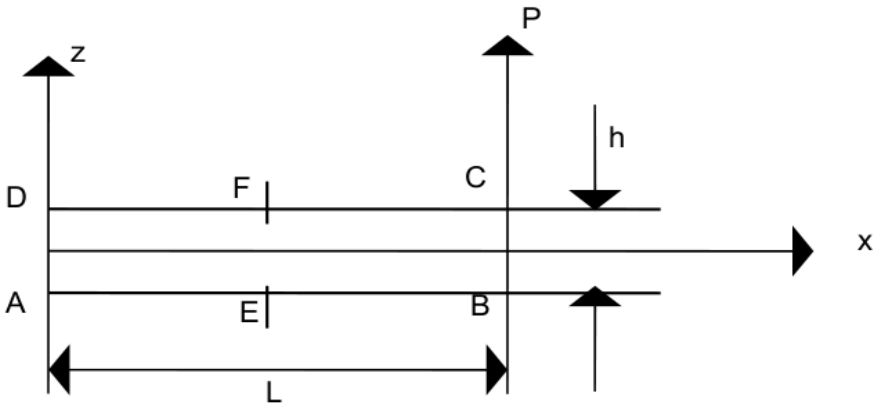
SSLP303 - Plate cantilever charged at its end

Summarized:

The goal of the test is to validate key word FORCE_CONTOUR, from a load applied at the end of a plate. With the problem is dealt in plane stresses.

1 Problem of reference

1.1 Geometry



Not E = medium of AB point F = medium DC

Length: $L=1\,m$

Width: $l=0.1\,m$

Thickness: $h=0.005\,m$

Main moment of inertia of section: $l_Y=\frac{h^3 l}{12}=1.042\times10^{-9}\,m^4$

1.2 Material properties

Modulus Young: $E=2.1\times10^{11}\,Pa$

Poisson's ratio: $\nu=0.3$

1.3 Boundary conditions and loadings

- Fixed support of the edge AD ($u=v=0$).
- Charge with resultant $P=85\,N$, applied to the edge BC (constant linear load).

1.4 Boundary conditions and loadings

Without object for the static analysis.

2 Reference solution

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:

$v_L=\frac{PL^3}{3\mathrm{EI}_y}$ (neglected shears)

from where $v_L=0.129\,m$

the stress field σ_{xx} of bending is given by:

$\sigma_{xx}=\frac{Ph}{2\mathrm{I}_y}(L-x)$ on the edge AB

is $\sigma_{xx}=2.04\times10^8(L-x)(Pa)$

2.2 Results of reference

- Displacement v_L of the nodes B and C
- Nodal stresses σ_{xx} A and B E

2.3 Uncertainty on the analytical

solution Solution.

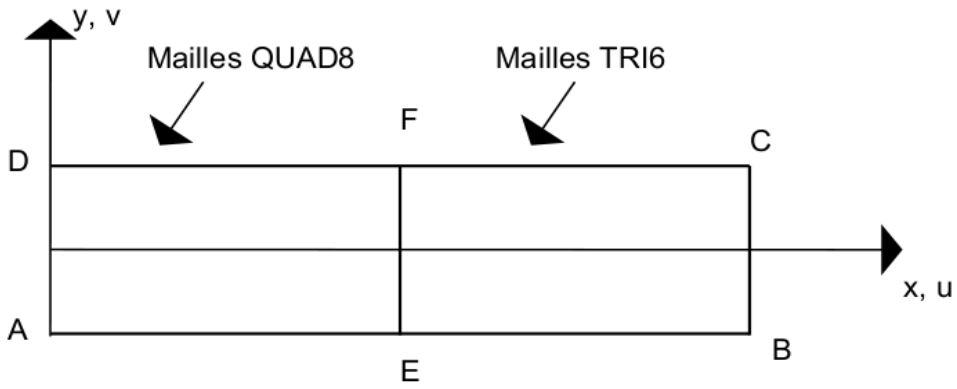
2.4 Bibliographical references

1) S. TIMOSHENKO, Strength of materials, 1st part. Polytechnic library CH. Béranger, Paris, 1947. p 169 to 168

3 Modelization A

3.1 Characteristic of modelization

C-PLAN, meshes TRI6 and QUAD8



Not E = medium of AB point 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 Characteristic of the mesh

Many nodes: 905

Number of meshes and types: 100 QUADS 8,200 SORTED 6,208 SEG3

3.3 Values tested

Standard	Localization of value	Reference	% difference
Points B , C	v_L (m)	0,129	0.4
Point A	σ_{xx} (Pa)	2,04E+8	2.3
Point E	σ_{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 the modelization used: dimensions of structure, very slender, do not make it possible indeed to observe the plane constraints.

4 Summary of the results

This test, based on a solution of hurled plate, is treated in 2D (plane stresses) in order to validating the edge loading (key word FORCE_CONTOUR). The solution obtained is close to the analytical solution (0.4% of difference on displacements) and thus validates this kind of modelization.