Example 3.2 Influence of a new neighboring building II on an old one I

1 Description of the problem

For the explanation of the influence of a neighboring building, the influence of a new building on an existing old one is examined in this example.

Figure 3.6 shows plan and section of a new building II beside a similar old one I. The building I was constructed since long time, while the building II will be constructed close to the first one. The two buildings have the same construction geometry and loads. Also, every building is symmetrical about both *x*- and *y*-axes.

2 Soil properties

The subsoil under the buildings consists of a layer of stiff plastic clay 5.70 [m] thick, overlying a rigid base (Figure 3.6a). The soil is supposed to have the following parameters:

Modulus of compressibility for loading	E_s	= 5 000	[kN/m^2]
Modulus of compressibility for reloading	W_s	= 15 000	[kN/m^2]
Unit weight	γ_s	= 18	[kN/m^3]
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 clay is assumed to be zero.

3 Foundation material and thickness

Foundation 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	= 0.0	[kN/m^3]
Foundation thickness	d	= 1.0	[m]

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

4 Mathematical model

The influence of surrounding structures and external loads can be taken into consideration only for the Continuum model (methods 4 to 9). The Continuum model bases on the settlement at any node is affected by the forces at all the other nodes. In this example, the Modulus of compressibility method (method 7) is chosen to analyze both of the two buildings.

5 Analysis

To analyze the foundations, each foundation is subdivided into elements with 189 nodes as shown in Figure 3.6b. Two independent names are chosen to define the data of the two buildings. The data are quite similar for the two buildings except the origin coordinates, which are chosen to be (x_o, y_o) = (10.28, 0.0) and (0.0, 0.0) for buildings I and II, respectively. In spite of the two buildings are closed to each other, a small distance of 20 [cm] is assumed between them to avoid overlapping their nodes.

The analysis of the new building II is carried out first to obtain the contact pressures under it. Due to these contact pressures, settlements will occur not only under the building II but also outside under the building I. Then, under the assumption that left beside the old building a new building will be constructed, the contact pressures, settlements and internal forces of the old building are determined.

6 Results and evaluation

Figure 3.7a shows the contact pressure distribution that was originally available under the old building. As it is expected, the contact pressures are distributed symmetrically, because the building was analyzed under the assumption that the loads are symmetrically applied.

Figure 3.7b on the right shows the changes in contact pressures under the old building, while the opposite figure on the left shows the contact pressures under the new building. Through comparison it is to recognize that considerable differences occur in the contact pressure distribution under the old building. The contact pressures became smaller at the edge between new building and old building due to the additional settlements from the influence of the neighboring building. From equilibrium of the vertical forces, the contact pressures became larger in the middle of the old building. Of course, the change in contact pressure distribution under the building will cause also changing and shifting the stress of the old building. Accordingly, the moments of the old building will be affected.

Figure 3.8a shows the settlements as contour lines under the old building I without the influence of the neighboring building. Because there is a centric resultant load, the settlements are symmetrical.

Figure 3.8b on the right shows the settlements of the old building I and on the left the settlements of the new building II. As it is expected, the old building settled additionally at the edge to the new building. Consequently, the settlements are regressive on the right side of the old building. This means a tilt of the old building occurs.

Figure 3.9 shows the settlements s, contact pressures q and moments m_x at the middle of the foundations for both buildings I and II.

From the results it is recognized furthermore, that the settlements at the edge nodes of the old building near to the new building increase strongly (Figure 3.9a). Therefore, the settlement increased from 4.79 [cm] to 7.31 [cm] at the middle of the foundation.

The influence of the neighboring building is very clearly noticeable in curves of Figure 3.9c. Due to the greatest positive moment (column moment with load *P* = 2000 [kN]), which increased from 787 [kNm/m] (only new building) to 654 [kNm/m], the sign of the field moment is changed. The field moment (only new building) reaches 20 [kNm/m], while with the influence of a neighboring building at the same node the field moment reaches -200 [kNm/m].

By these results you can now estimate the addition stress on the old building due to the influence of the new building and consequently prevent damages of the old building.

