

Acoustics BULLETIN

VOL 28 No1 Jan/Feb 2003



Autumn Conference Report: Action on environmental noise

**Reproduced Sound 18: Perception:
reception, deception
Road surfaces: noise and
skidding performance
Use of WHO community noise guidelines**

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Acoustics**

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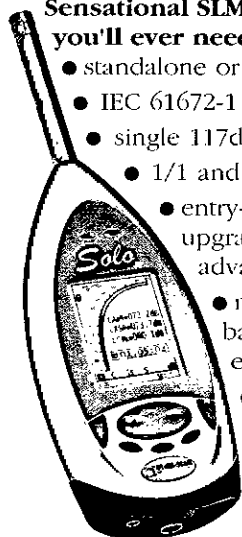
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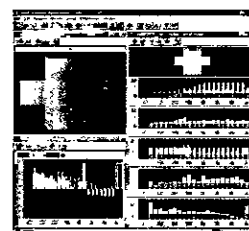
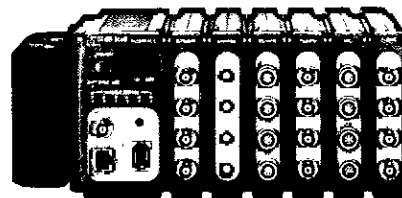
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Acoustics

BULLETIN

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Institute of
Acoustics

The Institute of Acoustics was formed in 1974 through the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society and is the premier organisation in the United Kingdom concerned with acoustics. The present membership is in excess of two thousand and since 1977 it has been a fully professional Institute. The Institute has representation in many major research, educational, planning and industrial establishments covering all aspects of acoustics including aerodynamic noise, environmental, industrial and architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics and vibration. The Institute is a Registered Charity no 267026.

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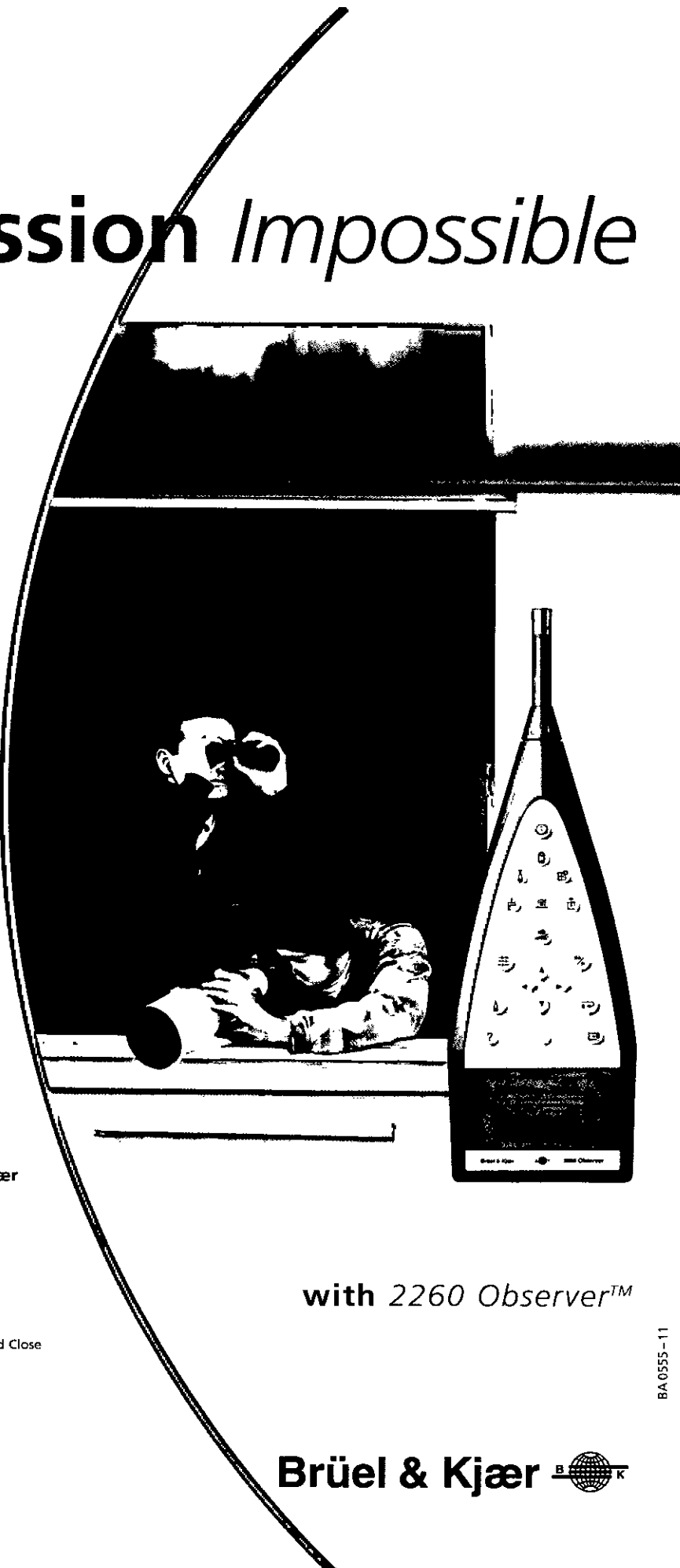
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R D Bratby

**Dear Members**

In the last Bulletin I invited you to contact me if you are interested in helping the Institute by serving on one of its committees or even Council itself. Council has recommended that we streamline the nomination process, but because this involves revising the Articles of Association it will take a little time. Council is still obliged to put forward suitable candidates for the next elections, so if you are interested in being nominated, or know any corporate members who are, please let me know. Alternatively there is an opportunity to be nominated directly when the AGM notice is issued.

I have been busy over the past two months attending various functions including the excellent Autumn Conference and Reproduced Sound 18 in Stratford, and the joint REHIS/Scottish Branch 'Noise Update' meeting. The last provided an opportunity for both inexperienced and experienced acousticians and environmental health officers to exchange views and information. This was a very useful exercise and my congratulations go to those members in Scotland who contributed to its success.

At all three events, and at others including Council, I have either spoken or led discussion on the 'the future of the profession'. I have mentioned before the growing concern in many parts of the discipline that qualified acousticians are in short supply, a shortage unlikely to be addressed by newly qualified undergraduates because those numbers are static or decreasing. The discussions have been lively and the feedback positive. There is definite concern to raise the profession's profile. This must be done not only to attract more qualified scientists and engineers to acoustics but to make the public more aware of the value that acousticians add to society by enhancing the quality of life. We must make everyone aware that acousticians not only advise on noise control but are involved in sound reproduction and communications, medical physics, architecture and building design, environmental protection, defence, speech and hearing, underwater detection and many others. Your views and comments are welcome, so please make them known.

Finally, our search for a suitable Chief Executive continues. Roy Bratby has kindly volunteered to postpone his retirement until a successor is found but if you know anyone who might be interested, I would like to hear from them.

With best wishes

Geoff Kerry
President

Measurement and Instrumentation Group

Did the earth move for you?

There are not many Institute events where the directions to the meeting include 'turn left at the large dinosaur in the foyer', but 68 delegates braved this necessity at the Natural History Museum in London in pursuit of the Measurement and Instrumentation Group's latest presentation, on 9 October 2002.

Rupert Thornely-Taylor (Rupert Taylor Ltd) began the day with an authoritative invited paper on *Ground vibration prediction and assessment*. The additional difficulties of environmental vibration measurement over noise were discussed with amplification of source, propagation and receiver issues. Difficulties of understanding soil parameters and the many types of waves propagating were discussed, and the usefulness of modelling examined. The human body is the most common receiver, but the variable nature of perception and the large number of weighting functions employed make predictions difficult.

Rupert was on the panel of experts which also included the next speaker, **Richard Greer** (Arup Acoustics), who had collaborated in producing the book discussed in his paper *Good Practice in Groundborne Noise and Vibration Measurement and Analysis*. The guidelines were drawn up under the auspices of the Association of Noise Consultants, and Richard discussed the objectives behind the book, particularly in relation to BS6472 and BS 6841, and what could be considered as good practice in respect of monitoring and analysing vibration as perceived by people. Advice on transducers, frequency weighting, locations and equipment were supplemented by a reporting structure that is hoped will produce a more uniform presentation of data in the future.

The practical side was then emphasised by **Rick Jones** (AEA Technology Rail) with a presentation of *Statistical techniques for separating ground-borne sound and airborne sound within buildings adjacent to railways*. Based on many measurements of both sound and vibration, it was shown that the effects of alterations in rail track could be predicted inside properties close to the track where both airborne and groundborne noise was expected using statistical techniques, and this could in turn enable cost-effective design of mitigation. The morning concluded with a presentation of two case studies by **Nigel Cogger** (The English Cogger Partnership) of 'Propagation of industrial noise and vibration to housing'. The first case discussed was an industrial unit close to housing that was enlarged to include many new machines, whose 24-hour working was subject to planning conditions, and the discussions and

measurements that ensued in trying to satisfy all parties. Faulty identification of the original requirements led to remedial action that at best only achieved a partial solution to the effects of the vibration.

The second case was conversion of industrial buildings to dwellings close to existing industrial premises.

The lack of original thought of the effects of the industrial activities caused considerable remedial work partway through conversion in order to meet requirements of the local planning authority. Earlier consideration of the problems would have produced cheaper and better solutions to both difficulties.

After a lunch that would not have been sufficient for a dinosaur, the meeting resumed with a presentation from **Mike Breslin** (ANV Measurement Systems Ltd) entitled 'Monitoring and control of vibration from demolition and construction'. Monitoring of vibration levels from redevelopment sites was compared with information in BS 6472, BS 5228 part 4, and BS 7385 part 2, and figures derived from these Standards were used to predict the effects on local communities. The subjective response

to impulsive, intermittent and continuous vibrations were discussed in terms of the peak particle velocity, and vibration measurement and its use in the control of site operations were illustrated, not least by a graph that included the effects

of the earthquake of 23 September 2002.

A very different presentation given by **James Talbot** (Cambridge University) followed. He discussed *The effect of side-restraint bearings on the performance of base-isolated buildings*. The practice of mounting buildings on vibration isolators at their foundations is not unusual, but at times there is a requirement (eg. a lift shaft) where side restraints are thought necessary for

structural integrity. If the base isolation is not to be undermined, then the side restraint must also have vibration isolation. Three mathematical models were presented to show how these effects may be assessed, and the conclusion of the theoretical studies so far is that the stiffness of any side restraint should be minimised for maximum performance. Work was still ongoing to determine the stiffness

below which the restraint was of little practical use.

The contents of BS 6472:1992 *Guide to the measurement of human response to vibration in buildings* were raised and

discussed at many times during the meeting. As a conclusion to the day's event, **David Trevor-Jones** (David Trevor-Jones Associates) discussed *Issues raised in the review of BS 6472*. As a member of the Committee tasked with updating the Standard, an insight was given into the detailed work and thought being put into the review. Many of the supposed shortcomings of the current Standard have been scrutinised, and attempts have been made to clarify and expand the text. The absence of any really new research evidence to help the Committee was bemoaned, and any relevant input from practitioners was invited.

The day concluded with a lively discussion led by the meeting organiser, **John Shelton** (Acsoft Ltd), during which the lack of funding for many aspects of vibration measurement and investigation was underlined, noting that many of the interested parties were no longer able to offer opportunities for this type of activity.

If there were dinosaurs around, then the earth would definitely have moved under their influence. As we left the meeting, we were all treated to some of their sounds, but without the vibrations that would have accompanied them.

Richard Tyler FIOA
Chairman, Measurement and Instrumentation Group

a lack of funding for many aspects was underlined

Predicting and assessing ground vibration

IOA welcomes a new Sponsoring Organisation

The Institute of Acoustics is delighted to welcome to its ranks a new Sponsoring Organisation: **Greenwood Air Management Ltd**. The company manufactures a complete range of extract and supply fans, accessories and installation kits including the market-leading *Greenwood Airvac Fans* for kitchens and bathrooms, and *Greenwood Eco Fans* for commercial and light industrial buildings. There is also

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email: info@greenwood.co.uk

Design and build unplugged

BAG workshop on 8 April 2003 will explore the issues

When it works well a **Design and Build** procurement route allows the consultants and contractor to fine tune a set of well written user objectives (*Employers Requirements*) into a cost effective and easy to build project. The contractor can direct the consultants away from expensive and time consuming construction techniques before too much time is spent in designing them and the contractor can have confidence that the consultants will interpret the objectives with the skill and flair that the employer is expecting. However, some consultants feel that D & B projects are more stressful than the more traditional procurement methods. It is apparent from general research that there is often a lack of understanding of the difference in the objectives of a traditional client and a D & B contractor. For example, the traditional client may not be too concerned with how the building is constructed but only that its purpose is achieved, whilst the D & B contractor may not be so interested in its purpose but more interested in the detail of how it is constructed. Both corporate objectives are valid, but a consultant has to establish the differences between the two and modify his business practices accordingly, as they will

fundamentally affect the type of information to be produced by the consultant.

The above issues are not specific to acoustic consultants but the matter is complicated in acoustics by the fact that the design parameters cannot easily be explained in layman's terms. For example, say a set of mechanical and electrical Employers Requirements ask for an internal temperature of 22°C and the contractors team has developed a cost effective

solution that achieves 21°C. All parties can understand the implications of both the original requirements and the Contractors Proposal and act accordingly.

However, a set of acoustic Employers Requirements might state an internal ambient level of 35dB (often there is no more information than that). The contractors acoustic consultant has to decide what interpretation to put on this (bearing in mind the contractor, his client, will expect him to offer the least onerous). Once this has been submitted as a qualification, the employer is quite likely to need the services of his own acoustic consultant to help him interpret the offer and decide the implications.

The Building Acoustics Group is planning to explore these issues, in an attempt to

make life easier for acoustic consultants working on Design and Build projects, through a half day workshop on 8 April 2003. The afternoon will begin with talks from four eminent and enthusiastic speakers, well qualified to examine the overall topic from their respective viewpoints (in the fields of architecture, acoustic consultancy, contracting and the legal profession). It will be followed by an organised discussion session chaired by further selected professionals. Please come to what will be the first of a series of Professional Practice seminars aimed at general topics surrounding the acoustic industry.

