Integral bridge abutment - approach embankment interaction

Olli KEROKOSKI
Dr.Tech. (PhD), Tampere University of Technology, Department of Civil Engineering, P.O. Box 600, FIN-33101 Tampere Finland
web: www.tut.fi/rtek/en

Hans PÉTURSSON
Lic.Of Tech, Luleaa University of Technology, Dep of Civil, Mining and Environmental Engineering, LTU SE-971 87 LULEA, Sweden

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

Abstract

The study deals with the development of long jointless bridges with a focus on soil–structure interaction. The instrumentation of Haavistonjoki Bridge was completed in the autumn of 2003. The data were collected by monitoring altogether 191 gauges installed in the bridge structures during construction. The instrumentation was used to measure, for instance, the abutment's horizontal displacement, abutment rotation, abutment pile strains, earth pressures behind abutments, superstructure displacements, frost depth, and air temperature. Haavistonjoki Bridge is a 56 m long continuous 3-span slab bridge. The measured earth pressures were compared with calculated pressures. The bridge over Leduån is a single span composite bridge. The cast-in-place concrete deck acts together with two steel beams. The 40 m span bridge is very slender with the height of superstructure 1.7 m. Totally 34 measurements were constantly recorded and stored in a period of at least 18 months. The bridge over Edslan has a 19.8 m span and a 7.65 m wide concrete slab. The test results are verified with calculations.

Keywords: bridge tests, bridge abutments, soil-structure interaction, earth pressure.

1. Introduction

Integral bridges are defined as bridges with no expansion joints between the superstructure and the supporting abutments. Use of such structures was first considered after observing the successful performance of old bridges with inoperative joints. Hence, because of several problems resulting from the traditional practice, the jointless bridge has been adopted in several countries.

The structural elements of the typical abutment of an integral bridge usually consist of an abutment wall, two wing walls, and two or more supporting piles. The abutment walls and wing walls are usually of reinforced concrete. The piles are either of structural steel or reinforced concrete.

The superstructure of jointless bridges with integral abutments is cast integrally with their substructure. The superstructure is permitted to expand and contract without joints. Thermal movements affect also the behaviour of the substructure and the soil around intermediate piers and abutments.

This research concentrates on unskewed reinforced concrete structures and approach embankments. It studies the forces and stresses from temperature fluctuation as well as from loadings with a test truck. Earth pressures against the abutment and mid-span deflections are also discussed. The soil-structure interaction is calculated according to Swedish practice.

The approach embankment and transition slab also have to behave satisfactorily and large bumps are not allowed.

2. Field tests, Finland

2.1 Superstructure and substructure

Haavistonjoki Bridge in Finland is a 56 m long continuous 3-span slab bridge. Total length of the

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