Example 18: Verifying simply supported slab

1   Description of the problem

To examine the accuracy of the calculation of Finite elements-method and the convergence characteristics of the stiffness matrix, the maximum values of deflection w, moments m_x, m_y and m_{xy} of a simply supported rectangular slab are obtained at different nets of finite elements. The slab carries a uniform distributed load of $p = 100$ [kN/m^2] as shown in Figure 29. *Young's* modulus of the slab material is $E_b = 1.2 \times 10^7$ [kN/m^2] and *Poisson's* ratio is $v_b = 0$ [-]. The slab thickness is $d = 0.1$ [m].
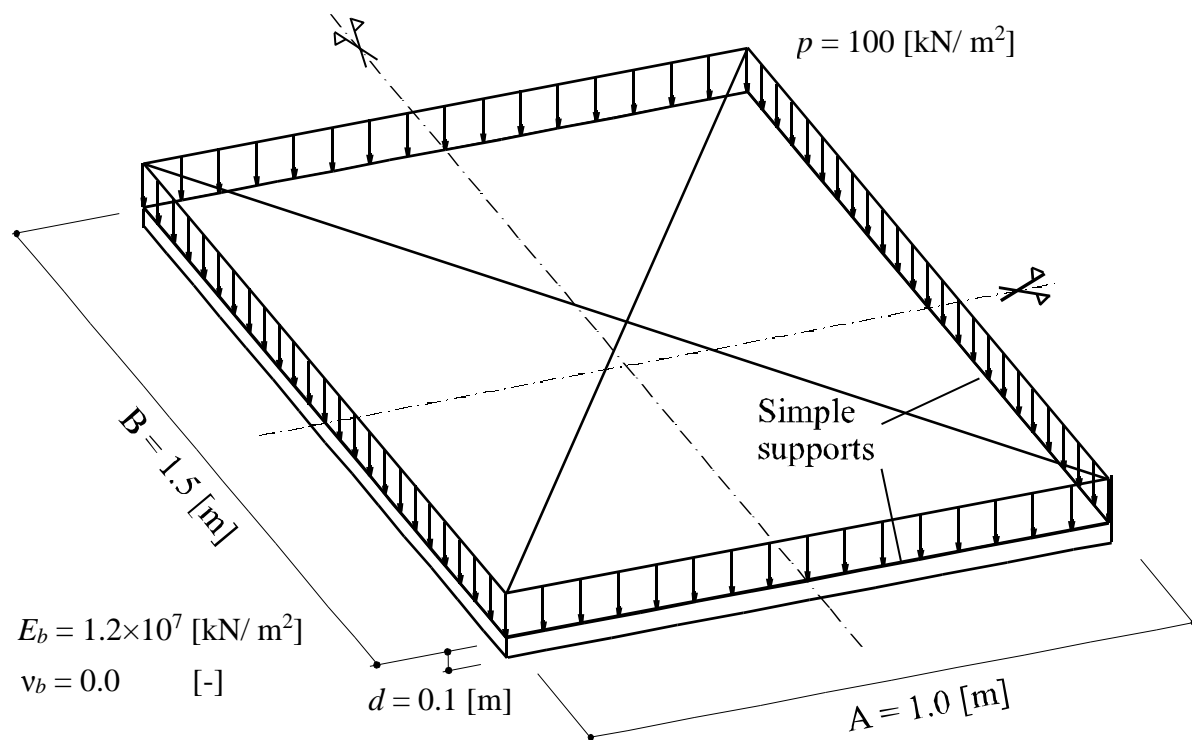

