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

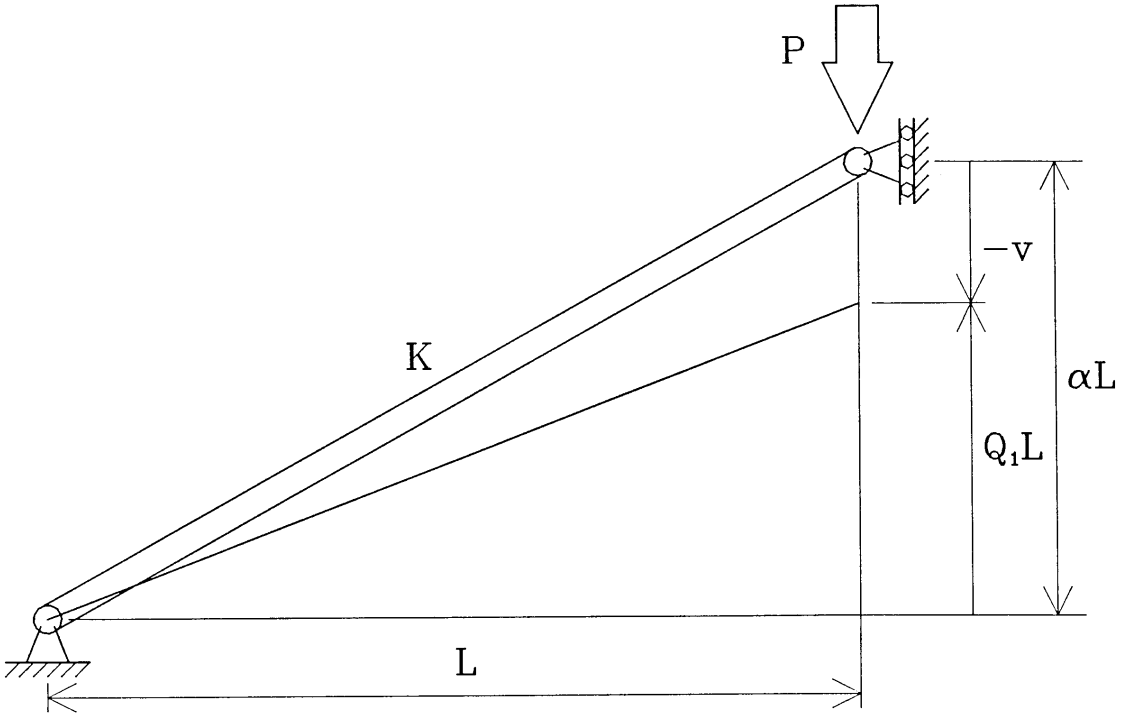
pivot:

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 sliding along a line. A a certain time the stiffness becomes negative (= negative slope). This test is drawn from guide NAFEMS (analytical solution). The structure will be charged by means of a control by displacement.

The plate is modelled by 12 plane elements (MECPQU4). The material has a linear behavior and one takes into account the geometric nonlinearities. One uses the key word factor "COMP_ELAS" 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

