Building on water: design projects using aluminium structural elements

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Summary

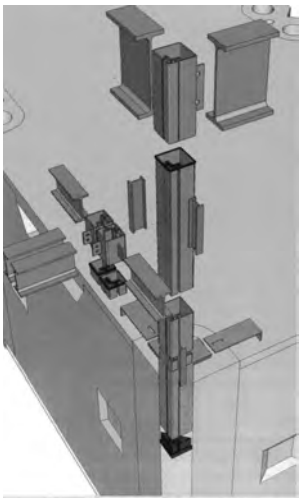
In the last decades design initiatives have been taken in The Netherlands regarding building on water. Three design projects, incorporating aluminium as the main structural material, are shown in the paper. The projects include a floating building, a floating road and a floating connection between building and road. The building and the connection are worked out on designers level, while the road has also been calculated and tested in practice. Aluminium is concluded to be a suitable material for building on water due to its typical material properties.

Keywords: building on water, floating structures, aluminium structures.

1. Introduction

Building on water is gaining popularity in the last decades. This development is encouraged by changing environmental conditions. Within the discussions on the effects of changing climate some design initiatives have been taken in building on water. Three projects using aluminium structures are worked out in the paper.

2. Floating building



The load bearing structure of the floating building consists of two parts: a concrete substructure and a lightweight aluminium upper structure.

The substructure is formed by a modular system of floating reinforced concrete pontoons, which function as a stable foundation for the building upper structure due to its low gravity centre. The pontoon is derived from an existing foundation for floating greenhouses. It fits in a modular system of 2.4 by 2.4 meter. The pontoons include holes for temporary water inserts as well as for the transfer of cables and services for installations. The pontoon also provides an internal buffer for rain water.

The upper structure consists of aluminium I-profiled beams and aluminium tubular columns. Actual dimensions are dependent on loading conditions and span lengths. For reasons of flexibility each pontoon carries its own upper structure. Figure 1 shows an exploded view of all structural parts. The tubular columns contain extruded insertions, which allow for an easy assembly with fixation in x- and y-direction by using I-formed locking elements. The beam to column connections are bolted connections, which allow for a demountable building structure.

Fig. 1: Exploded view of aluminium structure on concrete pontoons

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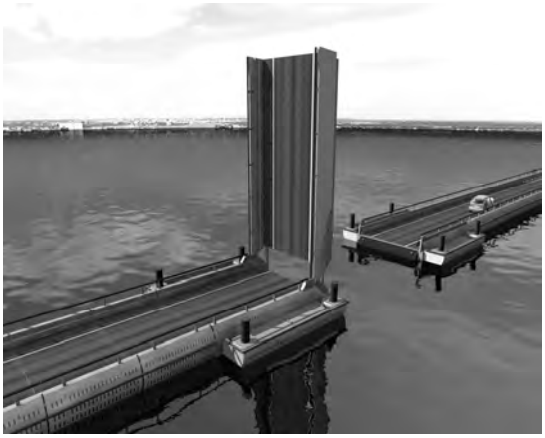
3. Floating road



The floating road consists of all aluminium pontoons, build up out of a box frame of welded extruded sections, extruded decks, sidewalls and bottom plates. The pontoons are connected at top and bottom by clamps, which results in a stiff stretch of road allowing a safe and comfortable ride.

The pontoons are partly filled with polystyrene blocks to make them unsinkable. Water is allowed to enter the lower part of the pontoons creating a kind of ballast tank to improve the hydrodynamic behaviour. The floating road is accessed by a ramp that allows for fluctuations in the water level. The structure is horizontally fixed by foundation piles (see fig. 2).

Fig. 2: Floating aluminium road

4. Floating connection

The connection (see fig. 3) is designed for the horizontal transport of persons, goods, energy and data between the floating building and floating road. The element is called aquanect.

The main structure is realized by four 160x100x10 mm hollow square aluminium beams spanning from building to road. The substructure consists of 140x100x10 mm beams. For the connection at building site one centrally positioned ball bearing is used, while two dampers are added at the sides for comfort reasons. The connection between aquanect and the floating road is realized by vulcanized rubber, which simulates a hinge that allows for small rotations.

Fig. 3: Aquanect, a structural connection between floating buildings and road

5. Conclusions

In the described projects aluminium is used as the main structural material. In all cases aluminium was chosen because of its light weight. Further the corrosion resistance, leading to low maintenance costs, is an advantage in practice. And at last the easy to form cross sections using extrusion technology have led to smart solutions for the structural connections in all projects.

The floating building and floating connection have been developed as a design project. Detailed calculations or tests have not been carried out until this moment. Further investigations are needed. The floating road however has been worked out in more detail. Calculations and real scale tests revealed that the movement of the road is kept within the limits with regard to safety and comfort.