MILJØSTYRELSENS
REFERENCELABORATORIUM
FOR STØJMÅLINGER

Udøvende institution:
DELTA
Venlighedsvej 4
2970 Hørsholm
Telefon: +45 72 19 40 00
Telefax: +45 72 19 00 01
www.referencelaboratoriet.dk

Teknisk Notat

Ny Viden

2010-1

MILJØSTYRELSENS
REFERENCELABORATORIUM
FOR STØJMÅLINGER

Titel	Ny Viden 2010-1
Journal nr.	RL 10/10
Sagsnr.	A581355-13
Vores ref.	JEL/BP/ilk
Rekvirent	Miljøstyrelsen Strandgade 29 1401 København K
Rekvirentens ref.	Jørgen Jakobsen

DELTA, 29. juli 2010

Jens E. Laursen

Indholdsfortegnelse

1. Baggrund og formål

Miljøstyrelsen har ønsket, at en del af Referencelaboratoriets aktiviteter i 2010 skulle være at formidle ny viden til Miljøstyrelsen. Referencelaboratoriet har gennemgået tidsskrifter og overvåget årets kongresser for at identificere ny viden af betydning for måling og administration af ekstern støj. Notatet udsendes to gange om året. Søgningen i tidsskrifter er afsluttet i juni 2010.

Indholdsfortegnelser for de valgte tidsskrifter findes på de respektive hjemmesider på Internettet. Links til disse hjemmesider er angivet i Bilag 1.

2. Afgrænsning

Valg af emner og vægtning af stoffet er rettet mod Miljøstyrelsens sagsbehandlere.

3. Tidsskrifter

3.1 Journal of the Acoustical Society of America (JASA)

Årgang 2009: Vol. 126, no.6, Dec.

Vol. 171, no.1– 4, Jan – April

Et link til dette tidsskrift findes i Bilag 1. Følgende artikler er udvalgt:

A comparison of the temporal weighting of annoyance and loudness

Vol. 126, Nr. 6, pp. 3168–3178, Kerstin Dittricha og Daniel Oberfeld

Artiklen er ikke fundet relevant.

Noise-induced annoyance from transportation noise: Short-term responses to a single noise source in a laboratory

Vol. 127, Nr. 2, pp. 804–814, Jaehwan Kim, Changwoo Lim, Jiyoung Hong and Soogab Lee

Nordkoreansk undersøgelse af genevirkningen af trafikpassagestøj på basis af binaurale lydoptagelser af alm. flystøj (propel 250 km/t), militærflystøj (jet 250 km/t), togstøj (diesel-elektrisk 80-100 km/t) og vejtrafikstøj (motorvej 80-120 km/t). Optagelserne var enkeltpassager bortset

fra vejtrafikken, som blev målt som et almindeligt trafikflow fra en motorvej. Der medvirkede 51 deltagere, som fik præsenteret lydoptagelserne via hovedtelefoner i et lyddødt rum. Når lydoptagelserne havde samme L_{eq} (uanset frekvensvægtning), var flystøj mest generende, og derefter kom militærflystøj, togstøj og vejtrafikstøj. For at opnå samme genevirkning som vejtrafikstøj skulle der lægges henh. 8 dB, 5 dB og 5 dB til civilflystøj, militærflystøj og togstøj. Forskellene forklares som et større indhold af højere frekvenser og større niveauvariationer end i trafikstøjen.

Når lydoptagelserne havde samme maksimale A-vægtede niveau var togstøjen 3 dB mindre generende end vejtrafikstøj.

A field study of the exposure-annoyance relationship of military shooting noise

Vol. 127, Nr. 4, pp. 2301–2311, Mark Brink, Jean-Marc Wunderli

Kun abstrakt er læst.

Schweizisk undersøgelse af dosis-respons forhold for militær skudstøj, foretaget for 1002 beboere omkring 8 militære træningsbaner. Telefoninterview blev udført og evalueringer indført på en 5-punkts skala. De akustiske parametre var bl.a. dosismålene L_{AE}, L_{CE}, $L_{CE} - L_{AE}$ (forskellen mellem C- og A-vægtede niveauer) samt antal af skud over et vist C-vægtet niveau. Støjen blev beregnet med en schweizisk støjmodel "WL04" på basis af militærets oplysninger om fordeling af 3 kaliberkategorier af skud. Begge dosismål L_{AE} og L_{CE} gav, i forhold til de andre akustiske parametre, en bedre overensstemmelse med den observerede dosis/respons-sammenhæng - i hvert fald for små og mellemstore kalibre. For større våben, som samtidig genererer vibrationer, beskrives genevirkningen bedst ved de C-vægtede niveauer (L_{CE}).

3.2 Applied Acoustics

Årgang 2010: Vol. 72, No. 2 – 8 (Feb.–Aug)

Et link til dette tidsskrift findes i Bilag 1. Følgende artikler er udvalgt:

A method of developing regional road traffic noise management strategies

Vol. 71, No. 7, Pages 640-652, Daniel Naish

Artiklen er ikke fundet relevant.

Aircraft noise annoyance estimation: UK time-pattern effects

Vol. 71, No. 7, Pages 661-667, Peter Brooker

Artiklen beskriver en analyse af forskelle i gene fra flystøj i to områder med forskelligt tidsmønster af støjen.

Analysen er baseret på data fra en tidligere publiceret undersøgelse fra 1985 kaldet ANIS (Aircraft Noise Index Study) udført af Peter Brooker m.fl. i UK. Undersøgelsen omfattede måling af et 16 timers L_{eq} (dag og aften) over en uge i 26 boligområder og en bestemmelse af genen udtrykt ved procentdelen af meget generede i hvert boligområde. I undersøgelsen var anvendelsen af to parallelbaner (afstand 1400 m) med retningen øst-vest forskellig for østgående og vestgående trafik. For begge baneretninger var baneanvendelsen segregeret, hvilket vil sige, at den ene parallelbane blev anvendt til starter, mens den anden blev anvendt til landinger. Ved anvendelse af bane 09 (østvendt flyveretning) blev den højre bane (09R) altid anvendt til starter, mens den venstre (09L) altid blev anvendt til landinger. For bane 27 anvendtes der derimod et skift i princip, således at 27R anvendes til starter og 27L til landinger i den ene del af døgnet, mens 27L anvendtes til starter og 27R til landinger i den anden del. Den ene tidsperiode var morgen til midt-eftermiddag, mens den anden er resten af døgnet.

