SSLV318 – Validation of the tridimentionnelles crack X-FEM catalog

Abstract:

The purpose of this document is validating the definition of a three-dimensional crack X-FEM *via* the catalogs of predefined forms.

1 Problems of reference

1.1 Geometry of "right-angled" crack of form

One considers a cube of with dimensions of $1\,m$. This cube comprises a crack in the shape of rectangle with angles rounded. The crack is located in the plane of norm y halfway between the front and back face of the cube (see Figure 1.1-1). The crack is in fact a half-rectangle. The complete rectangle has for length $2a$ and a width $2b$. Moreover, the corners of the rectangle are rounded, with a radius r. The center of the complete rectangle is thus the point of coordinates $(0,5\,;0,5\,;1)$. The center of the reference is the point $P4$. In the continuation, one will take $a=0,3$, $b=0,15$ and $r=0,05$.

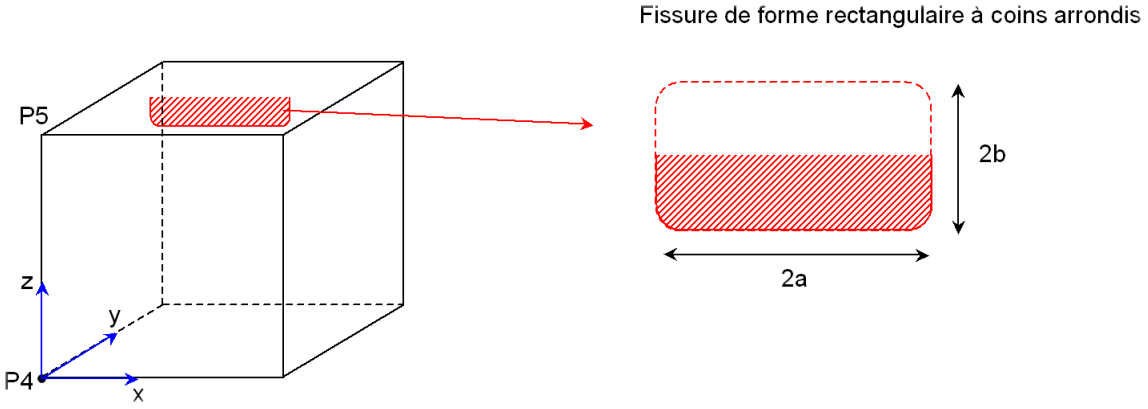

Figure 1.1-1: diagram of the cube fissured by "right-angled" crack of form

1.2 Geometry of crack of form "rolls"

One considers the same cube as previously, but comprising a crack in the shape of cylinder. The axis of the cylinder is parallel to the axis y and passes by the point C of coordinates $(1\,;0,5\,;1)$. The radius of the cylinder is $r=0,5$. The crack front is thus a quadrant. The lips of crack are located in the half space $y\leq 0,5$ (see Figure 1.2-1).

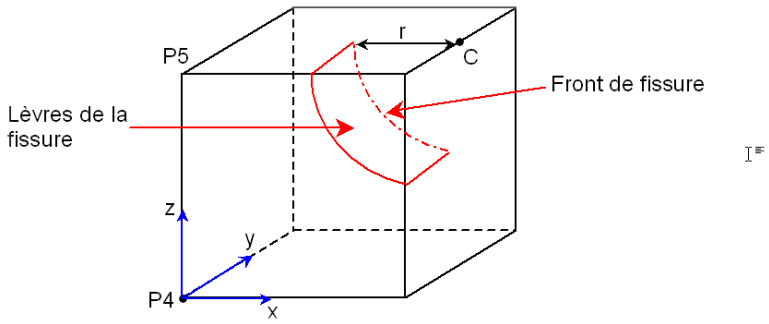

Figure 1.2-1: diagram of the cube fissured by crack of form "rolls"

2 Reference solution

2.1 Fissures of “right-angled” form

the goal of this test is of the level sets to validate the definition of this crack by computation associated. The test carries in fact only on the value of lst at the points $P4$ and $P5$. A fast given computation $lst(P4)=\sqrt{((\frac{1}{2}-(a-r))^2+(1-(b-r))^2)}-r$ and $lst(P5)=0,2$.

2.2 Fissure of form “rolls”

the goal of this test is of the level sets to validate the definition of this crack by computation associated. The test relates to the values of lsn and lst at the points $P4$ and $P5$. A fast given computation:
$lsn(P4)=\sqrt{2}-r$ and $lst(P5)=1-r$,
$lst(P4)=-0,5$ and $lst(P5)=-0,5$.

3 Modelization a: fissures of “right-angled” form

This modelization tests “right-angled” crack of form.

3.1 Characteristics of the mesh

The mesh initial is healthy: it is discretized in $40\times5\times40$ HEXA8.

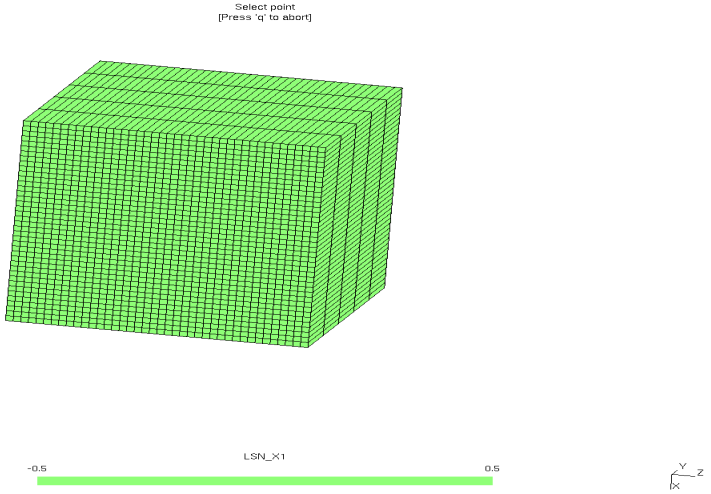

Figure 3.1-1: initial sane mesh

3.2 Quantities tested and results

the test relates to the value of lst at the points $P4$ and $P5$.

Standard	identification of reference	Value of reference	Tolerance
$lst(P4)$	"ANALYTIQUE"	0.884077	10-12
$lst(P5)$	"ANALYTIQUE"	0.2	10-12

4 Modelization b: fissures of form “rolls”

This modelization tests crack of form “rolls”.

4.1 Characteristics of the mesh

The mesh is identical to that of the modelization A

4.2 Quantities tested and results

the test relates to the value of lsn and lst at the points $P4$ and $P5$.

Standard	identification of reference	Value of reference	Tolerance
$lsn(P4)$	"ANALYTIQUE"	0.914214	10-12
$lsn(P5)$	"ANALYTIQUE"	0.5	10-12
$lst(P4)$	"ANALYTIQUE"	-0.5	10-12
$lst(P5)$	"ANALYTIQUE"	-0.5	10-12

5 Summary of the results

This test makes it possible to validate the definition of a three-dimensional crack X-FEM of following form:
- rectangular with corners rounded,
- cylinder.