SSLL108 - Discrete elements 2D

Summary:

The problem is quasi-static linear in mechanics of the structures.

One analyzes the answer of a bar, modelled by 10 discrete elements, with a loading of traction, to validate the two-dimensional discrete elements.

Only one modeling uses at the same time the operators MECA_STATIQUE, and STAT_NON_LINE, to validate the use of these elements (of which the behavior remains linear) with other finite elements with unspecified behavior.
1 Problem of reference

1.1 Geometry

A bar length \( L = 10\text{m} \), along the axis \( X \), modelled by 10 discrete elements with 2 nodes.

1.2 Material properties

Each discrete element has a stiffness: \( k = 1000\,\text{N/m} \)

1.3 Boundary conditions and loadings

\begin{align*}
\text{In } x &= 0 & dx &= dy = 0 \\
\text{In } x &= L & F_x &= 10\text{N}
\end{align*}

2 Reference solution

2.1 Method of calculating used for the reference solution

Analytical solution: displacement for an element is given by: \( U_x = F / K_x \)

Thus for \( n \) springs: \( U_x = n\,F / K_x \)

2.2 Results of reference

Values of displacement for \( x = L/2 \) and \( X = L \), as well as effort in the elements (constant):

\( U(L/2) = 0.05\,\text{m} \), \( U(L) = 0.1\,\text{m} \), \( N = 10\text{N} \)

2.3 Uncertainty on the solution

Exact analytical solution.
3  Modeling A

3.1  Characteristics of modeling

Modeling 2D_DISCRET

3.2  Characteristics of the grid

10 meshes SEG2.

3.3  Sizes tested and results

<table>
<thead>
<tr>
<th>Identification</th>
<th>Reference</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>MECA_STATIQUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$DX(L/2)$</td>
<td>0.05</td>
<td>1.0E-07</td>
</tr>
<tr>
<td>$DX(L)$</td>
<td>0.10</td>
<td>1.0E-07</td>
</tr>
<tr>
<td>$N_{SIEF_ELGA}$</td>
<td>10.00</td>
<td>1.0E-03</td>
</tr>
<tr>
<td>STAT_NON_LINE</td>
<td></td>
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4 Summary of the results

This very simple test voluntarily makes it possible to check the good performance of the discrete elements 2D with STAT_NON_LINE, which makes it possible to use them with other modelings.