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DESIGN OF MOVABLE BRIDGES – SELECTED EXAMPLES

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Summary

To develop successful cycling and walking networks in the Netherlands often navigable waterways need to crossed. In theory this can be done with a fixed bridge if it has a large enough vertical clearance. However, to access high bridges like these often long winding ramps are required. In practice such ramps prove to be difficult to integrate in an urban context.

Therefore a movable bridge can be the preferred solution despite the higher lifecycle costs. In a study for a possible new footbridge crossing a canal in Rijswijk this was the case.

In this paper important aspects of the design of a movable bridge are described, from the why of a movable bridge to aspects like possible mechanisms, types of machinery and the required safety measures and how to integrate all these aspects successfully.

This is done by first describing the design process of the movable bridge in Rijswijk in detail and then striking elements of others designs for movable bridges.

Keywords: movable bridge; mechanisms; machinery; safety measures; integrated design

Fig. 1. Overview swing bridge Rijswijk

1. Swing Bridge Rijswijk: an Efficient Eye-catcher

The city of Rijswijk asked ipv Delft to research possible locations for bridges and bridge designs to cross the Schie canal with a footbridge. The available budget for the new footbridge was 7 million euros.

1.1 Network, Context, Users

The most logical location in the network for the new connection was found by analysis of the expected traffic between residential and business areas on both sides of the canal.

In the context 4 locations were found that offer a fairly direct connection between the existing bicycle and pedestrian routes. For all locations a solution had to be found to overcome the height difference between the existing routes parallel to the embankments of the canal and a bridge without disturbing these routes.

The bridge is intended to be used by cyclists, pedestrians. The waterway is mainly used by cargo ships.

1.2 Spatial Integration

For all the 4 potential bridge location found in the context a location specific bridge concept was developed and the associated building costs (BC) were estimated.

Location 1: a fixed arch bridge located directly next to the bridge in highway A4. The required ramps with a length of at least 300 m proved impossible to integrate in the context. BC: 4 million euros.

Location 2: a double draw bridge. This bridge lands directly on the existing bicycle routes parallel to the embankment of the canal. BC: 6 million euros.

Location 3: an asymmetric cable-stayed swing bridge. A swing bridge is less susceptible to wind than a drawbridge. Therefor it is easier to build a swing bridge with a large horizontal clearance. BC: 4 million euros.

Location 4: a large symmetric cable-stayed swing bridge that bridges as well the canal as the entrance of the harbour. BC: 5.5 million euros.

Because of the direct connection to existing routes, minimal expected hindrance to ships and acceptable expected costs the decision was made to further develop the swing bridge concept for location 3.

1.3 Bridge Design

The asymmetric swing bridge for location 3 was further developed. Widening the waterway locally on the west side created a space where the bridge deck can turn into when opening. Minimizing the structural height of the bridge deck and optimizing the alignment decreased the height difference between the existing cycling lane and the bridge. Now it was acceptable to integrate the required ramps in the existing cycling lane. The pivot point of the bridge supports the pylon and houses the machinery.

2. Four Appealing Designs for Movable Bridges in Short

The Kadoelen bridge in Amsterdam shows how a technical principle can be a good occasion to make an appealing design for a movable bridge. This bridge has eye-catching counterweights at the sides of the deck.

The Willem III Bridge in Assen is simple, affordable yet Attractive. This elegant and slender steel drawbridge stands out both because of its operating mechanism and because of its integrated design.

The two mutually rotated steel portals of the Dolder bridge in Steenwijk now form a symbolicate gate to the city, but can be used to turn the bridge into a vertical-lift bridge.

A drawbridge was considered the best option for the N207 bridge in Gouda. The towers of the drawbridge are low, in order for the bridge to optimally fit in with its horizontally orientated, typically Dutch surroundings.

3. Movable Bridges Require Close Collaboration between Disciplines

Designing movable bridges is a specialism in itself. Often a wide variety of unique solutions is possible for a specific location. This makes it necessary that a lot of attention is paid to integration of important aspects like the opening mechanism, machinery and safety measures. Therefor a close collaboration between mechanical, structural and electrical engineers and bridge designers is essential.