SSNP305 - Element of bar in compression - Appearance of a negative pivot

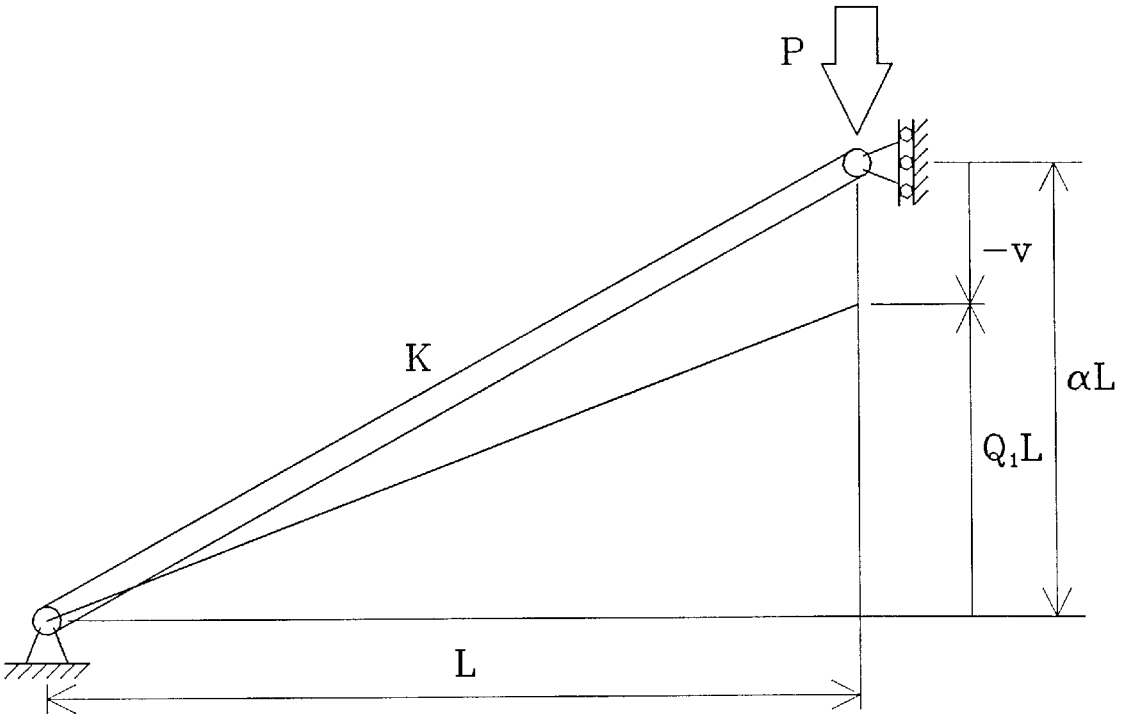
Summary:

This test of linear quasi-static mechanics 2D consists in charging an element with bar in compression. On a side, the element is fixed according to the degrees of translation on a node. Other side, the element is fixed according to the second degree of translation on a node in order to model the slip along a line. At a certain moment the stiffness becomes negative (= negative slope). This test is drawn from guide NAFEMS (analytical solution). The structure will be charged by using a piloting by displacement.

The plate is modelled by 12 elements plans (MECPQU4). The material has a linear behavior and one takes into account nonthe geometrical linearities. The keyword factor is used BEHAVIOR option GREEN.

1 Problem of reference

1.1 Geometry



1.2 Material properties

Isotropic elastic material

$$E = 200000\ MPa$$
$$\nu = 0.0$$

1.3 Boundary conditions and loadings

Not A : $u_x = 0.$
$u_y = 0.$
Not B : $u_x = 0.$

Loading by a force P on the point B. The force will be increased by using a piloting by displacement of the point B.

