

Code_Aster

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Titre : SSLV314 - Propagation plane d'une fissure déboucha[...]
Responsable : GÉNIAUT Samuel

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SSLV314 - Propagation planes of a crack emerging with X-FEM

Summary:

The goal of this test is to compare the methods of propagation simplex, grid, upwind, geometrical of the operator PROPA_FISS for a crack 3D solicited in mode I pure.

1 Problem of reference

1.1 Geometry

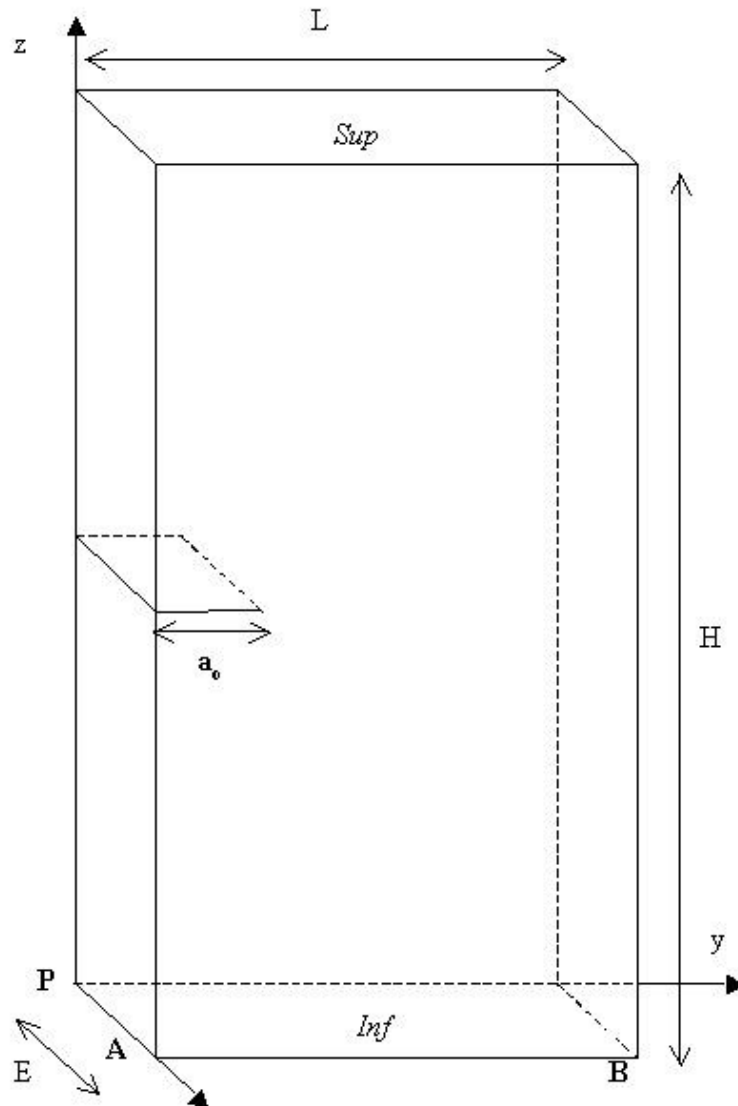


Figure 1.1-a: geometry of the fissured plate

Geometrical dimensions of the fissured plate:

width	$L = 8 \text{ m}$
thickness	$E = 1 \text{ m}$
height	$H = 18 \text{ m}$

The crack is horizontal, the face being initially positioned in $(x, 2, 9)$.

1.2 Properties of material

Young modulus $E = 205000 \text{ MPa}$

Poisson's ratio $\nu = 0.3$

1.3 Boundary conditions and loadings

Boundary conditions:

- Not 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 : $P = -1 \text{ MPa}$

2 Reference solution

2.1 Method of calculating

Not regression.

2.2 Sizes and results of reference

The results of modeling B (method Grid) are taken as reference.

For modeling B and C, one checks to it not regression of the code compared to the position of the bottom of crack.

For modelings A, D, E and F, one checks that the nodes closest to the trace of the bottom of crack on the plan $(1, y, z)$ at the last moment of propagation their level-sets very close to zero have.

Moment of propagation	Node	Coordinate y_i	Coordinate z_i
	<i>N926</i>	2.33	8.80
3	<i>N1028</i>	2.33	9.00
	<i>N1130</i>	2.33	9.20

These nodes are those included in a ray of capture being worth the backbone of an element, centered on the trail of bottom of crack on the plan $(1, y, z)$.

One identifies these nodes in the .mess of modeling B and one estimates the value of their level-sets in modelings A, D, E and F.

3 Modeling A

3.1 Characteristics of modeling

Method **simplex** is used by `PROPA_FISS`.

3.2 Characteristics of the grid

The structure is modelled by a grid made up of 2040 elements `HEXA8` (see Figure 3.2-a).

