

## SSLP303 - Plate cantilever charged with sound end

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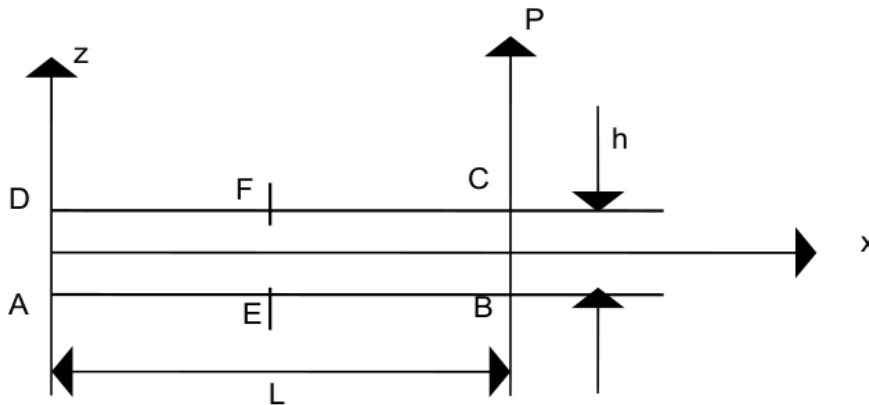
### Summary:

The goal of the test is to validate the keyword `FORCE_CONTOUR`, starting from a load applied at the end of a plate. With the problem is dealt in plane constraints.

## 1 Problem of reference

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### 1.1 Geometry



Not  $E$  = medium of  $AB$       not  $F$  = medium of  $DC$

Length:  $L = 1\text{ m}$

Width:  $l = 0.1\text{ m}$

Thickness:  $h = 0.005\text{ m}$

Moment of inertia of section:  $I_y = \frac{h^3 l}{12} = 1.042 \times 10^{-9}\text{ m}^4$

### 1.2 Material properties

Young modulus:  $E = 2.1 \times 10^{11}\text{ Pa}$

Poisson's ratio:  $\nu = 0.3$

### 1.3 Boundary conditions and loadings

- Embedding of the edge  $AD$  ( $u = v = 0$ ).
- Load of resultant  $P = 85\text{ N}$ , applied to the edge  $BC$  (constant linear load).

### 1.4 Boundary conditions and loadings

Without object for the static analysis.

## 2 Reference solution

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### 2.1 Method of calculating used for the reference solution

The value of the field of displacement  $v$ , at the loose lead of the plate (edge  $BC$ ) is given by:

$$v_L = \frac{PL^3}{3EI_y} \text{ (neglected shearing)}$$

from where  $v_L = 0.129 \text{ m}$

The stress field  $\sigma_{xx}$  of inflection is given by:

$$\sigma_{xx} = \frac{Ph}{2I_y}(L-x) \text{ on the edge } AB$$

that is to say  $\sigma_{xx} = 2.04 \times 10^8 (L-x) \text{ (Pa)}$

### 2.2 Results of reference

- Displacement  $v_L$  Nœuds  $B$  and  $C$
- Constraints  $\sigma_{xx}$  with Nœuds  $A$  and  $B$  and  $E$

### 2.3 Uncertainty on the solution

Analytical solution.

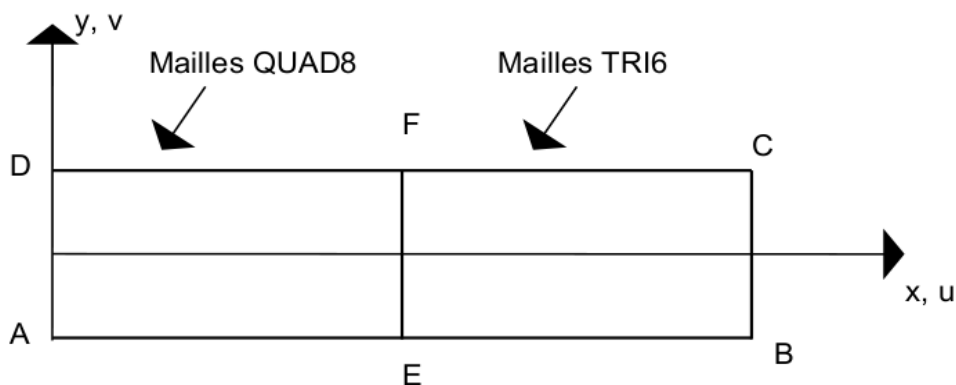
### 2.4 Bibliographical references

- 1) S. TIMOSHENKO, Resistance of Materials, 1<sup>ère</sup> part. Polytechnic bookstore CH. Béranger, Paris, 1947. p 169 to 168

## 3 Modeling A

### 3.1 Characteristics of modeling

C-PLAN, meshes TRI6 and QUAD8



Not  $E$  = medium of  $AB$  not  $F$  = medium of  $CD$

Name of the nodes:

Not  $A = N1$  Not  $D = N403$   
Not  $B = N455$  Not  $E = N201$   
Not  $C = N756$  Not  $F = N352$

### 3.2 Characteristics of the grid

Many nodes: 905

Number of meshes and ty pes: 100 QUAD8 , 200 TRIA6 , 208 SEG3

### 3.3 Values tested

Localization	Type of value	Reference	% difference
Points $B$ , $C$	$v_L$ ( $m$ )	0.129	0.4
Not $A$	$\sigma_{xx}$ ( $Pa$ )	2,04E+8	2.3
Not $E$	$\sigma_{xx}$ ( $Pa$ )	1,02E+8	0.5

### 3.4 Remarks

The variation with the analytical solution, of standard beam or hurled plate, is due to modeling used: dimensions of the structure, very slim, do not make it possible indeed to observe the conditions of plane constraints.

## 4 Summary of the results

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This test, based on a solution of hurled plate, is treated in 2D (forced plane) in order to validate the loading of edge (keyword `FORCE_CONTOUR`). The solution obtained is close to the analytical solution (0.4% of difference on displacements) and thus validates this kind of modeling.