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LKZ-METHOD: A METHOD TO CALCULATE NUMBERS OF NOISE EFFECTED CITIZENS IN URBAN AREAS

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ABSTRACT

In Germany noise maps are a well-trying tool to visualize noise pollution. But, noise maps can give only a qualitative overview. Normally, this is not sufficient. Especially decision-makers have to know where to start the implementation of noise abatement measures with the best cost-benefit-ratio. Therefore it is necessary to evaluate the effectiveness of proposed abatement measures quantitatively and to set clear priorities in the view of the available budget for noise reducing measures. One method for determining the number of noise-affected people and the degree of their affection is the LärmKennZiffer (LKZ)-Method (Noise-Evaluation-Index-Method). Also it is possible to calculate the depreciation of properties and the loss of taxes depending on noise pollution. The LKZ-method is applicable above all to the source groups *road traffic* and *railway traffic*.

1 - PRELIMINARY REMARKS

The objective of noise abatement planning is the reduction of noise impact on citizens. Therefore, one has to know at least

- whether there are areas with noise-caused conflicts, or not
- how many inhabitants are affected in those conflict areas,
- what measures do exist to reduce the noise pollution in the determined conflict areas and
- how effective the different measures are.

In Germany noise maps are a well-trying tool to visualize noise pollution. But, noise maps can give only a qualitative overview. Normally, this is not sufficient. Especially decision-makers have to know where to start the implementation of noise abatement measures with the best cost-benefit-ratio. Therefore it is necessary to evaluate the effectiveness of proposed abatement measures quantitatively and to set clear priorities in the view of the available budget for noise reducing measures.

This means in plain English: That area will be on top of a priority list where the most effective improvement of the noise situation for the most inhabitants could be reached with the lowest costs.

2 - LKZ-METHOD

One method for determining the number of noise-affected people and the degree of their affection is the LärmKennZiffer(LKZ)-Method (Noise-Evaluation-Index-Method). The LKZ-method is applicable above all to the source groups *road traffic* and *railway traffic*.

The calculations are considering beside the sound-level the following propagation parameters:

- type of building (e.g. detached houses, semi-detached houses, blocks),
- building structure (e.g. blocks parallel to noise source, ribbon development)
- use of the building (e.g. percentage of residential and commercial use),

- building density (e.g. number of floors) etc.

In the course of developing the LKZ-method simplified sound propagation calculations have been carried out based on above mentioned and further more parameters. The results of in total more than 1,000 case studies allowed the determination of 8 typical urban building structures (look at picture *Types of Building Structure – Examples*). For those, exact calculations (point by point) of sound levels have been made.

