SSNV147 - Traction of a bar endommageable: validation of piloting

Summary:

The use of lenitive laws can lead to *snap-back* brutal which makes difficult the course of calculation. To follow these instabilities, two types of piloting are available in *Code_Aster* : piloting by elastic prediction (PRED_ELAS), which depends on the law on behavior and piloting in deformation (DEFORMATION) credits. To validate these techniques, one carries out a tensile test on a bar of square section which one weakened a section in order to cause the localization of the damage.

1 Problem of reference

1.1 Geometry and boundary conditions

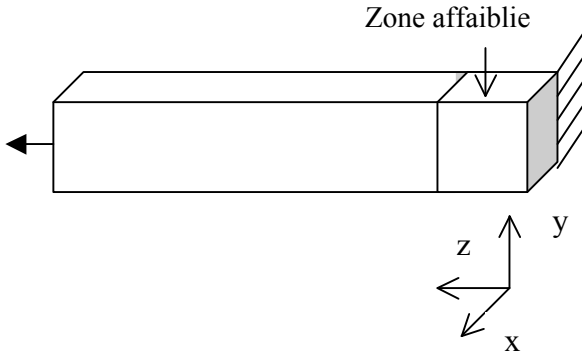


Figure 1.1-a : geometry of the studied structure

The studied structure is a bar of $1\,mm$ of length, square section of $0.1\times0.1\,mm$. A face is embedded, the opposite face is subjected to an effort FZ varying linearly with the time of 1 with $5\,N$.

1.2 Material properties

Law of behavior	Elastic behavior	Damaging behavior (healthy part)	Damaging behavior (weakened zone)
ENDO_FRAGILE	$E=20\,000\,MPa$ $\nu=0$	$\sigma_y=6\,MPa$ $E_T=-10000\,MPa$	$\sigma_y=5\,MPa$ $E_T=-10000\,MPa$
ENDO_ISOT_BETON	$E=20\,000\,MPa$ $\nu=0$	$\sigma_y=6\,MPa$ $E_T=-10000\,MPa$	$\sigma_y=5\,MPa$ $E_T=-10000\,MPa$
ROUSS_PR and ROUSSELIER	$E=206\,400\,MPa$ $\nu=0.3$	$D=2$ $\sigma_1=490\,MPa$ $f_0=5E-04$ traction diagram: $R(p)=r_i+(r_o-r_i)e^{-bp}$ p : cumulated plastic deformation $r_i=1500\,MPa$ $r_o=520\,MPa$ $b=2.4$	$D=2$ $\sigma_1=400\,MPa$ $f_0=5E-04$ traction diagram: $R(p)=r_i+(r_o-r_i)e^{-bp}$ p : cumulated plastic deformation $r_i=1500\,MPa$ $r_o=520\,MPa$ $b=2.4$
BETON_DOUBLE_DP	$E=31000\,MPa$ $\nu=0.22$	$f_c=38.3\,MPa$ $f_t=4.0\,MPa$ $\beta=1.16$ $G_t=2.83E-04\,Nmm/mm^2$ $G_c=2.83E-02\,Nmm/mm^2$	$f_c=38.3\,MPa$ $f_t=3.0\,MPa$ $\beta=1.16$ $G_t=2.83E-04\,Nmm/mm^2$ $G_c=2.83E-02\,Nmm/mm^2$

2 Reference solution

The values tested are values of not-regression.

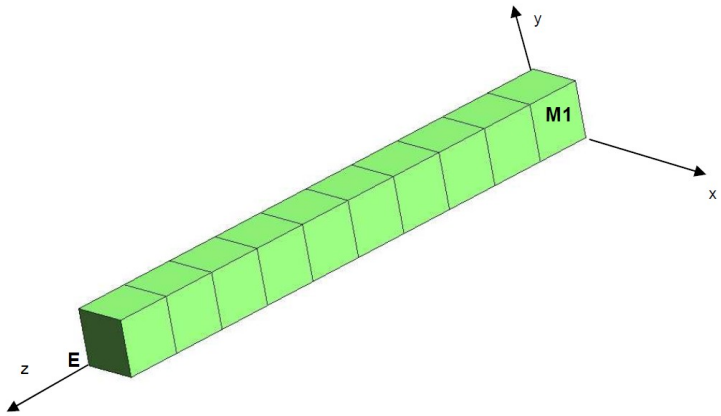
3 Modeling A

3.1 Characteristics of modeling

The model tested is 3D. The law of behavior used is the law ENDO_FRAGILE. One validates piloting by elastic prediction.

