Environmentally conscious structural design and material selection of short-span bridges

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Abstract

In Hungary and in the Eastern European region the maintenance of small-span bridges built in recent decades – mostly for pedestrians and railways – tends to be less than perfect, so it is not a rare phenomenon that structurally adequate bridges have to be demolished well before their theoretical 100-year design life. Consequently, a critical part of current design tasks is to help our structures cope with very little maintenance but without reduction in their useful life. In addition, in new design tasks, sustainability must be pursued, keeping in mind the principles of environmental awareness that are increasingly coming to the fore. This can be achieved with smart structural design solutions and adequate material selection. This paper presents design principles used in recent projects to create more sustainable bridges supported by LCA calculations.

Keywords: design; weathering steel; short span bridges; corrugated girder; sustainability; LCA.

1 Introduction

The Hungarian road network has seen a previously unparallelled growth in the recent decades. Several roads and motorways have been built with the aim of closing up to the European state of development. In the course of reaching that objective the investors focused primarily on keeping the costs as low as possible while environmental costs were not considered high priority. That attitude shall be revised [1] as the EU targeted a 55% reduction in the emission of greenhouse gases (GHG). The FIT FOR 55% directive stipulates that all member states are set obligatory reduction quotas for their emissions, which concerns construction industry to a large extent – concrete and steel products are especially affected. At UNITEF '83 PLC structural engineers have been working on innovative structural solutions for the latest challenges and such solutions have been effectively used in recent bridge construction projects [2].

The vast majority of currently existing road, pedestrian and bicycle bridges in Hungary are reinforced concrete structures. The recent years of infrastructure development has also seen the dominant application of superstructures consisting typically of precast prestressed concrete bridge girders and reinforced concrete mass substructures based mostly on pile foundations.

In contrary to the sudden growth, maintenance of bridges is not really sufficient or systematic. The need for as little maintenance as possible coincides with the minimization of environmental effects, and is also an important aspect.

The central objective was to find a way of building ordinary bridges using sustainable solutions with reduced GHG emission. This paper presents our progress through our recent projects.

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