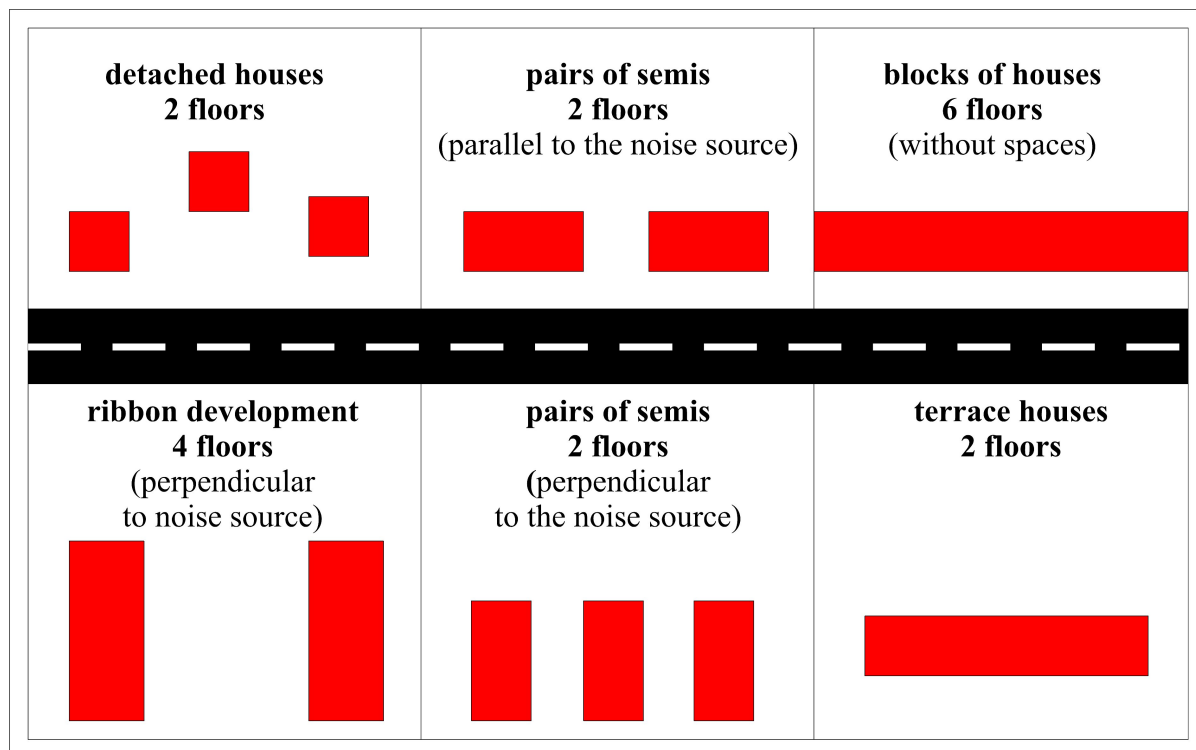


Figure 1: Types of building structure – examples.

3 - RESULTS IN PRINCIPLE

The results of calculations with this method are as follows:

- DIFF: exceeding of defined guideline values depending on different land uses (DIFF = difference between guideline values and calculated sound levels)
- E: number of inhabitants affected by noise exceeding defined guideline values
- LKZ: degree of affection (LKZ = product of E and DIFF)

In addition to that, detailed information is provided about the number of inhabitants suffering from

- sleep-disturbance caused by noise pollution (at night more than 45 dB(A) – mentioned by the WHO in 1998) and
- from health-risk caused by noise pollution (more than 65 dB(A) – mentioned in the targets for environmental quality of the Federal Environmental Agency).

A model to calculate the depreciation of properties and the loss of taxes depending on noise pollution is going to be developed.

4 - PRESENTATION OF RESULTS

The figures E, DIFF and LKZ can be calculated for example for

- defined parts of an urban area (e.g. districts, streets lined with houses),
- different types of roads (e.g. urban roads, motorways) and railways as well as for

- raster-areas.

These results could be added up to results for a whole town. Also they can be calculated for single buildings or groups of buildings.

	Affected Inhabitants [E]		LKZ [dB(A) × E]	
	Night	Percentage	Night	Percentage
District A	340	7 %	2,077	8 %
District B	942	20 %	5,750	21 %
...	1,132	24 %	7,236	26 %
In total:	4,655	100 %	27,400	100 %

Table 1: Example – analysis of noise pollution divided into different districts.

	Affected Inhabitants [E]		LKZ [dB(A) × E]	
	Night	Percentage	Night	Percentage
Urban Roads	1,459	7 %	2,077	8 %
County Roads	1,582	20 %	5,750	21 %
National Roads	227	5 %	1,540	6 %
....	1,381	30 %	11,509	42 %
In total:	4,655	100 %	27,400	100 %

Table 2: Example – analysis of noise pollution divided into different types of roads.

