SMILE

Guidelines for Road Traffic Noise Abatement

Sustainable Mobility Initiatives for Local Environment

Guidelines for Road Traffic Noise Abatement

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Part 3. Selected examples of effective noise abatement measures in European towns and cities

Introduction

Noise contributes greatly to diminishing city dwellers' quality of life. In particular exposure of people to noise levels above 65 dB(A) can cause severe health problems. Road traffic is a main source of noise in urban areas, accounting for about 80 % of total noise pollution.

Against this background, the European directive on environmental noise requires local authorities to assess noise levels in their local environment, to fulfil common noise indicators and to produce action plans in order to prevent or reduce harmful effects of environmental noise.

In this context this publication as part of the SMILE project deals primarily with the issue of road traffic noise. The main focus of the 'Guidelines for road traffic noise abatement' is an identification of innovative activities directed towards reducing noise due to urban traffic; practical principles are elaborated with the aim of pointing out existing potential for noise abatement measures in a field for which local authorities are responsible and can therefore more easily take action.

This publication aims to present and to disseminate innovative and successfully implemented examples of noise abatement planning in selected European towns and cities.

The main objective in these guidelines is to facilitate putting into practice planning for noise-reducing measures in the following fields:

- reduction of traffic density; reducing percentage of heavy goods vehicles; reduction of speeds; renewal of public transport and (heavy) goods vehicles; changing road surfaces etc.; noise screening; sound-proof windows and urban planning.

Non-technical issues, organisational and strategic approaches, are equally relevant and are also outlined:

- an organisational approach is essential for integrating noise abatement planning into current planning processes at local level and cooperating with stakeholder and the public within a city. The strategic approach should ideally aim at linking a local noise policy with policies at regional, national and EU level.

In outlining the topics described above, the guidelines are directed towards giving decision makers, experts and professionals working in this field readily-available practical information on initiating new ideas and inspiration or furthering existing activities and thus successfully to plan and implement noise-reducing measures according to a municipality's local needs and demands. The instruments and overall concepts presented are designed to provide valuable benefits for citizens seeking approaches with regard to fighting urban noise pollution in order to create a more habitable urban environment.

The guidelines and associated recommendations are based on the following four elements:

- a survey conducted in 86 towns and cities in EU member states and eastern European accession countries;
- a Task Force working group comprising noise experts from Denmark, Germany, France and Italy, who both individually and collectively provided valuable input in elaborating the guidelines based on their expertise, knowledge and experience, in the course of four meetings held between May 2002 and June 2003;
- the European workshop entitled 'Guidelines for Road Traffic Noise Abatement' which was held in Berlin on 20 and 21 October 2003;
- policy guidelines giving recommendations for planning, managing and implementing noise abatement strategies at local level.

By means of this publication those involved hope to contribute to on-going activities of the European Commission in order to improve the built environment and enable a better quality of life for the inhabitants of European towns and cities.

Compilation of these guidelines can be attributed to the members of the Task Force working group, in particular to:

- Dr. Daniele Bertoni, City of Modena, Italy
- Guillaume Dutilleux, Centre d'Etudes de Techniques de l'Est, Strasbourg, France
- Hugo Lyse Nielsen, noise expert, Copenhagen, Denmark
- Gertrude Penn-Bressel, Federal Environment Agency, Berlin, Germany
- Christian Popp, Lärmkontor GmbH, Hamburg, Germany
- Catherine Serve, Centre d'Etudes de Techniques de l'Est, Strasbourg, France

All the partners in the SMILE project would like to thank everyone who contributed to the survey, during the European workshop in Berlin and in any way towards elaboration of the guidelines, for their fruitful and significant collaboration.

The SMILE consortium

Part 1. Overview of research results

In order to gain an overview of the situation and activities in the field of noise abatement planning in local authorities, a research study was carried out. For this purpose a questionnaire was sent to selected to European towns and cities. The focus of the questionnaire was centred on road traffic noise as local authorities can act on their own in this field. In addition, a principal criterion was that the measures had to be or have been implemented, as the overall objective of the survey was to identify concrete examples which were put into practice, particularly as noise-reducing measures are very often not implemented. It should be noted that some towns and cities may be active in only one of the categories for measures listed below, whilst other combine their efforts, carrying out a bundle of measures.

Number of dispatched and returned questionnaires

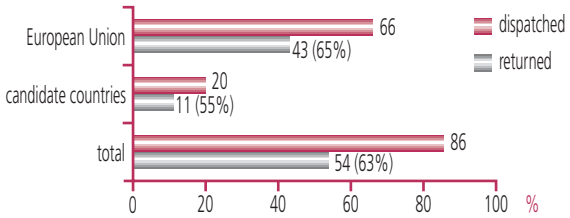


Table 1: Number of dispatched and returned questionnaires

Evaluation comment

In total, 86 questionnaires were dispatched to local authorities, of which 66 were sent to municipalities in EU member states and 20 in accession countries. There was a total of 54 responses, 43 from member states and 11 from candidate countries. The overall return rate of questionnaires was 63 %, showing that almost two-thirds of the local authorities responded to the survey and indicating a high level of awareness for traffic-related noise issues.

Cities' size according to number of inhabitants

Cities up to 100,000 inhabitants	12
Cities > 100,000 inhabitants	19
Cities > 250,000 inhabitants	23

Table 2: Cities' size according to number of inhabitants

Though the overall number of dispatched and returned questionnaires cannot to be seen as representative in terms of numbers, however, the cities provide a well-balanced mixture of small, medium-sized and large municipalities based on numbers of inhabitants, as shown in table 2. Thus it can be assumed that the varying structure of the participating cities give a valuable overview concerning implemented noise-reducing measures, enabling transferability of measures to other European local authorities.

Type of measure implemented or action taken in road traffic noise abatement

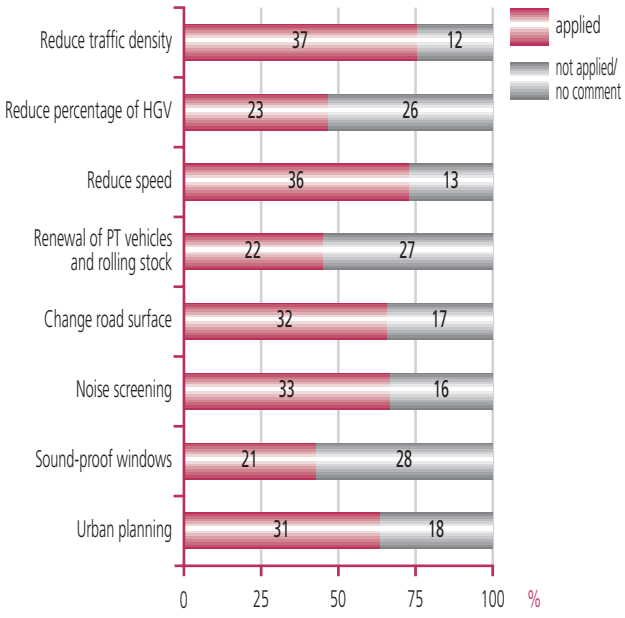


Table 3: Type of measure or action implemented for road traffic noise abatement

Evaluation comment

The majority of cities are pro-actively realising measures in fields such as 'reduce traffic density', 'reduce speeds' and 'urban planning'. So it appears that traffic-related noise questions are easily integrated in current planning processes or will be integrated into new processes, including road maintenance, urban renewal or revision of an existing land use plan. The issue 'reduce percentage of HGV' seems to have a much lower priority, even though re-routing of HGV can be seen as a comparatively inexpensive and very effective measure.

Measures such as 'changing road surface' and 'noise screening' also have high priority. The high percentage for the first issue seems to indicate that changing road surfaces often includes replacing uneven surfaces, e.g. cobblestones, by smoother asphalt surfaces in the course of on-going road maintenance; on the other hand, low-noise road surfaces are rather expensive.

Noise screens such as barriers or earth banks are often constructed along roads with high volumes of traffic, e.g. inner city sections of a motorway, a main road/fly-over linking the centre with a motorway, or along railway lines. 'Sound-proof windows' are mostly introduced in noise-sensitive areas, e.g. residential housing along main arterial routes where there is no space to build noise barriers, or in specific buildings such as schools. In many cases barriers and sound-proof windows are co-funded by regional or national administrative bodies.

The 'renewal of PT vehicles and rolling stock' requires major investment, so it currently seems to have a lower priority for many local authorities as it can be achieved only on a long term basis.

Forms of information and participation of involving people affected, associations and organisations

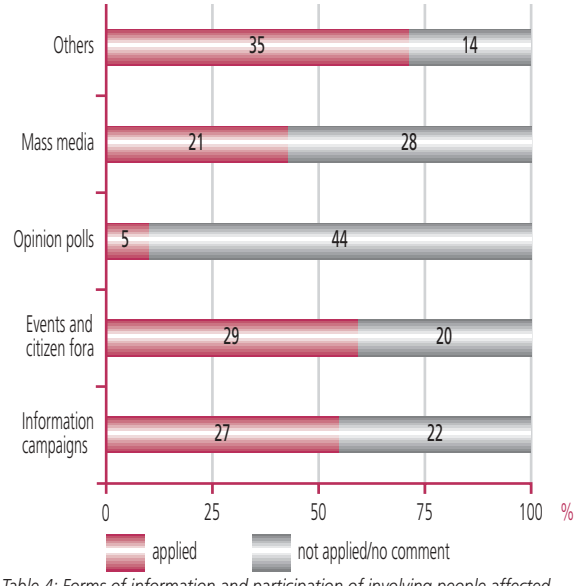


Table 4: Forms of information and participation of involving people affected, associations and organisations

Evaluation comment

Most commonly 'events and citizen fora' and 'information campaigns' as well work with 'mass media' are used for participation and information. In addition, specific consultation and dialogue processes such as targeted meetings with residents, local shop owners' association, special training for technicians are used as well, as indicated by the large proportion of 'other' approaches.

It is necessary to point out that, depending on the scope or range of measures and actions planned, e.g. re-designing a main road or urban rehabilitation in an inner city, these various instruments are often combined: firstly, to raise awareness for the noise issue and secondly, in order to involve as many members of the public as possible, aiming at a high level of acceptance for the proposed plan or measures. In general it can be noted that the Internet is playing an increasing role as an instrument for information purposes in the category 'others' (miscellaneous).

Evaluation of measures and actions

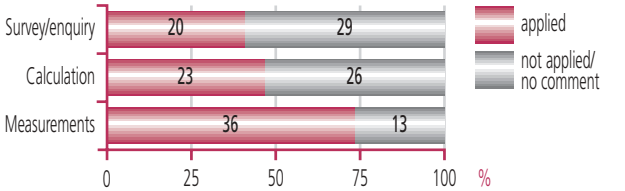


Table 5: Evaluation of measures and actions by assessing effectiveness of an activity before and after the implementation process

Evaluation comment

The majority of towns and cities surveyed makes assessments of measures or actions regarding their noise-reducing effects. In many cases this is carried out by measurement. However, some towns and cities also carry out calculation of the before and after situation. Sometimes this is done additionally to measurement related to specific action, e.g. to minimise noise impact for future development of a newly-built housing area, or in the implementation process of a large urban rehabilitation project, measurements are made during on-going construction and work phases. Enquiries such as surveying residents are also used but not as frequently as the other methods.

Criteria used to set priorities in implementing planned measures

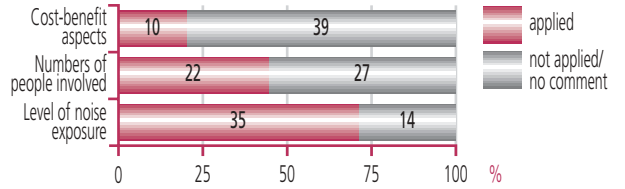


Table 6: Criteria used to set priorities in implementing planned measures

Evaluation comment

The majority of towns and cities surveyed uses noise exposure levels as criteria to set priorities for action. Some local authorities also take numbers of people affected as an additional indicator. Cost-benefit aspects are considered only by a few local authorities as an instrument in setting priorities for implementation of measures and actions.

Financial support from national governments or other institutions

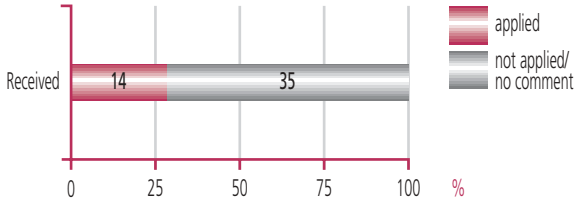


Table 7: Financial support from national governments or other institution

Evaluation comment

A large number of cities have received funding from regional, national and European sources, as indicated in table 7. In most cases the funding is provided for specific actions or projects, such as co-funding for road maintenance on a national road, purchase of new PT vehicles, implementation of sound-proof windows and noise barriers. Other issues include providing technical assistance and/or research through external funding.

Reactions to the realised measures

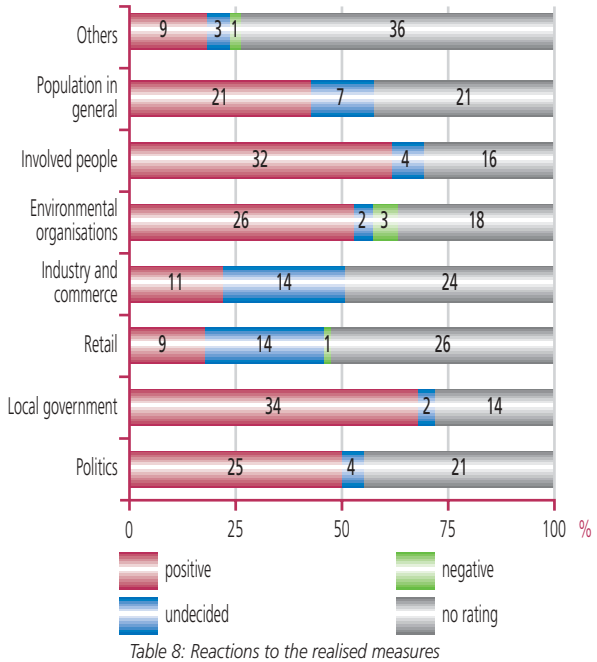


Table 8: Reactions to the realised measures

Evaluation comment

In table 8 reactions to measures of the groups considered are summarised, and it is clear that they vary considerably. The reactions of local government and people affected are very positive. The reactions of environmental groups, politicians and the population in general are still positive. However, at the political level 'undecided' or 'no rating' responses are at the same level as positive reactions. Thus it seems there is need to improve awareness for noise issues among these decision makers.

Industry and commerce as well as retail seems rather hesitant regarding their evaluation of noise abatement planning as positive reactions are low and 'no rating' or 'undecided' responses predominate.

Summary

The research element may be summarised as follows:

- there is a high level of awareness for traffic-related noise issues in local authorities;
- small, medium-sized and large municipalities are engaged in work on implementing noise-reducing measures;
- predominent fields of action are 'reducing traffic density', 'reducing speeds' and 'urban planning' which can be easily integrated into current or new planning processes;
- in the case of participation and information, 'events and citizen fora' and 'information campaigns' as well work with 'mass media' are commonly used;
- to assess the 'before and after' situations, measurement and calculation are carried out;
- priorities for action are identified by the use of noise level exposure and/or numbers of people affected;
- funding from regional, national and European sources is obtained mostly for specific action or projects;
- in principle, reactions towards noise abatememt measures are positive, however, there seems some need to improve awareness for noise issues among local political decision makers. In addition, better communication with retail, industry and commerce appears necessary as these actors will be directly affected by implementing traffic management measures.

Introduction to the European Environmental Noise Directive

In June 2002, DIRECTIVE 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise entered into force. The environmental noise directive (END) aims to establish a common approach, and thereby prevent or reduce the harmful effects of environmental noise. This aim is to be achieved using a bundle of measures:

- introducing harmonised noise indicators
- harmonising the calculation methods for determining noise levels
- harmonising the procedures used to create noise maps and action plans for noise reduction
- providing information to the public on the environmental impact of noise

The END contains the following detailed provisions:

- It introduces the noise indices L_{den} (the average value of the noise level over 24 hours with weighting factors of 5 dB(A) and 10 dB(A) for the four hour evening period and the eight hour night period respectively) and L_{night} (the average value over the eight hour night period), to be used for strategic noise mapping and reporting to the Commission. Member States (MS) may transfer up to two hours of the evening period to either the day or night period, thus enabling them to take climatic and cultural differences into account.
- Noise indices can be determined in accordance with national regulations during a transitional period. The results must then be converted into the harmonised noise indices. If no national regulations exist, the 'interim methods' indicated in the END are to be used. The transitional period ends when the harmonised calculation procedures for L_{den} and L_{night} enter into force.
- MS must provide information to the Commission concerning all relevant limit values, and convert them if necessary into the European harmonised noise indices.
- In an initial phase, 'strategic noise maps' must be created for agglomerations with more than 250,000 inhabitants, for roads that carry more than 6 million vehicles per year, for railways with more than 60,000 train journeys per year and for all civil airports with more than 50,000 flights per year, by the summer of 2007.
- In a second phase, 'strategic noise maps' must be created for agglomerations with more than 100,000 inhabitants, for roads that carry more than 3 million vehicles per year, and for railways with more than 30,000 train journeys per year, by the summer of 2012.
- Action plans must be created for the relevant areas within a period of twelve months, in cases where the criteria (such as limit values) determined by the individual MS have been exceeded.
- The public must be informed about any relevant activities. Furthermore, public participation is a required element of the action plan preparation process.
- Data on the estimated number of citizens exposed to certain noise levels must be sent to the Commission.

