Long-term Monitoring of Haavistonjoki Bridge

Anssi LAAKSONEN
M. Sc. (Civil Eng.)
Tampere University of Technology
Tampere, FINLAND
anssi.laaksonen@tut.fi

Anssi Laaksonen, born 1979, received his civil engineering degree from Tampere University of Technology in 2004

Olli KEROKOSKI
Dr. Tech. (Civil Eng.)
Tampere University of Technology
Tampere, FINLAND

Olli Kerokoski, born 1960, received his civil engineering degree from Tampere University of Technology in 2006.

Summary

Integral and semi-integral bridge expansion due to temperature changes is not symmetrical measured from the bridge's centre point. The movements are strongly influenced by the nonlinear behaviour of the embankment soil. Due to different embankment stiffnesses, the western abutment was much stiffer than the eastern one, and occasionally the expansion length of the 50 m long symmetrical bridge exceeded 35 metres. The bearing movements of a semi-integral bridge can be predicted based on the presented integral bridge's monitoring results.

In the presented field study the focus was on the reversible and non-reversible earth pressure actions caused by an integral bridge. The changes in earth pressure were the result of bridge abutment movements due to bridge deck temperature changes. According to the observations made, it is possible to determine which actions are the result of bridge abutment movements.

Deck temperature changes either expand or contract the deck which, again, affects the earth pressures behind abutments. The highest average deck temperature during the two-year observation period was 30.4 ˚C, the lowest was –14.9 ˚C, and the average 7.7 ˚C. At the edges and top, measured deck temperatures corresponded most closely to air temperature changes. At the bottom deck temperatures also followed air temperature changes, but more slowly. The smallest temperature changes were measured in the middle of the deck.

Keywords: Integral bridge, Semi-integral bridge, Soil-structure interaction, Thermal expansion, Expansion length, Instrumentation, Monitoring

1. Introduction

Integral bridges are defined as bridges with no joints between the superstructure and the supporting abutments. The thermal movements of a jointless superstructure influence the behaviour of the substructure and the soil adjacent to the intermediate piers and abutments. On the other hand, semi-integral bridges have bearings, for example, at the abutments. The results on Haavistonjoki Bridge are to some extent applicable to semi-integral bridges.

The instrumentation was used to measure, for instance, horizontal abutment movement, abutment rotation, strains in several structures, earth pressure behind abutments, superstructure displacements, frost depth, air temperature, and thermal gradients in superstructure and approach embankment.

The presented paper focuses on the following aspects of the integral abutment bridge: horizontal abutment movement, earth pressure behind abutments and thermal gradients in superstructure.

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