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Responsable : Samuel GENIAUT

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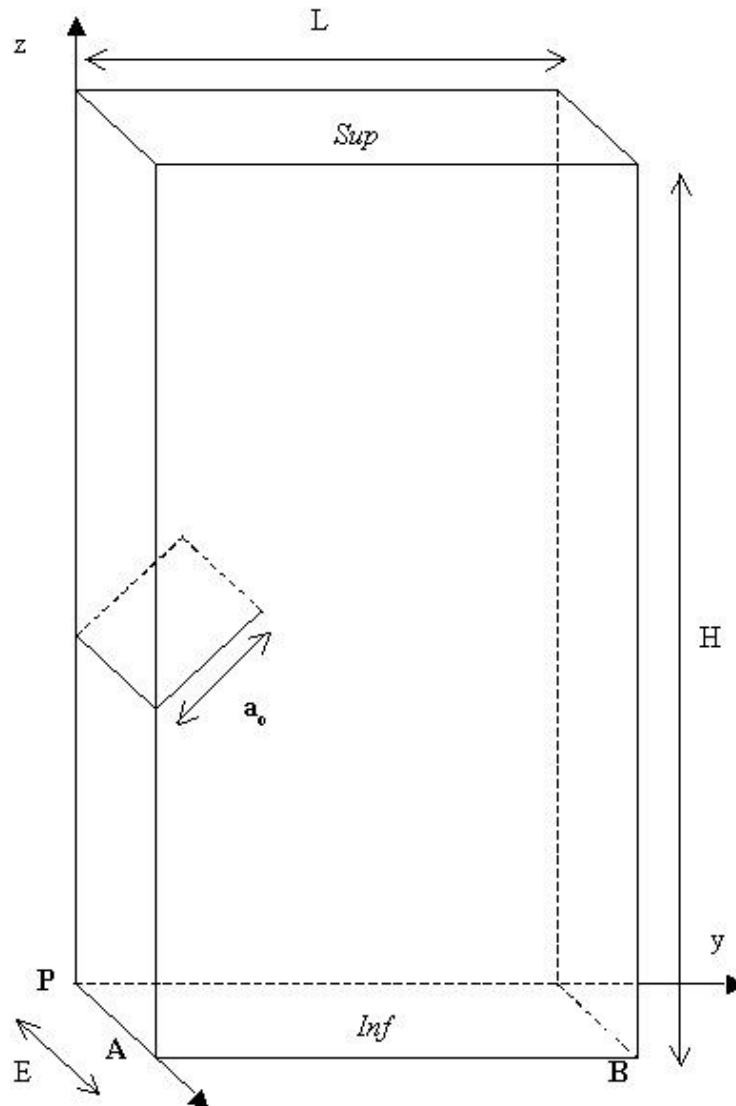*Clé : V3.04.315   Révision : 7508*

SSLV315 – nonplane Propagation of a crack emerging with X-FEM

Summarized:

The goal of this test is to compare the methods of propagation SIMPLEXE, MAILLAGE, UPWIND and GEOMETRIQUE of operator PROPA_FISS for a crack $3D$ requested in mixed mode.

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1 Problem of reference

1.1 Geometry

Appears 1.1-a: geometry of the fissured plate

geometrical Dimensions of the fissured plate:

width	$L = 8\,m$
thickness	$E = 1\,m$
height	$H = 18\,m$

the crack is initially directed with $45°$, the front being initially positioned in $(x, 2, 9)$.

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1.2 Properties of the material

Young's modulus $E = 205000\, MPa$
Poisson's ratio $\nu = 0.3$

1.3 Boundary conditions and loadings

Boundary conditions:
　　Point: P $\Delta X = \Delta Y = \Delta Z = 0$
　　Points on the segment AB : $\Delta X = \Delta Z = 0$
　　Points on surface INF : $\Delta Z = 0$

Loading:
　　Pressure on surface SUP : $P = -1\, MPa$

2 Reference solution

the results of the modelization B (method Mesh) are taken as reference.
For the modelization B and C, one checks non regression code compared to the position of the crack tip.
For the modelizations A, D and E, one checks that the nodes closest to the trace of the crack tip on the plane $(1, y, z)$ at the last time of propagation have their level-set very close to zero.