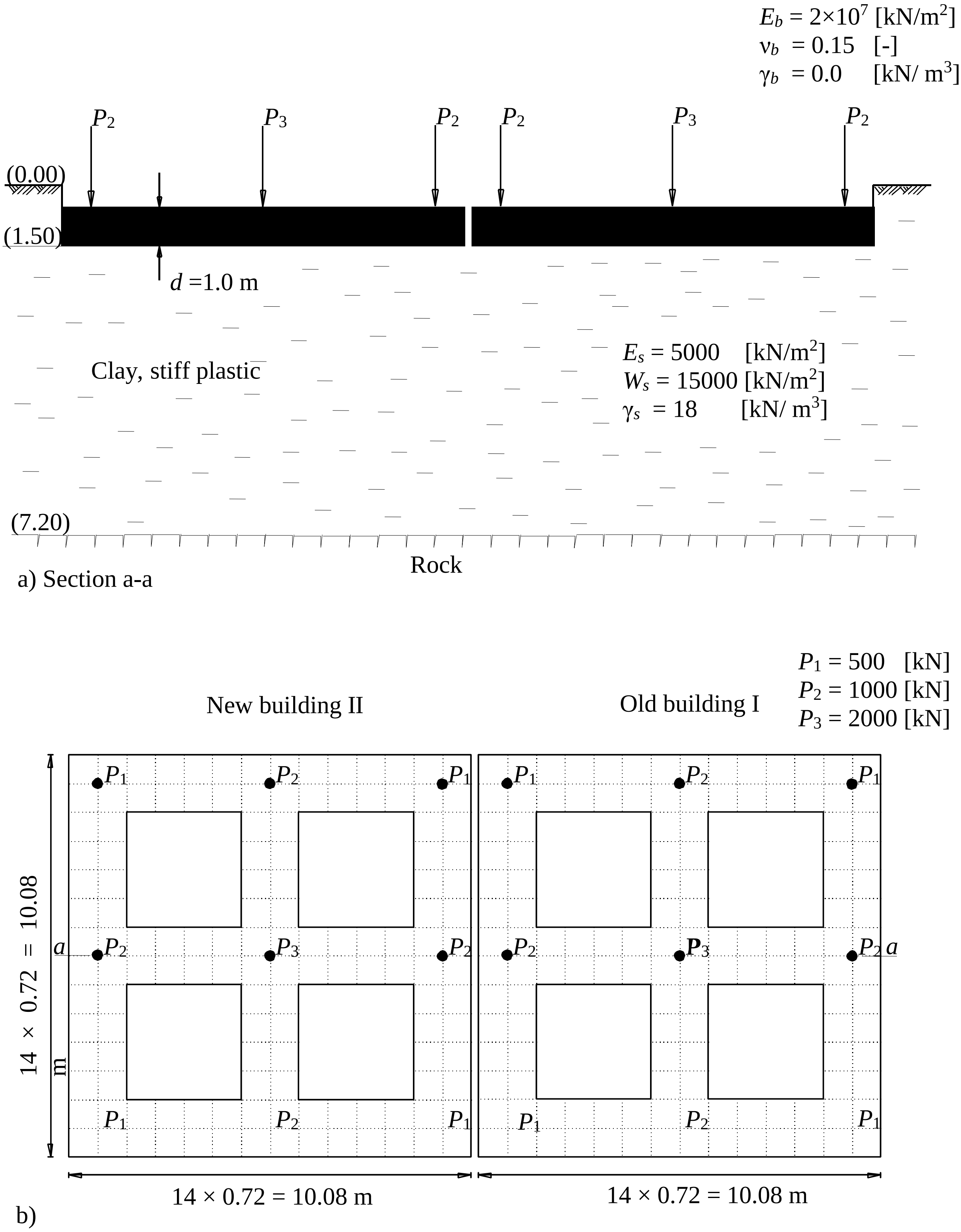
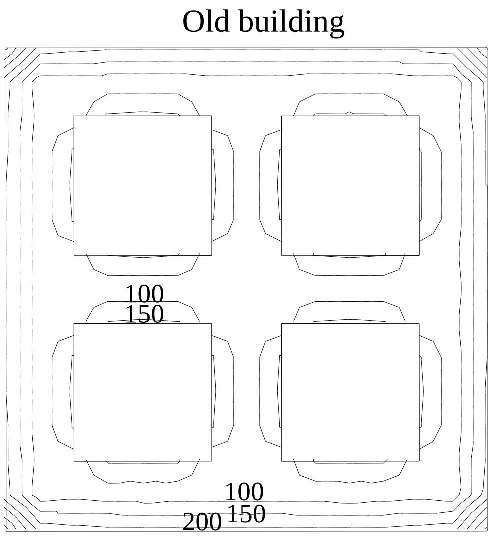
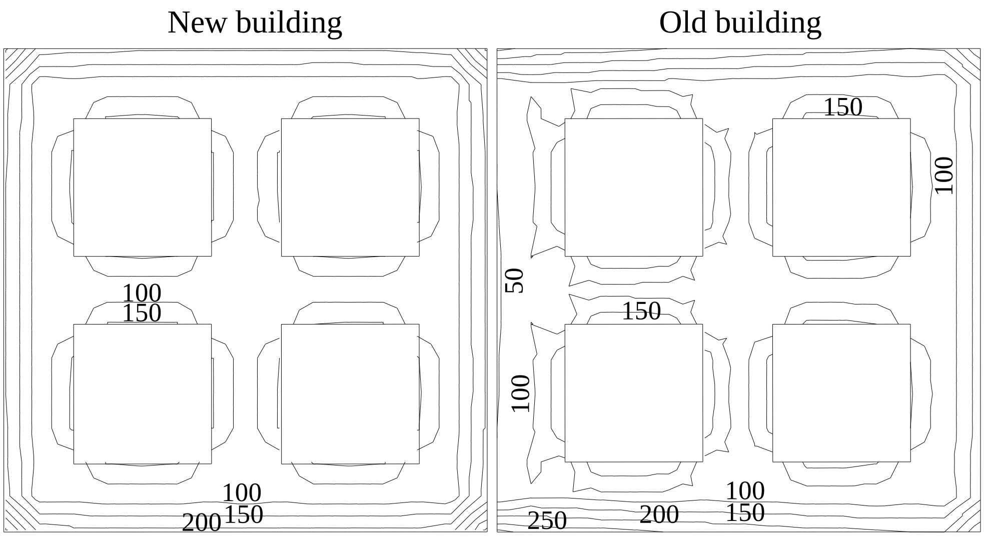