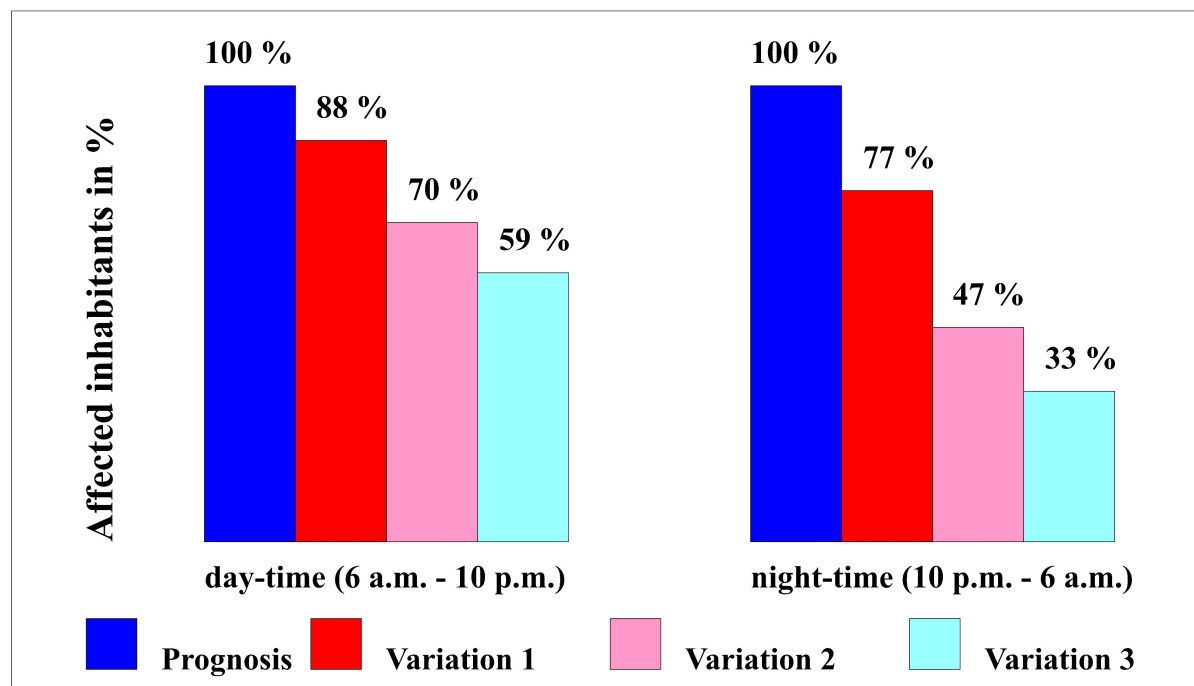


Figure 2: Example – noise reduction potentials divided into planning variations.

	Development of the Number of People suffering from...	
	... health-risk	... sleep-disturbance
<i>Scenario Road Planning</i>	+ 6 %	+ 3 %
Scenario Environment	- 19 %	- 6 %
Scenario Public Transport	- 16 %	- 4 %
Target Scenario	- 21 %	- 8 %

Table 3: Example – number of affected people depending on different scenarios (*in italics: increase in comparison with the Analysis 1998; normal: decrease in comparison with the analysis 1998*).

