Edinburgh, Scotland
EURONOISE 2009
October 26-28

Is simple better than accurate?

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ABSTRACT

We are always trying to improve the accuracy of noise measurements and become more aware of how accurate our measurements are. As scientists and engineers these are laudable if not essential aims. But we should also be aware of how accurate our measurements need to be. We should start measurement work with a clear idea of what we are doing the measurements for. We are usually doing measurements to help us do one of two things. The first is to protect people's amenity such as by limiting industrial noise at noise sensitive locations or ensuring good sound insulation in housing. The second is to improve people's quality of life, such as by designing spaces for the perfect reproduction of music or soundscapes that enhance the environment. Is a 3 hour road traffic measurement on one day in one set of weather conditions sufficiently accurate to predict amenity over a longer period? Is a procedure to measure domestic sound insulation to one tenth of a decibel too accurate? The author discusses whether sometimes we are being too accurate and, as a result, becoming obscure and remote from the people we are serving.

1. INTRODUCTION

This paper deals mainly with the ways in which consultants work, though it applies equally to the acoustics industry in general.

There is no doubt that we should strive to make measurements and calculations of noise and acoustics as accurate as we can. There is no excuse for contaminating measurements of noise with wind noise on the microphone because a proper windshield has not been used. We cannot justify using propagation models that are known to produce inaccurate results in the particular circumstances of a case or relying on a standard reverberation time formula that is known not to be accurate in the particular absorber layout of the room under examination.

But, in day to day acoustic consultancy, obtaining the greatest accuracy possible is neither necessary nor is it practicable. We can obtain the best accuracy in measuring road traffic noise by measuring for long periods of time, different days of the week and different weather conditions but we don't normally do that because the extra time and expense involved does not justify the additional accuracy. The other area in which we can justify being inaccurate or at least imprecise is in the presentation of results to clients. This is not because clients are dim but simply because their expertise is not in acoustics.

We need to keep things as simple as possible so that we can give clients and the public in general the information that they need in a way that it can be readily understood.

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Whenever we can we should be saying to clients that a sound insulation value is 45dB rather than say it is a DnT,w+Ctr of 45dB. In every job we have to make a judgement as to how accurate we need to be and how precisely we need to explain our results.

2. A CASE HISTORY

For those who are not familiar with the planning procedure in Britain it is in two stages. The first is "outline planning permission" and the second is "full planning permission". For outline planning you say, "I want to put some houses on this site, please give me permission". Full planning permission gives approval for details such as the design of the windows and whether you need any special attenuation measures against traffic noise. Well, that description is not entirely accurate – but it's simple and it conveys all I need to convey at the moment.

This case relates to the application for outline planning permission for a development of 5,000 houses, built in phases over 12 years. The site is a brownfield site in the south of England. The land is going to be parcelled up by the owner into blocks and, when outline planning permission is obtained, the blocks will be sold off to different developers. We need to provide a noise assessment for the landowner to go with her tender documents for the sale of each parcel of land. The housing is to be built to comply with the local authority requirement that internal noise levels with windows closed shall not exceed a certain level. There is an existing main road and new roads will be built to service the development as the phases progress. The noise consultant carries out all his investigations and calculations and produces his report. It is comprehensive. It is 200 pages long and has noise levels for each of the 12 years of the development on each of the roads in the development and each part of the road. It has one-third octave band values for traffic noise and it has transmission loss values for each of the types of glazing needed for housing exposed to different levels of traffic noise.

Time goes by and the project is changed. Road layouts are altered and the whole noise impact changes with it. The client requires another noise report. This time the work is carried out by a different consultant. The second consultant produces his report. It is one sheet of paper printed on two sides plus a key development plan. Is this adequate?

Let us consider what my client wants. She wants to sell her land and sell it at the best price without the risk of being taken to court by the purchasing developer for misleading him. So she needs to tell each prospective purchaser what they will need to do to the houses to comply with the planners requirements. The purchaser can then factor this cost into his offer. So all my client needs is a table saying that all the housing in Street 1 will need enhanced double glazing units to such and such a specification and all the housing in Street 2 will need . . . and so on. We do not need an analysis of all the phases – just the final situation because the individual purchasers will build their houses to the final situation. We do not need a report that sets out all the noise data in such a way that each purchaser has to employ a consultant of his own to tell him what he needs to do to comply with the local authority requirement. That might be good for noise consultants but not to anyone else.

3. WHAT IS THE PURPOSE OF THE JOB?

What we need to do, as soon as we get a job inquiry, is ask "what does the client need?" This is often not the same as what the client asks for. What is the client's ultimate aim in commissioning a consultant? If necessary we need to go back to the client and suggest to him that he is asking the wrong question.

We should start measurement and design work with a clear idea of what we are aiming to achieve. It is no good simply saying "I am measuring environmental noise so I need to take measurements in accordance with ISO 7445" or use some other guidance document. We are usually doing measurements to help achieve one of two things. The first is to protect people's amenity for example by limiting noise at noise sensitive locations or ensuring good sound insulation in housing. The second is to improve people's quality of life, such as by designing spaces for the perfect reproduction of music or soundscapes that enhance the environment. Each task has to be approached in a different way. The significance of the difference it makes if I reduce the amount of sound absorbent in a space depends on what the function of the space is. At one extreme we may be designing an anechoic chamber and at the other extreme we may be designing an atrium for a public building. In the first case there will be strict technical design standards that have to be met. In the second we are working as part of a team to design a building that people will like. We may be able to make compromises in the acoustics if we can end up with a building that people like because it is the overall perception that is important. Good soundscapes are no use if they don't work visually. It is the whole end product that is important.

