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# Strengthening the foundations of the main building of Tartu University, Estonia

Renforcement des fondations de l'edifice principal de l'Université de Tartu, Estonie

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## Abstract

Strengthening the foundations of the Tartu University main building was done in 1995-1996. The work covered the central part of the building and was done by method of underpinning, using jacked steel tube piles. Strengthening work and archaeological diggings were carried out side by side during the project.

## THE UNIVERSITY BUILDING

The University main building was built in 1805 - 1807, after the University of Tartu was reopened in 1802 with a status of Russian State University.

Outer dimensions of the building are 36 m x 11-14 m with three floors above ground level and a cellar. The main hall of the building and the doric style columns of the main entrance reach up to the third floor level.

Massive brick walls and pillars rest on massive stonework at ground level and under. Massive stones are set over two to three layers of timber rafts which are supported on timber piles.

## PRE-WORK SITUATION

The building had slowly sunk due to lowering of the ground water level and the northern part of the building was already strengthened in 1977.

In early 1990's it was noticed that the situation under the central part was critical. In pre-work archeological diggings the wooden rafts were in some places totally rotten, leaving empty cavities at places they used to be. Especially the area of the main entrance needed immediate repair to avoid serious damages.

## UNDERPINNING WORK

Steel tube piles were jacked down under the structure, using the structure itself as counterweight. A field load test was performed as repeated load test on each pile and the rate of settlement was measured. Each pile was tested with  $P_t = 1.5 P_w$ . Archaeological diggings were carried out stage by stage ahead of the piling work.

Inside the building, massive pillars were supported against piles using steal beams, which were inserted through the old structure.

Thick external wall under the main entrance was not possible to dig underneath. The wall was supported both

sides with reinforced concrete beam  $h \times b = 2.0 \times 0.5 \text{ m}^2$  (figure 1). The old stone and brick masonry of the wall was injected and the beams were post-tensioned against the old wall. Each post-tensioned anchorage consists of seven plastic-sheathed greased strands (monostrand) SUP 1630/1860,  $A_s=140\text{mm}^2$ . Each anchorage was tensioned to 1350kN and confirmed to 1050kN nine months later.

Jacked piles  $\varnothing 218 \times 10$  were made under reinforced concrete beams. The permissible load for each pile was  $P_w=500\text{kN}$  and the load test/end wedged action was  $P_t=750\text{kN}$ .

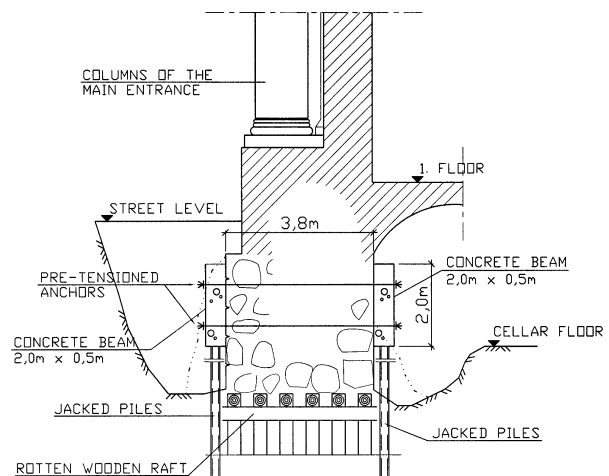


Figure 1. The principal of the work under the main entrance wall of the building.

## OBSERVATIONS

Movements of the old structures were closely measured during and after the work. Movements were relatively small and no real deformations appeared. The columns and the wall under the main entrance settled down 2...3 mm during the piling process, in other parts of the building movements were smaller.