Thanks are due to Griffiths and Armour for inspiring some of the thoughts in this article.

Website traffic up

Mark Tatham reports that in recent months the number of visitors to the Institute web site www.ioa.org.uk has steadily increased. In July 2002, 15800 hits were registered, and this had increased to 38300 a month by the end of November. This means that there are more than 150 daily visitors to the site, reflecting the quality and appeal of the information available there.

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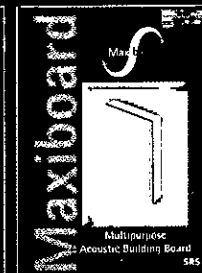
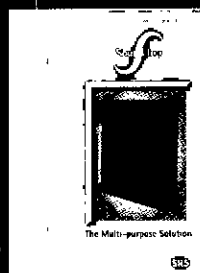
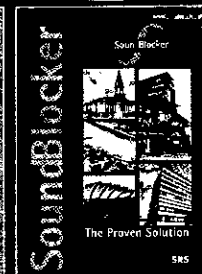
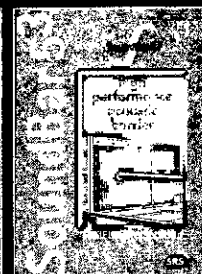
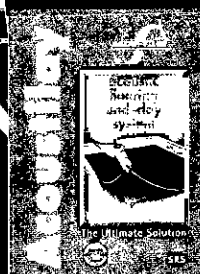
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[EXAMINATION RESULTS]**Certificate of Competence in Environmental Noise Management**

The following were successful in the May 2002 examination

University of Liverpool

Ayres J
Bellamy N J
Cope R S
Fowler J B
Jones R G
Lewis I D
Matthews J
Morgan A W
Neves De Sousa A L
Woodin K L

Colchester Institute

Bass S
Borobokas A
Collins S
Gray J P
Harrison G
McKee D
Peacock M E
Scott S
Small J P
Summerland S C

NESCOT

Carr S
Jones E
Willis S K

University of the West of England Bristol

Chapman R N
Didcott P G
Edwards C A
Jones R M

Morby S R
Reynolds S
Roberts O L
Sharpe R
Stevens S F
Wallace N M
Walters D G
Wolstenholme J A

Bell College

Birkin P A
Buchanan C M
Buchanan D
Campbell G
Doig D G
Halliday P
Kelly P
McGibbon J L
Mears A
Morrison S L
Murray J E
Parkins B
Phillips M W
Smith D J

University of Ulster

Brady L C

University of Birmingham

Allen Z E
Butt U S
Dudley S J
Elcock A
Gilbert M P
Harris S L
Johnson J
King B
Ledden J

Storey R C D
Todd I J
Williams J A

CoNEL

Chana G S
Dawson A
Joynes S
Kinsey A D
Ritherdon B
Triner N G
Walker S M

The following were successful in the November 2002 examination

Colchester Institute

Cornish C J
Jeffrey A
Palmer D E
Teare S A
Watson M I
Wilkinson, M

NESCOT

Andrew D R
Baldwin D A
Biberstein K J
Edwards K L
Ford R C

Hele E
Sykes P
Taylor L W
Wilson A R

University of Derby

Barrett M A
Brookes H L J
Bufton P
Burnett J A
Coulthard A M
Kehoe S
Mills C
Mills J P
Morris R S
Phillips G
Shanahan S V
Tilley P A

Bell College

Goodship I

Strathclyde University

Applegate G J
Black M J
Buchan D P
Cavanagh E S
Cole S T
Dowling G
Hammond A C D
Hatton G E
Hayes F

Hazzard J L
Hickson M J
Isbister I
Johnson T
Joyce E M
King D M
Knox A I
Lang J A
McGinnes C
McTaggart J
Schofield C
Sheppard Y

University of Leeds

Fairclough B
Leith J
Mehraban R
Moran S

University of Birmingham

Barnes S J
Farrow R J
Holman K H
Hyatt A
McEwan J W T
Powlson J G
Smith A
Smith S A
Stringer B
Webley P

Certificate course in the Management of Occupational Exposure to Hand Arm Vibration

The following were successful in the April 2002 examination

Institute of Naval Medicine

Allen G
Bukieda T D
Dobbs A S
Holden J A
Hoskins M J
Layfield M
Lewis P
Lord S J
Ryder S J
Stewart M A
Waddell B T

EEF Sheffield Association
Emmerson C
Glossop M

The following were successful in the November 2002 exam

Institute of Naval Medicine

Anderson C A L
Ansell C B
Cousens A R
Dobson M J
Johnson P
King M
King N P
Purcell P A

Thomson S W
Watson G

Leeds Metropolitan University
Fryers R
Reay G H

EEF Sheffield Association

Birchall C
Galloway D L
Houlden S P
Hunt D
Jones A J
Norman B
Small A
Wadie M

INSTITUTE OF ACOUSTICS

CHIEF EXECUTIVE

Applications are invited from suitably qualified individuals with proven administrative and financial management skills, able to pursue a strategic vision of the Institute's role and development. A science or engineering background would be advantageous.

The Institute of Acoustics was established in 1974 and is based in St Albans. A professional society with charity status serving some 2500 members, it supports a wide range of educational, publications and conference activities. The Institute maintains several specialist groups and regional branches, a professional development programme and strong international links.

To receive further information, expressions of interest should be sent as soon as possible to:-

Roy D Bratby Chief Executive
Institute of Acoustics, 77A St Peter's Street,
St Albans, Hertfordshire AL1 3BN
email: roy.bratby@ioa.org.uk

Certificate of Competence in Workplace Noise Assessment

The following were successful in the November 2002 exam

Colchester Institute

Anderson H
Brown A
Garrad C S
Hornby G
McKnight H
Quinn G M

University of Derby

Carne B B E
Ewers G
Grayson P
Shanks G W

Amber Acoustics

Whitehead N J

EEF Sheffield Association

Dyson S
Emmerson C
Glass C
Moor P
Moore F
Stephenson D A
Taylor I
Tough D

MEMBERSHIP

**At Council on 10 October 2002
the following were elected to the
membership grades shown**

Fellow

Brind, R J
Dunbavin, P R

Member

Brown, P R
Burton, N J S
Butterfield, M E
Carmichael, B
Chan, K L
Charles, D J
Colam, S J
Cornish, R H
Dinn, P A
Do O'monteiro, D M
Durrant, K M
Evenden, E
Higginbotham, M
Holmes, I P
Johnson, B
Manifold, R
Martin, W R
McCullough, P R
Meachin, A S
Merricks, N P
Mooney, D G
Morrissey, H S
Penman, J M
Scott, S M
Southwood, R M L

Associate Member

Abbott, P J
Adams, P B
Berry, A
Bithell, G R
Bolton, P J
Brewin, A J
Bruce, K E
Byrne, J
Caldwell, D A
Capelin, M J
Cass, H A
Chandler, N A
Clark-Monks, A
Cummings, D P
Dawson, A J
Didcott, P G
Digges La Toche, S V
Dodd, D J
Dunne, J D
Edwards, P
Edwards, P J
Evans, S E
Finnegan, P

Fox, G K
Garner, B J
Gibson, A M
Gould, D J
Grainger, M
Grant, M A
Hanlon, R J
Hornby, A J
Hounslea, A S
Humphrey, P J
Huntley, J L
Hyden, M B
Ip, C W R
Jordan, C
Kennett, J L
Krasnic, A S
Macfarlane, G J
Mason, Pa
Mcswiggan, P
Measures, P G
Mellor, S K
Moore, K S
Mudge, P G
Mullin, J A
Nugent, C
O'carroll, K L
Pattison, I R
Pickering, P g
Potts, M D
Powell, D
Power, P
Raper, C E
Robins, T P
Salisbury, C S
Sharpe, S E
Sherlock, I D
Smith, A J G
Smith, M K
Stedman, N
Tsangarides, N
Van Beever, R
Waller, J L
Waterlow, S J
Webster, M D
Willmott, J
Worsley, G P

Associate

Cuthbert, T
Peacock, M E M

Student

Brooks, C J
Enee, P N D

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Editor's Notes



Ian F Bennett BSc CEng MIOA
Editor

It is just as well we have had the opportunity to recharge the batteries over the holiday season: I hope a relaxing and peaceful Christmas was enjoyed by all. Here we are with the first issue of a new year, and even a cursory glance will reveal just how much activity there has been recently in the Institute. The technical sessions, one-day meetings and the usual annual events have all come thick and fast during the last couple of months, and all those I managed to get to were very

well attended. The quality of the papers presented was consistently high, amply rewarding all the members who invested their valuable time. We tried a new venue for the meeting on the 2000 Building Regulations – Approved document Part E, which appropriately enough took place at RIBA headquarters in Portland Place. There will be a full report in the next issue – there simply wasn't enough space for it this time (and yes, it has been written already!). Personally, I was impressed by the quality of the food and drink: when you consider that about 120 people had to be fed in the space of three-quarters of an hour, this was no mean achievement. RIBA even managed to make palatable tea (perhaps they imported the water from Manchester).

By the time this is in your hands, the first meeting of 2003 will already have taken place, with the Underwater Acoustics Group discussing calibration and measurement. The Measurement and Instrumentation Group is organising a meeting on the EU Vibration Directive on 19 March, and the Building Acoustics Group will be unplugging Design and Build contracts on 8 April.

Copy for the next issue should reach me no later than 10 February. Suggestions for further Pioneers are also particularly welcome. Who's your favourite acoustician?

Ian Bennett

Meeting Notice

Research Symposium: Acoustic characteristics of surfaces – measurement, prediction and applications



18-19 September 2003
University of Salford, Manchester, UK

Surfaces play a key role in airborne acoustics, in rooms, semi-enclosed spaces and outdoors. This symposium will bring together people working on surface acoustics to investigate the design, application, characterisation, measurement, modelling and predicting the effects of absorbers, diffusers and other surfaces in acoustics. Areas of interest include:

- * Modelling of surface effects in outdoor sound propagation and rooms.
- * Characterisation and application of diffusers.
- * In-situ measurement of material properties.
- * Modelling of porous and other absorptive materials.
- * New designs for absorbers and diffusers.
- * Innovative applications of new acoustic surface treatments.
- * Active and hybrid surfaces.
- * Non-linear effects in absorbers: measurement and modelling.
- * Ambient noise control: road/tyre noise, barriers and other surfaces.
- * Advances in numerical methods for surface reflection/scattering.

Deadline for abstracts: 31 January 2003
email abstracts to the Chair of the organising committee
t.j.cox@salford.ac.uk

Organisations:

- EAA Technical Committees:**
- Room & Building Acoustics
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For further information: www.ioa.org.uk/salford2003

Action on Environmental Noise

Dr Nigel Cogger FIOA reviews the Autumn Conference

2002's Autumn Conference programme, organised by the Environmental Noise Group and held at Stratford-upon-Avon on 13 and 14 November, was based around the recently published EU Directive on the Assessment and Management of Environmental Noise. The Conference was broadly split into two themes – the practicalities of noise mapping and the environmental noise action plans that follow the identification of noisy areas through mapping.

NOISE MAPPING

The conference opened with a joint paper by **Alan Bloomfield** (now with the Greater London Authority, but formerly with DEFRA) and **Steve Turner** (Casella Stanger) on the *Noise Mapping of England Project*. This outlined the organisation of the UK noise mapping project which, in accordance with the Directive, seeks to identify transport noise and industrial noise sources in a series of 'agglomerations'. The calculation methods for transportation and industrial noise were reviewed and the reasons for adapting existing UK algorithms given. It was emphasised that the project was to provide information for policy making and development planning and, particularly importantly, that noise mapping should complement measurement and not be considered as a replacement.

Then followed **Edgar Wetzel** (Wölfel), on the quality assurance procedures for noise mapping. This interesting paper provided an overview of the interim computation methods proposed by the EU and the limitations of these in relation to the requirements of the Directive – particularly the use of the $L_{DEN, 1 \text{ year}}$, which needs to take account of 'average' meteorological conditions. Whilst countries are initially permitted to use their own methods, the accuracy of the mapping is to be in relation to the reference provided by the adopted interim computation methods.

How accurate?

Jenny Stocker (Cambridge Environmental Research Consultants) presented a paper entitled: *How Accurate is a Noise Map Created with Air Quality Data?* This showed that, whilst overlapping data from air quality assessments was widely available and could be used as the initial basis for road traffic noise mapping, the road locations were generally not accurate, buildings and minor roads were not considered and speeds need to be adjusted from the 'congested speed' data. The study had included the empirical checking of a noise model of part of Cambridge, based on air quality data, and a reasonable correlation between measured and calculated results had been established.

Simon Shilton (Hepworth Acoustics) followed this review of a project mapping noise in Cambridge with a report on noise mapping undertaken in conjunction with the City of Westminster. The council is developing a three-dimensional map incorporating road, rail and industrial sources, based on GIS data for street layouts and GLA emissions data for road traffic. To date, however, insufficient information has been available for modelling rail noise. This project



Alan Bloomfield opened the conference proceedings with a paper on the Noise Mapping of England project

demonstrates how electronic mapping data can be used in practice to develop detailed noise models and is currently being tested against the council's records of measured noise data.

The European harmonised model for the prediction of road and rail noise over distances of up to 2km (*Harmonoise*) was introduced by **Greg Watts** (TRL) in a joint paper with **P Morgan**. It is intended that the model would use frequency based data, rather than the overall A-weighted level, and take account of meteorological conditions, ground types and cover, scattering from trees and buildings and screening by barriers. The model is to be validated by long term measurements and some benchmark testing has taken place. Up to date information on the project can be obtained from the web site, www.harmonoise.com.

Two further papers looked at the measurement of road traffic noise. **Sue Bird** (Bird Acoustics) outlined her work with **Mike Fillery** (Symonds Group), which investigates the relationship between short and long term L_{Aeq} measurements of traffic noise, to determine whether measurements over a period of 2 to 3 hours can be used to derive the daytime (16-hour) and night-time (8-hour) L_{Aeq} noise levels. Clearly, if this can be done, the implications for monitoring traffic noise would be significant.

