

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

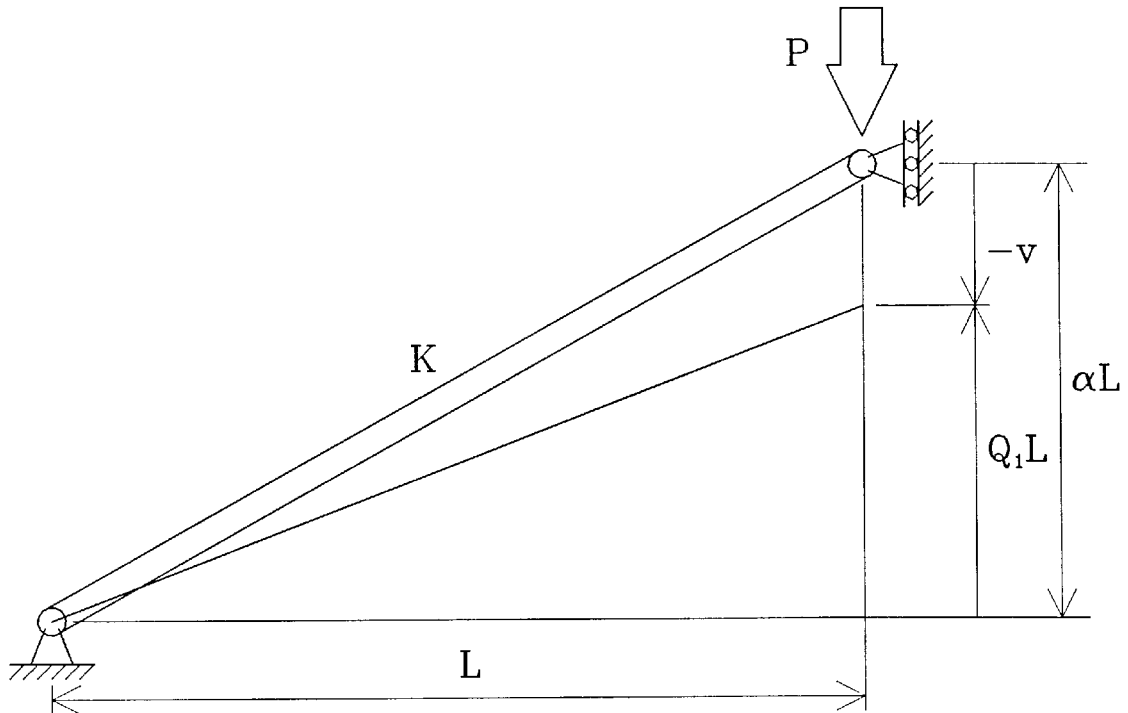
Summary:

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

$$E = 200000 \text{ MPa}$$

$$\nu = 0.0$$

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 .

$$L = 2500 \quad \alpha L = 2500$$

$$A = 250$$

2 Reference solution

2.1 Method of calculating used for the reference solution

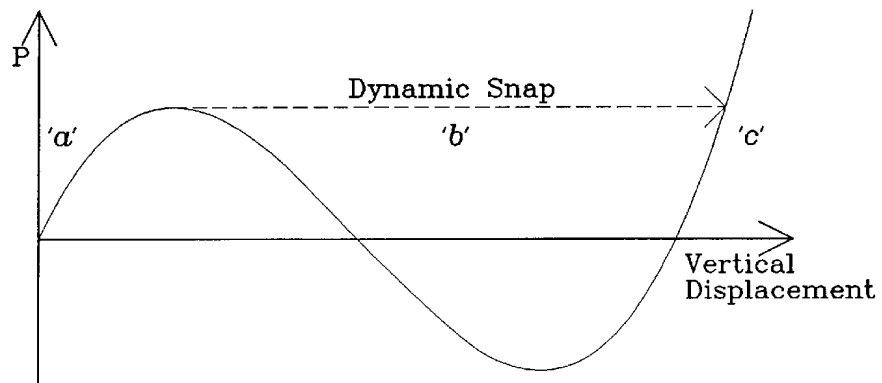
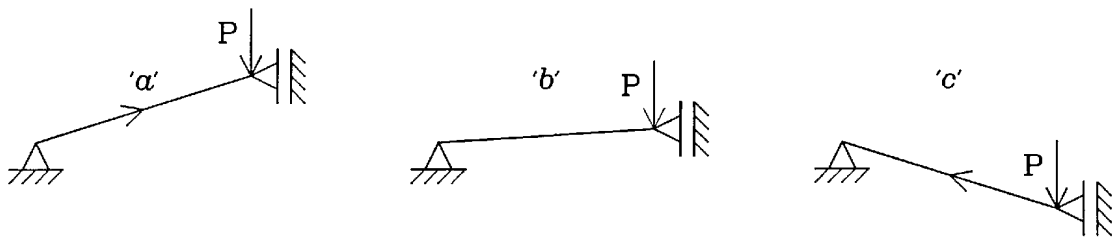
Analytical solution.

2.2 Results of reference

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

Deformation 'GREEN'

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

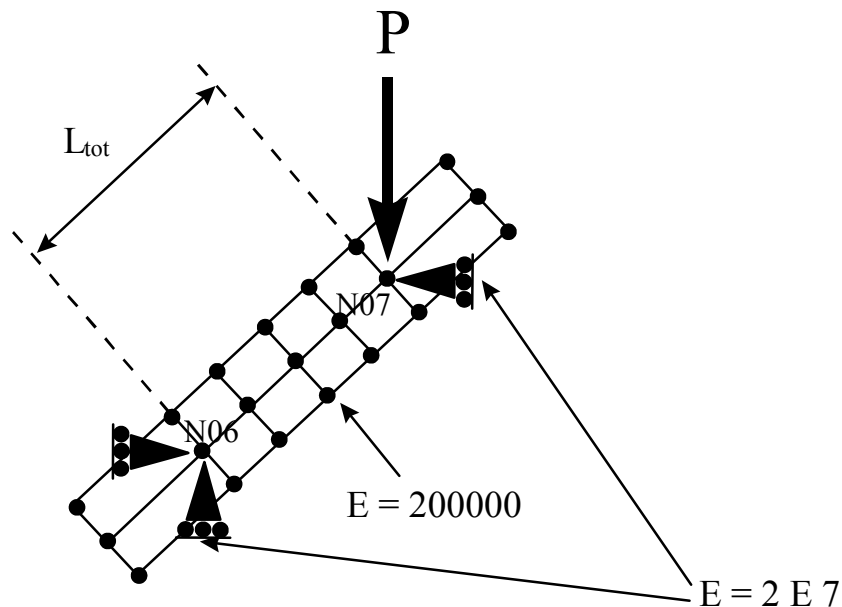


2.3 Bibliographical references

- 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:

```
DDL_IMPO: (NODE: N7 DX: 0.)
           (NODE: N1 DX: 0. DY: 0.)
```

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 $2E7 MPa$.

The other meshes are affected face value of $200000 MPa$.

3.2 Characteristics of the grid

Many nodes: 21
Many meshes: 12 MECPOU4

3.3 Values tested

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

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

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.