Proceedings of the 4th International Conference on Environmental Pollution and Remediation
Prague, Czech Republic, August 11-13, 2014
Paper No. 178

Mapping Traffic Caused Noise in the City of Győr, Hungary

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Abstract – Acoustic noise is one of the most significant environmental effects of urban traffic causing several mental and physiological diseases. Noise mapping techniques are widely uses to estimate spatial distribution of noise exposure. Noise measurement and manual traffic counting were performed in the centre of city Győr along high-traffic main roads. Noise maps were calculated from traffic data and compared to noise measurement data. Observed values exceeding noise limit were indicating elevated risk of health-effects. Good accordance of model data with field data underlines that measured noise can be explained by traffic.

Keywords**:** road-traffic noise, noise measurement, noise mapping, field measurement, Győr.

1. Introduction

Traffic-related noise is one of the most prominent environmental issues in cities of Europe beside air pollution. Since a significant part of the population lives in cities and combustion engine based traffic is not lessen, exposure to traffic noise is still ubiquitous. A wide range of psychological and physiological diseases proved to be associated with noise which accounts for the loss of more than one million healthy life years annually in western Europe alone (Sygna et al., 2014; Babisch, 2006; WHO, 2011). In the European Union noise exposures is regulated by European Directive about Environmental Noise 2002/49/EC (EU Directive 2002/49/EC, 2002), additionally laws at national level noise transmission and limits are also settled in Hungary (Ministry Regulation (MR) 27/2008 (XII. 3.) KvVM; Governmental Regulation (GR) 280/2004. (X. 20.); MR 25/2004. (XII. 20.) KvVM; GR 284/2007. (X. 29.)).

Our study area, Győr is a middle sized city with about 130 000 inhabitants. There is a bypass highway around the city, however, main roads inside the city are exposed to heavy through traffic.

The aim of our study was to track inside city temporal and spatial differences of noise levels supplementing a complex air pollution survey (Rácz et al., 2014). Field measurements of noise at five sampling sites and manual traffic count was performed parallelly. Noise maps and daily profiles were counted to compare noise distribution.

2. Methods

Sample points were selected at the main roads inside and near to the city centre (Fig. 1.). A one-day-long survey was performed to investigate a single crossing in details, and another day measurements were taken along two main roads. Average workdays on September 2013 were selected. The weather was sunny and moderately windy on the days of measurements. Devices RION NL-20, 21 and BOOGIE were used for sound measurements. Traffic was manually counted separately for traffic lanes and 3 vehicle categories in one quarter hour time-resolution on both measurement days form 5 am to 11 pm. The measurements were taken according to Annex 3 of GR 25/2004. (XII.20.) about strategic noise maps. Hungarian standard recommends measuring time three times for an hour at daytime in the following time intervals: 6:00-10:00, 14:00-17:00, 18:00-22:00 and at night-time in the two busiest periods: 5:00-6:00 and 22:00-23:00.

Fig. 1. Sample sites in Győr (map based on Web-1).

Noise maps are widely used modelling tools aiding prediction of noise exposure (Tsai et al. 2009). The noise mappings were made by IMMI, which covers a wide range of applications from noise mapping to air pollution modelling. IMMI calculates noise levels L_{eq}, L_{day}, $L_{evening}$, L_{night}, L_{den}, L_{Amax}, L_{10} and other sound or statistical indicators. IMMI can be equipped with noise calculation methods for road traffic, railway traffic, air transport, industrial and recreational noise (Wölfel, 2012).

3 D models of the concerned city parts were constructed in AutoCAD®. Noise maps were calculated for the Jókai and Szt. István Street crossing (I×J) for each hours from 5 am to 11 pm.

Average noise levels for investigated one hour-long periods were counted and compared to generated model values and average daily trading volume data available in literature (Web-2; Web-3).

3. Results

Traffic data of the investigated crossing (I×J) shows remarkable local differences in number of vehicles per hour and also in category distribution (Fig. 2-4.). Traffic on the northern part of Jókai Street reaches only one fifth of Szt. István Street's in number of vehicles, but the extremely high number of busses in a narrow geometry generates similarly high level of noise (Fig. 3.).

