Summary:

This test makes it possible to validate the nonintrusive rocker between models 1D and 3D, developed in [1]. It is about a mixed model 1D-3D of a beam hurled on two supports, subjected to a static loading. The results of calculations are compared with those obtained by Code_Aster with a mono-model of reference 3D. The results coincide perfectly with the reference solution.
1 Problem of reference

The objective of this case test is to validate the nonintrusive rocker of a model of beam to a mixed model Beam-3D Dyears Code_Aster.

One compares the results got with those resulting from a modeling complete 3D in Code_Aster.

1.1 Geometry

A slim mean structure is considered of length 0.25 m according to axis Z and of circular section. It is supported on its two ends located respectively at the positions −0.1 m (support 1) and 0.15 m (support 2). The ray of the section is equal to 0.005 m.

![Image 1.1-1: Geometry of the rotor]

1.2 Material properties

The bi--supported beam has a density of \( \rho = 7800 \, \text{kg/m}^3 \).

The Young modulus is \( E = 2 \times 10^{11} \, \text{N/m}^2 \) and the Poisson's ratio is \( \nu = 0.3 \).

1.3 Boundary conditions and loadings

The beam rests on two infinitely rigid supports:

- \( DX = DY = DZ = 0 \) on the level of support 1
- \( DX = DY = DZ = 0 \) on the level of support 2

Also, the rigid movement of body of rotation according to the axis of the beam is blocked (\( DRZ = 0 \)) on all the structure.

2 Reference solution

The reference solution is a calculation complete 3D carried out with Code_Aster (cf modeling B).

3 Modeling A

3.1 Characteristics of modeling

The bi–supported structure of length \(0.25\,m\), extending enters \(Z=-0.1\,m\) and \(Z=0.15\,m\), is connected to the levels of the nodes with the positions \(0.0\,m\) and \(0.05\,m\) with a model 3D by the option 3D_POU keyword LIAISON_ELEM of AFFE_CHAR_MECA.

It is modelled by elements of beam of Timoshenko (POU_D_T) and of the quadratic voluminal elements (PENTA15 and HEXA20).

DYNA_LINE_TRAN calculate the dynamic response of the structure during 3 S, due to a nodal force of a value equal to 100 NR on the node of the grid 3D located at \(Z=0.02\,m\). The rocker of the model 1D to mixed model 1D-3D is done at the moment \(Tb=2\,s\).

3.2 Characteristics of the grid

Many meshes HEXA20 150
Many meshes PENTA15 50
Many meshes POU_D_T 20

Table 3.2-1

3.3 Sizes tested and results

The tables below give the digital values tested in this CAS-test. They is displacements minimal and maximum in X of a node of the grid 3D located at \(Z=0.04\,m\).

<table>
<thead>
<tr>
<th>Identification</th>
<th>Moment of the maximum one</th>
<th>Type of reference</th>
<th>Value of reference</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal displacement in X</td>
<td>2.2115 S</td>
<td>‘AUTRE_ASTER’</td>
<td>-0.0003266</td>
<td>7.00%</td>
</tr>
<tr>
<td>Maximum displacement in X</td>
<td>2.7065 S</td>
<td>‘AUTRE_ASTER’</td>
<td>+0.0003264</td>
<td>7.00%</td>
</tr>
</tbody>
</table>

Table 3.3-1: Summary of the results tested
4 Modeling B

4.1 Characteristics of modeling

The structure is entirely modelled by quadratic voluminal elements (PENTA15 and HEXA20). It is supported on the level of its two ends.

DYNA_LINE_TRAN calculate the dynamic response of the structure during 3 S, due to a nodal force of a value equal to 100 NR on the node of the grid 3D located at \( Z = 0.02 \) m.

4.2 Characteristics of the grid

<table>
<thead>
<tr>
<th>Many meshes HEXA20</th>
<th>750</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many meshes PENTA15</td>
<td>250</td>
</tr>
</tbody>
</table>

Table 4.2-1

4.3 Sizes tested and results

The tables below give the digital values tested in this CAS-test. They is displacements minimal and maximum in X of a node of the grid 3D located at \( Z = 0.04 \) m.

<table>
<thead>
<tr>
<th>Identification</th>
<th>Moment of the maximum one</th>
<th>Type of reference</th>
<th>Value of reference</th>
<th>Tolerance</th>
</tr>
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<tbody>
<tr>
<td>Minimal displacement in X</td>
<td>2.2115 S</td>
<td>'AUTRE_ASTER'</td>
<td>-0.0003266</td>
<td>7.00%</td>
</tr>
<tr>
<td>Maximum displacement in X</td>
<td>2.7065 S</td>
<td>'AUTRE_ASTER'</td>
<td>+0.0003264</td>
<td>7.00%</td>
</tr>
</tbody>
</table>

Table 4.3-1: Summary of the results tested

The answers of the models 1D and mixed 1D-3D of the structure are represented on the graph below.
5 Summary of the results

The cas-test implements in Code_Aster a nonintrusive rocker in dynamics of a model 1D of beam to a mixed model 1D-3D on the basis of bi--supported structure. The results of the resulting mixed model are compared compared to the results got with the model are equivalent complete 3D in Code_Aster.