SSLV160 - Bi--supported beam subjected to a nodal force on its neutral fibre

Summary:

This test makes it possible to validate the connection between models 1D and 3D, within the framework Harlequin (3D_POU_ARLEQUIN) [1].

It is about a model of beam hurled on two supports, subjected to a nodal force.

The results of calculations are compared with those obtained by Code_aster with a model of reference 1D and a mixed model 1D-3D connected with the option 3D_POU. The results coincide perfectly with the reference solutions.

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)

1 Problem of reference

The objective of this case test is to validate the connection Harlequin Beam-3D in Code_Aster.

One compares the results got with those resulting from two modelings in Code_Aster:
- mono-modeling of reference 1D
- mixed modeling of reference 1D-3D with connection 3D_POU

1.1 Geometry

A slim mean structure is considered of length 0.25 m according to axis X 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 Mr.

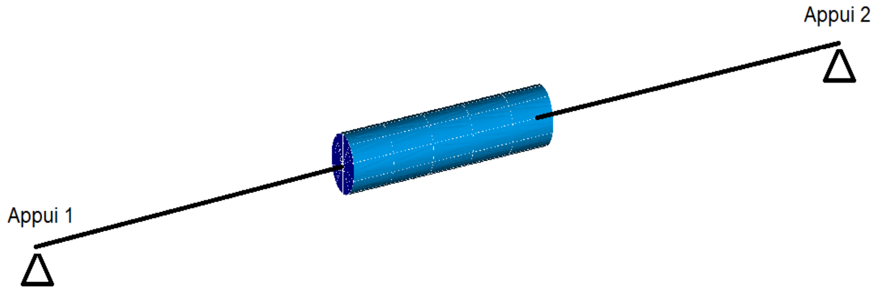

Image 1.1-1: Geometry of the rotor

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 (DRX = 0) on all the structure.

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)

2 Reference solution

The reference solution is resulting from a calculation 1D carried out with Code_Aster (cf modeling C).

[1] A. Ghanem, "Contribution to the advanced modeling of the revolving machines in transitory dynamics within the framework Harlequin", thesis of INSA de Lyon.

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)

3 Modeling A

3.1 Characteristics of modeling

The bi--supported structure of length 0.25 m, extending between X = -0.1 m and X = 0.15 m, are connected in volume in the zone of covering, which extends between the positions 0.0 m and 0.05 m, with a model 3D by the option 3D_POU_ARLEQUIN keyword LIAISON_ELEM of the operator AFFE_CHAR_MECA.

It is modelled by elements of beam of Timoshenko (POU_D_T) and of the linear voluminal elements (PENTA6 and HEXA8).

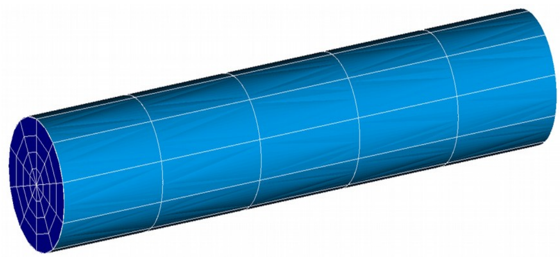

Image 3.1-1: Grid of the voluminal model 3D

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 X = 0.02 Mr.

3.2 Characteristics of the grid

Many meshs HEXA8	150
Many meshs PENTA6	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 Z of a node of the grid 3D located at X = 0.04 Mr.