3.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements HEXA8 (only one element in the section)



3.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 11:

1) following displacement z face on which the loading is imposed,
2) the constraint zz as well as the value of the damage in the weakened mesh

Name of the field	Component	Place	Tolerance
DEPL	DZ	E	defect
SIEF_ELGA	SIZZ	$M1$, point 1	defect
VARI_ELGA	V1	$M1$, point 1	defect

One also tests elastic work on the structure as well as the real work obtained thanks to the order POST_ELEM.
More specifically to validate the constancy of piloting, one in addition checks with the same sequence number (11) the value of the moment and of ETA_PILOTAGE.

Name of the field	Component	*Code_Aster*
TRAV_EXT	TRAV_ELAS	3.3125E-07
TRAV_EXT	TRAV_REEL	1.91875E-06
INST	-	11
ETA_PILOTAGE	-	0.5

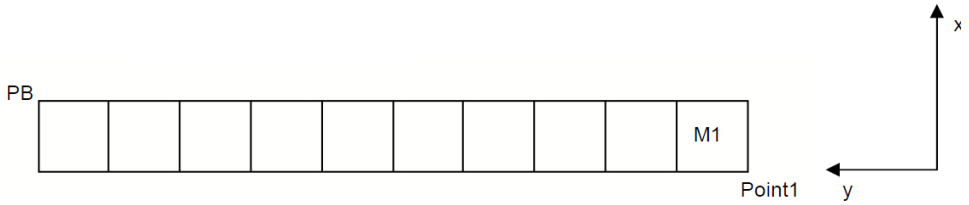
4 Modeling B

4.1 Characteristics of modeling

Modeling tested is AXIS. The law of behavior used is the law ENDO_FRAGILE. One validates piloting by elastic prediction.

4.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements QUA8.



4.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 11:

1) following displacement y face on which the loading is imposed,
2) the constraint yy as well as the value of the damage in the weakened mesh

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Name of the field	Component	Place	Tolerance
DEPL	DY	PB	defect
SIEF_ELGA	SIYY	$M1$, point 1	defect
VARI_ELGA	V1	$M1$, point 1	defect

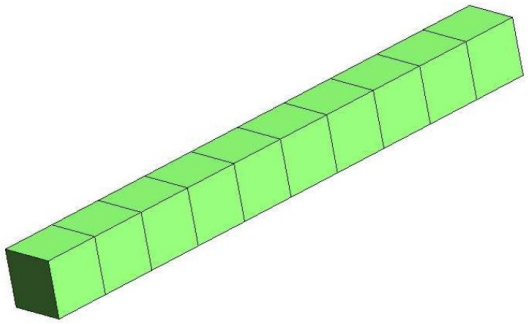
5 Modeling C

5.1 Characteristics of modeling

The model tested is 3D. The law of behavior used is the law ENDO_ISOT_BETON. One validates piloting by deformation.

5.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements HEXA8 (only one element in the section),



5.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 41:

1) following displacement z face on which the loading is imposed,
2) the constraint zz as well as the value of the damage in the weakened mesh,

Name of the field	Component	Place	Tolerance
DEPL	DZ	E	defect
SIEF_ELGA	SIZZ	$M1$, point 1	defect
VARI_ELGA	V1	$M1$, point 1	defect

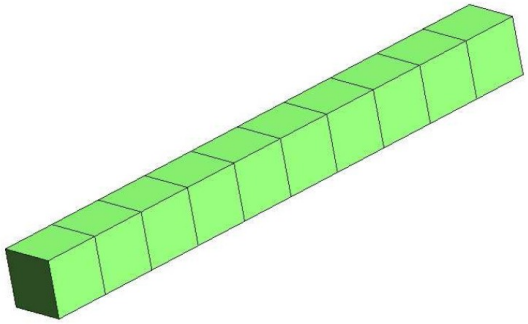
6 Modeling D

6.1 Characteristics of modeling

The model tested is 3D. The law of behavior used is the law ROUSS_PR. One validates piloting by deformation.

6.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements HEXA8 (only one element in the section)



6.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 20:

1) following displacement z face on which the loading is imposed,
2) the constraint zz in the weakened mesh

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Name of the field	Component	Place	Tolerance
DEPL	DZ	E	defect
SIEF_ELGA	SIZZ	$M1$, point 1	defect

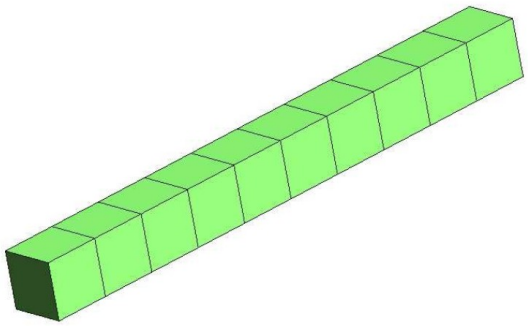
7 Modeling E

7.1 Characteristics of modeling

The model tested is 3D. The law of behavior used is the law ENDO_ISOT_BETON. One validates piloting by elastic prediction.