Herved oplevede boligområderne beliggende vest for lufthavnen altid perioder i løbet af døgnet med reduceret støj enten i den ene eller den anden periode, når bane 27 anvendtes. Det samme var ikke tilfældet for boligområderne øst for lufthavnen, når bane 09 anvendtes, da den samme bane altid anvendtes til starter (09R).

Formålet med re-analysen af ANIS-data har været at undersøge, om genen af støjen ved samme støjbelastning var forskellig vest for lufthavnen i boligområder med virkningen af rotationsprincippet og øst for uden virkningen af rotationsprincippet. Analysen viser lavere gene vest for lufthavnen. Forskellen i gene angives i artiklen at svare til 4 dB i støjbelastning. Problemet i dette resultat er dog, at personer med tilknytning til lufthavnen udviser mindre gene ved samme støjbelastning end personer uden tilknytning til lufthavnen, og at andelen af personer med tilknytning til lufthavnen var størst i boligområderne vest for lufthavnen. Analysen er derfor gennemført, så disse to effekter kan adskilles, og konklusionen i artiklen er, at virkningen af rotationsprincippet alene udgør omtrent 2 dB (kaldes ADC: alternation decibel correction).

Traffic noise spectrum analysis: Dynamic modeling vs. experimental observations

Vol. 71, No. 8, Pages 764-770, A. Can, L. Leclercq, J. Lelong, D. Botteldooren

Artiklen er ikke umiddelbart fundet relevant.

3.3 Journal of Low-Frequency Noise, Vibration and Active Control

Årgang 2009: Vol. 28, No. 3 – 4 (Sept–Dec)

Et link til dette tidsskrift findes i Bilag 1. Ingen af artiklerne er fundet relevante.

3.4 Noise Control Engineering Journal

Årgang 2009: Volume 57, No. 6 (Nov.)

Årgang 2010: Volume 58, No. 1 – 2 (Jan–March)

Et link til dette tidsskrift findes i Bilag 1.

Følgende artikler er udvalgt:

Wind-induced pseudo-noise and leaf-rustle noise

Vol. 58, No. 2, pp. 121-131, Paul Schomer and Geoffrey Beck

Kun abstract er læst, idet hele artiklen ikke var tilgængelig.

Formålet med denne undersøgelse var kvantitativt at beskrive vind-induceret støj i typiske miljøer, hvor vinden ikke er ekstrem, og hvor vindfølsomme støjkilder såsom træer er til stede. Baggrundsstøjniveauet i sådanne områder med lav vindstøj (og specielt bladraslen) er målt i forbindelse med *Air Tour Management Plans (ATMP),* hvortil der er anvendt mikrofonvindskærme med diameteren 20-30 cm. Resultaterne for "vind-induceret pseudo-støj" i boligområder er vedlagt artiklen (dvs. støj generet i mikrofonvindskærmen). Resultaterne er afbildet som funktion af frekvens (1/3-oktavbånd) og vindhastighed. Forfatterne foreslår, at disse data kan benyttes til at korrigere målinger foretaget i boligområder. Generelt er korrektionen ikke nødvendig ved lave vindhastigheder (2-5 m/s), da mikrofonhættestøjen ligger langt under støjen fra svag bladraslen.

Prediction of sound radiated from tunnel openings

Vol. 58, No. 2, pp. 201-211, Wolfgang Probst

Kun abstract er læst, idet hele artiklen ikke var tilgængelig.

Lydudstrålingen fra vej- eller jernbanetunneller kan beregnes med støjudbredelsesberegningsprogrammer, som en udstråling fra en punkt- eller en arealkilde. Kildestyrken for tunnelmundingen kan beregnes på grundlag af tunnelens udformning og beklædning. Forfatteren har

gode erfaringer med beregning af mundings-lydudstrålingen baseret på rumakustiske målinger foretaget i 150 rum og sale. Teknikken er blevet standardiseret til en computerbaseret metode, som sammen med lydudbredelsesprogrammet kan beregne støjudstrålingen fra tunnelåbninger.

3.5 Acta Acustica

Årgang 2009: Vol. 95, No. 6 (Nov/Dec)

Årgang 2010: Vol. 96, No. 1 – 3 (Jan/Feb – May/June)

Et link til dette tidsskrift findes i Bilag 1. Følgende artikler udvalgt:

The Potential of Natural Sounds to Mask Wind Turbine Noise

Vol. 96, No. 1, pp. 131-137, Bolin, Karl; Nilsson, Mats E.; Khan, Shafiquzzaman

Undersøgelse af vindmøllestøj i relativt stille områder og om hvorvidt den oplevede gene fra vindmøllestøjen kan reduceres ved at tilføre lyde fra naturen (auditiv maskering). Der blev foretaget 2 laboratorieforsøg (30 deltagere) med vindmøllestøj som kilde (både enkeltmøller og vindmølleparker) og med tre naturlige lyde som maskering (vinden i nåletræer, løvfældende træer og havbølger). I det første forsøg fandtes tærskler for vindmøllestøjen i forhold til de naturlige lyde ved hjælp af en tærskel-målemetode. I det andet forsøg skulle deltagerne forsøge at matche loudness af delvis maskeret vindmøllestøj med loudness for umaskeret vindmøllestøj. Resultaterne viste, at detektionstærsklen for vindmøllestøj overlejret med naturlige lyde var omkring -8 til -12 dB (S/N-forhold). Desuden blev der fundet en reduktion af den opfattede loudness for vindmøllestøj på op til 2 dB (S/N-forhold). Ved 0 dB S/N-forhold var den maskerende effekt 5 dB. Der fandtes ikke store forskelle mellem de 3 anvendte naturlyde eller mellem de 2 anvendte vindmøllelydeksempler. Da undersøgelsen foregik i et laboratorium er der parametre, som der ikke er taget hensyn til her, og som i det naturlige miljø kan influere på den observerede maskering, fx lydens retning og sigtbarheden til lydkilden.

Resultaterne er kun relevante for udendørs støj. Resultaterne blev sammenlignet med beregninger fra to modeller for delvis maskering (henh. stationær og tidsvarierende støj). Generelt lå de empirisk fundne tærskler og loudness-sammenligninger højere end forudsagt af de to modeller.

4. Kongresser

4.1 Euronoise

Afholdtes sidst den 26.-28. oktober 2009 i Edinburgh, Skotland.

Link:

www.euronoise2009.org.uk

4.2 Inter-Noise

Afholdtes sidst den 13.-16. juni 2010 i Lissabon, Portugal. I bilag 2 findes udvalgte abstracts fra konferencen i 2010. Inter-Noise afholdes næste gang 4.-7. september i Osaka, Japan.

