Strengthening and underpinning the foundations of the Ministry of Employment and the Economy of Finland at Alexander Street No. 4 and 6

Renforcement et travaux de reprise en sous-oeuvre des fondations du Ministère de l'Emploi et de l'Économie de Finlande, rue Alexandre No. 4 et 6

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ABSTRACT

Strengthening and underpinning of the foundations of The Ministry of Employment and the Economy buildings in the capital Helsinki (formerly Ministry of Trade and Industry) was realised in several stages; first in 1981-83 for the building at Alexander Street No. 4, and furthermore, in two separate stages for buildings No. 6 and No. 8...10 of the same street (1985-91). For the purpose of this article the scope will be limited to the structural renovations at No. 4 and 6. The buildings were built in the 19th century, when Finland was part of the Russian Empire, and most were planned by famous architects of the time**.** They are located in the heart of what constitutes the Neoclassical architectural ensemble of Helsinki, and each one of them has a unique character and particular history.

Because of the high vehicle traffic near the buildings, the foundations had to be strengthened since they are partly lying on layered silty sand / silty clay, and partly on moraine or rock. In the initial stages of the work, underpinning was realised for a new basement for the building at Alexander Street No. 4, as well as for lowering the existing basement floor in other parts of the structure. Some years later, the project was significantly enlarged and some parts of bedrock were blasted away for the newly planned archive space, also extending underneath the premises of Alexander Street No. 6. The work covered design of temporary and permanent structures (steel and concrete), geotechnical and structural design of the foundations, blasting design, as well as the design of all concrete structures from basement up to the ground floor.

RESUMÉ

Le renforcement et les travaux de reprise des efforts en sous-oeuvre des fondations des édifices du Ministère du Travail et de l'Economie dans la capitale Helsinki (Précéd. Ministère du Commerce et de l'Industrie), ont été réalisés en plusieurs étapes. D'abord en 1982-83 pour l'édifice au No. 4 de la rue Alexandre, puis en deux étapes pour les edifices du No. 6 et No. 8 à 10 de la même rue (1985-91). Cet article se limite aux renovations structurales des No. 4 et 6. Ces édifices ont été érigés au XIXième siècle, durant la 'période russe' de Finlande, et furent pour la plupart planifiés par des architectes renommés de leur temps. Ils sont situés dans ce qui constitue l'ensemble architectural de style néo-classique d' Helsinki, et chacun d'eux possède son histoire et caractère propres.

En raison de l'importante circulation de véhicules près des édifices, les fondations furent renforcées dû au fait qu'elles reposent sur une couche de sable limoneux / argile limoneuse et partiellement sur de la moraine et du roc. Dans la phase initiale des travaux, le renforcement et la reprise des efforts en sous-oeuvre ont été faits pour un nouveau sous-sol au No. 4 e la rue Alexandre, ainsi que pour abaisser le sous-sol existant dans d'autres parties de l'édifice. Des années plus tard, l'étendue du programme fut augmentée significativement, et des secteurs de roc furent excavés afin de faire place à un espace d'archives s'étendant aussi sous l'édifice du No. 6 de la rue Alexandre. Les travaux ont couvert la planification et le réalisation de structures temporaires et permanentes (acier et béton), plans géotechniques et structuraux des fondations, planification des excavations par explosifs, ainsi que le design de toutes les structures en béton du sous-sol jusqu'au rez-de -chaussée.

Keywords: strengthening, underpinning, blasting, stiffening gel

1 HISTORY

Helsinki has witnessed many changes since its foundation by the Swedish King Gustav Vasa in 1550. The city center was moved to its current location one hundred years later, and at that time consisted of a town square, town hall, church and cemetery. Following the Great Northern War and the destruction of most of the city, merchants began in 1721 to build the first residential buildings alongside the square and what is known today as Alexander Street. As a result of the war of 1808-1809 between Sweden and Russia, Finland was ceded by Sweden and annexed to the Russian Empire as an autonomous grand duchy. Also, a great fire ravaged the city center in 1808, and the original buildings situated at Alexander Street 4 and 6 were totally lost. Helsinki became the capital of the grand duchy in 1812, and a new town plan was devised by the army officer Johan Albrecht Ehrenström (1762-1847).

