Structures of data FOND_FISS

Summary:

This document describes the structure of data Fond_fiss produced by the operator DEFI_FOND_FISS [U4.82.01] and used by the operators of breaking process CALC_G [U4.82.03] and POST_K1_K2_K3 [U4.82.05].

1 General information

An object of the type fond_fiss described a bottom of crack of a grid 3D or 2D (in this case, the bottom of crack is tiny room to a node). This concept is obligatorily produced by the operator DEFI_FOND_FISS [U4.82.01].

2 Relationships to the other structures of data

A concept fond_fiss is defined on a grid, via the entities NODE, GROUP_NO, MESH, GROUP_MA describing the crack.

3 Tree structure of the structure of data fond_fiss

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fond_fiss (K8)   :: =  record

   ♦  '.INFO'            :  S  V  K8
   ♦  '.FONDFISS'        :  S  V  R
   ♦  '.FOND.TYPE'       :  S  V  K8

   #si the bottom is defined by only one group of nodes or meshs
   ◊  '.FOND.NOEU'       :  S  V  K8

   #SI the bottom is defined by a bottom sup and a bottom inf
   ◊  '.FONDINF.NOEU'    :  S  V  K8
   ◊  '.FONDSUP.NOEU'    :  S  V  K8

   #SI the bottom is defined on the auxiliary grid
   ◊  '.FONDFISG'        :  S  V  R

   #If CONFIG_INIT=' DECOLLEE' in DEFI_FOND_FISS
   ◊  '.NORMALE'         :  S  V  R

   #If CONFIG_INIT=' COLLEE' in DEFI_FOND_FISS
   ◊  '.BASEFOND'        :  S  V  R
   ◊  '.LTNO'            :  CHAM_NO
   ◊  '.LNNO'            :  CHAM_NO
   ◊  '.BASLOC'          :  CHAM_NO
   ◊  '.FOND.TAILLE_R'   :  S  V  R

   ◊  '.DTAN_ORIGINE'    :  S  V  R
   ◊  '.DTAN_EXTREMITE'  :  S  V  R

   #If LEVRESUP is present in DEFI_FOND_FISS
   ◊  '.LEVRESUP.MAIL'   :  S  V  K8
   ◊  '.SUPNORM.NOEU'    :  S  V  K8

   #If LEVRESUP is present in DEFI_FOND_FISS
   ◊  '.LEVREINF.MAIL'   :  S  V  K8
   ◊  '.INFNORM.NOEU'    :  S  V  K8
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4 Contents of the objects JEVEUX basic

'.INFO' : Vector (K8) containing information on the crack

'.FOND.NOEU'	:	vector (K8) containing the list of the NR nodes ordered of the bottom of crack
'.FONDINF.NOEU'	:	vector (K8) containing the list of the NR nodes ordered of the bottom and pertaining to the lower lip of crack
'.FONDSUP.NOEU'	:	vector (K8) containing the list of the NR nodes ordered of the bottom and pertaining to the upper lip of crack
'.FONDFISS'	:	vector of real containing the coordinates as well as the curvilinear X-coordinates of the nodes of the bottom.
'.FOND.TYPE'	:	Character string (K8) describing the type of mesh in bottom of crack
'.FONDFISG'	:	vector of real containing the coordinates as well as the curvilinear X-coordinates of the nodes of the bottom on the auxiliary grid.
'.BASEFOND'	:	vector of real 2*DIM*N containing the components of the normal vector to the average plan of the lips then vector of propagation of the crack, locally to each node of the bottom of crack.
'.NORMALE'	:	vector of 3 real containing the components (n_x, n_y, n_z) normal with the plan of the lips (case of a crack planes) (see convention of sign in [U4.82.01 §3.4])
'.DTAN_ORIGINE'	:	vector of 3 real containing the components of the tangent to the structure in the beginning of the bottom of crack, in the plan of the lips (see convention of sign in [U4.82.01 §3.5])
'.DTAN_EXTREMITE'	:	even thing that .dtan_origine at the end of the bottom of crack
'.BASLOC'	:	field with the nodes (CHAM_NO) containing the origin and the vectors of the local base at the bottom of crack
'.LTNO'	:	field with the nodes (CHAM_NO) scalar which contains for each node of the grid the actual value of the level set tangent to the crack.
'.LTNO'	:	field with the nodes (CHAM_NO) scalar which contains for each node of the grid the actual value of the level set normal to the crack.
'.LEVRESUP.MAIL'	:	vector (K8) containing the list of the meshs of the upper lip of the crack
'.LEVREINF.MAIL'	:	vector (K8) containing the list of the meshs of the lower lip of the crack
'.SUPNORM.NOEU'	:	vector (K8) containing the list of the nodes of the upper lip on the normal direction than the bottom of crack
'.INFNORM.NOEU'	:	vector (K8) containing the list of the nodes of the lower lip on the normal direction at the bottom of crack
'.FOND.TAILLE_R'	:	vector of real container for each node of the bottom, an estimate of the size according to the radial direction, of the meshs which are connected to them.