4. SOUND INSULATION IN HOUSING

In the latest Building Regulations for England and Wales the sound insulation required of a sample of separating walls between flats is normally tested. The testing procedure is precise, detailed and systematic both for carrying out the measurements and for the processing of the results. Testing can only be carried out by a UKAS accredited laboratory or by a person registered to carry out such testing who is employed by a company that is a member of the Association of Noise Consultants. The idea is that we will produce the most accurate and the most repeatable results to within a fraction of a decibel.

Before Approved Document E in England and Wales – and still in Scotland – tests can be carried out by any competent person and the test procedure is not as accurately defined. It may be the case that UKAS accredited companies and members of the Association of Noise Consultants registered to carry out tests are, on average, more competent than other people but there is no guarantee of that and there are many people who have been carrying out these tests quite adequately for many years.

There is an element of practicality here. Even if the registered person produces results that are more accurate than the non-registered one the values will rarely differ much. These tests are almost universally carried out using test equipment with built-in software. Even the procedures used by the non-registered operator are likely to result in the repeatability being around 1dB compared with perhaps 0.5dB for the correct procedure. This is not a difference that will be detected subjectively. In fact, the most common error in these tests is background noise influencing the receiving room measurements which will produce a lower sound insulation value than the real one. All this matters because the registration procedure deters people who have a relatively small market from continuing to do tests. There is a benefit in developers being able to call upon a pool of people who can carry out the work quickly and at reasonable cost. In remoter areas – much of Scotland for example – this work might currently be carried out by local authorities or by people who have the expertise and the equipment but whose main business is not acoustic consultancy. The end result will be that, in these areas, housing simply will not be tested at all. If the registration scheme were adopted this could lead to a reduction of standards. So a measure designed to improve standards may well have the opposite effect.

5. WIND TURBINE NOISE

The Nord2000 noise propagation model is currently being adapted for the prediction of wind turbine noise. The idea is that wind turbine noise at any particular receptor changes by time of day, weather conditions, wind speed and direction. The research and validation work that is being carried out here is of immense value to give us an understanding of how all these factors affect the propagation of noise from wind turbines but is it useful to assess the impact of noise on neighbours?

The model considers three elements of the terrain – height contours, roughness of the ground creating wind shear and absorption of the ground. It considers meteorological conditions – temperature, temperature profile, wind speed, wind speed profile and humidity. Most of these parameters vary with time. The model ends up with 25 meteorological classes and applies each of these to the frequency of occurrence of each of the classes at the site. All these factors will differ for each turbine-receptor combination. When we have gathered all this data we can calculate the noise levels at the receptor for each month of the year and time of day in that month and we can work out the average turbine noise level, the maximum, the ten percentile or any other parameter we choose.

When we are assessing the impact of noise on neighbours of an industrial development we need to be able to describe to them the conditions that they will experience. It is usually difficult enough explaining the concept of decibels but there is certainly no need or advantage in describing the situation in great detail. We want something that enables us to say to affected resident "we are confident that this is level you will hear the turbines at when you are downwind. Mostly it will be less than this. It won't happen very often but a few times it will be a bit more but only by a margin that you will not be able to detect or will hardly be able to detect." We don't want to go to local residents and say "You will have an average of 38dB in January and on the odd day it might rise to 38.7 dB. In February the average will be 38.3 . . . ."

6. ROAD TRAFFIC NOISE

My last example is one of pragmatism in action. In the UK we assess a site for new housing near transportation routes by a procedure set out in government advice. In Scotland this is called Planning Advice Note 56. For road traffic we can measure or calculate the noise level and arrive at figures for traffic noise over a 16 hour day and an eight hour night. These levels are then compared with ranges of noise levels to determine which of four categories, A to D, the site falls in.

Almost all local authorities will accept traffic noise measurements for a period of three hours in the middle of the day to describe the 16 hour day time figure. The level at night is usually obtained by subtracting 8 to 10dB from the day time figure because we all know that that is normally the difference. You would be expected to choose a typical day with dry roads but otherwise this methodology is almost universally accepted in Scotland. It is not entirely accurate but it is close enough for our purpose.

Having established the night and day time noise levels we can place the site in one of the 4 categories. Category A states that noise need not be a determining factor and Category D says that planning permission should normally be refused. Even then the guidance blurs the edges of the categories. For example in Category A it says ". . . although the noise level at the high end of the category should not be regarded as desirable" and in Category B "For proposed development subject to the high end of the category a Noise Impact Assessment will assist . . . ".

In a final show of realism the advice, in defining the noise level boundaries of each category says “Where there is a clear need for new residential development in, for example, an already noisy area some or all NECs might be increased by up to 3dB(A) above the recommended levels. In other cases, a reduction of up to 3dB(A) may be justified; particularly in tranquil areas.”

This is a document that allows local authorities to make their own decisions as to what is best for them. It allows a degree of negotiation between consultant and local authority. It is simple and not very accurate but it works.

7. CONCLUSIONS

Nothing in this paper is to suggest that we should not strive for accuracy wherever we can. What I am saying is that accuracy for its own sake is not enough. We have to ask whether the level of accuracy we are adopting is consistent with what we are trying to achieve. The methodologies used in designing a concert hall are not the same as those used in designing a shopping mall. We need to ask ourselves what is best for the community at large. Not what is best for the noise consultant.