Figure 1. Alexander Street No. 4 today.

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After his tour of major cities in Europe, it was the German architect Carl Ludvig Engel (1778-1840) who was chosen to implement the plan and draw the new buildings which constitute one of the finest Neoclassical ensembles in Europe today. The buildings at Alexander Street 4 and 6 are situated in the vicinity of the Senate Square and follow the guidelines of the city's town plan (figure 2).

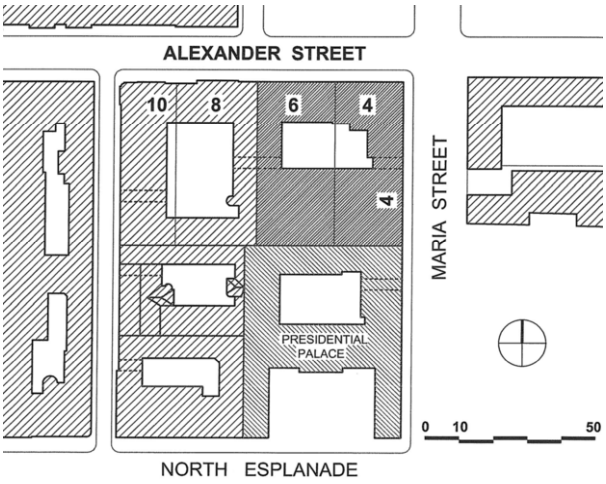

Figure 2. Site plan.

It was Engel himself who had planned a 3 storey building at Alexander Street No. 4. However, in the 1820's the residential structure was built, but not in accordance to the architect's drawings. In 1856, a building with a festive hall was erected at the location of the stables. In 1880's the owner and merchant C.O. Lindström added a third storey to the building while changing the facade to neo-renaissance style. It was in 1812 that a two storey stone building was planned for Alexander Street No. 6 by L. Wannberg. It was however built with 3 stories and maintained its original appearance until 1915. In 1864 the lithographer Liewendal built a 2 storey building which consisted of a warehouse, a residence and an atelier on the property. In 1886 the first privately owned Finnish pawn shop opened its doors on the premises. 10 years later, the state acquired the building and combined it with its neighbour No. 4 for a number of governmental agencies. Liewendal's building was dismantled except for the external walls.

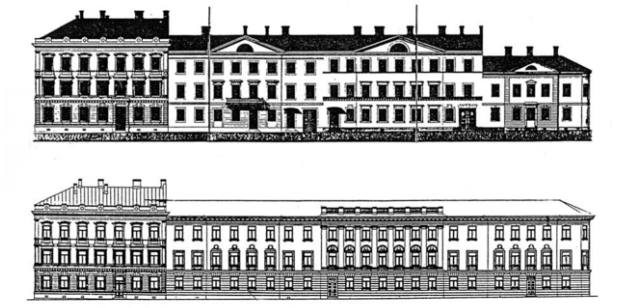

Figure 3. Original facades of Alexander Street and remodelling of 1915 unifying No. 6, 8 and 10.

Renovations in 1913 expanded the premises of Alexander Street No. 6, and in 1915 the facades of the 3 contiguous state addresses were redesigned as a whole, in a uniform Neoclassical style (figure 1 and 3). The current aspect of the ensemble dates from the 1930's when buildings opposite to Alexander Street 4 and 6 were torn down. Around the two courtyards additional functions were grouped in an effective plan. Some of the halls and rooms of the old merchant homes were preserved on the street sides, and parts of the original basements also were kept.

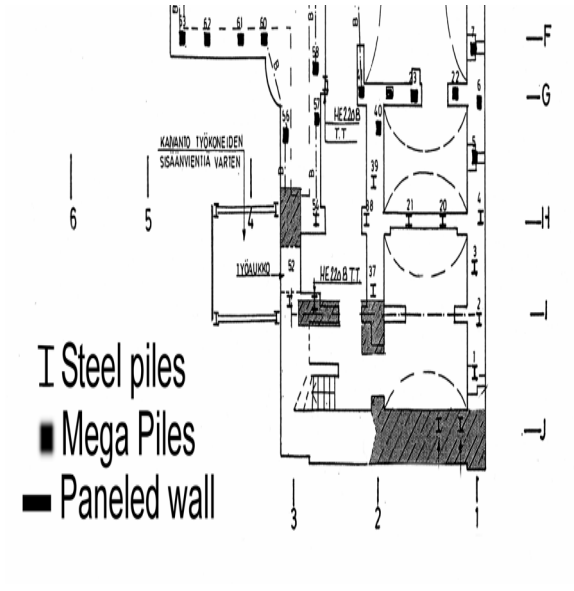

Figure 4. Underpinning plan for the building at Alexander Street 4.