Identification	Moments of the maximas	Type of reference	Value of reference	Tolerance
Minimal displacement in Z	2.205 S	'AUTRE_ASTER'	-0.00033054	7,00%
Maximum displacement in Z	2.700 S	'AUTRE_ASTER'	+0.00033065	7,00%

Table 3.3-1: Summary of the results tested

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

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)

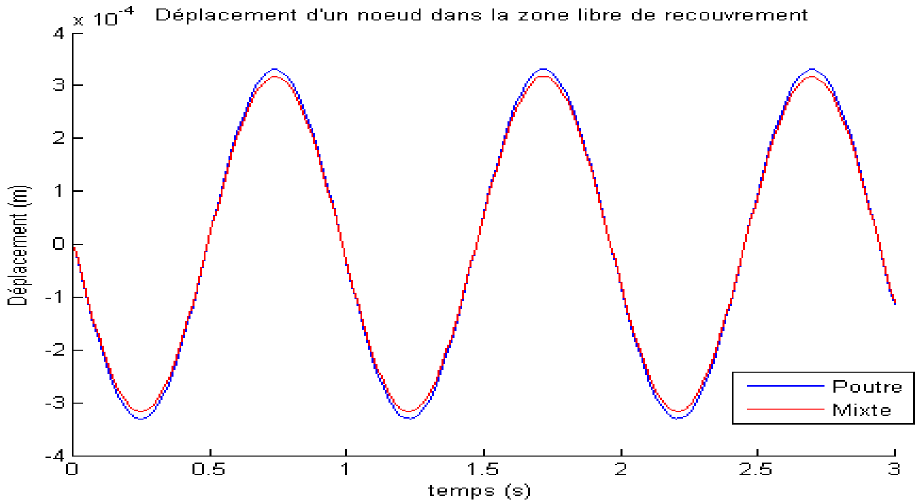

Image 3.3-2: Answers of the models 1D and mixed 1D-3D

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)

4 Modeling B

4.1 Characteristics of modeling

The bi--supported structure of length 0.25 m, extending between Z = -0.1 m and Z = 0.15 m, is connected in volume in the zone of covering, which extends between the positions 0.0 m and 0.05 m, with a model 3D by the option 3D_POU_ARLEQUIN keyword LIAISON_ELEM of the operator AFFE_CHAR_MECA.

It is modelled by elements of beam of Timoshenko (POU_D_T) and of the linear voluminal elements (PENTA6 and HEXA8).

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 X = 0.02 Mr.

4.2 Characteristics of the grid

Many meshs HEXA8	150
Many meshs PENTA6	50
Many meshs POU_D_T	20

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 Z of a node of the grid 3D located at X = 0.04 Mr.

Identification	Moments of the maximas	Type of reference	Value of reference	Tolerance
Minimal displacement in Z	2.205 S	'AUTRE_ASTER'	-0.00033054	7,00%
Maximum displacement in Z	2.700 S	'AUTRE_ASTER'	+0.00033065	7,00%

Table 4.3-1: Summary of the results tested

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)

5 Modeling C

5.1 Characteristics of modeling

The structure is entirely modelled by elements of beam of Timoshenko (POU_D_T) . It is supported on the level of its two ends.

DYNA_NON_LINE calculate the dynamic response during 3 S, due to a nodal force of a value equal to 100 NR on the node of the grid 3D located at X = 0.02 Mr.

5.2 Characteristics of the grid

Many meshs POU_D_T	25

Table 5.2-1

5.3 Sizes tested and results

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

Identification	Moments of the maximas	Type of reference	Value of reference	Tolerance
Minimal displacement in Z	2.2115 S	'NON_REGRESSION'	-0.00033055	7,00%
Maximum displacement in Z	2.7065 S	'NON_REGRESSION'	+0.00033065	7,00%

Table 5.3-1: Summary of the results tested

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)

6 Summary of the results

The cas-test implements in Code_Aster voluminal connection 1D-3D within the framework Harlequin on the basis of bi--supported slim structure. The results of the resulting mixed model are compared compared to the results got with a model of reference are equivalent 1D and a mixed model 1D-3D connected with the option `3D_POU` keyword `LIAISON_ELEM` of the operator `AFFE_CHAR_MECA` of Code_Aster.

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 2019 EDF R&D - Licensed under the terms of the GNU FDL (http://www.gnu.org/copyleft/fdl.html)