Point: A $u_x = 0.$
$u_y = 0.$
Point: B $u_x = 0.$

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

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

2 Reference solution

2.1 Method of calculating used for the analytical reference solution

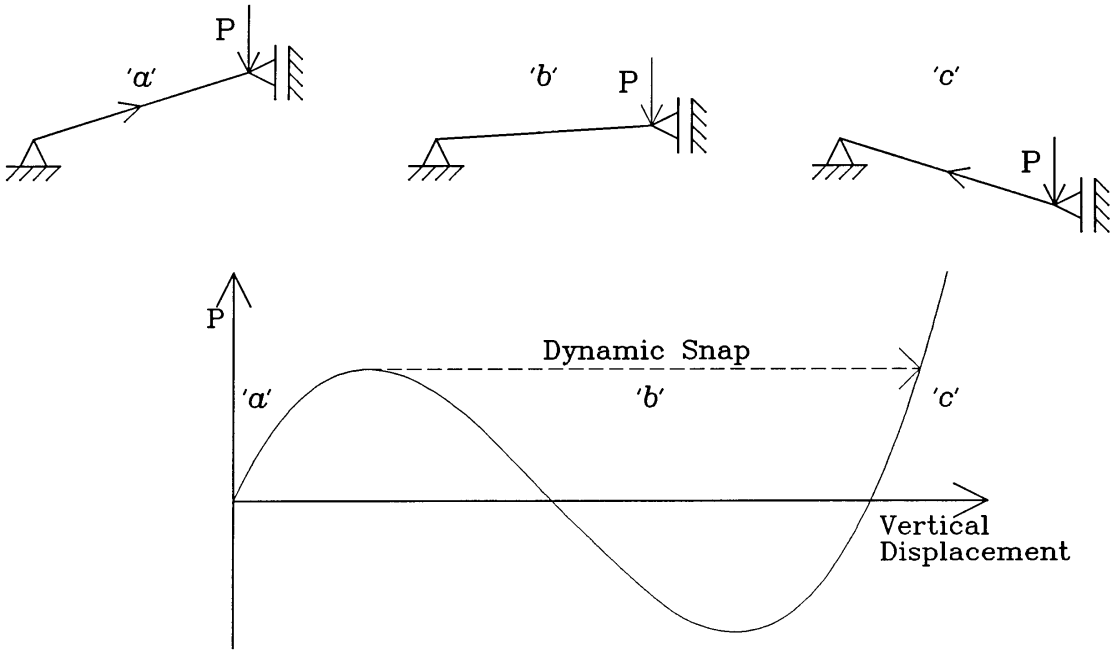
Solution.

2.2 Results of reference

vertical Displacement $v=(Q_1-\alpha)L$

Strain "GREEN"

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

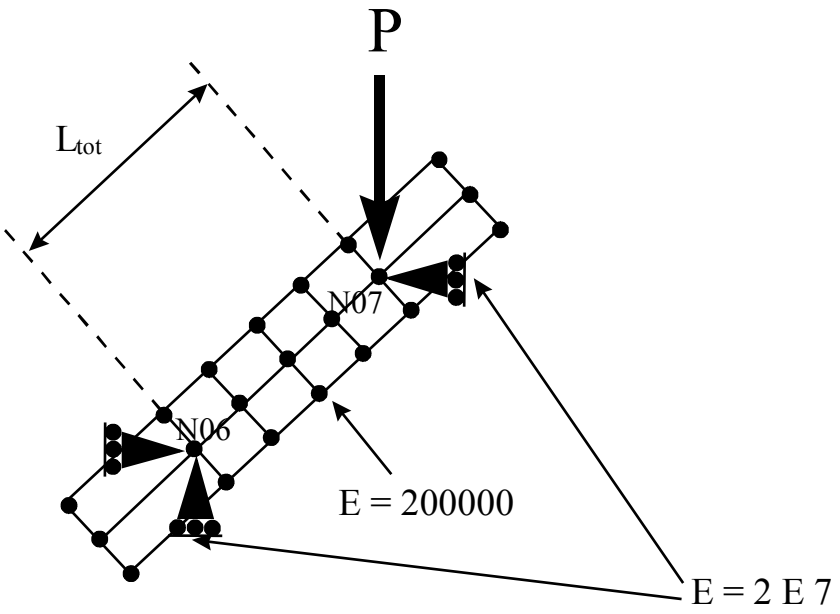


2.3 bibliographical References

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

3 Modelization A

3.1 Characteristic of the modelization A



Modelization in plane stresses: C_PLAN

the loading and the boundary conditions are modelled by:

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DDL_IMPO:     (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
PROFILE OF THE EXCLU TYPE NODE: N7    DX: 0.)
              (THE NODE IS OUTSIDE THE FIELD OF DEFINITION WITH A RIGHT
          PROFILE OF THE EXCLU TYPE 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 others meshes are affected face value of $200000\,MPa$.

3.2 Characteristics of the mesh

Many nodes: 21
Number of meshes: 12 MECPQU4

3.3 Values tested

Identification	Reference
$FY(N7)$ to $DX=-250$	1511441
$FY(N7)$ to $DX=-500$	2545584
$FY(N7)$ to $DX=-750$	3155464

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

3.4 Remarks

the application of the loading are carried out with 100 increments.

4 Summary of the results

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