Optimized Design for Soil-Pile Interaction and Abutment Size of Integral Abutment Bridges

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Summary

In the last few years, the integral abutment bridge (IAB) concept has become quite common. It is, incidentally, not a newly developed concept, its formulation dating back at least to the 1930s, in order to deal with long-term structural problems frequently occurring with conventional bridge design. At present, the IAB concept is generating considerable interest among bridge engineers because of the enormous benefits due to elimination of expansive joints and reduced installation and maintenance costs. The superstructure of integral abutment bridges is made continuous through a composite cast-in-place concrete deck slab over prestressed concrete or steel girders and continuity diaphragms, and the system constituted by the sub- and the super-structure acts as a single structural unit.

A usual and important problem in the design of IABs is how to deal with the soil-structure interaction behind the abutments or next to the foundation piles: this can be considered as a fundamental aspect for the thorough understanding of this type of structures, which requires iterative and nonlinear analysis. In this paper, a 2D simplified finite-element model of a real 400 meters long IAB, built in the Province of Verona-Italy, will be implemented and used to perform non linear analysis on the bridge. Then, based on the results obtained from a parametric study on the IAB, the analysis of effects of soil-pile interaction and the abutment size will be carried out to find out the relative key parameters in IABs design.

Keywords: integral abutment bridge (IAB); soil-structure interaction; optimized design; parametric analysis; abutment stiffness.

1. Introduction

1.1 Integral Abutment Bridge

In recent years the integral abutment bridge (IAB) concept has become quite common. It is, incidentally, not a newly developed concept as its formulation dates back at least to the 1930s and was introduced to deal with long-term structural problems frequently occurring with conventional bridge design [1]. The original IAB concept was not well managed at that time and it turned out to cause numerous problems relating to the post-construction life of the structure due to the specific type of design and to the soil–structure interaction problems that still represent a challenging issue that requires a close cooperation between structural and geotechnical engineers. The IAB concept is currently generating much interest among bridge engineers because of the enormous benefits deriving from the elimination of expansion joints and the reduced installation and maintenance costs accruing. The superstructure of integral abutment bridges is made continuous through a composite cast-in-place concrete slab over pre-stressed concrete or steel girders and rigid transverse diaphragms: the system acts as a single structural unit [2].

The monolithic connection between the super-structure and the sub-structure makes IABs different from other conventional bridges and allows for a remarkably increased redundancy, with improved

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