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## SSNV108 - Test-tube CT-Round Robin European in Breaking process (1985)

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### Summary

It is about a test in statics for a three-dimensional non-linear elastic problem. This test allows:

- to make sure of nonthe regression of the features of *Aster* in breaking process,
- to check the invariance of the calculation of  $G$  compared to the crowns of integration.

The functionality tested is `CALC_G`.

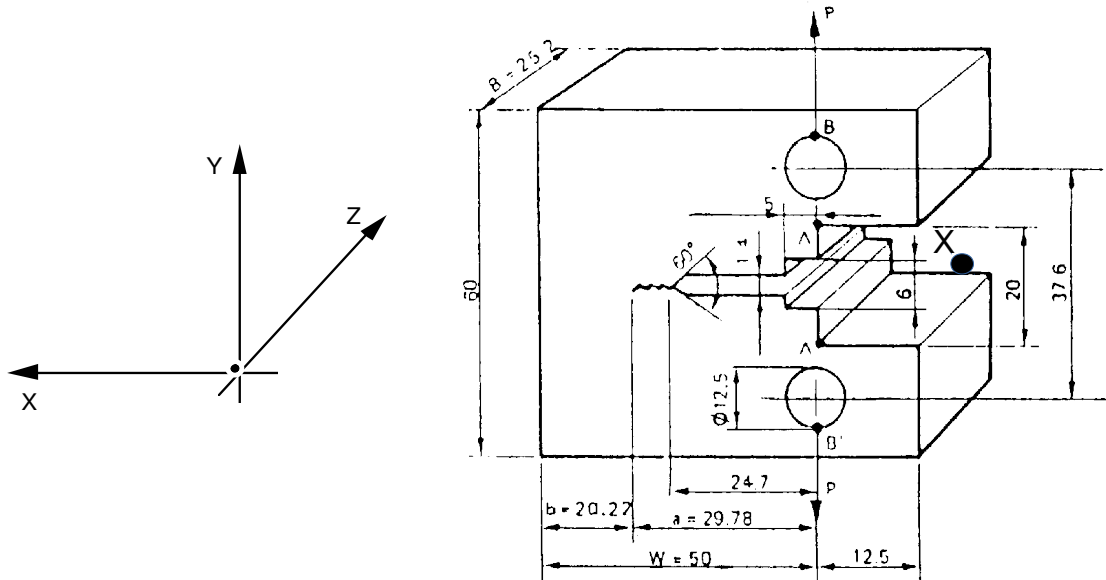
Four modelings are available:

- modeling a: fissures with a grid, quadratic isoparametric elements 3D,
- modeling b: fissures nonwith a grid (X-FEM), elements 2d
- modeling C: crack nonwith a grid (X-FEM), elements 3D

The formulation of this test is resulting from the Round European Robin in breaking process of 1985.

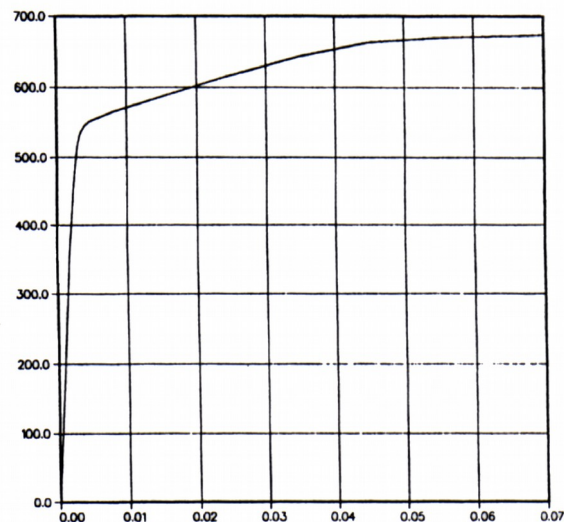
## 1 Problem of reference

### 1.1 Geometry



### 1.2 Properties of materials

Nonlinear elasticity (Von Mises Isotrope)  
 $E = 205\,000 \text{ Mpa}$   
 $\nu = 0.3$



### 1.3 Boundary conditions and loadings

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

- Displacements imposed on a line parallel with the axis  $Z$  and passing by the point  $B$  :
- Symmetry plane  $y=0$  :
- Symmetry plane  $z=0$  :
- Not  $O$  blocked:

$$\begin{aligned} u_y &= -1. \\ u_y &= 0. \\ u_z &= 0. \\ u_x = u_y = u_z &= 0. \end{aligned}$$

## 2 Reference solution

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### 2.1 Method of calculating used for the reference solution

Without object.

### 2.2 Results of reference

There strictly speaking does not exist reference solution but a set of results of the participants in the Round Robin. These results are got by calculations Finite elements with various codes and by using very different modelings: 2D (plane constraints, plane deformations), 3D, small or great displacements, etc...

However, the digital values tested in this case test result from a former execution of Aster. It is a case test of not-regression.

