

SDLL150 - Clean modes of a beam with offset heart

Summary:

The objective of this test is to validate the calculation of the clean modes for the multifibre beams of Euler-Bernoulli `POU_D_EM` whatever the position of the reference axis.

The case test validates the good taking into account of offsetting in the calculation of the matrix of rigidity (`RIGI_MECA`) and that of the matrix of mass (`MASS_MECA`).

1 Problem of reference

1.1 Geometry

The model is a beam comforts length $5m$ directed according to the axis X . The cross-section is in the shape of I, with higher and lower soles of different sizes (Figure 1). (Figure 2).

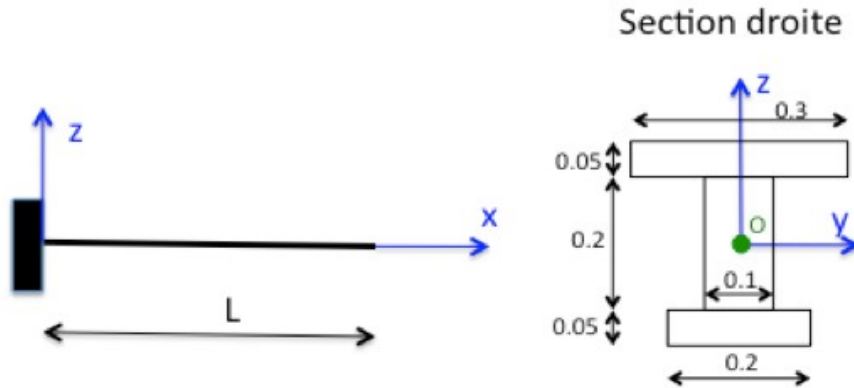


Figure 1: Geometry

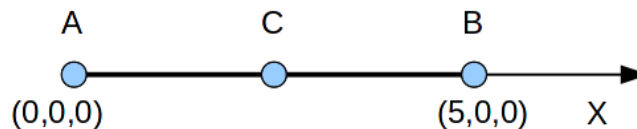


Figure 2: Grid of the beam

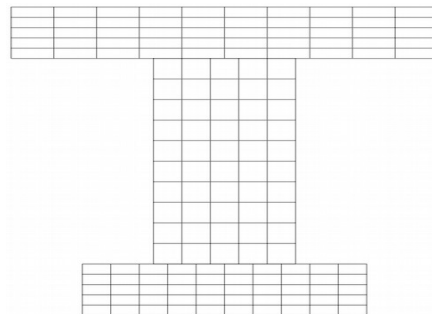


Figure 3: Grid of the cross-section

1.2 Properties of materials

The properties of material are indexed in the following table.

Material	Concrete
Young modulus	$2 \times 10^{10} Pa$
Poisson's ratio	0.25
Density	$9167.0 kg/m^3$

1.3 Boundary conditions and loading

The beam is embedded with the one of its ends: all the degrees of freedom of node A are blocked.

An effort of $1.E4 NR$ is imposed on the node B in direction Z.

2 Reference solution

2.1 Method of calculating

The first calculation was carried out with *Code_Aster*.

For this calculation, the reference axis is the elastic center of the cross-section, confused with the barycentre G since the section is homogeneous:

$$\vec{OG} = y_G \vec{y} + z_G \vec{z}$$

with:

$$y_G = 0$$

$$z_G = 1/S \sum z_{Gi} S_i = 1/0.27 \times 0.05 \times (0.125 \times 3 + 0 - 0.125 \times 2) = 0.023148148 \text{ m}$$

The reference solution is thus obtained with:

$$\text{COOR_AXE_POUTRE} = (0. , 0.023148148)$$

The values of the Eigen frequencies and modal displacements are retained like reference. Indeed, these values should not depend on the position chosen for the reference axis of calculation (keyword `COOR_AXE_POUTRE` of the operator `DEFI_GEOM_FIBRE`).

Note:

Because of nonsymmetry of the cross-section, the point O is not the centre of gravity of the cross-section.

3 Modeling A

3.1 Characteristics of modeling

Modeling used is POU_D_EM.

Calculation is carried out by choosing a reference axis, using keyword COOR_AXE_POUTRE of the operator DEFI_GEOM_FIBRE voluntarily very excentré: $z_G=0.5m$.

3.2 Characteristics of the grid

The grid consists of 2 meshes of the type SEG2.

3.3 Sizes tested and results

Modal calculation:

NUME_ORDRE	Component	Value of reference	Tolerance
1	FREQ	1.9740586420219	1.E-6
2	FREQ	3.3155178878428	1.E-6

NUME_ORDRE	Not	Field	Component	Value of reference	Tolerance
1	B	DEPL	DY	0.044067411231561	3.E-3
2	B	DEPL	DY	0.044043066332150	1.E-6

4 Summary of the results

The values of the Eigen frequencies and displacement modal do not depend on the position of the reference axis chosen by the user.