ENBRI
Construction Technology in Europe
March 2002
Quarterly digest of news from the members of the European Network of Building Research Institutes (ENBRI)
Issue 19

New Nordic Prediction Methods for Rail and Road Traffic Noise

New Nordic methods to predict rail and road traffic noise will soon be available. They are based on a complete separation of source emission and sound propagation. Each vehicle is modelled as a number of point sources each with a certain sound power with or without directivity. The source model is connected to point source sound propagation theory to yield the sound pressure level in an arbitrary receiver position. The propagation model is based on accurate analytical models and it is capable of predicting propagation effects both with and without the influence of meteorological parameters. Thus the new methods are well adapted to calculate the day-evening-night weighted yearly average L_{den}, which, according to a proposal for a new European directive, is most likely to become the measure to use for the assessment of environmental noise in Europe.

Figure 1 New prediction methods for environmental noise have been developed for use in the Nordic countries.

General

Each source, be it a rail or road vehicle, is treated as a moving source consisting of a number of sub sources emitting noise within a wide frequency range. The strengths of the sources depend on vehicle category, speed, track/road quality, driving conditions, etc.. The sub sources are located at different heights above the rail/road surface. The strengths of the sources are expressed as sound power levels. The sources are either omni directional or assigned a specified directivity. All calculations are carried out in one-third octave bands.

When the noise propagates from a source to a receiver it will be affected by spherical spreading, air attenuation, ground reflection, screening, scattering, etc. In some cases it will be amplified due to reflections from vertical surfaces. The propagation will also depend on vertical wind and temperature gradients. The attenuation during propagation is calculated for each point source. The propagation model is identical for industrial noise, road and rail traffic noise.

The noise contributions of each source are summed up by adding the sound exposure levels during pass-by. The vehicle track is divided into a number of segments. First the sound exposure level of each sub source is calculated for each segment. Then all sources and all segments are added and the L_{eq} level is calculated. L_{eq} can be calculated for any combination of vehicle categories, traffic flow and weather conditions. The only limitation is the availability of relevant input data.
The maximum sound pressure level (time weighting F) is calculated from the sound power level.

The prediction methods can calculate L_{eq}, A-weighted or in frequency bands, for any combination of vehicles provided that suitable input data are available. It is also possible to calculate maximum sound pressure levels corresponding to time-weighting F. The maximum levels can be calculated from individual vehicles or combinations thereof. However, the prediction methods do not give statistical methods to calculate maximum levels of vehicle combinations.

The prediction methods can handle different uncomplicated weather conditions. However, very strong or varying wind gradients and layered atmospheric conditions have been excluded. By combining results from different weather conditions it is possible to calculate yearly averages such as the L_{den} proposed by the European Union.

The prediction method can handle any number and any combination of varying ground conditions with and without screens. In principle any number of screens could be dealt with but for practical reasons the algorithms have been limited to two screens. The screens can be thin or thick or wedge shaped. At present more complicated or sophisticated screen tops cannot be dealt with by the model itself and data on extra attenuation by such devices must be provided elsewhere.

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in brief

FP6 workprogramme discussions

As noted elsewhere in this newsletter the new E-CORE network is now established. One of its recent actions was to support the Commission in managing a workshop to present the construction industry's views on the workprogramme needs for Research Priority 3.3 (New Production Processes and Devices) in FP6. Details of the outcomes of this workshop and other information relating to this process can be found on the E-CORE Forum pages in the E-CORE website at http://www.e-core.org

General progress in FP6

It is worth noting that progress on the development of both FP6 and the European Research Area (ERA) is detailed in the RTD beyond 2002 service on CORDIS. The service provides a central repository where all the most recent and relevant documents are available on its home page. The page can be found at http://www.cordis.lu/rtd2002. Details on progress are particularly important now as FP6 gets closer to being a reality.

ENBRI Newsletter special

It is planned that the next issue of Construction Technology in Europe will be a 'FP5 Special' in which the highlights of ENBRI members participation in the EU's Fifth Framework Programme will be presented.

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European Commission funds new Thematic Network in major boost for construction research in Europe

The European Council for Construction Research, Development and Innovation (ECCREDI) has been awarded a contract by the European Commission for a new Thematic Network to be known as E-CORE, the European Construction Research Network, (http://www.e-core.org).

E-CORE will become the electronic reference point in Europe for obtaining information on the state-of-the-art and the status of RTD in the construction sector. E-CORE will also facilitate dissemination of cutting edge technology and building techniques as well as their implementation, identify knowledge gaps and advise on RTD strategies for the sector at the European level.