### 2.3 Uncertainty on the solution

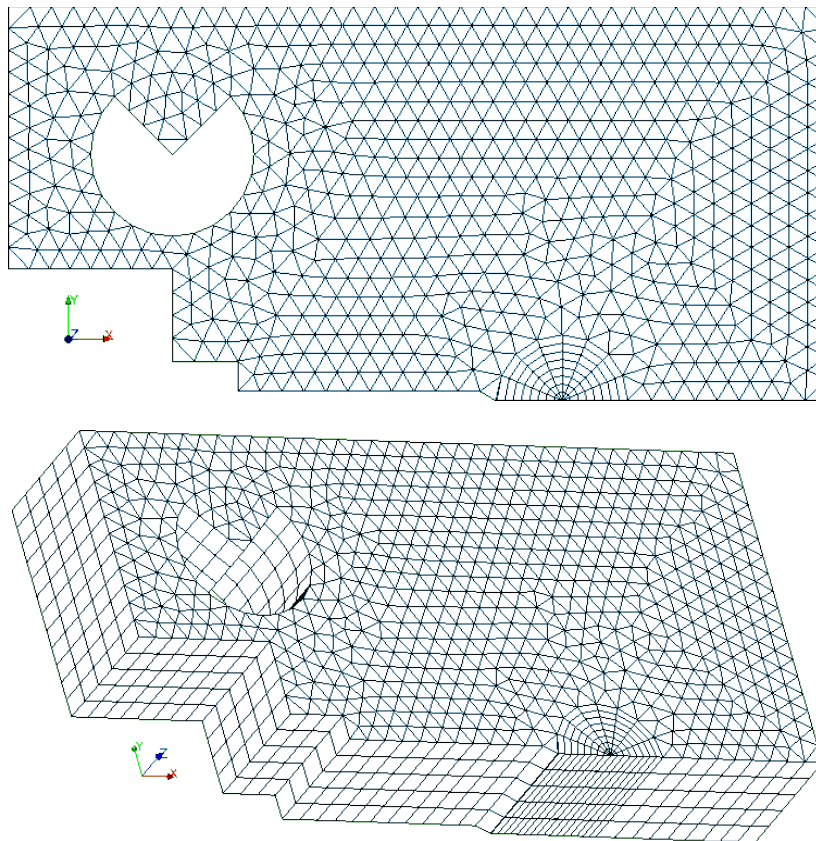
Without object.

### 2.4 Bibliographical references

- 1) L.H. LARSSON: EGF Numerical Round Robin one EPFM.
- 2) J.L. CHEISSOUX: "Round Robin" of calculation in elastoplastic mechanics of the rupture - 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 rupture. Note EDF HI/5696-07 of the 2/25/87.
- 4) L.H. LARSSON: "Calculational Round Robin of the EPFM: specifications for phase 2". 162/194/19B2 (Ispra, June 1982).
- 5) M.P. VALETA, MR. BUSSON: "Study of the modeling of a CT25" - Report DMT/95-602.

## 3 Modeling A

### 3.1 Characteristics of modeling



### 3.2 Characteristics of the grid

Many nodes: 21048  
 Many meshes and types: 6380 PENTA18 and 280 HEXA20

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

### 3.3 Values tested and results of modeling A

Identification	Standard test	Value	Precision
DY with the node X	NON_REGRESSION	8.64270887097E-01	1.e-12

Identification	Standard test	Value	Precision
INST	NON_REGRESSION	1.0E0	0,10%
ITER_GLOB	NON_REGRESSION	8	0

The keyword is used SYME in the operator DEFI\_FOND\_FISS, what results in taking into account half of the structure in the operator CALC\_G. It is thus necessary to multiply by two the following results to have the rate of refund of energy of the complete structure.

Identification	Standard test	Value	Precision
G_GLOBAL – Crown 1	NON_REGRESSION	4201.1	0,02%
G_GLOBAL – Crown 2	NON_REGRESSION	4065.0	0,02%
G_GLOBAL – Crown 3	NON_REGRESSION	4063.9	0,02%

Identification	Standard test	Value	Precision
G_LOCAL – Crown 1	NON_REGRESSION	51.14	0,02%
G_LOCAL – Crown 2	NON_REGRESSION	54.28	0,02%
G_LOCAL – Crown 3	NON_REGRESSION	52.98	0,02%

G\_LOCAL is calculated in the symmetry plane perpendicular to the crack

## 3.4 Remarks

Nothing.

## 4 Modeling B

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### 4.1 Characteristics of modeling

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

### 4.2 Values tested and results of modeling B

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

Identification	Standard test	Value	Precision
<i>DY</i> with the node <i>X</i>	AUTRE_ASTER	-7.8967073390778E-01	0,16

This test is doubled of a test of not-regression.

## 5 Modeling C

### 5.1 Characteristics of modeling

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

### 5.2 Values tested and results of modeling C

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

Identification	Standard test	Value	Precision
<i>DY</i> with the node <i>X</i>	AUTRE_ASTER	-7.8967073390778E-01	0,18

This test is doubled of a test of not-regression.

Identification	Standard test	Value	Precision
G (local)	NON_REGRESSION	408,87	0,02%

## 6 Summaries of the results

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This test makes it possible to validate the calculation of the rate of refund in non-linear elasticity with a crack with a grid or not-with a grid (X-FEM).