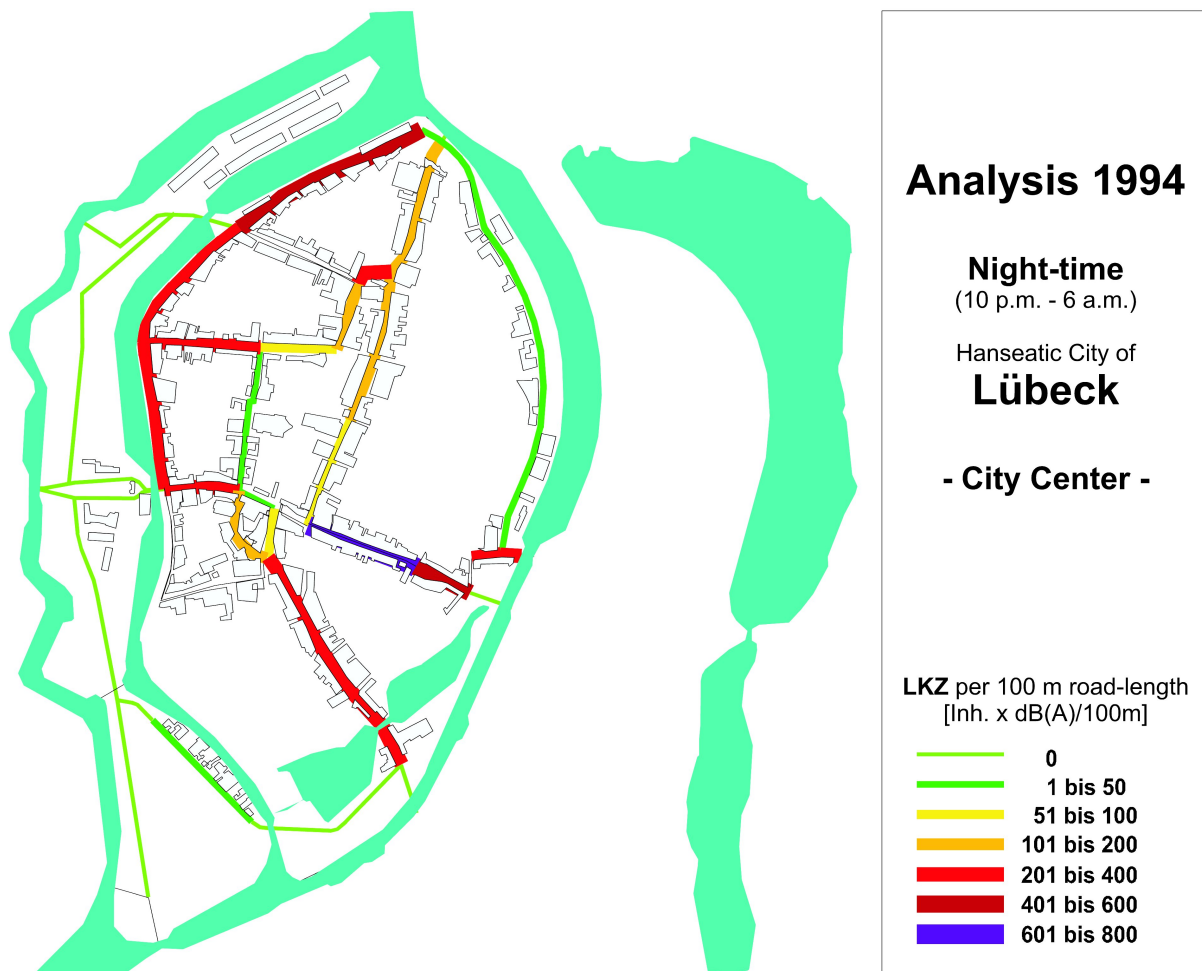


Figure 3: Example – simplified LKZ-map.

5 - ADVANTAGES

With the establishment of priorities in the course of noise abatement planning, first, the number of the LKZ is being considered:

- A high LKZ can mean e.g. either a few people affected by high noise levels or many people affected by low noise levels.
- A high LKZ points out a high level of conflict.

The evaluation of noise impacts with the LKZ-Method spares the classical conflict plan or at least supports it, as:

- Wherever noise affected people are, there is also a conflict.
- Wherever high noise affection is registered, there is a strong need of noise abatement.

Especially for the most dominating noise source, the road traffic, the advantage of this calculation model is clearly obvious:

- It helps to quantify precisely and in a short span of time the effects of noise abatement measures and concepts.
For the input parameters of the database it will only be necessary to put in the data of traffic density, road surfaces, permitted maximum speed etc. During data input calculation is carried out. That means: Results are available at once.
- The clear and comprehensible figures could at once show precisely, where noise abatement measures could be implemented with most success. With regard to increasing restrictions on the budgets of

the municipalities, the results of this transparent, quick and easy calculation method will especially be of interest for political stakeholders.