5 Contents of the objects of sd_fond_fiss

5.1 General information

5.1.1 .INFO

Vector of K8 length 3:
V (1) contains the value of the keyword CONFIG_INIT of DEFI_FOND_FISS: 'DECOLLEE' or 'COLLEE'
V (2) contains the value of the keyword SYME of DEFI_FOND_FISS: 'YES' or 'NOT'
V (3) specifies if the bottom is opened or closed: 'OPEN' or 'FIRM'

5.2 Description of the entities of the bottom of crack

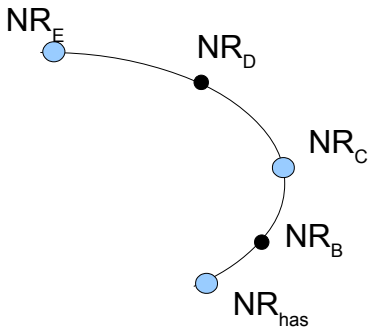
The list of the names of the ordered nodes of the bottom of crack is given either by:
- the vector .FOND.NOEUD if the bottom of crack is simple
- vectors .FONDINF.NOEUD and .FONDSUP.NOEUD if the bottom of crack is double.

The bottom is simple if it consists of a set of contiguous nodes in an element.
The bottom is double if it consists of two units distinct from contiguous nodes in an element. Each node of a unit is colocalisé with a node of the second unit.

5.2.1 .FOND.NOEUD

This vector contains the whole of the nodes describing the bottom of crack. These nodes constitute the intersection of the nodes of the lips lower and higher.

In the quadratic case, the convention of the scheduling of the nodes is not the same one as in the connexity of the meshs. In other words, this one does not take account owing to the fact that the node is top or not. For example, if nodes N_a, N_c and N_e are nodes tops, the vector .FOND .NOEU will be:
$(N_a, N_b, N_c, N_d, N_e,)$



5.2.2 .FONDINF.NOEUD

This vector contains the nodes describing the bottom of crack and pertaining to the lower lip. No node is common to .FONDSUP.NOEU.

5.2.3 .FONDSUP.NOEUD

This vector contains the nodes describing the bottom of crack and pertaining to the upper lip. No node is common to .FONDINF.NOEU.

5.2.4 .FONDFISS

The vector.FONDFISS is a vector of real containing the coordinates of the nodes of the bottom of crack. The points are ordered according to the order given in .FOND.NOEUD in the case of a simple bottom or in .FONDSUP.NOEU. in the case of a double bottom, so that one curvilinear X-coordinate can be defined.
If NFON is the number of nodes of the bottom of crack, then the length of the vector.FONDFISS is 4xNFON. For each point of the bottom of crack, the first 3 components correspond to the 3 coordinates (in 3D) of the point, and the fourth component is its curvilinear X-coordinate.
This structure is not modified in 2D. However one uses only the 2 first components, because neither the curvilinear X-coordinate nor the last geometrical component are relevant in 2D.
In 3D, when the bottom is closed, the last point is equal to the first. The last 4 terms of the vector .FONDFISS are then identical to the 4 first.

5.2.5 .FONDFISG

The vector.FONDFISG is a vector of real containing the coordinates of the nodes of the bottom of crack defined on the auxiliary grid.
If NFON is the number of nodes of the bottom of crack over the auxiliary grid, then the length of the vector.FONDFISG is 4xNFON. For each point of the bottom of crack, the first 3 components correspond to the 3 coordinates (in 3D) of the point, and the fourth component is its curvilinear X-coordinate.
This structure is created only when one uses the Upwind methods or Simplex in 3D for the update of the level sets.