The research was based on data obtained in the *Noise Incidence Survey* and showed that simple relationships could be derived to approximate day and night-time noise levels from such short sample measurement periods. The correlation for daytime levels was found to be strong (supporting the principle of the CRTN 'shortened measurement procedure'), but the correlation for the night-time



Sue Bird outlined research carried out with Mike Fillery into the measurement of road traffic noise

period was only found to be strong for A-roads. Measurement during the two-hour period between 05:00 and 07:00 appeared to give the best correlation for the 8 hour night-time L_{Aeq} – an unfortunate conclusion for those who prefer surveys during the early part of the night to the early part of the morning!

Greg Watts then presented a second paper, on behalf of P Abbott and P Nelson of TRL, describing the DEFRA project being undertaken to develop an interim computational method that would comply with the requirements of the EU Directive. The study concluded that adaptation of the existing CRTN method for calculation of road traffic noise to determine the L_{DEN} and L_{night} from the L_{A10} would be the most appropriate. A strategy for adapting the L_{A10} values has been proposed and compared with measured data from the *National Noise Incidence Survey*, which showed that, whilst there was generally good agreement between the measured data and the predicted L_{DEN} and L_{night} values for road traffic sources, the measured L_{DEN} was found to be particularly susceptible to extraneous sources,

especially when these occur at night (eg. the dawn chorus).

The final paper of the session was presented by Ian Jopson (CAA) and co-authored by Darren Rhodes and Peter Havelock. This reviewed the INM and ANCOM2 aircraft noise models and showed the importance of accuracy of the models. As an example, it was demonstrated that an error of 1dB in the estimation of a noise contour could lead to the population affected by a level of aircraft noise to be in error by as much as 75,000 people. Such errors can arise because the flight profiles and manufacturers' noise data assumed in the model can be different from those occurring in practice. The CAA therefore validates the ANCOM2 model using flight profile information and comprehensive noise measurements to ensure that the model can be used to calculate accurate noise contours at UK airports and, therefore, meet the requirements of the EU Noise Directive.

Delegates fire the questions

The first day's sessions were concluded with a question session. Alan Bloomfield reassured the audience that noise is becoming a more important issue at government level but in response to another question, commented that, whilst ISO.9613 was not adopted by the UK as a prediction method, we now had no choice and would be required to use that method. Richard Greer (Arup Acoustics) pointed out that noise mapping was primarily to determine the numbers of people (in agglomerations) affected by noise and was, consequently, somewhat coarse, while more detail would be required for planning at local level. Alan Bloomfield replied that the mapping provides a linked and coherent strategic approach that could be developed to provide more local assessments.

Edgar Wetzel added that the purpose of the Directive was for strategic planning and high level policy decision making, rather than for smaller scale local measures and emphasised that other methods and indicators from those specified by the Directive

continued on page 10

Questions and discussion between speakers and delegates concluded the first day's programme



Action on Environmental Noise

continued from page 9

can still be used for other purposes, such as local planning issues. **Roger Munt** was concerned that the modelling methods adopted for the Directive did not take account of the frequency dependent propagation mechanisms, but Edgar Wetzel felt that this was not so relevant for strategic modelling.

In answer to a question on the *Harmonoise* project, **Greg Watts** confirmed that the current methods (CRTN, CRN, etc) would continue to be used in the short term. **Nigel Cogger** pointed out that, whilst the Directive and the recommendations on calculation methods and noise indices were intended for strategic policy making, this was also the intention of the WHO guidelines on environmental noise. The latter were now being (mis)used in a wide range of applications outside their original intent, which is resulting in difficulties in achieving practicable and pragmatic local planning and development decisions and he wondered whether this would happen with the Directive.

The sessions concluded with the presentation of the *RWB Stephens Medal* to **Geoff Leventhall** for his work on low frequency noise and active noise control. Geoff then gave the *RWB Stephens 100th Birthday Anniversary Lecture* on 35 years of low frequency noise. As usual, Geoff was both informative and entertaining and provided a fascinating insight into the mechanisms and assessment of low frequency noise.

As the second day opened, the session on noise mapping continued with a particularly interesting presentation by **Nigel Jones** (Casella Stanger) on *GIS in noise mapping*. Nigel is not an acoustician, but a specialist in geographical information systems themselves, and was able to provide a much needed insight into the structure of GIS and the information available, as well as the development of the Ordnance Survey 'MasterMap' system, which will provide

seamless mapping of the UK (rather than the 'tile' systems currently in common use) and an 'intelligent' mapping database.

Mike Fillery (Symonds Group) opened the session on action plans with his paper *Tranquillity and Relatively Quiet Areas* – prompted by the EU Directive

ACTION PLANS

and the recently published UK Rural White Paper, which specifically refers to tranquillity in the context of noise. Mike pointed out that there is often a high level of noise in rural areas (and, indeed, areas described as tranquil), as a result of natural sources as well as the influence of man. He then referred to the difficulty of defining tranquillity in measurable terms and the CPRE/Countryside Commission mapping of tranquil areas and proposed that a pragmatic approach to defining tranquil areas was needed, based on the existing conservation areas, to ensure that proactive policies to maintain tranquillity (however defined) can be implemented speedily.

This paper formed the introduction to a general discussion on tranquillity and the actions needed to maintain quiet areas, as required by the EU Directive. This discussion will be reported in more detail in a future issue of *Acoustics Bulletin*.

Richard Greer (Arup Acoustics) then gave a joint paper entitled *Noise Mapping and Action Plans – the Rail Industry Realities*, which ably straddled the two themes of the conference – the practicalities of noise mapping and action plans to deal with noise issues. The paper reviewed a series of pilot studies being undertaken for the Railway Forum and Railtrack to investigate the implications of the Directive and the *National Ambient Noise Strategy*. The studies showed that current mapping does not give adequate detail of rail features, such as rail levels, cuttings, fences, and noise barriers, although this information together with operational details is held by Railtrack or can be accessed by Railtrack from the operating companies.

It was also proposed that mapping would not be a suitable basis for forming action plans directly, but to identify areas of population affected by noise and local 'hot spots'. More detailed local studies would be required in areas defined by the mapping, to enable a suitable strategy for action to be developed. It was also emphasised that any action in a local area, relating to the rail network, should take account of the importance of sustainable travel strategies and the desirability of switching from road to rail transportation.

Chris Skinner (BRE) followed with a detailed account of the *BRE Noise Incidence Studies* in a joint paper with **Colin Grimwood**. The results of the national studies undertaken in 1990 and the period 1999-2002 were discussed and trends in noise levels during the ten year period outlined. In addition to the measured noise levels, the studies included questionnaire surveys to determine the attitude of people to noise. These demonstrated that, whilst there was no significant increase in the number of people being adversely affected by noise from road

Geoff Leventhall gives his RWB Stephens 100th Birthday Anniversary Medal Lecture



Awards for Achievement presented during the Conference



Laurent Galbrun (right), Heriot Watt University, receives his ANC Award for the best paper given by a young person at an IOA meeting, from Philip Dunbavin

traffic and aircraft, there have been increases in those affected by specific types of road traffic (private cars/vans and motorway noise) and specific types of aircraft (microlights/powered gliders and private/commercial helicopters). Dissatisfaction with the many forms of neighbour noise was also shown to have increased.

The final formal presentation was given by **Mark Dixon** (GLA) on *The Mayor's Draft London Ambient Noise Strategy*, co-authored by **Alan Bloomfield**. This paper outlined the draft noise strategy developed by the GLA in response to the Greater London Authority Act 1999. The paper outlined the challenges to achieving lower noise levels and the approaches to be adopted, including improved road surfaces, an increased emphasis on public transport, spatial planning for buildings and an integrated noise management strategy.

Discussion from the floor

A brief discussion session on the sessions papers followed. **Alan Bloomfield** asked **Richard Greer** about the benefits of rail grinding, rather than wheel grinding. Richard pointed out that the main problem with rail/wheel noise results from wheel flats, although this affects the L_{max} rather than the L_{eq} . The action that can be taken by Railtrack, however, is limited because whilst rail roughness can be controlled, wheels are not its responsibility. **Steve Quigg** commented on the *National Noise Incidence Survey* and stated that, whilst people often complained to the police about noise, such complaints were usually then directed to the local authority. He also pointed out that complaints over 'traffic noise' are often related to isolated or specific

The ANC Award for best Diploma Project went to Joe McElhinney, Nottingham City Council, pictured (right) with Philip Dunbavin



Patrick Abbott (right) receives his 2002 Diploma Prize from IOA President, Geoff Kerry

vehicle movements rather than traffic in general.

Chris Skinner responded that a breakdown of traffic noise had been undertaken as far as was practicable and where possible particular vehicles identified in the study. **Andy McKenzie** asked about the differences between the 1990 and 2000 measurements that may be due to the use of different sound level meters. Chris replied that although there appeared to be a small systematic error, the mechanism for which was unknown, deviations were less than or equal to 1dB. **Declan Waugh** wondered if differences in meteorological conditions were taken into account in the Noise Survey, as he had found that 2000 was a relatively 'calm' year. Chris answered that measurements were controlled by limiting the survey to times when weather conditions were suitable and that the weather conditions at the start and end of each measurement were noted.

The formal presentations being completed, the meeting then reverted to a structured open discussion on action plans. The session was recorded and a detailed report of the discussions will appear in the March/April issue of *Acoustics Bulletin*.

Steve Turner then closed what had been a very useful and illuminating conference, with thanks to those involved in the preparation of the conference, the authors and presenters of papers, the exhibitors, the staff of the Stratford Victoria Hotel and, of course, **Ken Dibble** for providing the sound reinforcement and 'interval' music.

RWB Stephens Medal awarded to Herbert Geoffrey Leventhall FIOA

Citation

Geoff Leventhall joined the staff at Chelsea College, London in 1959 as a lecturer following completion of a part time MSc course in acoustics at the College, during which Dr RWB Stephens, from Imperial College, had given the lectures. In due course Geoff became Reader in Acoustics and Head of the Applied Acoustics Group at Chelsea, responsible for the development of teaching and research in acoustics. He helped establish two respected Master's courses; one in Applied Acoustics and the other in *Acoustic and Vibration Technology*. During his 22 years at Chelsea, Geoff's research interests included the measurement of damping in materials, the noise assessment of gas flames, noise from domestic appliances, building acoustics, low frequency noise and active noise control.

Together with RWB Stephens, he edited *Acoustics and Vibration Progress* between 1974 and 1976. His interest in low frequency noise led to a contributory chapter to *Infrasound and Low Frequency Vibration*, edited by Dr Bill Tempest. Together Geoff and Bill organised, and continue to organise, a successful series of conferences on low frequency noise and vibration. Geoff also carried out fundamental work in active noise control. He supervised more than 30 PhD students in the area of the effects of noise and its control and has been external examiner for doctoral degrees in acoustics for Universities in the UK, Denmark and Sweden.

Geoff left Chelsea College in 1982 to become Head of Acoustics and Technical Director at WS Atkins, putting into practice much of what he had researched and taught others. He went back to an academic post in 1988 as Professor and Head of the Institute of Environmental Engineering at South Bank Polytechnic, which he left in 1992 to return to consultancy.

Geoff has also made substantial contributions to acoustic activities both in the UK and internationally and was the 1978 recipient of the Institute's *Tyndall Medal*. He was President of the IOA from 1984 to 1986



Dr Geoff Leventhall (right) receives the RWB Stephens Medal from the President, Geoff Kerry

following service as Council Member, Treasurer, Chairman of the Meetings Committee and Chief Examiner for the Diploma. From 1986 to 1989 he was a Director of the International Institute of Noise Control Engineering. He has served as Honorary Secretary to the Association of Noise Consultants and as a member of the BSI committee on building acoustics.

He was Deputy Chairman of the UK Noise Council, a member of the Noise Review Working Party (*Batho Report 1990*), the Mitchell Committee on Railway Noise (1991), its follow up Working Group developing the Calculation of Railway Noise (1995) and the Government 'Noise Forum'. Geoff has also served on an international committee advising the Swedish Research Council on noise research. In September 2002 he was made an Honorary Member of the ANC.

Geoff Leventhall's extensive acoustic career encompasses research, teaching and practice. A former student and colleague of Dr RWB Stephens, he has maintained the high standards set by his mentor. He has introduced many students to acoustics and has subsequently equipped them with a knowledge and enthusiasm for the subject which serves them well in their careers in acoustics.

In recognition of these achievements, Geoff Leventhall was awarded the *Institute of Acoustics RWB Stephens Medal for 2001* and was invited to present the **Medal Lecture**.

During the conference, the President presented IOA Distinguished Service Awards to John Tyler, associate editor *Acoustics Bulletin* (right) and Dawn Connor (far right)





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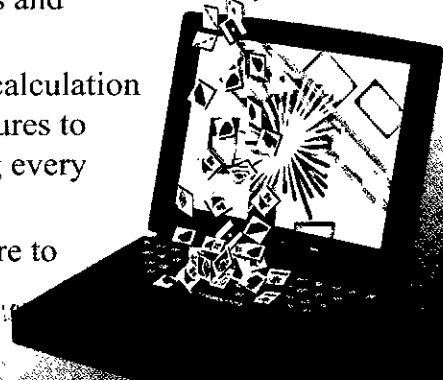
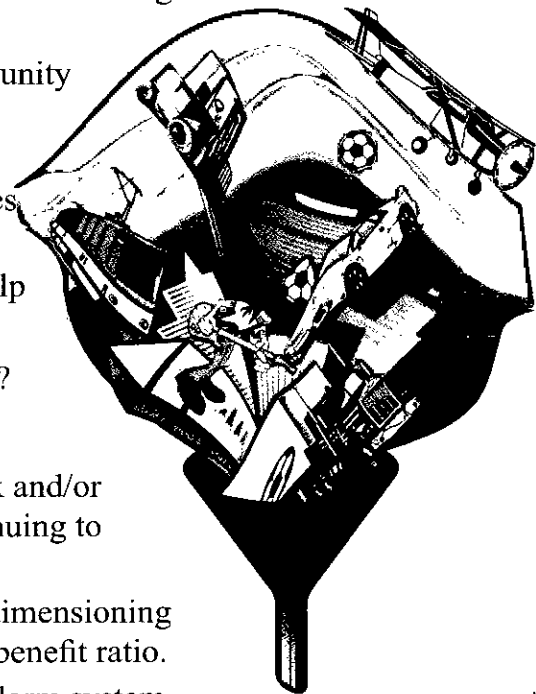
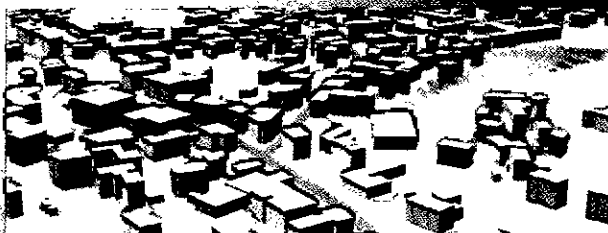
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Reproduced Sound 18

Perception, Reception and Deception - how do you know?