Links:

www.spacustica.pt/internoise2010

www.internoise2011.com

4.3 International Conference on Noise as a Health Problem

Afholdes normalt hvert 5. år, sidst den 21.-25. juli 2008 i Mashantucket, Pequot Tribal Nation (CT, USA), som en del af "The 9th Congress of the International Commission on the Biological Effects of Noise (ICBEN)". Papers fra denne konference kan hentes på www.icben.org.

Konferencen afholdes næste gang den 24.-28. juli i London, England.

Link:

www.icben2011.org

4.4 Forum Acusticum

Afholdes hvert 3. år, sidst den 29. juni-4. juli 2008 i Paris, Frankrig (5th European Congress on Acoustics). Afholdes næste gang den 27. juni-1. juli 2011 i Aalborg, Denmark.

Links:

www.acoustics08-paris.org

http://www.fa2011.org

4.5 Baltic-Nordic Acoustics Meeting

Afholdes hvert 2. år, sidst 10.-12. maj 2010 i Bergen, Norge (BNAM2010). Afholdes næste gang 18.-20. juni 2012 på Syddansk Universitet i Odense, Danmark.

Links:

www.bnam2010.com (abstracts fra konferencen i Bergen kan hentes herfra)

www.bnam2012.com

4.6 Low Frequency Noise and Vibration and its Control

Afholdtes sidste gang den 9.-11. juni 2010 i Aalborg, Danmark. Konferencen afholdes næste gang i 2012.

Link:

www.lowfrequency2010.org

4.7 Wind Turbine Noise 2009

Afholdes hvert 2. år, sidste gang den 17.-19. juni 2009 i Aalborg (3rd International Conference on Wind Turbine Noise). Den næste konference foregår i 12.-14. april 2011 i Rom, Italien.

Links:

www.windturbinenoise2009.org

www.windturbinenoise2011.org

Bilag 1

Links til tidsskrifters hjemmesider

Journal of the Acoustical Society of America (JASA)

http://scitation.aip.org/jasa/

Applied Acoustics

http://www.sciencedirect.com/science/journal/0003682X

Journal of Low-Frequency Noise, Vibration and Active Control

http://multi-science.metapress.com/content/121510/

Noise Control Engineering Journal

http://scitation.aip.org/dbt/dbt.jsp?KEY=NCEJD5

Acta Acustica

http://www.ingentaconnect.com/content/dav/aaua;jsessionid=2hrx8pvp3nh7.victoria

Bilag 2

Udvalgte abstracts fra Inter-Noise konferencen 2010, Lissabon

Noise policy and regulation

EU-Noise Maps: analysis of submitted data and comments

Martin van den Berg, Gaetano Licitra.

Nearly all EU member states have submitted noise map data as required by EU Directive 2002/49. All the submitted data was published on the EU-web site, which makes it possible to compile and analyze the data.

As could be expected, not all data was usable as published. Even when the EU-data format was used (which most did), confusion could arise on the figures. After scrutiny, data for 72 million people was obtained with respect to road traffic noise in agglomeration, and for significant lower part of the population for the other noise sources. This is 59% of the data to be reported, and 17% of the EU27 population.

Apart from some unexpected glitches, the overall impression is that the quality of the data is fair and yields important information on the exposure of the EU-population to noise. The rough estimates from the Green-paper from 1996 are largely confirmed.

How European noise policies can support actions at a local level

Henk Wolfert.

Nowadays a lot of the competent bodies as meant in the Environmental Noise Directive have finalized their Noise Maps and most of them have set up their action plans. Provisional data en data from the Noise Questionnaire that was set out by the Working Group Noise of EUROCITIES give a global insight in the noise situation in European agglomerations. As generally known most of the noise exposed people are living in cities. This is not surprising because more than 70% of the European citizens are living in cities and their numbers are still increasing [EUROSTAT]. This means that the number of exposed and annoyed people in Europe will increase as well if measures stay behind. The percentage of people that is exposed to 55 dB LDEN amounts 50 per cent and the percentage of people that is exposed to noise levels above 65 dB L_{DEN} amounts 15 per cent. This is based on the EUROCITIES Noise Questionnaire that was set out among 130 large cities in Europe. Approximately 44 per cent of the cities responded which means that the outcomes of the analysis are well founded and can be used for an estimation of exposed people in urbanized areas in Europe. In this paper some suggestions will be done towards the European Commission and European Parliament about how to support the actions that must be taken at local level.

Industrial noise

Environmental noise caused by building activities

Piet Sloven.

Constantly renewing cities will build at times not disturbing regular activities. But avoiding noise in the evening and at night. While construction noise ranks the third place of environmental noise problems in The Netherlands regulations are poor. Attention given to environmental noise from building and demolition grows. A guide with directions is to be published, but in practice building noise will stay a matter of local authorities. They protect citizens against annoyance and sleep disturbance. Constructors and civil servants has to work together to reduce this noise. Best results are made when there is a willingness to change things in the way of building, used installations and planning schemes. Once the construction is on the way it is difficult to reduce noise. And what's more, this stimulates resistance of the surrounding inhabitants. Diminishing nuisance isn't reducing noise-levels. Not working at night, avoiding impulsive and lowfrequent noise, acting with silent machinery are helpfull. Good communication has the same importance. Transparency of considerations about the environmental impact of building, taking care for a directly responding phonenumber, a personal way in dealing complaints are very helpfull to accept noise. To reduce this kind of nuisance acoustical monitoring construction projects, combined with evaluating the process and figures makes quick progresses possible. This is supported when it is accompanied with a little pressure and fair requirements of the local authorities. The intention: building in cities is nice, the first aim is consciousness and better understanding of noise. In extreme circumstances a small license-structure will force this.

Auditory filters at low-frequencies: Filter shape in the range 50 Hz to 1000 Hz

Carlos A. Jurado, Christian S. Pedersen, Henrik Møller.

