SSNV108 - Test-tube CT-Round Robin European in Fracture mechanics (1985)

Summarized

It acts of a test in static for a three-dimensional nonlinear elastic problem. This test allows:

to make sure of non regression features of *Aster* in fracture mechanics,
to check the invariance of computation from G ratio with integration contours.

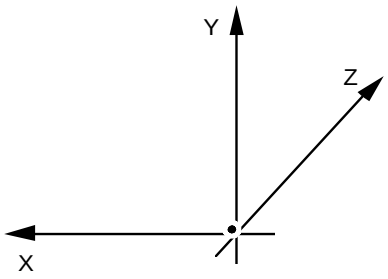
The functionality tested is CALC_G .

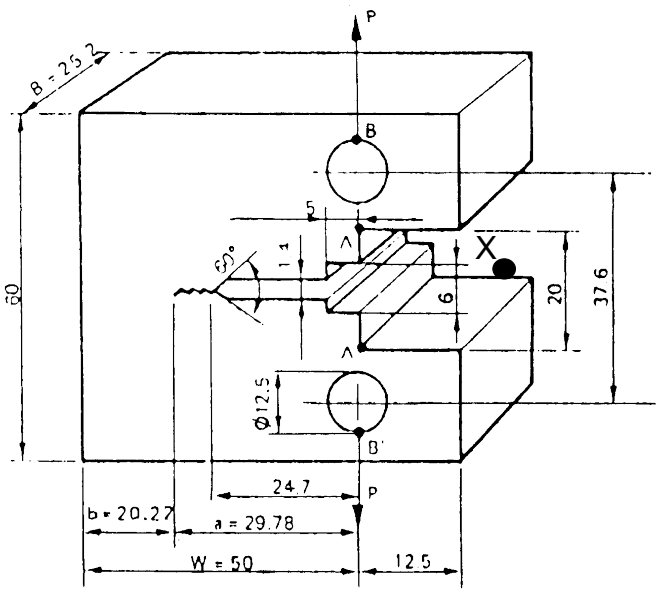
Four modelizations are available:
-modelization a: fissures with a grid, quadratic isoparametric elements 3D,
-modelization b: fissures nonwith a grid (X-FEM), elements 2d
-modelizations C and D: fissure nonwith a grid (X-FEM), elements 3D

the formulation of this test is resulting from the Round European Robin in fracture mechanics of 1985.

1 Problem of reference

1.1 Geometry



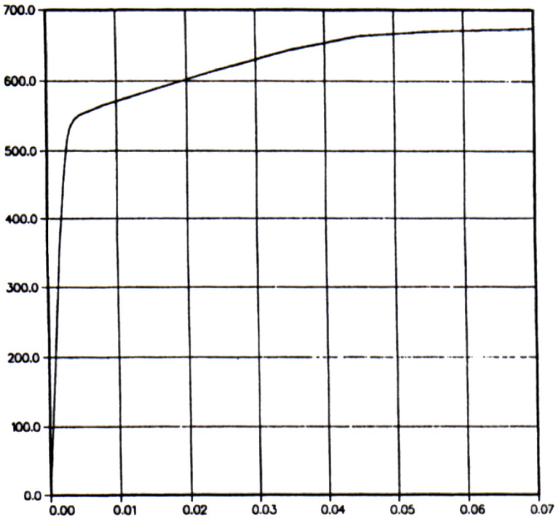


1.2 Properties of the materials

nonlinear Elasticity (Isotropic Von Mises)

$E = 205\,000\ Mpa$

$\nu = 0.3$



1.3 Boundary conditions and loadings

By reason of symmetry one models $1/4$ structure, (half of the higher part).

Displacements imposed on one line parallel with the axis Z and passing by point: B	u_y	= – 1.
Symmetry plane $y=0$:	u_y	= 0.
Symmetry plane $z=0$:	u_z	= 0.
O Not blocked:	$u_x = u_y = u_z$	= 0.

2 Reference solution

2.1 Method of calculating used for the reference solution

Without object.

2.2 Results of reference

It does not exist of reference solution strictly speaking but a set of results of the participants in the Round Robin. These results are got by computations Finite elements with various codes and by means of the very different modelizations: 2D (plane stresses, plane strains) 3D , small or large displacements, etc…

However, the numerical values tested in this case test result from a former execution of Aster. It is a case test of NON-regression.

2.3 Uncertainty on the solution

Without object.

2.4 Bibliographical references

1) L.H. LARSSON: EGF Numerical Round Robin one EPFM.

2) J.L. CHEISSOUX: “Round Robin” of computation in elastoplastic mechanics of the fracture - Note DRE/STRE/LMA 82/480 (09/82).

