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

Summarized:

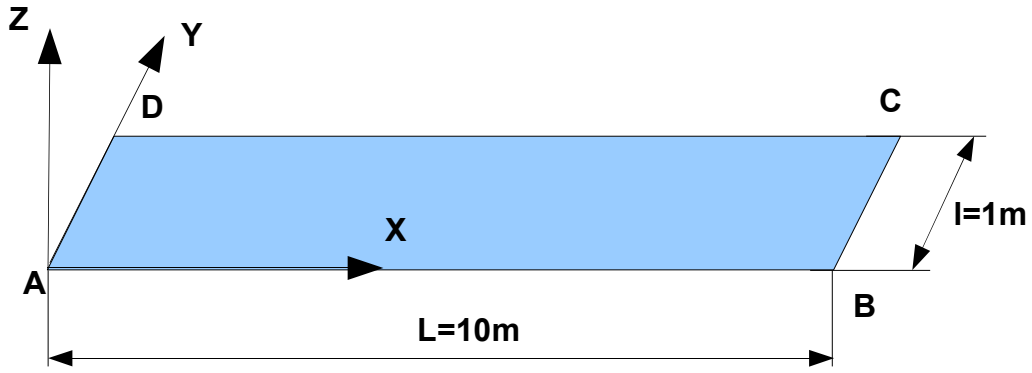
This test represents dynamic computation with damping of Rayleigh of a straight beam, embedded at the two ends and subjected to a constant pressure.

Two modelizations are carried out:

1) Modelization A makes it possible to test the model Q4GG with QUAD4,
2) Modelization B makes it possible to test Q4GG with TRIA3 the model.

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 $\nu=0,22$
- Density $\rho=2500\,Kg/m^3$
- $\alpha=AMOR\_ALPHA=6.69\times10^{-5}$
- $\beta=AMOR\_BETA=20.06$

1.3 Boundary conditions and loadings

- Fixed support on dimensioned AD and BC : $DX=DY=DZ=DRX=DRY=DRZ=0$
- The distributed pressure uniformly on the beam grows linearly until $0.1\mathrm{m}$ S then remains constant and equal to $p=10^5\,Pa$ until the end of computation ($0.27\mathrm{m}$ S)

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 obtained with Europlexus.

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

2.2 Results of reference

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

Quantity	Localization	Elements Europlexus	
		Q4GS	T3GS
following Displacement Z	$X=5.m$	$-1.79497\times10^{-5}\text{m}$	$-1.79508\times10^{-5}\text{m}$
Velocity 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/s²	-39.17340 m/s²

2.3 Uncertainty on the numerical

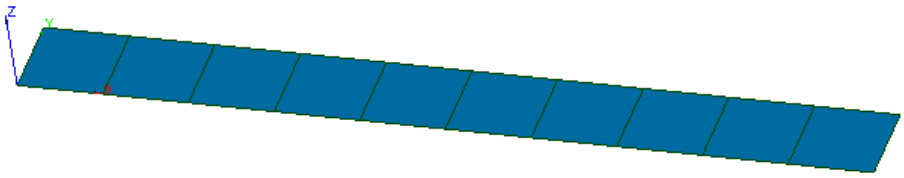
solution Solution.

2.4 Bibliographical references

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

3 Modelization A

3.1 Characteristic of the modelization



3.2 Characteristics of the mesh

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

3.3 Quantities tested and results

Time (S)	Component	Quantity	Standard	Node of Reference	Reference	Tolerance (%)
$t=0.001\text{s}$	DEPL	DZ	N9	"SOURCE_EXTERNE"	$-1.79497\times10^{-5}\text{m}$	12.0
$t=0.001\text{s}$	DZ	N9	"	SOURCE_EXTERNE QUICKLY"	$-3.76207\times10^{-2}\text{m/s}$	5.5
$t=0.001\text{s}$	ACCE	DZ	N9	"SOURCE_EXTERNE"	$-39.09299\ \text{m/s}^2$	2.5

3.4 Remarks

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

4 Modelization B

4.1 Characteristic of the modelization

4.2 Characteristics of the mesh

Many nodes: 22

Number of meshes and type: 20 TRIA3

4.3 Quantities tested and results

Time (S)	Component	Quantity	Standard	Node of Reference	Reference	Tolerance (%)
$t=0.001\text{s}$	DEPL	DZ	N9	"SOURCE_EXTERNE"	$-1.79508\times10^{-5}\,\text{m}$	12.0
$t=0.001\text{s}$	DZ	N9	"	SOURCE_EXTERNE QUICKLY"	$-3.76309\times10^{-2}\,\text{m/s}$	7.5
$t=0.001\text{s}$	ACCE	DZ	N9	"SOURCE_EXTERNE"	$-39.17340\,\text{m/s}^2$	1.0

4.4 Remarks

computations were carried out with a diagram of temporal integration explicit of differences type finished centered with a diagonal mass matrix (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, the velocity and the acceleration in the center of the beam according to time. This response is compared with that obtained with Europlexus (EPX).