SSLX200 – Connection `3D_POU`: Simple traction and pure inflection of a embed-free beam

Summary:

The objective of this test is to validate the taking into account of the connection `3D_POU` (`AFFE_CHAR_MECA`). This connection allows to establish a connection between a modeling of type beam with modeling of a voluminal type. The cas-test represents a beam:

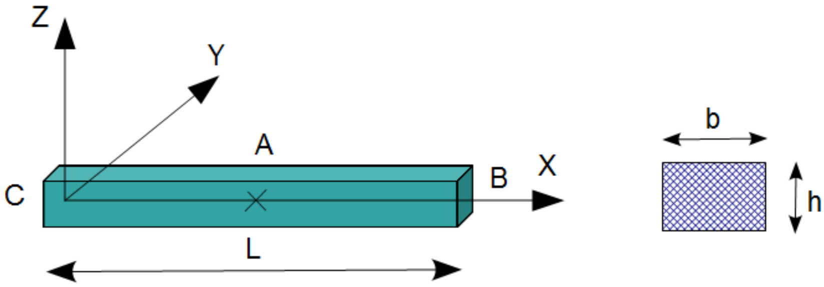
- A part is modelled with voluminal elements and the other part modelled with elements beams,
- Embedded an end has and free the other end has,
- Subjected has inflection and tractive efforts.

Two ty pes of analyses is carried out:

- Linear static analysis: one tests displacements and the constraints in the case of a loading of traction and inflection,
- Dynamic analysis: the first two modes of inflection are tested.

1 Problem of reference

1.1 Geometry



$L = 10. m$
$b = 3. m$
$h = 2. m$

1.2 Properties of material

- $E = 200000. Pa$ Young modulus
- $\nu = 0.3$ Poisson's ratio
- $\rho = 10000\ Kg/m^3$ Density

1.3 Boundary conditions and loadings

- Boundary conditions
  - Not C : embedding
  - Not B : free
- Loadings
  - Traction $FX = 10. N$
  - Pure bending $MY = 2. N.m$
  - Pure bending $MZ = 3. N.m$

1.4 Initial conditions

Without

2 Reference solution

2.1 Method of calculating

2.1.1 Statics

Displacements in B

- Simple traction $u_x=\frac{F_x L}{E S}$
- Pure inflection $u_z=-\frac{M_y L^2}{2 E I_y}$ $\theta_y=\frac{M_y L}{E I_y}$
- Pure inflection $u_y=\frac{M_z L^2}{2 E I_z}$ $\theta_z=\frac{M_z L}{E I_z}$

Maximum constraint in A

- Simple traction $\sigma_x=\frac{F_x}{S}$
- Pure inflection $\sigma_x=-\frac{M_y}{\frac{2 I_y}{h}}$
- Pure inflection $\sigma_x=-\frac{M_z}{\frac{2 I_z}{b}}$

2.1.2 Eigen frequencies in inflection

Mode 1: $f_1=\frac{3.516}{2 L^2 \pi}\sqrt{\frac{EI}{\rho S}}$

Mode 2: $f_2=\frac{22.0345}{2 L^2 \pi}\sqrt{\frac{EI}{\rho S}}$

2.2 Sizes and results of reference

2.2.1 Statics

- Displacements (m)

Not	DX	DY	DZ
B	8.3333×10^{-5}	1.6667×10^{-4}	-2.5×10^{-4}

- Constraints (N/m^2)

Not	$SIXX$	$SIYY$	$SIZZ$	$SIXY$	$SIXZ$	$SIYZ$
$A1(5.0,1.5,-1.0)$	-0.3333	0.	0.	0.	0.	0.
$A2(5.0,1.5,1.0)$	1.6667	0.	0.	0.	0.	0.

2.2.2 Eigen frequencies in inflection

Mode	**Frequency** Hz
1	0.014449
2	0.090549

2.3 Uncertainties on the solution

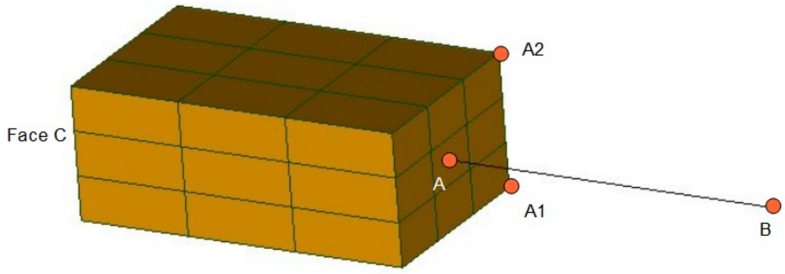
Analytical solution.

3 Modeling A

3.1 Characteristics of modeling

One is used:

- Modeling 3D and POU_D_E for the beam,
- An element DIS_TR of type POI at the point C ,
- Connection 3D_POU at the point With to connect the beam and the face of volume,
- Connection 3D_POU at the point C to connect the element DIS_TR and the face of volume.



3.2 Characteristics of the grid

The grid contains 212 nodes and 107 meshs of which:

- 2 SEG2
- 24 SEG3
- 54 QUAD8,
- 27 HEXA20.

3.3 Sizes tested and results

- Displacements

Identification		Type of reference	Value of reference	Tolerance (%)
Not	Size			
B	DX	'ANALYTICAL'	$8.3333\times10^{-5} m$	0.0001
	DY	'ANALYTICAL'	$1.6667\times10^{-4} m$	0.0001
	DZ	'ANALYTICAL'	$-2.5\times10^{-4} m$	0.0001

- Constraints

Identification		Type of reference	Value of reference	Tolerance (%)
Not	Size			
$C1(5.0,1.5,-1.0)$	$SIXX$	'ANALYTICAL'	$-0.3333 N/m^2$	0.0001
$C2(5.0,1.5,1.0)$	$SIXX$	'ANALYTICAL'	$1.6667 N/m^2$	0.0001

- Eigen frequencies

Mode	Type of reference	Value of reference	Tolerance (%)
1	'ANALYTICAL'	0.014449	2.5
2	'ANALYTICAL'	0.090529	18.0

4 Summary of the results

This CAS-test with licence to test, in linear statics and dynamics (search for Eigen frequencies), the connection 3D_POU allowing to connect a voluminal modeling with a modeling beam .