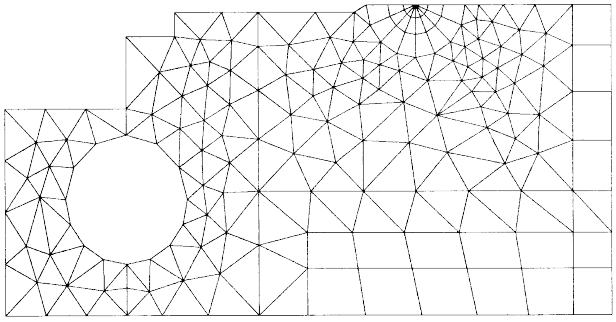
3) Y. WADIER: Application of the method Theta under investigation of a test-tube CT in three-dimensional elastoplastic fracture. Note EDF HI/5696-07 of the 2/25/87.

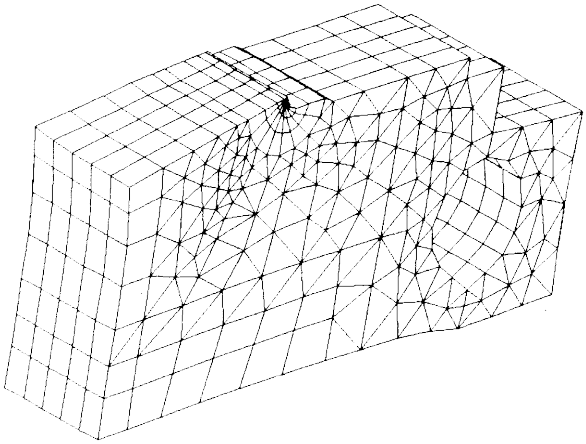
4) L.H. LARSSON: “Calculationnal Round Robin of the EPFM: specifications for phase 2”. 162/194/19B2 (Ispra, June 1982).

5) M.P. VALETA, MR. BUSSON: “Study of the modelization of a CT25” - Ratio DMT/95-602.

3 Modelization A

3.1 Characteristic of the modelization





3.2 Characteristics of the mesh

Many nodes: 5159
Number of meshes and types: 1280 PENTA15 and 200 HEXA20

the nodes mediums of the edges of the elements touching the crack tip are moved with the quarter of these edges.

3.3 Values tested and results of the Standard modelization

A	Identification test	Value	Accuracy
DY with Standard X	node	NON_REGRESSION	-7.9431973268239E-01

1.e-12	Identification test	Value	Accuracy
INST	NON_REGRESSION	1.0E0	0,10%
ITER_GLOB	NON_REGRESSION	8	0

One uses key word SYME in operator DEFI_FOND_FISS, which results in taking into account half of structure in operator CALC_G. It is thus necessary to multiply by two the following results to have the rate of energy restitution of complete structure.

Standard	identification test	Value	Accuracy
G_GLOBAL – Contour 1	NON_REGRESSION	3316,0	0,02%
G_GLOBAL – Contour 2	NON_REGRESSION	3457,2	0,02%
G_GLOBAL – Contour 3	NON_REGRESSION	3449,6	0,02%

Standard	Identification test	Value	Accuracy
G_LOCAL – Contour 1	NON_REGRESSION	42,97	0,02%
G_LOCAL – Contour 2	NON_REGRESSION	43,61	0,02%
G_LOCAL – Contour 3	NON_REGRESSION	41,76	0,02%

G_LOCAL is calculated in the symmetry plane perpendicular to the crack

3.4 Remarks

Nothing.

4 Modelization B

4.1 Characteristic of the modelization

the crack is not with a grid (modelization X-FEM).
One places oneself in assumption of Plane stresses.
One models the upper part and the lower part of structure.

4.2 Values tested and results of the modelization B

One tests the value of the displacement of the node (even node that tested in the modelization A).

Standard	identification test	Value	Accuracy
DY with the node X	AUTRE_ASTER	-7.8967073390778E-01	0.16

This test is doubled of a test of NON-regression.

5 Modelization C

5.1 Characteristic of the modelization

the crack is not with a grid (modelization X-FEM).
Structure in 3D is modelled.
One models the upper part and the lower part of structure.

5.2 Values tested and results of the modelization C

One tests the value of the displacement of the node (even node that tested in the modelization A).

Standard	identification test	Value	Accuracy
DY with the node X	AUTRE_ASTER	-7.8967073390778E-01	0.18

This test is doubled of a test of NON-regression.

Standard	identification test	Value	Accuracy
G (local)	NON_REGRESSION	408.87	0,02%

6 Modelization D

It is a data-processing test which C takes again the modelization but which uses COMP_INCR instead of COMP_ELAS.

7 Summaries of the results

This test makes it possible to validate the computation of the rate of refund in nonlinear elasticity with a crack with a grid or NON-with a grid (X-FEM).