Table 1: Timetable for the creation of noise maps and action plans

Area / source to be mapped	Strategic noise maps by	Action plans by
Agglomerations		
• >250,000 inhabitants	30 June 2007	18 July 2008
• >100,000 inhabitants	30 June 2012	18 July 2008
Major roads		
• >6,000,000 vehicles / year	30 June 2007	18 July 2008
• >3,000,000 vehicles / year	30 June 2012	18 July 2008
Major railways		
• >60,000 train journeys / year	30 June 2007	18 July 2008
• >30,000 train journeys / year	30 June 2012	18 July 2008
Major airports		
• >50,000 flights / year	30 June 2007	18 July 2008

Findings and suggestions for successfully planning noise abatement measures

This presentation both reflects and summarises outcomes of the Task Force working group discussions, identifying possible problems and pitfalls in this area, based on their expertise, knowledge and experience, with the aim of helping towns and cities starting new initiatives and/or modifying on-going activities, as well as trying to avoid unintended or unexpected effects in the process of noise abatement planning.

Overall, the following issues will be outlined:

- psychological effects: are small reductions in noise worth the effort?
- experiences gained from traffic calming
- noise screening
- changing road surfaces
- reduction in property value due to noise
- protecting quiet areas
- disadvantages of bypass roads
- possibilities for reducing costs
- maintenance costs of measures
- step-by-step approach
- information and communication

Actions	Efficiency
• technical standards of vehicles / tyres (prognosis for the year 2005)	-2...-3 dB(A)
• traffic calming, 30 kph	-2...-3 dB(A)
• steady driving	0...-3 dB(A)
• lorry bans	-1...-3 dB(A)
• reduction of the number of vehicles by	
20 %	-1 dB(A)
50 %	-3 dB(A)
90 %	-10 dB(A)
• shift from private car to public transport depending on technical standard and occupancy of the vehicles	+6...-9 dB(A)
• redistribution of road space e.g. bus lanes	-1...-2 dB(A)
• noise barriers	+3...-15 dB(A)
German Noise Reduction Goal: in order not to exceed 65 dB(A) during day time in residences in the neighbourhood of all urban roads	-13 dB(A),

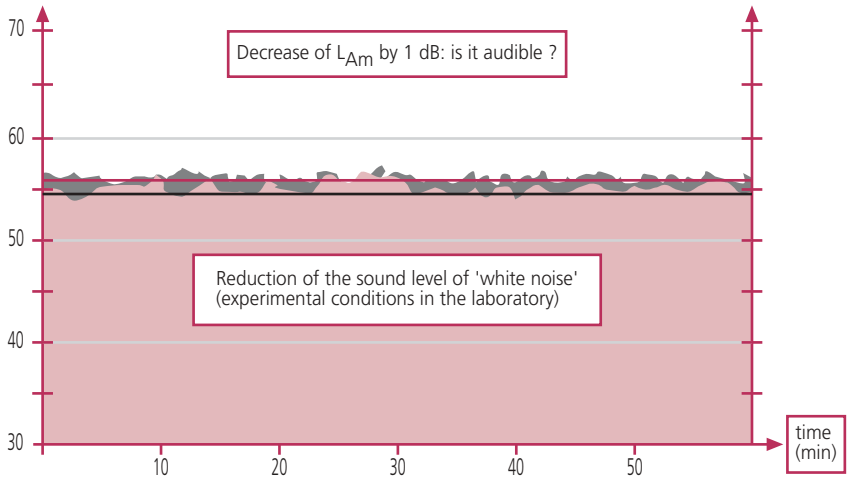
Table 1: Abatement of Road Traffic Noise

Psychological effects: are small reductions in noise worth the effort?

A problem common to most noise reduction activities is that noise can only be reduced in the short term using small steps. Common low cost measures include reducing speed limits, night time lorry bans, and deviating through traffic. Taken individually, these measures result in noise reductions ranging from 1 to 3 dB each (see table 1). A combination of these measures will probably result in greater noise reduction, however in the initial stage it is often only possible to put one of these measures into practice.

Laboratory-based research using artificial sounds like 'constant white noise' has led to results where many of the people involved did not think it would be worthwhile to reduce the average sound level of traffic noise by less than 3 dB(A), as no one would notice the difference (see diagram 1).

Diagram 1: Momentary Sound Level and Average Sound Level



However, these findings in laboratories based on artificial sounds do not apply to real traffic noise situations in residential areas, actual reductions in noise brought about by lorry bans or speed limit reductions on urban roads. This is because traffic noise is a combination of the noise made by different kinds of vehicles moving at different speeds. When listening to traffic noise, the human brain does not restrict itself to accumulating information on the vehicle fleet, driving speeds, acceleration or braking manoeuvres. Instead, it probably also includes negative thoughts on traffic-related dangers, the impact on health of exhaust fumes, or sleep disturbances at night, or it broods on the idea that many people spare no thought for others when they take the shortcut through the town instead of the bypass road.

Noise thus has many psychological features. Given this fact, it comes as no surprise that reducing sound levels and reducing noise disturbances are two separate issues, and that in some cases even a large reduction in sound levels will not be fully appreciated by those affected, whilst in other cases even small changes to sound levels may be perceived as a considerable improvement.

Recent experience with traffic noise reduction activities in Berlin provides a practical example of the latter situation. In the context of a pilot project, different kinds of traffic restrictions were implemented at night on a selection of trunk roads in Berlin. The restrictions consisted of either speed limits (30 km per hour), lorry bans or recommendations that lorries use certain bypass roads. The inhabitants of the trunk roads were questioned regarding their opinion of these actions (see diagrams 2 and 3).

Diagram 2: Community reaction to noise reduction activities

To what extent do you feel disturbed or annoyed during night time by traffic noise?

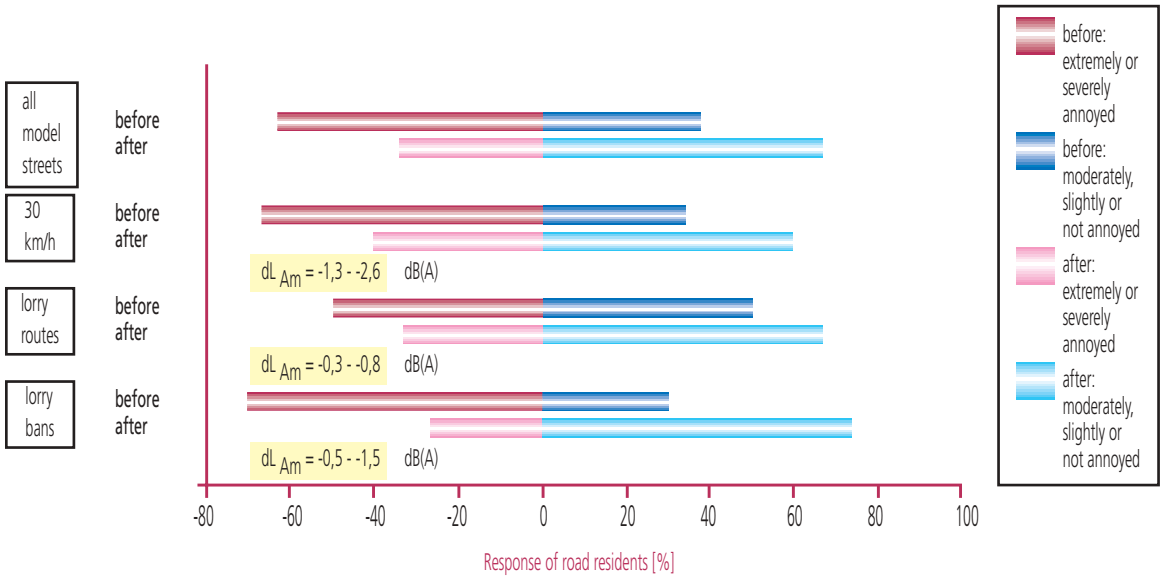
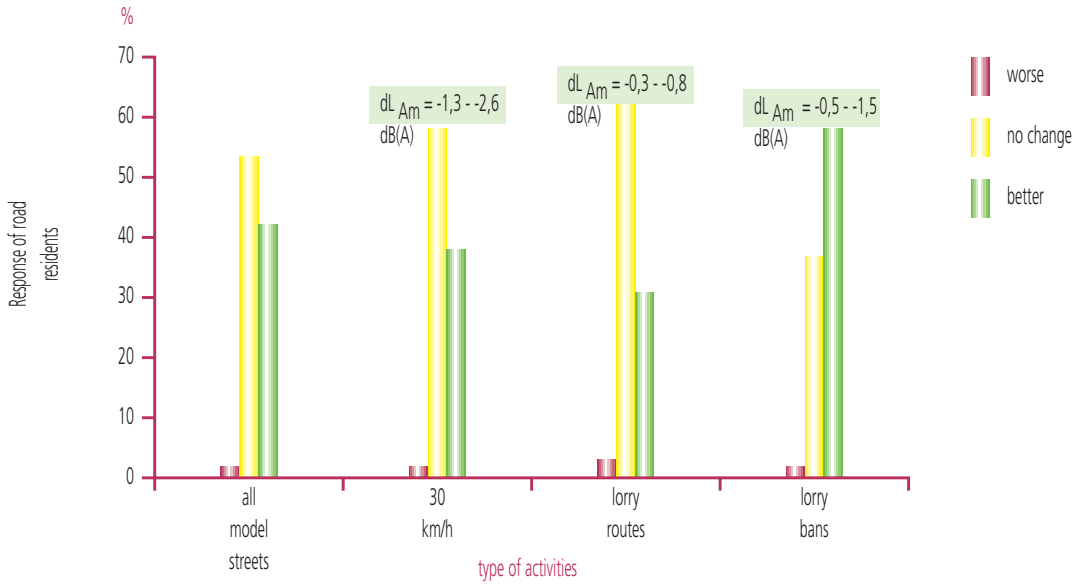


Diagram 3: Community reaction to activities of noise reduction

How do you estimate the traffic situation after the start of traffic restrictions?



The actions resulted in reductions in average sound levels ranging from 0.3 dB(A) to 2.6 dB(A). The greatest reductions in the average sound level were achieved by speed limits, while the smallest reductions were the result of recommended lorry routes. The effects of the lorry bans fell between the other measures.

Lorry bans were the most successful in reducing the noise disturbance (cp. diagrams 1 and 2), followed by speed limit reductions and recommended lorry routes. The road residents stated that the latter also had quite significant effects. Thus, although there was only a moderate reduction in the average sound level, the residents perceived that the situation had improved.

A possible explanation for these findings is that lorry bans and recommended lorry routes reduce the number of very loud incidents. People are very aware of this, even if the change to the average traffic noise sound level as a whole is only slight (see diagram 4).

In the case of speed limits, it is not the number of loud incidents that is affected, but instead the peak sound level of every passing vehicle is reduced (see diagram 5). Furthermore, the sound quality changes and seemingly improves to a quite remarkable extent. The sound level created by each of the vehicles increases and decreases more slowly and smoothly, and the frequency distribution of the sound is altered. The intensity of high frequencies decreases because of the reduction in tyre noise at lower velocities.

Diagram 4: Momentary Sound Level and Average Sound Level

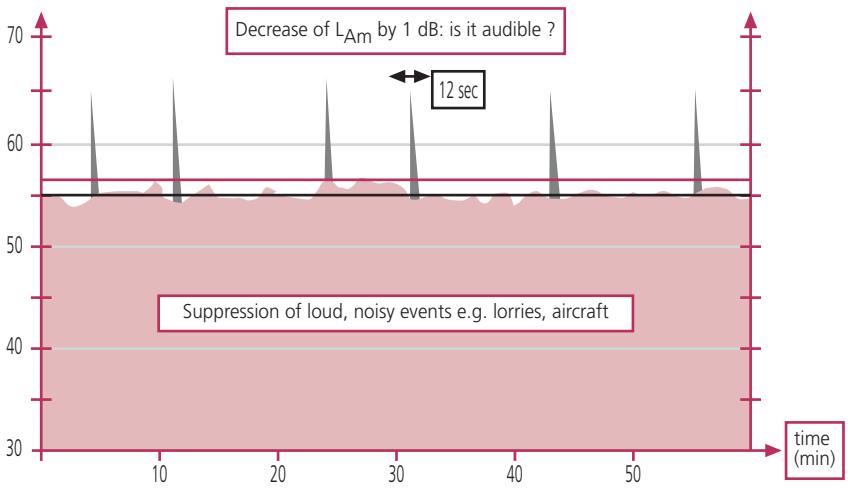
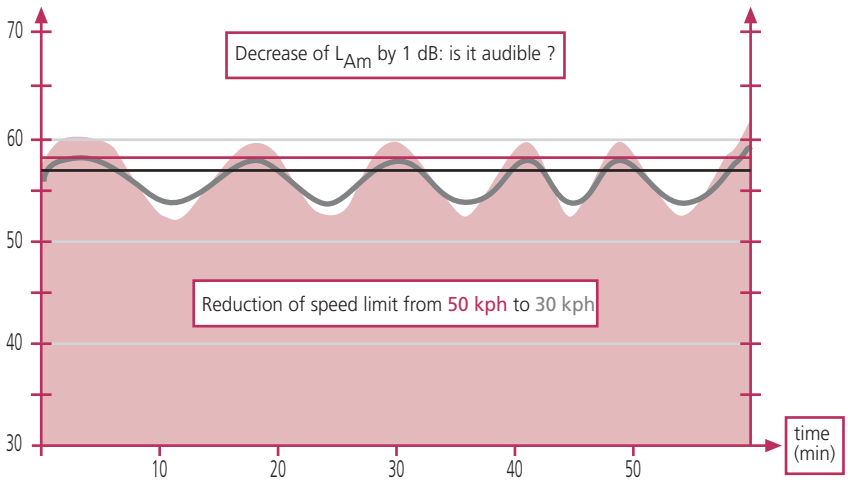


Diagram 5: Momentary Sound Level and Average Sound Level



Experiences gained from traffic calming

Previous experiences related to traffic calming in other German towns (Kastka et al) confirmed that for residential roads, the reduction in noise disturbance achieved by slowing vehicles down and thus lessening the dangers posed by car traffic, improving the surroundings by planting trees, bushes and flowers, and giving pedestrians more space by reducing the space allocated to motor traffic will be far greater than may have been expected based on the reduction in average sound level.

A systematic comparison was made of road residents' perceptions of the disturbance from many different traffic noise sites. It revealed that using traffic calming measures of this type to reduce the average sound level on residential roads by 1 dB(A) had an equivalent disturbance reduction effect to reducing the average sound level by 10 dB(A) on conventional roads by decreasing the amount of traffic (without reducing speed limits).

Screening noise

Noise barriers are less effective at reducing disturbance than is reducing the volume of traffic. Nonetheless, noise barriers do reduce the disturbance if the average sound level is reduced by at least 4 dB(A). Furthermore, the design of the noise barriers proved very important to their acceptance by residents. Roadside noise barriers are only acceptable for highways and other bypass roads where pedestrians do not need to cross. On busy urban streets, which are crossed by pedestrians along their entire lengths, noise barriers cannot be placed directly at the roadside. Instead, they can be erected at the boundaries of private properties or public institutions to protect sensitive buildings or areas (e.g. hospitals, schools and public parks, private dwellings and gardens).

If new dwellings are being constructed and cannot be shielded by noise barriers, it is crucial that these houses and apartments are designed in such a way that each apartment has at least one or two quiet rooms at the rear of the building (Schluchter, Holzmann et al).

Soundproof windows are the only possibility for further protection against noise, if no other measures can be applied or if the effect of other measures is insufficient. However, the windows must be kept closed to be effective, and many people have trouble adjusting to this restriction on their normal behaviour.

In any case, to encourage people to keep the windows closed and to avoid damp patches forming on the walls, it is very important that the windows be equipped with devices that supply fresh air and combat moisture, and, if necessary, regulate the room temperature in summer.

Changing road surfaces

Renewing road surfaces or replacing rough paving with smooth asphalt is another action that can be taken to reduce sound levels and noise impact. Measures need to be taken to ensure that vehicle speeds do not increase following the resurfacing of the road.

Any increase in speed will lead to an increase in noise, and may either reduce road safety or suggest a possible reduction in road safety to the residents.

In the case of noise-reducing road surfaces, the findings outlined briefly below should also be taken into consideration.

Open porous surface layers

The second interim report of the Working Group on 'Noise-reducing road surfaces in urban areas' (issued 1992, Germany) early concluded that open porous surface layers are unable to make a lasting and economically justifiable contribution to noise reduction for the following reasons:

- The noise-reducing effect of the open porous surface layers could no longer be discerned after a very short time (sometimes as soon as one year later).
- The costs related to the drainage systems, parts of which are very complex, are often extremely high.
- It was impossible to clean the open porous surface layers to an extent where they could achieve anything approaching the noise-reducing effect of new layers. In addition, cleaning costs of up to 1 €/m^2 per cleaning process were not acceptable.
- Preventing the run-off of 'hazardous' liquids into drains following accidents (involving tankers, for instance) usually required a great deal of technical outlay in the case of open porous surface layers equipped with curbs and the necessary drainage systems (by means of 'channel cushions' stored in a suitable place).
- Furthermore, where cracks appeared in roads, preserving the transverse drainage of the open porous layer proved extremely expensive.

