PERF011 – Elastic design of a cylinder

Summary:

The objective of this CAS-test is to measure the performances of an elastic design of a bi-metallic cylinder subjected to a thermal loading.

This case test is declined in 2 modelings which are identical. The differences are related to the change of many processors:

1) Modeling a: solver MUMPS on 1 processor,
2) Modeling b: solver MUMPS on 4 processors,
1 Problem of reference

1.1 Geometry

The geometry is the following one:

1.2 Properties of material

Four parameters are indicated, it acts of:

\[ E : \] Young modulus, expressed in \( Pa \),
\[ nu = 0.3 \] Poisson's ratio,
\[ \text{With :} \] isotropic thermal dilation coefficient, expressed in \( ^\circ C \),
\[ \text{TEMP_DEF_ALPHA} = 20 : \] value of the temperature to which values of the thermal dilation coefficient \( ALPHA \) were determined, expressed in \( ^\circ C \).

For the external part:

<table>
<thead>
<tr>
<th>Temperature (( ^\circ C ))</th>
<th>( E )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.9E+11</td>
</tr>
<tr>
<td>350</td>
<td>1.7E+11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature (( ^\circ C ))</th>
<th>( ALPHA )</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>1.60E-005</td>
</tr>
<tr>
<td>450</td>
<td>1.80E-005</td>
</tr>
</tbody>
</table>

For the internal part:

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1.3 Boundary conditions and loadings

Imposed displacement:

- Lower face: \( DZ = 0 \)
- Not A: \( DX = DY = 0 \)
- Not B: \( DX = 0 \)
- Higher face: Equality of displacements along the axis \( Z \)

Interior pressure and on the faces higher and lower imposed variable according to time:
2 Reference solution

2.1 Method of calculating

The results of reference were got in version 10.2.5 of Code_Aster. The values tested are displacements along the axes $X$ and $Y$ on two nodes whose coordinates are:

Node $C$: $X = -1.775388$; $Y = +1.301768$; $Z = -3.100000$

Node $D$: $X = +1.614099$; $Y = -1.183506$; $Z = -5.054278$

2.2 Uncertainties

Digital solution (not-regression).
3 Modeling A

3.1 Characteristics of modeling A

Number of processor: 1

Modeling 3D:

| Many nodes | 284,544 |
| Many meshes | 158,400 |

That is to say:

- POI1: 10,944
- SEG3: 67,392
- QUAD8: 14,400
- HEXA20: 65,664

3.2 Results

<table>
<thead>
<tr>
<th>Size</th>
<th>Reference</th>
<th>Tolerance (%)</th>
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<tbody>
<tr>
<td>DEPL DX Point C</td>
<td>-7.59E-004</td>
<td>1.e-3</td>
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<td>DEPL DY Not C</td>
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<td>4.0006E-04</td>
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3.3 Environment of execution

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<tr>
<th>Machine</th>
<th>Version</th>
<th>Memory (Mo)</th>
<th>Number DDL</th>
<th>Time execution (MECA_STATIQUE) (dryness)</th>
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<tbody>
<tr>
<td>Linux 64 bits (ia64) “Bull”</td>
<td>10.2.23</td>
<td>6,500</td>
<td>5 822.6</td>
<td>TO USE: 5 863.8, SYSTEM: 67.5, TO USE +SYS: 2 931.4, ELAPSED: 2 969.0</td>
</tr>
</tbody>
</table>
4 Modeling B

4.1 Characteristics of modeling B

Number of processor: 4

Modeling 3D:

- Many nodes: 284,544
- Many meshes: 158,400

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