Development of a traffic load model for bridge structures within an urban subway system

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Abstract

Subway systems are a key component of today's urban infrastructure. However, current engineering standards such as the Eurocode only give few indications regarding the modelling of traffic loads for subway trains. For this reason, a traffic load model is developed based on load model LM71 from Eurocode 1 - Part 2, the standard load model for rail bridges. The aim is to scale this load model so that it is able to cover the extreme load effects resulting from actual subway trains within the subway network. Within the scope of these investigations, different structural systems and load effects are studied, as well as different strategies for modifying LM71 and its scaling factor α. Additionally, the results obtained for simplified beam systems are validated on real structures to account for effects like two-dimensional bearing capacity for the determination of the scaling factor α. These investigations are performed for the subway system of the city of Munich.

Keywords: traffic load model; rail bridges; urban subway system; load model LM71

1 Introduction

Public transportation systems have an important role within urban infrastructure networks. Therefore, the subway is nowadays considered an essential part of public transport in bigger cities. Urban subway networks are characterized mainly by tunnels and underground structures but they also comprise a significant number of bridges or bridge-like structures, such as the ceilings of underpasses or tunnel crossings (in the following simply referred to as "bridges"). However, there are often no uniform traffic load models for bridge structures within subway systems specified in engineering standards, as is the case in Germany. Hence, a planning engineer has the possibility either to apply the standard load model LM71 from the current Eurocode 1 - Part 2 [1], which refers to general rail traffic, or to approximate all rail vehicles of a system by their respective load patterns. While using LM71 is expected to yield conservative results because of the higher loads of general (i.e., heavy) rail traffic compared to light rail traffic in urban subway systems, the application of every subway train is a costly option due to the large number of calculations required to analyse each single load pattern. For this reason, the development of a user-friendly and reliable traffic load model for new subway system construction is of great interest and benefit.

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