7.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements HEXA8 (only one element in the section)



7.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 19:

1) following displacement z face on which the loading is imposed,
2) the constraint zz as well as the value of the damage in the weakened mesh.

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Name of the field	Component	Place	Tolerance
DEPL	DZ	E	defect
SIEF_ELGA	SIZZ	$M1$, point 1	defect
VARI_ELGA	V1	$M1$, point 1	defect

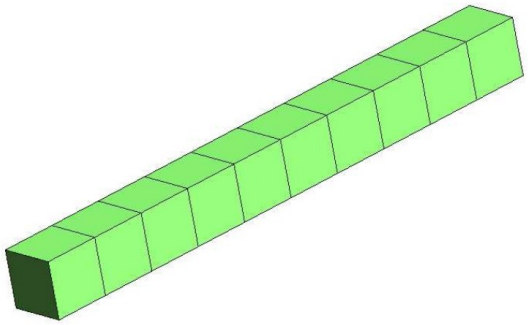
8 Modeling F

8.1 Characteristics of modeling

The model tested is 3D. The law of behavior used is the law BETON_DOUBLE_DP. One validates piloting by elastic prediction.

8.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements HEXA8 (only one element in the section)



8.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 41:

1) following displacement z face on which the loading is imposed,
2) the constraint zz in the weakened mesh.

Name of the field	Component	Place	Tolerance
DEPL	DZ	E	defect
SIEF_ELGA	SIZZ	$M1$, point 1	defect

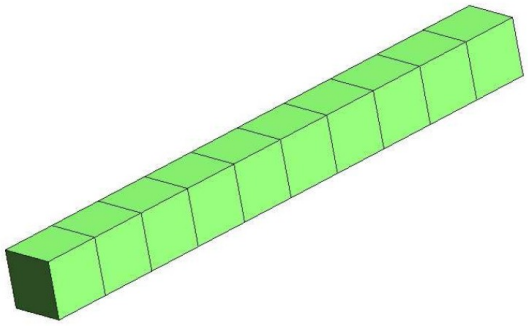
9 Modeling I

9.1 Characteristics of modeling

The model tested is 3D. The law of behavior used is the law ROUSSELIER (in great deformations of the type SIMO_MIEHE). One validates piloting by deformation.

9.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements HEXA8 (only one element in the section)



9.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 21:

1) following displacement z face on which the loading is imposed,
2) the constraint zz as well as the value of the damage in the weakened mesh
3) the value of the indicator of plasticity in the weakened mesh.

Name of the field	Component	Place	Tolerance
DEPL	DZ	E	defect
SIEF_ELGA	SIZZ	$M1$, point 1	defect
VARI_ELGA	V3	$M1$, point 1	defect

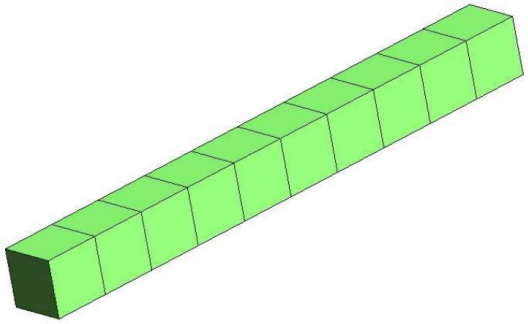
10 Modeling J

10.1 Characteristics of modeling

The model tested is 3D. The law of behavior used is the law ROUSSELIER with the option (PORO_TYPE = 2, cf U4.43.01) allowing to calculate porosity according to the total deflection (into large deformations of the type SIMO_MIEHE). One validates piloting by deformation.

10.2 Characteristics of the grid

The grid is obtained by GIBI. It is composed of 10 elements HEXA8 (only one element in the section)



10.3 Sizes tested and results

To validate the solution obtained, one tests with the sequence number 21:

1) following displacement z face on which the loading is imposed,
2) the constraint zz as well as the value of the damage in the weakened mesh
3) the value of the indicator of plasticity in the weakened mesh.

Name of the field	Component	Place	*Tolerance*
DEPL	DZ	E	10th-6
SIEF_ELGA	SIZZ	$M1$, point 1	10th-6
VARI_ELGA	V3	$M1$, point 1	10th-6

11 Summary of the results

This CAS-test makes it possible to check the good performance of piloting for the various lenitive laws of behavior. The got results provide values of not-regression.