SDNL301 – Vibration of a beam with impact multipoint

Abstract:

The purpose of this benchmark is to simulate the dynamic response with damping of a beam with impact-multi-points:

- The beam is subjected has sinusoidal requests.
- The impacts (obstacles) have a normal stiffness and a normal damping.
- Only one modelization `POU_D_T` is carried out

One to determine value RMS of the normal force at the loose lead with or without taking into account of the static modes.

1 Problem of reference

1.1 Geometry

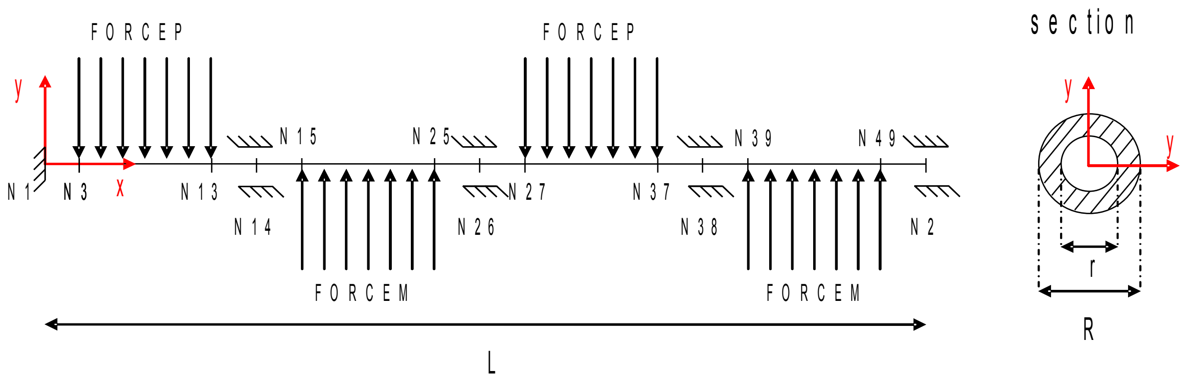

Figure 1.1 Geometry of the problem and system of loading

Geometry of beam: (m)

$L=2.436$

$R=0.00795$

$r=0.00680$

1.2 Properties of the material

Beam

$E=2.07\,E11\,Pa$	Modulus Young
$\nu=0.3$	Poisson's ratio
$\rho=7870.0\,kg.m^{-3}$	Density
$AMOR\_ALPHA\ =\ 1.79\text{E}-5\,N.s.m^{-1}$	
$AMOR\_BETA\ =\ 0.1526\,N.kg^{-1}$	

the coefficients α and β make it possible to build a viscous damping matrix proportional to the stiffness and the mass $[C]=\alpha[K]+\beta[M]$

Obstacles

$RIGI\_NOR=1.75\text{E}6\,N.m^{-1}$	normal coefficient of stiffness
$AMOR\_NOR=0.28\,N.m.s^{-1}$	normal damping coefficient

1.3 Boundary conditions and loadings

imposed Displacement:

All the nodes of beam:	$DZ=0 \quad DRY=0$, $DRX=0$
The node is outside the field of definition with a right profile of the EXCLU type node: $N1$	$DX=0 \quad DY=0$, $DRZ=0$

imposed Loading (N) :

Nodes $N3$ with $N13$ and $N27 \quad N37$	$FORCEP=4.138 \ \sin(\omega t)$
Nodes $N5$ with $N25$ and $N39$ with $N49$	$FORCEM=-4.138 \ \sin(\omega t)$

$\omega=251.2\, rad.s^{-1}(40\, Hz)$

Obstacles located in the plane Y according to the direction y :

$N14$	Clearance = $0.406\mathrm{E}-3 \ m$	origin = $(0.609, 0.0, 0.0)$
$N26$	Clearance = $0.406\mathrm{E}-3 \ m$	origin = $(1.218, 0.0, 0.0)$
$N38$	Clearance = $0.406\mathrm{E}-3 \ m$	origin = $(1.827, 0.0, 0.0)$
$N2$	Clearance = $0.406\mathrm{E}-3 \ m$	origin = $(2.436, 0.0, 0.0)$

2 reference and

2.1 Reference solution Quantity result

One uses a reference NON_REGRESSION to test the value of RMS over the total time of the normal force at the loose lead of the beam.