For these reasons, the working group on noise-reducing road surfaces in urban areas decided that the open porous surface layers had failed the tests and halted the testing procedure.

Closed surface layers

The above-mentioned disadvantages of open porous layers do not usually apply to closed surface layers. However, these closed surface layers can only achieve an average reduction in noise level of 1 dB(A).

When the tests commenced in 1986, it was assumed that open porous asphalts could make a significant contribution to lessening the noise problem in city

centres. This proved to be untrue. Closed surface layers were then included in the tests, primarily mastic asphalt 0/5 and 0/8, which although marred by far fewer structural problems, have only a relatively minor effect on noise reduction of on average about 1 dB(A) for the reference layer of asphalt concrete 0/11.

Thus it can be concluded that low noise porous road surfaces for use in cities at low speeds have not yet been developed to a point for practical use. However, two layer porous pavements have been developed, but for the time being the question remains unanswered whether it will be possible to obtain sufficient lifetime for durability and noise reduction.

Reductions in property value due to noise

It is an established fact that people who have no financial constraints on their choice of dwelling prefer ceteris paribus quiet locations to noisy ones. The result is a drop in property values due to noise or even, as is now the case in some regions of in the eastern part of Germany, an inability to sell dwellings in noisy areas at a reasonable price. This has been exacerbated by the large and diverse range of real estate currently on the market, combined with a lack of potential buyers, which are the result of a decline in population following migration in previous years.

In other German regions, where the housing market is more stable, it was found (Borjans et al) that noise could reduce the value of a plot of land by at least 1.5 % for every decibel exceeding 50 dB(A) during the day. Even at times when the demand for individual dwellings was extraordinarily high, a plot of land with an average sound level of 70 dB(A) was found to cost 30 % less than a plot with an average sound level of 50 dB(A).

Protecting quiet areas

While one aim of planning is to reduce loud noise at black spots, another important goal is to preserve areas which are still tranquil. Quiet areas offer many opportunities for public recreation. They are thus not only of value to their residents, but can also improve the quality of life of people living in adjacent but noisy roads, by affording opportunities for peaceful recreation from time to time. Hence, it is very important that existing quiet areas be preserved, and that new ones be created where possible.

New housing areas should be planned from the outset in a way that ensures that at least the central area is quiet. This involves designating the centre of new areas as pedestrian and cycling zones, or at least providing traffic calming measures.

Furthermore, protecting the open areas outside towns and villages from additional noise sources (e.g. extra streets) is very important. Even if only very few dwellings are located outside of towns, the countryside is essential in many cases not only for human recreation, but also as a habitat for wild animals. Traffic noise and the segmentation of the countryside by roads and railways are contributing to the loss of species, which is still occurring in many European regions.

Disadvantages of bypass roads

The main objection to bypass roads is that they usually create as many problems as they solve. The reduction in noise on one road is often more than compensated for by the increase in noise at the new site. Many people are affected when a previously quiet area is destroyed.

Moreover, the noise reduction from bypass roads is often overestimated in public discussions. In real situations on urban roads, the potential noise reduction from bypasses is in the order of magnitude of 2 dB(A) or even less. The effect on the average sound level is probably no higher than the effect of speed limit reductions, while the effect on disturbance may be less than the effects of traffic calming. For this reason, if traffic is diverted from one road to others, speed limits or traffic calming should also be applied.

Practical experience has shown that the reason for the weak acoustical impact of bypass roads is that the share of traffic in urban areas that might use the bypass in future is generally less than 40 %. The rest of the traffic cannot be diverted, as it is travelling to destinations within the town and must thus stay on the old road.

The decision on whether a bypass road will improve the situation as a whole should be based on noise monitoring and an assessment of the future increase and decrease of noise levels, of noise impact, and of the segmentation of the countryside, that takes into account the issues mentioned above.

Possibilities for reducing costs

There are three main ways to minimise the costs of noise prevention and noise reduction:

- In the case of existing noise sources or sensitive buildings affected by noise, noise reduction activities can be coordinated with scheduled maintenance and modernisation activities. The renewal of road surfaces or waste water systems provides an excellent opportunity to also redesign the road to accommodate traffic calming and improve conditions for pedestrians, to introduce bicycle lanes or rearrange parking lots. The renovation of buildings can be combined with the installation of soundproof windows, which might simultaneously contribute to a considerable reduction in energy consumption. For

this reason, noise reduction planning should take account of the investment or maintenance plans of the responsible institutions or building proprietors.

- Where new noise sources are being created in the vicinity of existing sensitive buildings, or where new sensitive buildings are being constructed near existing noise sources, the most cost effective way to reduce noise is to take it into account from the very beginning of the planning process. This will ensure that:
  - a sufficient distance is maintained between the noise source and the sensitive building
  - noise sources, including roads or parking lots, are located on the outskirts of the area, which are already affected by noise, while dwellings are situated in the quiet parts of the area
  - modern technology is installed in industrial or commercial plants
  - building facades are used to create shielded areas
  - apartments, balconies and terraces are designed in a noise-adapted way
  - the soil from the excavation of new buildings is used to build noise barriers
- Where a new noise source is being created, the main questions are:
  - whether this is absolutely necessary, and whether the benefits really outweigh the disadvantages. If the answer to this question is 'yes', the next issue is
  - where to locate the noise source so that it causes the minimum possible damage. In the initial planning stage of new bypass roads in particular, the most important question is always whether a new road will really solve the problem.

Maintenance costs of measures

Some measures may involve additional costs for maintenance. This is especially true of noise barriers, which have to be cleaned periodically, and of sound-absorbing road surfaces, which experience has shown need more frequent maintenance than normal asphalt road surfaces.

Roads that have been redesigned for speed reduction or traffic calming purposes require the same level of maintenance as normal roads. Where additional plants have been added, a good solution within the framework of the public-private partnership is to encourage the residents of the street to adopt and take special care of them.

Bicycle and pedestrian lanes require the same type of cleaning and maintenance.

Step-by-step approach

In most cases, action plans for noise reduction are implemented in a step-by-step manner, beginning with low cost measures such as speed limit reductions or deviations for lorries, which can be put into practice after a few weeks of preparation and impact assessment. The final step involves investing in larger projects, which require more preparation or extra funding, such as noise barriers or, where appropriate, bypass roads or new housing areas.

Medium term projects include action plans for redesigning roads (i.e. for traffic calming), or installation of soundproof windows, for which funding is made available to the proprietors of noise-exposed buildings who wish to renovate. Action plans for the reconstruction of roads should be closely coordinated with road maintenance plans.

Continuous follow-up of all public building and maintenance activities is crucial, as it ensures that all available opportunities to take noise into account are utilised right from the very beginning of the activity.

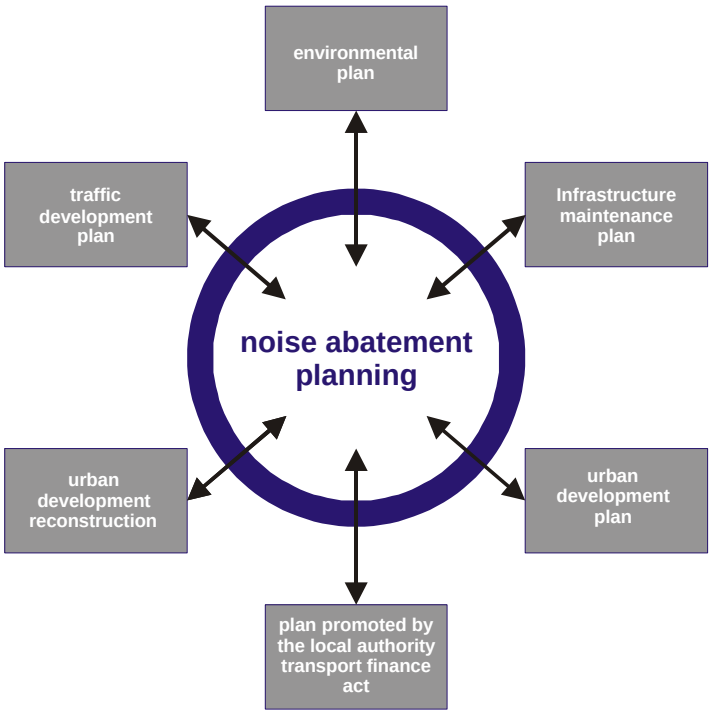
Information and communication

To achieve a high degree of acceptance for the realisation of noise-abatement measures by the public, a well-structured participation and consultation process is crucial. Based on the principles of dialogue, discussion, and exchange of experience, it will become clear to the public that noise pollution is everyone's business and that everyone can contribute to the reduction of annoyances and disturbances from noise.

Part 2. Guidelines for Noise Abatement Planning Principles

Integrating noise abatement planning into the planning process

An effective and comprehensive planning process requires plans by local authorities which affect noise emission (see figure) to be dovetailed with noise abatement planning. Noise abatement is also becoming increasingly significant in the context of integrated environmental relief programmes, as required by Local Agenda 21, especially given that many Europeans are exposed to road traffic and other noise-related disturbances. Where noise abatement planning is not prioritised in the planning hierarchy of a local authority, and is subordinate to planning areas such as land use, and urban and traffic development, there is a risk that the latter planning areas will create conditions that promote undesirable noise levels. This could lead to the downgrading of the noise pollution map to a list of shortcomings and noise abatement planning being reduced to crisis management. Early integration of noise abatement planning into the planning process enables efficient and comprehensive planning and evaluation to be conducted, e.g. of the overall framework plan for urban development, the land use plan, transport development plan, urban development plan, landscape plan, air quality plan, and regional and national plans for transport and environmental issues.



In this context, the following non-technical issues should be considered when commencing the planning process for noise abatement measures:

- Organisational approaches (non-technical) — *internal and external coordination / information and participation*
- Strategic approaches (non-technical) — *integrated approach*

Overall plans to combat road traffic noise

Experience has repeatedly shown that to create an effective ***overall plan*** for the reduction of road traffic noise, the individual measures outlined above must be consolidated into a single set of measures. Examples of this consolidated approach include the following:

- **Traffic avoidance plans** that combine walking, cycling and public transport (focus: promoting and linking environmentally friendly modes of transport)
- **Speed reduction plans** involving partial access zones, stabilising traffic flows and reducing driving speeds (focus: 30 kph, traffic calming measures)
- **Traffic flow relocation plans** (focus: bypass roads, diverting traffic to less sensitive routes)
- **Plans to relocate noise** black spots (focus: creating gateway facilities, optimising traffic signals)
- **Traffic volume optimisation plans** (focus: availability of parking spaces)
- **Plans to improve road surfaces** and maintenance (focus: low-noise road surfaces)

However, it must be emphasised that internal and external cooperation is necessary for the successful implementation of overall plans.

Non-technical issues

Organisational approaches

What does this step involve?

The primary aim of noise abatement strategies is to put planning into practice. Thus, the main focus is on how measures can best be implemented that will result in beneficial improvements for citizens. The bundling of responsibilities and competencies is important in this regard. Implementing a noise abatement strategy is a process that includes internal coordination, external cooperation, public relations and stakeholder participation in the realisation and management of a comprehensive noise strategy.

Internal coordination

The following questions and issues should be considered when commencing the process of noise abatement planning, in order to identify and appoint an overall coordinator:

- What kind of organisational structure is necessary - a new structure, such as a competence centre, which can help to better coordinate fragmented responsibilities and competencies for noise-related issues, or the existing administrative structures?
- Which department has the capacity to coordinate, monitor and evaluate the activities planned for the implementation process - civil / traffic engineering, environmental services, town or transport planning?
- Which other city departments need to be involved in the process – the industrial inspection board, land registry and surveying office, highways department, road traffic authority, regulatory authority, health authority?
- How will local politicians be involved in the planning process, thereby gaining and ensuring political support?
- Will external experts be necessary, for instance involving engineering or planning consultants in the development and elaboration of alternative approaches where personnel capacity is limited, particularly in smaller towns and cities?
- Do specific local ordinances on noise reduction already exist, which require special noise insulation to create a 'quiet' facade on at least one side of a building?
- How is public participation and / or a consultation process organised - by means of informative meetings, or via well-structured round table fora that include proposals from citizens and stakeholders in the planning process?
- Will the planning process be accompanied by a special campaign to raise citizens' awareness, requiring the establishment of a special public relations unit?
- Where have funds been allocated that are relevant to the implementation of measures, e.g. maintenance budgets, revenues from fees or charges, funds for planned roadwork projects that may be included in the planning and implementation process?

To help take the above mentioned issues into account, local authorities will be able to establish support structures, pool financial resources, and appoint a coordinator responsible for managing and overseeing the project during its entire duration.

External cooperation

Partners for external cooperation can include railway companies, the local chamber of commerce and industry, local transport companies and other relevant professional associations.

Contractual issues are another aspect of external cooperation, and include the creation of agreements aimed at reducing the harmful effects of noise. For example, local authorities can include low-noise and low-emission vehicles as a criterion in invitations to tender for public transport or waste collection services, with the aim of setting specific noise reduction requirements.

Public information and stakeholder participation

Communication and information aim to bring about a change in attitude and behaviour. Target groups include the general public, school pupils, decision makers, and stakeholder groups. Informative publications can take the form of regular bulletins on a city's noise situation, booklets and brochures to provide information and show residents how to reduce noise, poster campaigns, web sites dedicated to noise, telephone hotlines for noise-related problems, and media campaigns.

It is essential that information on noise-related issues is communicated clearly, using accessible language and avoiding technical terms. Thus, decision makers and citizens are best able to understand information about existing noise levels and anticipated reductions when they are discussed in terms of the number of people affected by noise pollution.

A well-structured process of public participation and consultation is crucial to achieving a high degree of acceptance for the implementation of measures. For example, organising round tables for citizens and stakeholders can help with the compilation of very comprehensive catalogues of proposed measures and engender a strong commitment amongst the participants in the planning process. It goes without saying that the administration should assess these suggestions to determine their potential for implementation. However, experience has shown that the outcome has generally been positive, with only a few proposals being ruled out, and most being incorporated into the noise abatement plan. Dialogue and exchange help the public to understand that noise pollution affects everyone, and that we can all contribute to reducing noise-related annoyances and disturbances.

Paris, Valencia: *special ordinance on noise;* ***Berlin, Stockholm:*** *testing various methodological approaches by reducing noise.* ***Madrid:*** *awareness raising campaign,* ***Vienna and Dublin:*** *development framework with many types of measures****, Heidelberg:*** *development working group for noise abatement planning with an accompanying external expert for coordination.*

Non-technical issues

Strategic approaches

What does this step involve?

In addition to the organisational arrangements for a comprehensive noise abatement strategy, experience has shown that it is also useful for a local authority to create an overarching policy framework. This enables a city's noise abatement policy to also be included in the context of regional, national and EU environmental policies. The following issues can be particularly helpful in this context:

- Allocating funding for a comprehensive noise abatement strategy
- Creating a competence centre for information and documentation purposes
- Including a local noise abatement strategy in the regional, national and EU context

Allocating funding to implement a comprehensive noise abatement strategy

The implementation and scope of noise abatement measures naturally depend on a municipality's size and urban structure. However, experience in various countries has shown that the most popular methods for obtaining regional, national or European funding to facilitate the financing of noise abatement measures are as follows:

- Launching European pilot or research projects, if possible in collaboration with other towns and cities, e.g. with the aim of developing practical noise abatement measures or facilitating the evaluation of noise abatement strategies
- Receiving technical assistance from specialised regional or national government bodies for research on the monitoring and evaluation of implemented measures
- Obtaining direct regional or national funding through existing environmental protection programmes
- Combining existing local, regional and national funds from budget lines or comprehensive programmes, e.g. urban renewal and / or general infrastructure maintenance and construction, into which noise abatement measures can be integrated for environmental purposes
- Acquiring finances from regional or national sources for specific transport measures, e.g. for the purchase of low-noise and low-emission public transport vehicles

Thus, local authorities can draw on a wide range of funding opportunities to implement noise reduction measures. However, the local authority should bear in mind that varying levels of supplementary funding will be required from its budget. Furthermore, the combination of different financing from different sources requires a careful review of various budget lines and programmes.

Establishing a competence centre to improve the coordination of activities

The creation of a competence centre, e.g. a noise observatory, can be helpful in large conurbations, as competencies and responsibilities for noise may be fragmented among different levels of regional, local and regulatory administrative bodies. The tasks of such a centre are to:

- Bring together the various actors, including stakeholder organisations
- Bundle and document information to improve administrative coordination
- Develop better tools for decision-making, that enable concise and detailed priorities to be set for action in complex urban situations
- Inform and advise the general public on noise-related issues

Including a local noise abatement strategy in the regional, national and EU context

As a first step, a municipality should ideally develop an overarching policy framework, which includes urban development, transport and environmental issues, as this type of policy approach integrates aims and activities that focus on a city's development over a period of several years. Noise-related measures can include decreasing traffic-related environmental pollution, urban renewal measures incorporating changes to street layout, the diversion of through traffic, etc. Although the cross-sectoral approach is not yet commonly used, it has the advantage of helping to reduce planning costs for noise abatement measures, as all relevant local (and regional) administrative bodies become involved at a very early stage. Furthermore, this type of comprehensive strategy facilitates access to relevant data and plans. In addition, using a policy framework to link a city's noise abatement strategy with the regional, national and / or EU policy level may enhance access to the financing outlined above.
Further activities can include political lobbying at national and EU level, e.g. for a gradual increase in the costs of mobility by internalising actual transport costs.