Figure 29   Simply supported rectangular slab

2   Analysis and results

Because of the symmetry it is sufficient to analyze only one quarter slab. The finite element nets of the slab are shown in Figure 30. Results of *ELPLA* are compared by the exact solution using the known charts from *Czerny* (1955) and Finite elements-solution from *Falter* (1992) in Table 23 to Table 26. From the tables, it can be noticed that results of deflection and moments obtained by *ELPLA* are the same as those of *Falter* (1992), Example 14.2, page 378, which are calculated using Finite elements-method. A sufficient accuracy for the results may be considered at slab mesh of 4 elements according to *Czerny's* charts.
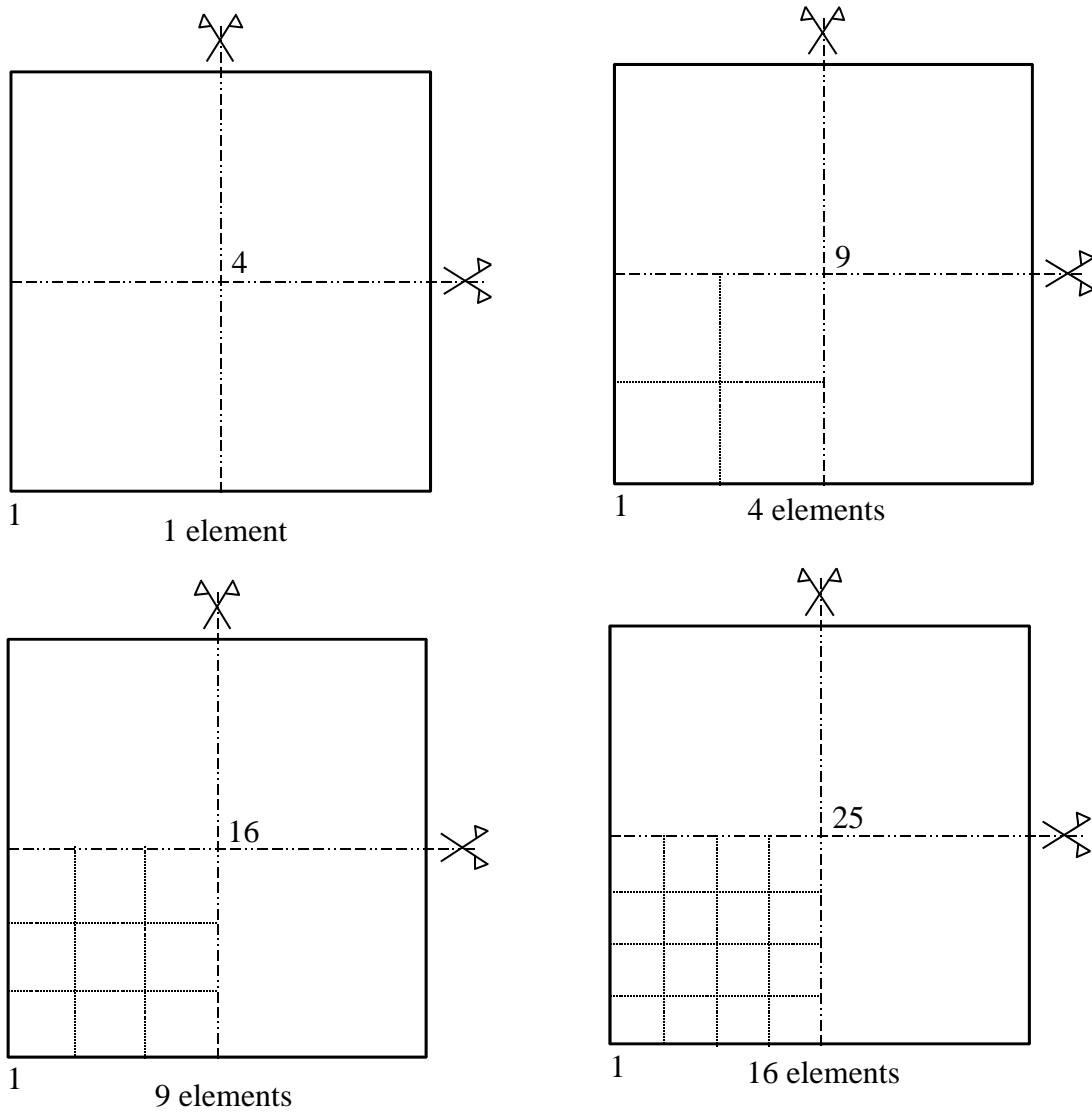
Figure 30   FE-Nets of the slab

Table 23   Deflection *w* [cm] computed by *Czerny's* charts (1955), *Falter* (1992) and *ELPLA*

No. of elements	Node No.	Deflection *w* [cm]		
		Czerny (1955)	*Falter* (1992)	*ELPLA*
1	4		0.094	0.094
4	9		0.082	0.082
9	16	0.077	0.079	0.079
16	25		0.078	0.078

Examples to verify and illustrate *ELPLA*

Table 24   Moment m_x [kN.m/m] computed by *Czerny's* charts (1955), *Falter* (1992) and *ELPLA*

No. of elements	Node No.	Moment m_x [kN.m/m]		
		Czerny (1955)	*Falter* (1992)	*ELPLA*
1	4	7.30	10.29	10.29
4	9		7.99	7.99
9	16		7.58	7.59
16	25		7.45	7.45

Table 25   Moment m_y [kN.m/m] computed by *Czerny's* charts (1955), *Falter* (1992) and *ELPLA*

No. of elements	Node No.	Moment m_x [kN.m/m]		
		Czerny (1955)	*Falter* (1992)	*ELPLA*
1	4	2.88	3.36	3.36
4	6		3.42	3.29
9	12		2.98	2.98
16	20		2.89	2.89

Table 26   Moment m_{xy} [kN.m/m] computed by using *Czerny's* chart, *Falter* (1992) and *ELPLA*

No. of elements	Node No.	Moment m_x [kN.m/m]		
		Czerny (1955)	*Falter* (1992)	*ELPLA*
1	1	6.13	6.57	6.57
4	1		6.35	6.35
9	1		6.26	6.26
16	1		6.22	6.22