With a budget of ∈2,1 million over 3.5 years, E-CORE will also aim to achieve a better co-ordination of efforts and more rapid diffusion of research results, thus ensuring that research activity generates real innovation for construction and related industries, while seeking to further promote integrated (holistic) and problem-solving approaches to achieve sustainable development.

An essential 'building block' for constructing the European Research Area E-CORE will specifically contribute towards establishing a 'European Research Area' as called for by Research Commissioner Busquin.

In particular, it aims to bring together and collate results from European, national and regional RTD initiatives through, amongst others, a pro-active Technology Watch approach.

Principal objectives

E-CORE's main objectives are to:

- establish a single access point where information on National or European projects which have been recently completed, are ongoing or are in an advanced planning stage and to foster, where possible, synergy and collaboration between related projects.
- provide a channel for filtering technology and building techniques that might have useful applications in construction against the dual requirements of the technology's contribution to improve productivity and sustainable development. A particular objective is to further stimulate SMEs both to participate in RTD actions and to benefit from the RTD efforts of others.
- identify RTD needs and develop a RTD strategy for the European construction sector.

Work Packages

To achieve these objectives, 5 dedicated work packages (WP) have been established:

- Construction RTD Databases and web portal.
- Technology Watch, Transfer and Innovation.
- Development of an RTD Strategy for the Construction Industry.
- Dissemination and Communication.
- Management.

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Rapid tests for contaminants in hard construction materials

These days a gradually aggravating pollution of the environment is evident. Contaminants are especially important in an industrial or urban environment where they substantially influence the function and durability of hard construction materials (such as concrete, artificial stone, ceramics, natural stone blocks etc.).

In the course of periodical checks, renovations etc, there is a frequent need to determine the extent of contamination.

Therefore, processes must be used that cause relatively little damage to the basic structure and which rapidly provide - ideally on site - the information that can be applied in repairing the structure. EMI have developed such a method. This method is particularly useful if it is only necessary to detect the contamination qualitatively and the stone material is of relatively inhomogeneous texture.

Development of the method

The challenge of generating a sample

Conventionally, in order to determine the contaminants, a powder sample is taken from the stone by percussion drill and the removed powder is analysed.

Figure 1 depicts a characteristic concrete structure, where the location of larger grains is shown, with the material sections removed by the penetration of the drill.

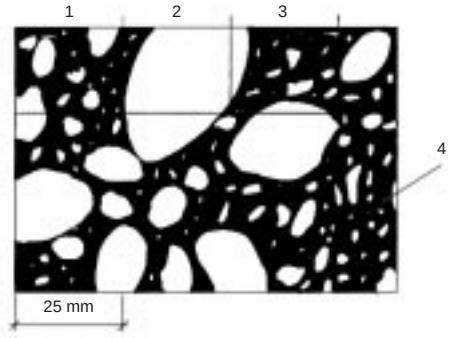

Figure 1 Typical material cross section

Since the bit diameter of the percussion drill is limited (up to 25mm), the powder samples taken from points 1 - 4 give an extremely broad picture about the material composition due to the grains which are unevenly distributed in the structure.

In order to make the result more accurate it is essential to increase the number of parallel samples.

EMI has tried to develop methods that offer obvious and rapid results from a relatively small number of samples. The method is primarily suitable for qualitative and semi-quantitative determinations. EMI has developed a special probe for obtaining samples.

The test is carried out as follows.

- At 1 to 3 points, using a percussion drill or dry crown bit, a hole of 15 to 20mm diameter is bored in the stone or concrete structure.
- The surface inside the hole is cleaned by a wire brush and special tampons to remove the powder. The hole is then vacuum cleaned.
- The wet adsorbent or the adsorbent paper/sheet soaked with the reagent is placed on the surface of the probe.

The design of the probe is shown in Figure 2.

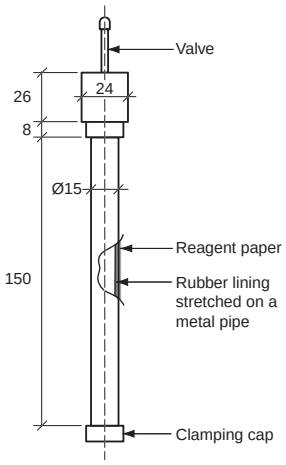

Figure 2 Sampling probe (units in mm)

The probe is used as follows.

