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).

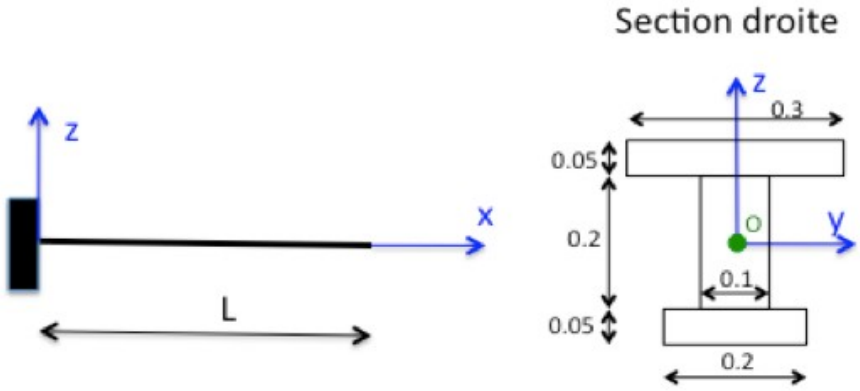

Figure 1: Geometry

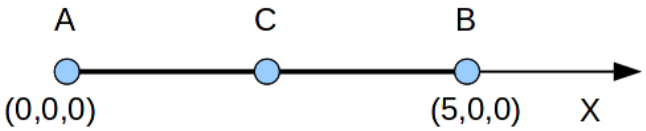

Figure 2: Grid of the beam

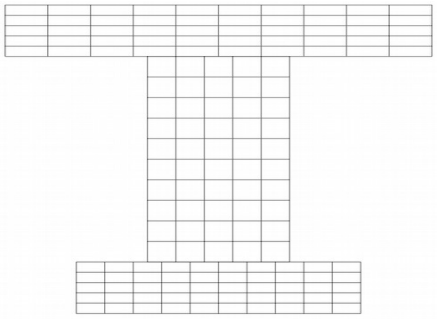

Figure 3: Grid of the cross-section

1.2 Properties of materials

The properties of material are indexed in the following table.

Material	Concrete
Young modulus	$2\times10^{10}\,Pa$
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:

$$y_G = 0$$

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

The reference solution is thus obtained with:

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COOR_AXE_POUTRE = (0. , 0.023148148)
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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: $z_G = 0.5\,m$.

3.2 Characteristics of the grid

The grid consists of 2 meshs 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.