Time of propagation	Node	Coordinated y_i	Coordinated z_i
	N219	3.14	9.00
	N1576	2.57	8.70
3	N1577	2.86	8.70
	N2636	2.57	9.30
	N2637	2.86	9.30

These nodes are those included in a radius of capture being worth the backbone of an element, centered on the trail of crack tip on the plane $(1, x, y)$.

One B identifies these nodes in the message file $.mess$ () of the modelization and one estimates the value of their level-sets in the modelizations A, D and E.
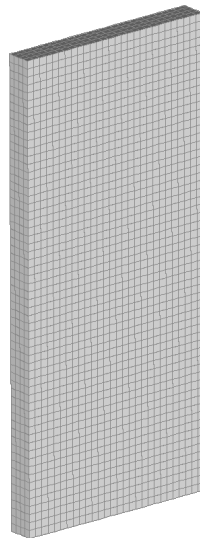
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3   Modelization A

3.1   Characteristic of the modelization

method SIMPLEXE is used by PROPA_FISS.

3.2   Characteristics of the mesh

the structure is modelled by a mesh made up of 6720 elements HEXA8 (see Appear 3.2-a).

Appear 3.2-a: mesh of structure

The mesh is not very refined to reduce the computing time. The size of the elements is uniform and equal to $0.29 \times 0.33 \times 0.25\,m$.

3.3   Quantities tested and results

One extracts the level set norm (LSN) and tangent (LST) by means of operator POST_RELEVE_T and one checks that the values maximum and minimal remain understood in the circle of capture of the nodes tested around the crack front, that is to say $2/3$:

Propag. i	*Max LSN$_i$*	*Min LSN$_i$*	*Max LST$_i$*	*Min LST$_i$*
the 3	0.257	0.333	0.243	0.404

got results show well that the level-sets remain lower than the radius in which the crack front was localised. That means that the crack tip was correctly located by method SIMPLEXE.

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4 Modelization B

4.1 Characteristic of the modelization

the method MAILLAGE is used by PROPA_FISS.
Option CALC_K_G is used by CALC_G.

4.2 Characteristics of the mesh

One uses the same mesh as for modelization A.

4.3 Grandeurs tested and results

One tests, into non regression, the position of the crack tip to the last iteration of propagation.

Time of Coordinated	Coordinated y_i	propagation z_i
3.2.8		9

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5 Modelization C

5.1 Characteristic of the modelization

the method MAILLAGE is used by PROPA_FISS.
Option POST_K1_K2_K3 is used by CALC_G.

5.2 Characteristics of the mesh

One uses the same mesh as for modelization A.

5.3 Grandeurs tested and results

One tests, into non regression, the position of the crack tip to the last iteration of propagation.

Time of propagation	Coordinated y_i	Coordinated z_i
3.2.8		9

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6   Modelization D

6.1   Characteristic of the modelization

method UPWIND without auxiliary grid is used by PROPA_FISS.

6.2   Characteristics of the mesh

One uses the same mesh as that of modelization A.

6.3   Grandeurs tested and results

One extracts the level set norm (LSN) and tangent (LST) by means of operator POST_RELEVE_T and one checks that the values maximum and minimal remain understood in the circle of capture of the nodes tested around the crack front, that is to say $2/3$:

$Propag.i$	$Max\,LSN_i$	$Min\,LSN_i$	$Max\,LST_i$	$Min\,LST_i$
the 3	0.268	0.336	0.341	0.235

got results show well that the level-sets remain lower than the radius in which the crack front was localised. That means that the crack tip was correctly located by method UPWIND.

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7 Modelization E

7.1 Characteristic of the modelization

method GEOMETRIQUE is used by PROPA_FISS.

7.2 Characteristics of the mesh

One uses the same mesh as that of modelization A.

7.3 Grandeurs tested and results

One extracts the level set norm (LSN) and tangent (LST) by means of operator POST_RELEVE_T and one checks that the values maximum and minimal remain understood in the circle of capture of the nodes tested around the crack front, that is to say $2/3$:

Propag. i	Max LSN_i	Min LSN_i	Max LST_i	Min LST_i
the 3	0.235	0.397	0.333	0.272

got results show well that the level-sets remain lower than the radius in which the crack front was localised. That means that the crack tip was correctly located by method GEOMETRIQUE.

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8   Summary of the results

All the methods of propagation used (SIMPLEXE, MAILLAGE, UPWIND and GEOMETRIQUE) of operator PROPA_FISS made it possible to calculate the position of a crack well propagating in mixed mode in a structure 3D .