Figure 3.6 Action of new building II on the old building I



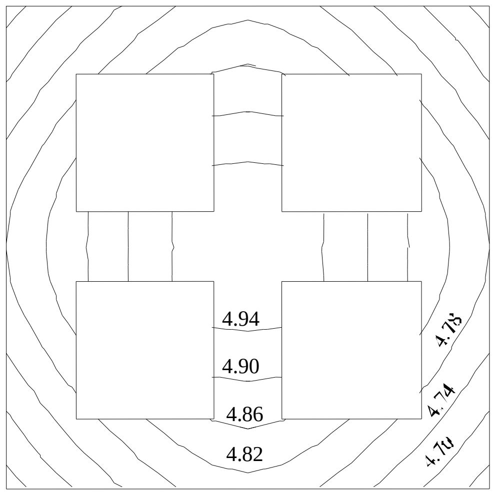
a) Only old building



b) New building + old building

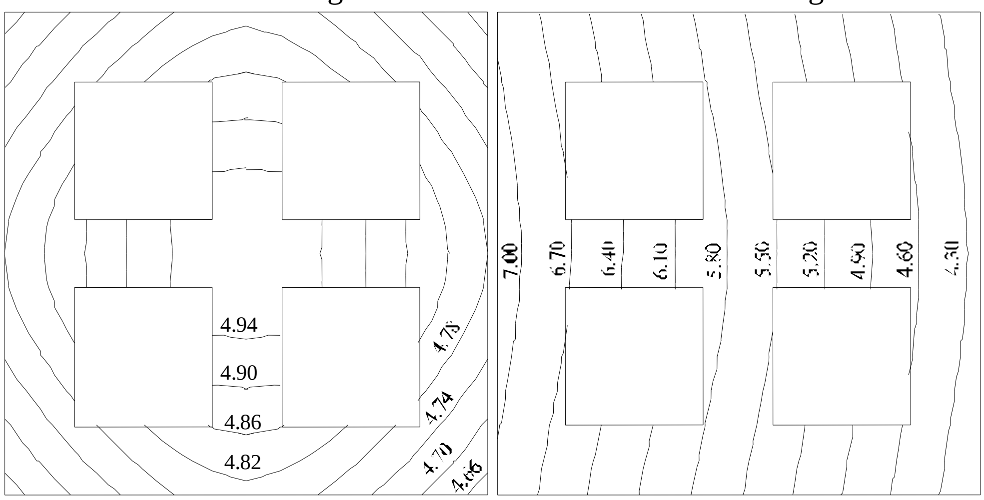
Figure 3.7 Contour lines of contact pressures [kN/m^2] under the new and old buildings