- A rubber jacket is pulled onto the metal tube (made of acid resistant steel or brass) and is clamped at both ends by clamping rings. The jacket can be inflated through holes located in the perimeter of the tube and through a check valve at the end of the tube. The test paper is placed over the rubber jacket.
- The probe is placed into the drilled hole and the rubber jacket is inflated. Now the test paper clings to the wall of the hole in the stone structure and absorbs any contaminant.
- The air is discharged from the probe, which is then removed from the hole.
- The test paper is taken out by pincers and the test is carried out directly on the paper or in the case of indirect methods it is treated on site by the appropriate reagents.

In this way, the local character of contaminants can be identified; the part of the structure the contamination has reacted with can be determined as can the identification of dense areas of contamination.

Tests carried out on the samples

The activities carried out so far serve for the purpose of obtaining a chemical 'footprint' of the surface in the drilled hole. In general terms, the distribution of contamination can be mapped directly when the material used as an absorbent or test plate is spread out. The system can be used adequately for example to detect the salt contaminants of concretes, stones and masonry.

Detecting chloride ions for instance is the most frequent task in the structures of transport routes or in nearby buildings. By using this method, identifying the chloride ion is possible in various ways.

For example, by Mohr's method where in the basic reaction $AgNO_3 + Cl^- \rightarrow AgCl + NO_3^-$ colour reaction on the test paper is obtained by introducing a K_2CrO_4 solution into the system.

In this case $2AgNO_3 + K_2CrO_4 \rightarrow Ag_2CrO_4 + 2KNO_3$ and as a result, red silver chromate will only develop at the points where no silver chloride is present because the latter is more insoluble and this binds the silver nitrate solution locally.

Other contamination ions may also be detected by classical analytic methods.

In many cases a complex test is necessary. Here we should also be aware of the major cation-anion interactions in each stain. For such cases, EMI has developed the thin-layer chromatography procedure. Each ion has been tested by chromatography from the contamination stain under survey.

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Perimeter chilled beams – more guidance needed

Perimeter chilled beams can give valuable energy savings, but a gap in current guidance means that many designs don't deliver the performance and energy efficiency improvements of which they are capable.

Tests have highlighted a problem in integrating perimeter chilled beams with other elements of the building fabric, and prompted the UK Government to fund a project to:

- improve the design of the interface between the building fabric and perimeter chilled beams
- develop design guidance for architects, ceiling manufacturers and chilled beam manufacturers.

The difficulty lies in predicting the interactions between the building's interior structural elements and the heat gains in the area of its perimeter. This is particularly important when displacement ventilation is being used because the air displacement can be disrupted by air mixing from the perimeter area.

Demonstrating the problem and its solutions is not easy because of the low velocity of the air movements in these systems. The only viable method is to build physical mock-ups and measure the cooling performance and thermal comfort in the perimeter zone.

Developing design solutions to the problems caused by the interactions between heat gains and interior structural elements when passive chilled beams are used for cooling, will involve testing a wide range of physical component

combinations. This will be done at BRE's Environmental Test Facility and supplemented with numerical modelling.

The project will conclude in October 2003. Its findings and practical design guidance will be disseminated through articles in professional and technical journals, a workshop that will look at physical mock-ups in BRE's Environmental Test Chamber, and a project website that will include video clips showing the physical configurations and air distribution patterns.

The project is supported by the UK's Department of Trade and Industry under the Partners in Innovation scheme. The partners are: Hoare Lea Consulting Engineers, Rybka Battle, SAS Ceilings, Barret Ceilings Ltd, Klima Therm, FBE and CIBSE.

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The chilled beams being investigated are passive cooling systems designed to counter the effects of solar gain in buildings. Cold water passes through the beams in thin tubes, cooling the room by natural convection. The use of perimeter chilled beams to offset solar gain reduces the need for full air conditioning and is potentially very energy efficient. Chilled beams can be used in conjunction with displacement ventilation to produce high levels of thermal comfort and indoor air quality.