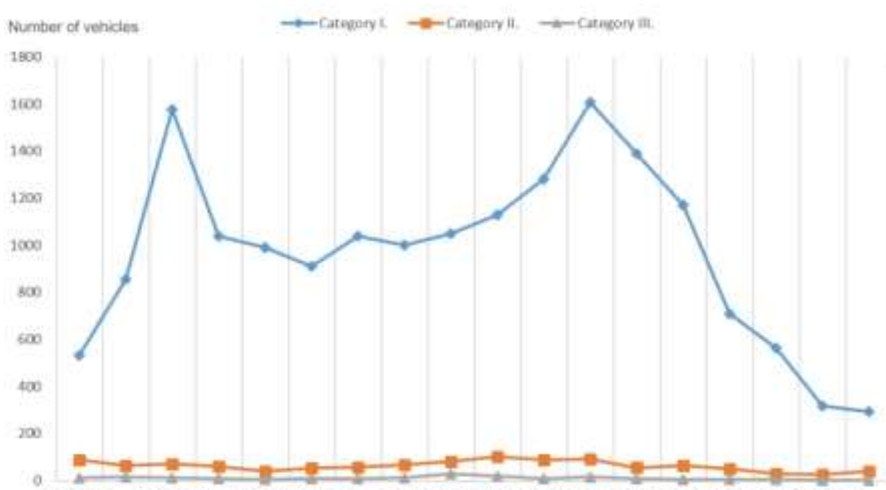

Fig. 2. Daily profile of vehicle distribution on Szt. István Street based on one hour manually counted data. Category I.: cars and light commercial vehicles; Category II.: busses, light trucks, and motorcycles. Category III.: heavy trucks and articulated busses.

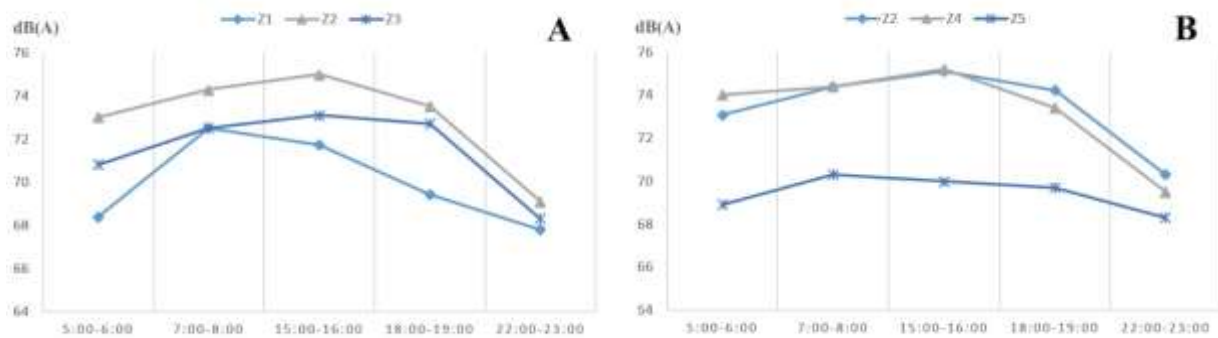

Fig. 3. A. Measured noise level at the I×J (10. Sept. 2013). B. Measured noise level at main roads of Győr (12. Sept. 2013). Noise measurement points: Z1. Jokai Street. Z2. Szt. István Street (W). Z3. Szt. István Street (Middle). Z4. Szigethy Street. Z5. Szt. István (East). See map (Fig 1).

