Flood proof architecture

Concepts and constructive solutions to adapt to rising water levels

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Introduction

Soil compaction and subsidence, urbanisation and climate change increase the vulnerability of (urban) areas to floods. The government is going to invest heavily in the necessary knowledge development, to be able to face climate change.

For this task, the building trade can and should make a crucial contribution with new concepts of ''building with water'. Especially in highly populated areas, living with water may be a sustainable adaptive solution for future challenges. More and more Dutch designers are getting into 'flood proof' architecture. This has already led to a whole range of concepts and constructive and non-constructive solutions. Noticeable examples of building methods are: floating construction, amphibious construction, construction on piles, elevated construction, dry- and wet proof construction. Practical examples are floating- and amphibious houses, platform houses, artificial islands or reefs, floating offices and floating greenhouses. These items are the specialism of Dura Vermeer, a construction and development company in the building industry. This article illustrates some of their concepts.

Floating greenhouses

Floating greenhouses offer the opportunity to combine two functions on the same square metre: greenhouse horticulture and water storage. There is an increasing demand for this multiple use of space, because space in The Netherlands is restricted, while the demand for living-, working- and recreational locations is increasing. In the years to come many tens of thousands of hectares will be used for water storage, taking up valuable space. Creating space for water storage is not simple in a densely populated country as the Netherlands. Combining water storage with an economic function may more easily create the necessary space.

The concept of floating greenhouses has been developed from the idea that it contributes to the solution of spatial limitations that arise from the redevelopment of greenhouses and will create space/ room for water storage.

A pilot project for a floating greenhouse is to be realised in the province of South-Holland. The lowest point of The Netherlands is situated in this area: 6,76 metre below NAP (NAP = about average sea level). The idea is to plan an area where a pilot project floating greenhouse can be realised on a commercial basis. The pilot will be an example of a sustainable development of glasshouses combined with water storage. Apart from the development of a floating greenhouse, the business case also comprises a research programme covering the environmental effects. A public-private partnership has been working on the business case for two greenhouse growers since 2005. In 2012 we hope to finally celebrate the opening of the five hectares floating Greenhouse: the Floating Roses.

First - built floating greenhouse in the world *- Demonstration version, municipality of Westland (photos: Dura Vermeer).*

***Amphibious homes** (photos: Dura Vermeer)*

***Impression of a residential district on water** (source: Knowledge Project Bouwen met Water)*

Amphibious and floating homes

Unlike the houseboats that line many Dutch canals or the floating villages of Asia, these amphibious homes are being built on solid ground — but they also are designed to float on flood water. They look much like regular houses; the only difference is that when the water rises, they rise.
Each house is made of lightweight wood, and the concrete base is hollow, giving it ship-like buoyancy. With no foundations anchored in the earth, the structure rests on the ground and is fastened to 15-foot-long mooring posts with sliding rings, allowing it to float upwards in times of flood. All the electrical cables, water and sewage flow through flexible pipes inside the mooring piles.

Realisation in Maasbommel

The desire to integrate water management issues in the Netherlands in sustainable spatial planning, has led Dura Vermeer to translate this aim into the development and realisation of 32 amphibious and 14 floating houses in Maasbommel in the Province of Gelderland. The houses are the solution to the demands for living-, working- and recreational space and the need for a sound and sustainable water storage. The location in Maasbommel is just outside the dyke ring in a water recreational area, connected with the river Maas. Recent flood events and the subsequent strengthening of the dykes in the river basin have led to the development of houses by an entirely new concept: houses that will float at high water. In order to enable the houses to move with the fluctuating water level, the houses are fixed on concrete floating platforms with a suspension mechanism. At a low water level, the houses rest upon a foundation of concrete. To keep the houses as light as possible the framework consists of timber. To prevent the houses from floating away at high water they are fixed to flexible moorings, with which tugs can be absorbed. It is expected that once every five years the water level will rise so much (over 70 centimetres) that the houses will indeed float. The houses can cope with a water level difference of up to 5,5 metres. That is above the height of the top of the levee.

Residential district on water

In the framework of expertise development, Dura Vermeer made a design for a residential district on water, applied to a pilot location in the low-lying polder Haarlemmermeer, south west of Amsterdam. In this concept, urban functions are integrated with water retention and storage. The result is an environment that not only respects the water system level, but moreover, creates a high-quality living environment and a net saving on space. To answer questions about the feasibility of a pilot residential district on water, a study is to be carried out. This study will show under what circumstances a residential district on water in the Haarlemmermeer is likely to be successful. Based on this, the parties involved can decide whether they want a pilot residential district on water. The developed expertise on the possibilities to combine water storage and construction will first be applied to the Haarlemmermeer. However, since this expertise is also applicable elsewhere, ideas for other locations can also be submitted.

Conclusions

In recent years, the knowledge and experience in the field of flood proof construction has increased strongly. It is an issue, which is not only relevant to the Netherlands, but has also been taken up by other countries. Some remarkable examples of practical applications have been realised, from which learning points are being shared. These experiences are subsequently used in developing the expertise and concepts further and its translation into daily construction practice. This means that expertise is now available for modelling damage because of flooding, construction concepts have also been elaborated, which are based on a sound financial footing, situation-specific and solutions offered and cost-benefit analyses made.
The concepts of flood proof architecture can be an efficient method for adapting to the potential impacts of climate change.

Websites

www.duravermeerbusinessdevelopment.nl
www.bouwenmetwater.nl
www.drijvendekas.nl
www.floatingroses.nl

English language websites

Flexbase: www.flexbase.eu
Floodprobe-Project: www.floodprobe.eu
Urban flood management, Dordrecht city: www.ufmdordrecht.nl