5.2.6 .FOND.TYPE

In 3D, this character string is worth:

If the bottom were defined by a group of meshs:
- 'SEG2'if the meshs all are linear.
- 'SEG3'if not

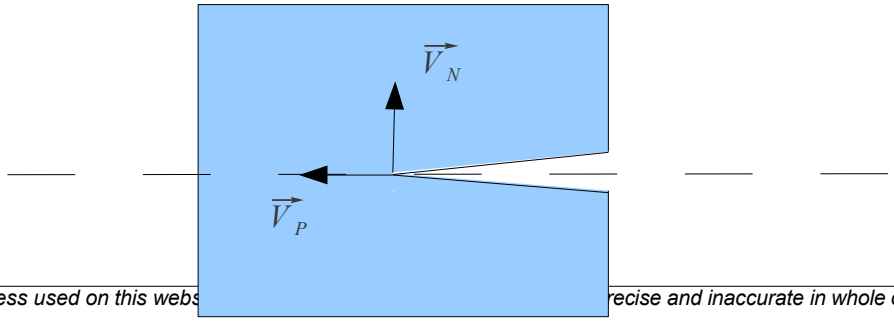
If the bottom were defined by a group of nodes:
- 'NOE2'if the meshs connected to the bottom of crack are all linear.
- 'NOE3'if not

In 2D, this character string is worth: "

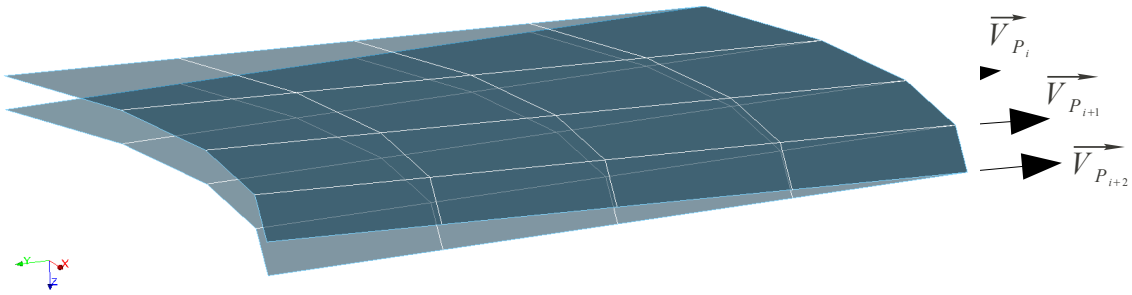
5.3 Description of the reference marks related to the bottom of crack

5.3.1 .BASEFOND

In 2D, the vector .BASEFOND consists of 4 real components. The two first are those of the vector of propagation of the crack $\overrightarrow{V_P}$. The two last constitute the normal $\overrightarrow{V_N}$.



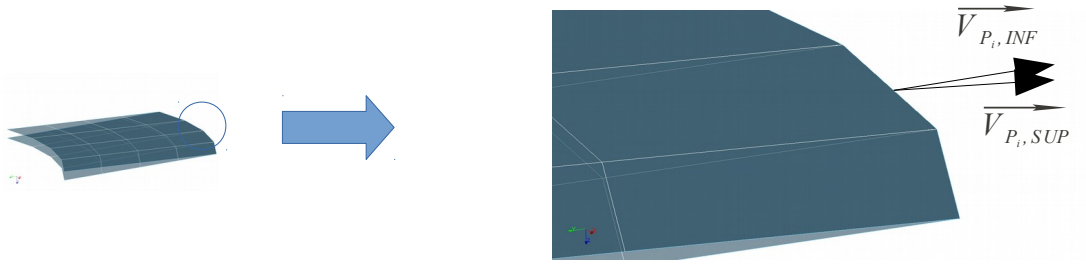
In 3D, the vector .BASEFOND consists of 6 real components per node of the bottom of crack. For each node N_i, the first three components are those of the local vector of propagation $\overrightarrow{V_{P_i}}$ at the bottom of crack and the three following ones are those of the normal vector to the average plan of the crack $\overrightarrow{V_{N_i}}$.



Initially, the local bases are built by couple of nodes top in bottom of crack in other words per segment which one will note E_i. For each face containing E_i and pertaining to the upper lips and lower, one calculates the orthogonal vector with E_i and in the plan of the face and the normal vector with the face. Thus, we obtain two couples of vectors:

- ($\overrightarrow{V_{P_i,SUP}}$, $\overrightarrow{V_{N_i,SUP}}$) for the higher face
- ($\overrightarrow{V_{P_i,INF}}$, $\overrightarrow{V_{N_i,INF}}$) for the lower face.

