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City Noise Mapping without Traffic Data

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The authors have a large experience on transport and noise planning and mapping with projects on many communities of different size in France. Within the time scale of a mapping project, it is very common to have a large variation of the accuracy in traffic data, especially for roads (largest source data base). Furthermore, in many cases, no traffic data is available on less exposed roads.
This paper illustrates how variation of input data accuracy and lack of data were tackled for various types of urban territories, in order to provide city noise maps, with the required accuracy and information for political action and communication.

1 Introduction

According to the European Directive 2002/49/CE, noise maps of roads in urban areas should present the noise generated by roads in an exhaustive manner with no minimum level of traffic. Data of reliable assumptions are generally available for main roads (counts, classification, traffic models) but local roads with a lower level of traffic, numerous in urban areas, rarely have quantitative traffic data.

A relatively low level of precision is required for traffic data because of, on one hand their logarithmic translation in terms of noise levels and on the other hand because of the nature of noise issues in terms of statistical noise exposition for the populations, some "fixed values" approaches are possible to estimate traffic parameters on theses roads.

However, for a prospective use of these noise maps in urban areas, the uncertainty level for entry data can be penalising. Therefore, In order to complement the classic "fixed values" approach, we present two levels of more detailed methodological approaches developed in common by noise management and transport planning experts. It enables the attribution of assumptions of traffic levels on urban roads in accordance with their use for strategic noise mapping, according to each local context.

2 Issues

In France, we dispose of data or traffic estimations (from the work related to noise classification according to the current regulation), for all roads that could potentially have in the medium term an average daily traffic of more than 5000 vehicles

However, the entry data from the noise classification of urban roads, excluding the main axes, are often very approximate. For these roads, or those for which the estimated flow is higher than 5000 vehicles /day, the use of noise maps can become difficult given the uncertainties related to the entry data of the mapping model.

Even if, in nature, the issues lay less with the reduction of excessive noise for local population, the question remains regarding:

- The relevance of noise evaluations for local residents exposed to moderate noise level on the territory
- The characterisation of quiet areas
- The exploitation of noise mapping in a prospective way (crossed analysis, urban planning, action plan on other sources,…)
- More globally, the credibility of the informative role for noise maps.

For example, the change of a traffic plan or the introduction of a dedicated public transport lane can modify, for an important number of residents, their exposition to road related noise. The acoustic analysis of this type of action, even if it is conducted in a comparative manner (and not with absolute value) can constitute an important issue, which requires data as reliable as possible.

3 Several possible approaches

3.1 Introduction

The production of transport data on the noise mapping perimeter can be undertaken according to three main approaches which all respond to the initial requirements of noise mapping but which offer different accuracy levels and moreover different options of use of the noise mapping as a decision tool for local stakeholders.

We describe below these three approach levels detailing their respective advantages and limits.

3.2 « Fixed values » methodology

The first approach takes into account a « fixed values » method. This approach, which can be considered as approximate, is generally applied to noise mapping studies (according to the recommendations in existing methodological guidance). It consists of indicating the traffic on each road section from the classification of the road network according of the road use (transit, distribution, local access, etc).

The results can then be compared with partial count data that can be collected on the territory and possibly, some manual corrections can be applied punctually.

This methodology has the advantage of being undertaken rapidly and can be sufficient to perform the required calculations for population or sensitive buildings exposition given the inaccuracies affecting the other data required for these calculations (population data) and their evaluation characteristics (calculations 4m away from the frontage the most exposed). However, this methodology has its limits.

The first limit is the fact that it is based on a network classification established by a third party (usually an external contractor supplying the database) and who does not take into account the real use of the road. In addition,

the « fixed values » applied does not take into account the real traffic on the network since, for a given road type, the same traffic is applied independently from the road localisation and its real role in the network grid.

Thus, it seems really important, following the use of this method, to perform a posteriori a rigorous control of the traffic assumptions resulting from this process. This control can take the form of a second reading of thematic maps (fig.1) showing the suggested traffic parameters (flows, %HGV, speed, etc).