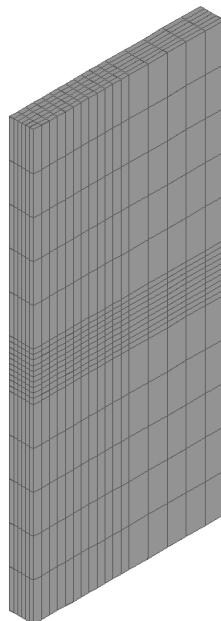


Figure 3.2-a: grid of the structure

The grid is very coarse to reduce the computing time. Elements a little smaller are used in the zone of propagation of the crack. The dimension of the elements is $0.17 \times 0.33 \times 0.2 m$ in this zone. The largest element used has a dimension equalizes with $0.17 \times 0.8 \times 1.6 m$.

3.3 Sizes tested and results

One extracts the level set normal (LSN) and tangent (LST) by using the operator `POST_RELEVE_T` and it is checked that the values maximum and minimal remain understood in the ray of capture of the nodes tested around the face of crack, that is to say 1/3:

$Propag. i$	$Max LSN_i$	$Min LSN_i$	$Max LST_i$	$Min LST_i$
3	0.2	0.2	0,267	0,267

The got results show well that the level-sets remain lower than the ray in which the face of crack was localised. That means that the bottom of crack was correctly located by the method **simplex**.

4 Modeling B

4.1 Characteristics of modeling

Method `GRID` is used by `PROPA_FISS`.

The option `CALC_K_G` is used by `CALC_G` to estimate the stress intensity factors.

4.2 Characteristics of the grid

One uses the same grid as for modeling A.

4.3 Sizes tested and results

One tests, in nonregression with a tolerance of 0.1% , the position of the bottom of crack to the last iteration of propagation by raising the extrema of the ordinates of the points which compose it.

Moment of propagation	Max Coord y_i	Min Coord y_i
3	2.6	2.57

5 Modeling C

5.1 Characteristics of modeling

Method `GRID` is used by `PROPA_FISS`.
The operator `POST_K1_K2_K3` is used to estimate the stress intensity factors.

5.2 Characteristics of the grid

One uses the same grid as for modeling A.

5.3 Sizes tested and results

One tests, in nonregression with a tolerance of 0.1% , the position of the bottom of crack to the last iteration of propagation by raising the extrema of the ordinates of the points which compose it.

Moment of propagation	Max Coord y_i	Min Coord y_i
3	2.6	2,592

6 Modeling D

6.1 Characteristics of modeling

Method `UPWIND` without auxiliary grid is used by `PROPA_FISS`.

6.2 Characteristics of the grid

One uses the same grid as that of modeling A.

6.3 Sizes tested and results

One extracts the level-set normal (LSN) and tangent (LST) by using the operator `POST_RELEVE_T` and it is checked that the values maximum and minimal remain understood in the ray of capture of the nodes tested around the face of crack, that is to say 1/3:

$Propag.i$	$Max LSN_i$	$Min LSN_i$	$Max LST_i$	$Min LST_i$
3	0.2	-0.2	-0,267	-0,267

The got results show well that the level-sets remain lower than the ray in which the face of crack was localised. That means that the bottom of crack was correctly located by the method upwind.

7 Modeling E

7.1 Characteristics of modeling

Method `GEOMETRICAL` is used by `PROPA_FISS`.

7.2 Characteristics of the grid

One uses the same grid as that of modeling A.

7.3 Sizes tested and results

One extracts the level-set normal (LSN) and tangent (LST) by using the operator `POST_RELEVE_T` and it is checked that the values maximum and minimal remain understood in the ray of capture of the nodes tested around the face of crack, that is to say 1/3:

$Propag. i$	$Max LSN_i$	$Min LSN_i$	$Max LST_i$	$Min LST_i$
3	0.2	0.2	0,267	0,267

The got results show well that the level-sets remain lower than the ray in which the face of crack was localised. That means that the bottom of crack was correctly located by the geometrical method.

8 Modeling F

8.1 Characteristics of modeling

Method `SIMPLEX` is used by `PROPA_FISS`.

8.2 Characteristics of the grid

One uses the same grid as that of modeling A.

One makes a refinement Lobster on the initial grid to obtain pyramidal meshes.

That makes it possible to test the method on various meshes and to observe that the result remains correct.

8.3 Sizes tested and results

One extracts the level-set normal (LSN) and tangent (LST) by using the operator `POST_RELEVE_T` and it is checked that the values maximum and minimal remain understood in the ray of capture of the nodes tested around the face of crack, that is to say 1/3:

$Propag. i$	$Max LSN_i$	$Min LSN_i$	$Max LST_i$	$Min LST_i$
3	0.2	0.2	0,267	0,267

The got results show well that the level-sets remain lower than the ray in which the face of crack was localised. That means that the bottom of crack was correctly located by the geometrical method.

9 Summary of the results

All methods of propagation used (simplex, geometrical grid, upwind and) of the operator `PROPA_FISS` allowed to calculate the position of a crack well propagating in mode I pure in a structure 3D .