Vectors $\overrightarrow{V_{N_i,SUP}}$, $\overrightarrow{V_{N_i,INF}}$ even directions have: they are directed such as the trihedron ($\overrightarrow{V_{P_i,SUP}}$, $\overrightarrow{V_{E_i}}$, $\overrightarrow{V_{N_i,SUP}}$) that is to say direct with $\overrightarrow{V_{E_i}}$ directed vector following the scheduling of the nodes of the bottom.

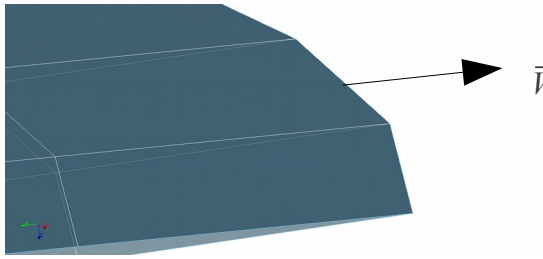


The local base is calculated like arithmetic mean of the vectors obtained. In other words, the vector of propagation locally to the segment E_i is calculated by the following expression:

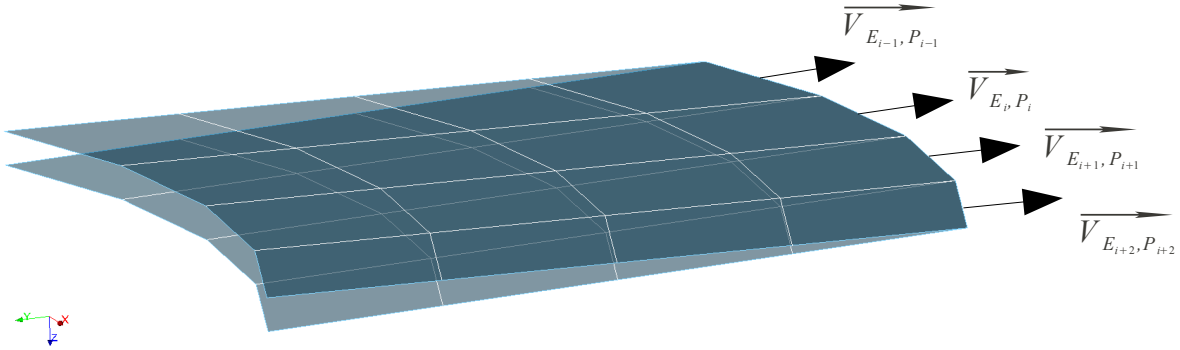
$$\overrightarrow{V_{E_i,P_i}}=\frac{\overrightarrow{V_{P_i,SUP}}+\overrightarrow{V_{P_i,INF}}}{2}$$

and the normal vector locally with the segment E_i is calculated by the following expression:

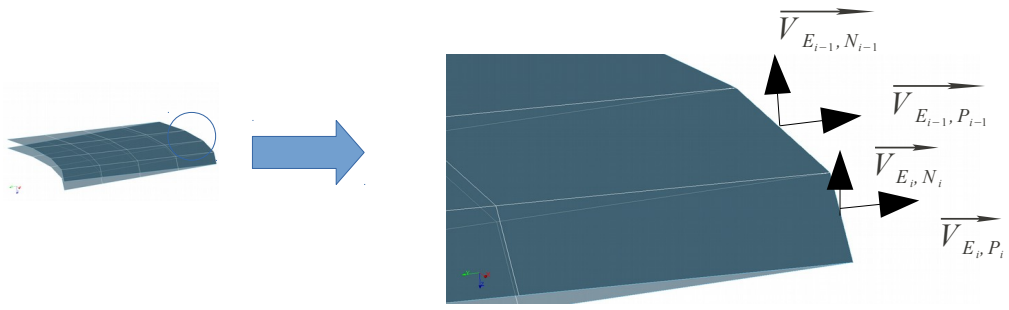
$$\overrightarrow{V_{E_i,N_i}}=\frac{\overrightarrow{V_{N_i,SUP}}+\overrightarrow{V_{N_i,INF}}}{2}$$