In his introduction, Robin Cross FIOA, chairman of the organising committee, welcomes 'healthy and noisy debate'

I arrived at the excellent Victoria Hotel, Stratford upon Avon on the Thursday evening before the conference. Not all delegates came that evening but a steady hum of conversation and debate built up as more arrived. This to me was the backdrop to the *Eighteenth Reproduced Sound Conference* held from 15 - 17 November. Over the whole weekend, the attentive listening during the conference papers was punctuated and contrasted by continuous conversation, still at full throttle by Sunday breakfast. I made a mental note of how the ideas and enthusiasm of the delegates created so much healthy and noisy debate.

This year's theme was 'Perception, Reception and

Deception - How do you know?' The premise behind this cryptic title was that you can have the most accurate measuring devices in the world but plugging those results into a flawed model actually won't help much, and in fact can be counterproductive as the 'expensive' results tend to transfer their provenance into the final answer. This probably seems obvious, but in my 37 years' experience of laboratory experimentation, it cannot be repeated too often. So it's good to have the theme sitting in the background and keeping a watchful eye on the proceedings.

During the conference, awards were made to two worthy recipients.

The *Peter Barnett Memorial Award*, received by **Dr Wolfgang Ahnert** ADA, Acoustics Design, was presented by the President at the Conference.

An *IOA Distinguished Service Award* went to **Ken Dibble**, which was presented by the President at the Conference dinner.

This is my third and final year as Chairman of the papers committee as I resigned at the AGM on the Friday evening. I have found the last three years highly rewarding and would like to thank and acknowledge my fellow committee members for their support, energy and ideas. The full committee is: Peter Mapp, Paul Malpas, Mark Bailey, Julian Wright, Ken Dibble, Ken Jacob, Sam Wise, Peter Philipson, Bob Walker, Martin Roberts and Steve Jones.

Next year's Chairman is Mark Bailey from JBL Professional. I know Mark is looking forward to the challenge and I also know he is going to produce an excellent conference for us.

We are beginning to see a core of delegates and presenters who travel from the United States and Australia to attend the conference. In some cases this is their only business in the UK. They will all tell you that there is no other Conference of similar technical quality and standing which blends together with the informal nature of the weekend. We have a unique product, one of which we are justly proud. Why not come along next year and see for yourself!

The Conference Papers

a brief review by John W Tyler FOIA
(who also took all the photographs for both events)

Friday 15 November

LOUDSPEAKER TECHNOLOGY PART 1

Chairman: Mark Bailey

○ Sparse loudspeaker arrays and their design

J A S Angus, University of Salford

James looked at the problem of achieving controlled directivity from array loudspeakers when the density of drivers is less than the minimum required to avoid spatial aliasing. He first examined the basic theory behind array loudspeakers and then went on to look at the effects of spatial aliasing. Methods of reducing this, including spatial filtering were then discussed.

He then described various strategies for designing sparse arrays. True to form, James lightened the texture of his subject with an amusing demonstration, as illustrated.

○ Reconstruction of the congress hall at Prague Congress Centre (KCP) and the application of VRAS to achieve concert hall responses

Z Kestner and M Antek, LCS

Zdenik Kestner outlined the dramatic improvements in acoustics required to make this space suitable for music.

Opened in 1981 as the Palace of Culture, Prague Congress Centre is one of the largest conference facilities in Central Europe. Since the annual meeting of the International Monetary Fund and World Bank in 2000 it has undergone substantial upgrade. The complex's main Congress Hall, with its full capacity of nearly 3000 seats and a volume of 40,000m, was from the beginning designed as a typical multipurpose facility. However, strict requirements of the Communist Party administration substantially restricted freedom in its acoustic design.

The first requirement was for perfect intelligibility which led to an RT of a mere 1.5 seconds and represented further drawbacks in design. As a substantial part of the hall refurbishment, a new system for enhancement of acoustic conditions - Variable Room Acoustic System, VRAS - has been designed and installed. The contribution of VRAS together with the architectural changes has ensured highly satisfactory acoustic conditions for orchestral concerts.

○ A high frequency device for vertically articulated line arrays

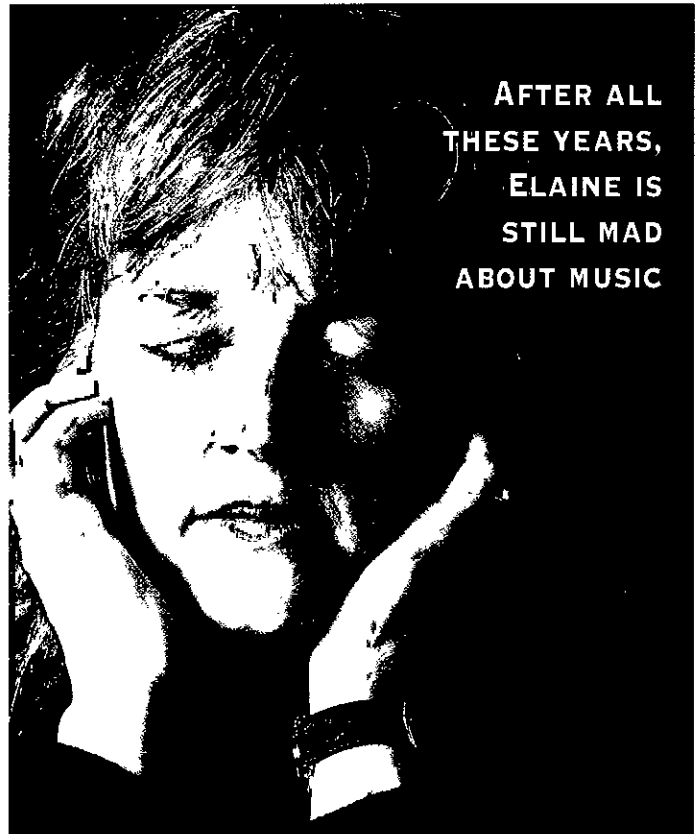
D J Button, JBL Professional, Northridge, California

Douglas outlined a specific acoustical wave shaping device that can be used in multiples to build a large articulated vertical line array utilising compression drivers for the high frequencies in order to achieve maximum efficiency and wide bandwidth. For a large scale sound reinforcement implementation of a line or articulated array, due to the limited bandwidth and output capability of typical full range transducers, there is a need to use multiple bands of transducers specifically designed for higher output with adequate bandwidth. While at low frequencies a continuous line of direct radiators works well, at high frequencies a different solution is required to meet the sound pressure level requirements. Measured results were contrasted with modelled results to compare the performance of the device as it relates to true line and shaped arrays.

continued on page 16



James Angus, Salford University, gives the opening paper in his usual relaxed style!



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THESE YEARS,
ELAINE IS
STILL MAD
ABOUT MUSIC**

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Reproduced Sound 18

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○ The dual coil drive loudspeaker

D J Button, JBL Professional, Northridge, California

Douglas's second paper described the first examples of loudspeakers using oppositely-wound dual voice coils positioned along the same axis. These date from the 1950's. Recent interest in the design has begun practical implementation and proliferation of this concept. The fundamental design involves two coils that are opposite in phase and reside in oppositely polarised magnetic gaps, thus providing a Lorentz force in the same axial direction. The two gaps are formed from the same magnetic circuit, and both coils are wound on the same form, separated by some distance, connected or wound out of phase, and attached to a single diaphragm. Douglas described different design options in magnetic materials, magnetic circuit geometries and voice coil topologies. The focus is on performance trade-offs and advantages in weight, power handling, power compression and distortion, relative to a single gap design. System applications in the areas of high level sound reinforcement and studio monitoring were discussed.

○ Practical aspects of DML panel design

Lampos Ferekidis, New Transducers Ltd.

In recent years an increasing number of companies have adopted DML (Distributed Mode Loudspeaker) technology in their products utilising the properties of this acoustic transducer, so engineers are facing the problem of developing and adopting DMLs for their specific purposes and demands. Among other acoustic parameters, like frequency range, power handling, and maximum SPL, the radiation characteristic remains one that is difficult to change when using conventional piston-like moving coil transducers. A systematic procedure was described that allows quantifying differences in radiation characteristic between panels. The effects of multiple exciter arrangements on radiation characteristics and their sonic implications were discussed.

INTELLIGIBILITY

Joint Chairmen: Peter Mapp, Ken Jacob

○ Some further thoughts on STI – how accurate are the measurements in practice?

P Mapp, Peter Mapp Associates

Over the past ten years, there has been an ever-increasing awareness of the need for public address and voice alarm systems to provide emergency as well as general announcements with a high degree of intelligibility. RASTI (and STI) have been at the forefront of this revolution as the need to measure and verify system performance has gathered importance and momentum. Peter discussed the relationship between STI and RASTI, based on examination of the data taken from over 80 sound



IOA President Geoff Kerry (right) presents the Peter Barnett Memorial Award 2002 to Dr Wolfgang Ahnert, ADA Acoustic Design

systems. He showed that RASTI is generally an inaccurate predictor of STI for a wide range of conditions. Some of the practical complications and limitations when testing sound systems were also discussed.

○ Checking the accuracy of MLSSA STI measurements

Tony N Stacey, AMS Acoustics Ltd

Predicting the expected STI or RASTI values for a proposed voice alarm system is an essential part of the design stage. Ultimately though, the STI or RASTI of the system will need to be measured and the predictions verified. Tony presented the results of an investigation comparing mathematically predicted STI and RASTI values with those measured using MLSSA v10 under a set of controlled conditions. The method of measurement and prediction was described. Differences in STI and RASTI for both measured and predicted values were highlighted. The results showed that when all parameters are correctly accounted for, the predicted STI and RASTI values agree well with MLSSA measurements.

○ Speech intelligibility predictions and measurements – Making the ends meet

Glen Leembruggen, Arup Acoustics, Sydney, Sam Wise, Paul Malpas, Angus Deuchars, Arup Acoustics

Glen presented this paper and started by saying that as consultants, we do not have as many opportunities as we would want to compare our predictions of intelligibility with measurements. Closing the loop between predicted and measured intelligibility is a valuable way to calibrate and refine design skills and to validate the assumptions and accuracy of our predictions. He described the process and results of comparing predictions and measurements of speech intelligibility for three simple loudspeaker systems in a church situation. The systems comprised an omnidirectional speaker, a small driver simulating a voice, and a church sound system employing horns and direct radiators. He explored the unconventional use in each of the speech octave bands of some well-known equations, and found good agreement between two disparate methods. Some correlations between EDT, MTI, STI and C_{50} data were also investigated.

○ Sound masking system design and speech privacy *Kenneth P Roy, Armstrong World Industries*

Speech intelligibility and speech privacy are two related acoustic issues that must be considered in the design of architectural spaces such as offices and healthcare facilities. Whilst it is generally obvious that individuals must be able to communicate effectively within an office space, it is equally important (although not as obvious) that those conversations be held either confidential from others, or at the very least not be a distraction (annoyance) to others. Proper acoustical design requires that both the architectural performance of the space (intruding signal), and the background masking (noise) in the space be controlled since speech intelligibility/privacy are based on the S/N ratio.

Kenneth's presentation addressed the issues of: (1) consequence of acoustic design for speech privacy on occupant productivity; (2) integrated design principles for speech privacy; (3) design principles for electronic masking sound systems; (4) field tests results for both traditional and ceiling plane masking systems; and (5) masking design and tuning tools for electronic masking systems.



During his invited lecture, 'An acoustic history of reproduced sound', Peter Mapp demonstrates a piece of equipment with 'all the bells and whistles'

○ Invited lecture: An acoustic history of reproduced sound

The formal proceedings of the day were concluded by **Peter Mapp** who delivered this invited lecture. Peter maintained a light hearted and rapid-fire delivery of his potted history of reproduced sound illustrated by several set-piece demonstrations, as shown in the accompanying photograph.

After this, the President Geoff Kerry, presented the *Peter Barnett Memorial award* to **Dr Wolfgang Ahnert**, ADA Acoustics Design.

Following the conference dinner, Geoff's address took the theme: *Perspectives on the profession*. Amongst other aspects, he repeated his request - also made at the earlier Autumn Conference, *Action on Environmental Noise* - for suggestions on how to encourage young people to choose a career in acoustics.

Then followed the **Electro-Acoustics Group AGM**.

For those who were not completely exhausted by the day's efforts, **Mark Bailey** (JBL Professional) hosted a demonstration entitled *Reprocessing v Preprocessing* which compared, by means of high quality sound reproducing equipment, the available surround formats on the market which can derive multichannel surround from stereo recordings.

Saturday 16 November

LOUDSPEAKER TECHNOLOGY PART 2

Chairman: Julian Wright

○ Multichannel audio in cars: The application of Logic 7 surround processing to the reproduction of 2 channel and '5.1' sources

Tim Nind, Harman/Becker Automotive Systems

The morning session was opened by Tim Nind, who explained Logic 7 - an in-car surround sound decoding system which produces seven discrete channels from a two-channel source. Tim discussed the limitations of the 5.1 systems and explained the benefits of Logic 7, including enhanced spatial reproduction and improved rear seat performance.

○ The perception of the reception of a deception

Philip Newell, Consultant, Spain

Then followed Phil Newell's discussion of the relationship between measured low-frequency performance and subjective assessment, with the suggestion that a 'figure-of-merit' parameter is required in order to correlate them.

○ A waveguide utilising the geometrical properties of conicoids: principles, design and results

Francois Defarges, Nexo, France

Francois then described the development of a loudspeaker waveguide with a constant velocity profile at the mouth. To achieve this he used the geometrical properties of conicoids. These patented waveguides allow generation of concave, flat or convex acoustic isophase wavefronts which are of great benefit in loudspeaker array design.

