Exigence of Sound Insulation Measures in the Vicinity of Airports and Traffic Routes

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Introduction

In noise mapping projects, the assessment of the noise levels is intended to result in actions to reduce the noise impact for the inhabitants in the investigated area. This aim has already been part of national regulations on noise immission maps and is emphasised by the EC-directive on Environmental Noise [1].

Noise Reduction Measures

Possible actions to reduce noise impact are either emission, transmission or immission related. Some relevant actions for the different aspects are:

Emission related actions:

- road pavings with low noise surface
- speed limits
- selection of quieter sources (e.g. aircraft)
- technical measures at sources

Propagation related actions:

- noise reduction along roads (barriers and embankments)
- enclosures (e.g. absorbing baffles or even tunnels)
- screening by buildings or blocks of buildings

Immission related actions:

- reduction of sound transmission (building facade elements)
- restrictions in land use planning

This paper focusses on the reduction of sound transmission by improving the sound insulation of facades of buildings.

Evaluation of Facade Levels

Prior to judging whether the sound insulation of a facade or facade components are sufficient the noise impact at the building locations has to be evaluated. The noise levels at buildings should preferably be calculated in equal distances on lines reaching round the whole building at each floor. The derivation of building noise levels using horizontal noise maps even with a dense grid is not useful. As has been shown, in cities we have only few and often only one grid point between buildings, and it's distance from the facade is different from point to point [2]. Figure 1 shows the real calculation points on a 10 m grid in a typical situation. Some arbitrary extrapolation rule has to be applied to estimate the facade level. In comparison, figure 2 shows the receiver points for a building evaluation of a multi-storey building. With contemporary software techniques the facade levels and the sound reduction index of the facade elements can be evaluated.

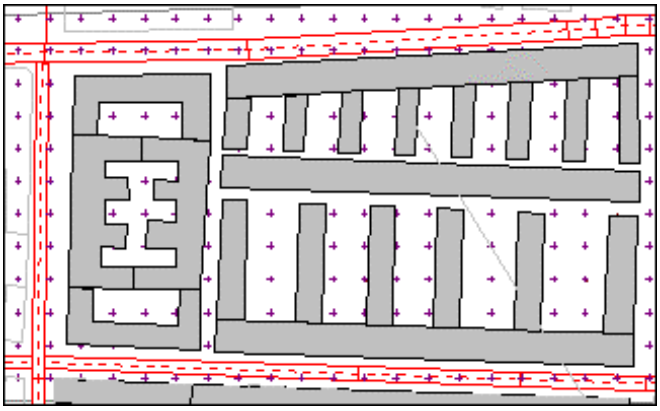

Figure 1: Densily build-up situation with calculation points on a 10 m grid. Derivation of facade levels from this grid causes inaccurate evaluations because of arbitary extrapolation rules applied.

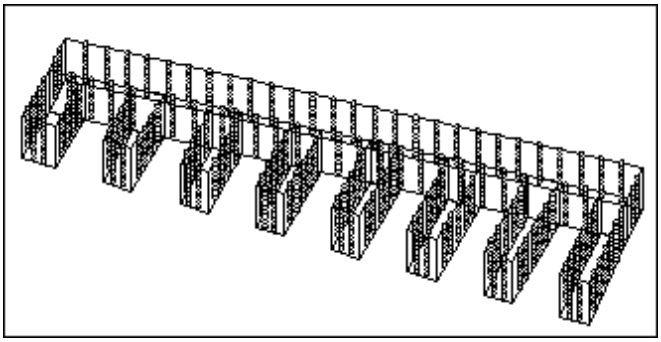

Figure 2: The distribution of calculation points along one of the multi-storey buildings in Fig. 1. Façade levels are calculated at each individual receiver point.

Assessing of Sound Insulation

For rough estimations the performance of windows is used to assess which buildings in the area need further treatment or even a complete reinstallation. When a more detailed study is required the building facade composed of different parts (e.g. facade/roof, window, air intake) can be modelled in detail making use of the outdoor level as calculated with the noise mapping software. Both techniques are discussed in the following.

Assessing Window Sound Insulation

The resulting sound insulation of facades is often dominated by the sound insulation of the window. In order to judge whether the sound insulation of windows for all residential buildings in a project is sufficient in relation to the facade level the design characteristics of windows have to be evaluated. This can be achieved by using a simple check list. The windows are classified into performance classes, e.g. according to VDI-guideline 2719 [3].

In the noise immission software **CadnaA** [4]**,** user-defined text variables can be addressed to any objects via the memo window which can be accessed e.g. in the Result Table. The memo-box of each **CadnaA**-object may contain an arbitrary number of text variables with figures addressed to. Afterwards these variables can be accessed using various commands (e.g. with the Result Table, with object colors, and more).

