SDNL139 - Rock nonintrusive 1D-3D of a bi-- supported beam

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 $0,005\,m$.

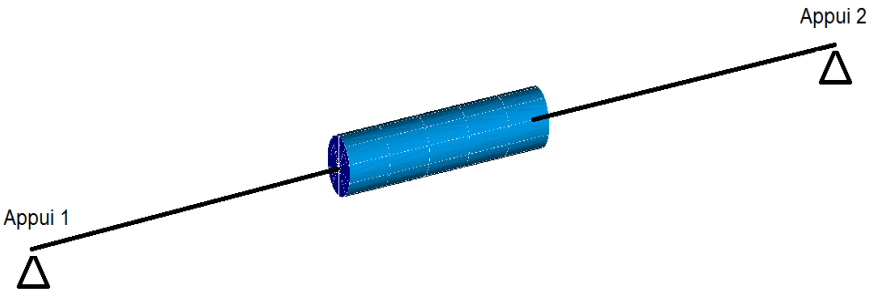

Image 1.1-1: Geometry of the rotor

1.2 Material properties

The bi--supported beam has a density of $\rho=7\,800\,kg/m^3$.
The Young modulus is $E=2.10^{11}\,N\,m^{-2}$ 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).

[1] M.Tannous, Development and evaluation of coupled approaches of digital modeling 1D and 3D of contact rotor-stator, Thesis of the Central School Nantes .

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).

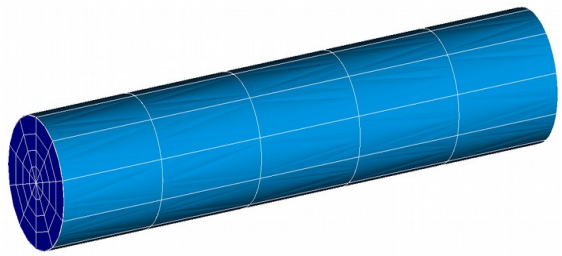

Image 3.1-1: Grid of the voluminal model 3D

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 meshs HEXA20	150
Many meshs PENTA15	50
Many meshs 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 $Z=0,04\,m$.

Identification	Moment of the maximum one	Type of reference	Value of reference	Tolerance
Minimal displacement in X	2.2115 S	'AUTRE_ASTER'	-0.0003266	7,00%
Maximum displacement in X	2.7065 S	'AUTRE_ASTER'	+0.0003264	7,00%

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

Many meshs HEXA20	750
Many meshs PENTA15	250

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 $Z=0,04\,m$.

Identification	Moment of the maximum one	Type of reference	Value of reference	Tolerance
Minimal displacement in X	2.2115 S	'AUTRE_ASTER'	-0.0003266	7,00%
Maximum displacement in X	2.7065 S	'AUTRE_ASTER'	+0.0003264	7,00%

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.

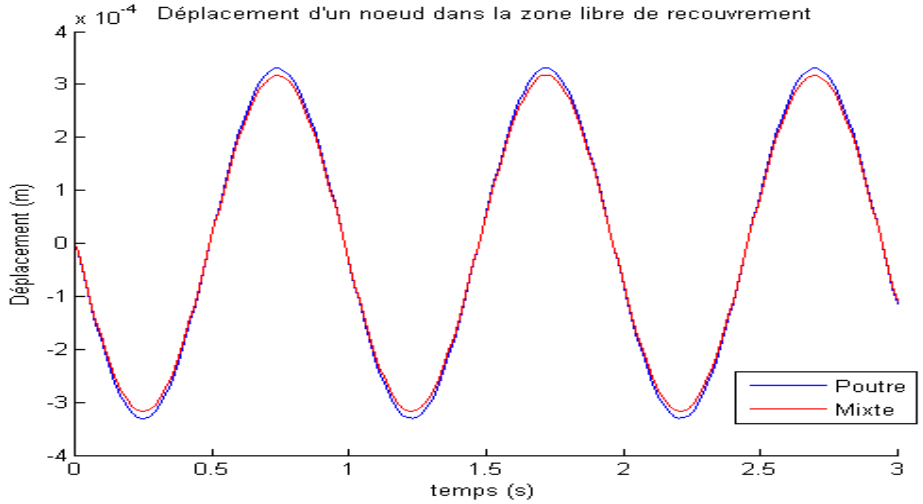

Image 4.3-2: Answers of the models 1D and mixed 1D-3D

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*.