

ZZZZ238 - Normal displacements imposed on curved faces of hexahedrons on 20 and 27 nodes and pentahedrons on 18 nodes

Summary:

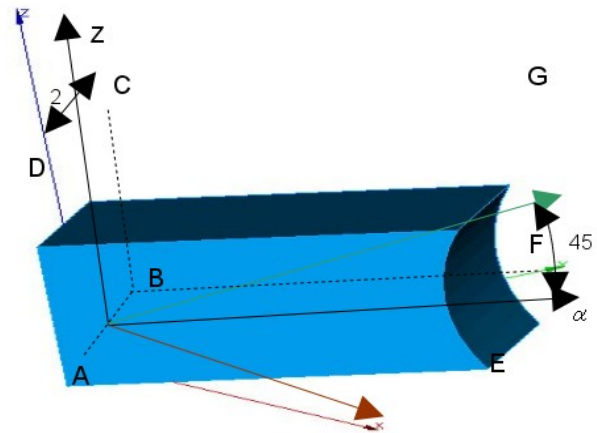
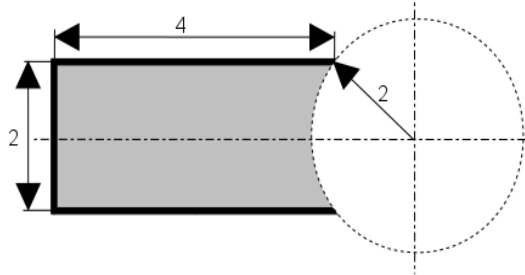
Validation of the keyword `DNOR` keyword factor `FACE_IMPO` of the operator `AFFE_CHAR_MECA`. This validation was carried out with three following modelings:

- Modeling a: grid `HEXA20`, `DNOR` imposed on a curved face,
- Modeling b: grid `HEXA27`, `DNOR` imposed on a curved face,
- Modeling C: grid `PENTA18`, `DNOR` imposed on a curved face,

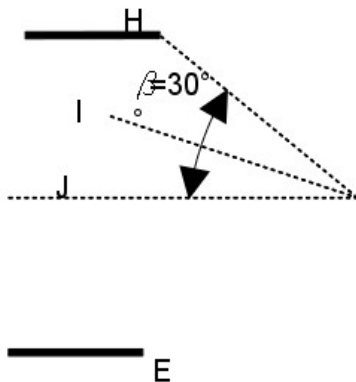
Comparison with analytical solution, and comparison `HEXA20` and `HEXA27` and `PENTA18`.

1 Problem of reference

1.1 Geometry



Dimensions in meters



Groups of meshes:

- LEFT : face $ABCD$
- RIGHT-HAND SIDE : face $EFGH$

The face $AEFB$ is coplanar with the plan (xy)
Direction (AE) fact an angle $\alpha = 45^\circ$ with
 (Ox)

1.2 Properties of material

- $E = 200\,000. N/mm^2$
- $\nu = 0.$

1.3 Boundary conditions and loadings

- Embedding on the face $ABCD$: $DX = DY = DZ = 0.$
- Normal displacement imposed on the face $EFGH$: $DNOR = 0.15$

2 Reference solution

2.1 Method of calculating

Displacement at the point J :

- $DX = 0.15 \sin(45^\circ)$
- $DY = 0.15 \cos(45^\circ)$
- $DZ = 0.$

2.2 Results of reference

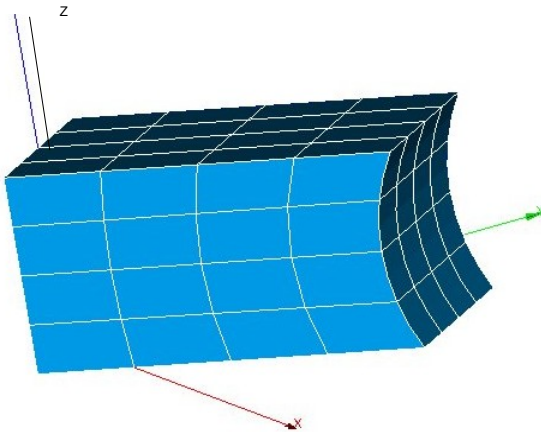
- $DX = 0.106066$
- $DY = 0.106066$
- $DZ = 0.$

2.3 Uncertainties

Analytical solution

3 Modeling A

3.1 Characteristics of modeling A



Modeling in 3D: 64 elements HEXA20.