In this case, the sound insulation class of the windows of each building is imported from a spreadsheet via ODBC-connection into a memo-variable called SSK („Sound Insulation Class"), followed by a number according to the estimated window performance. All buildings inside the relevant areas with a characteristic building noise level exceeding a limiting value and with windows of a specified sound insulation class can easily be identified or marked. Figure 3 illustrates how buildings having a building noise level of more than 70 dB(A) and window sound insulation class SSK less than 2 accord. to VDI-guideline 2719 are colored.

Figure 3: Buildings fulfilling a specified citerion are shaded.

In this evaluation, only those buildings have been included into the building evaluation having a height of more than 3 m and a ground area of more than 50 m² leading to a result for residential buildings only.

Assessing sound insulation of facades

This procedure is useful when national building regulations specify the indoor noise level as performance parameter. With the building acoustics software **BASTIAN** [4] even complex situations can be modelled. The outer element (facade or roof) can be composed of several parts, including windows, roller shutter boxes, or ventilation devices. A receiver point defined in **CadnaA** is addressed as sending level for outdoor noise transmission in **BASTIAN** (Figures 4 and 5). By the live-update feature changing the time domain (day-nighttime) and switching between **CadnaA**-variants is accounted for. This link between noise immission and building acoustics software allows to study the indoor noise level in case of different scenarios very easily and comfortably.

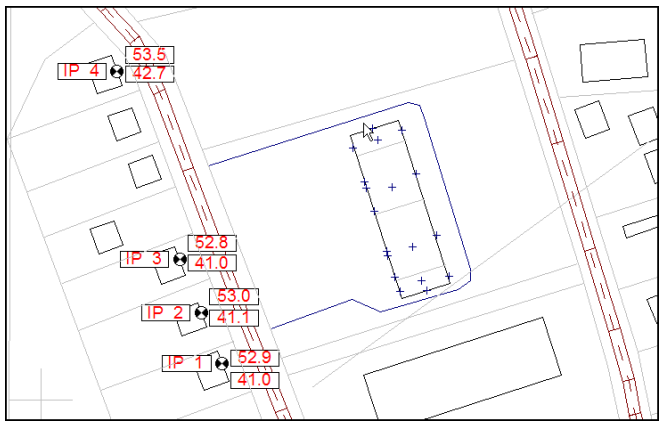

Figure 4: Situation with industrial and road noise with four receiver points; daytime level (upper level box) and nighttime level (lower level box). The daytime level of 53,5 dB(A) at IP 4 is transferred to **BASTIAN** and live-updated.

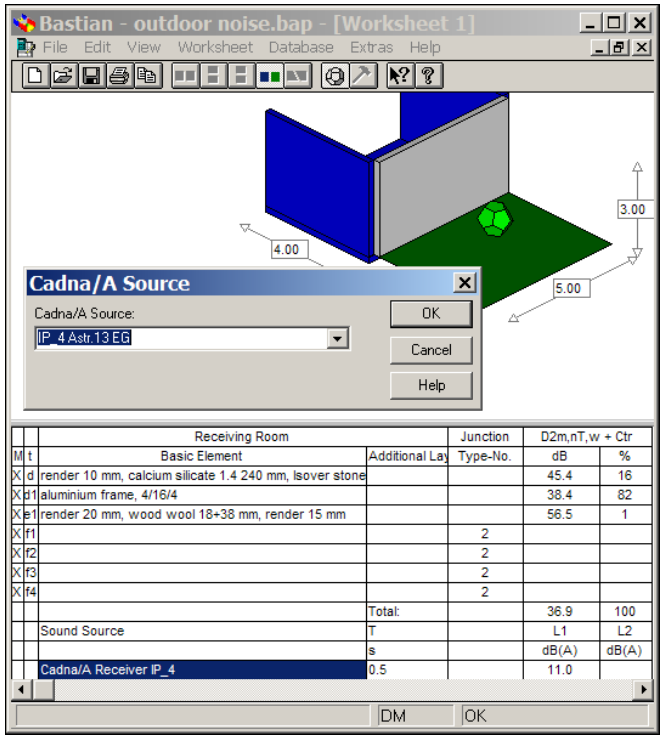

Figure 5: Designing the façade sound insulation using the building acoustics software **BASTIAN**. The daytime level at receiver point IP 4 is addressed as outdoor level (marked cell) when calculating the indoor level.

References

[1] Directive 2002/49/EG of 25 June 2002 relating to the assessment and management of environmental noise, Official Journal of the European Communities L 189/12 dated 18.7.2002.

[2] H.A. Metzen, W. Probst: How to fulfill the Requirements of the EU-Directive about Environmental Noise, Euronoise 2003.

[3] VDI-guideline 2719: Schalldämmung von Fenstern und deren Zusatzeinrichtungen, Edition 8/1987.

[4] http://www.datakustik.de