Prediction and assessment of low-frequency noise problems requires information about the auditory filter characteristics at low-frequencies. Unfortunately, data at low frequencies is scarce and practically no information exists for frequencies below 100 Hz. Extrapolation of previous results indicates the filter bandwidth would keep decreasing below 100 Hz, although at a low-rate and finally stabilizing. In this study, main auditory filter characteristics were obtained for center frequencies in the range 50 Hz to 1000 Hz. The notched-noise method was used, with the masker at moderate levels. Data from a total of 7 subjects is discussed. Considering the system as a whole (i.e. without removing the assumed middle-ear transfer function), the asymmetry of the auditory filter tended to change from steeper right-side slopes at 1000 Hz to steeper left-side slopes below 100 Hz. This effect was explained as due to increasing steepness at low-frequencies of the middle-ear high-pass filter. The dynamic range of the auditory filter steadily decreased with decreasing center frequency. The filter bandwidth at 63 Hz was about 36% of the center frequency, its value being smaller than at 125 Hz in all cases, confirming expectations from extrapolating previous findings. However, at 50 Hz results were much more subject dependent: while a decrease in bandwidth was observed in some cases, in most cases selectivity was very small, i.e. the bandwidth was found to increase again.

Noise evaluation of sound sources related to port activities

Johannes Hyrynen, Panu Maijala, Velipekka Mellin.

Port activities generate sound that is propagated to the environment. In some cases the people affected by the noise are very close to the port and are highly disturbed by the activities. There is a large number of sound sources in the port area and the nature of noise generated can vary a lot depending on the source. The sound sources very often depend on the operating mode of the machine and one piece of machinery can include various sound sources located apart from each other. The sound emitted can be either continuous or intermittent.

This study deals with sound power measurements and results of typical sound sources in the port area. The sound sources include operation of various mobile machinery, reefers, container handling and ship loading events and sound sources related to berthing ships.

The results are presented as sound power levels and a ranking of the sources has been made. In addition, annoyance indicators are presented for some of the sources.

Ports and Noise

Noise control of harbours

Jürgen Hünerberg, Dieter Knauss

Harbour areas are often sources of noise complains especially during night-time, since the noise from harbours consists of short noise pulses caused, for example, by the handling of containers. The levels from such activities strongly depend on the operation modus making standard noise reduction measures impossible. One method to reduce the noise from such sources is to implement an active noise control. The noise control system consists of various measurement locations inside or close to the harbour area, noise measurements at the residential area and a central unit. In the central unit the data from the sensors will be processed and information about the noise status can be immediately send to the noise control manager if a given noise level threshold is exceeded. In this way immediate action can be taken to reduce the noise from the identified activity or area. For the identification of the noise sources a correlation analysis of the different signals as well as pattern recognition is used. This paper will report on the special requirements of a harbour noise monitoring system and the experience with an existing system, which is now running for the past 6 years at a harbour site in North Germany.

Noise in the spotlights. Research on noise coming from remote Rotterdam-port areas

Piet Sloven.

In the Netherlands noiselimits obstruct expansions. Importance grows to know which elements influence the upper decibells on annoyance. Aspects of time, noise character , acoustical climate and virtual noise are studied.

Since the originate of the western harbours of Rotterdam, inhabitants at 3 km tell recognisable noise "falls down". Investigations were done in the past. On low-frequency noise and other measurements. Without connecting nuisance and noise, but leading to doubts about noise transmission. Hours with strange sounds exist, but inhabitants indicate also an incongruous situation in their natural area, where in their perception "it should be quiet".

Authorities and industry work together to mitigate nuisance learning which factors influence annoyance. With participation of villagers. In a unique setting because the diversities of participants, size, duration and broad of research.

Subprojects are: analysis of complaints related to time and meteorological circumstances, involvation of inhabitants and companies, development of new meteo-acoustical model (see contribution F. van den Berg: A View on Sound), measuring transmissions of artificial noise from industrial terrain to village plus a four-months monitoring campaign. Monitoring comprises permanent measurements of: noise from harbours to village, industrial activities, atmosphere, complaints, other sounds.

The project took two years. Much analysis is done. On traffic (land, rail, water), variations in industrial emissions, shift of frequencies and temporal effects. Often variations in noiselevels are small. Complaints can partially be related to atmospherical circumstances - not necessarily downwind. Calculations show even vaste measures reduce just of a few decibells. An acoustical forecast is a new thought.

Urban development in the port area of Rotterdam: challenging noise constraints

Miriam Weber. DCMR Environmental Protection Agency, Netherlands.

The city of Rotterdam is facing economic and environmental challenges in strengthening employment, mobility and housing in the next decades. One of the major projects until 2020 is reconstructing and redesigning former harbours into areas assigned for clean activities (education and offices) and living; the so-called "Cityharbour" project (Stadshavens).

The Netherlands, academically reckoned for its spatial planning system, has been a forerunner in integrating noise and spatial planning. Its Noise Abatement Act contains the principle of zoning and - rather unique - even sets (immission) limits for various noise sources. However, operationalisation of urban environmental planning at the local level encountered various challenges, as regional and local spatial planning initiatives faced strict noise limits set at national level.

Example instruments for integrating environmental policy and spatial planning are ROM-projects (process tool); MILO (environmental aspects of living conditions) and City-and-Environment (legally embedded process tool).

Noise from industries and transport of Rotterdam's port has been one of the major issues to be addressed in urban development projects during the last decades. In this presentation a short overview of the instruments for (noise) policy integration used in the Rotterdam port area during the last decades will be presented. Furthermore, noise and spatial planning challenges for the coming years and possible mechanisms, identified in the "Cityharbour" project, will be focussed on. Varying instruments, with a basis on noise (zone) manage-

ment and permitting, through innovation projects and early involvement and integration of noise in spatial planning initiatives are assessed and discussed.

Urban planning in port noise dominated conflict areas - the HafenCity solution

Christian Popp, Marion Bing (Laermkontor GmbH, Hamburg, Germany)

A lot of ports experienced a development in their border areas of a conversation of industrial uses to residential uses. In the same time the port uses itself expanded noticeably. The HafenCity in Hamburg is situated in a conflict area of road, railway and port noise. In Germany the national noise regulations are very complex and differ from source to source. While urban planning in regard to residential uses in conflict areas of road and railway noise is a comparatively common and manageable problem, the management of port noise turns out to be not as easy to handle.

Dealing with this impact situation, Hamburg has worked out a solution, based on definite specifications:

1. during the day-time (6 - 22 h) the limit values are not exceeded significantly and

2. in bedrooms during the night-time a noise level of less than 30 dB(A) [with slightly opened window] can be guaranteed.

3. quality of life is safeguarded through

- permanent supply of fresh air and if

- residents are not cut off acoustically from the outside world.

This solution combines both contribution of the port and the city. This means on the one hand the allocation of noise shares as contribution of the port. This is necessary to reduce ore state noise to a definite level. On the other hand recommendations on innovative noise protection on buildings in the HafenCity have been worked out by the City.