2 FIRST STAGE: ALEXANDER STREET NO. 4

The ground engineering duties covered geotechnical and structural designs of temporary and permanent structures. These designs were implemented for foundation work as well as for concrete structures from the basement up to the ground floor level.

The most important area of the building at Alexander Street 4 was founded on silty sand layer under which is a significant layer of silty clay. The vibration cause by the surrounding traffic was measured in different parts of the structure at a maximum velocity of 10 mm / sec. It was on the basis of this study that the decision to strengthen the foundations was taken. For the part of the building which was resting on a smooth area, walls were underpinned with jacked steel piles and concrete Mega Piles comprising of a section of 30 x 30 cm (figure 4). As for the wall parts of the building which were resting over a hard area, they were paneled (cast in place concrete). The piles situated under the facade walls where the particule velocity was highest (most important traffic vibrations), were jetted. In fact these were the first Mega Piles to be jetted in Finland. Every pile was subsequently tested for characteristic load (serviceability limit state) and the results proved more than satisfactory.

Figure 5. Elevator shaft with exposed underpinned foundation behind.

3 SECOND STAGE: ALEXANDER STREET NO. 4 AND 6

On the side of the common courtyard of Alexander Street 4 and 6, part of the wall was underpinned with Mega Piles. The reason for this was the opening of a back wall to make way for a newly planned connecting corridor as well as a service elevator shaft (figure 5). The base slab of the elevator being lower than the floor slab, the pile depth had to be extended accordingly. The additional bearing capacity needed from the piles was compensated by the injecting of the pile tips with a stiffening gel obtained by mixing sodium silicate with calcium chloride.

Figure 6. View of pretensioning device.

Under the building at No. 4 of Maria Street (same building as Alexander Street 4) it was necessary to make adequate space for the new archival depository of the Ministry. For this assigned area, the floor level had to be lowered and the existing supporting structures reinforced or replaced. Some of the old concrete supporting walls had to be removed and replaced by new reinforced concrete columns. Also, a layer of between 1 and 2 meters of bedrock had to be blasted. In one instance, to avoid structural collapse, a special procedure was devised. This consisted of pretensioning on its whole length a supporting wall with anchored tension bars, as well as pretensioning laterally the rock beneath it (figure 6 and 7). Removal of the old concrete wall proceeded incrementally with a diamond boring machine. This was realised in alternation with casting concrete for the new concrete columns.

4 CONCLUSION

Amongst others, the delicate interventions of special blasting within built premises were carried out with minimal damage, and only of a superficial nature. This was sustained during the whole period of the work because of the precautions taken. In most instances, temporary supports as well as pretensioned structures were used. The important pilling work was also carried out successfully. This challenging work was kept within budget and constitutes a contribution to the preservation of the national heritage, the buildings being part of the famous Neoclassical architectural ensemble of Helsinki.

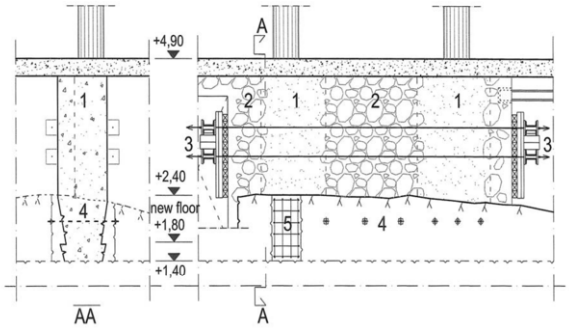

Figure 7. Pretensioned wall during work: 1-Old concrete pilaster 2-Bolder fill 3-Pretensioning device 4- Tensile rods in rock 5- New column section.

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