○ The thermal analysis of a NdFeb loudspeaker motor using finite element analysis

Mark Dodd, Celestion International Ltd

Mark presented work on the thermal analysis of a loudspeaker using finite element analysis. He summarised the different ways in which heat is

continued on page 18



Philip Newell, Reflexion Arts, 'conducting' his paper on perception

Reproduced Sound 18

continued from page 17

transferred in a driver and provided a detailed explanation of the application of the thermal finite element method, which has been applied to enable a new loudspeaker design topology.

○ The intelligent loudspeaker

Paul Williams, BSS Audio / Mark Bailey, JBL Professional

Mark Bailey discussed an implementation of an 'intelligent' loudspeaker – one which provides computer-assisted commissioning and in-situ performance monitoring.

○ The effects of various types of cables on the performance of high frequency loudspeakers

Philip Newell, Sergio Castro, M Ruiz, Julius Newell, Reflexion Arts; Keith Holland, ISVR, University of Southampton.

The session was closed by Phil Newell, who revisited the effects of cables on loudspeaker performance. The last time this was discussed at *Reproduced Sound* great debates and controversy ensued. This time, Phil's careful analysis left the audience quite subdued!

ROOM ACOUSTICS AND PERCEPTION

Chairman: Peter Philipson

○ Internal acoustic design for a multi-channel control room: measurement and perception

B M Fazenda and J A S Angus, University of Salford

The first paper, presented by Bruno Fazenda,

discussed the design of a multi-channel recording studio control room. This emphasised the importance of controlling early reflections and the relevance of a reflection free zone to cater for both stereo and surround sound monitoring. The design has been implemented and early subjective test results suggest that the design has been successful.

○ Perception of music - the element of surprise

Mark Bailey, JBL Professional

Mark gave a highly entertaining paper on the perception of music, even making analogies with food and comedy. He used several demonstration recordings and explained how significant both the acoustic listening environment and audio reproduction system are in the perception of music.

○ The simultaneous measurement of time and frequency

Bob Walker, BBC Research and Development Department

This author provided an informative discussion on the simultaneous measurement of time and

Time to pause, for an unofficial music workshop



The Ancientmariner.com

by Les Barker

It is an ancient Mariner,
And he stoppeth one of three.
"By thy long grey beard and glittering eye,
Now wherefore stopp'st thou me?"

"The Bridegroom's doors are opened wide,
And I am next of kin;
The guests are met, the feast is set:
May'st hear the merry din."

He holds him with his skinny hand;
"Take thou this cd-rom;
Look at me now and know my name:
Ancientmariner.com

Our course was set across the net;"
The old man told his tale;
"The good ship Internet Explorer
Weighed anchor and set sail.

With sloping masts and dipping prow
We headed south," quoth he -
"Our sails were full, our modem fast -
Across the rolling sea.

And far astern, a distant speck,
The home page departed from.....
Till the gods browsed and selected
Ancientmariner.com

O wedding guest, they chose me
And they cursed me then because
I happ'ed upon the web site
Of a man called Albert Ross.

He was noted for his wingspan
And his wanderings as well.
He had a Power Mac;
His ISP was AOL.

Oh gods ye could have chosen
Any Harry, Dick or Tom;
You moved your mouse and clicked on
Ancientmariner.com

My PC crashed, my cursor froze,
No sight, nor sound nor motion,
As idle as a painted ship
Upon a painted ocean.

Water, water everywhere,
Nor any drop to drink
My RAM was full of spam
And my printer out of ink.

Oh wedding guest, I searched for peace,
I cut and pasted 'Om'
In MS word, but no one heard
Ancientmariner.com

I swung the mouse hard starboard
But the helm did not respond;
My com port was disconnected;
Only blackness lay beyond

I gazed into despair,
I drifted helpless to defeat;
I speak the sad man's mantra:
control alt delete.

Wedding guest, go to my home page,
Say goodbye to dad and mom;
Tell my friends I'm out there somewhere...
Ancientmariner.com"



Ken Dibble (left) receives his IOA Distinguished Service Award from the President during the conference dinner

frequency, by first explaining how different measurement methods can produce different results and how an uninformed experimenter may not realise this. By implementing a model of a room reflection, a series of different measurement techniques could be tested and compared, leading to some recommendations on time measurement methods.

Modern loudspeaker technology meets the medieval church

Paul Darlington, Apple Dynamics Ltd

Paul presented an interesting paper on the problems associated with the acoustics of churches, particularly when using multi-loudspeaker public address systems. He discussed how the public has always had to suffer with poor intelligibility in churches and suggested ways in which the placement and selection of digitally controlled loudspeaker arrays can improve matters, backing this up with some objective measurements.

Parametric SDM encoder for SACD in high-resolution digital audio

Malcolm Hawksford, University of Essex

Malcolm expertly explained the principles behind sigma-delta modulation encoding of audio signals and described the implementation of a fifth and ninth order design. Parametric equalisation of the noise shaping transfer function was shown to improve the coding accuracy and provide signals that compare well with 24 bit PCM encoders.

And finally....

Two events enlivened the conference dinner. Firstly, **Ken Dibble** was presented with his *IOA Distinguished Service Award*, after which **Robin Cross**, as chairman, thanked members of the organising committee, before delivering another poem by Les Barker. Delegates present at last year's RS17 will recall with affection his rendering of *The Mask of Mono*. His skilful delivery of Les's *The Ancient Mariner.com* was also received with much merriment and applause.

Dinner over, there followed an evening workshop presented by **Zdenik Kesner**, **Michael Antek** and **Joachim Schwarz**, Medias Pro.

This demonstration of the VRAS system was a corollary to the paper by Zdenik Kesner on the

Prague Congress Centre, whose refurbishment involved the use of VRAS. Various set-ups were demonstrated including the generation/enhancement of ER and reverberation. The effects produced by the system were very impressive and appreciated by the small but enthusiastic audience.

Thus ended another successful RS conference and I would like to echo the words of Robin Cross in his introduction: "We have a unique product, one that we are justly proud of. Why not come along next year and see for yourself?"

Readers requiring more information on a particular paper can order a copy of the *Proceedings on CD ROM* from IOA HQ. My thanks go to those chairmen who provided notes on their sessions. - **JWT**



At last it's all over! Celebrating the end of another successful Reproduced Sound Conference are, from left: Julian Wright, Robin Cross, Lamos Ferekidis, Annie Wright and Keith Holland

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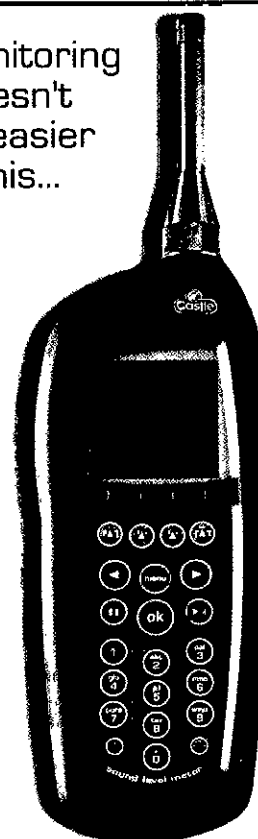
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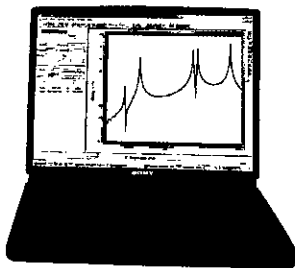


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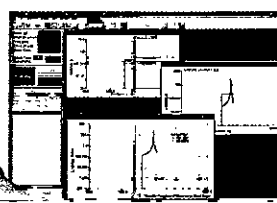
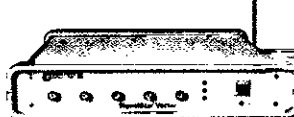
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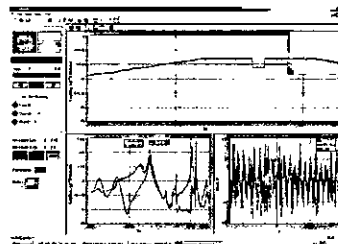


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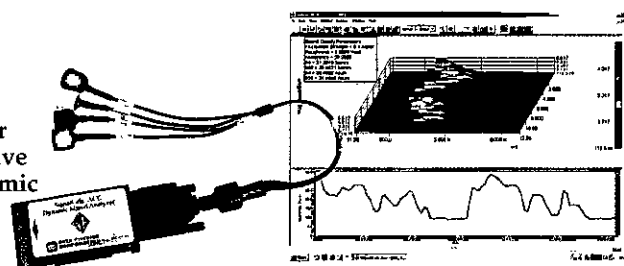


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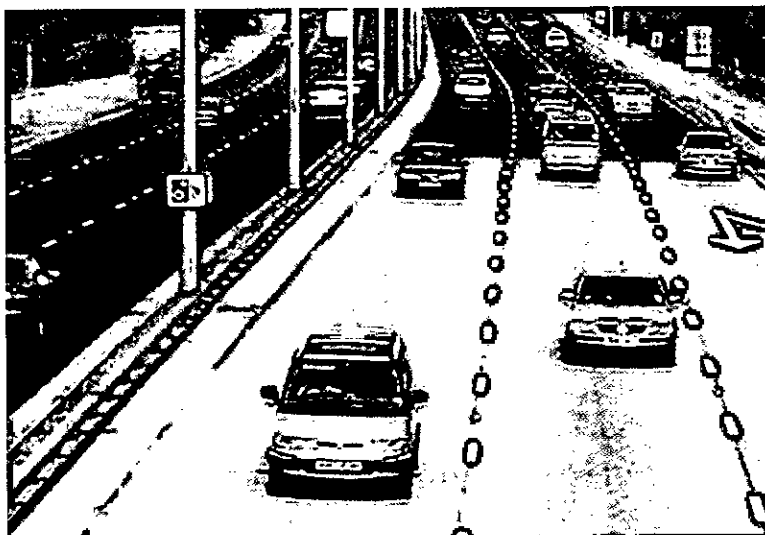
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Identifying road surface characteristics associated with noise and skidding performance

Steve Phillips MIOA and Peter Kinsey



Abstract

It has been known for many years that the roughness of a road surface strongly influences both its skidding resistance in wet conditions and the level of traffic noise, particularly at high speed. The UK specifies a minimum average depth of texture for newly constructed road surfaces to ensure adequate skidding resistance and calculates the influence of different road surfaces on traffic noise on the same measure. Noise corrections for concrete and asphalt road surfaces are based on empirical linear relationships derived from noise and texture measurements on a large sample of surfaces. For porous surfaces, a fixed reduction in noise level is assumed.

In recent years, it has become apparent that new methods of controlling the surface finish of roads can result in significantly lower levels of traffic noise than predicted from their measured texture. The desirability of road surfaces with lower noise characteristics has created a strong market in proprietary products. It was necessary for us to develop a type approval procedure, called HAPAS, to establish compliance with fundamental requirements for safety and durability, monitored on trial sites under traffic for a minimum of two years. Because of the increased emphasis on noise, HAPAS also includes an optional noise performance test.

The UK currently requires in-service measurements of low speed skidding resistance (SCRIM) as a road safety measure. However, laser based methods of routinely measuring road surface profiles are being introduced.

Research has demonstrated a robust relationship between skidding performance and laser measured texture depth. It is our hope that such profiles can also be analysed for other characteristics to enable the prediction of vehicle noise levels.

This article describes the refinements of measurement and analysis techniques needed to develop a more accurate and flexible method of predicting traffic noise from surface measurements. The prospects for defining new parameters to control surface regularity are also considered.

The importance of the interaction between tyres and road surfaces as the major cause of noise from traffic is widely acknowledged. It is over 25 years since Harland (1) identified tyre/road noise as the dominant noise source for vehicles travelling at moderate to high speeds and established its relative contribution to overall vehicle noise for different classes of vehicle over a wide range of operating conditions. Since then various factors have increased the contribution of tyre/road noise, the most important of which has been the influence of vehicle noise legislation in reducing noise emissions from vehicle engines, transmissions and exhausts.

Tyre noise is dependent on tyre size and design but is mainly influenced by the characteristics of the road surface. In fact, the surface can affect both the generation and the propagation of tyre noise, through a number of complex mechanisms. It is clear that modified surface textures will be required to bring about reductions in noise. But it has been a major concern in the UK to ensure that the development of quieter road surfaces has been undertaken without compromising our established standards of skidding resistance. Before considering the potential for improvement in the methods used for characterising road surface properties, it is worthwhile reviewing how current standards and specifications for skidding resistance and noise control were developed.

Development of the UK texture specification

Skidding resistance

UK highway management practice for over 30 years has been to maintain road surfaces with sufficient texture to ensure that tyres obtain grip in a wide range of driving conditions. Texture is particularly important when the road surface is wet, but also contributes to grip in dry weather. Two independent mechanisms determine this grip. The first of these is adhesive friction derived from molecular bonding between the tread compound and the road surface materials. The second mechanism, hysteretic friction, occurs as the rubber tread dissipates energy in a deformation cycle while moving over a rough surface. These two mechanisms have long been associated

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Identifying road surface characteristics associated with noise and skidding performance

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with different scales of surface texture. The former is associated with microtexture, characterised by the roughness of the individual aggregate particles and the latter with macrotexture, identified with the size and shape of the particles.

Adhesive friction is greatest at low speeds and falls off with increasing speed because the time in which molecular bonds can be created is reduced. Increasing microtexture increases adhesive friction and is therefore the main determining surface factor for good skidding resistance at low speeds. However, tyres suffer more rapid wear on highly abrasive surfaces. Hysteretic friction, on the other hand, increases as speed rises. On wet surfaces, the relative importance of hysteretic friction increases as the water film grows between the tyre and the road and prevents adhesive contact. In addition to generating hysteretic friction, macrotexture provides drainage paths for the water film, which then enables a greater amount of adhesive bonding to take place. Higher levels of macrotexture therefore act to limit the loss of skidding resistance as speed increases.

Road surface textures in the UK are consequently specified in two ways to address these independent mechanisms. Microtexture has been specified since 1976 by the polishing resistance of the aggregate measured using the Polished Stone Value (PSV) test. The PSV of the aggregate is specified in accordance with the expected traffic conditions in order to maintain an appropriate level of skidding resistance at low speeds.

