SDLS123 – Right beam with damping of Rayleigh (elastic behavior)

Summary:

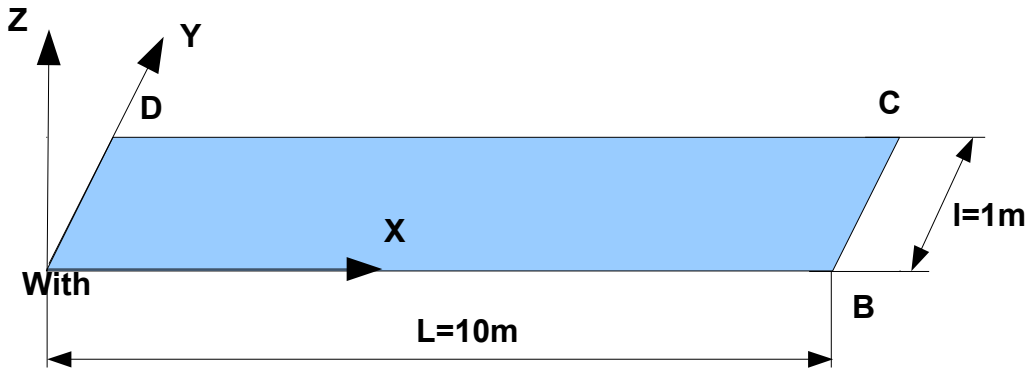
This test represents dynamic calculation with damping of Rayleigh of a right beam, embedded at the two ends and subjected to a constant pressure.

Two modelings are carried out:

1) Modeling `With` allows to test the model `Q4GG` with `QUAD4`,
2) Modeling `B` allows to test the model `Q4GG` with `TRIA3`.

1 Problem of reference

1.1 Geometry



Thickness: $1\mathrm{m}$

1.2 Material properties

The mechanical properties are the following ones:

- Young modulus $E=3.5\times10^{10}\,Pa$
- Poisson's ratio $\nu=0,2$
- Density $\rho=2500\,Kg/m^3$
- $\alpha=AMOR\_ALPHA=6.69\times10^{-5}$
- $\beta=AMOR\_BETA=20.06$

1.3 Boundary conditions and loadings

- Embedding on with dimensions ones AD and BC : $DX=DY=DZ=DRX=DRY=DRZ=0$;
- The pressure distributed uniformly on the beam grows linearly until $0.1\,ms$ then remains constant and equal to $p=10^5\,Pa$ until the end of calculation ($1.0\,ms$).

1.4 Initial conditions

The beam is initially at rest in a virgin state.

2 Reference solution

2.1 Method of calculating used for the reference solution

The results of reference were got with Europlexus.

The grids used by Europlexus and Code_Aster are the same ones.

2.2 Results of reference

The results of reference corresponds to following displacement Z node $N9$ located at the center of the beam. They were obtained at the moment $t=0.001\text{s}$.

Size	Localization	Europlexus elements	
		Q4GS	T3GS
Following displacement Z	$X=5.m$	$-1.79497\times10^{-5}\text{m}$	$-1.79508\times10^{-5}\text{m}$
Speed according to Z	$X=5.m$	$-3.76207\times10^{-2}\text{m/s}$	$-3.76309\times10^{-2}\text{m/s}$
Acceleration according to Z	$X=5.m$	-39.09299 m/s^2	-39.17340 m/s^2

2.3 Uncertainty on the solution

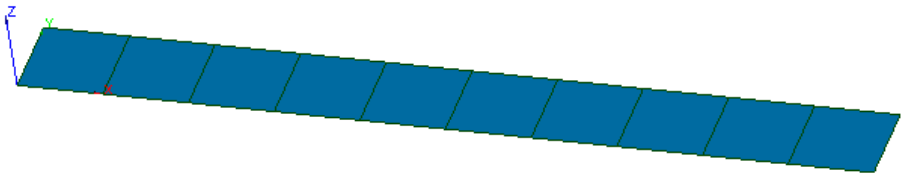
Digital solution.

2.4 Bibliographical references

[1] MARKOVIC D., “Establishment of a new finite element of thick hull (T3GS) in Europlexus”, Notes EDF/R & D /AMA H-T-62-2008-00080-FR.

3 Modeling A

3.1 Characteristics of modeling



3.2 Characteristics of the grid

Many nodes: 22
Number of meshs and type: 10 QUAD4

3.3 Sizes tested and results

Moment (S)	Size	Component	Node	Type of Reference	Value of reference	Precision (%)
$t=0.001\text{s}$	DEPL	DZ	N9	'SOURCE_EXTERNE'	$-1.79497\times10^{-5}\text{m}$	1.0
$t=0.001\text{s}$	QUICKLY	DZ	N9	'SOURCE_EXTERNE'	$-3.76207\times10^{-2}\text{m/s}$	1.0
$t=0.001\text{s}$	ACCE	DZ	N9	'SOURCE_EXTERNE'	-39.09299 m/s^2	2.5

3.4 Remarks

Calculations were carried out with a diagram of temporal integration explicit of differences type finished centered with a matrix masses diagonal (MASS_DIAG=' OUI' under DYNA_NON_LINE).

4 Modeling B

4.1 Characteristics of modeling

4.2 Characteristics of the grid

Many nodes: 22

Number of meshs and type: 20 TRIA3

4.3 Sizes tested and results

Moment (S)	Size	Component	Node	Type of Reference	Value of reference	Precision (%)
$t=0.001\text{s}$	DEPL	DZ	N9	'SOURCE_EXTERNE'	$-1.79508\times10^{-5}\text{m}$	1.0
$t=0.001\text{s}$	QUICKLY	DZ	N9	'SOURCE_EXTERNE'	$-3.76309\times10^{-2}\text{m/s}$	1.0
$t=0.001\text{s}$	ACCE	DZ	N9	'SOURCE_EXTERNE'	$-39.17340\,\text{m/s}^2$	1.0

4.4 Remarks

Calculations were carried out with a diagram of temporal integration explicit of differences type finished centered with a matrix masses diagonal (MASS_DIAG=' OUI' under DYNA_NON_LINE).

5 Summary of the results

The got results are satisfactory.

On the figures below, we traced the evolution of displacement, speed and the acceleration in the center of the beam according to time. This answer is compared with that obtained with Europlexus (EPX).