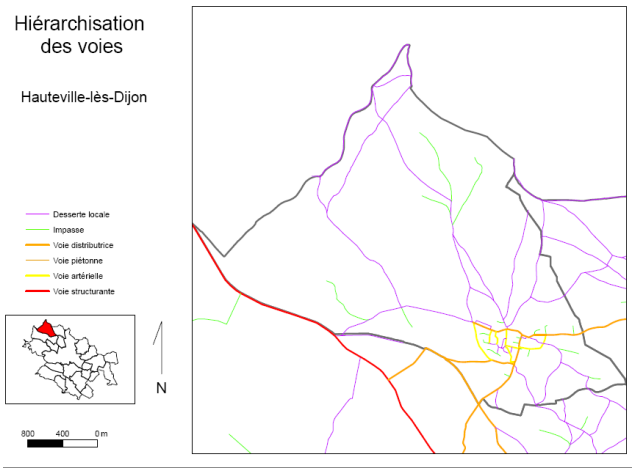

Fig 1 Example of thematic map of the road hierarchy before « fixed values » of the flows for expert analysis by local stakeholders

This work requires a collaboration with the technical services responsible for the road network in order to check according to their knowledge that there are no major distortions (for example, the affectation of « fixed values » traffic on a recently pedestrianised street! – fig. 2).

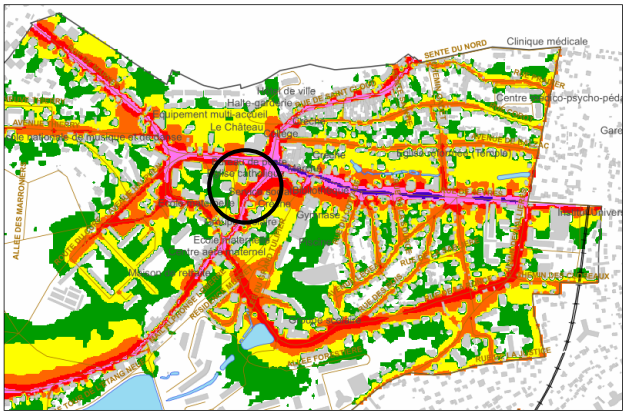

Fig 2: example of inaccuracy on the representation of urban noise because of a local error of traffic « fixed values »

Therefore, we recommend the application of this type of methodology of « fixed values » on limited perimeter on which manual checks can easily be performed by local stakeholders. An illustration of the type of approach applied to Dijon urban area where this methodology is currently being used will be presented during the session. Another limit of this type of methodology relates to the use of noise mapping as a decision tool. Indeed, this methodology can enable the testing of measures taken in order to reduce disturbances caused by existing traffic (acoustic barriers, appropriate road surface, etc.), but does not allow the measure of the impact on noise of measure taken in terms of transport policies (new road network classification, traffic bypass, increase of public transport supply, etc.) which are the only measures that tackle the source of the noise.

3.3 Use indicators

As we have seen it before, one of the limit of the "fixed value" methodology is the fact that the local context end the real uses of the road network are not taken into account.

In order to address this issue, we have developed a methodology based on the definition of a use indicator of the road network based on a transport modeling approach.

This approach consists of defining, from a set of mobility data that can be obtained on a territory (commuters, travel surveys, etc.), a potential demand in the form of a demand matrix.

This matrix is then affected on the road network according to a simplified affectation process which takes into account the physical characteristics of the network (road type, speed, capacity). This affectation can easily be performed by an existing modelling software such as the software Cube developed by Citilabs.

The affectation first produces an indicator qualifying the use intensity of each road section of the network.

The second step consists of rectifying automatically this indicator by using existing partial count data on the territory. Some corrective measures can then be applied in order to get closer to some aggregated indicators (such as the number of vehicle.km by network type that can be made available from other sources).

The advantage of this type of method is to have, on extended and complex perimeters, an automated process enabling the evaluation of a traffic charge on each of the road section that would be compatible with available data. An illustration of this type of approach, applied to a part of the urban area of Montpellier where this type of approach is currently being used will be presented during the session.