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Risk prevention

Assessment of 'slipperiness' of floor coverings

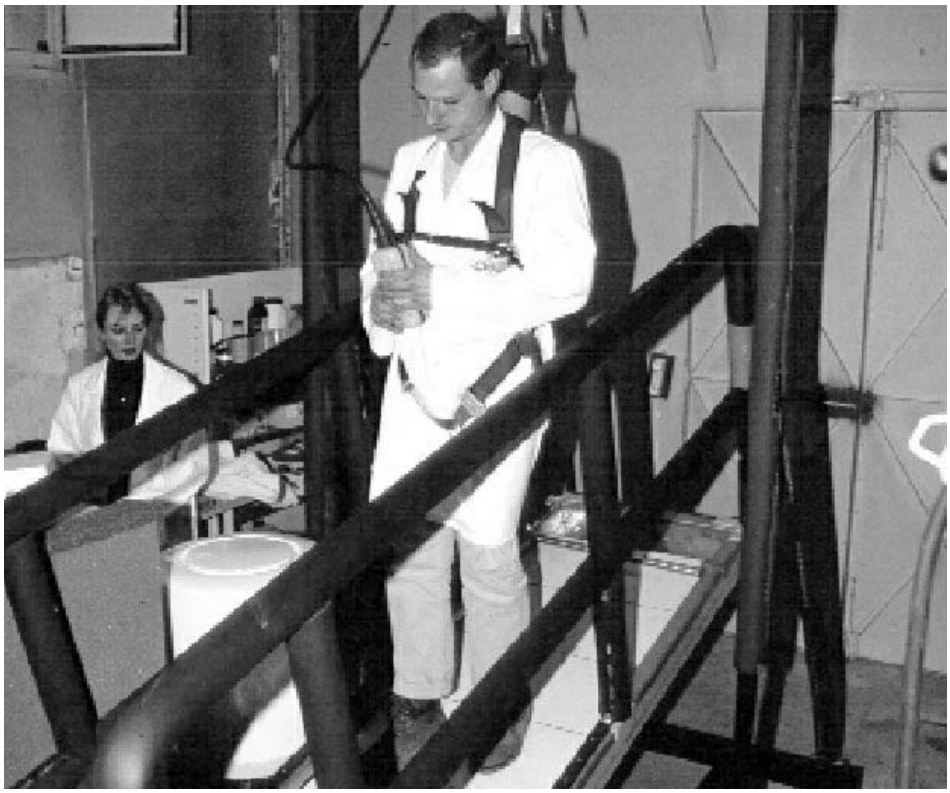
Inadvertent slipping is responsible for 12% of working accidents in France and 5% of serious accidents for people over 60 years of age in Europe. This is because, when it is raining, access to certain buildings turns out sometimes to be perilous for the users.

Conscious of the social cost of this risk, the European Legislature considers slippery floors in the same way as they consider fire reaction for the essential use safety requirement for the EC label for floor coverings. And they must be assessed by the same method for all products. Whatever the country or the type of covering, we slip the same way. The European Standardisation Committee is today creating a transversal Technical 'Slipperiness' Committee.

Participating closely in European standardisation work for more than ten years, CSTB has always stood up for a single test. With this in mind, it has begun experimental research in collaboration with the manufacturers of coverings, ie plastic, textile, tiles, laminates, resins. The researchers have begun critically analysing the various methods used in Europe, about sixty of them, before endorsing the most significant one, the sloping plane method.

Slipperiness is characterised based on a friction coefficient, taking into account the nature of the body in contact with the covering (shoe or foot), the nature and quantity of water or lubricant in presence on the floor, along with the bio-mechanical factors linked to the individual (slipping of the heel, contact pressure, etc).

The dynamics of walking and, particularly, the dynamics of the heel are complex phenomena which cannot be simply reproduced by machines. Utilising an operator, this test makes it possible to reconstitute the situations which are most frequently found in daily life, ie dry floors, wet floors, with or without detergent (residues from domestic cleaning compounds) or oil spots (in workshops, for example). The operator walks from the front to the rear on the plane covered with the floor covering to be tested. The plane slopes gradually until the operator loses balance.



CSTB has succeeded in providing good reproducibility of the assessments of the floor coverings for which it is responsible. It is equipped with a sloping plane test stand and has initiated a study to extend its application to all the types of floor coverings used both inside and outside. This has been followed up by a series of inter-laboratory experimental tests on the various families of coverings used in current buildings. More than 50 materials were selected.

Used in Germany for many years now, the sloping plane test method was adopted in the draft of the harmonised European standard related to plastic and laminate floors, to be used in kitchens and bathrooms. It also appears among the four methods recommended in the draft of the harmonised European Standard for assessing the slipperiness of ceramic tiles. It opens the way to a classification of the risks to enable the consumer to select a covering based on safety criteria.

Measuring the slipperiness of floors on sites

CSTB is often called upon to provide its technical service on the site to assess the slipperiness of floors in case of disputes. To do this, it selected a portable apparatus which can be correlated with the reference test involving the sloping plane.

The sloping plane: a reference method

The sloping plane test method is suitable for all walking situations from bare feet to safety shoes, and including conventional town shoes. All types of floor coverings can be examined with all the wetting or polluting compounds encountered in daily life, i.e. water, water with detergent added or foaming compounds, oil.

