Example 14: Verifying beam foundation on elastic springs

1 Description of the problem

To verify the mathematical model of *ELPLA* for analyzing beam foundations, the results of beam foundation on elastic springs obtained by *Rombach* (2000), Section 2.4.2, page 34, are compared with those obtained by *ELPLA*.

Geometry and load of the foundation are the same as those of *Rombach* (2000) as shown in Figure 20. A strip foundation of thickness d = 0.60 [m] and length L = 5.0 [m] is considered. The analysis is carried out for 1.0 [m] width stripe. The beam cross section yields Moment of Inertia I = 0.018 [m^4] and Torsion modulus J = 0.045077 [m^4]. The beam is subjected to a wall load of P = 1000 [kN/m] at the center.

The parameters of beam material (Concrete C30/70) are *Young's* modulus E_b = 3.2 × 10^7 [kN/m^2] and Shear modulus G_b = 1.3 × 10^7 [kN/m^2]. Modulus of subgrade reaction of the soil is k_s = 50000 [kN/ m^3].

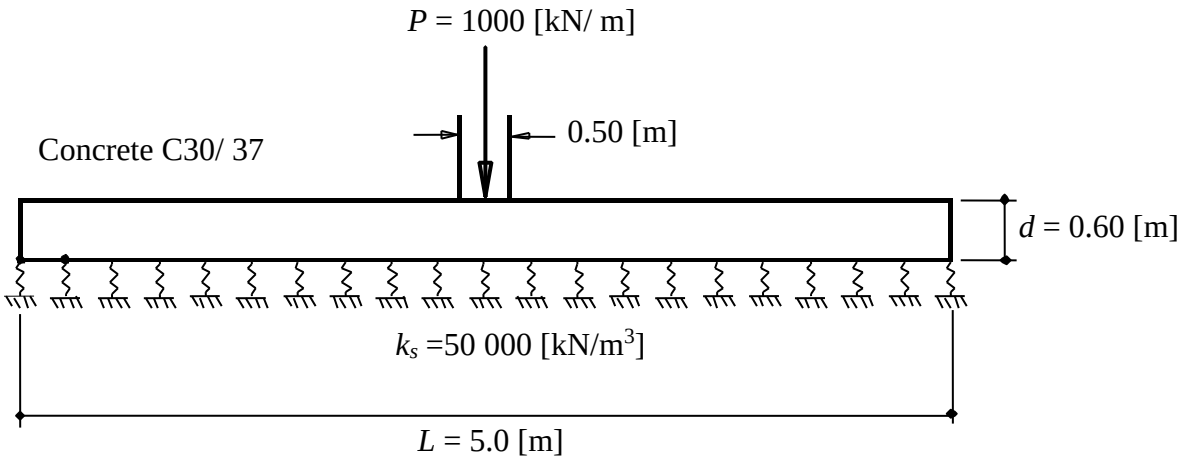

Figure 20 Beam on elastic springs, dimensions and load

2 Analysis and results

In *ELPLA* either ribbed rafts or only beams can be analyzed using plate elements together with beam elements. In which the grid elements are placed in regions close to plate element boundaries. In case of analyzing only beam foundation one can eliminate the plate element by assuming its rigidity to be zero (E_b = 0). Therefore, in this example the entire foundation is subdivided into rectangular elements, in which the width of the element is chosen to be equal to the width of the beam strip B = 1.0 [m]. Each element has area of 0.25 × 1.0 [m^2]. Accordingly, the beam elements represent the beam on the net as shown in Figure 21. The corresponding spring constant for nodes under beam elements is k_s = 50000 [kN/m^3] while for nodes under plate elements is k_s = 0.

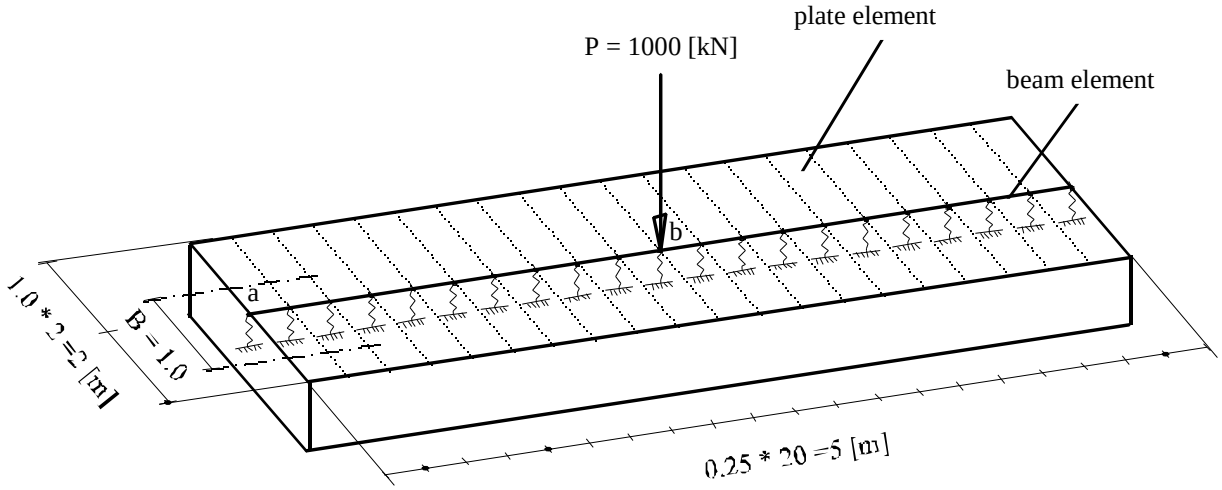

Figure 21 FE-Net of the foundation

3 Results

Table 19 shows the comparison of the results at two selected points *a* and *b* on the beam obtained by *ELPLA* with those obtained by *Rombach* (2000). From this table it can be seen that the results of both analyses are in good agreement.

Table 19 Comparison of the results at two selected points *a* and *b* on the beam obtained by *ELPLA* with those obtained by *Rombach* (2000)

Point	Settlement s [cm]		Moment M_b [kN.m]		Shear force Q_s [kN]	
	Rombach (2000)	*ELPLA*	*Rombach* (2000)	*ELPLA*	*Rombach* (2000)	*ELPLA*
a	0.31	0.31	-	-	-	-
b	0.47	0.46	520	582	471	471