Sustainable strategy and noise solutions in urban development and infrastructure

Sound Transmission Loss through Naturally Ventilated Residential Facades

Tim Waters-Fuller, Daniel Lurcock (Edinburgh Napier University)

The sustainability agenda promotes natural ventilation as the preferred means of providing fresh air for residential development. There is however a deficit of published sound transmission loss data for naturally ventilated residential facades; beyond an ‘open-window' approximation of 10 - 15 dBA.

A program of laboratory measurements have been undertaken to address this imbalance, through acoustic transmission loss measurements across naturally ventilated residential façades i.e. ventilated using either window openings or window frame ventilators.

The measurements were undertaken using an anechoic chamber (with demountable rear wall) as the source room into which a cavity masonry 'façade' wall was installed to partition the adjacent reverberation chamber. A residential sized receiver room was built adjoining the separating wall. Seven sets of window frames were installed in the test partition allowing the investigation of a number of variables i.e. window size, opening style and open area.

Urbines – Roof top urban wind turbines- A comparison between horizontal and vertical axis designs

Stephen Dance[1], Linda Liviani[2], Salih Hassan[1]. ([1]London South Bank University, [2]Capita Symonds, London)

The current planning guidance in London requires that all new large buildings being designed or refurbished should include 20% renewables. As part of a study two urbines have been erected on a residential building in central London to determine the effectiveness of locally generating electricity using wind power. The two urbines are a Proven 6 kW traditional turbine and an experimental vertical axis Quiet Revolution 5 turbine. The investigation includes long term wind, weather, noise, electricity and vibration monitoring. The effect on the residents, the local community and the building structure has been determined. The electricity utilization has been calculated over 2 years for the Proven urbine and 1 year for the QR urbine.

Wind Turbine Noise

Exposure-response relationships for annoyance by wind turbine noise: a comparison with other stationary sources

Sabine Anne Janssen[1], Henk Vos[1], Arno R Eisses[1], Eja Pedersen[2]. [1]TNO, Delft, Netherlands, [2]Halmstad University, Halmstad, Sweden

There are indications that, given a certain level of noise exposure, the expected annoyance by wind turbine noise is higher than that by noise from other sources such as industrial noise or transportation noise. The aim of the present study was to establish the exposure-response relationship between wind turbine noise exposure and the expected percentage annoyed residents on the basis of available data. Data from two surveys in Sweden (N=341, N=754) and one survey in the Netherlands (N=725) were combined to achieve relationships between Lden and annoyance indoors as well as annoyance outdoors at the dwelling. In addition, the influence of several individual and situational factors was assessed. In particular, annoyance was lower in residents who received economical benefit from wind turbines, and higher in residents for whom the wind turbine was visible from the dwelling. Age and noise sensitivity had similar effects on annoyance to those found in research on annoyance by other sources. The exposure-response relationship for wind turbine noise is compared to previously established relationships for industrial noise.

Acoustic propagation in variable sound speed profiles

Andrew Peplow, Hoare Lea Acoustics, Bristol, United Kingdom

Acoustic waves in variable sound speed profiles An important topic in the area of airborne sound propagation is the prediction of sound propagation above an impedance ground with an atmospheric profile whose sound speed varies with height. Even if this problem is simple in concept, it leads to complications for general velocity profiles. This work illustrates the existence of a large class of realistic atmospheric profiles for which analytical solutions exist to be used as benchmark solutions for numerical methods. Spectral finite element results are discussed for sound propagation in a half-space situated above a ground surface impedance.

Wind turbine sound - how often is it heard by residents living nearby?

Eja Pedersen[1], Kerstin Persson Waye[2]. [1]Halmstad University, Halmstad, Sweden, [2]University of Gothenburg, Gothenburg, Sweden

Sound power levels of wind turbines and consequently also the immission sound pressure levels at nearby residents vary with the wind speed. A standard meteorological situation is therefore commonly used when the immission levels are discussed; wind speed 8 m/s at 10 m height downwind. There is a need for a more comprehensive description of the sound that could be included in the Environmental Impact Assessment. The objectives of this study were to explore if it is possible to measure how often the sound is heard, and if the occurrence could be related to the standardized immission levels or the performance of the wind turbine. Twenty four people living in three wind turbine areas (A-weighted sound pressure levels 29.6 - 45.9 dB) filled in diaries for three weeks, noting when they were at home, when they were outdoors, and when they could hear sound from wind turbines. The incidents when the wind turbines were heard varied largely from 0% to 100% of the times spent outdoors. The percentage increased with increasing standardized immission levels ($r = 0.56$, $p < 0.01$). In two of the areas it was possible to get data from the nearest turbines for the study period. The sound was more easily heard at wind speeds above 5 m/s than at lower wind speeds. No indication of a decreased possibility to hear the sound when the wind increased further was found. Possibility to hear the sound was most closely related to the electrical power generation.

Health – psychological, cardiovascular

Medical, psychological and genetic aspects of noise sensitivity

Marja Heinonen-Guzejev, Heikki Vuorinen, Helena Mussalo-Rauhamaa, Kauko Heikkilä, Markku Koskenvuo, Jaakko Kaprio. University of Helsinki, Department of Public Health, Helsinki, Finland

The study was based on the Finnish Twin Cohort of same-sex twin pairs. In 1988 a questionnaire was sent to twin pairs discordant for hypertension. 1495 individuals (688 men, 807 women) aged 31-88 years replied, including 573 twin pairs. 218 of the subjects lived in the Helsinki Metropolitan Area. Self-reported noise sensitivity, lifetime noise exposure and hypertension were obtained from the questionnaire study in 1988 and other somatic and psychological factors from the questionnaire study in 1981 for the same individuals. In

addition, noise map information from the Helsinki Metropolitan Area and mortality follow-up 1989-2003 were used. To evaluate the stability and validity of noise sensitivity, a new questionnaire was sent in 2002 to a sample of the subjects who had replied to the 1988 questionnaire.

Of all subjects 38 % were noise sensitive. Noise sensitive subjects reported transportation noise exposure outside the environmental noise map areas almost twice as often as non-sensitive subjects. Noise sensitivity was associated with hypertension, emphysema, use of psychotropic drugs, ex-smoking, stress and hostility, even when lifetime noise exposure was adjusted for. Monozygotic twin pairs were more similar with regards noise sensitivity than dizygotic twin pairs and quantitative genetic modeling indicated significant familiality. The best fitting genetic model provided an estimate of heritability of 36 %. Follow-up of subjects showed that cardiovascular mortality was significantly increased among noise sensitive women, but not among men. For coronary heart mortality the interaction of noise sensitivity and lifetime noise exposure was statistically significant in women.