Its principle is simple. A self-drawn runner measures the average friction coefficient of the floor to be tested (from 0 to 1). The coefficients measured make it possible to compare the slipperiness of the zones tested. The various appraisals carried out on inside or outside walkways are going to be inscribed in a catalogue in order to set up a classification of risks based upon applications.

Research is also being conducted to include in the test the effects, on the slipperiness of floor coverings, of grime accumulation and maintenance.

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Productivity and efficiency in the Construction Industry

BYGGFORSK
Norwegian Building Research Institute

Productivity improvements are regarded as a major pre requisite for continuous economic growth, positive development of competitiveness and profitability. In this perspective the construction industry plays a major role as the industry employs a large number of people and manages assets worth millions. Construction often accounts for a significant proportion of a country's Gross Domestic Product. In almost all the Norwegian counties, the construction industry is a more important employer than other primary industries.

The Norwegian Building Research Institute has a project to develop methods to enable businesses and the industry to analysis and measure productivity and efficiency. The NBI aims to establish the numerical data and establish best practice information for the construction industry. The work will start by establishing best practice norms and the productivity possibilities will then be determined by applying the Data Enveloping Analysis (DEA).

What is meant by productivity?

Although productivity is often used in our daily language people seldom mean the same things when they talk about it. In general terms productivity is the relationship between production and resources used. It is easy to establish a productivity measure if one product is being produced and both the production and the input resources can be measured. The problems arise when there are several products and several resources required. When looking at all the input resources in relation to one production result the measure is called Total Factor Productivity (TFP). It is called partial productivity when one looks at productivity related to only some of the inputs eg. labour and/or capital and/or energy. It is important to notice that common usage of the word productivity seldom explains whether it is productivity related to a single factor or TFP; labour productivity is commonly named productivity.

Purpose and value of the project

It is important to maintain productivity to create value and sustain the level of welfare in Norway. The problem related to the current situation is the lack of methods and tools for analysis available both at national, business, project and activity level for the construction industry. There is however a growing recognition that the building process is of major importance to obtain substantial growth in productivity. There is a need to improve the relationship between all parties involved in the building process and include life cycle considerations into the building process.

Looking at the latest work undertaken in Norway it is clear that there are great uncertainties related to the data used for calculating productivity and efficiency and there are no data available related to project level and activity level.

It is assumed that performance measures when appropriately selected will be a useful tool for management decisions. Performance measures will enable businesses to disclose and map the changes that take place over a period of time for individual companies, project activities and the industry distribution.

Initially NBI will concentrate on developing productivity indicators at project and activity level. In addition NBI will also attempt to establish productivity indicators at a Nordic, national and business level. Through NBI's development work we expect to be able to identify initiatives and activities that can be initiated to improve the productivity.

It is an expectation that the results from the project will make it possible to achieve a systematic increase of productivity in the construction industry which will result in both better quality and increased profitability for the businesses operating in the industry.

A lot of the work in the project will be based on establishing networks and reference groups.

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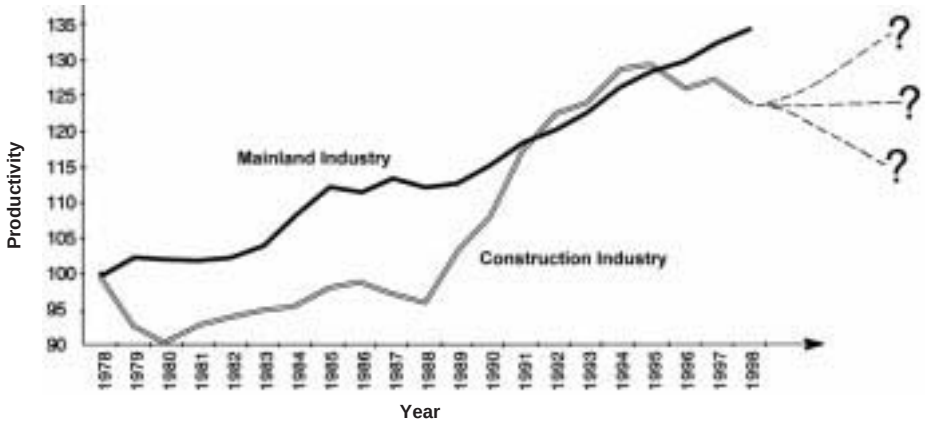

Productivity in Norway (1978 = 100)

BRE

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