3.2 Features tested

Order	Option		
AFFE_MODELE	MODELING	3D	
AFFE_CHAR_MECA	FACE_IMPO	DNOR	0.15
MECA_STATIQUE			

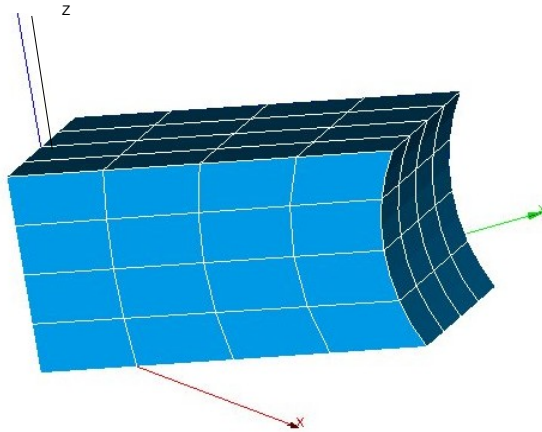
3.3 Results

Points	Size	Reference	Code_Aster	Relative error (%)
<i>H</i>	<i>DX</i> *	1.126635E- 1	1.126635E -1	1.16E- 5
	<i>DY</i> *	1.144527E-1	1.144527E- 1	1.91E- 5
	<i>DZ</i> *	-2.177228E-2	-2.177228E- 2	6.27E- 6
<i>I</i>	<i>DX</i> *	1.073518E-1	1.073518E- 1	6.91E- 6
	<i>DY</i> *	1.071796E-1	1.071796E- 1	4.72E- 6
	<i>DZ</i> *	-1.341602E-2	-1.341602E- 2	1.16E- 4
<i>J</i>	<i>DX</i>	0.106066	1.060872E-1	0,020
	<i>DY</i>	0.106066	1.060449E-1	- 0,020
	<i>DZ</i>	0.0	3.74492E-16	3.74E-16

* Values of nonregressions obtained with Code_Aster in version 9.2.25.

4 Modeling B

4.1 Characteristics of modeling B



Modeling in 3D: 64 elements HEXA27.

4.2 Features tested

Order	Option			
AFFE_MODELE	MODELING	3D		
AFFE_CHAR_MECA	DDL_IMPO	DNOR	0.15	
MECA_STATIQUE				

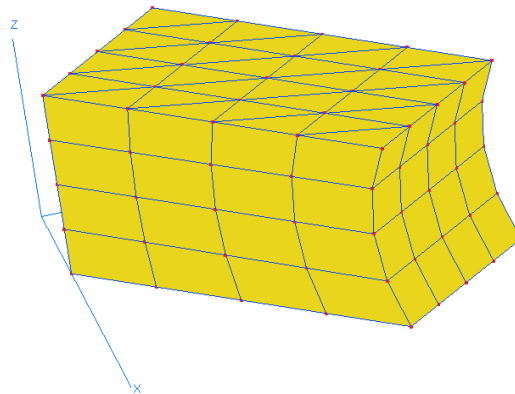
4.3 Results

Points	Size	Reference	Code_Aster	Relative error (%)
<i>H</i>	<i>DX</i> *	1.126635E-1	1.129919D-1	0,291
	<i>DY</i> *	1.144527E-1	1.129919D- 1	-1,276
	<i>DZ</i> *	-2.177228E-2	-2.316107D- 2	6,379
<i>I</i>	<i>DX</i> *	1.073518E-1	1.072795D- 1	-0,067
	<i>DY</i> *	1.071796E-1	1.072795D- 1	0,093
	<i>DZ</i> *	-1.341602E-2	-1.334324D- 2	-0,542
<i>J</i>	<i>DX</i>	0.106066	1.060660D-1	1.62E- 5
	<i>DY</i>	0.106066	1.060660D-1	1.62E- 5
	<i>DZ</i>	0.0	-4.18783 9D-17	-4.19E-17

* Values of nonregressions obtained with modeling A (Meshs HEXA20)

5 Modeling C

5.1 Characteristics of modeling C



Modeling in 3D: 128 elements PENTA18.

5.2 Features tested

Order	Option		
AFFE_MODELE	MODELING	3D	
AFFE_CHAR_MECA	DDL_IMPO	DNOR	0.15
MECA_STATIQUE			

5.3 Results

Points	Size	Reference	Code_Aster	Relative error (%)
<i>H</i>	<i>DX</i> *	1.0986534E-1	1.0968894D-1	0.16
	<i>DY</i> *	1.0975895E-1	1.0972729D- 1	0.03
	<i>DZ</i> *	-1.7046775E-2	-1.7401956D- 2	2.1
<i>I</i>	<i>DX</i> *	1.0734417E-1	1.0739643D- 1	0,049
	<i>DY</i> *	1.072603E-1	1.0733993D- 1	0,074
	<i>DZ</i> *	-1.3223189E-2	-1.28751799D- 2	2.6
<i>J</i>	<i>DX</i>	0.106066	1.06137138D-1	0,067
	<i>DY</i>	0.106066	1.05994896D-1	0,067
	<i>DZ</i>	0.0	-1.42247D-16	1.4E-16

* Values of nonregressions obtained with meshes PENTA15

6 Summary of the results

Results with *Code_Aster* for HEXA20, HEXA27 and PENTA18 are in very good agreement with the analytical solution at the point of observation *J*.

For the other points of observation the comparison of displacements between HEXA20 and HEXA27 on the curved face is correct: One notes a maximum change of 6.4%.