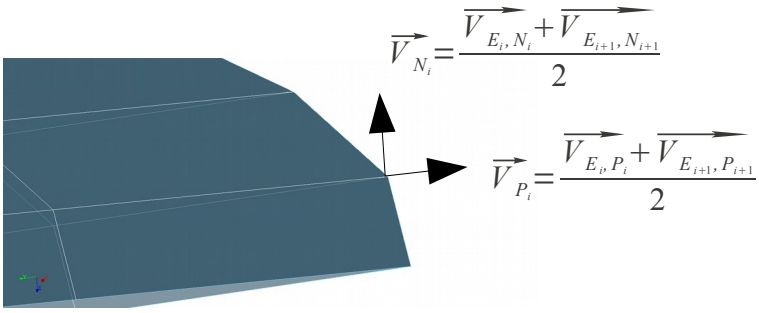
$$\overrightarrow{V_{E_i,P_i}}=\frac{\overrightarrow{V_{P_i,SUP}}+\overrightarrow{V_{P_i,INF}}}{2}$$



Thus, one obtains a local base by element in bottom of crack.



In the second time, the local base of a node top is calculated as being the arithmetic mean of the components of the vectors of the bases of the related elements in this node. For the node-tops placed at the ends, one defers the bases calculated to the elements ends.



In 3D, when the bottom is closed, the last point is equal to the first. The last 4 terms of the vector .BASEFOND are then identical to the 4 first.

5.3.2 .NORMAL

This vector contains 3 realities which constitute the components (n_x, n_y, n_z) normal with the plan of the lips (case of a crack planes) (see convention of sign in [U4.82.01 §3.4])

5.3.3 .DTAN.ORIGINE

This vector contains 3 realities which constitute the components of the tangent to the structure in the beginning of the bottom of crack, in the plan of the lips (see convention of sign in [U4.82.01 §3.5]). In the case of symmetry compared to the average plan of the crack and thus of indetermination of the direction of propagation of the crack, this information is used to define the direction.

5.3.4 .DTAN.EXTREMITE

This vector contains 3 realities which constitute the components of the tangent to the structure in the beginning of the bottom of crack, in the plan of the lips (see convention of sign in [U4.82.01 §3.5])

5.3.5 .LTNO and .LNNO

The concept.LTNO (resp. .LNNO) is a field with the nodes (CHAM_NO) scalar which contains for each node of the grid the actual value of the level set tangent (resp. normal) with the crack.

5.3.6 .BASLOC

The concept .BASLOC is a field with the nodes (CHAM_NO) with 9 real components (in 3D). It contains the origin and the vectors of the Local Base at the bottom of crack. For each node, the first three components are the coordinates of the project of the node on the bottom, which corresponds at the origin of the local base. The three following components are the coordinates of the 1er vector of the base: vector of direction of propagation. This vector will be noted GRLT. The three last components are cordonnées of the 2ème vector of the base: normal vector on the surface of the crack, directed lower lip towards the upper lip if LEVRE_SUP is defined in DEFI_FOND_FISS. This vector will be noted GRLN. 3ème vector of the base is not stored, because it is determined easily as being the vector product of the first 2 vectors.

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V =.BASLOC (I);
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V (1)	Coordinate according to x project of node I on the bottom
V (2)	Coordinate according to y project of node I on the bottom
V (3)	Coordinate according to z project of node I on the bottom
V (4)	Coordinate according to x from the 1er vector of the local base

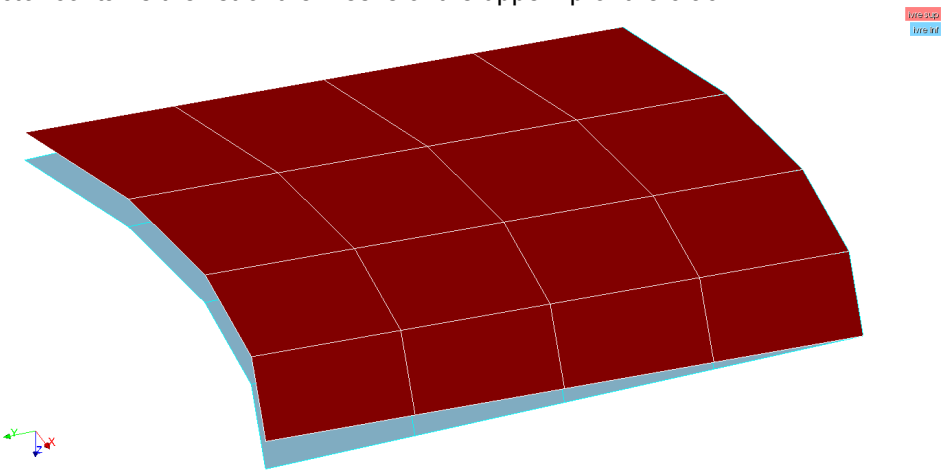
V (5)	Coordinate according to y from the 1er vector of the local base
V (6)	Coordinate according to z from the 1er vector of the local base
V (7)	Coordinate according to x from the 2ème vector of the local base
V (8)	Coordinate according to y from the 2ème vector of the local base
V (9)	Coordinate according to z from the 2ème vector of the local base