Old building



a) Only old building

New building Old building



b) New building + old building

Figure 3.8 Contour lines of settlements [cm] under the new and old buildings

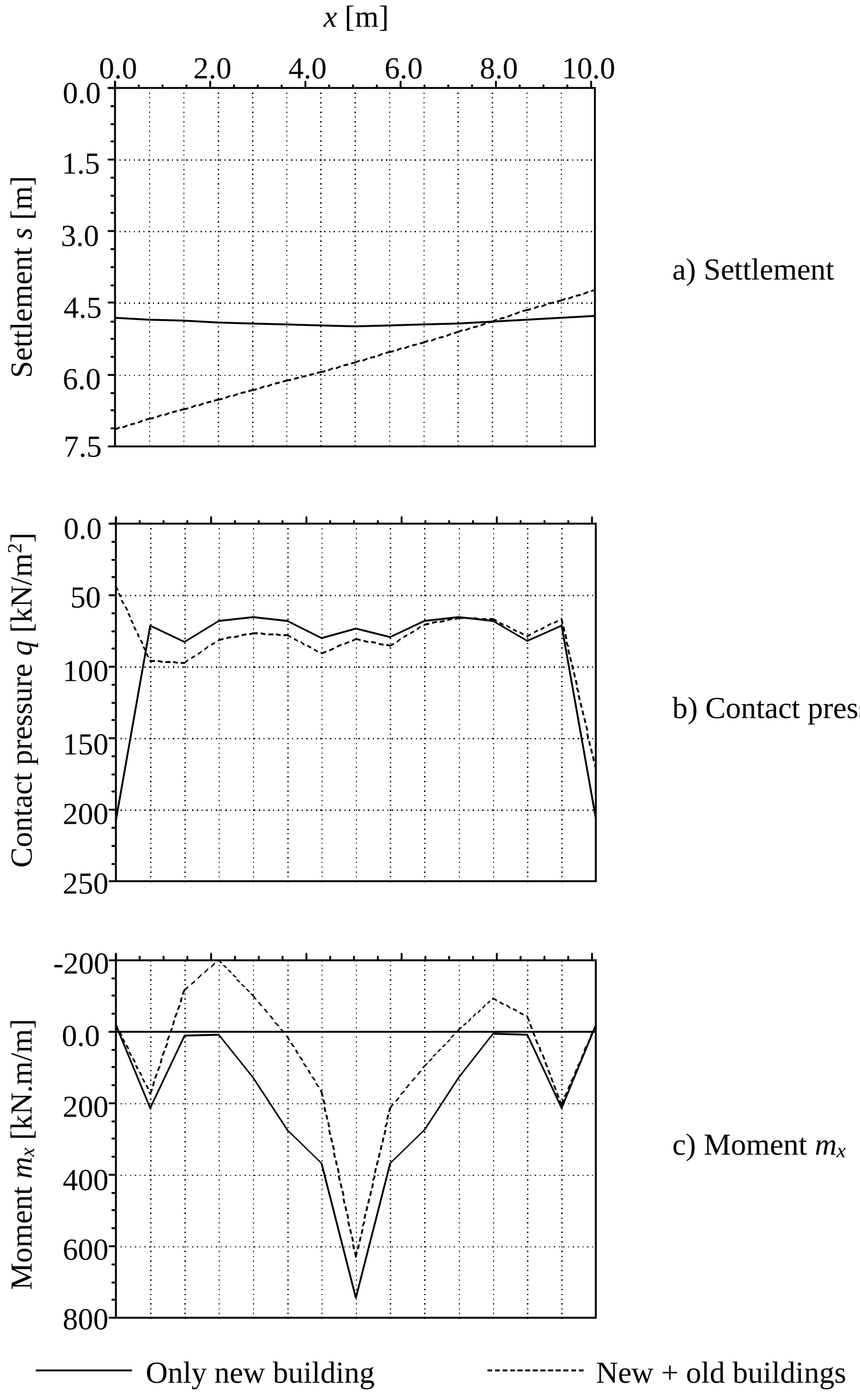


Figure 3.9 Settlements, contact pressures and moments at the middle of the foundation