Paris: *development working group noise and an observatory of noise;* ***Vienna, Dublin:*** *development framework with many types of measures;* ***Heidelberg:*** *development working group for noise abatement planning with an accompanying external expert for coordination.*

Noise abatement opportunities available to local authorities

Various possibilities must be utilised to achieve effective noise abatement. These include the following types of measures:

- traffic-related
- technical
- structural
- urban design
- planning-related
- organisational

Preventative measures which are already in place at the noise source should be given high priority. The following table contains a breakdown of available measures to reduce, avoid or relocate the various types of noise source. These guidelines focus mainly on road traffic noise, as many surveys have shown it to be a major issue. Furthermore, most local authorities are responsible for this area and can thus take action more easily.

Road traffic

Reducing traffic density • Promoting public transport • encouraging cycling and walking • traffic management and parking	• Promoting environmentally friendly means of transport, e.g. walking and cycling • Enlarging the public transport system • Providing P+ R facilities • Parking management concepts • Stabilising traffic flows • Reclassifying and / or declassifying roads
Reducing the percentage of heavy goods vehicles • designating HGV routes • road management, e.g. bypasses	• Traffic bundling on appropriate routes • Designating heavy goods vehicle routes • HGV bans and restrictions at certain times
Speed reduction / traffic calming measures	• Reducing excessive driving speeds • Designating 30 km/h zones • Redesigning street layout • Designating traffic-calmed (business) zones
Renewal of public transport and (heavy) goods vehicles Public transport and (heavy) goods vehicles	• Introducing low-noise buses and trams • Promoting low-noise (heavy) goods vehicles
Changing the road surface • improvements to roads • improvements to tram tracks	• Use of low-noise road surfaces • Tram track rehabilitation and regular track maintenance
Noise screening	• Noise barriers (with solar cells) and earth banking • Use of building structures for screening • Use of tunnels and troughs
Sound-proof windows	• Windows with ducted ventilation • Ventilation system
Urban planning	• Reducing / avoiding traffic by decentralising local amenities into sub-centres of settlement • Interposing less sensitive uses between the noise source and sensitive uses

Noise reduction measures are naturally also needed in the rail and air traffic sectors. However, the local authorities have very limited scope for action in this area, due to the involvement of national and international administrative bodies. Nonetheless, decision-makers at the local authority level and noise experts should bear this issue in mind when devising noise abatement plans.

Initial situation: what is the first step? how should priorities be set?

What does this step involve?

When setting priorities for noise abatement measures for individual areas, the number of residents affected and the level of disturbance should be taken into consideration. This involves standardising the number of people affected and the disturbance (e.g. for circa every 100 metres of road). These standardised values can then be used to compare the disturbances on individual roads and town districts. Priority is allocated according to the level of each disturbance. This step can be carried out for one or more of the noise disturbance parameters. Level 1 designates the highest number of people affected by noise and / or the level of noise disturbance, and thus constitutes the highest priority for noise abatement. In addition, consideration should also be given to such non-acoustic parameters as the need for special protection and previous urban development and urban planning in specific areas.

Priorities ranked by district	***Level (Level 1 = highest priority)***
Upper town	***1***
Centre	***2***
Suburb I	***3***

Priorities ranked by street	***Level (Level 1 = highest priority)***
Main Street	***1***
Main Square	***2***
Central Boulevard	***3***
Upper Avenue	***4***
Old Town Street	***5***
New Town Avenue	***6***

What details are required for this step?

- *Previous urban development of the area, including existing town planning advantages and drawbacks*
- *Current plans, future urban development goals, planned major investments*
- *Number of inhabitants per area, per km_ etc.*
- *Protection level required for specific uses (residential areas, hospitals, schools)*

Who should be involved in this step?	*Railway Company*	*Industrial inspection board*	*Chamber of Industry and commerce*	*Land registry and surveying office*	*Local transport companies*	*Regulatory authority*	*The public*	*Urban planning authority*	*Highways department*	*Road traffic authority*	*Civil engineering authority*	*Environmental protection agency*	*Traffic planning authority*
	x	***x***	***x***	***x***	***x***	***x***	***x***	***x***	***x***	***x***	***x***	***x***	***x***

What are the advantages of this step?	*The setting of priorities enables the local authority to make a quick comparison of noise abatement possibilities. The use of impact analysis in establishing priorities thus greatly assists sound decision making, which in turn enables the local authorities to make efficient use of budgetary resources.*

What approaches are contained in a set of measures?

Reducing traffic density • promoting public transport

• Back

Description

Potential improvements to the public transport network are assessed on the basis of the existing local public transport network. This can lead to both improvements in the quality of transport (e.g. reducing travel times by giving priority to public transport and / or installing bus lanes and increasing the frequency of buses) and in the areas served (e.g. increasing the number of bus stops).

An efficient approach involves including street layout and urban development plans that affect the relevant area in the evaluation process, alongside the acoustic parameters.

Required details

- Local public transport network
- Current plans, future urban development goals, and planned major investments
- The design and layout of the streetscape

Actors

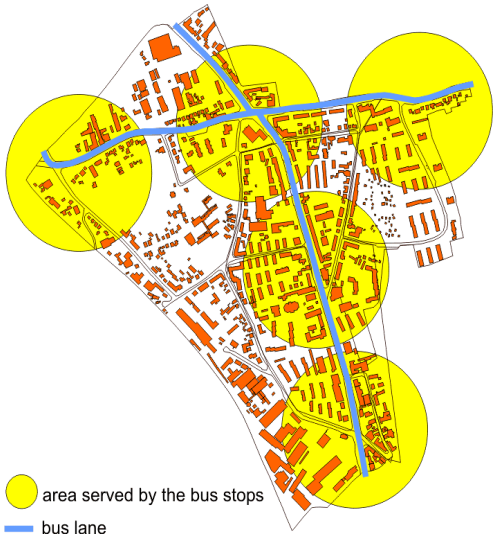
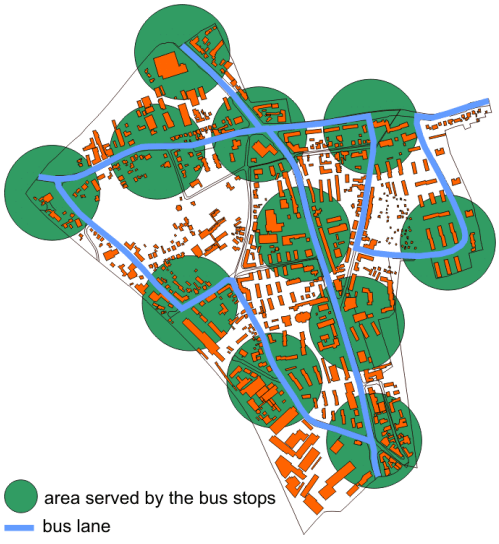
Local transport companies	x
Regulatory authority	
Urban planning authority	x
Highways department	x
Road traffic authority	x
Civil engineering authority	x
Environmental protection agency	x
Traffic planning authority	x

Impact

		1	2	3	4	5	
Scale							
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- Focus on substitution rather than extension, i.e. reducing private traffic in favour of PT traffic (e.g. by creating bus routes)
- Consider the potential side effects of traffic relocation on the areas affected by the new routes.

Initial situation	Proposed measures
	

Vienna: *Traffic master plan combines the transport needs of the town in a European context with its needs at a district level; extension of PT network, establishment of goods distribution centres;* ***Annecy:*** *redirection of through traffic, complete overhaul of directions for traffic circulation, counter-flow circulation for PT*

Reducing traffic density

• *encouraging cycling and walking*

Description

Potential improvements to bike paths on individual roads (sections of road) in the city centre and around the city are assessed on the basis of the existing bike path network. This can result in both the improvement of existing bike paths and the construction of new bike paths in the city centre and / or throughout the city.
An efficient approach involves including planned building measures and traffic-related plans that affect the relevant area in the evaluation process, alongside the acoustic effects and existing street layout.
In addition, specific provisions for pedestrians should be considered, e.g. the introduction of pedestrian islands.

Required details

- Maximum permitted speeds in the relevant road network
- Planned construction work and traffic-related plans affecting the relevant area, such as the layout of roads, renewal of sewage or other utilities
- Current plans, future urban development goals, and planned major investments
- Public sector maintenance measures or subsidised development programmes
- The design and layout of a streetscape

Actors

Local transport companies	
Regulatory authority	
Urban planning authority	x
Highways department	x
Road traffic authority	x
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	x

Impact

		1	2	3	4	5	
Scale							
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- Give priority to bike tracks or lanes
- Design bike routes with direct connections, e.g. by using short cuts
- Ensure the network accommodates cyclists travelling in both directions
- Provide bike racks at larger PT interchanges and bike facilities on trains

Initial situation	**Proposed measures**
	

Breda: *main bike route network and express bike route, which avoids crossroads, for example;* ***Heinnigsdorf****: special networks for walking and cycling;* ***Rankweil:*** *extension of bike route network;* ***Reggio Calabria:*** *construction of bike routes*

Reducing traffic density

• *traffic management and parking*

Description

Traffic management potential is evaluated on the basis of the sources and destinations of traffic, in combination with the trunk road network and the local public transport network. One possible measure is the implementation of parking management. Traffic and parking management should be based on limiting access to congested areas by imposing high parking charges. This measure can result in both the promotion of public transport and a reduction in traffic density.

An efficient approach involves including street layout and urban development plans affecting the relevant area in the evaluation process, alongside the acoustic effects.

Required details

- Trunk road network
- Traffic sources and destinations
- Local public transport network
- Current plans, future urban development goals, and planned major investments
- The design and layout of a streetscape

Actors

Local transport companies	x
Regulatory authority	
Urban planning authority	x
Highways department	x
Road traffic authority	x
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	x

Impact

Scale		1	2	3	4	5	
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- Good knowledge of traffic circulation is essential
- The time difference for journeys in private cars compared to public transport must be minimised, requiring an overall approach to urban transport development
- Parking fees must be set carefully

Initial situation

Proposed measures

Annecy and Parma: *construction of car parks along public transport routes, with shuttle bus services;* ***Kecskemet:*** *traffic from a downtown central boulevard redirected to a new bypass;* ***Padua and Parma:*** *introduction of roundabouts for improved traffic flows*

Reducing the percentage of heavy goods vehicles • Back

• designating HGV routes

Description

The potential for bundling HGV routes throughout a city or in a specific area is evaluated on the basis of the existing lorry route network.

An efficient approach involves including current plans and future urban development goals in the evaluation process, alongside the acoustic parameters.

This is often combined with time restrictions for lorries in residential areas.

Required details

- HGV route network
- Current plans, future urban development goals, and planned major investments
- Land use plans

Actors

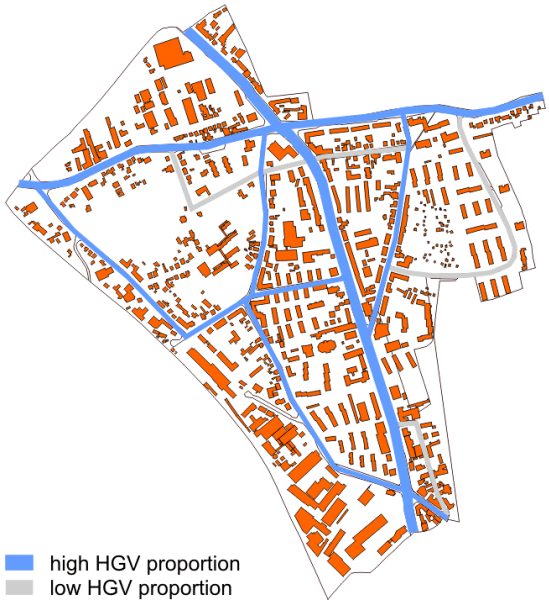
Local transport companies	x
Regulatory authority	
Urban planning authority	
Highways department	x
Road traffic authority	x
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	x

Impact

Scale		1	2	3	4	5	
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- Possible side effects on areas along HGV routes must be considered when redirecting and bundling HGV traffic
- The needs and demands of shops and businesses must be taken into account when introducing time restrictions on access to some areas

Initial situation	Proposed measures
	

Heidelberg: *development zone with priority access for low-noise HGVs,* ***Paris and Valencia:*** *restricted hours for access by delivery services;* ***Madrid:*** *access to historic centre only by special permit;* ***Celle:*** *lorry route strategy;* ***Berlin:*** *testing methodological approaches to redirecting or banning HGVs*

Reducing the percentage of heavy goods vehicles

• road management, e.g. bypass roads

Description

The potential for relocating the bulk of traffic is evaluated on the basis of the existing main thoroughfares. Bypass roads can be seen as a potential measure.

An efficient approach involves including current plans and future urban development goals in the evaluation process, alongside the acoustic effects. In this step, it is particularly important to evaluate whether the proposed measures could give rise to new harmful effects on the environment. This can be ascertained via an environmental impact assessment.

Required details

- Main thoroughfares
- Current plans, future urban development goals, and planned major investments
- Traffic development plans

Actors

Local transport companies	
Regulatory authority	
Urban planning authority	x
Highways department	x
Road traffic authority	x
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	x

Impact

Scale		1	2	3	4	5	
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- The plan should be adopted only after careful reflection, due to the potential for loss of retail income
- Existing roads should be redesigned to improve their integration into the urban structure, e.g. reduction from 2 x 2 lanes to 2 x 1 lane
- Costs associated with a bypass can be very high
- Possible side effects on areas along the bypass should be considered, e.g. new noise pollution in formerly quiet residential or recreational areas

Initial situation	**Proposed measures**
	

Angers and St. Etienne: re-routing HGVs via bypasses

Speed reduction / traffic calming measures • *Back*

Description

The possibility of imposing a speed limit on individual roads or sections of road is evaluated on the basis of the existing maximum permitted speeds in the relevant road network.
An efficient approach involves including traffic-related plans affecting the relevant area, such as 30 km/h zones or traffic-calmed (commercial) areas, in the evaluation process, alongside the acoustic effects. This approach must be supported by on-road measures, which contribute to improving road safety. It is advisable to supplement these measures by enforcing the speed limits.

Required details

- Maximum permitted speeds in the road network under consideration
- Traffic-related plans which affect the relevant area, such as 30 kph zones or traffic-calmed (commercial) areas
- Existing plans, future urban development goals, and planned major investments
- Public sector maintenance measures or subsidised development programmes

Actors

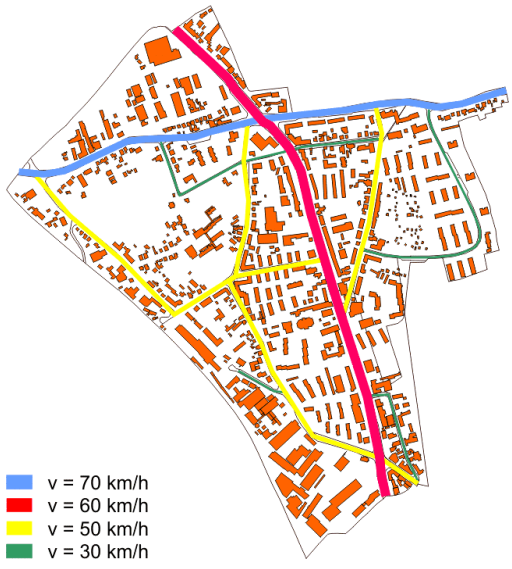
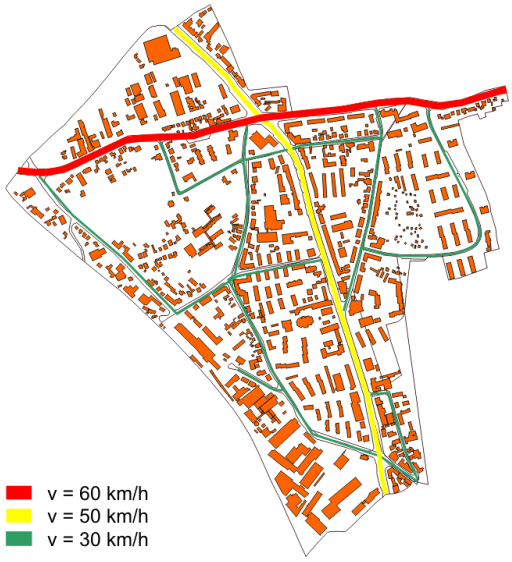
Local transport companies	x
Regulatory authority	
Urban planning authority	
Highways department	
Road traffic authority	x
Civil engineering authority	
Environmental protection agency	(x)
Traffic planning authority	x

Impact

Scale		1	2	3	4	5	
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

To ensure the speed limit is respected:
- Carefully design speed reduction devices that avoid new noise disturbances arising from the deceleration and acceleration of vehicles
- To be successful, speed limits must be enforced, particularly in the introductory phase

Initial situation	**Proposed measures**
	

Berlin: *enforcement of speed limits (30 kph), visual narrowing of streets;* ***Modena:*** *raised crossroads with block paving, raising of pedestrian crossings;* ***Breda:*** *narrowing roads.*

Renewal of public transport and (heavy) goods vehicles • *Back*

Description

The possibility of facilitating the renewal of vehicles is evaluated on the basis of the existing fleet of public transport and (heavy) goods vehicles.

