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8. Strengthening the Foundations of a Building in Helsinki (Finland)

Owner: *Säästöpankkien Keskus-Osake-Pankki SKOP*
Architectural planning: *Järvinen Simo & Co.*
Structural planning: *Heiskanen RJ & Co. Ky*
Building contractor: *YIT-Yhtymä Oy*
Execution time: *13 months*
Execution year: *1986*

The main office of the bank SKOP, in central Helsinki, is a typical example of its period, the late 19th century. The building contains six floors and a subterranean level. The ground and first floors serve the general public, as customers of the bank, whereas the second, third, fourth and fifth floor contain offices. In the basement is a restaurant.

The foundations of the part of the building to be rebuilt stand on finely grained but firm earth. The building's ground sole consists of stone walls made from large natural stone. On top of the stone walls, laid brick walls continue, basically all the way up to the roof structure. The ceiling of the subterranean floor is made in the form of brick vaults between rolled steel beams. The intermediate floors and the roof structure are based on massive beams of solid wood.

The main reason for the rebuilding was to create open plan premises suitable for modern banking, covering an area of some 1000 m² on the bottom floor, with as few dividing walls and structures as possible. During the works, normal office procedures were to be conducted undisturbed in the other parts of the building. To achieve the open plan, the only alternative was to replace some of the old supportive brick walls with a structure based on pillars and beams. This was carried out using concreted steel beams. This gave architectonically pleasing beam solutions supported by slender pillers that require a minimum of floor space. The strengthening of the building structure at the level of the ground floor ceiling was carried out by means of a horizontal steel lattice which transferred the sideways stresses to the supportive wall structures along the edges of the new open plan space.

The stresses on the new pillars caused by the heavy superstructure of the house were remarkable varying individually between 1000 and 2650 kN. The transferring of such loads into the ground by means of the old ground structure was clearly impossible.

The structural changes thus required new foundations of the rebuilt portion of the building.

The alternative solutions discussed at the early planning stages consisted mainly of various methods of driving piles into the ground. Since the natural location of the pillars and the beams was along the old supportive walls, the driving of piles would have been a highly complicated process, since these would have had to pass through the old stone walls that were serving as the ground sole. The new foundation also had to ensure the safety of the massive brick walls of the upper structure, these being very vulnerable to sagging and vibration. Such considerations led to a solution where the stresses are led down to bedrock by means of steel piles, put down by drilling.

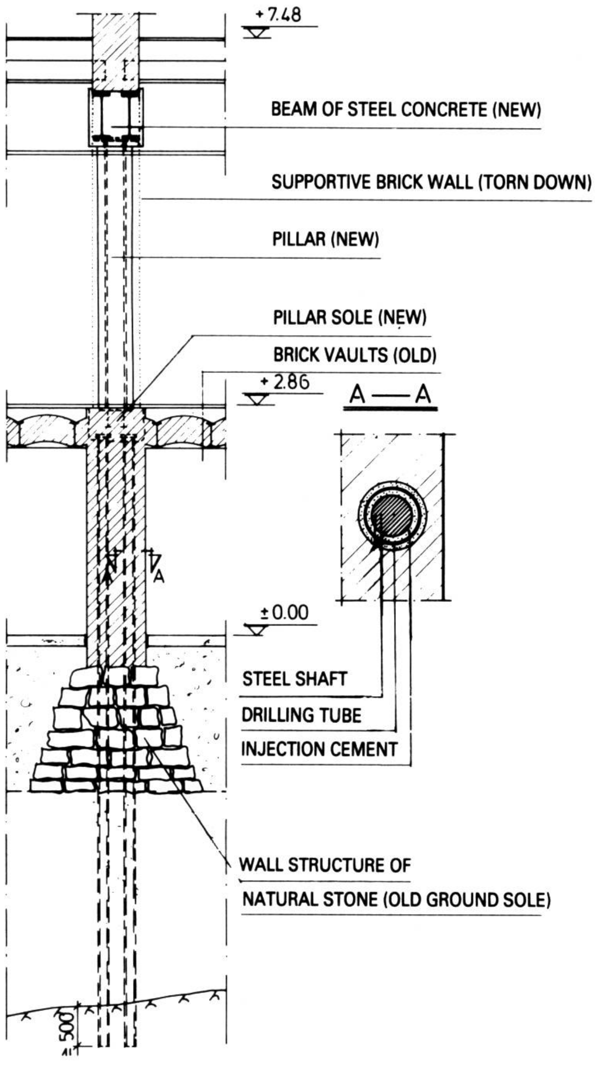

Fig. 1 Location of piling in the basement wall

According to the first plan, the piles were to be sunk from the subterranean level, with the pillar beam soles to be placed at the basement floor level, and the pillars of steel concrete placed within the existing brick walls. This would have involved considerable tearing down of brickwork, contrary to the wishes of the restaurant management, which had stressed the beauty and the rare qualities of the wall surface materials.

The solution finally adopted was that the piles were driven from the ground floor level, through and within the walls of the basement restaurant level. Fig. 1 shows the applied solution. Through excavations in the supportive brick walls, later to be removed, holes were sunk vertically through the basement walls. The drilling was continued through the old foundations of natural stone, and further down, each drilling to penetrate no less than

0.5 metres into solid bedrock. The tubes used in the drilling process, Ø 140 × 4.0, were left in position. The actual supportive piles, steel shafts, were then sunk into these holes, with each hole being filled with injection cement before insertion of the piles. Each steel concrete pillar is supported on a group of 3-5 such piles. The total length of piling was some 700 metres, with an average pile length of 7 metres, 2.5 metres of which was contained inside the brick walls of the basement restaurant. The piles were assembled on site from lengths of 1.5 metres, joined together by welding fig. 2.

The pile material was Ø 100 solid steel shaft with the tensile strength classification Fe 37 B (lower yield point limit 220 N/mm^2). The pile was dimensioned to form a slim supportive structure, with the surrounding earth as a flexible support. The permissible pile stresses thus achieved were 400 and 570 kN, depending on the length of the subterranean portion of each pile. The geotechnical supportive properties of such a pile is, according to Finnish regulations, 90 MN/m^2, which gives a permissible P value/pile (Ø 100 mm) of 707 kN.

To summarize the above, it can be noted that the amount of work carried out in the basement was less than originally planned. The valuable brick surfaces of the restaurant walls were left intact, and the casting of concrete pillars inside the walls was rendered unnecessary. The transfer of drilling equipment into the cellar would have involved dismantling much of the interior, and the height limits set by the cellar ceiling would have made it necessary to carry out the drilling operations in mere 600 mm stages. Furthermore, the required period for the restaurant to be closed for business was reduced.

(I. Varstela, P. Roitto, M. Haapala, M. Rasilainen)

Fig. 2 Through excavations in the supportive brick walls holes were sunk vertically through the basement walls.