Kaponjärbron Göteborg - The Future of Footbridges in Göteborg

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Stephen has 20 years' experience as an architect working on large scale transport and infrastructure projects.

As leader of Bridge Design in Ramboll's London office, Stephen's work has helped maintain Ramboll's position at the forefront of modern pedestrian bridge design.

1. Summary

This paper focuses on the design development of a ground-breaking pedestrian bridge project in Göteborg, Sweden. Building on the city's rich automotive and ship-building industrial heritage; Ramboll's proposal is for an ultra-lightweight FRP structure, thought to be the first of its kind in Sweden.

At less than ¼ the weight of an equivalent structure in steel, the FRP structure requires reduced foundations, imposes minimal loading on the fragile historic walls, and will greatly ease buildability. The use of advanced composites allows this to be achieved with a graceful, organic monocoque form that appears to float above the waterline.

Keywords: Pedestrian bridge, Lightweight, Fibre-reinforced Polymer, Monocoque, Innovation, Aesthetics, Materials, Sustainability.

2. Introduction

In the summer of 2013, a team comprising Ramboll UK and Ramboll Sweden won an international competition, organised by the City of Göteborg, to design Kaponjärbron, the first of this new generation of footbridges. Implementation of the project is to be a collaboration between Göteborg's City and Traffic Planners, with City Planners responsible for the development of the proposals, and Traffic Planning responsible for their delivery.

3. The Site

The new bridge will cross the canal to the west of the city centre next to the Feskekorka, literally translated as 'Fish Church' but actually a fish market that is an institution in Göteborg and a popular tourist destination. The canal is working today much as it was first intended, as a physical barrier, and this once important area of the city has lost some connection with its surroundings as the area has developed. Kaponjärbron is intended to improve the accessibility and spatial quality and act as a catalyst for future development.

4. Design Development

Ramboll's initial design studies investigated a wide variety of approaches to the site in order to develop the most appropriate direction. Through regular and open dialogue with the client we were able to quickly set on a preferred design concept for the bridge.

The approved design concept was for a unique bridge form that rises and falls as a wave crossing the canal. The bridge springs from within a public space to the north addressing the Feskekörka, and then spans over the quay walls, imposing no loads on the delicate structure. It crosses the canal in a

shallow arch, swooping down to a single support within the canal then springing back up as a cantilever, stopping short of the southern quay.

The form was originally seen as a series of ribbons of steel, offset from each other and each determined by single curvatures and welded from stainless steel plate. However, just as the automotive and shipbuilding industries have adopted advanced composites, such as carbon fibre, in recent years, it was felt this might also be a suitable approach for the Kaponjärbron design.

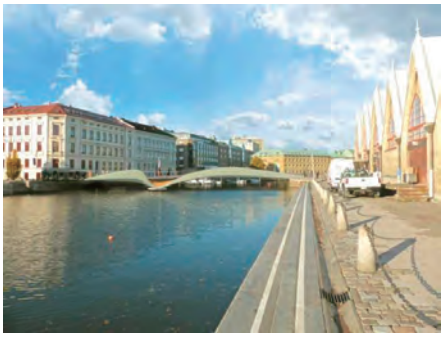
5. Advanced Composites

Despite its ideal characteristics of strength, lightness, and resistance to fatigue and corrosion the construction industry has been resistant to adopting FRP and advanced composite materials in general. Recent advances in FRP technology have helped to allay the fears, and resistance to change across the industry is reducing. With improvements in resin formulations and manufacturing processes in recent years large structures have emerged which are beginning to impact upon bridge design.

6. FRP Design

The relative freedom associated with FRP moulding procedures enabled us to be less constrained with the form which could now be a much clearer expression of the practical and aesthetic design criteria and the structural forces at work.

Key control points that defined the geometry were manipulated to optimise the aesthetic appearance and structural performance of the monocoque form. Further parameters were set to define key features such as the deck width, the parapet height and edge profiles.



Figs 1 and 2: the final approved form for the FRP Bridge.

7. Final Design

The whole superstructure of the bridge is now confirmed as a single undulating, curvilinear, monocoque FRP form. A total FRP weight of 16 T, based on limited use of carbon fibre and glass composite with structural PVC foam core, compares favourably with over 60 T for an equivalent steel structure.

Our design gained the City's formal approval and in September 2014, Ramboll was instructed to commence to full tender design. Details of the new bridge have recently been made available to the general public and Ramboll now aim to deliver Sweden's first FRP pedestrian bridges by early 2016.