EXPERIENCE WITH LARGE SCALE AND CITY NOISE MAPPING

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Introduction

Noise Mapping is the basis for a EC-wide noise reduction policy and it is therefore of major concern to use effective and economically optimized strategies. Taking into account the financal efforts necessary to fulfil the requirements of the EC directive about environmental noise, it is worth to think about the best use of these data and produced results even on national and local level. Any improvement of strategies and technical procedures using all the experiences with latest projects seems to be justified.

Some years ago it was rather impossible to calculate a noise map of a large city with customary business computers in one sweep. Newest software technologies have changed this completely – we are not only in a position to use all available business equipment for noise mapping, but we can even calculate noise levels exactly in front of the most exposed façade, use the exact number of inhabitants of the buildings to derive the statistical analysis required by the directive and update these results from time to time nearly automatically with databases and GIS used by a community. The ability of a software package to handle the data transfers to GIS and database as well as being able to do all operations of noise calculation and evaluation as stand alone system opens a lot of additional applications for the environmental agencies of cities and communities, because they are able to control and fulfil legal requirements of planned projects on the basis of the dataset developed in the frame of EC noise mapping. Some important aspects that are a consequence of the last years projects are presented.

Noise reduction – the main target

The reason for all these efforts of noise mapping is at the end to prevent us from raising annoyance caused by noise or even to reduce annoyance where accepted limits are exceeded.

A reduction can be achieved by technical and organisational measures. Actions to reduce the noise are generally defined for larger areas, so it is advantageous to do a certain spatial averaging if the noise load of areas shall be ranked.

All evaluations should be oriented at this last target – the achievable noise reduction. Only those quantities should be taken into account, that may influence the ranking of problems and the decisions about measures. On the other side such an analysis is erraneous, if parameter values with apparent influence are not taken into account.

The Strategic Noise Map – Spatial Distribution of Levels

With a spacing of generally 10 m the noise levels are calculated on a horizontal grid. Interpolating between the grid points, a horizontal distribution of noise levels can be presented as coloured noise map.

It is important to take into account that this is only a noise distribution and gives no information about the noise that annoys people. It may even be that nobody lives in an area that is presented as “Hot Spot” in the strategic noise map.

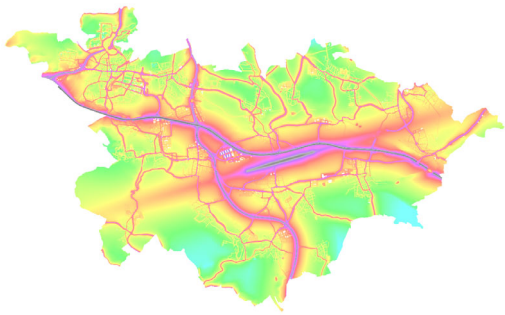

Figure 1: Strategic noise map of the Fildern area

Ranking the Annoyance of People caused by Noise

If we want to indicate how noise annoys people it is necessary to know the noise levels at the position of buildings where these people live. The EC directive requires to use the noise levels at the most exposed façade as basis and to determine the distribution of inhabitants relative to 5 dB level intervals.

The levels at the most exposed facades can be detected by calculating on a grid that covers these facades completely. Even if it is allowed or even compulsary to derive these “building noise levels” from strategic noise maps in the frame of the EC directive it is not recommended to use this procedure for planning purposes. The 10 m spacing of the grid is to large and the information to unprecise to get reliable results.

Calculating these façade levels for all buildings, we know the highest and the lowest level for each building.

Different and alternatively possible situations can be ranked acoustically if we sum up levels and people annoyed using the equation

$$X_i = n_i \cdot 2^{(L_i - L_{lim})/10} \qquad (1)$$

with n_i the number of inhabitants of building i, L_i the level in front of the most exposed façade of building i and L_{lim} a

limiting value that – if taken constant for all buildings – does not influence the result.

If we produce a map with coloured buildings where the colour of each building represents the value X_i, we get a better representation of annoyance because this takes the number people annoyed into account.

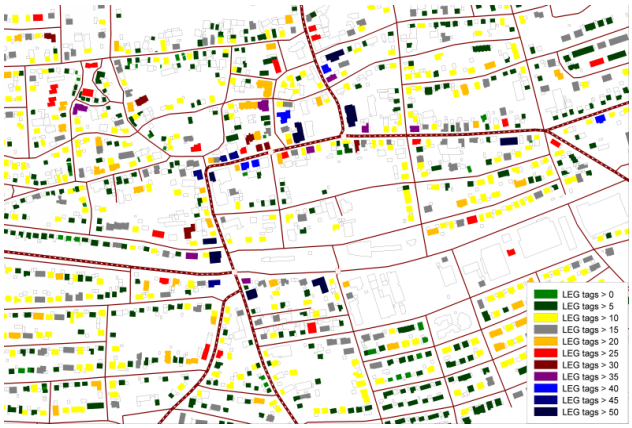

Figure 2: Colours of buildings to show the noise load

Coloured buildings are no solution if we want to show this results on large scales, because buildings are reduced to points in this case and the information of colour disappears. With larger scales we use the technique of "Object Scan" for the map. It produces a coloured map in any scale, where the "Noise Load" is spatially averaged. To produce this map of Noise Load, the following procedure is repeated for all grid points in a 10 m x 10 m grid:

A quadratic polygon of 50 m x 50 m is centered around the grid point. Then the value X_i from (1) is summed up for all buildings inside the polygon. If only a certain percentage of the ground surface of a building is inside the polygon, this same percentage of X_i is taken into account and summed up. At the end the summed up value for this polygon is divided by the area of the polygon and multiplied with a reference area (generally 1000). This result value – the noise load according to (1) for 1000 m² - is the value connected to this grid point.

After shifting the polygon 10 m and centering it around the next grid point, the procedure of summing up the noise load and normalizing it is repeated. The presentation of this map of Noise Loads allows much better than the strategic noise map to identify the "Hot Spots" where noise reduction measures should be considered.

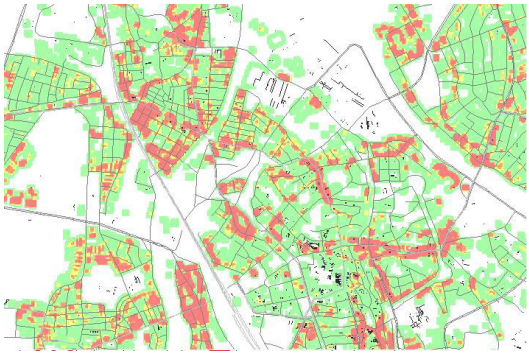

Figure 3: Noise load presented as 50m x 50m spatial average

This last presentation is good basis to rank the noise problems in an area and to decide about the necessity of noise reduction measures.

Different Sensitivities of Areas – the Conflict Map.

The conflict map shows the difference of existing levels and limiting values. With different limiting values for different land use we express that the sensitivity against noise or our expectation about it may be different.

Another problem are the different limiting values L_{lim} for different noise types in action planning. If we have a sporting facility with L_{lim} = 50 dB(A) near a road with L_{lim} = 60 dB(A) and the noise from the sport field is 53 dB(A), that of the road 58 dB(A), then there is only a conflict from the sporting area. In reality we know that measures at this sporting area like barriers or modification of opening times will not give any benefit because the road noise dominates. This means nothing else but not to calculate conflicts related to noise types and to sum these up. For city planning purposes it is much better to add the noise levels and to compare these with any defined target level.

This procedure has proved to be the best basis for action plans supported by cities and communities, because it meets their own requirements. Nevertheless the same data can be used to use exactly the approach recommended by the EC directive.

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