In 2D, there are only 2 components according to x and y, are 6 components for BASLOC. In 2D, there is one node at the bottom of crack, therefore all the nodes of the grid have the same project on the bottom of crack and the same vectors GRLT and GRLN.

5.4 Description of the lips

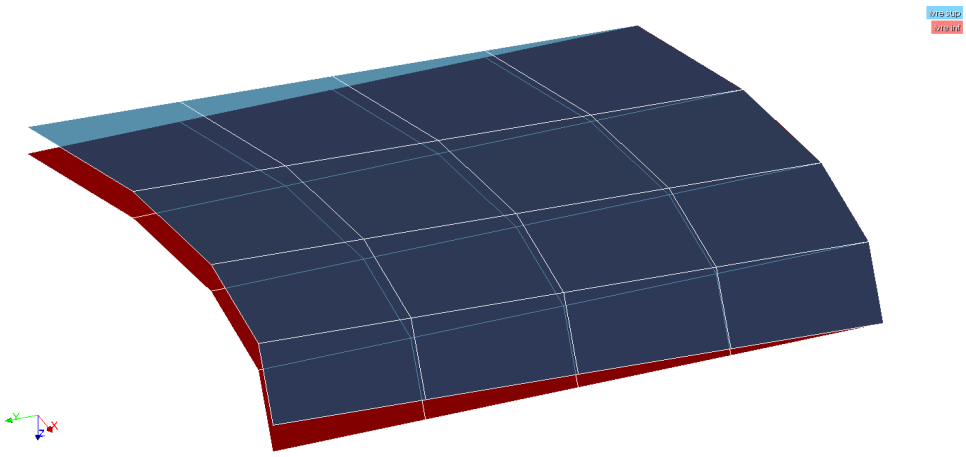
5.4.1 .LEVRESUP .MAIL

This vector contains the list of the meshs of the upper lip of the crack



5.4.2 .LEVREINF.MAIL

This vector contains the list of the meshs of the lower lip of the crack



5.4.3 .SUPNORM.NOEU

This vector contains the list of the nodes of the upper lip on the normal direction than the bottom of crack.

5.4.4 .INFNORM.NOEU

This vector contains the list of the nodes of the lower lip on the normal direction at the bottom of crack.

5.4.5 .FOND.TAILLE_R

This vector contains for each node of the bottom, an estimate of the maximum size according to the direction of propagation, of the meshs which are connected to them. These sizes are ordered according to the order of the nodes given in.FOND.NOEU.

One notes $\overrightarrow{V_{P_i}}$ the vector of propagation of the local base to the node of the bottom N_i and $\vec{a}_{ij}$ j ème edge connected to the node N_i.
For each node of the bottom N_i, the edges are projected $\vec{a}_{ij}$ on the vector of direction of propagation $\overrightarrow{V_{P_i}}$. Maximum size T_i meshs connected to N_i is the maximum value of the absolute values of its projections. In other words, size T_i is equal to

$$T_i = \max_{1 \le j \le Nb_{arêtes,i}} \left(\left| \vec{a}_{ij} . \overrightarrow{V_{P_i}} \right| \right) ,$$

where $Nb_{arêtes,i}$ is the number of edges connected to the node N_i.

The edges must form an angle lower than $70°$ with the vector of direction of propagation $\overrightarrow{V_{P_i}}$ to be projected there. In the contrary case they are ignored. For a node N_i, if no edge checks this condition, an alarm is emitted and cuts it T_i is worthless.

When the elements connected to the bottom of crack are quadratic, the segments of the bottom of crack contain a node in their medium. For each one of these segments, the size of mesh allotted to its node medium, is the average of the sizes calculated with its nodes tops.