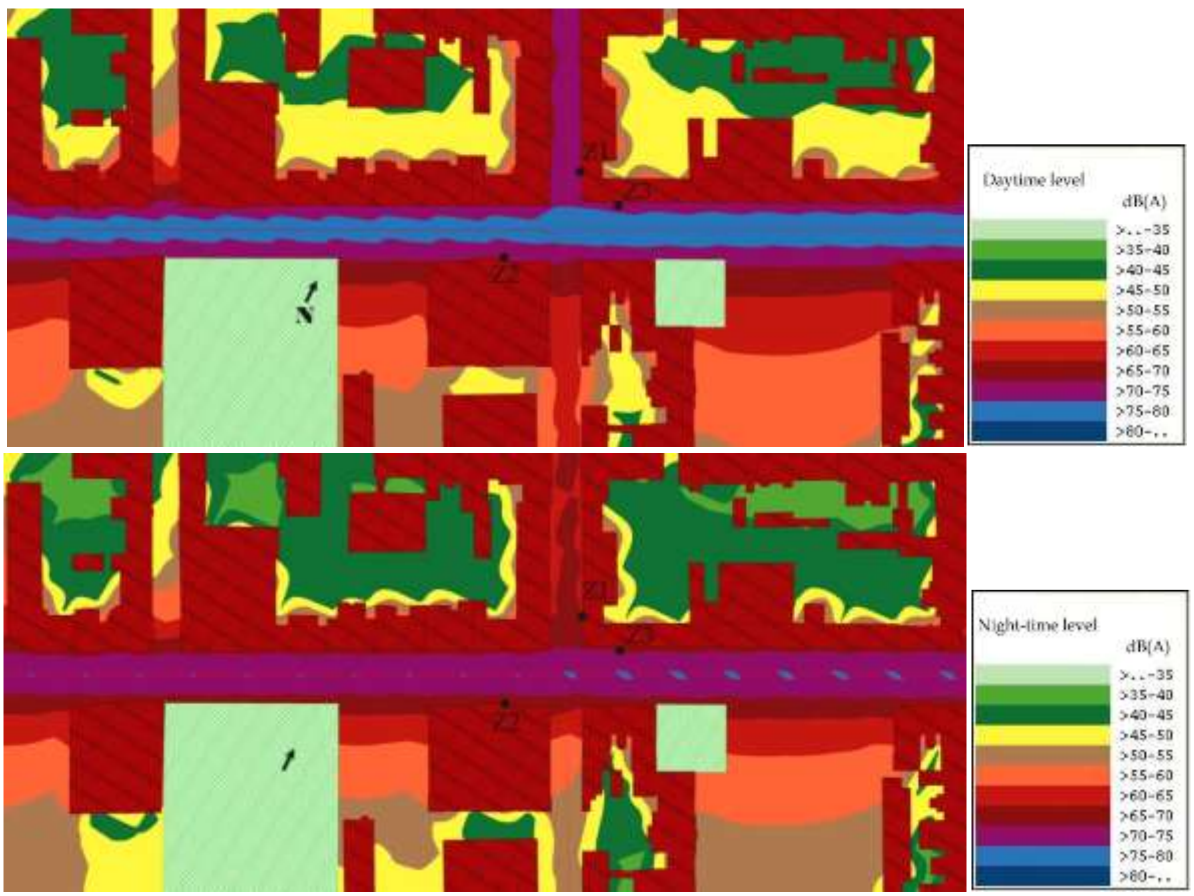

Fig. 4. Traffic noise maps generated from traffic data of Szent István (horizontal) and Jókai Street. A. Daytime peak (7:00-8:00 period). B. Night-time peak (5:00-6:00).

Similar daily rhythm and peaks were observed in different main road location of the city. Corrected Average Daily Traffic (L_{AM}) calculated with our noise measurement data were exceeding both daytime (65 dB(A)) and night-time (55 dB(A)) limits (at Szt. István Street L_{AMday} at Z2 and Z3 were 74.3 and 72.8 dB(A), respectively and $L_{AMnight}$ at Z2 and Z3 were 69.9 and 67.5 dB(A), respectively). Elevated noise level is especially critical, because there are busy bus stops and a high school at this crossing.

4. Conclusion

Noise transmission modelling and noise mapping are extremely helpful tools of environmental management. Our survey underlies that noise exposure in the city centre of Győr is still a challenging environmental factor. Modelled data based on traffic counts and direct noise measurement are in accordance, hence noise primarily originates from road traffic in the city. Small scale spatial differences in noise exposure can be significant, and should get more attention in particular at the city centre where large part of inhabitants spend daytime.

Acknowledgements

Our research was supported by TÁMOP-4.1.1.C-12/1/KONV2012-0017 fund.

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