The surfacing standard for UK high-speed roads (2) is the sand-patch texture depth (SPTD) as the primary measure of macrotexture. SPTD levels were shown to correlate with the decrease in skidding resistance measured in locked wheel tests carried out at high and low speeds in wet conditions. Surfacing specifications were chosen to limit the decrease in high speed skidding resistance to approximately 10% of that measured at low speed. This resulted in the average SPTD for new roads being required to be at least 1.5mm for asphalt surfaces and 0.65mm for transversely textured concrete surfaces.

Noise considerations

Whilst deeper-textured road surfaces generally provided a greater degree of high-speed skidding resistance, they have been associated with higher vehicle noise levels. In the 1970's, TRL derived a simple empirical relation between the variation in skidding resistance afforded by a surface and the total noise generated by vehicles passing over it at reasonably high speeds (3). The data and regression obtained from the original study together with some more recent measurements are shown in *Figure 1*.

The variation in traffic noise with the percentage change in skidding resistance between tests carried out at 50km/h and 130km/h was found to be statistically independent of the type of texture pattern or of surfacing material. However distinct intervening relationships between noise and surface texture (SPTD) were developed for bituminous (ie. randomly textured) and concrete surfaces, which at that time were transversely textured (either grooved or brushed).

However, it has become apparent in recent years

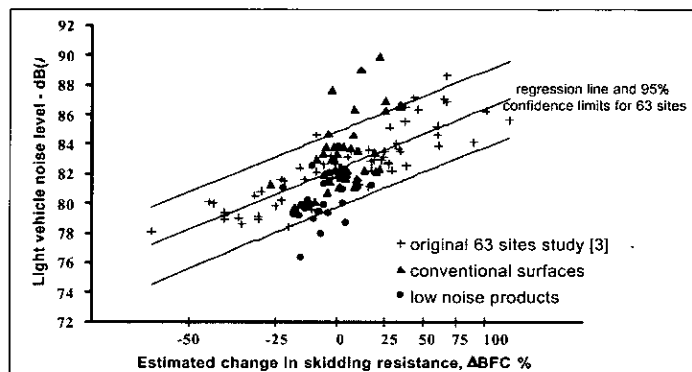


Figure 1: Estimated change in skidding resistance and light vehicle noise

These relationships underpinned the calculation of the road surface influence introduced into the UK's prediction method for traffic noise, 'Calculation of Road Traffic Noise' (CRTN) in 1988 (4)

that these empirical relationships do not apply to some newly laid forms of road surface and in some cases can considerably under-predict or over-predict noise levels, as may be seen in *Figure 1*.

New methods of characterising surface texture

More recently, advances in laser technology have provided a detailed profile of a continuous longitudinal trace along the road surface. Much research has been devoted to developing better statistics of the road surface texture in an attempt to correlate these with noise emissions. A popular method has been to characterise surface texture in terms of its pseudo-periodic longitudinal features. The same mathematical technique (Fourier analysis) used to analyse complex sounds can be applied to convert the random profile into a texture wavelength spectrum. For convenience, three broad ranges of texture wavelength (λ) have been defined (5) as having significantly different effects on tyre/road interactions. These are microtexture ($\lambda < 0.5\text{mm}$), macrotexture ($0.5\text{mm} < \lambda < 50\text{mm}$) and megatexture ($50\text{mm} < \lambda < 500\text{mm}$).

Research by Sandberg and Descornet (6) showed that for car tyres running on different surfaces, certain frequency bands of tyre noise were strongly correlated with specific texture wavebands. For tyre/road noise frequencies below 1500Hz, the best correlation was obtained with texture wavelengths greater than 10mm. Higher frequencies in the tyre/surface spectra were best correlated with smaller scale texture wavelengths. It was suggested that two distinct mechanisms were involved in generating tyre noise. The lower frequency elements of the spectra were attributed to noise resulting from tyre vibration

whereas the higher frequencies were related to the compression of air within the region of the tyre/road contact.

More recently, research by TRL has examined the relationship between Statistical Pass-By (SPB) (7) vehicle noise levels and the amplitude of a broad range of longitudinal surface texture wavelengths. From this work, strong differences in the degree of correlation between the amplitude of irregularities in the road surface texture and noise frequencies emerged for different types of road surface. The relationships for surfaces with transverse texture, such as brushed concrete, were clearly distinguishable from those with random texture, such as asphalt and exposed aggregate concrete (8). An example of these differences is shown in Figure 2 which shows the degree of correlation between the one-third octave noise levels for light vehicles and texture amplitudes in octave wavelength bands on the two types of surface.

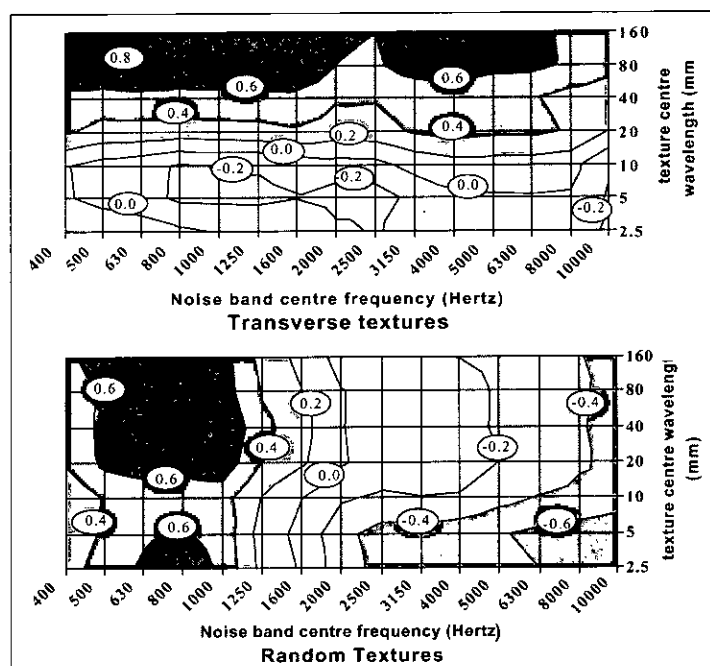


Figure 2: Correlation of light vehicle pass-by noise frequency levels and octave band texture amplitudes

The contours show the degree of correlation between the amplitude of the texture and noise levels within the frequency bands shown. Transversely textured surfaces show strong positive correlations across a broad range of frequencies for texture wavelengths around 80mm leading to an expectation of noise levels increasing with amplitude of megatexture. The weaker negative correlations over a narrow range of frequencies in the 5mm texture band support previous findings of a reduction in noise with increasing amplitude for this range of texture wavelengths.

A very different picture emerged for random textures in which the important frequencies of pass-by noise (ie 800Hz and 1000Hz) were positively correlated with a range of texture wavelength bands from 160mm to 20mm. There were negative correlations between shorter wavelength amplitudes and higher noise frequencies. Taking account of these findings for random surfaces, further work has been

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Identifying road surface characteristics associated with noise and skidding performance

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undertaken to establish the strength of relationships between noise emissions and megatexture spanning texture wavelengths between 56 and 226 mm. The distinct relationships between overall noise level and megatexture amplitude A_{mega} for the two types of surface texture are shown in Figure 3.

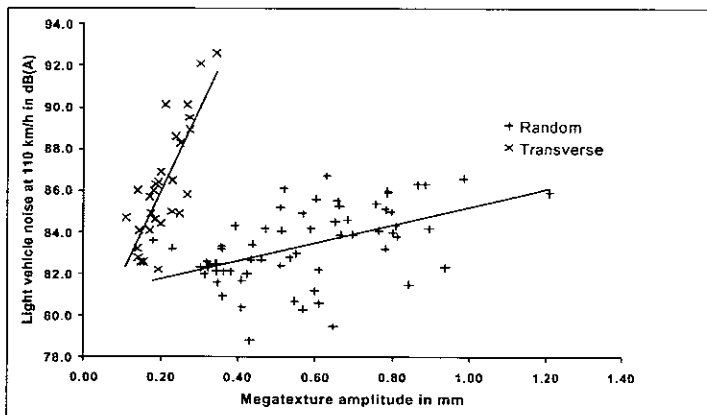


Figure 3: Light vehicle pass by noise on a range of surfaces
Amplitude of megatexture and overall noise levels (8)

These results show that the pass-by noise levels for light vehicles could be determined with some accuracy from the megatexture amplitudes of transverse textured surfaces, but that this was not sufficient to characterise randomly textured surfaces. It was clear that further research was needed to account for the residual scatter in the noise data for these surface types.

In parallel with the recent work on noise, further research was conducted into the skidding performance of different types of road surface. This has shown that the absolute level of high-speed skidding resistance for all types of surfacing can be predicted from their low-speed skidding resistance and the Sensor Measured Texture Depth or SMTD¹ (9). (Note that all skidding tests are carried out using a tyre with no tread). The relationship between SMTD and high-speed skidding resistance shown in Figure 4 indicates a particularly rapid loss of resistance for surfaces with SMTD lower than about 0.7 mm.

This research also found a strong correlation ($r = 0.86$) between SMTD and megatexture amplitude for randomly textured surfaces. This result is not surprising in view of the overlap in the ranges of the two texture scales ($2.5 < \lambda_{\text{SMTD}} < 300\text{mm}$, $56 < \lambda_{\text{Amega}} < 226\text{mm}$).

However, the correlation between the two measures was much poorer for transverse textured surfaces. The strongest correlation for both types of surface

¹ Sensor Measured Texture Depth is the rms amplitude of texture based upon a moving average of laser measured profile depths

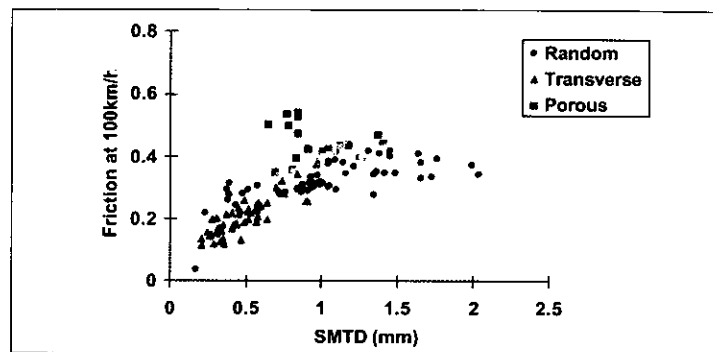


Figure 4: High speed friction and sensor-measured texture depth (9)

was between SMTD and central macrotexture amplitude (texture scale - $14 < \lambda_{A20} < 28\text{mm}$). While the relationship for light vehicle pass-by noise levels on transverse textured surfaces was found to be most strongly influenced by megatexture, a combination of macrotexture measures provided the best fit relationship for random textured surfaces.

This inter-correlation of texture measures implies that skidding performance needs to be carefully considered when developing quieter surfaces for high-speed roads. Transversely textured concrete surfaces are no longer used for new national roads in the UK because the noise and safety issues could not be reconciled. Exposed Aggregate Concrete (EAC) which has a random texture is now the only concrete surface permitted.

Development of a noise performance test

The introduction of new proprietary surfaces into the UK and the failure of previous empirical relationships to accurately predict noise levels from surface measurements led us to consider the need for direct measurements of noise. The Highway Authorities Products Approval Scheme (HAPAS) was already under development to assess the durability and safety of products for use on highways. This was being extended to cover the approval of proprietary thin surfacing materials (10) and it was decided that an optional noise test should be included. The test procedure developed by TRL largely follows the ISO Statistical Pass-by (SPB) method (7). For HAPAS, the additional requirement for the SMTD of the road surface in the nearside wheel-track at the noise measurement position to be within 10 per cent of the average for the length of surface under test ensures that test sites are representative. HAPAS also requires that the surface being assessed has been trafficked for at least 12 months before testing for noise.

Pass-by data for three classes of vehicle (light, two-axle and multi-axle trucks) are collected at the trial sites and a linear regression analysis of noise against speed performed in accordance with the standard SPB method. The SPB level L_{veh} for each vehicle category is defined as the ordinate of the regression line at the reference speed for the category of road given in Table 1. These results are combined into a single ranking of noise emission for given traffic conditions and compared with the noise level predicted for the standard surface assumed in CRTN (4) (equivalent to a random textured surface with a SPTD of 2 mm). The Road Surface Influence (RSI) for

a test surface is defined as the difference between the noise level calculated from pass-by tests and the theoretical level for the reference surface with the same traffic conditions. $RSI_x = L_{A,eq(TESE)} - L_{A,eq(REF)}$

A simplified version of this equation was developed for HAPAS to allow the overall level of the surface influence on traffic noise to be calculated for the relevant road speed category using the weighting factors given in Table 1. The RSI is then:

$$RSI_x = 10 \log_{10} (a 10^{\frac{L_{veh,L}}{10}} + b 10^{\frac{L_{veh,Tb}}{10}} + c 10^{\frac{L_{veh,Tb}}{10}}) - k$$

Where the coefficients in the formula for different road categories are:

Road category (x)	light vehicles		two-axled trucks		multi-axled trucks		k
	reference speed	a	reference speed	b	reference speed	c	
High speed	110	7.8	90	0.578	90	1.0	95.9
Medium speed	80	11.8	70	0.629	70	0.157	92.3

Table 1: Parameters for the determination of HAPAS Road Surface Influence

Whereas the HAPAS noise test provides a basis for the classification of surfaces for noise control, a number of important limitations restricts its wider applicability for other purposes. Firstly, the SPB method imposes a number of restrictions on measurement sites. Secondly, the results are strictly valid only for the short length of surface near the microphone and generally, it is impractical to take measurements other than for vehicles in the nearside lane. Thus, the method is not capable of detecting any variability in noise emission characteristics across a road or determining averages over a length of road.

A supplementary noise measurement technique, the close-proximity method, is being developed for the purpose of continuous assessment of road surfaces. This may help authorities to classify road surfaces for noise emissions and possibly to assess the conformity of production of newly laid surfaces. However, it is not expected that the method will be acceptable for routinely assessing a road network as it does not allow for the full range of traffic types and speeds, nor for other influences on noise experienced at the roadside.

Summary and discussion

This article demonstrates the importance and influence of road surface texture on the generation of tyre noise and skidding performance. It is clear that there is substantial overlap between the current measures of texture developed for these purposes. SMTD texture depths of about 0.7mm have been identified as being the limit below which skidding resistance dramatically falls with speed. But on some types of surface, this still generates relatively high noise levels.

