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Input Data for Tram Noise Analysis

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Abstract

The European Union passed the Environmental Noise Directive in 2002. The Directive deals with issues relating to the assessment and management of environmental noise in Member States. This main EU instrument requires that the information on environmental noise and its effects are predicted as accurately as possible. In general, the most accurate data on noise levels can be collected by measurement; however, it is a lengthy and complicated method, inapplicable to making predictions of noise levels in practice. The acoustic situation is therefore more easily determined by calculation. The Directive recommends the "Schall 03" Methodology for the calculations of tramway noise levels. Strategic noise maps are regularly produced to provide an overview on noise levels in residential areas and noise management action plans are prepared to reduce unacceptable exposures to noise. The article analyses input parameters used in the calculations of final levels of tramway noise. The basis for the analysis was a parametric study of input data, field measurements and the statistical evaluation of the measurement results. After making some generalizations and analyzing the influence of individual parameters on the calculation of tramway noise levels, it can be stated that the emphasis in calculations should be placed on the most accurate determination of the speed of a tram.

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1. Introduction

Environmental noise, especially traffic noise, poses a serious problem in densely-populated urban areas, where residential and business centres are situated in the proximity of main traffic corridors.

Many sources of noise coexist in urban environments, including road traffic, urban trains, but also tramlines [1], [2]. Directive 2002/49/EC relating to the assessment and management of environmental noise is the main European

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Union (EU) instrument to identify noise pollution levels [1]. The Directive requires Member States to prepare and publish noise maps and noise management action plans. The aim of the strategic noise maps is to describe the noise situation in the vicinity of significant sources of noise (traffic, industry) and to identify exceedance of noise limit values

For the elimination of negative impacts and the mitigation of transportation noise, it is essential to determine the noise load in the immediate vicinity of roads as accurately as possible. These noise levels are estimated using either a standardised design methodology or measurements according to regulations or standards currently in use. The most accurate data on noise levels along tramways can be collected by measurement. As this method is time-consuming and hardly applicable to new project designs, the utilization of calculation methods of predicting the future acoustic situation in the vicinity of tramways is now standard practice in the urban environment. The German “Schall 03” computational methods of detecting tramway noise indicators are employed in the European Union [1].

The article provides a brief analysis of input parameters and their influence on the final noise levels.

2. Parameters influencing tramway noise levels

The analysis of a noise event caused by a tram travelling along the tramways is a very complex issue. The acoustic energy generated during the passage of a tram and spread into the surrounding environment results from the vibrations of a complicated mechanical system, including a tram itself as well as the base it runs along, i.e. a set of tramway rails. The extent to which individual parameters contribute to the whole depends on numerous factors [3]-[7].

Among other things, the parameters affecting the noise levels of tram operations are:

- The volume of traffic/tram operations.
- The technical condition of tramways.
- The technical condition of trams.
- The type of the tramway structure/permanent way.
- The type of tram and the number of carriages.
- The speed regime.
- The longitudinal profile and vertical alignment of tramways.
- Surface pavement selection.
- The configuration of land.
- Sound propagation, such as sound absorption and reflection factors, and other similar locale-specific factors ([3], [5], and [6]).

Fig.1. Tramway in Kosice
(a) panelled permanent way (b) classical permanent way covered in bitumen (c) classical open permanent way with wooden or concrete sleepers.