Example 3.1 Settlement outside the foundation

1 Description of the problem

Besides the possibility of studying the influence of neighboring structures on the foundation by the program *ELPLA*, the described algorithm of *ELPLA* can be used also for the calculation of settlements outside the foundation. This can be carried out through one of the following two ways:

i) Using a net for the foundation and the unloaded areas outside the foundation. Then, the rigidity of the unloaded areas can be eliminated by assuming very small thickness

ii) Using two independent nets, one for the foundation and the other for the unloaded areas outside the foundation as considered in this example

Figure 3.2 shows an irregular raft that has the contact area I with opening inside it. It is required to determine the settlements at the area II around the raft and at the opening of area III.

2 Soil properties

The raft of contact area I and the outside areas II and III are on regular subsoil. The soil is supposed to have the following parameters:

Modulus of compressibility	E_s	= 9500	[kN/m^2]
Poisson's ratio	ν_s	= 0.0	[-]

The displacement of the soil is considered only in the vertical direction. Therefore, *Poisson*'s ratio for the soil is assumed to be zero.

3 Raft material and thickness

The raft material and thickness are supposed to have the following parameters:

Young's modulus	E_b	= 2×10^7	[kN/m^2]
Poisson's ratio	ν_b	= 0.25	[-]
Unit weight	γ_b	= 0	[kN/m^3]
Raft thickness	d	= 0.7	[m]

Unit weight of the raft material is assumed zero to neglect its own weight in the analysis.

4 Loads

The raft carries 12 concentrated loads as shown in Figure 3.2.

5 Mathematical model

The influence of surrounding structures and external loads can be taken into consideration only for the Continuum model (methods 4, 5, 6, 7 and 8). The Continuum model bases on the settlement at any node is affected by the contact forces at all the other nodes. In this example, the Isotropic elastic half-space soil medium (method 5) is chosen to analyze the raft I and outside areas II and III.

6 Analysis

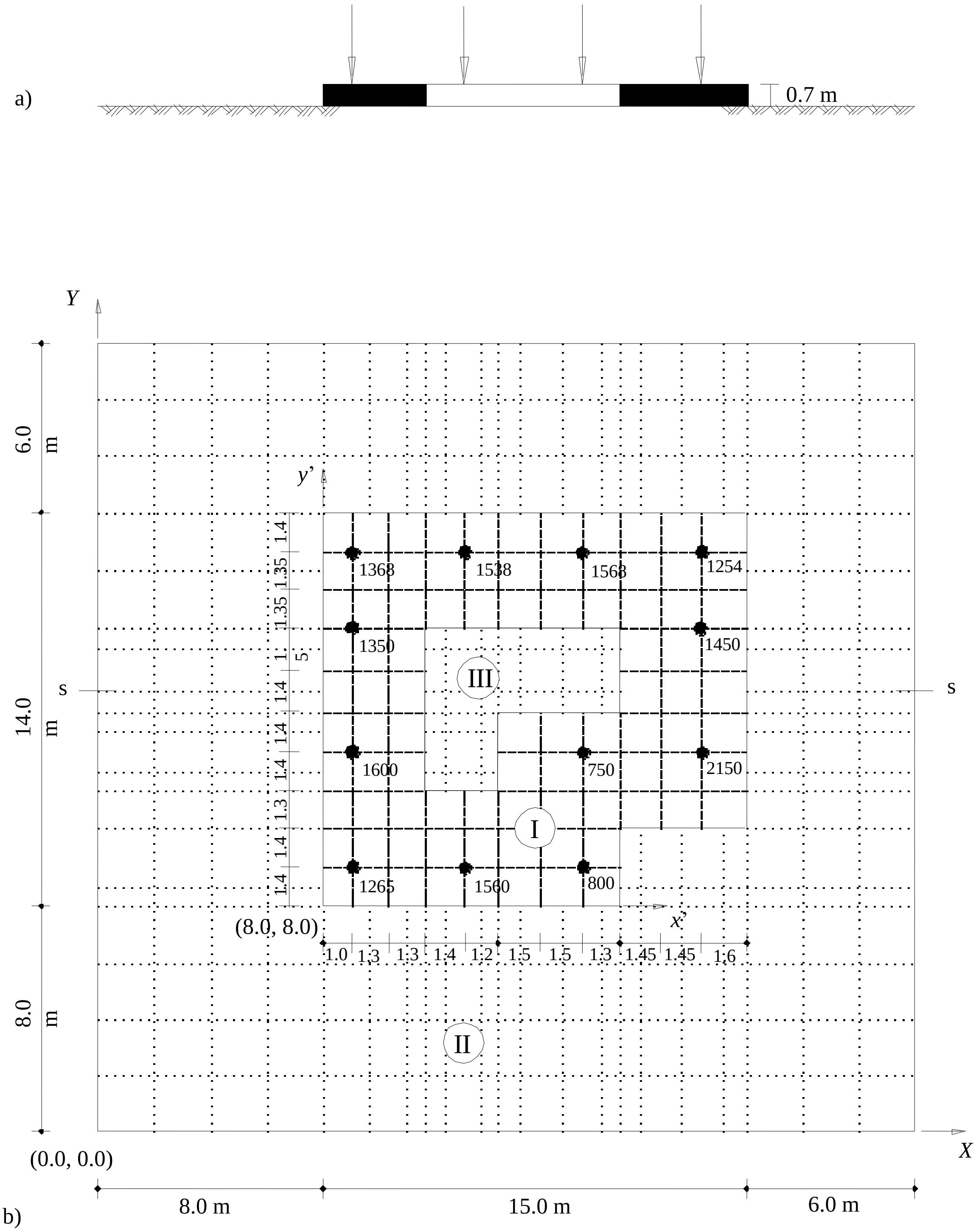
To carry out the analysis, the raft I and the outside areas II and III are subdivided into two independent element nets as shown in Figure 3.2b. Two independent names are chosen to define the data of the raft and the outside areas. The origin coordinates of the raft are (x_o, y_o) = (8.0, 8.0), while for the outside areas are (0.0, 0.0).