Research has shown that the pass-by noise levels for light vehicles could be determined from the megatexture amplitudes of transverse textured surfaces. But that a broader range of texture wavelengths influence comparable noise measurements associated with random textured surfaces.

The difference between random and transverse textures has been shown by considering the correlation between octave band texture amplitudes and one-third octave pass-by noise levels.

Our current practice is to increasingly use quieter

forms of random textured surfaces. This includes proprietary asphalts and exposed aggregate concrete (EAC). A test for the classification of noise of new types of road surfacings has been developed in the UK and supplementary tests for noise are being considered. Despite this, there is a need to better characterise the texture of the road surface in ways that can be adapted to data captured by high-speed surface measurement devices.

Detailed analyses of the shape of the surface texture are currently being undertaken in an attempt to separately characterise noise emissions and skidding resistance. Even if the mechanisms of noise generation and skidding resistance are physically attributable to similar features of surface texture, it may still be possible to reduce tyre noise without prejudicing safety, provided that new surface texture descriptors provide a better means of balancing the conflicting requirements.

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Acknowledgements

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WHO Community Noise Guideline Values

Application to statutory nuisance and planning cases

Dani Fiumicelli MIOA

Since 1980 The World Health Organisation (WHO) has made available guideline values for community noise, defined as 'noise emitted from all noise sources except noise in the industrial workplace' (1). The current WHO Community Noise Guidelines provide a table of the recommended sound levels, as shown below.

Specific environment	Critical health effect(s)	L_{Aeq} [dB]	time base [hours]	L_{Amax} fast [dB]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School classrooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoors	Sleep disturbance	30	sleeping-time	45
School playground, outdoor	Annoyance (external source)	55	during play	-
Hospitals, ward rooms, indoors	Sleep disturbance, night-time	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, treatment rooms, indoors	Interference with rest and recovery	(1)		
Industrial, commercial	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons: <5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/earphones	Hearing impairment (free-field value)	85 (4)	1	110
Impulse sounds from	Hearing impairment (adults)	-	-	140 (2)
toys, fireworks and firearms	Hearing impairment (children)	-	-	120 (2)
Outdoors in parkland and conservation areas	Disruption of tranquillity	(3)		

1. as low as possible

2. peak sound pressure (not L_{Amax} fast), measured 100mm from the ear

3. existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

4. under headphones, adapted to free-field values

At first sight the WHO guideline values appear to provide a simple test for assessing statutory noise nuisance. It would seem that all the practitioner has to do is measure or predict the noise level from a particular source and compare it with the relevant WHO guideline value. Should the noise level of a specific source exceed, or cause the existing ambient noise level to exceed, the appropriate WHO guideline value, then the unwary could assume that statutory nuisance was likely. Conversely, if the target noise level fell below the appropriate value then it could be supposed that a statutory nuisance was not being caused.

However, using the WHO Community noise guideline levels in such a crude manner poses significant risks of underestimating or overestimating the likelihood of statutory nuisance. This is primarily because other considerations besides the absolute sound level of a noise or its impact on existing sound levels are important when judging statutory nuisance, and also because there are problems with

the degree of correlation between the WHO community noise guideline noise levels and the disturbance caused by certain noise sources

Statutory nuisance

Statutory nuisance is something that has been designated a nuisance by statute. Section 79(1)(g) of the *Environmental Protection Act 1990* defines this as: 'noise emitted from premises so as to be prejudicial to health or a nuisance'. The *Noise and Statutory Nuisance Act 1993* amended the EPA 1990 so that noise from vehicles (except traffic), machinery and equipment in the street can also be a statutory nuisance. Consequently there are two limbs to noise based statutory nuisance that can apply either separately or jointly (2).

Nuisance

The legal concept of nuisance has long been established in English common law and has been defined (3a) as 'unlawful interference with a

person's use or enjoyment of land or some right over, or in connection with it', with further guidance (3b) that the 'liability [for nuisance] has been kept under control by the principle of reasonable user' – the principle of give and take as between neighbouring occupiers of land, under which 'those acts necessary for the common and ordinary use and occupation of land and houses may be done, if conveniently done, without subjecting those who do them to an action' – see *Bamford v Turnley* (7).

Essentially nuisance deals with the unreasonable interference with the ordinary reasonable use of land and involves a degree of concession on both sides. Neither the *Environmental Protection Act 1990* nor common law nuisance provides a fixed decibel based definition of what noise level constitutes a nuisance (4). This is because in English law what is reasonable use of land is not fixed and several factors other than the simple level of a noise will influence whether it is a legal nuisance. For example:

- ☐ The noise must have or be likely to have an effect.
- ☐ The nature and character of a locality is important in determining if a nuisance is being caused. From long established case law (5) comes the classic pearl of judicial wisdom that 'what would be a

nuisance in Belgravia would not necessarily be so in Bermondsey'. Consequently the legal principle of nuisance provides no fixed standard of protection from noise that every person can expect in all circumstances.

☐ Duration of the noise is important, as the general rule is that noise will not be classed a nuisance if the noise is short term, temporary or occasional (6).

☐ Time of day is also important (7): noise that takes place during night time is more likely to be a nuisance than daytime noise.

☐ Sensitivity of the plaintiff is relevant and if the complainant or use of the land affected is deemed to be abnormally sensitive, there can be no actionable nuisance (8).

Essentially it is not sufficient simply to show that a fixed guideline noise level has been exceeded to demonstrate statutory nuisance: other factors as outlined above must also be considered. In the context of the WHO community noise guidelines, this was confirmed by the Court of Appeal in the case of *Murdoch v Glazier Metal* (9). In this case the appellants claimed they were subject to a noise nuisance from night-time operations at a local factory and that the noise, which fluctuated, amounted to an actionable nuisance. The noisy factory had been in operation since the 1950s in Ilminster, Somerset. The appellants had purchased a property close to the factory in 1979 and had acquired further adjoining land in 1988. The area was accepted as being a 'mixed area' (industrial and residential) and the relatively busy A303 road passed close to the appellants' property. An extension to the factory had been built with planning permission in 1987 and the appellants' complaint related to the noise from the factory over a period of five to six years.

The appellants' principal claim was that they had suffered from noise 24 hours a day, seven days a week. To support their claim they adduced evidence that the WHO guideline noise levels for undisturbed sleep were being exceeded, albeit marginally, and alleged that a lower court had been wrong to find that the noise complained of was not a legal nuisance. However, the Appeal Court decided that the appropriate test to be applied in determining whether there was an actionable nuisance was not whether the noise from the factory exceeded a fixed level, but whether there was a nuisance by the standards of an ordinary person taking into consideration the character of the area. The Appeal Court decided that the amount of noise deemed acceptable would depend on the types of property and land use in the area and they were reluctant to overturn the findings of a lower court that had found no actionable nuisance. In its judgement the Appeal Court stated that when considering the existence of an actionable nuisance the lower court was right to consider, not only the question of sleep disturbance, but the overall situation as well. Consequently the residents' appeal was dismissed.

Prejudicial to health

The *Environmental Protection Act 1990* defines prejudicial to health as something that is 'injurious, or likely to cause injury, to health' (10). As the WHO community noise guidelines are essentially aimed

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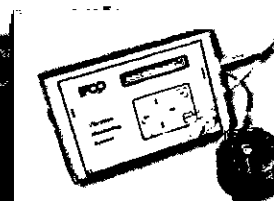
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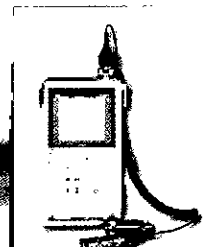


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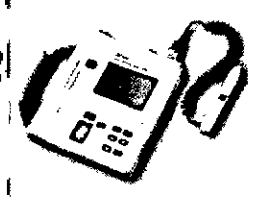




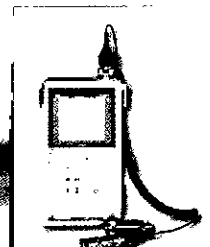
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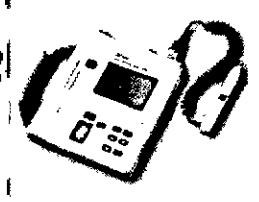


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WHO Community Noise Guideline Values

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at protecting health it would appear that they would provide a suitable test for the prejudicial to health limb of statutory nuisance.

However, in *Cunningham (11)*, Mr Justice Astill produced a judgement that the proper test to apply in assessing whether or not a matter was prejudicial to health was objective rather than subjective. The court ruled that it was common ground that an objective test was to be applied to nuisance and that he (the judge) could not accept the submission that the presence of an objective test on one limb was a ground for holding prejudicial to health was a subjective test (12). In this context an objective assessment means that when assessing the health impact of noise this should be in terms of the likely impact of the noise on the health of a notional ordinarily normal person without special sensitivities or pre-existing medical conditions that might lessen their ability to tolerate noise or which noise might worsen.

The High Court stated that if a subjective test that allowed for special sensitivities was to be applied for the prejudicial to health limb of statutory nuisance, this would place on those responsible an undue burden to contemplate the health requirements of every person who might be affected, including those who may be more than ordinarily sensitive to or affected by the matter complained of. As a result there is no requirement that matters, including noise,

must not be prejudicial to the health of everyone irrespective of sensitivity or existing medical condition. Consequently the prejudicial to health limb of statutory nuisance only protects those of ordinary susceptibility or sensitivity.

Unfortunately the WHO community guideline noise levels appear not to be set at values that protect only those who are only normally sensitive or susceptible to noise. The document reports that 'the guideline values consider all identified adverse health effects' and that an adverse health effect of noise 'refers to any temporary or long-term impairment of physical, psychological or social functioning'. Consequently the guideline values seem to be aimed at protecting all, including those outside the normal range of sensitivities or susceptibility for noise.

For example, in recommending a 30dB L_{Aeq} guideline value for undisturbed sleep the editors have referenced research that includes the effects of noise on the sleep of persons suffering from insomnia. Additionally the summary tables of guideline values in the WHO document imply that if the recommended guideline value for undisturbed sleep of 45dB L_{Amax} is exceeded once during sleep then negative health effects occur. This may be true for those most sensitive to noise. However, both the research cited in support of this value, and section 3.4 of the WHO document on 'Sleep Disturbance', refer to a need for exceedance of 45dB L_{Amax} 10 to 15 times a night before any effect is detected.

Besides not satisfying all the established tests for statutory nuisance under English law, the WHO community noise guideline levels can for other reasons be inappropriate for assessing whether certain types of noise are causing statutory nuisance. The broad definition of community noise given in the preface to the guidelines means that the sound level values can be construed as covering all noise sources except noise in the industrial workplace. However, the research used to derive the WHO community noise guideline levels for outdoor annoyance and for undisturbed sleep is dominated by studies based on transportation noise, with few (if any) other noise source types being considered.

Consequently if the guideline values are used for noise sources other than transportation noise they may significantly underestimate or overestimate the impact of other noises. A prime example is music noise. Many of those who have dealt with amplified music from short-term outdoor pop concerts have found that even where the noise level exceeds the WHO outdoor annoyance guideline levels of 50dBA for moderate annoyance and 55dBA for serious annoyance, the result is not necessarily unacceptable disturbance. The author and others have found that for events lasting up to four days, each finishing before midnight, the music noise levels can be significantly higher than the recommended WHO outdoor annoyance guideline levels by up to 15 or 20 dB in rural locations and 20 to 25 dB in urban areas, without unacceptable disturbance.

Conversely, where the music noise is persistent and regular in its occurrence, especially late at night, music noise levels below the WHO daytime

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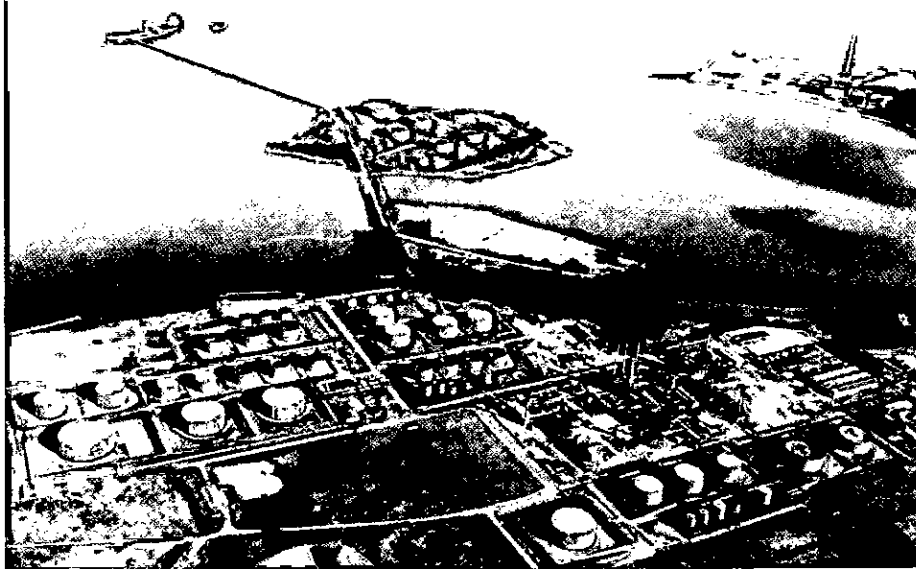
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The amount of noise deemed acceptable could depend on the types of property and land use in the area

and evening guideline level (for indoor speech intelligibility and moderate annoyance) of 35dB L_{Aeq} and the night-time sleep disturbance level of 30dB L_{Aeq} can cause statutory nuisance. This was illustrated in the case of *Howson-Ball* (13). In the High Court's judgement there was no contention in the circumstances of the case that music noise at a level of around 30dBA in the flat above a pub was not a statutory nuisance (the appeal was brought and lost on legal technicalities). This case suggests that under some situations the WHO guidelines can significantly underestimate the impact of non-transportation noise which is in fact a statutory nuisance.

Planning

Central government sets out its policy in relation to planning and noise in the document PPG24: *Planning and Noise* (14) which offers Local Planning Authorities and developers advice on the use of the planning system to mitigate the impact of existing noise levels on new noise-sensitive development and new noisy development on existing noise sensitive premises.