Two types of analyses were carried out:

- First analysis to consist in calculating the response transient dynamics on a modal base made up of the first 30 eigen modes.
- Second analysis to consist in calculating the response transient dynamics on a modal base made up of the first 30 eigen modes to which one adds the static modes.

The procedure of computation is the following one, one:

- calculate the first 30 eigenfrequencies and the ($4800\mathrm{Hz}$ until) associated eigen modes,
- projects on modal base the stiffness matrixes, of mass and of damping,
- projects on modal base the forces.
- calculate the response transient dynamics on modal base
- calculates the RMS over the total time of the normal force to the node $N2$

One thus does not have a value of reference RMS for this problem one presents way independent the two results.

2.2 Reference variable

•RMS_T_TOTAL : value RMS over the total time of normal force (FORCE_NORMALE) to the node $N2$.

3 Modelization A

3.1 Characteristic of the modelization A

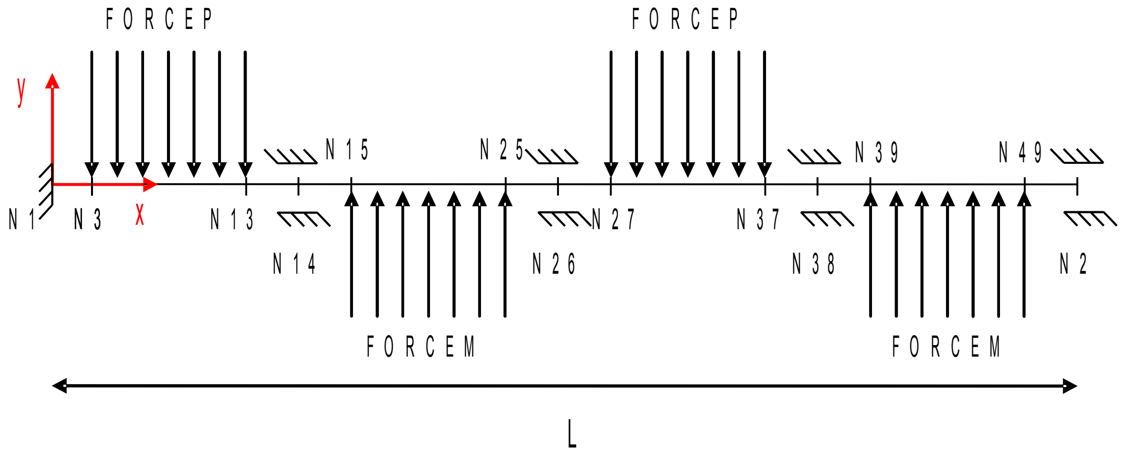

Figure 3.1. Mesh of the modelization A

Modelization POU_D_T :

Many nodes	49			
Number of meshes	48	Are:		
			SEG2	48

Mesh group

$GM1$: together meshes from type SEG2 which composes the beam

3.2 Quantities tested and results

For the first analysis of the modelization, by considering the response transient dynamics on a modal base made up eulement of the first 30 eigen modes, one obtains a value of RMS as follows:

Component	quantity	Node	Computed value
FORCE_NORMALE	RMS_T_TOTAL	$N2$	22.56

For the second analysis, by considering static correction for modal base, one obtains a value of RMS slightly different and certainly nearer to reality count-held from the improvement of modal base:

Component	quantity	Node	Computed value
FORCE_NORMALE	RMS_T_TOTAL	$N2$	23.419

4 Summary of the results

the got results confirms the influence of the static correction of a modal base on the results. One notes a difference of 3.66% between values RMS over the total time of the normal force with and without without taking into account of the static modes.