The effects of road-traffic noise on blood pressure of children aged 7-11 years in Belgrade

Katarina Paunovic[1], Goran Belojevic[1], Branko Jakovljevic[1], Vesna Stojanov[2], Jelena Ilic Zivojinovic[1].
[1]Institute of Hygiene and Medical Ecology, School of Medicine, Belgrade, Serbia, [2]Clinical Centre of Serbia, Belgrade, Serbia

Background: The aim of this study was to investigate the effects of urban road-traffic daytime noise around schools and nighttime noise near residences on blood pressure of school children.

Methods: A cross-sectional study was performed on 856 school children (413 boys and 443 girls) aged 7-11 years, who attended 8 primary schools in Belgrade. A residence was regarded noisy if L_{eq} exceeded 45 dB(A) during night and quiet if $L_{eq} \leq 45$ dB(A). School was regarded noisy if L_{eq} exceeded 60 dB(A) during day and quiet if $L_{eq} \leq 60$ dB(A). Four groups were created: quiet residence and quiet school, quiet residence and noisy school, noisy residence and quiet school and noisy residence and noisy school. A medical doctor measured blood pressure with mercury sphygmomanometer. The parents completed a questionnaire on children's noise sensitivity, physical activity, sitting by TV or computer and eating crisps.

Results: Systolic pressure was significantly higher among children from noisy schools and quiet residences, compared to children from both noisy environments (1.5 mmHg on average) or from both quiet environments (2 mmHg on average) ($p<0.001$). Multiple linear regression, after allowing for gender, age, BMI-for-age percentile, family history of hypertension and noise insulation at school, showed significant positive correlation between noise exposure at school and children's systolic pressure ($B=0.566$, $t=2.681$; $p<0.001$), and diastolic pressure ($B=0.110$, $t=1.994$; $p<0.05$).

Conclusion: High level urban road-traffic noise ($L_{eq}>60$ dB(A)) around schools is associated with higher systolic and diastolic pressure in school children.

Noise disease burden: DALYs might be the answer, but what was the question?

Guus de Hollander[1], Irene van Kamp[2], Anne Knol[2]. [1]Netherlands Environmental Assessment Agency, Bilthoven, Netherlands, [2]National Institute of Public Health and the Environment (RIVM), Bilthoven, Netherlands.

Quantitative health impact assessment to support public health policies more and more involves estimation of the so-called attributable disease burden. As they aggregate different dimensions of health (morbidity as well as mortality), disease burden measures such as 'disability-adjusted life-years' (DALYs) enable comparison between different environmental and public health risks. Furthermore, in economic evaluation of environmental policies an aggregate public health indicator is also required to compare the health benefits of different options and establish the best deals in health risk management. Nonetheless, there is still a vivid debate going on whether, when and where the use of DALYs in environmental health risk management is suitable. Using a Dutch 'noise related burden of disease' study as an example this paper will discuss the DALY-method, the rationale behind it, as well as several methodological, economical and ethical challenges behind the 'appealing' concept of attributable disease burden.

Environmental noise and health in the elderly;an Australian case study

Irene van Kamp[1], Julie Hatfield[1], Jessica Santos[1], Wei Du1. [1](RIVM) National Institute of Public Health and the Environment, Bilthoven, Netherlands, [2]NSW Injury Risk Management Research Centre, University of NSW, NSW, Australia, Sydney, Australia, [3]Medical Faculty,University of NSW, NSW, Australia, Sydney, Australia, [4]The George Institute for International Health, University of Sydney, NSW, Australia, Sydney, Australia

The project "Ageing well in Australian cities" addresses knowledge gaps regarding the relationship between residential environment and the health of older residents, at the neighbourhood level. The projecct extents the LARES project conducted by the WHO (EU) to Australia (Sydney), and to focus on older people (aged 60+), and their particular health problems. The present paper focuses on the influence of road traffic noise on health outcomes in the context of key residential and personal characteristics. Five localities in the City of Sydney council area were selected based on having a large proportion of elderly residents, heterogeneity of residential amenity, housing design/condition and socioeconomic status. Following focus groups discussions 124 elderly residents were interviewed in their homes using a structured protocol, and housing features were recorded on-site. Data regarding road type and distance to road were used as a proxy for levels of noise exposure. Poisson regression analyses showed relationships of noise and housing features, annoyance and sleep disturbance that are comparable to previous findings in adult populations. There was no direct association of noise and housing features with diagnosis or medication use for hypertension/CVD. Our findings do not indicate that the elderly are more vulnerable to noise in terms of annoyance and sleep disturbance, but health effects were, as previously found in general populations, mediated by length of residency and annoyance due to different noise sources. Results provide insight into the noise health relationship amongst the elderly, which warrant future attention especially in view of inner city housing and traffic policies.

Road traffic noise, sensitivity, annoyance and self-reported health

Ronny Klæboe, Aslak Fyhri, Astrid H Amundsen. Institute of Transport Economics, Oslo, Norway.

To shed light on the relationships between noise exposure, exposure to air pollution, noise sensitivity, demographic and lifestyle factors and self-reported health, alternative explanatory models are explored. Using structural equation models, the empirical support for different causal models are assessed. The analyses are performed on cross-sectional data consisting of questionnaire responses from 1842 respondents and the calculated noise exposure on the most exposed façade of their dwellings, along with air pollution indicators for each dwelling based on 6 months of hourly calculated exposure data using real meteorology. Results from the analyses indicate that only sensitivity to noise is related to hypertension and chest pain. No relationships between road traffic noise annoyance and health complaints were identified. Instead of a traditional ambient stressor model of noise and other environmental exposures being the causal agent of stress that in turn induces health problems, the results suggest that noise annoyance -- health relationships in these studies may be spurious. It is conceivable that individual vulnerability is reflected both in ill health and in being sensitive to noise. The benefit of including contextual variables in a model of noise-health relationships is supported.

Health and Sleep

Nocturnal transportation noise - its effects on heart rate

Barbara Griefahn, Mathias Basner, Peter Bröde, Anke Marks

Noise-induced alterations of autonomic functions during sleep are suspected to bear a pathogenetic potential. If so, this is highly relevant for people living near airports, along major roads or railway tracks. This paper concerns heart rate (HR) responses to transportation noise and the impact of acoustic parameters, situational and individual influences. 12 women and 12 men (19-28 yrs) slept in 3 consecutive weeks 4 nights each in the laboratory. The 4 nights each week consisted of a random sequence of a quiet night (L_{Aeq} = 32 dBA) and 3 nights where either aircraft, rail or road traffic noises occurred with L_{Amax} of 45-77 dBA. The polysomnogram and the electrocardiogram were recorded during all nights.