An efficient approach involves including the financial situation and investment plans of the local transport and logistics companies, possible sponsorship and the cost-benefit ratio in the evaluation process, alongside the acoustic effects.

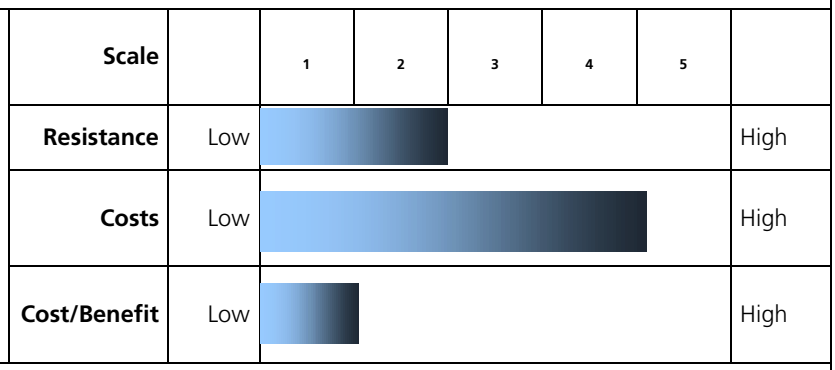
Required details

- Noise emissions from existing public transport / (heavy) goods vehicles
- State-of-the-art of noise emissions from new public transport / (heavy) goods vehicles
- Sponsorship of the renewal of low-noise vehicles
- Financial situation and investment plans of the local transport / logistics companies
- Cost-benefit ratio

Actors

Local transport companies	x
Regulatory authority	x
Urban planning authority	
Highways department	
Road traffic authority	
Civil engineering authority	
Environmental protection agency	(x)
Traffic planning authority	

Impact



Warnings

- This measure is often taken over a long period of time, thus the effects appear very gradually
- When renewing municipal fleets of vehicles, e.g. waste disposal vehicles, preference should be given to low-noise vehicles
- This principle can also be applied to local authorities' invitations to tender for particular services, such as PT, thus requiring private and public operators to use low-noise and low-emission vehicles

Athens - Chemnitz - Nancy – Warsaw - Parma : *purchase of new public transport vehicles - buses and trams*

Changing the road surface • *Back*

• *improvements to roads*

Description

Potential improvements to the surfaces of individual roads (sections of road) are evaluated on the basis of the existing road surfaces under consideration.

An efficient approach involves including planned building measures which affect the relevant area - in particular the need to renew supply and waste routes - and maintenance measures and urban development plans in the evaluation process, alongside the acoustic effects.

Required details

- The design and layout of a streetscape
- Road surfaces in the network under consideration
- Planned construction measures affecting the relevant area, especially the need to renew supply and disposal pipelines
- Current plans, future urban development goals, and planned major investments
- Public sector maintenance measures or subsidised development programmes

Actors

Local transport companies	
Regulatory authority	
Urban planning authority	x
Highways department	x
Road traffic authority	
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	

Impact

Scale		1	2	3	4	5	
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low	(in the case of cobblestones)					High

Warnings

- Costs of constructing and servicing porous layers are usually high
- Durability: porous layers require more frequent renewal than traditional surfaces
- Winter usage is often a source of problems
- Changing the road surface, e.g. from cobblestones to a smooth asphalt, can also reduce noise considerably at a more reasonable cost

Initial situation

Proposed measures

Copenhagen - Burgos - Valencia : *renewal of road surfaces with noise-reducing road surface*

Changing the road surface

• *improvements to tram tracks*

Description

Potential improvements to the surfaces of individual tracks (sections of track) are evaluated on the basis of the existing track surfaces under consideration.

An efficient approach involves including planned building measures which affect the relevant area - in particular the need to renew supply and waste routes - and maintenance measures and urban development plans in the evaluation process, alongside the acoustic effects.

Required details

- The design and layout of a streetscape
- Track surfaces in the network under consideration
- Planned construction measures affecting the relevant area, especially the need to renew supply and disposal pipelines
- Current plans, future urban development goals, and planned major investments
- Public sector maintenance measures or subsidised development programmes

Actors

Local transport companies	
Regulatory authority	
Urban planning authority	x
Highways department	x
Road traffic authority	
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	

Impact

		1	2	3	4	5	
Scale							
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- 'anti-vibration' is not synonymous with 'noise reduction'

initial situation

proposed measures

Noise screening • Back

• noise barriers

Description

Where no effective possibility exists for reducing noise by limiting / regulating its source (usually road or railway traffic), the noise must be mitigated along the propagation path, e.g. through noise screens. Opposition from house owners may arise in this case, should the noise barriers obstruct their view.

The potential for constructing noise screens is evaluated for individual roads (sections of road) or railway tracks on the basis of the existing noise disturbance. Buildings can also be used as screens.

An efficient approach involves including planned building measures which affect the relevant area, urban development plans, and the financial situation in the evaluation process, alongside the acoustic effects. The cost-benefit ratio must be taken into account when calculating the length and height of the noise screen.

Required details

- Current plans and future urban development goals
- Public sector maintenance measures or subsidised development programmes
- Urban development situation in the area under consideration
- Ownership structure of the construction area for which noise screening is planned
- Consider the cost-benefit ratio when calculating the dimensions of the noise screens

Actors

Local transport companies	
Regulatory authority	
Urban planning authority	x
Highways department	
Road traffic authority	x
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	x

Impact

Scale		1	2	3	4	5	
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- Visual aspects must be considered
- Balance the cost of the noise screens against the number of houses that will benefit

Birmingham: *extended some motorway noise barriers;* ***Frankfurt:*** *development of strategy to reduce noise by building screening structures;* ***Modena - Padua - Gothenburg:*** *noise screens.* ***Vienna:*** *transparent noise barriers.*

Noise screening

• sound-proof windows • Back

Description

Where no effective possibility exists for reducing noise by limiting / regulating its source (usually road or railway traffic) or mitigating noise along the propagation path, the next step can involve providing direct protection against noise to those exposed to the disturbance, e.g. using soundproof windows. It should be borne in mind that this type of noise insulation measure only functions when the windows are closed, and has no effect on the external areas of a house, such as balconies.

The possibility of soundproofing windows in individual houses is evaluated on the basis of the existing noise disturbance experienced in each house and the building's existing level of noise insulation.

An efficient approach involves including planned building measures which affect the relevant area and urban development plans in the evaluation process, alongside the acoustic effects. The dimensions of the soundproof windows must be calculated for every single building under consideration.

Required details

- Current plans and future urban development goals
- Urban development situation in the area under consideration
- Ownership structure of the buildings under consideration
- Existing noise insulation for the buildings under consideration
- Existing layout of apartments inside the buildings

Actors

Local transport companies	
Regulatory authority	x
Urban planning authority	(x)
Highways department	
Road traffic authority	
Civil engineering authority	
Environmental protection agency	(x)
Traffic planning authority	x

Impact

		1	2	3	4	5	
Scale							
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- Soundproof windows alter the balance between indoor noise from other flats and outdoor noise. This measure often results in a beneficial masking effect of outdoor noise.
- Soundproof windows do not usually provide adequate insulation in old or low-cost constructions.
- Noise is however only one aspect; the following factors must be considered:
  - ventilation
  - fire safety
  - climate-related constraints: closed windows are impractical in Mediterranean regions
- Possible opposition of apartment owners or tenants to construction work in their homes

Arhus - Valencia - Breda - Birmingham, Stockholm, Padua, Göteborg : *measures to screen sensitive uses / areas.*

Urban planning • *Back*

Description

Local authorities are involved in planning procedures to ensure that future developments are designed and constructed in such a way as to minimise noise disturbances. Collaboration between town planners, civil engineers and noise experts is needed from the outset to achieve this goal.

Suitable abatement measures for the noise disturbances identified should be considered and incorporated into the project, e.g. the position, direction and height of new buildings, along with their function, their distance from roads, and the position of noise barriers and buffer zones with low sensitivity to noise.

Decisions may also be made to improve public transport, and create parking lots, bike paths, pedestrian zones and low speed zones. Local authorities should be aware that the early integration of noise abatement planning into the overall planning process results in an improved environment and helps to avoid costly noise abatement measures further down the track.

To ensure a coordinated urban planning strategy, all of the authorities whose responsibilities touch on this area should be involved at the earliest possible stage.

Required details

- Urban development plans / project and development plans
- Urban redevelopment
- Traffic development plan

Actors

Local transport companies	x
Regulatory authority	
Urban planning authority	x
Highways department	
Road traffic authority	
Civil engineering authority	x
Environmental protection agency	(x)
Traffic planning authority	x

Impact

		1	2	3	4	5	
Scale							
Resistance	Low						High
Costs	Low						High
Cost/Benefit	Low						High

Warnings

- Noise issues are often considered at too late a stage in projects

Gothenburg: *existing guide values for noise levels are applied to planning;* ***Lyon, Nice:*** *use of planning of urban moving;* ***Arhus:*** *construction of new apartments and offices at PT exchange;* ***Modena:*** *new planning procedure with a special focus on noise and other environmental issues*

Evaluation of measures

What does this step involve?

The evaluation of noise abatement measures should include an assessment of the estimated noise reduction.

The impact analysis method is a useful tool in this context. A clear evaluation of the effects of the different noise abatement measures being proposed can be gained by comparing the estimated levels of noise reduction they will achieve (as indicated e.g. by noise impact analysis).

In this regard, considerable care should be taken to ensure that the noise abatement planning measures do not give rise to any serious new noise disturbances or other environmental problems.

In addition to the acoustic effects of noise abatement measures, their features, feasibility and cost should also be taken into account. These factors are listed together with the bodies responsible for their implementation and the time frame for completion as outcomes of the noise abatement planning procedure.

Bearing in mind the budgetary situation, effective, cost-efficient measures should be prioritised for implementation in the short and medium term. These should be integrated into the local authority's planning process at the correct stage.

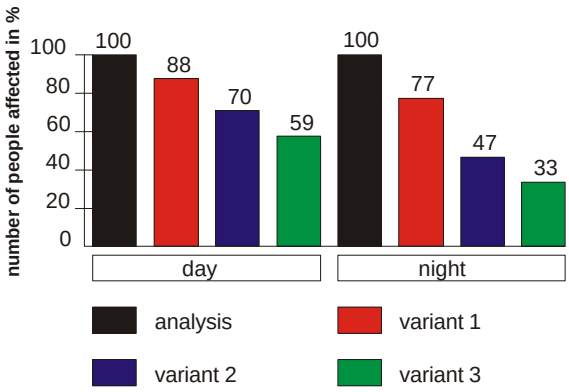
Thus, the priority of individual investments, which already form the subject of financial planning at local authority level, can be re-evaluated within the framework of noise abatement planning in light of their contribution to noise reduction. This also enables those local authorities that lack additional funding for noise abatement measures to at least implement their noise abatement plans in the long term.

Evaluation situation: **Changes in disturbances as compared to the analysis**

Impact table
Evaluation situation:
Change in disturbance as compared to the analysis

	Day	Night	Day	Night
Analysis	**2,000**	**2,500**	**100 %**	**100 %**
Variant 1	**-240**	**-575**	**-12 %**	**-23 %**
Variant 2	**-600**	**-1,060**	**-30 %**	**-53 %**
Variant 3	**-820**	**-1,340**	**-41 %**	**-67 %**
All measures	**-1,400**	**-1,600**	**-70 %**	**-80 %**

Graph



Who should be involved in this step?	**Local transport companies**	**Regulatory authority**	**Urban Planning authority**	**Highways department**	**Road traffic authority**	**Civil Engineering authority**	**Environmental protection agency**	**Traffic Planning authority**
	x	x	x	x	x	x	x	x

What are the advantages of this step?

Using impact analysis, the noise abatement potential of the various measures can be evaluated for each section of road, each district and the overall area. By comparing the different variants, the local authority can immediately ascertain the improvements to be expected from each, thereby gaining a clear and comprehensible quantifying method for use in decision-making. Evaluating the measures on the basis of the impact analysis also enables the local authorities to make effective use of their budgetary resources.

Part 3. Selected examples of effective noise abatement measures in European towns and cities

Annecy

• Back

Noise reduction in the city of Annecy

Michel Delleur

Annecy is both an industrial and tourist city in the French Alps. The medium-sized city (134 000 inhabitants in 2000) has experienced a large increase in population in the last decade (+11.6 %). There is a great pre-occupation about noise amongst the inhabitants. The Mayor committed the city at a very early stage to activities related to noise abatement, and concern for this topic is one of the constants in political life in Annecy.

Early regulatory action:

- Heavy goods vehicles were banned from the city centre in the 1970s;
- speed limits were reduced from 50 to 30 kph at a very early stage.

Current practice:

Reduced noise sources:

- checks on noisy vehicles are carried out (goods vehicles, motor scooters...);
- when investing in replacement service vehicles the local authority pays attention to noise emission levels;
- containers for glass recycling are located underground.

Action regarding public concern

- public complaints about noise are treated with great attention by the city authorities;
- public information activities take place regarding noise issues as they affect inhabitants.

Urban mobility plan

The French national regulation on air pollution issued in 1996 was the origin of this plan. At the time, the trend was towards large increases in motorised traffic over the years to come. In addition, mobility analysis showed that 75 % of journeys were based on cars. A significant part of inner-city traffic was transit traffic. This led to the following targets:

- reduce transit traffic
- develop bus lanes
- promote 'soft' (more environmentally friendly) mobility: cycling, walking
- maintain access for city centre shops and residents
- increase road safety.

These objectives were translated into several actions:

- ban transit traffic from the inner city and redirect it to a by-pass
- create traffic 'pockets' and 'blocks'
- develop one-way streets and bus lanes
- extend car free (pedestrianised) areas

This urban mobility plan required a high degree of consultation and coordination with all the actors involved: local authorities, inhabitants, shop keepers, transport companies, non-profit organisations. It resulted in very careful scheduling of civil engineering works, and public information for 'users' of the city. Work started in July 2001 and is planned to take 3 years. Some objectives have already been reached; for example, travel time for buses has decreased, car traffic has been reduced, road safety has improved, and the pedestrianised areas are now significantly larger.

However, there are some negative side effects:

- some of the problems have moved to other parts of the city, including noise and other pollution. As a consequence, complaints about noise emerge now from other groups of inhabitants;
- some people no longer visit the city, because they feel they have lost their 'traffic landmarks'.

Therefore, it must be emphasised that such urban transformation towards a quieter and more accessible city requires a strong and stable political will in order to face opposition.

- **Click here to view complete Annecy presentation (PowerPoint - FR)**

Berlin

• Back

Outcomes of the HEAVEN pilot trial in Beusselstrasse and conclusions to be drawn for air quality management and noise abatement planning

Bernd Lehming

Background

The Berlin Regional Ministry of Urban Development was involved, in collaboration with Rome, Rotterdam, Paris, Prague and Leicester, in a major EU project known as HEAVEN[1], which was concluded in March 2003. Amongst other things, the project was designed to consider what part might be played by traffic regulation measures (speed limits; re-routing or completely banning traffic) in complying with requirements to keep to new EU-wide threshold limits on air quality and on reducing noise pollution.

As an element in the Berlin pilot project trials, from the beginning of July up to the middle of August 2002, the following test measures were tried out in Beusselstrasse in the Moabit district of Berlin:

- a speed limit of 30 kph was introduced and
- subsequently a three-week long ban on HGV of more than 3.5 t was imposed.

These trial measures were accompanied by extensive measurements of air quality and noise pollution.

This road, Beusselstrasse, is in a category of very highly affected roads, which may be primarily explained by a high proportion of goods vehicles. EU threshold values for fine particulates and NOx are exceeded by a wide margin, noise nuisance is, as may be imagined, of a similar order.

Significant results of the pilot scheme

Evaluation of the measurements taken revealed the following effects of these measures:

• effects on the traffic

during the period of the lower speed limit, it was observed that speeds fell by only 5 kph. Only when speeds were visibly being monitored by the police was it possible to detect speeds being noticeably reduced by 10 kph, which was then translated into effects on air quality and noise immission;

during the HGV ban approx. one-third less goods vehicles were recorded using the road. This meant that approx. half of the drivers whose vehicles were covered by the ban complied with the regulation;

• effects on noise

during the period of the lower speed limit, measurements indicated noise levels had been reduced by over 2 dB(A). If the lower speed limit had been totally (100 %) observed a noise abatement effect of at least 3 dB(A) could have been expected. Given the achieved rate of compliance, these results are within the same compass as those established in 1999/2000 in the road traffic noise abatement pilot schemes which were in place at 13 road cross-sections as part of a longer-term scheme;

the HGV ban produced noise abatement effects of somewhat more than 1 dB(A) during the day time. This effect was generally speaking in line with predictions, because the ban applied only to vehicles of over 3.5 t.

