SSLP01 – Shearing and flexbeam in its plan

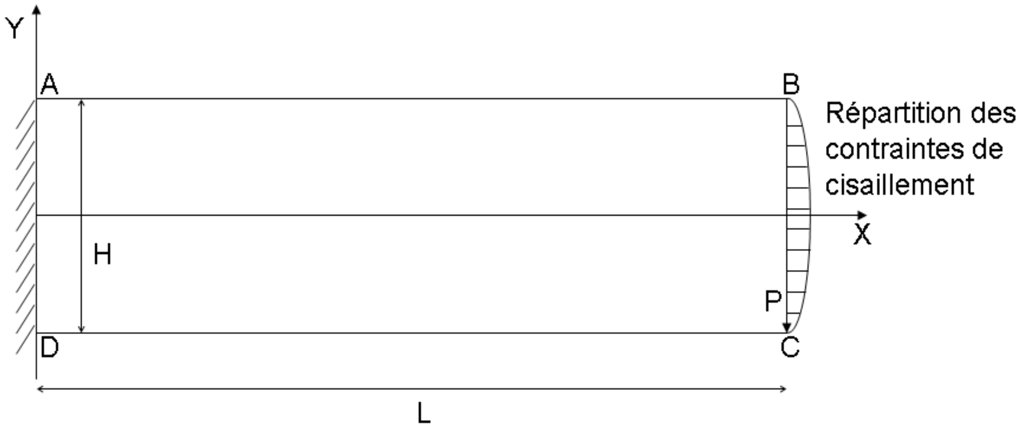
Summary:

In this CAS-test one models the behavior of a shearing and flexbeam in his plan.

Only one modeling is carried out: C_PLAN

1 Problem of reference

1.1 Geometry



Coordinates of the points (m) :

$A:(0.,6.\cdot 10^{-3})$
$B:(48.\cdot 10^{-3},6.\cdot 10^{-3})$
$C:(48.\cdot 10^{-3},-6.\cdot 10^{-3})$
$D:(0.,-6.\cdot 10^{-3})$

Geometry of the plate (m) :
Thickness: $h=0,001$
Width: $L=0.048$
Height: $H=0.012$

Group of meshs: $BORD\_CH$ surface of right-hand side (BC)
Group of meshs: $ENCAST$ surface of left (AD)
Group of meshs: $SURF$ internal surface

1.2 Properties of material

- $E=3.\cdot 10^{10}\,Pa$
- $\nu=0.25$

1.3 Boundary conditions and loadings

- Imposed displacement:
  - $ENCAST \quad : DX=DY=0.$
- Loading:
  - Parabolic distribution on the height, constant on the thickness.

$Y(m)$	-0.006	-0.003	0	0.003	0.006
Shear stress 2D ($Pa.m$)	0	3.75E6	5.00E6	3.75E6	0

The integration of this constraint on the height H conduit with a constraint resulting from $80.10^3\,Pa.m$ that one notes P in what follows.

2 Reference solution

2.1 Method of calculating

The result of reference was got by analytical calculation with the method of the functions of Airy.

- Plane constraints:

$$\sigma_{xx} = (12.\mathrm{Py}.(x-L))/2.\mathrm{H}^3$$
$$\sigma_{yy} = 0$$
$$\sigma_{xy} = 6.\mathrm{P}.((H^2/4)-y^2)/2.\mathrm{H}^3$$

- Displacements:

$$u = \frac{12\mathrm{P}}{EhH^3}[y(\frac{x^2}{2}-Lx)-(1+\frac{\nu}{2})\frac{y^3}{3}]+Ay+B$$
$$v = \frac{-12\mathrm{P}\nu}{EhH^3}\frac{y^2}{2}(x-L)+\frac{12\mathrm{P}}{EhH^3}[\frac{-x^3}{3}+\frac{Lx^2}{2}+(1+\nu)\frac{H^2x}{4}]-Ax+C$$

- Constants A, B, C depend on the boundary conditions on displacements:

$$u(0,0) = v(0,0) = \frac{\partial v}{\partial x}(0,0) = 0$$
$$u(0,-\frac{H}{2}) = v(0,-\frac{H}{2}) = u(0,\frac{H}{2}) = v(0,\frac{H}{2}) = 0$$

2.2 Results of reference

Displacement according to y at the point $x=L\,;y=0$: $v=0.3413\cdot10^{-3}$ m
Constraint according to x at the point: $x=0\,;y=-H/2$ $\sigma_{xx}=80.\cdot10^{6}$ Pa

2.3 Uncertainties

Analytical solution

3 Modeling A

3.1 Characteristics of modeling

Modeling C_PLAN :

Many nodes	177			
Many meshs	80	That is to say:		
			SEG3	32
			QUAD8	48

3.2 Results

Points	Size	Reference	Tolerance (relative)
$x=L\,;\,y=0$	DY	$3.41\cdot10^{-3}\quad m$	0.023
$x=0\,;\,y=-H/2$	$SIXX$	$80.\cdot10^{6}\quad Pa$	0.015

4 Summary of the results

Results obtained in displacement and constraint with modeling C_PLAN are satisfactory.