Reconstruction of old quay walls in the Port of Rotterdam

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Henk Voogt has started his career in the design and construction of quay walls and has since 2001 worked as asset manager marine structures at the Port of Rotterdam. He is in this position among others from the beginning involved in investigating and solving the problem of corrosion in Rotterdam as well as in the development of the asset management tool KMS.

Summary

The Port of Rotterdam dealt with the question how to preserve the old fashioned look of quay wall from the last century and meanwhile guarantee the structural integrity.

Keywords: quay walls; reconstruction; soil loss; detoriation

1. Introduction

The quay walls in the center of Rotterdam are old. A number of them were built in the nineteenth century. The total length is 4 -5 kilometer. They are built on timber piles with a timber floor and a brick wall of basalt. As the years passed by the floors will detoriate causing sand to run away. That caused increasing settlement of the pavement behind the quay wall. For about 10 years the maintenance works on the quay walls increased more and more. Since then there were no more activities in loading and unloading ships at these quay walls (only mooring facilities). First plans were made to replace the quay walls by basalt embankments. The municipality wanted to preserve the visual aspect from these quay walls and granted a budget for the renovation of the city walls. This program is one of the longest-running investment projects within the Port of Rotterdam. In 2003 the program started with the Maaskade. The Port took successively since then every year a quay wall under construction. After the Maaskade followed Antwerpse Hoofd, the Feyenoordkade, Oosterkade, Westerkade, Willemskade, Boompjeskade and now the Parkkade. The refurbishment is of quite different nature. At one quay wall it was sufficient to put geotextile on the wooden floor. In another case the soil loss was made impossible by a concrete floor. Bottom line is that every quay wall has been examined to find the most appropriate method of repair. The soil loss has to be stopped in the most efficient way without losing the visual aspects.

2. General description

2.1 The problem

At the beginning of this century the Port of Rotterdam started to investigate the reconstruction of several old quay walls at the Maaskade and Antwerpse Hoofd in the centre of the city of Rotterdam. This was caused by increasing corrective maintenance that had to be executed due to several unexpected settlement of the soil behind the quay wall. Several causes for this soil loss were discovered. Main causes were detoriation of wooden floors, deformations differences in construction parts, scour caused by trusters of ships, differences in water level in front and behind the quay wall and roots of trees growing along the quay wall that penetrate in the wooden floor. The urgency was even more emphasized by the plans of the municipality of Rotterdam to refurbish the outdoor environment. The refurbishment made it necessary to do the reconstruction of the quay walls, before the work on the outdoor infrastructure. For this reconstruction several alternatives were available.

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2.2 Solutions and alternatives

For the reconstruction several alternatives are available to solve the problems described above.

2.2.1 Replacing the quay wall with an embankment

The quay wall and the mooring system are being demolished including the wooden floor. Only the wooden piles are kept in place. After that an embankment with natural rock material is being constructed. A disadvantage of this method is the loss of mooring space for ships and the fact that more space is needed for this type of construction. This results in a reduction of the width of the river and a reduction of the outlet capacity of the river.

2.2.2 Sealing the wooden floor with a geotextile.

This method starts with excavating the soil behind the top wall to the topside of the wooden floor. After fixing a geotextile to the wooden floor, this will prevent the geotextile from moving concrete tiles are placed on it. The geotextile is mounted to the top wall by using a steel strip.

2.2.3 Constructing an arch over the excisting structure

In this solution a concrete floor is built about 1,50 meter below street level. That is just above the ground water level. The space above the new floor is needed and use for cables and pipes and for tree roots. The floor will be founded on the waterside on the top wall and on landside on new placed tubular steel piles.

2.2.4 Replacing the quay wall with a new quay wall

The last method is the most radical one, namely demolishing the existing quay wall and build a new one. The new construction will be a steel sheet pile wall with a anchor system. If needed for the visual aspects, there is a possibility to mount prefabricated elements in front of the steel sheetpile. So the “old look” of the quay wall is preserved.

2.3 Ranking the solutions

Once the alternatives have been engineered and the cost estimation has been done, it is time to find the most effective and efficient method for the quay wall in question. To do so it is necessary to look at different aspects. These are: remaining lifetime after reconstruction; costs; risks during construction; maintenance costs; nuisance for environment and residents; mooring facilities; visual aspects and influence on the river

3. Conclusion

From the above the conclusion can be drawn that solutions with an embankment construction are relatively cheap in building and maintaining and have relative long lifetime. In addition there are no severe risks involved. On the first hand these alternative seem to be the best options.
When the disadvantages are taken into account, this solution is not so good. The construction type needs a lot of space, the visual aspect changes completely and the mooring facilities will disappear. The other alternatives do not have these disadvantages but these alternatives are more expensive or have a shorter lifetime or have many risks during construction and in maintenance. The best option will be different for each location. Local circumstances will highly influence the choice for a method.