• effects on air quality

the lower speed limit brought about noticeable reductions in those atmospheric pollutants where threshold limits were being exceeded in this road and in other main thoroughfares. For example, measured levels of particulates (PM10) were reduced by approx. 2 %, and those for NOx by about 3 %;

The effects of the HGV ban were even more striking, showing a fall of about 8 % in particulates (PM10) and about 20 % for nitrogen oxide.

The range of effects for environmental protection have been summarised in the table below.

		HGV ban	30 kph speed limit
soot		- 7% (± 3%)	- 3% (± 3%)
fine particulates (PM10)		- 7% (± 5%)	- 2% (± 2%)
NOx		- 20% (± 10%)	- 3% (± 2%)
noise	day time	- 1.3 dB(A)	- 2.0 dB(A)
	night time	- 1.0 dB(A)	- 1.2 dB(A)

Conclusions

in Berlin in many of the main thoroughfares EU threshold values for fine particulates and for NOx are already being exceeded;

consequently, the City authorities are obliged to draw up an action plan in 2004 which will lead to the threshold values being observed;

the need to take action on transport and traffic measures is increasing. In particular as regards fine particulates, the situation has clearly deteriorated over the course of 2002. There is currently no sign of any change for the better. In the event of values being continually exceeded beyond 2005 and/or 2010, the authority's requirement to take more drastic measures continues to expand up to and including total traffic bans;

[1] *HEAVEN = Healthier Environment through Abatement of Vehicle Emission and Noise.*

Berlin's (resident) HGV fleet contains within it a sizeable potential for using low-pollution vehicles (EURO IV, natural gas fuelled vehicles) to enable fine particulate and NOx pollution levels to be reduced;

even so, there will still be a number of heavily affected locations within the Berlin network of main roads, at which additional measures will need to be taken in order to comply with threshold values;

- the pilot scheme carried out as part of the HEAVEN project, showed that using traffic management measures such as speed limits and traffic bans on HGV traffic can achieve local demonstrable improvements in air quality and noise pollution situations. Thus environment-oriented traffic management opened up additional opportunity, over and above the urgently required technical up-grading of the vehicle fleet, to work towards the stated objective of achieving the threshold values. The transport and traffic data produced by the work of the Berlin Traffic Management Centre (VMZ) - in conjunction with further modernisation of the Berlin traffic signal infrastructure - open up the possibility through dynamic junction controls for local improvements in pollution levels due to air-borne pollutants and to noise.

- ***Click here to view complete Berlin presentation (PowerPoint - DE)***

Breda

• Back

Looking at noise in Breda - combating traffic din with 'black' and 'red'

Ghislain Rooijmans

Introduction

Breda is located in the south west of the Netherlands and has a population of 165,000. Together with two adjoining municipalities, the total population is 260,000. Between 1997 and 2002, the nuisance from traffic noise in Breda increased from 30 to 41 per cent (source: Breda Municipal Authority). Car use in the city is higher, bicycle and public transport use are lower than in comparable Dutch cities. Accessibility by car is still therefore considered to be relatively good, and parking problems are less serious than elsewhere. However, a number of large projects are now being prepared and implemented that require measures to be taken so that the quality of life, levels of accessibility, and traffic safety can continue to be safeguarded or improved. These measures involve not just car, but also public transport and bicycle infrastructure. This presentation focuses on car and bicycle infrastructures.

Municipal programme to address traffic noise

The Noise Abatement Act, which has been in force since 1979, also deals with traffic noise. This Act, with its related regulations and subsidies, is extremely detailed and leaves almost no room for interpretation. However, under the influence of European regulations and social developments, the law is now being changed, creating more room to develop local noise policies. In the spring of 2003, therefore, a municipal noise memorandum entitled a look at Breda noise was drawn up. This memorandum records the line of reasoning to be followed by noise policy, which still has to be worked out in more detail. Thus, the basic principle involves taking appropriate measures at source; it is not so much the norm but rather the perception of noise that is more important. Furthermore, attempts are made to prevent or remove traffic noise problems wherever possible - for example, in projects involving major maintenance and repairs, in refurbishment projects and in new projects that may result from the Breda Traffic Plan described below.

The municipal council will adopt the Traffic Plan in late 2003, which a project group has been working on for four years. The basic principles are: Accessibility – Safety – Quality of Life. The great virtue of the plan is that it structures the city's traffic network. It also lays the basis for a systematic way to tackle the problem of traffic noise.

Objective of the presented measures

The most important measures, dealt with below, satisfy the three basic principles as far as car and bicycle traffic are concerned. Of course, public transport ought also to contribute to the objectives, but that is not within the scope of this presentation.

Better use of urban main thoroughfares

This can be realised by introducing advanced traffic regulations, 'dosing' levels of use at peak traffic moments and guiding traffic flows, as well as by (suitably) expanding the infrastructure (the city is growing and acquiring more homes, more business parks, more cultural institutions, more events). The use of low noise road surfaces is part of this measure. The costs amount to around € 64 million.

Customisation and preservation of the city's characteristics

The quality of life in Breda, its historical, green character and its spatial quality, are central. Car traffic will therefore only be given the space that is strictly necessary. As a result, there will be more space for spatial planning and for cyclists and pedestrians. A number of district approach roads have already been narrowed from 2x2 to 2x1 lanes. In addition, free-standing cycle paths have been constructed in these locations, plants and street light fittings have been chosen so that the road blends better with its surroundings.

Experience has shown that residents, though they complain about traffic noise, often prefer to preserve the characteristic appearance of the street than to accept measures that change the road surface. They often want to keep their clinker brick road surface, for example, instead of opting for a quieter asphalt road surface. Moreover, there is often an - unfounded?- fear that motorists will drive faster on the asphalt surface. In such cases, a 30 kph rule is always introduced, although this 30 kph limit need not be taken too seriously. In one case, it was decided to replace the existing clinker bricks with low noise clinkers, even though this was more expensive and less effective than the use of a quiet thin layer, dense road surface. The costs come to a total of € 40 million.

Bicycle traffic

Car use in the city must be reduced for shorter distances of up to 6 kilometres. The intention is to allow cyclists to travel safely, quickly and comfortably from door to door. Existing bicycle networks in the city must therefore be expanded and completed. This includes safe, well-positioned bicycle sheds and parking zones, both guarded and unguarded. Along main traffic routes - if space allows - two-way cycle paths with a width of 3.5 metres will be constructed in red asphalt on both sides of the road. The costs are € 14 million, and the provincial government is to provide a 30 per cent subsidy for the main cycle routes.

Bicycles will be given priority in residential areas, and on many regulated junctions cyclists will have priority over cars when crossing the road. Detection loops installed in the asphalt will detect a cyclist's approach, and a traffic light will flash a message "Seen; wait for green". The lights will then change to green as soon as possible.

The express cycle route between Breda and Etten Leur is a good example of a special cycle path. It is a fully lit, free-standing, two-way cycle path in red asphalt, 3.5 metres wide and 7.5 kilometres long. It links Etten Leur (population: 43,000) with Breda city centre. The total costs came to € 3.37 million, € 2.38 million of which was subsidised by the provincial government. In the suburban area, around 1,100 cyclists now use the cycle path every day, and in the urban area around 3,500 cyclists. Growth of a further 25 per cent is expected.

A total of around € 155 million has been budgeted for all measures up to the year 2013, including those not mentioned here. However, the plans will probably have to be implemented in different phases, as they would otherwise make too many demands on currently available resources. In the meantime, work can be carried out on different parts of the plan in the context of necessary repairs and maintenance and in the context of a number of larger construction plans with their own financing, for which the existing road network will have to be adapted or improved.

The planning and realisation process in brief

The basic principle is that all the relevant disciplines will sit together around the table in Breda as soon as possible. As far as traffic noise is concerned, the situation 'on the ground' will be taken advantage of as much as possible; i.e. if a sewer has to be replaced and the road surface has to be dug up, low noise asphalt can be laid immediately if that is desirable from the point of view of traffic noise. It is also important not just to solve existing bottlenecks but also to prevent bottlenecks from arising later. It is not a good idea to start autonomous noise projects which all too often lead to loss of capital. But this is not the only reason that a support base is lacking for such projects - it is also because there are no serious or conspicuous traffic noise problems (> 70 dB(A)). The objective will therefore always be to improve the quality of public space + improve traffic safety + improve the quality of life + maintain and renew technical infrastructure. In short, as integrated an approach as possible.

Because the planning of civil engineering projects is so liable to changes for various reasons, the best approach is probably to deal with the problem in a flexible way, not uncompromisingly stick to any schedule that might have been drawn up.

The participation of residents also makes it necessary to have more flexibility. Plans are never completely worked out and then disclosed to residents; instead, they are submitted to residents during the draft phase so that discussions can be held about the basic principles. In all cases, communication takes place with residents to a greater or lesser extent. Sometimes, sounding board groups of residents are formed for that purpose and, together with municipal officials, they discuss the plans and can offer their opinions. In other cases, there is even an open planning process in which residents have as much say as officials.

The main difficulties

In almost all cases up to now, it has been possible to attract enough attention for measures that restrict traffic noise in projects. Again, however, the main difficulty always involves gaining an adequate support base within the municipal system, which is less difficult in some cases than in others. One reason, as is probably the case everywhere, involves lack of integrated thinking, where financing is too often seen as an isolated factor. Here, of course, the internal organisational structure plays a major role. Responsibilities and budgets are distributed over a number of departments and city councillors. This is especially the case with small and medium-sized projects which are often not managed in the same way as larger projects. As well as this, greater knowledge is required on a wide range of issues. The main thing is that all interests should be weighed in connection with each other and included in an implementation plan, but it is difficult to estimate a quality such as the spatial characteristic at its true value.

Financing and costs

In a number of cases, subsidies from the state or the provincial government can be used to finance various projects. As far back as the early 1980s, the Ministry for Housing, Regional Development and the Environment (VROM) has been granting subsidies to combat nuisance from traffic noise. These are divided into subsidies for insulating homes, for taking traffic measures and for constructing noise screens or barriers. In principle, subsidies cover costs, but related conditions are stringent and inflexible. Only in 2001 was an incentive subsidy introduced to encourage the use of low noise road surfaces. However, due to its great success, this scheme only lasted for a short time because the money was soon spent. Breda submitted six projects to the Ministry, four of which were subsidised. The total subsidy amount received was € 415,000.

The costs of measures contributing to reducing traffic noise are often difficult to specify exactly, as is shown by the following list: use of low noise road surfaces; narrowing roads from 2x2 to 1x1 lanes so that the average speed is reduced; use of a 'green wave' system so that vehicles brake and accelerate less frequently. Added to this, free-standing cycle paths are also usually constructed with the intention of stimulating bicycle and reducing car use. Often, therefore, calculations are only based on the costs of the low noise asphalt.

Integrated plans, on the other hand, tackle a wide range of aspects that also automatically have a positive effect on traffic noise and on air quality.

Most of the low noise road surface has been paid for by Breda itself. Additional costs are always relative, certainly when set off against the consequences of not using a low noise road surface - which include, for example, building further from the road, higher sound-proofing screens, thicker insulation in buildings and no contribution whatsoever to reducing the blanket of traffic noise in the city. Sometimes people do not want a sound-proof screen or barrier, and a low noise road surface is the only alternative. In this case costs are paid for out of the operating costs of a zoning plan or out of the ordinary maintenance budgets. In the years to come, financing by the State will change due to the Ministry of Housing, Regional Development and the Environment, and municipalities will have much more freedom to decide themselves how the noise problem should be solved, without being tied to a specific subsidy scheme.

In addition, there are a number of subsidies available from the Ministry of Transport and Public Works and from the provincial government, especially for construction or expansion of the rail and vehicle infrastructure, public transport and bicycle amenities.

The participation process

Breda Traffic Plan was drawn up by a project group in which a number of municipal departments took part. A sounding board group of various interest groups with economic, ecological, traffic management and social backgrounds also played an important part. All the people of Breda also had opportunity to voice opinions during public participation meetings, and there was a lot of public information in special publications or in the local press - incidentally, a press that is very interested in the subject. Furthermore, at different moments the public could also make their views known in writing.

When compiling the noise memorandum entitled a look at noise in Breda, interviews with various key figures were held. In order to work out details of the noise policy, which covers a much broader area than just traffic noise, the best way to involve interest groups and residents is still a subject of investigation. After all, noise is an emotional subject which requires a very special approach. The preparatory noise memorandum was received with unanimous approval, however. People appreciate the fact that it is written in understandable language, and that it focuses a lot on the concepts of 'perception' and 'nuisance'. The term 'decibel' occurs only once in the main text, for example, and the memorandum concentrates much less on norms and rules than on factors that are important in causing a nuisance. The film commissioned by the Breda Municipal Authority, entitled "Life in the city, a look at noise in Breda", also played a positive part in bringing the multifaceted theme of noise to the political forefront.

The intention is that from now on to communicate more - not just with residents, the business sector and other interest groups, but also within the municipal system - to make it clear that noise is unavoidable and is a part of normal life, but that there are also limits to what people and the environment should have to put up with.

Evaluating the measures

Technical: reducing noise levels

In order to gain a quantitative insight into noise levels in the city and into the number of people bothered by noise, the TNO-INRO Institute based in Delft is currently surveying all traffic noise using a GIS system called URBIS. This will also provide an understanding of noise produced by rail traffic and industry, as well as air quality as a result of road traffic. The survey focuses on the current situation as well as on projections for the year 2015.

By using low noise road surfaces, it is possible to obtain noise reductions of around 4 dB(A) (thin layer dense road surface) to a maximum of around 7 dB(A) (2-layer sound-absorbing road pavement). The result of the last close proximity (CPX) measurements of thin layer dense road surfaces (Microflex 0/6) was: 4.5 dB(A), 4.1 dB(A) and 4.4 dB(A). The current preference is for the thin layer dense road surfaces, not only because noise level reduction is greater, but also because of the life span of the material. At the moment, therefore, this seems to be the best solution. It also has the largest internal support base.

The effect on average traffic speeds of making roads narrower was not measured, unfortunately, and its effect on noise levels is therefore not known. Moreover, it is not possible to say whether the increase in bicycle traffic is having an effect on noise levels. The impression is that bicycle traffic is growing but there are no exact figures. A monitoring system is currently being developed.

Subjective: opinions of the people actually bothered by noise

People's opinions of the low noise road surfaces are very positive, both on a national and a local level. This is evident from a large number of individual interviews with residents, and the fact that various political parties in the municipal council support the use of the surfaces. A mini-survey carried out by students showed the great enthusiasm of residents in a street where (by way of experiment) a thin layer dense road surface was applied to part of the street, and double-layer sound-absorbing road pavement to another part. In the future, it is advisable to evaluate projects and involve the residents more. There are already good intentions in this respect, but they need to be put into practice much more.

One worry is that too little attention seems to have been paid to maintenance and management of these special road surfaces. After all, the 2002 Breda urban monitoring report states that the general satisfaction of residents with the way roads and cycle paths were maintained fell from around 74 per cent in 1996 to around 57 per cent in 2002. The necessary improvements will have to be made in this area.

- **Click here to view complete Breda presentation (PowerPoint - EN)**

Parma

• Back

Improving noise pollution in the city of Parma: evolution from 1998 to 2003

Pietro Vignali and Emanuelle Morruzzi

From 1998 to 2003, many modifications were carried out on public (and private) transport systems in Parma. The goals were, on one hand, to improve traffic flow in the whole road network, and to promote public transport, but to avoid criminalising private cars.

This involved complete redefinition of parking areas, which were made mostly toll-parking zones, elimination of traffic light crossings, which were replaced with roundabouts, and creating transfer parking areas ('park and ride') in order to attract car drivers to use public buses to reach the centre of town.

As for vehicles employed for public transport, the available vehicle fleet was revamped: most of the older, large buses were sold, and new, smaller and smarter vehicles were purchased. These included alternative propulsion vehicles, employing methane engines or hybrid diesel-electric models. Some were even equipped with battery-operated electric engines, employed for crossing more acoustically sensitive areas such as the hospital; batteries are then recharged when the vehicle is running outside these areas, employing the normal internal combustion engine.

Quantification of the improvement obtained was possible in a quite accurate way, because in 1998 a series of measurements and evaluation were made, as a consequence of a civil suit raised by a group of citizens. The citizens sued the municipality and the public transport company (owned by the municipality), claiming that noise limits, which were set in March 1998 by adoption of an acoustical classification of the entire municipal territory, had been or were being exceeded.

The result of the suit was that limits were actually being exceed in the streets of the town centre, but the excess noise was due mainly to private transport.

However, the municipality reacted strongly, modifying the public transport services programme, redefining the rules for accessing the city centre applicable to private transport.

Another action was to re-make the road pavement in the principal directions.

These immediate action steps already produced a significant effect; in the following years, progressive substitution of vehicles and creation of a new service, named 'ProntoBus', further improved the situation.

'ProntoBus' is a service based on small buses, in which the route and frequency of services are not pre-set; on the contrary, they are dynamically modified following requests by citizens, who call a 'green' number asking to be picked up by the bus. In practice, citizens perceive this service as calling for a taxi, but the price of the transport is the same as on normal buses.