$L = 2500$ $\alpha L = 2500$
$A = 250$

2 Reference solution

2.1 Method of calculating used for the reference solution

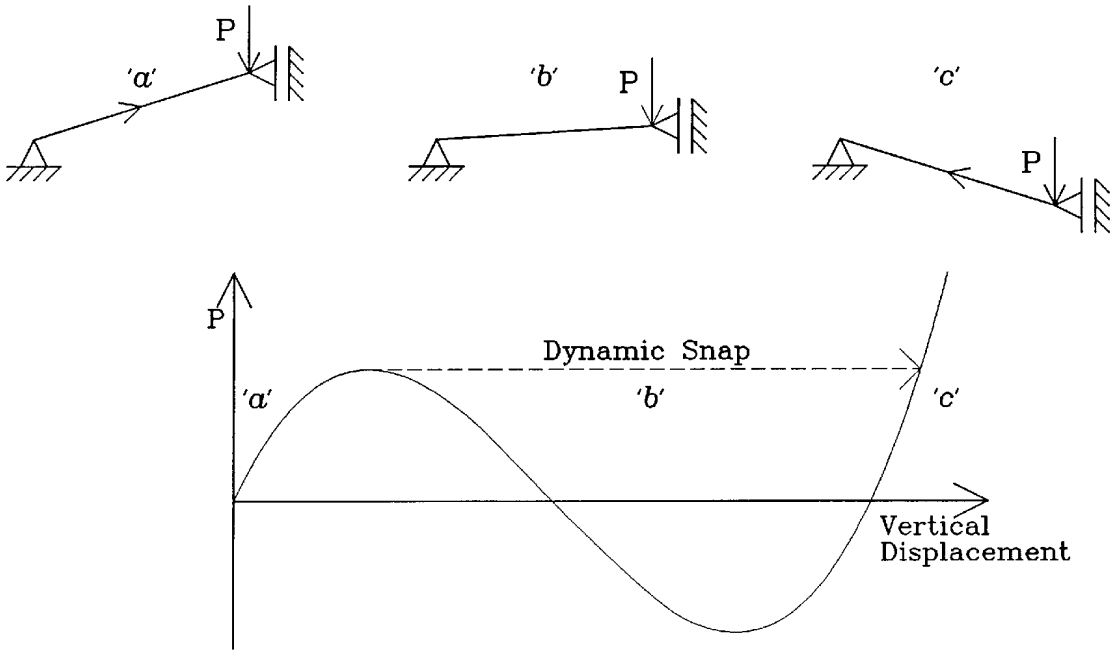
Analytical solution.

2.2 Results of reference

Vertical displacement $v=(Q_1-\alpha)L$

Deformation 'GREEN'

$$P=-EAQ_1\left[\frac{Q_1^2-\alpha^2}{2(1+\alpha^2)^{\frac{3}{2}}}\right]$$

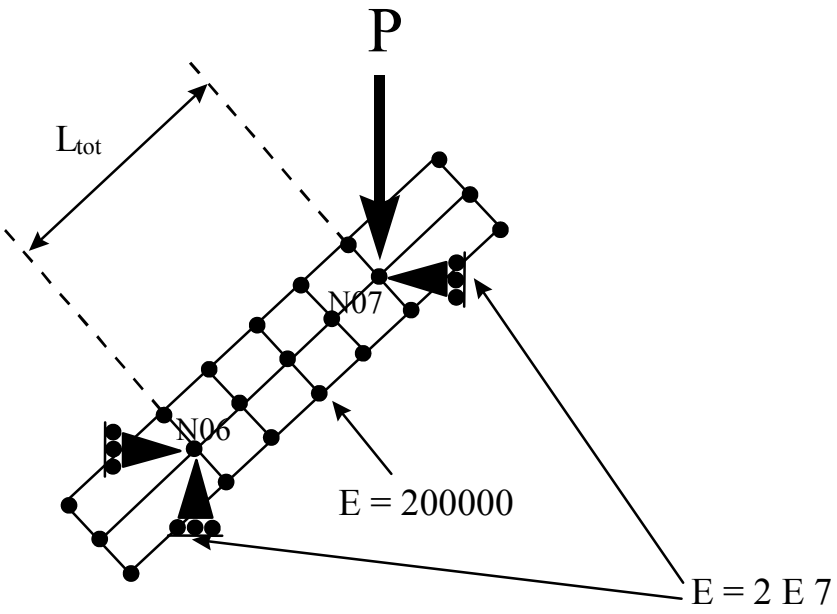


2.3 Bibliographical references

- Benchmark tests for solution procedures for geometric non-linearity, NAFEMS, 1987

3 Modeling A

3.1 Characteristics of modeling A



Modeling in plane constraints: C_PLAN

The loading and boundary conditions are modelled by:

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DDL_IMPO: (NODE: N7 DX: 0.)
              (NODE: N1 DX: 0. DY: 0.)
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In order to respect the best possible behavior of bar, one prolongs the length of the bar and one imposes on this surplus of matter a Young modulus of $2\mathrm{E}7\,MPa$.

The other meshs are affected face value of $200000\,MPa$.

3.2 Characteristics of the grid

Many nodes: 21
Many meshs: 12 MECPQU4

3.3 Values tested

Identification		Reference
$FY(N7)$ $DX=-250$	with	1511441
$FY(N7)$ $DX=-500$	with	2545584
$FY(N7)$	with	3155464

$DX=-750$		
$FY(N7)$ $DX=-1050$	with	3401961
$FY(N7)$ $DX=-1500$	with	2969848
$FY(N7)$ $DX=-2000$	with	1697056
$FY(N7)$ $DX=-2500$	with	0

3.4 Remarks

The application of the loading is carried out with 100 increments.

4 Summary of the results

The results provided by Aster are in perfect agreement with the reference solution.