This method remains nevertheless limited in terms of prospective and does not allow testing measures taken with regards to transport policies.

MVA has set up this methodology in the context of production of pollution maps where the issues in terms of knowledge of traffic are similar to those described for noise mapping. We have used these principles to undertake a study for the Ecology Sustainable Development Ministry resulting in a national inventory of air pollution generated by mobile sources in France.

3.4 Transport modelling

The third methodology is the most complete and enables noise mapping to be used as a real decision tool in the implementation of projects by the authorities.

This method consist of creating an interface between the noise emission model and the transport model which can be either an affectation model or a complete multimodal model.

The illustration below presents the result of an urban affectation model which can be directly used in the context of noise mapping. The width are directly proportionate to the intensity of traffic and the color represents the road saturation level (speed). This model can therefore be applied in the base scenario and in the project scenario to evaluate traffic changes and therefore the consequences of noise measures implemented for noise management.

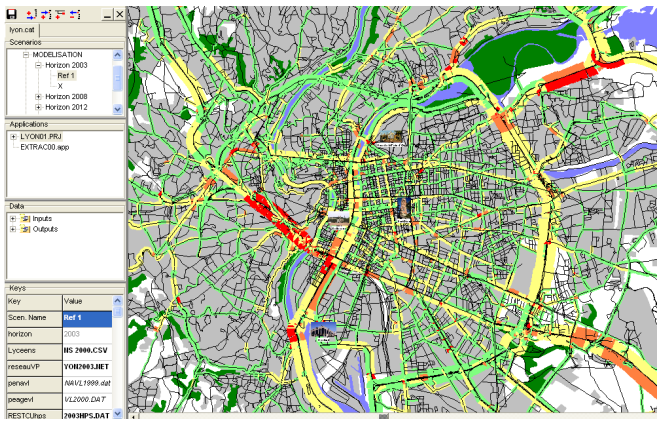

Fig n°3 : Example of results from an urban affectation model (saturation levels)

The principal limit of this method is that it generally exceed the financial constraints linked to noise mapping because it is based on a the implementation of much more complex tools and involves wider issues. However, the initial investment can be considered in the sense that it can help the update of future noise maps (imposed at least every 5 years by the regulation) and the use of noise mapping to test scenarii.

Therefore, we recommend this methodology to authorities that wish to engage in the development of a complete procedure in order to obtain a decision tool in transport planning. In this context, it seems interesting to develop a synergy between transport models and acoustic models. Beside the interest of possessing more reliable tools, the main advantage lays with the fact that in addition to traditional analysis of project impact (usually limited to traffic), they would be able to measure noise impact and therefore to integrate fully this element in their planning policies. An illustration of this type of approach applied to the exemple of Nice urban area where it is being implemented will be presented in the session.

4 Conclusion

The close relationship linking urban noise management and the knowledge of trip patterns requires, for urban areas, to associate acoustic expertise and transport expertise. This expertise can take the form of various levels of involvement depending on the local context (work perimeter, transport strategic orientations, development issues, political will, integration of noise environment in planning choices, …).

Depending on these various contextual parameters and the technical and financial means dedicated to the realisation of noise mapping, three types of methodological approaches can be implemented. The choice of the working process to apply depends first of all on the precision level required to perform the road related noise mapping. When the client does not wish to go further than the regulatory frame, which does not require a great level of precision for the entry data, the traditional “fixed values” approaches can be sufficient although they depend on the validation of the road classification by local stakeholders as “experts” for their territory.

Whenever the authority has an objective of use of noise mapping as a decision tool in the context of its planning policy or its local transport plan, or also as a justification to defend a solution or a scenario for its noise prevention plans, then it is relevant to rely on a methodology derived from transport planning techniques. Its can call on:

- Either a simplified affectation process enabling the use of a indicator if road use delivering traffic data closer to reality than general assumptions
- Or the development with a complete transport modelling tool which gives the advantage of a real dynamic decision tool which helps the understanding of links between urban transport and noise.