'Prontobus' is actually the only bus service available during the night time period, and eliminating traditional night bus service lines contributed considerably towards complying with noise limits. It must be noted that in Italy noise limits are differentiated for the day period (06-22 hrs.) and the night period (22-06 hrs.), and the difference is 10 dB. In the city centre, the day limit is 65 dB(A) [Leq] and the night limit is 55 dB(A). Typically, it is much more common to exceed the night time than the day limit; consequently, eliminating standard buses during the night time resulted in a significant reduction of the likelihood that these limits would be exceeded.

In the information below, some quantitative information is provided, thus making it easier to evaluate the effects of the actions taken.

In 1998, a very important road was chosen as a 'trail blazer' for the situation of the whole city centre: via Farini, which connects the central square of Parma with the South Gate of the ancient walled town. The walls are now gone, and an inner-city ring road surrounds the circular city centre (Parma take its name from the ancient Roman shield, the parma, which was perfectly round).

In 1998, 4 bus lines were running along via Farini, each with a frequency of service of between 10 and 15 minutes, in both directions. The total number of passages was 477 during the day and 15 during the night. Furthermore, most of the road was open also to private vehicle traffic (only in the direction from city centre to suburbs), and the road pavement was very rough (large rectangular stones, badly aligned and not levelled).

The result was that noise limits were significantly exceeded, as is shown by the following table:

Time period	day	night
no. of bus passages	477	15
L_{eq}, total	72.8	65.3
L_{eq}, buses only	67.3	55.3
L_{eq}, remainder	71.4	64.8

The separation of noise caused by buses from noise caused by private transport was possible by means of advanced measurement techniques (detection of noise events above a pre-defined trigger level, with recording of the sound during each event, and subsequent classification). In this way, it was possible to evaluate the SEL (Single Event Level) of each bus passage, both outdoors, inside the house with open windows, and inside the house with windows closed. The following table illustrates these results:

Location	exterior	interior, open window	interior window closed
SEL average	88.1	78.5	56.5
dev. std SEL	3.22	3.74	5.62

As a result of modification in the bus service programme, the number of passages was greatly reduced. Furthermore, the average SEL of each transit was also reduced by employing the new, smaller and more environmentally friendly buses.

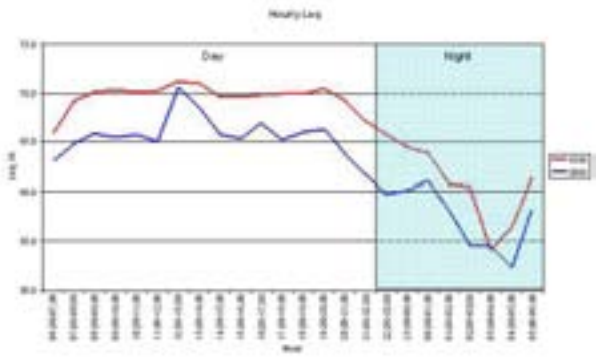
The following table compares the situation in 1998 with the situation in 2003, both in terms of number of transits and of SEL of each transit; the Leq caused by the buses only are also shown:

Year	vehicle type	SEL (dBA)	no. of passages, day time	no. of passages, night time	L_{eq},bus, day dB(A))	L_{eq},bus, night dB(A)
1999	1982 model bus, 90 pax	88.1	477	15	67.3	55.3
2003	2001 model bus, 40 pax	80	128	4	53.5	41.4

Furthermore, private traffic was almost completely banned on via Farini, except for the very last part.

Acoustic measurements were performed in October 2003, in the very same locations employed in June 1999. The comparison between the noise profiles is self-explanatory, showing a significant reduction of the overall noise and complete disappearance of the prominent peaks caused by the passage of old, heavy buses.

The following figure shows the comparison between these profiles.



The following table summarises the results:

Time period	day	night
L_{eq}, 1999, total	72.8	65.3
L_{eq}, 2003, total	66.1	58.2
reduction	6.7	7.1

Although the noise limits of 65/55 dB(A) have still not been achieved, an average reduction of 7 dB(A) was obtained.

As the action steps taken are the same within the whole city centre, it can be concluded that similar noise reductions have been achieved, not only in via Farini, but in the whole town of Parma.

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Valencia

• Back

Acoustic road surfaces: experiments in the city of Valencia

Ramon Isidro Sanchis Mangrinan and Alfonso Novo Belenguer

The aim of this report is to give a brief summary of the local authority's attempts to combat noise pollution, and of experiments developed by Valencia City Council to reduce urban traffic noise through use of acoustic road surfaces. Starting with the initial phase of experimental research, carried out with the support of the Polytechnic University of Valencia, the report goes on to describe the more general use of the University proposals after they had been implemented.

Noise has become a significant polluting agent, above all in the urban environment. The principal causes for this are growing population density, mechanisation of most activities and increase in the use of motor vehicles to transport of people and merchandise. Precisely because of this increase of acoustic energy in our cities, measures are now starting to be taken to control it.

Research into noise generated by traffic in the urban environment, as opposed to that on motorways, has not been extensive; studies of traffic noise in the city have been few and limited. Moreover, the causes of noise in the two environments differ. In the city, rolling noise from a tyre on the road surface plays a smaller part, due to lower speeds, while the power units of vehicles have greater impact, and also require far more complicated arrangements for construction and maintenance than is the case for motorways.

It is important to outline the wide social impact that a reduction of several decibels could have in the areas surrounding urban roads. Although in absolute terms these reductions are not as great as those achieved on motorways, a far greater number of people will notice an improvement in their quality of life. It is this idea that forms the framework for the report presented here. Valencia City Council aimed to draw up a plan for traffic noise reduction in the city, for which reason it commissioned the Transport Department of the Polytechnic University of Valencia to carry out the corresponding developmental research.

Structure of the research report

- Local management of noise
- Acoustic road surfaces
- Previous state of the art:
  - rolling noise of tyre on road surfaces
  - international solutions
  - experimental research
  - boundaries considered
  - porous experimental road surfaces:
    - PA-5, 1.5 cm
    - PA-5, 2.5 cm
    - PA-8, 2 cm
    - PA-8, 4 cm
    - PA-10, 3 cm
    - PA-10, 5 cm
  - double-layered:
    - PA-5, 1.5 cm
    - PA-10, 3 cm
  - discontinuous micro-agglomerates:
    - SMA-5, 1.5 cm
    - SMA-8, 2 cm
    - SMA-11, 2.5 cm
  - semi-solid mixes:
    - S-12, 4 cm
- Experimental development

  choice of urban carriageway design:

  single direction carriageway, not too wide;
  minimum length of 50 - 70 m;
  buildings on both sides;
  heavy traffic;
  away from possible interfering agents;
  of low social impact

  data processing

  traffic (spirals + CCTV);
  acoustic (sound meters)

  results of experiments

  reduction in noise levels - Leq
- Implementation of proposals
- General use
- Other measures for noise reduction
  - covering side walls/panels and tunnel roofs in the city with sound-absorbent panelling
  - covering tunnel openings with tunnel silencing device

Conclusions

- All experimental road surfaces:
  - appreciable acoustic reductions

    maximum particle sizes for small sand and cement mixes:

    generate less traffic noise

    for fine mixes (5 - 8 mm):

    discontinuous micro-agglomerates are more suitable

    for medium mixes (10 - 12 mm):

    porous mixes are more suitable

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Vienna

• Back

Noise abatement in Vienna: examples from real life/praxis

Wolfgang Khutter

The City of Vienna is currently working to combat noise on the basis of the following framework and activities

SLIM – Straßenlärmimmissionskataster (catalogue of road noise immission): this database indicates noise levels in the main road network in Vienna at the building line at a height of 5m (above ground). It can be accessed on the Internet at www.lois.wien.at

- SLIK – Schienenlärmimmissionskataster(catalogue of rail noise immission): this document, which is not available in digital form, indicates a noise assessment level at night time at a height of 5m (above ground) in the noise zone categories of > 65 dB; 60 – 65 dB; 55 – 60 dB
- public opinion surveys: in Vienna there are regular opinion surveys (approx. every five years). Analysis and evaluation of answers in the environment field serve as significant bases in judging the level of noise pollution amongst the inhabitants of Vienna.
- the City of Vienna's Dept. for Environmental Protection operates a modelling system for sound dispersal, which is used both for specific project applications and also in the course of urban planning activities by the City of Vienna
- the following are subject to measurement by the Environmental Protection Dept.: industrial noise, public events, noise complaints (on behalf of the statutory authorities) as well as checking and calibration for (road -building) projects/developments
- the EU LIFE project known as SYLVIE (SYstematische Lärmsanierung in innerstädtischen WohnVIErteln - SYstematic noise abatement in inner city residential areas): this project is based on assuming a cooperative approach towards solving inner city noise problems/conflict. The development of a process along these lines took place from October 1999 to October 2002, with the support of EU funding. Currently these processes initiated by SYLVIE are being further developed and implemented in several Vienna districts. Further information may be found at www.sylvie.at
- in the form of a fundamental source of public information, LOIS (Lärm Online InformationsSystem - on-line noise information system) was made available on the Internet at www.lois.wien.at. On this site anyone can access all the relevant information on questions of noise in Vienna

Transparent sound absorbent barriers

- measures already implemented include transparent sound absorbent barriers in particular in specific locations where there was no possibility of public funding derived from the road or rail building (maintainence) budget. To enable these barriers to be financed semi-transparent overlays with advertising slogans were affixed which helped to finance the measures.
- these transparent sound absorbing barriers may be seen at the following locations in Vienna:
  - Vienna district no. 10, Laaerbergstrasse
  - Vienna district no. 14, western access road (motorway B1)
  - Vienna district no. 5, St. Johann Park (situated at the Margarete belt road)
  - Vienna district no. 17, Hofferplatz
- problems encountered and approaches used for transparent sound absorbent barriers:
  - for financing various types of public-private-partnerships are conceivable; in Vienna some have also been implemented. The partners are for example advertising media or solar energy (photo-voltaic) system operators;

The problem of bird strikes (hitting the barriers) must receive particular attention from the point of view of environmental protection. A study carried out by the Vienna Environment Agency has shown that bird strikes can only be prevented by patterns of strips which are 13 mm wide, with gaps also 13 mm wide. Further studies are at the time of writing also being carried out (cp.: Vienna Environment Agency by going to http://www.wien.gv.at/wua/).

- maintaining these transparent sound absorbent barriers continues to present difficulties: possible approaches include in this instance as well various public-private-partnership models. Another avenue of approach might include particular types of construction and special choice of materials such as multi-layer safety glass; plexiglass; glass with what is known as the lotus blossom effect (i.e. self-cleaning surfaces).

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Göteborg

• Back

Good examples on decreasing annoyance from traffic noise

Thomas Hammarlund

Disturbance due to traffic in Göteborg city is relatively small compared to other European cities. Nevertheless, a significant number of people in Göteborg city do live in areas that are significantly affected by noise. Furthermore, it is expected that the guiding levels that are set for noise levels in various environments will take years to meet.

In the case of traffic noise, the Swedish Parliament has determined guiding values for construction of new residential buildings or infrastructure (such as roads and railways). Current guiding levels concerning residential buildings are thus:

- 30 dB (A) equivalent level indoors
- 45 dB (A) maximum level indoors at night time (between 22.00 and 06.00 hrs.)
- 55 dB (A) equivalent level on exterior wall (at the façade)
- 70 dB (A) maximum level in outdoor areas close to dwellings

The parliament also determined guiding levels for already existing buildings and roads. These are:

- 55 dB (A) maximum level of noise indoors from tram or railway traffic
- 65 dB (A) equivalent level of noise from road traffic outdoors at the façade

The goal is that by 2007, these levels will not be exceeded in any residential buildings.

The guiding limits are difficult to meet in the city centre of Göteborg. A significant part of residential buildings lining streets in the centre are subject to noise levels exceeding 65 dB(A) outside the windows. Despite significant measures taken to reduce the amount of traffic in the city - for example by constructing roads outside the central part of the city - too many city inhabitants experience too high levels of noise in their homes.

Various means are being used to reduce traffic noise annoyance in people's homes. Two approaches are to replace windows (in order to reduce indoor noise levels), and to create what are called 'silent' façades.

Replacing windows

Since 1992, the Traffic and Public Transport Authority in the city of Göteborg has subsidised replacement of windows in residential buildings that are exposed to high levels of traffic noise. In order to receive a subsidy, certain requirements - which have changed over the years - have to be fulfilled. Generally it is required that the outdoor noise level exceeds 65 dB(A), while the indoor noise level exceeds 35 dB(A). While the subsidy has also differed in magnitude, it has usually covered 25 % of the costs associated with replacing windows.

Usually property owners/landlords have replaced windows with triple-glass windows in order to reduce indoor noise levels caused by road traffic. It is estimated that some 3000 people residing in areas with high levels of traffic noise have as a result a better home environment (indoors) at a total cost of 1.4 million €, of which 600,000 € were subsidies.

Silent façade

In areas where the level of traffic noise is particularly high, the approach is that it is necessary for residential blocks to have at least one 'silent' façade, as it is known. When this term is referred to, this implies that no noise at all is acceptable at one of the walls in a residential building (for example the side facing a back yard or court). No noise includes noise from traffic, as well as ventilation and refrigeration systems.

There are guiding levels for noise from such systems, which are:

- 40 dB(A) equivalent level from 22.00 – 07.00 hrs.
- 50 dB(A) equivalent level from 07.00 – 18.00 hrs. on normal days
- 45 dB(A) equivalent level from 18.00 – 22.00 hrs.; (on public holidays from 07.00 – 18.00 hrs.)
- 55 dB(A) maximum level from 22.00 – 07.00 hrs.

In order to meet these levels at residential buildings where there may be several ventilation and refrigeration systems, currently work is in progress towards more severe requirements for individual systems. This implies that no system placed near residential property is allowed to exceed a noise guiding level of 30 dB(A).

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Modena

• Back

Acoustical planning procedures: lessons learnt in the city of Modena

Daniele Bertoni

Acoustical planning tools provided by Italian law

According to Italian law, environmental noise control policies must be based on a land use zoning system, called acoustical zoning, which is carried out by municipalities.

Each of the seven zones delineated by law is linked to different day time and night time outdoor noise limits as equivalent sound pressure levels (see table 1).

To give some examples: hospitals, schools and parks always come under class I; whether something is in II, III or IV is based on the density of inhabitants, workshops, service trades and on the kind of roads.

Class	type of area	day time L_{eq} dB(A) (06.00-22.00)	night time L_{eq} dB(A) (22.00-06.00)
I	noise sensitive areas	50	40
II	residential areas	55	45
III	mixed areas	60	50
IV	high human activity areas	65	55
V	industrial areas	70	60
VI	exclusively industrial areas	70	70

Table 1: Noise limits according to acoustical zoning

The framework law on environmental noise 447/95 identifies two planning tools aimed at ensuring that development does not cause unacceptable noise increases: 'noise impact assessment', which must be carried out for new activities and infrastructure that produce noise, and 'noise climate assessment', which must be applied for new residential areas and noise-sensitive land uses which need to be protected from noise.

These procedures allow noise level prediction before development, compliance of new installations with noise limits and planning any action necessary to ensure limits are observed.

Noise impact assessment

Noise impact assessment must be submitted to the municipality if one of the following are built or modified: airports, highways and roads, discotheques, clubs and shops with noisy machinery, recreational facilities, railways and other public rail transport.

Noise impact assessment must be presented when applying for building permission, for municipal licences to use buildings or infrastructure and for licences to start up shops, workshops, industrial plants, recreational facilities and shopping centres.

Comparison between the measured background noise levels at a location and the anticipated noise levels from proposed activities or infrastructures is performed to demonstrate that a project complies with the framework, in other words to show that noise limits will be observed.

Noise climate assessment

The Italian law requires 'noise climate assessment' for areas where it is expected that schools, hospitals, parks, new houses near airports, railways, streets, discotheques, clubs and shops with noisy machinery and recreational facilities will be built.

Ways to compile a climate assessment document are to be defined by regional authorities.

Local authorities require this document, since they consider it to be a useful tool for improving the quality of new residential developments, in fact making it possible to check whether noise levels comply with the noise limits set by acoustical zoning.

To perform noise climate assessment noise measurements have to be taken to describe the present situation, and noise level predictions drawn up, allowing changes in traffic flows or other noise sources that might be introduced to be taken into account.

Noise climate assessment gives town planners information that is useful for positioning buildings according to their use, for setting minimum distances of buildings from roads in order to keep to noise limits, or for setting the maximum height of buildings to be in the shadow zone of a noise barrier, and may also establish the need for noise reduction measures, such as barriers, low-speed zones or devices directly on noise sources.

In substance, this procedure allows noise level prediction before constructing residential buildings and planning any action necessary to ensure noise limits are respected.

Lessons learnt in the city of Modena

In February 1999, for the first time in Italy, the City of Modena adopted acoustical zoning and the Noise Abatement Action Plan. The reason for this choice may be found in the fact that since the 1980s, the City of Modena has been giving priority to environmental noise reduction policies.

Important measures were carried out such as noise mapping the urban area in 1988, and a survey on inhabitants' reactions to road traffic noise in 1991; this survey pointed out noise thresholds that, if exceeded, annoyed residents.

These experiences led to improve sensibility of local authorities towards introducing acoustical planning as part of land use planning procedures.

