Semi-Precast Segmental Bridge Construction Method: construction of a prototype and shear tests on cross-frames

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Abstract

The Institute for Structural Engineering of TU Wien is investigating the use of thin-walled pre-fabricated elements, for the construction of box girder bridges. Thin-walled pre-fabricated elements, such as double walls and semi-pre-fabricated slab elements have been used successfully in building construction for years. The aim of the research project is to create a fast, economic and resource saving construction method for the erection of lightweight bridge girders from segments, utilizing thin-walled pre-fabricated elements and post-tensioning.

The newly developed construction method consists of the following steps:

- Highly automated production of thin-walled concrete elements in a pre-fabrication plant
- On site assembly of box-girder segments using the thin-walled elements and standard steel screws
- Connection of the segments with post-tensioning tendons to form a bridge girder
- Movement of the lightweight semi-pre-fabricated girder to its final position using any chosen construction method as for example incremental launching or the balanced lift method.
- Completion of the cross-section by pumping in-situ concrete onto the girder in its final position

In the paper, the construction method will be described. Based on this, the planning and construction of a prototype-segment made from thin-walled prefabricated elements will be shown. Furthermore, shear tests on double wall elements and thin-walled plates with steel girders, which are essential parts for the newly developed construction method, will be presented and compared to manual calculations based on the Eurocode 3 for two of the tested specimens.

Keywords: bridge construction, semi-precast segmental bridges, thin-walled prefabricated elements, post tensioning, box girder bridge, unfilled double wall, shear

1 Introduction

An approach for the application of thin-walled prefabricated elements in the construction of plate girder bridges, was developed at the TU Wien and successfully implemented, as described in detail in[1], in a project in Austria in 2019 & 2020. In this project, U-shaped girders were utilized to build a bridge girder with a length of 116 m, using the balanced lift method, in which a girder is erected in a vertical position (Fig. 1 a) and then rotated into its final horizontal position (Fig. 1b). Once the final position was reached, the U-shaped girders were filled with pumped in-situ concrete creating monolithic rectangular cross sections, as shown in Figure 1c. In the next construction phase the roadway slab was erected on top of two concrete webs with a composite formwork carriage.