

## SDNL301 – Vibration of a beam with impact multipoint

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### Summary:

The objective of this CAS-test is to simulate the dynamic response with damping of a beam with impact-multipoints:

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

One determines 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

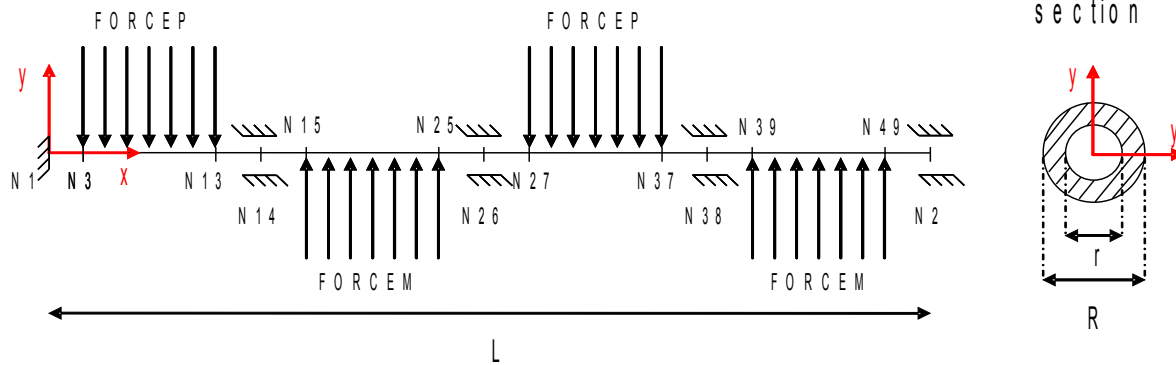


Figure 1.1 Geometry of the problem and system of loading

Geometry of the beam ( $m$ ) :

$$L=2.436$$

$$R=0.00795$$

$$r=0.00680$$

### 1.2 Properties of material

Beam

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

Coefficients  $\alpha$  and  $\beta$  allow to build a matrix of viscous damping proportional to rigidity and the mass  $[C]=\alpha[K]+\beta[M]$

Obstacles

$RIGI\_NOR=1.0E5 N.m^{-1}$	normal coefficient of rigidity
$AMOR\_NOR=0.28 N.m.s^{-1}$	normal damping coefficient

## 1.3 Boundary conditions and loadings

Imposed displacement:

All the nodes of the beam:	$DZ=0$ , $DRY=0$ , $DRX=0$
Node $N1$ :	$DX=0$ , $DY=0$ , $DRZ=0$

Imposed loading ( $N$ ) :

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

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

Obstacles located in the plan  $Y$  according to the direction  $y$  :

$N14$	Game = $0.406E-3$ m	origin = (0.609,0.0,0.0)
$N26$	Game = $0.406E-3$ m	origin = (1.218,0.0,0.0)
$N38$	Game = $0.406E-3$ m	origin = (1.827,0.0,0.0)
$N2$	Game = $0.406E-3$ m	origin = (2.436,0.0,0.0)

## 2 Reference solution

### 2.1 Size and result of reference

One tests the value of  $RMS$  in not-regression, over total time normal force at the loose lead of the beam.

Two types of analyses were carried out:

- First analysis to consist in calculating the transitory dynamic response on a modal basis made up by the first 30 clean modes.
- Second analysis to consist in calculating the transitory dynamic response on a modal basis made up by the first 30 clean modes to which one adds the static modes.

The procedure of calculation is following:

- one calculates the first 30 Eigen frequencies (until 4800Hz) and associated clean modes,
- one projects on the modal basis the matrices of rigidity, mass and damping,
- one projects on the modal basis the efforts.
- one calculates the transitory dynamic response on the modal basis
- one 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 has the two results independently.

### 2.2 Reference variable

- $RMS\_T\_TOTAL$  : value RMS over the total time of the normal force ( $FORCE\_NORMALE$ ) with the node  $N2$ .

## 3 Modeling A

### 3.1 Characteristics of modeling A

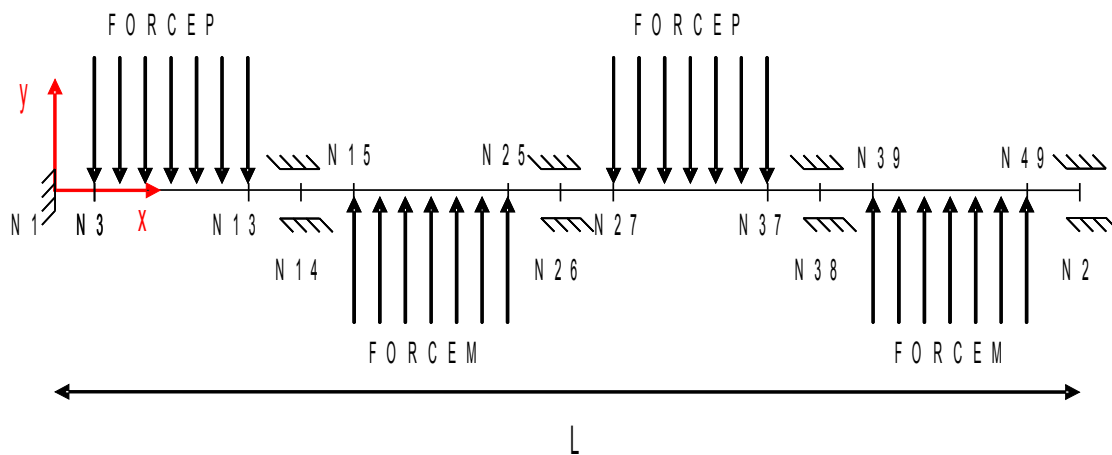


Figure 3.1. Grid of modeling A

Modeling POU\_D\_T :

Many nodes	49	
Many meshes	48	That is to say:
		SEG2 48

Group of meshes

GMI : together meshes of the type SEG2 who compose the beam

### 3.2 Sizes tested and results

For the first analysis of modeling, by considering the transitory dynamic response on a modal basis only made up of the first 30 clean modes, one obtains a value of *RMS* as follows:

Size	Component	Node	Computed value
FORCE_NORMALE	RMS_T_TOTAL	N2	23.98

For the second analysis, by considering the static correction for the modal base, one obtains a value of *RMS* slightly different and certainly nearer to reality taking into account the improvement the modal base:

Size	Component	Node	Computed value
FORCE_NORMALE	RMS_T_TOTAL	N2	24.538

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## 4 Summary of the results

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The got results confirms the influence of the static correction of a modal base on the results. One notes a variation 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.