

SSNA108 - Models of Weibull, Bordet and of Rice and Tracey

Summary:

This test of nonlinear quasi-static mechanics makes it possible to validate the models of Weibull and Rice - Tracey in 2D (order `POST_ELEM`) and of Bordet (order `CALC_BORDET`) in the case of a notched axisymmetric test-tube subjected to a simple tensile test.

The modeling of the test-tube is carried out with elements 2D (QUA8).

1 Problem of reference

1.1 Geometry

A notched cylindrical test-tube is considered:

- diameter of the test-tube: 18 mm ,
- ray of the notch: 5 mm .

1.2 Properties of material

One adopts an elastoplastic law of behavior of Von Mises with isotropic work hardening TRACTION whose traction diagram is given point by point:

ε	0.0027	0,005	0.01	0,015	0.02	0,025	0.03	0.04	0.05	0,075	0.1
σ (MPa)	555	589	631	657	676	691	704	725	741	772	794
	0,125	0.15	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
	812	827	851	887	912	933	950	965	978	990	

The deformations used in the relation of behavior are the linearized deformations. The Young modulus E rise with 200 GPa while the Poisson's ratio ν is worth $0,3$.

The coefficients of the models of Weibull and Bordet used are the following:

$$\begin{aligned}m &= 8 , \\V_0 &= 100\ \mu\text{m} , \\ \sigma_u &= 2630\ \text{MPa} , \\ \sigma_{ys,0} &= \sigma_{ys} 555\text{MPa} , \\ \sigma_{th} &= 600\text{MPa} .\end{aligned}$$

1.3 Boundary conditions and loadings

While referring to the figure of [§3.1] the boundary conditions are the following ones:

- BC : following imposed displacement (Y) ,
- OA : displacements blocked according to (Y) ,
- OB : displacements blocked according to (X) .

1.4 Initial conditions

Worthless constraints and deformations.

2 Reference solution

2.1 Method of calculating

Digital solution calculated by CASTEM2000 and Zébulon for the models of Weibull and Rice and Tracey; test of nonregression for the model of Bordet.

2.2 Sizes and results of reference

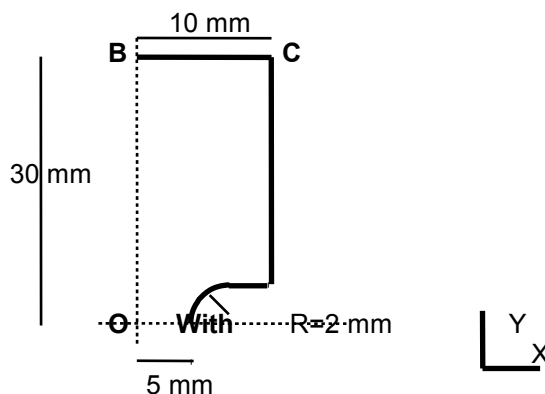
Constraints of Weibull (WEIBULL) and of Bordet as well as the rate of triaxiality (RICE_TRACEY) on various meshes were calculated at various moments.

2.3 Uncertainties on the solution

Precision of the codes.

3 Modeling A

3.1 Characteristics of the grid



3.2 Characteristics of the grid

Many nodes: 1219
Many meshes and types: 320 (QUA8).

3.3 Sizes tested and results

The variation noted with the reference solution remains lower than 1%.

4 Results of modeling A

4.1 Values tested

One tests the structural parameters of data results:

Identification	Reference	Test	Tolerance
INST for NUME_ORDRE= 1 0	10.0	ANALYTICAL	0,10%
ITER_GLOB	8	NON_REGRESSION	0,00%

Model of Weibull:

Identification	Reference	Test	Tolerance
C ontrainte of Weibull for <i>INST</i> = 2,0	1,4079E+003	NON_DEFINI	0,1% (relative)
C ontrainte of Weibull for <i>INST</i> = 4,0	2,4973E+003	NON_DEFINI	0,1% (relative)
C ontrainte of Weibull for <i>INST</i> = 6,0	3,3332E+003	NON_DEFINI	0,1% (relative)
C ontrainte of Weibull for <i>INST</i> = 8,0	3,7537E+003	NON_DEFINI	0,1% (relative)
C ontrainte of Weibull for <i>INST</i> = 10,0	4,0477E+003	NON_DEFINI	0,1% (relative)

Model of Rice-Tracey:

Identification	Reference	Test	Tolerance
Growth rate of the cavity for <i>INST</i> = 1,0	1,0000E+000	NON_DEFINI	0,1% (relative)
Volume of the cavity for <i>INST</i> = 1,0	3,7500E+000	NON_DEFINI	0,1% (relative)
Growth rate of the cavity for <i>INST</i> = 3,0	1,0014E+000	NON_DEFINI	0,1% (relative)
Volume of the cavity for <i>INST</i> = 3,0	6,2372E-001	NON_DEFINI	0,1% (relative)
Growth rate of the cavity for <i>INST</i> = 5,0	1,0076E+000	NON_DEFINI	0,1% (relative)
Growth rate of the cavity for <i>INST</i> = 7,0	1,0170E+000	NON_DEFINI	0,1% (relative)
Growth rate of the cavity for <i>INST</i> = 10,0	1,0315E+000	NON_DEFINI	0,1% (relative)

Model of Bordet:

Identification	Reference	Test	Tolerance
Constraint of Bordet for <i>INST</i> = 2,0	0,0000E+000	NON_DEFINI	0,1% (relative)
Constraint of Bordet for <i>INST</i> = 4,0	7,2180E+002	NON_DEFINI	0,1% (relative)
Constraint of Bordet for <i>INST</i> = 6,0	1,3024E+003	NON_DEFINI	0,1% (relative)
Constraint of Bordet for <i>INST</i> = 8,0	1,7305E+003	NON_DEFINI	0,1% (relative)
Constraint of Bordet for <i>INST</i> = 10,0	2,0225E+003	NON_DEFINI	0,1% (relative)

5 Summary of the results

Results got by *Code_Aster* are close to the reference solution since the variation with the reference solution is lower than 1%.