If the participants did not wake up, HR-responses were biphasic with initial accelerations and maxima of +9 bpm followed by a decrease below baseline values. These responses were influenced by traffic mode, acoustic parameters and momentary sleep stage. If the subjects woke up, the HR-alterations consisted of elevations for more than one minute with maxima of +29 bpm. Though obviously triggered by noise events, awakenings per se rather than the acoustical parameters determined the extents and the patterns of the responses.

The observed alterations revealed moderate increases during the course of the night. This suggests that these responses play a key role in the genesis of noise-induced cardiovascular diseases. If so, this is more likely for responses accompanied by awakenings than for situations without awakenings.

Effects of long-term road traffic noise exposure on sleep in a large population study.

Yvonne Kluizenaar de, Sabine A. Janssen, Frank J. Lenthe van, Henk M.E. Miedema, Johan P. Mackenbach

We investigated the association between night-time road traffic noise exposure (L_{night}) and sleep problems. Baseline questionnaire data were linked to detailed road traffic noise exposure, for a large population based cohort study (GLOBE) (~ 18 000 subjects), in a large urban region in the Netherlands. Logistic regression was conducted to study the association between exposure at the most exposed façade of the dwelling and sleep problems. For individual exposure assessment detailed spatial data (e.g traffic characteristics, buildings, screening objects) were used together with geographical information systems (GIS) and state-of-the-art modeling techniques. Measures of sleep problems were collected by questionnaire with questions on morning tiredness and use of sleep or tranquillizing medication. After adjustment for confounders a significant association was found between road traffic noise exposure and the risk of getting up tired and not feeling rested in the morning. Although the prevalence of sleep or tranquillizing medication use was higher at higher noise levels compared to the reference category ($L_{night} < 35$ dB), after adjustment for confounders this association was not significant. Long-term exposure to road traffic noise is found to be associated with an increased risk of getting up tired and not feeling rested in the morning in the general population. This result extends the earlier established relationship between long-term noise exposure and sleep disturbance assessed with questions that explicitly referred to disturbance caused by noise.

Human response to vibration – in transportation and buildings

Investigations to Measure Human Exposure to Vibration in Residential Environments.

James Woodcock, Eulalia Peris, Gennaro Sica, Andrew Moorhouse, David Waddington

The University of Salford is currently engaged in work to derive exposure-response relationships for human vibration in residential environments. The vibration sources to be considered are those affecting residents that are outside their control, such as construction, road and rail activities. The protocol involves the measurement of vibration outside and inside residences and a social study questionnaire based on face-to-face interviews with adults. This paper deals with the measurement of vibration, i.e. the ‘exposure' part of the required exposure-response relationship, and describes the development and practical implementation of the vibration measurement protocol. Reported here are findings obtained in preliminary field measurements made to investigate the feasibility of the proposed method. In addition, controlled tests performed to determine the suitability of the vibration mounting for various practical situations are described. On the basis of the findings of the preliminary field measurements, recommendations for the full study are made. [Work funded by the Department for Environment, Food and Rural Affairs (Defra) UK]

Human exposure to low frequency horizontal motion in buildings and offshore structures: an assessment of guidance in BS 6611 and ISO 6897

Henrietta Howarth, Michael Griffin

Building vibration produced by external sources (e.g. road and rail traffic) and internal sources (e.g. domestic equipment and footfalls) is usually within the frequency range 1 to 80 Hz. The excitation of structures by wind or waves can induce horizontal motion at frequencies less than 1 Hz. This paper reviews guidance on the measurement, evaluation and assessment of human exposure to horizontal motion over the frequency range 0.063 to 1.0 Hz as provided in British Standard 6611 (1985) and the equivalent International Standard 6897 (1984). The guidance is compared with standards applicable to exposure to vibration at higher frequencies. It is concluded that BS 6611 and ISO 6897 do not adequately allow for the effects of exposure duration or for differences in the effects of motion on different tasks. Acceleration limits for buildings proposed in BS 6611 and ISO 6897 for the worst 10 minutes of a wind storm with a return period of 5 years or more are similar to satisfactory magnitudes in BS 6472-1 (2008) and BS 6841 (1987) for 10-minute daily exposures. Mean thresholds for the perception of motion in BS 6611 and ISO 6897 are a little higher than those in ISO 2631-1 (1997), BS 6472-1 (2008), and BS 6841 (1987). The acceleration magnitudes expected to impair task performance in BS 6611 and ISO 6897 are lower than the magnitudes impairing hand control in BS 6841. Possible revisions to BS 6611 and ISO 6897 are discussed.

Wind turbine noise

Rating of wind turbine noise using Lden

G.P. van den Berg

Wind turbine noise is usually rated either at a standard sound power level or at sound power levels determined by a number of wind speed values. A new approach is to calculate the long term average sound power obtained from the long term wind speed distribution at hub height. From this a single long term sound power level can be calculated that serves as input to a sound propagation model to calculate a rating level according to the preferred European

Predicting annoyance by wind turbine Noise

Sabine A. Janssen; Henk Vos; Arno R. Eisses; Eja Pedersen

While wind turbines have beneficial effects for the environment, they inevitably generate environmental noise. In order to protect residents against unacceptable levels of noise, exposure-response relationships are needed to predict the expected percentage of people annoyed or highly annoyed at a given level of wind turbine noise. Exposure-response relationships for wind turbine noise were derived on the basis of available data, using the same method that was previously used to derive relationships for transportation noise and industrial noise. Data from surveys in Sweden and the Netherlands were used to achieve relationships between Lden and annoyance, both indoors and outdoors at the dwelling. It is shown that a given percentage of an-

noyance by wind turbine noise is expected at much lower levels of Lden than the same percentage of annoyance by for instance road traffic noise. Results were used to guide new noise regulation for wind turbines in the Netherlands.

Why is wind turbine noise poorly masked by road traffic noise?

Eja Pedersen, Frits van den Berg

The possibility of road traffic noise masking noise from wind turbines was explored among residents living close to wind turbines in the Netherlands (n = 725) with different levels of road traffic noise present. No general masking effect was found, except when levels of wind turbine sound were moderate (35 – 40 dB(A) Lden) and road traffic sound level exceeded that level with at least 20 dB(A). This low masking capacity may be due to the different time patterns of these noise sources, both on a small time scale (car passages/regular blade passing) and a larger time scale (diurnal and weekly patterns). Also, wind turbine sound is relatively easy audible and may be heard upwind more often than road traffic.

