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Applied Acoustics 64 (2003) 89–109

applied acoustics

www.elsevier.com/locate/apacoust

Vibration in dwellings from road and rail traffic — Part II: exposure–effect relationships based on ordinal logit and logistic regression models

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Received 23 April 2001; received in revised form 4 June 2002; accepted 10 June 2002

Abstract

The 1998 Norwegian Socio-vibrational Survey with 1503 respondents from 14 study areas was undertaken in the autumns of 1997 and 1998. Telephone interviews were used for obtaining people's reactions to vibrations in dwellings while in-dwelling vibration values were calculated for 1427 of these respondents. The response rate was 50%. The calculations of the vibration values were based on measurements and calculations by using a semi-empirical vibration prediction model. The logarithmic transformation of the calculated statistical maximum vibration value $v_{w,95}$ as defined in the new Norwegian Standard NS 8176, was selected as exposure measure. There were no significant differences in reactions to vibrations from different sources. An estimated exposure–effect ordinal logit model for degrees of annoyance as a function of the vibration exposure measure shows good fit and narrow statistical error bands. Further studies are needed to determine whether the exposure measure should also include the number and duration of vibration events.

Keywords: Perception of vibration; Traffic-induced vibration; Socio-vibrational study

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PII: S0003-682X(02)00053-1

1. Introduction

In the first paper of the three-part presentation of Nordic projects dealing with vibration in dwellings from road and rail traffic, Turunen-Rise et al. [1] presents the background for work with the new Norwegian Standard NS 8176 [2]. This new Norwegian standard defines the statistical maximum weighted vibration velocity $v_{w,95}$ (or alternatively the statistical maximum weighted acceleration $a_{w,95}$) and describes the measurement procedure. The reader is referred to part I for a description of this measure.

In order to assess the size of the adverse effects caused by vibrations for use in the standard, the 1998 Norwegian Socio-vibrational Survey [3] was undertaken. Its main purpose was to provide exposure–effect relationships between the new vibration velocity measure, $v_{w,95}$, and the degree of annoyance by vibrations and the new vibration measure, the statistical maximum vibration velocity measure ($v_{w,95}$). Relationships between this measure and other effects such as self-reported disturbances and rest were also to be obtained.

The original project included the determination of vibration values for the respondents in a Swedish socio-acoustic study [4]. This study contained questions on annoyance from vibrations, and could be retrofitted with vibration values The intention was to pool the data from the Swedish and the Norwegian studies and thus enhance both the quantity and quality of the data available for analyses. Results from existing vibration measurements in buildings in the Swedish study areas were therefore converted according to NS 8176 and used as input to the semi-empirical prediction model producing estimates of the vibration exposure measure ($v_{w,95}$) for the other dwellings along the track. However, the analyses of exposure–effect relationships utilising the converted vibration exposure measures gave inconsistent results. The exposure–effect relationships for each of the Swedish areas differed, as did the exposure–effect relationship based on the pooled Swedish data when compared with the relationship estimated from the pooled Norwegian data set. One problem with using the previously existing measurements was that they often were obtained from buildings where the inhabitants had complained about vibrations. The measurements might therefore not be representative for other buildings in the area. There were also concerns that there might be differences in the scaling of the measurement values. Lacking the resources to secure new measurements according to the new standard NS 8176 in these areas, a decision was made to proceed without these data.

The experiences from the Swedish study together with the 1998 Norwegian Socio-vibrational Survey formed the basis for the new Nordtest Method NT ACO 106 for assessing annoyance from vibrations from road and rail traffic presented in the third of the articles [5].

2. Methodology

2.1. Choice of study areas

Twelve study areas where ground conditions, building types etc. were known to result in vibrations in dwellings from road, rail, tram or subway traffic were in the