

SDNL103 - Dynamics of a gantry modelled by beam elements in large rotation. Comparison with an analysis in small rotation

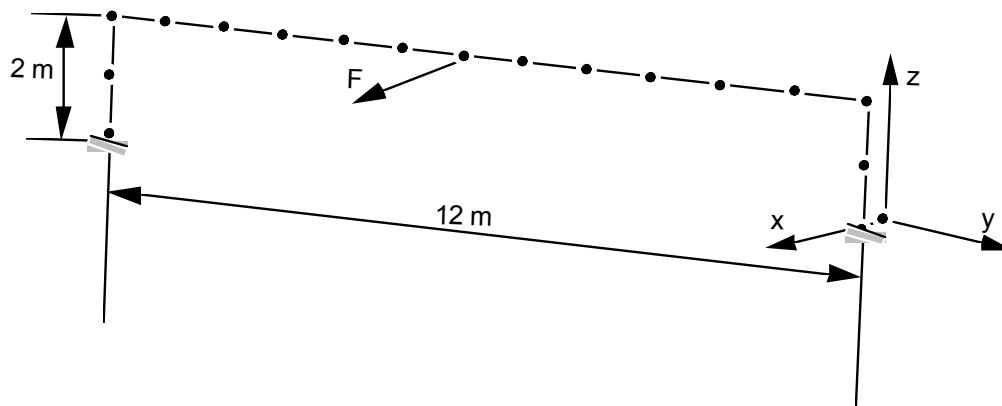
Summarized:

One analyzes the response of a gantry, embedded in feet and subjected to a dynamic force applied in the middle of his span and perpendicular to his plane. Displacements are small. Two modelizations of beams are compared: `POU_D_T_GD` and `POU_D_T`.

Interest: to test the beam element in large rotation `MECA_POU_D_T_GD` and command `DYNA_NON_LINE`.

1 Problem of reference

1.1 Geometry



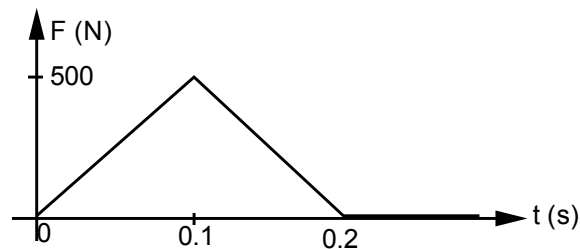
1.2 Material properties

For the span: $E = 7. E10 Pa$ $\nu = 0.3$ $\rho = 2700 kg/m^3$
 For the columns: $E = 5. E10 Pa$ $\nu = 0.3$ $\rho = 2500 kg/m^3$

1.3 Boundary conditions and loadings

Fixed support in foot of columns.

Evolution of the force F :



1.4 Initial conditions

static Equilibrium position; velocity null.

2 Reference solution

2.1 Method of calculating used for the reference solution

This problem does not have an analytical solution. But, as displacements are small, one takes for reference the modelization by beam elements `POU_D_T`.

2.2 Results of reference

Displacement of the medium of the span, in the direction x at times: $0.14 s$; $0.26 s$; $0.36 s$ and $0.47 s$.

3 Modelization A

3.1 Characteristic of the modelization

Characteristics of the span:

$$A = 2.24 E - 3 m^2 ; I_y = I_z = 3.7 E - 6 m^4 ; J_x = 7.4 E - 6 m^4 ; A_y = A_z = 1.2$$

Characteristics of the columns:

$$A = 3.14 E - 2 m^2 ; I_y = I_z = 4.5 E - 5 m^4 ; J_x = 9.0 E - 5 m^4 ; A_y = A_z = 1.2$$

The analysis relates to 0.5 s in 100 time step equal.

3.2 Characteristics of the mesh

the span is modelled by 12 beam elements; each column by 2 elements. All these elements have 1m length.

3.3 Quantities tested and results

Identification	POU_D_T	POU_D_T_GD Aster	% difference
<i>DX</i> into $t = 1.4 E - 1$	2.9706 E-2	2.9069 E-2	- 2.1
<i>DX</i> in $t = 2.6 E - 1$	- 2.6290 E-2	- 2.5376 E-2	- 3.5
<i>DX</i> in $t = 3.6 E - 1$	2.5126 E-2	2.5147 E-2	0.08
<i>DX</i> in $t = 4.7 E - 1$	- 2.5488 E-2	- 2.5390 E-2	- 0.4

4 Summary of the results

the variation compared to the reference solution is to the maximum of 3,5% during the transient. The reference solution being obtained with elements `POU_D_T`, in small displacements, this variation is thus explicable and remains weak in the course of time.