

Example 32: Verifying displacements of a cantilever beam with a coarse net**1 Description of the problem**

To verify the mathematical model of *ELPLA* for computing plane stresses, results of a cantilever beam having a thin rectangular cross section introduced by *Thakkar (2017)* are compared with those obtained by *ELPLA*. The cantilever carries a point load of $P = 10000$ [N] applied at the end as shown in Figure 90.

2 Cantilever dimensions

The cantilever has the following dimensions:

| | | |
|---------------------|-----------|------|
| Cantilever length | $L = 300$ | [mm] |
| Cross section depth | $h = 100$ | [mm] |
| Cross section width | $b = 1$ | [mm] |

3 Cantilever material

Material of the cantilever has the following parameters:

| | | | |
|-----------------|------------|-------------------|----------------------|
| Young's modulus | E_b | $= 2 \times 10^5$ | [N/mm ²] |
| Poisson's ratio | ν_b | $= 0.3$ | [-] |
| Unit weight | γ_b | $= 0$ | [N/mm ³] |

The self-weight of the cantilever is ignored.

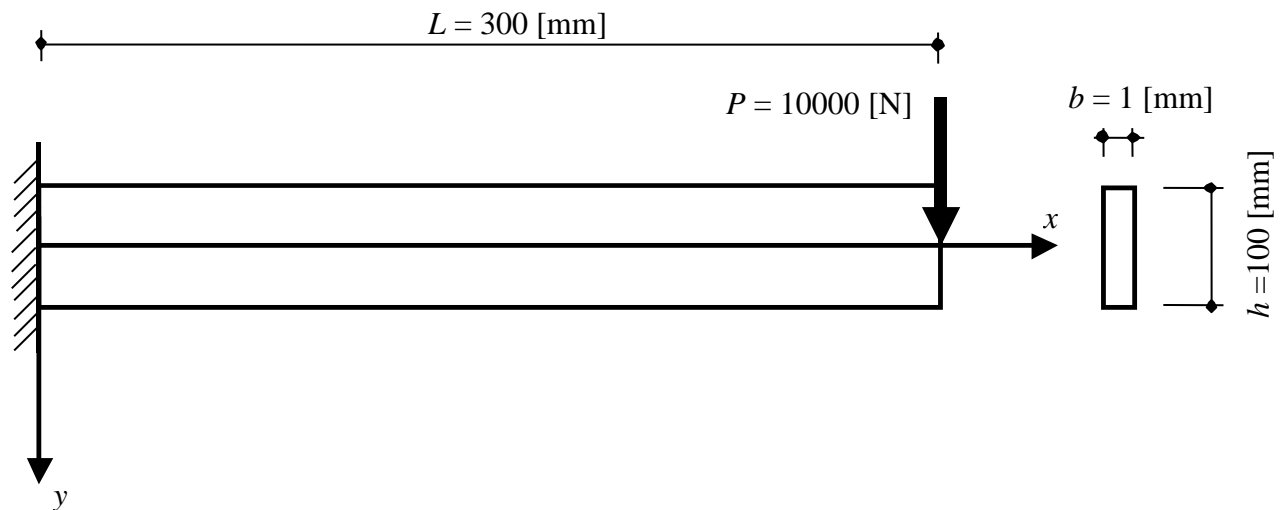


Figure 90 Cantilever beam loaded at the end

Examples to verify and illustrate *ELPLA*

4 Analysis

Because the cross section of the cantilever is thin, the cantilever may be considered as a plane stress problem. A good mesh would be to discretize this beam into a large number of elements. However, for the comparison, the beam is discretized into a coarse mesh as shown in Figure 91.

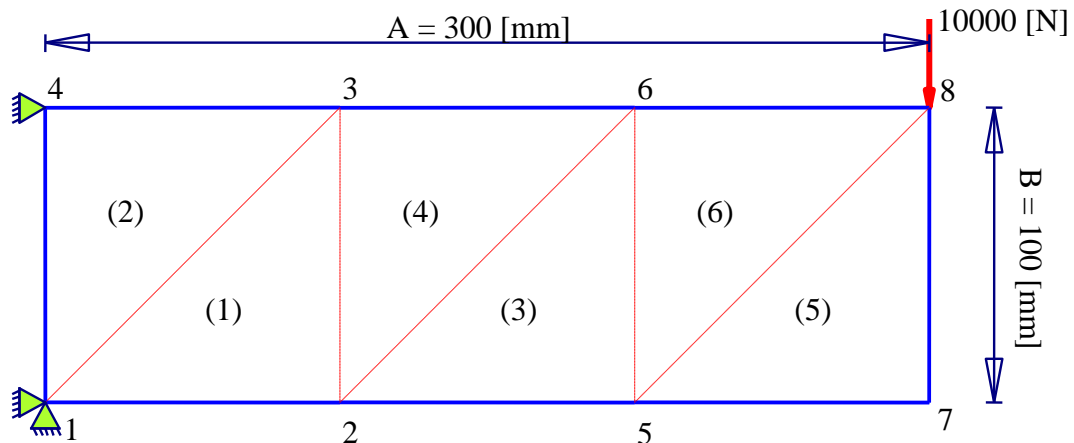


Figure 91 Finite element mesh with node and element numberings of the cantilever beam

5 Results

Results of *ELPLA* are compared with the that of *Thakkar (2017)* in Table 47. From this table, it can be noticed that results of displacements obtained by *ELPLA* are the same as those of *Thakkar (2017)*.

Table 47 Comparison of displacements obtained by *ELPLA* and *Thakkar (2017)*

| Node No. I [-] | Displacements obtained by <i>Thakkar (2017)</i> | | Displacements obtained by <i>ELPLA</i> | |
|------------------------|---|-------------|--|-------------|
| | u [mm] | v [mm] | u [mm] | v [mm] |
| 1 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | -0.190 | -0.429 | -0.190 | -0.429 |
| 3 | 0.232 | -0.411 | 0.232 | -0.411 |
| 4 | 0.000 | -0.158 | 0.000 | -0.158 |
| 5 | -0.298 | -1.085 | -0.298 | -1.085 |
| 6 | 0.328 | -1.063 | 0.328 | -1.063 |
| 7 | -0.321 | -1.842 | -0.321 | -1.842 |
| 8 | 0.351 | -1.864 | 0.351 | -1.864 |