



BIOMAA

Rudus

RAMBOLL

LIFE09 ENV/FI/575 ABSOILS

Technical report of piloting 2011



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Table of Contents

| | |
|-----------------------|----|
| 1. Introduction | 3 |
| 2. Arcada 2 | 4 |
| 3. Jätkäsaari | 9 |
| 4. Conclusion | 12 |



LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

1. Introduction

Technical report of piloting 2011 presents the results of the pilots finished during 2011. Two pilots were finished in 2011; Arcada 2 and first part of Jätkäsaari.

In Arcada 2 stabilised abandoned soft soil was used as a light weight structure. The structure was designed to replace an old embankment floating over clay layer. Test stabilisation in the area was performed in December 2010 and the construction work was performed from April 2011 till the end of August 2011

In Jätkäsaari dredged sediments were solidified by mass stabilisation technique. The area is a pre-construction area where the uncontaminated dredged sediments are utilised in the fillings and the contaminated sediments are being treated on the area. The stabilisation work was performed during April and May 2011.

More detailed descriptions of the pilots are presented in the following chapters.



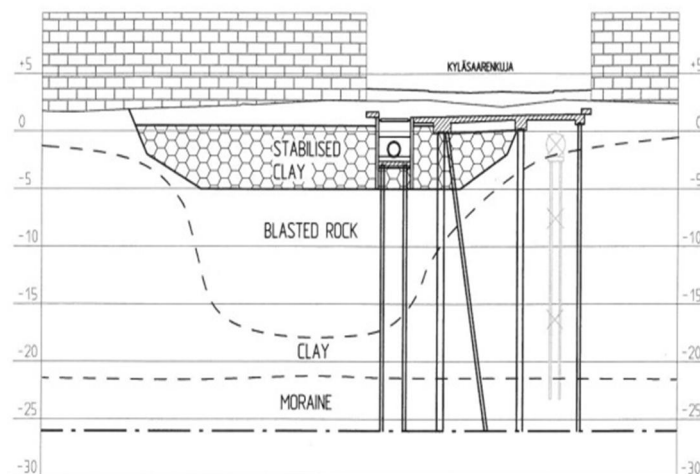
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2. Arcada 2

In Arcada 2 stabilised soft soil was used as a light weight structure. “Light weight” material means in this case that the material was lighter than the existing material (blasted rock), which was being replaced. The materials are located under seawater level, and because of the buoyant force stabilised clay is much lighter than blasted rock which was excavated out before the stabilised clay was used.

Arcada 2 is located in the Kyläsaari area of Helsinki (see the location in [Error! Reference source not found.](#)). The area had low stability and load bearing capacity. The site was originally filled from the sea with blasted rock in 1960's. The original aim was to displace the existing clay with blasted rock to create a foundation for a new highway. However because of the deep clay layer and difficult circumstances the mass exchange failed leaving the blasted rock to float on top of the clay layer. The route of the highway was also changed and the area was left for secondary use for decades. In the 21st century the development of the area has begun.

In the Arcada 2 project the aim has been to improve the area for construction use by removing contaminated soils, lightening the blast rock structure, installing steel-pipe columns for a pile beam structure on the road Kyläsaarenkuja area to stop the lateral expansion caused by the blast rock structure. The Absoils project includes only the construction stabilised “light weight” structure. A cross section of the embankment and the site is presented in Figure 4.





LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

Figure 1. Arcada II cross sectional cut of the site with stabilised clay and steel-pipe columns. Houses are built later on both sides of the road.

In the Arcada 2 the old structure material (blasted rock) was dug out from the floating embankment and abandoned soils were put to replace the rock aggregate. The density of the abandoned soils was decreased by adding water and the soils were stabilised on site with mass stabilisation machine. Test stabilisation in the area was performed in December 2010 and the construction work was performed from April 2011 till the end of August 2011.

Before the construction work begun, laboratory tests were made on the abandoned soils deposited on site to determine the optimum water content to achieve the optimum density and to determine the suitability of the materials for stabilisation. Stabilisation tests were done for the clays used in the stabilisation. On the basis of the results of the material tests one material was not used in the project because of the poor results on the stabilisation tests. The results of the laboratory tests are presented in the Absoils report "Intermediate materials report". The laboratory tests were also a part of the quality control of the stabilisation.

The stabilisation on Arcada was done by Absoils beneficiary Biomaa Oy as a subcontractor for VRJ Group Oy. On the first stage a test stabilisation was made in order to study the properties of the abandoned clay, the needed binder amount and the suitability of the stabilised clay for a light weight structure. The actual stabilisation was made on the basis of the findings in the test stabilisation.

The steps of the stabilisation in the Arcada 2 site were the following ones:

- Acquiring and transporting the abandoned soils (clay) to the stabilisation site including the logistics and the quality control of the soils.
- Acquiring and transporting the binder (cement) to the site and short term storage of the binder on site.
- Feeding the binder to the abandoned soils (stabilisation) and the quality control during the work
- The quality control of the stabilised structure

The stabilisation was done on 10 separate stabilisation basins. The total volume of the stabilised abandoned soils is about 32 000 m³. The soils were stabilised with Portland cement using 100 kg of cement on one cubic meter area. The cement supplier was Finnsement Oy. The areas and volumes of the basins and the binder amounts are presented in



LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

Table 1.



LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

Table 1. Stabilisation basin areas, volumes and used binder amounts.

| Stabilisation basins | Surface area [m ²] | Stabilised volume [m ³] | Binder amount [tonnes] | Date of stabilisation |
|----------------------|--------------------------------|-------------------------------------|------------------------|-----------------------|
| Basin 1 | 950 | 3400,0 | 340,00 | 4.4–8.4.2011 |
| Basin 2 | 300 | 1487,5 | 148,75 | 11.4–12.4.2011 |
| Basin 3 | 630 | 2860,0 | 286,00 | 12.4–14.4.2011 |
| Basin 4 | 220 | 1020,0 | 102,00 | 15.4–18.4.2011 |
| Basin 5 | 725 | 3397,5 | 339,75 | 2.5–4.5.2011 |
| Basin 6 | 360 | 1610,0 | 161,00 | 11.5–12.5.2011 |
| Basin 7 | 815 | 3835,0 | 383,50 | 1.6–7.6.2011 |
| Basin 8 | 901 | 4340,0 | 434,00 | 8.7–14.7.2011 |
| Basin 9 | 1260 | 6150,0 | 615,00 | 2.8–9.8.2011 |
| Basin 10 | 460 | 2119,0 | 211,00 | 9.8–16.8.2011 |
| Test stabilisation | 542 | 1725,0 | 175,95 | 2010 December |
| Total | 7163 | 31935,0 | 3196,95 | |

The stabilisation begun with abandoned soils from the Helsinki ring road 1, which had been proven to be suitable on the test stabilisation. Samples of the clay were taken before the transportation for analysis in the laboratory and also the water from the stabilisation basins were transported to the laboratory. The used laboratory was Absoils beneficiary Ramoll Finland Oy Luopioinen unit. The results of the laboratory tests are presented in the Absoils report "Intermediate materials report 2011".

The laboratory studies tested also the tolerance limits of the abandoned soils so that the density of the clay would be about 1500 kg/m³. The density was modified with the water that was taken from the stabilisation basins. When the water content of the soil was between 83–93 % the density of the material was about 1500 kg/m³.

The clay was transported to the site with articulated lorry and transported mainly by dumping the clay in to the stabilised basins or to the sides of the basins. Excavator was used to assist in the transportation of the clay. The scoop of the excavator was used in "loosening" the clay when the clay was transported. The aim of the loosening was to spread the clay evenly and to achieve the targeted density. Before stabilisation the abandoned soils was premixed with the mixer attached to the excavator and samples from the premixed soil was taken from every basin. The water contents and the densities of the samples were determined on site and from the basin number 3 the sample was send also to the laboratory in order to find out any differences between the laboratories. The results of the laboratory compared with the results



LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

from the site were similar and caused no further actions. The stabilisation of the abandoned soil is depicted in Figure 2.



Figure 2. The stabilisation on Arcada 2

Quality control soundings were done for the stabilised structure after the stabilisation. The results of the soundings are represented in the [Absoils Verification report](#).



LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

3. Jätkäsaari

Jätkäsaari is a whole new living area, which is being built to Helsinki on an old container harbour area. The area has originally been a group of islands (Jätkäsaari, Hietasaari and Saukko) and the sea area between the islands and the continent has been filled in 1930's, creating a peninsula. The area was originally built for the harbour area, but since the harbour moved to Vuosaari in 2008 the area has been freed for other purposes. The construction work in the area consists of dredging the sea area, building parks, roads and bridges and eventually houses on the area.

In Jätkäsaari the aim on the Absoils project was to solidify contaminated dredged sediment fast with mass stabilisation technique. The dredged sediments were deposited in three basins about the size of 40 m x 80 m and about 2,5–3,0 meters deep. The basins were not the final deposit for the sediments but only a treatment area from where the sediments were moved elsewhere.

The challenge of the pilot was to stabilise all of the sediments deposited in the basins. In order to mass stabilise the total amount, the access of an excavator the size of 30 tonnes on the basins was necessary. This meant that the stabilisation needed to be stable enough to carry the weight of the excavator. The stabilisation on Jätkäsaari is depicted in Figure 3.



Figure 3. Stabilisation work on Jätkäsaari.



LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

The needed binder amount to achieve the stability was studied in laboratory (Ramboll Finland Oy) and constructor (Biomaa Oy) used the binder amount recommended by the developer the city of Helsinki on the basis of the laboratory tests. The used binder was Portland cement and the amount was 60 kg/m^3 . The results of the laboratory studies are presented in "Intermediate materials report 2011" of the Absoils project. In addition to cement also other binder options were tested but cement was used because the environmental permit of the site prevented the use of industrial by-products as binders.

The stabilisation begun with preparations which included the removal of larger pieces of blast rock from the sides of the basins, the rounding-out of the slopes leading to the basins and making a refilling station for the binder. The preparations began on 11.4.2011.

The stabilisation work began 13.4.2011 from basin number 1 according to the principle presented in Figure 4. The sides of the basin were stabilised first on 5 m x 5 m area using the supportive banks of the basin. After the stabilisation a geotextile and loading embankment was spread on top of the stabilised layer to create a platform for the excavator. The stabilisation work succeeded from the outer limits of the basin towards the middle of the basin.



Figure 4. Stabilisation work on basin 2 (in front right corner of the picture one can see the loading embankment and geotextile and on the back of the picture is the stabilisation machine running, leaving the un-stabilised mass in the middle).



LIFE09 ENV/FI/575 ABSOILS – TECHNICAL REPORT OF PILOTING 2011

4. Conclusion

The stabilisations in Arcada 2 and Jätkäsaari were successful and no larger problems were encountered during the projects. On both sites good strength properties have been gained and it can be said that the quality of the soils as construction materials have improved. The results of the quality control studies of all of the pilots made in the Absoils –project are presented in "Verification Report" of the Absoils project.