Piston stayed bascule bridge: a novel mobile bridge typology at Temse, Belgium

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Summary

This paper discusses a novel typology for medium span mobile bridges: the piston stayed bascule bridge. The Temse bridge over the river Scheldt (Belgium) illustrates this system. This competition winning project runs 374m over seven fixed parts with spans varying between 18 and 74 m and two mobile spans of 28m. The design considerations and the structural static and kinematic system for this project are discussed. The main design idea is “structural integration” namely that one element fulfils more than one function. The structural innovation lies in the use of the piston stay that doubles up as static structural element and as a kinematic actuator. Combined with counterweights, this structural system presents a new and elegant solution for mobile bridges.

Keywords: bascule, piston, stay, mobile, multi-functional, typology

1. Introduction

The Temse bridge, situated over the river Scheldt in Belgium, introduces a new type of mobile bridge: the piston stayed bascule bridge. The engineering innovation lies in the design of a mobile bascule bridge whose static stiffness and dynamic actuation are ensured by one single element i.e. the piston stay. The bridge, designed for vehicular traffic, pedestrians and cyclists, is placed 10m next to a 1950’s monumental enclosed industrial girder truss bridge. With its light open filigree structure and opening mechanism with two 28m mobile spans (instead of one), the new Temse bridge complements the existing bridge.

2. The Bridge as a Structural System

The 374m long bridge consists of seven fixed stayed spans varying from 18m to 74m and two 28m long mobile spans. The 8.4m wide vehicular concrete deck consists of a 0.3 to 0.4m light weight semi-precast concrete slab. This slab spans between two steel girders whose upper flange doubles up as a stay that is attached to 6.7m tall masts for the fixed spans. In the 28m span mobile part, a light steel orthotropic steel deck spans between a series of secondary beams onto the two main girders.

3. Motion and Kinematics

A pair of masts is situated at the hinging point of the mobile part. Each of these masts is connected

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to the mobile part through a fixed-length stay and to the fixed bridge part by a variable length 0.56m diameter piston stay. The fixed-length stay forms a non-deformable triangle with the mast and the mobile part. The mast is used as a lever to tilt the bridge open or closed. The piston stay powers the opening and closing mechanism and forms a deformable triangle with the mast and the fixed part. In order to keep the piston force as small as possible (for operating and maintenance costs), a first top counter weight is placed between the mobile mast heads and a second larger bottom one underneath the bridge deck.

4. Conclusion

The Temse bridge will be opened to the public in 2009. This piston stayed bascule bridge with its slender elements does not dominate but complements the existing monumental 1950's truss girder bridge. The engineering ingenuity of the design lies in total integration of the kinematics into its structure. This approach is accomplished through a design process of structural integration and optimisation: one single element (the piston stay) performs more than one task. The innovative bridge typology, demonstrated with the Temse bridge as design example, offers a new and elegant solution for mobile bridges with a large range of spans.

Fig. 1: Perspective rendering of the new Temse bridge set against the 1950's existing bridge © Ney and Partners + Coreconceptz

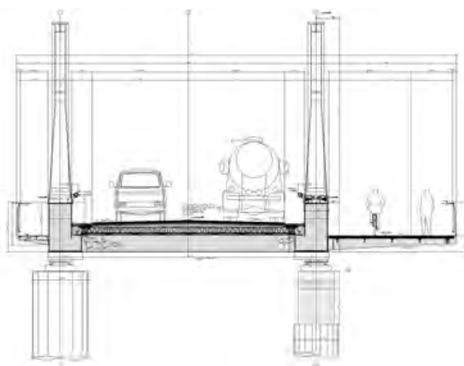

Fig. 2: Typical cross-section through fixed part, Temse Bridge, Belgium