Environmental noise

Appropriate descriptors for use in environmental noise policy

Marion Burgess

The aim of environmental noise legislation is to control excess noise so that an acceptable acoustic environment is achieved in the surrounding areas. As qualitative assessment of noise level varies with the perception of individuals, the Regulators incorporate quantitative assessment of noise levels in the legislative documentation. Descriptors for noise assessment, such a LAeq over a time period, are commonly used for such criteria. Such descriptors or metrics are relatively easy to measure but they may not adequately represent the annoying characteristics of the noise. Modern instrumentation offers the opportunity for more extensive measurements of noise sources. While this can provide more data on the noise, there is a limit to how this data can be used by the Regulators. The potential benefits of environmental regulations incorporating more sophisticated descriptors/metrics of noise will be discussed

One's Personal Noise Footprint: what's your share in environmental noise production?

Edwin Verheijen, Elly Waterman

Environmental noise is generally considered a problem that should be tackled at governmental level. This is justified as long as citizens cannot really influence the amount of noise that is produced in their neighborhood. The consequence, however, is that people are not aware of their share in environmental noise, or worse, they are not interested at all in environmental noise and its (hidden) effects on health. Changing this attitude may be required for a sustainable quieter environment. In many cases individuals can choose between different means of transportation. Citizens are willing to take environmental aspects like CO2 emission

and energy wastage into consideration, but up to now cannot decide on the noise impact. Will I take the bus or drive by car? Will I take the high speed train or an airplane? What is my share in noise impact, as a passenger, in these cases? To what extend do I have a share in industrial noise as well, being consumer and labourer? In this article a method is given to calculate one's personal contribution in environmental noise. In order to visualise this contribution, we are borrowing the concept 'noise footprint' which is used in aircraft noise control and reform this into a 'personal noise footpring (PNF)'. The PNF has no directional information. It represents the area which is exposed to noise and it indicates which activity of individuals is dominant. Besides visualisation advantages, the noise footprint features simple maths instead of logarithms. Strenght and weaknesses of concept are discussed in this article.

An indicator for area specific noise impact: Gden

M. Weber, J. Jabben

Noise legislation in the Netherlands and many Western European countries obliges authorities to adhere to various norms for noise sources, such as road traffic, industry and railways. These norms have to be included in spatial planning. Since the 1990s several initiatives searched for area-specific flexibility in setting noise limits, as local housing targets were hampered by strict noise limit values. Despite these initiatives, reflexive and local-level noise policy is still in its infancy; lacking accepted and unambiguous instruments. In this paper we will introduce a new promising instrument, the group noise level Gden. The group noise level is a generalized indicator for the noise impact on a group (area) of people, whereas Lden is used on single dwellings. The group noise level Gden is calculated by adding the Lden levels at all dwellings in the designated area (of all noise sources). Municipalities can apply Gden in developing area-specific (noise) ambitions and environmental quality targets. The paper discusses features and some possible applications of Gden.

Low Frequency Noise & Vibrations Experiences A Residential Torture without Social Liability? An Account of Solving Difficulties of an Exposed Family

Ruud S. Louw, Elizabeth Louw van Popering

The existence and consequences of the exposure to Low Frequency Noise and Vibrations (LFN&V), in particular in residential areas, are hardly known among the population, local authorities, magistrates and medical circuit. The goal of this report is to highlight some of the problems confronted by common citizens when a low frequency noise and vibration (LFN&V) situation is detected in their homes. The data provided herein will discuss sources of LFN&V that are inadequately isolated from residential settings, as well as, currently used methodologies for assessing noise in general, and LFN&V in particular. The pathways available to the common European citizen to solve a residential LFN&V problem are discussed, and suggestions for durable improvements are considered.

40-45 dB – criteria for a good sound environment in urban areas

Tor Kihlman & Mats E. Nilsson

Current guideline values for environmental noise outside urban dwellings are technical/economical compromises that seldom imply a good acoustical environment. A good sound environment must be one where noise does not interfere with rest and sleep, which implies no or low speech interference without raising voice level, where observed annoyance is close to zero and which is perceived as pleasant and restorative. Previous research and our own studies all indicate that these conditions to be fulfilled outdoors would require Aeq < 40-45 dB from noise sources which should be the political goal for a sustainable development. This goal demands much effort both in emission reductions and city planning.

On the relevance of nonacoustic factors influencing the annoyance caused by environmental sounds – a literature study

Joos Vos

The annoyance caused by environmental sounds is only in part related to the noise dose. Nonacoustic factors have systematic effects on annoyance also. In the present literature study we explored what nonacoustic factors may be considered as potential tools to reduce the annoyance. Studies designed to test the effect of the nonacoustic factors in an independent way are particularly relevant. The results of these studies showed that 1) a change in the attitude towards, in fact, the quality of noise management, resulted in a change in the annoyance, 2) availability of information about a noise mitigating measure diminishes annoyance, 3) information exchange may decrease annoyance, and 4) a fair procedure in the distribution of noise may result in less annoyance. The relevance to annoyance of 5) having voice in a decision process, however, could not be confirmed. Due to various methodological imperfections, however, most results of such experiments do not permit drawing firm conclusions. Examples of the experimental shortcomings are an inadequate way of measuring annoyance, the use of exceptionally high sound exposure levels or embedment of the pertinent process in a too narrow context. Both in field and in more elaborate laboratory experiments, these issues warrant to be investigated further.

Experiences with end action plans and environmental policy plans

Hans J.A. van Leeuwen, Michel H.M. van Kesteren

After calculating and drawing lots of noise maps the real work did start: the discussions on how to reduce noise levels and how to improve the environment effected by traffic or industry. The noise maps were the starting point and had to trigger politicians and citizens. Is annoyance due to environmental noise more important than air pollution and do we have financial funding for actions and measures? This paper gives some experiences on these discussions and some pessimistic but also very optimistic and promising results. Not only on action plans but also on environmental policy plans. Some recommendations for the second round of the European Noise Directive will be given.

A comparison of noise simulation models

S. Curcuruto, et al.

The Institute for the Environmental Protection and Research has organized a research activity, on assignment of Ministry of the Environment, in order to compare the results of the main noise simulation models. The comparison has taken in account of all noise sources – roads, railways, industries and airports. The results have allowed to evaluate the differences due to operator choices, most common commercial software tools – implementing the same models – and various infrastructure configurations.