

SSLP01 – Shearing and flexbeam in its plan

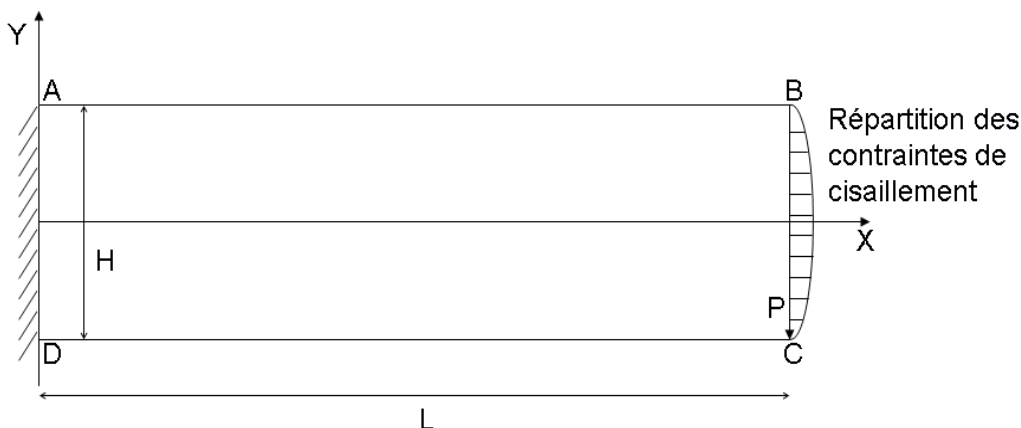
Summary:

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 meshes: *BORD_CH* surface of right-hand side (BC)

Group of meshes: *ENCAST* surface of left (AD)

Group of meshes: *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* : $DX = DY = 0$.
- 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:

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

- Displacements:

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

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

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

2.2 Results of reference

Displacement according to y at the point $x=L; y=0$: $v = 0.3413 \cdot 10^{-3} \text{ m}$

Constraint according to x at the point: $x=0; y=-H/2$ $\sigma_{xx} = 80 \cdot 10^6 \text{ Pa}$

2.3 Uncertainties

Analytical solution

3 Modeling A

3.1 Characteristics of modeling

Modeling C_PLAN :

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

3.2 Results

Points	Size	Reference	Tolerance (relative)
$x=L; y=0$	<i>DY</i>	$3.41 \cdot 10^{-3} \text{ m}$	0.023
$x=0; y=-H/2$	<i>SIXX</i>	$80 \cdot 10^6 \text{ Pa}$	0.015

4 Summary of the results

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