The analysis of the raft I is carried out to obtain the contact pressures under it first. Due to these contact pressures, settlements will occur not only under the raft I but also outside under areas II and III. Then, the settlements of the outside areas II and III are determined.

7 Results

Figure 3.3 shows the contact pressures under the raft I that cause the settlements under it and also at the outside areas II and III. Figure 3.4 shows the contour lines of the settlements under the raft.

Figure 3.5a shows the settlement at the middle section *s-s* of the outside areas II and III, while Figure 3.5b shows the contour lines of the settlements. As it is expected, the greatest values of settlements are near the raft.



<u>Figure 3.2</u> a) Section s-s through the raft
b) Raft (area I) with loads [kN] and neighboring areas II and III

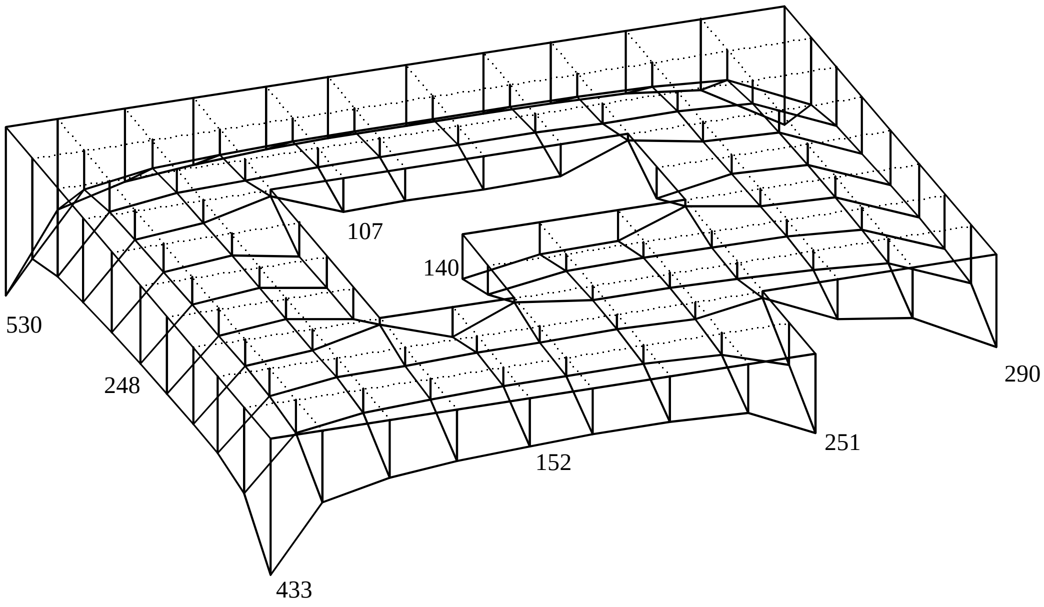


Figure 3.3 Contact pressures [kN/m^2] under the raft

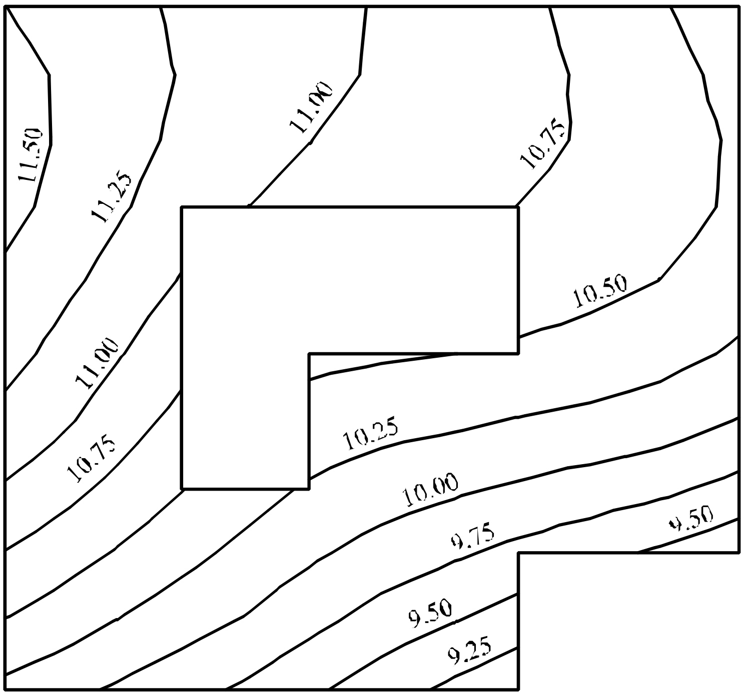


Figure 3.4 Contour lines of settlements [cm] under the raft

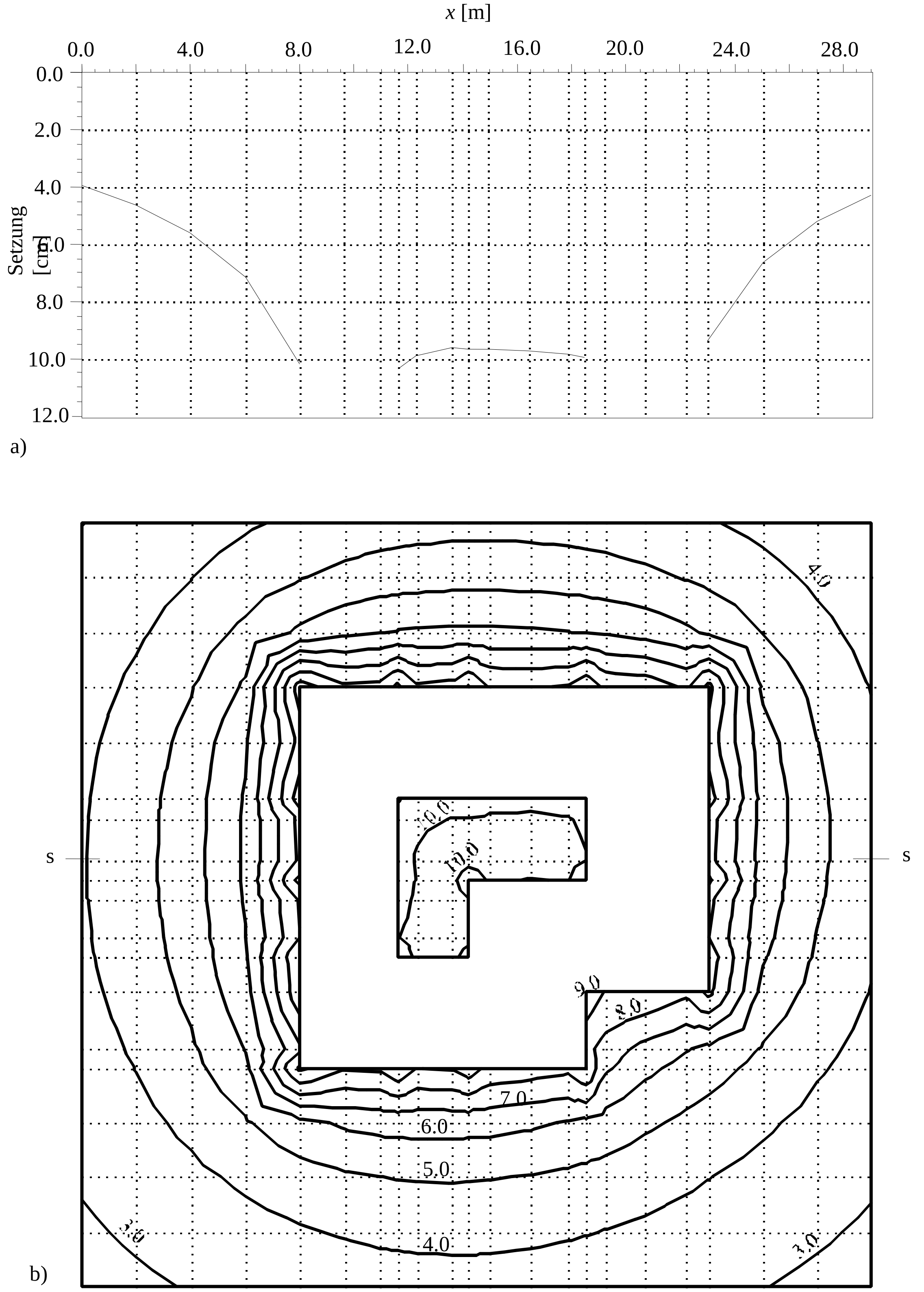


Figure 3.5 a) Settlements of neighboring areas II and III at section s-s
b) Contour lines of settlements [cm] of neighboring areas II and III