PERF001 - Elastic design of a hollow ring subjected to an internal pressure

Summary:

The objective of this CAS-test is to measure the performances of an elastic design 3D.

Five modelings carried out are the following ones:

- Modeling a: grid HEXA8, $5.0 \times 10^5$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling b: grid HEXA20, $5.2 \times 10^5$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling C: grid HEXA8, $1.0 \times 10^6$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling D: grid HEXA8, $2.0 \times 10^6$ degrees of freedom, MECA_STATIQUE ('MULT_FRONT')
- Modeling E: grid HEXA8, $5.0 \times 10^5$ degrees of freedom, MECA_STATIQUE ('MUMPS')
# Problem of reference

## 1.1 Geometry

Coordinates of the points \((m)\):

- \(A: (1., 0., 0.)\)
- \(A_2: (-1., 0., 0.)\)
- \(X_1: (0., 1., 0.)\)
- \(X_2: (1., 0., 15.)\)

Group of meshes: \(P1\) internal surface

## 1.2 Properties of material

- \(E = 5.0 \times 10^5\) Pa
- \(\nu = 0.3\)
- \(\rho = 9800\) kg\(m^{-3}\)

## 1.3 Boundary conditions and loadings

- Imposed displacements:
  - \(A\) : \(DX = DY = DZ = 0.\)
  - \(A_2\) : \(DY = DZ = 0.\)
  - \(X_1\) : \(DZ = 0.\)

- Internal pressure:
  - \(p = 2.0 \times 10^6\) Pa
2 Reference solution

2.1 Method of calculating

The result of reference (displacement following the axis \(Z\) point \(X_2\)) was obtained by making the average of the displacements calculated at the time as of modelings \(A\), \(B\) and \(C\).

2.2 Results of reference

Displacement at the point \(X_2\) : \(DZ = 5.87 \times 10^{-4} \text{ m}\)

2.3 Uncertainties

Digital solution.
3 Modeling A

3.1 Characteristics of modeling A

Modeling 3D:

- Many nodes: 168,000
- Many meshes: 225,248

That is to say:

- SEG2: 6,128
- QUAD4: 93,120
- HEXA8: 126,000

3.2 Results

<table>
<thead>
<tr>
<th>Points</th>
<th>Size</th>
<th>Reference (m)</th>
<th>Tolerance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>DZ</td>
<td>5.870E−4</td>
<td>3.000E-3</td>
</tr>
</tbody>
</table>
4 Modeling B

4.1 Characteristics of modeling B

Modeling 3D:

- Many nodes: 172,800
- Many meshes: 62,408

That is to say:

- SEG3: 2,352
- QUAD8: 26,496
- HEXA20: 34,560

4.2 Results

<table>
<thead>
<tr>
<th>Points</th>
<th>Size</th>
<th>Reference (m)</th>
<th>Tolerance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>DZ</td>
<td>5.870E-4</td>
<td>3.000E-3</td>
</tr>
</tbody>
</table>
5  Modeling C

5.1  Characteristics of modeling C

Modeling 3D:

- Many nodes: 336,000
- Many meshes: 405,472

That is to say:

<table>
<thead>
<tr>
<th>Element Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEG2</td>
<td>6,192</td>
</tr>
<tr>
<td>QUAD4</td>
<td>105,280</td>
</tr>
<tr>
<td>HEXA8</td>
<td>294,000</td>
</tr>
</tbody>
</table>

5.2  Results

<table>
<thead>
<tr>
<th>Points</th>
<th>Size</th>
<th>Reference (m)</th>
<th>Tolerance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>DZ</td>
<td>5.870E-4</td>
<td>3.000E-3</td>
</tr>
</tbody>
</table>
6 Modeling D

6.1 Characteristics of modeling D

Modeling 3D:

- Many nodes: 672000
- Many meshes: 785 632

That is to say:

- SEG2: 6672
- QUAD4: 190 960
- HEXA8: 588 000

6.2 Results

<table>
<thead>
<tr>
<th>Points</th>
<th>Size</th>
<th>Reference (m)</th>
<th>Tolerance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>DZ</td>
<td>5.870E-4</td>
<td>3.000E-3</td>
</tr>
</tbody>
</table>
7 Modeling E

7.1 Characteristics of modeling E

Modeling 3D:

Many nodes: 168,000
Many meshes: 225,248

That is to say:

- SEG2: 6,128
- QUAD4: 93,120
- HEXA8: 126,000

7.2 Results

<table>
<thead>
<tr>
<th>Points</th>
<th>Size</th>
<th>Reference (m)</th>
<th>Tolerance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X2</td>
<td>DZ</td>
<td>5.87x10^-4</td>
<td>3.00x10^-3</td>
</tr>
</tbody>
</table>

Warning: The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

Copyright 2020 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)
## Summary of the results

<table>
<thead>
<tr>
<th>Machine</th>
<th>Aster</th>
<th>MOD.</th>
<th>Nb DDL</th>
<th>Memory (Mo)</th>
<th>Time execution (MECA_STATIQUE, dryness)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Alloced</td>
<td>Used</td>
</tr>
<tr>
<td>Linux 64 bits (ia64) &quot;Bull&quot;</td>
<td>10.1</td>
<td>With</td>
<td>504,012</td>
<td>763</td>
<td>758</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B</td>
<td>518,412</td>
<td>1,348</td>
<td>1,221</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>1 008,012</td>
<td>1,690</td>
<td>1,263</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D</td>
<td>2 016,012</td>
<td>3,961</td>
<td>2,486</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E</td>
<td>504,012</td>
<td>624</td>
<td>570</td>
</tr>
</tbody>
</table>

Warning: The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

Copyright 2020 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)