At present, the City of Modena plans new developments taking into account, from the beginning, of environmental aspects, thanks to a working group where architects work together with other experts (noise, air pollution, sewerage, traffic, electric supply grid, parks and gardens).

According to this procedure, a town planner designing a local plan must from the beginning take noise reduction needs into account. Drawing up a project for a new residential development, the planner has at his disposal a 'noise climate assessment' which shows noise levels in the area where new houses will be built.

The position, the orientation and the height of new buildings may be decided taking into account their use and the distance from noise sources; also positions of noise barriers or creation of a low speed zone may be decided.

Planning the Torrenova residential area

Designing the residential area called Torrenova in the late 80s represented a significant example of acoustical zone planning.

The area, 130,000 m2 in size, was proposed to contain 560 apartments; on the northern side of the area is the ring road, and on the southern side another road (Via Nonantolana) indicates high traffic flows.

Noise contour maps were drawn up based on measurements taken at 2 m and 10 m above the ground (see figure 1).

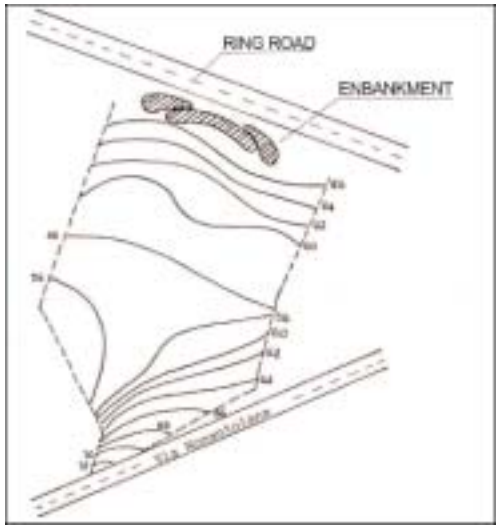

Figure 1: Noise contour map at 10 m above the ground in the Torrenova area

Taking into account noise levels, the original project was changed (see figure 2) modifying the location and the shape of residential buildings: a three-storey building (50 apartments) close to the embankment was substituted with lower buildings to be placed in the shadow zone of noise barriers; residential buildings alongside Via Nonantolana have been replaced with buildings for

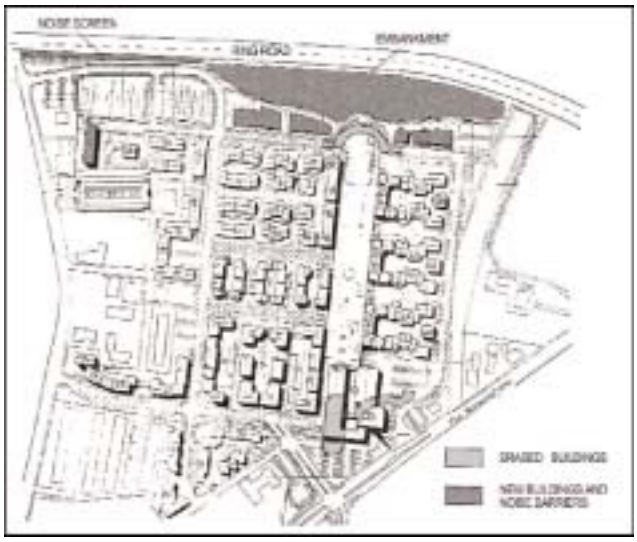

Figure 2: Plan of Torrenova residential area

service trades and public utilities; 20 apartments that were scheduled to be in these buildings were re-located in other buildings.

The existing embankment was raised and lengthened and a noise screen along the ring road was introduced.

Figure 3: Photograph of Torrenova residential area

At present, Torrenova, located close to important roads, is a good quality residential area with low noise levels.

Noise climate assessment of the Via della Pietra residential area

The urban development plan proposed in this area 224 apartments in residential buildings.

The ring road marks the boundary of this area on the eastern side and a less important road (Via della Pietra) forms the boundary on the southern side (see figure 4).

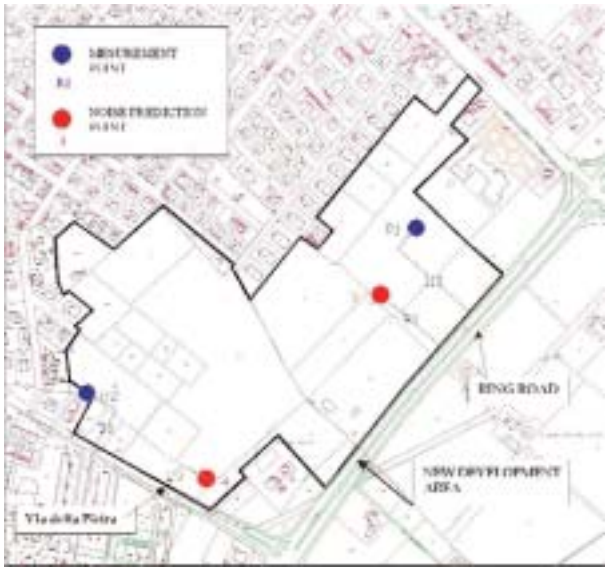

Figure 4: Plan of Via della Pietra residential area

The maximum traffic flow on the ring road is 2,500 vehicles per hour, and 740 vehicles per hour on Via della Pietra.

Noise measurements over 24 hours were taken at two points, 4 m above the ground.

Considering building locations in the draft of the plan, noise levels at the façade of the first line of buildings were calculated starting from measured levels, taking into account contributions to noise levels made by each road.

Table 2 shows day time and night time noise equivalent levels at the location where the first line of buildings is proposed to be placed, compared with noise limits.

Location	point 3	point 4			noise limits
	ring road element	ring road element	Via della Pietra element	total level	
day time	57.0	56.5	55.0	59	55
night time	50.5	49.5	50.0	53	45

Table 2: Calculated noise levels - L_{eq} dB(A)

The future residential development corresponds to class II in the acoustical zoning, that means noise limits are 55 dB(A) Leq during day time and 45 dB(A) Leq during night time (see figure 5).

Figure 5: Acoustical zoning of Via della Pietra area

Predicted noise levels would exceed limits, mainly during night time; therefore the following suggestions were made to the architects:

- build noise screens alongside the two roads; the screen along the ring road should be an embankment placed in the green area;
- building heights are not to exceed the height of the shadow zone behind noise barriers;
- keep the shape of buildings as in the draft plan, but with the courtyard on the opposite side to the ring road.

Conclusions

Analysing noise impacts in town planning procedures involves local authorities in ensuring that future developments will be planned, designed and constructed such that noise levels are minimised.

If potential noise impacts are identified, appropriate abatement measures are to be considered and incorporated into the project.

Local authorities should take into account that this effort achieves the goal of a better environmental quality.

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Paris

• Back

Dynamic mapping for road traffic noise in Paris

Alexandre Puchly / Yann Francoise / Gerard Thibaut

The project was initiated in 2000 by the urban ecology department of the City of Paris. The aim was to go beyond the classification of roads with respect to noise emission which has recently been published, namely:

- to integrate urban shapes into the computation of noise levels;
- to estimate inhabitants' noise exposure levels;
- to simulate effects on noise exposure of political or urban planning decisions;
- to allow noise action plans to be defined.

The noise map of Paris focuses on road traffic noise. It has been obtained by a numerical model that takes the following aspects into account:

- traffic flow and average speed of vehicles;
- geometry of streets and of buildings;
- nature of road surfaces/pavements.

Acoustic measurements are performed to check the validity of the computations and to adjust the modelling in fine detail. It must be emphasised that the emission data does not include noise peaks such as vehicle horns or motorcycles.

The computation is based on a combination of noise prediction software and a geographical information system. The data comes from several databases that provide three kinds of information: topography, traffic, density of inhabitants.

The overall cost of this operation is 120,000 Euros. The figure includes investment in simulation software, databases, computer hardware (8 high-end PCs) and also the human resources involved in the project: one technical expert and 3 co-workers. The project spans over 24 months. Half of this time was dedicated to computation activities. During this first phase, only day time noise levels were computed.

Various kinds of results can be retrieved from these computations:

- statistics on noise exposure with respect to population data;
- noise maps for community areas;
- noise maps at building façades.

The dynamic map has recently been used at the scale of a Paris city district in order to estimate the impact of an "In town without my car" day.

The noise map was published in 2003 for day-time levels only. The computations for night time are presently in progress. The publication is scheduled for March 2004. Concurrently, integration of the EU noise directive is being addressed. It is also planned to invest in new software and hardware in the years to come.

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Madrid

• Back

Madrid's awareness campaign against noise pollution

Placido Perera Melero

The EU green paper on noise identifies two targets:

- to increase public awareness and information
- to try to modify people's 'acoustic behaviour'.

In 1999 in Madrid at a meeting of European experts on urban noise pollution, it was concluded: "It is essential to make the citizen aware that noise pollution is a problem which affects everybody, and as a consequence, everybody must be involved and collaborate."

As a result, an awareness campaign against noise pollution was included in PERCA, the Madrid plan estrategico para la reduccion de la contaminacion acustica (strategic plan for reduction of noise pollution).

The concept: campaign objectives

- to make people aware of noise pollution;
- to show inhabitants how to combat the problem;
- to encourage residents of Madrid to participate in the solution.

The strategy

To take action over aspects that the general public can control, especially in situations where Madrid inhabitants are generating too much noise, asking for their help, by means of solidarity in their behaviour, in order to improve their environment and their own quality of life.

The slogan/motto

'Ssshhh…listen, for a quieter Madrid KEEP DOWN YOUR NOISE'

The publicity campaign image

The campaign highlighted two 'role models' of Madrid: two unquestionable, mythical characters who gave a good example.

Generic communication plan:

- Campaign schedule: education and motivation campaign in primary and secondary education levels (schools);
- Public communication campaign: media: radio, press, open-air locations such as building facades, web site, contests/competitions;
- External activities: streets, public parks, open-air and pavement cafes and restaurants, public houses.

Events

Primary and secondary schools: 320 schools visited, 42,000 children (9 - 14 year old pupils), 41,118 entries presented in the contest, 98 % of total children;

External activities: 72 (working days) in streets, public parks, open-air and pavement cafes and restaurants, public houses;

Media campaign: radio, press, open air sphere – advertising hoardings/billboards.

The project budget

The total budget for the city amounted to 1,153,943 €.

The time period

The campaign took place from 2002 - 2003.

- **Click here to view complete Madrid presentation (PowerPoint - EN)**

Celle

• Back

The Celle noise abatement plan: a brief description of measures taken

Helmut Knabe and Jörg Frohnert

Within the administrative area of the City of Celle, in the course of the last few years, a wide variety of measures has been implemented which individually may seem unspectacular. However, each one of the measures played a part in bringing about, in many sections of the municipal area, both in residential streets and also on main roads, significant noise abatement effects. In this contexts attempts were made, keeping at all times a sense of proportion, to strike an improved balance between the needs and requirements of inhabitants, commerce and motorised as well as non-motorised traffic.

The basis for these measures is provided by the Celle Traffic Development Plan (CDEP), in which conflicts between environmental problems due to transport and traffic and noise-sensitive uses as well as urban design and traffic and transport difficulties are studied in a very non-prejudiced way. On the basis of this integrated comprehensive transport and traffic planning document, all the forthcoming developments in Celle are examined with a view in addition to the noise abatement effects. In this way, noise abatement has become an essential element in day-to-day urban planning and building praxis, some illustrations of which will be given below.

Measure no. 1: setting up an effective routing system for heavy goods traffic (HGV) in order to relieve Celle city centre

In order to relieve the city centre a directional system for HGV was put in place by re-arranging traffic signs/routing, which has resulted in all heavy goods traffic of over 3.5 t permissible total weight being concentrated on a suitable tangential ring road. By this means it was possible to reduce the proportion of heavy goods vehicles in the city centre from approx. 7 - 8 % to approx. 3 - 5 %. The project objectives of concentrating traffic on suitable routes, relieving the city centre from through traffic, improving noise and air pollution levels in the oldest part of town and ensuring urban mobility were all achieved when this measure was implemented. Costs involved amounted to approx. 50,000.00 €, which was able to be financed through the allocation for maintenance in the city budget. The main difficulties encountered in implementation concerned transmitting the objectives, the lack of interest and understanding on the part of retailers, cooperation between various departments involved i.e. the city engineer's office/traffic planning and the traffic/transport authorities ran absolutely smoothly. Altogether, this measure has brought about lasting reduction of noise nuisance in the inner city area and in adjacent residential districts.

Measure no. 2: reducing excessive driving speeds in Gross Hehlen main (through) road (B3)

In the district of Celle called Gross Hehlen, the main through road, Celler Strasse, a federal highway, was re-aligned to the north-west of the local town centre at the same time as the cycle track was extended from this locality, Gross Hehlen, towards Wolthausen; on the road surface area car parking bays were inserted with tree-lined demarcations, in addition extensions to pedestrian areas were implemented at the intersections (road junctions) where the federal highway (B3) crosses Lange Strasse and Kraehenberg respectively. Road lane marking means that the previous width of 7.50 m has now been reduced to 6.50 m. By all these means it was possible to reduce average speeds on the road by 10 kph. The project objectives of increasing road safety, bringing about qualitative improvements for pedestrians and cyclists, changes in the vehicle parking situation (stationary vehicles), speed reduction for vehicular traffic and improving the noise pollution situation were achieved when this measure was implemented. Costs of realising the work amounted to approx. 800,000.00 €, which was obtained through a 60 % subsidy from the local authority highway support fund, 17 % derived from charges from residents for access improvement and 23 % was provided from the municipal budget. Problems in implementation arose due to a number of affected small businesses (apparent obstruction because of reduced free dimensions when the intersections were altered). Cooperation between all the local authority departments involved, city engineer's dept./traffic planning, parks and gardens/open space planning, town planning and the traffic regulation authorities was quite trouble-free. Implementing this measure brought about altogether lasting reduction in noise nuisance (- 1.3 dB(A)) as well as globally increasing road safety.

Measure no. 3: concept for small quantity deliveries to city centre locations

As an integral part of an over-arching concept (a concept for an environmentally compatible system of goods deliveries in the urban network in the Hannover 2000 EXPO area) a model or pilot approach was developed in order to handle both present and predicted goods traffic operations in the city centre area. At the present time loading and unloading take place generally speaking during normal business hours. Attempts are to be made to counter the associated negative effects on quality of life for passers-by and residents in the city centre area, by means of a short time window in which unrestricted deliveries may be carried out in this area (in the remaining time there is access only for low or zero emission light vehicles). Objectives in this project are to minimise goods vehicle journeys, to optimise goods vehicle loads, to encourage use of low or zero emission vehicles and to

provide more unimpeded space for pedestrians and cyclists, together with reducing air-borne and noise pollution. At the time of writing this measure is currently being implemented, in this context there is a wide range of coordination agreements to be set up with municipal bodies as well as with local level 'multiplier figures'. It is expected that implementing this measure will produce abatement of noise nuisance by up to 20 %.

Measure no. 4: Re-planning/-designing a federal highway (Braunschweiger Heerstrasse B 214)

Because it was necessary to renew the road surface after pipe-laying work in a federal road known as Braunschweiger Heerstrasse (B214), it was possible to advance the feeder road junctions on the western road margins in such a way that the car parking bays which are set back from the roadside give the optical effect of reducing the available lane width to 6 m. One significant noise abatement effect was brought about in this case by replacing the road paving by an asphalt surface. Project objectives for this measure included renewing old road surfaces, diminishing the separation effect produced by a main road, re-designing accessory layouts, changing bus bays into capes and reducing noise nuisance. Completion costs amounted to approx. 700,000.00 €. Financing was achieved by a 75 % grant from the local authority highway support fund, 11 % was acquired from residents' proportionate shares as per the law on local authority expenditure contributions, and 14 % came from the city budget. The principal difficulties encountered in implementing this measure stemmed from resistance on the part of small trading and service businesses as well as residents with access (proportion of costs). Cooperation between the local authority departments involved, i.e. city engineer's dept./traffic planning, the traffic authorities, parks and gardens/green space planning and town planning was quite trouble-free. As an overall result implementing this measure brought about lasting noise abatement (- 2.8 dB(A)).

Measure no. 5: re-building a road (Wehlstrasse) as part of conversion measures for civilian use of a former military area (barracks - Heidekaserne)

Subsequent use of land in an area formerly used by the military to become a residential and office/administrative location required a new access/supply planning concept which was incorporated into the urban development plan. The principal element in this planning was to re-build one road (Wehlstrasse) as an important traffic connection in the area. With this in mind, the routing of the road (degree of bend) was decided in such a way that, together with the required crossing fittings (central islands) and the character of a tree-lined cross-country road, speeds in excess of 30 kph would not be possible and thus 'preventive noise abatement' would be achieved. In practice, actual driving speeds have confirmed this approach to the problem. Costs for work carried out amounted to approx. 1.3 million €, which was eligible for 60 % support from the local authority highway building fund.

Overall, lasting noise abatement effects have been achieved by implementing all the measures described above. The current financial situation in many local authorities or municipalities means there is little room for very cost-intensive noise abatement programmes, therefore this approach in Celle of carrying out noise abatement measures in combination with other work which is to be done will be pursued in a single-minded and logical fashion.

- **Click here to view complete Celle presentation (PowerPoint - DE)**

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