/8 of torus pertaining to vfcoi1		
toretui1	1/8 of torus pertaining to vftui1		
vfcoi2	1/8 **block** volume **fissured body lower** side Y<0		
fvtui2	1/8 **block** volume **fissured pipe lower** side Y<0		
torecoi2	1/8 of torus pertaining to vfcoi2		
toretui2	1/8 of torus pertaining to vftui2		

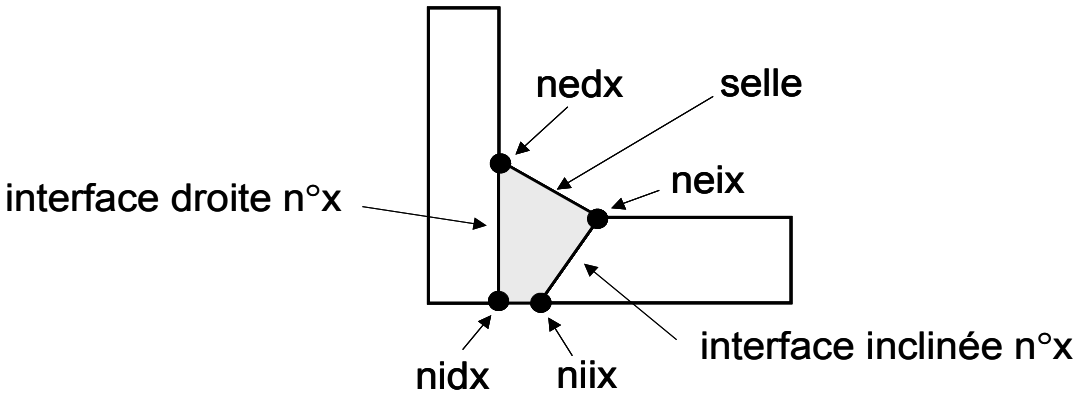
Table 5-1: Location of geometrical entities for the fracture mechanics

the other mesh groups, not specified here, are used with the geometrical transformation of the square in bypass, (resticking of surfaces and suppression of the double nodes) and for the automatic computation of the basic effect, in the macro-commands.

For the operational bypasses:

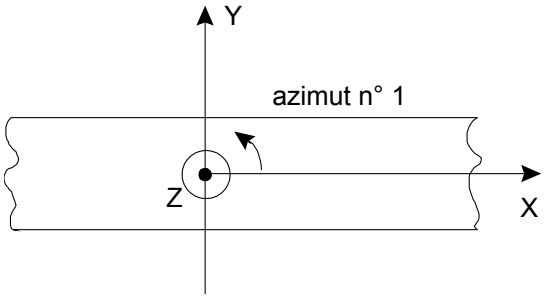
one notes for the azimuth n°x (X ranging between 1 and 48 for the refined meshes and between 1 and 40 for the coarse meshes):

- nedx : node external of the right segment,
- nidx : interior node of the right segment,
- neix : node external of the inclined segment,
- niix : interior node of the inclined segment,
- ldx : line energy of nidx with nedx,
- lix : line energy of niix with neix.



Appear 5-b: Names of the nodes groups to the azimuth n°x of the operational bypass

The classification of the azimuths (from 1 to 40 for the coarse meshes or from 1 to 48 for the fine meshes) is done in the trigonometrical meaning around the axis Z from the axis X of the body.



Appear 5-c: Classification of the azimuths for the operational bypasses

6 Example

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 directory “astest” of the installation and bear the names aspic *. MY

```
=MACR_ASPIC_MAIL (EXEC

              _MAILLAGE=_F (LOGICIEL  = “GIBI2000”), TUBULURE

              =_F (E_BASE  = 60.0, DEXT_BASE
                           = 872.0, L_BASE
                           = 298.0, L_CHANF
                           = 102.0, TYPE
                           = ' TYPE_1', E_TUBU
                           = 27.0, DEXT_TUBU
                           = 812.8, Z_MAX
                           = 3398.2), RAFF

              _MAIL=' GROS', SOUDURE

              =_F (H_SOUD  = 15.0, ANGL_SOUD
                           = 25.0, JEU_SOUD
                           = 10.0), CORPS

              =_F (E_CORP  = 60.0, DEXT_CORP
                         = 1500.0, X_MAX
                         = 4177.2), FISS

              _SOUDURE=_F (TYPE  = “LONGUE”, PROFONDEUR
                                 = 30.0, LONGUEUR
                                 = 300.0, AZIMUT
                                 = 0.0, POSITION
                                 = “INCLINE”, FISSURES
                                 = “DEB_INT”), PRINTING

              =_F (FICHIER
                    =   “FICH_MA”, UNITE
                    =     37, FORMAT
                    =    “CASTEM”,)
                         )
                    Bibliography
```

7 [1

] S. MUSI. Tools - trade ASPIC – Validations of the meshes for the computation of the transitoiresthermiques ones . Note SEPTEN E-N-T-MS/00-01108-A of the 1/25/2001.