

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:

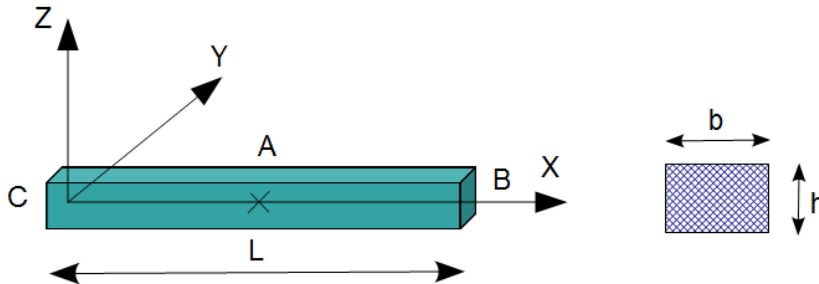
- A part is modelled with voluminal elements and the other part modelled with elements beams,
- Embedded an end has and free the other end has,
- Subjected has inflection and tractive efforts.

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

2.1.2 Eigen frequencies in inflection

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

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

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	<i>SIXX</i>	<i>SIYY</i>	<i>SIZZ</i>	<i>SIXY</i>	<i>SIXZ</i>	<i>SIYZ</i>
<i>A1</i> (5.0,1.5,-1.0)	-0.3333	0.	0.	0.	0.	0.
<i>A2</i> (5.0,1.5,1.0)	1.6667	0.	0.	0.	0.	0.

2.2.2 Eigen frequencies in inflection

Mode	Frequency <i>Hz</i>
1	0.014449
2	0.090549

2.3 Uncertainties on the solution

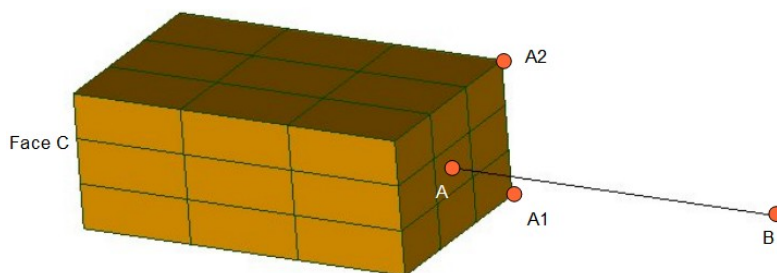
Analytical solution.

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 meshes 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'	$8.3333 \times 10^{-5} m$	0.0001
	DY	'ANALYTICAL'	$1.6667 \times 10^{-4} m$	0.0001
	DZ	'ANALYTICAL'	$-2.5 \times 10^{-4} m$	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 .