Paragraphs 4, 5, 10 and the end-note 1 of Annex 2 to PPG24 refer to the World Health Organisation, *Environmental Health Criteria 12 - Noise* (1980), which have subsequently evolved into the current WHO *Community Noise Guidelines*. Given the apparent government approval of the WHO document it seems that the WHO guideline values are suitable for use as targets for acceptable noise levels in the planning process. Indeed the High Court (15) has approved the use of WHO community noise criteria as suitable limits for new development. However, in other circumstances (16) the High Court has also recognised the limitations of the WHO guidelines for noise other than transportation noise and refused development where the predicted levels from non-transportation noise would be less than the WHO criteria. In each case the High Court carefully assessed the whole of the proposed development and weighed the

overall noise impacts with other material planning considerations before reaching its conclusions.

One way in which rigid application of the WHO Community Noise Guidelines can conflict with other legitimate planning objectives is the application of the recommended guideline values of 50 or 55 dBA for outdoor living areas. In order to prevent annoyance, WHO states that these limits are 'daytime levels below which a majority of the adult population will be protected from becoming moderately or seriously annoyed, respectively'. Recent research (17) suggests that at road traffic noise DNL 50dBA approximately, less than 10% of a population is predicted to be annoyed; and at DNL 55dBA approximately, less than 8% of a population is predicted to be highly annoyed.

Noise levels similar to the WHO outdoor living guidelines are not uncommon, and the recently published National Noise Incidence survey (18) estimates that in England and Wales 90% $\pm$ 2% and 55% $\pm$ 3% of the population lives in dwellings subject to daytime external noise levels above 50dBA and 55dBA respectively, primarily as a result of road traffic noise. In many urban locations otherwise suitable for residential development, and where PPG 3 - Housing, local plans, UDPs and Regional Planning bodies seek to promote residential development, with a significant proportion of affordable housing to meet a pressing social need, daytime noise levels can often exceed the WHO outdoor annoyance criteria.

Consequently, strict application of this criteria as part of the planning process could mean that much-needed housing which could readily be constructed to achieve acceptable indoor ambient noise levels would be refused planning permission because noise levels in external open spaces may exceed 50dB L_{Aeq} (daytime) even after remedial works such as acoustic barriers, bunding and the use of development components as screens for open spaces. People coming to live in these locations

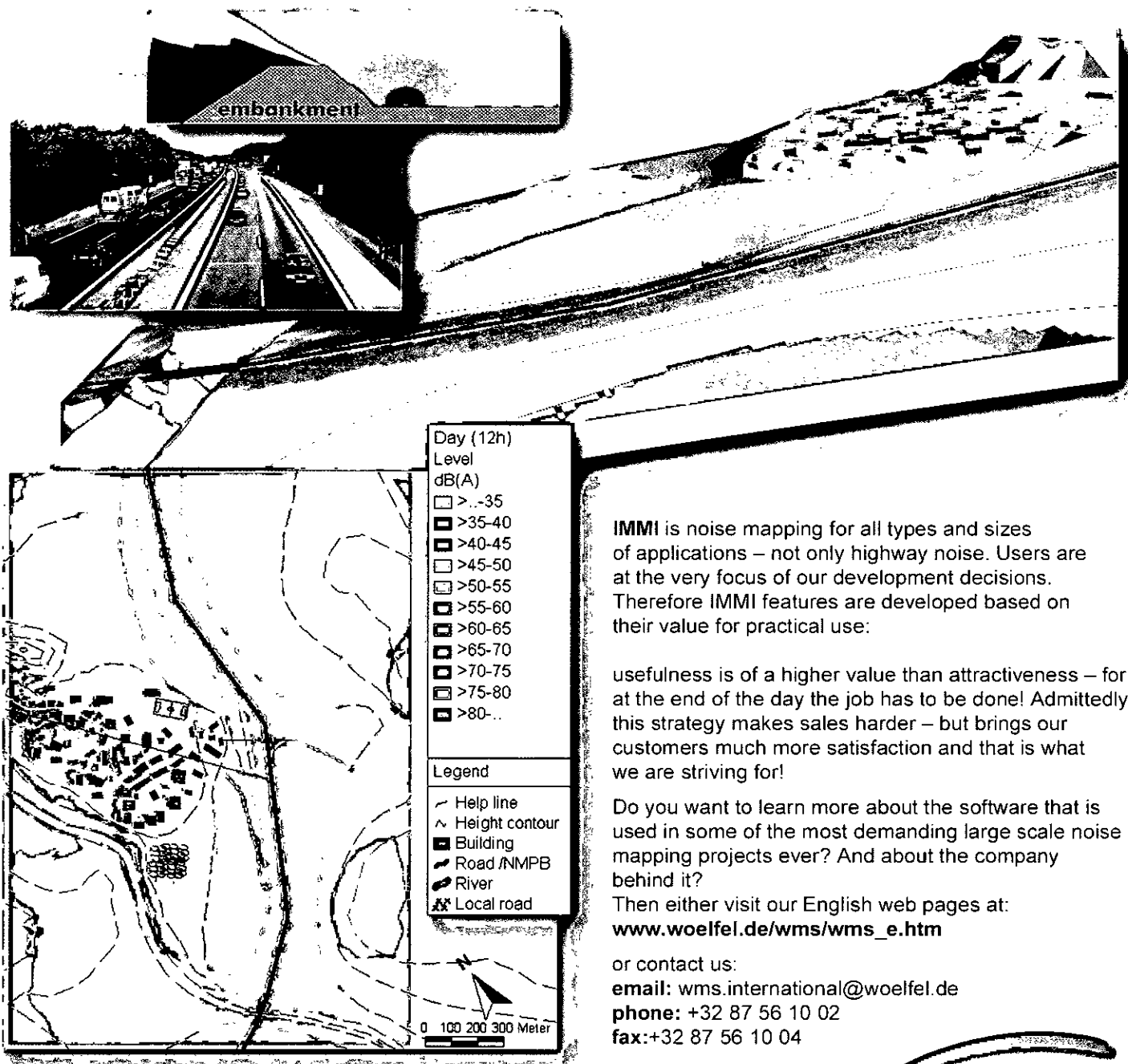
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would have done so knowing that the area was not a quiet rural retreat, and in most cases they would modify their expectations to match the reality. In these circumstances some local planning authorities may choose to give greater weight to meeting the social need for available housing than the desirable objective of provision of quiet open spaces in urban locations.

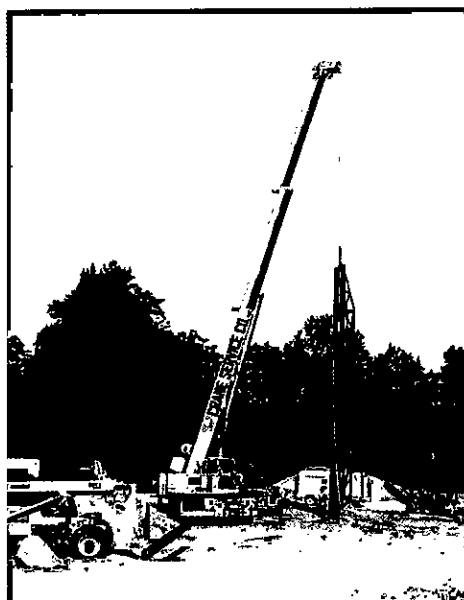
Conclusion

Fundamentally, the WHO Community Noise Guideline levels are set at values below which health effects are not detected or are unimportant. This does not mean that if these levels are exceeded that there will be significant health effects or that persons of normal sensitivity or susceptibility to noise would not tolerate any effect.

In judging statutory nuisance the Courts give weight to factors other than just the level of a noise. Typically they are reluctant to enforce a uniform fixed prescribed 'nil effect' standard for statutory nuisance, being more comfortable merely to require the restriction or control of noise to levels, times, durations and frequencies of occurrence that are reasonable within the context of the nature and character of a locality and the reasonableness of the activity giving rise to the noise.

The WHO Community Noise Guideline levels are aimed at achieving the desirable objective of reducing noise so as to guarantee no effect. Unfortunately the principles involved in statutory nuisance take a more pragmatic approach and aim to balance the desirable with the achievable in the overall context of the environmental, historical, social, economic and political realities of the circumstances in which the noise occurs. Consequently, even though the WHO guidelines represent a comprehensive consensus assessment of the health impact of noise, the essentially precautionary nature of the guideline values impairs their suitability for application to assessment of statutory nuisance.

Noise from
machinery and
equipment in the
street can also
be a statutory
nuisance



In respect of the planning process, because the government in its advice on the use of the planning system to mitigate the impact of noise to acceptable levels has alluded to the WHO guidance, and the fact that the Courts have upheld some of the criteria, weight appears to be lent to the use of the WHO guideline values as a starting point in setting acceptable planning noise limits. However, care should still be taken to balance the benefits of using the WHO guideline sound level values against the associated economic and social costs. Otherwise, there is a risk that development which may meet other pressing planning needs may be unduly prejudiced or denied, because of concerns about the impacts of noise levels that may exceed the WHO guideline criteria but which may not be significant or can be mediated by other benefits from the development.

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Dani Fiumicelli MIOA was formerly with Islington London Borough, and is now with Casella Stanger. The views expressed are those of the author and do not reflect the policy or opinion of any private sector, central or local government bodies or organisations.

Rippleprint

a new concept in traffic calming

John Tyler FIOA, Associate Editor, investigates

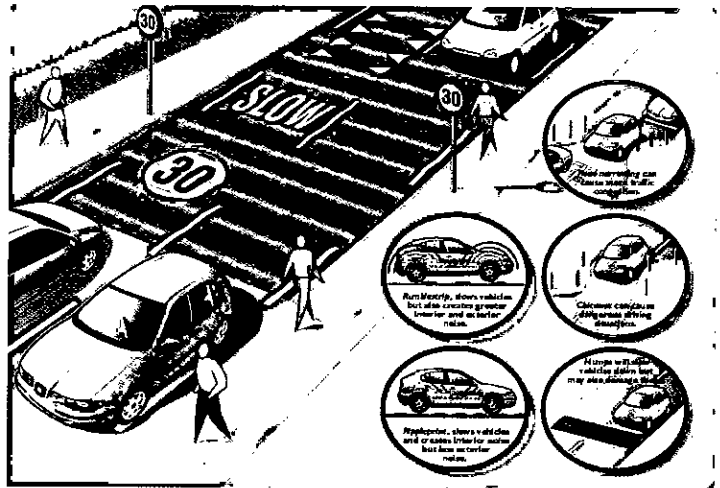
Infrastructure safety specialist Prismo Ltd recently launched a new traffic calming surface. Described as a 'noise-optimised' system, *Rippleprint* is a major step forward in traffic calming techniques.

Traditional traffic calming surfaces such as rumble bars and strips create significant levels of exterior noise disturbance to nearby residents, but the noise generated when driving over *Rippleprint* is said to be virtually indistinguishable from a regular road surface. Instead, the internal vehicle resonances are excited by significant horizontal vibrations, which are readily transmitted into the driver's cabin through the vehicle suspension.

The result is claimed to be significant noise and vibration in the cab but little discernible increase in noise outside. Associate Editor John Tyler FIOA went to TRL to investigate.

Introduction

Although rumble devices are widely used to alert drivers approaching villages, junctions and bends, these can cause considerable noise disturbance to nearby residents. In August 1999, the Department



How Rippleprint works

for Transport's CLT Division commissioned TRL to examine whether a traffic calming surface could be designed which would increase noise and/or vibration inside the cab of a vehicle without increasing noise levels outside the vehicle. The purpose of the design would be to alert drivers through the increase in noise and vibration and encourage them to reduce speed. Such a surface could be extremely useful in residential areas where there is great resistance to the use of traffic calming features such as rumble strips because of the noise produced in the neighbourhood.

TRL designed an optimised sinusoidal profiled surface, which was constructed by Prismo who developed a laying technique able to reproduce the desired wavelength and amplitude using a hot applied synthetic asphalt compound. A demonstration of this Prismo-applied surface - known commercially as *Rippleprint* - was held on 9 October 2002. Visitors were able to drive a range of private cars over the test length, to experience the internal noise, and then stand alongside the surface to assess external noise. The photographs show two of the cars used and the appearance of the *Rippleprint* surface, both from the outside and within the vehicles.

Background

As Professor Greg Watts, TRL's senior research fellow of the noise and vibration group, explained to visitors, in designing a surface with the desired characteristics they had to go back to basics and look at the physics of noise generation by the vehicle. Two requirements were considered important in reducing exterior noise while maintaining adequate interior levels: first, keeping the amplitude of any profile small while maximising the transmissibility of the tyre vibration to the interior of the vehicle; and second, reducing excitation at relatively low frequencies to prevent audible sound being generated outside by tyres or the vehicle. These considerations led to the use of sinusoidal profiled surfaces with an appropriately chosen frequency.

Experiments were carried out on the research track at TRL using a wide range of such surfaces, and two examples of conventional traffic calming surfaces for comparison. Four different vehicles were used for noise and vibration measurements: small and large passenger cars, a medium-sized van, and a 17-tonne heavy goods vehicle. Volunteer drivers



Left: *Rippleprint* being tested at TRL

Below: One of the *Rippleprint* trial sites in Fleet, Hampshire



gave assessments after driving over the surfaces at various speeds. Exterior noise was also assessed by using noise recordings played back to volunteers in listening rooms simulating both indoor and outdoor listening conditions.

From the trials it was determined that a sinusoidal profiled surface with a wavelength 350mm (peak to peak) and a peak to trough amplitude of between 6 and 7 mm produced the most desirable effect in terms of both noise and vibration. The alerting effect was comparable with conventional rumble strips with bars over 12mm thick, yet the exterior noise generation was much less. Extensive testing was carried out on the safety of the surface, with particular emphasis on motorcycles and pedal cycles, and the results were satisfactory. However, whilst the surface is safe for pedal cycles it can produce an uncomfortable ride, so it was felt necessary to provide an adjacent smoother surface for cyclists to ride along.

Benefits

But what effect does the new design have on traffic speed, accidents and residents perception? To provide some answers to these questions TRL obtained the co-operation of Hampshire County Council and Rushmore Borough Council who agreed to participate in public road trials, initially in Farnborough and Fleet but more recently in Gosport, Havant and Denmead.

For the two first sites in Hampshire, one on Trunk Road, Farnborough and the other on Reading Road, Fleet, Prismo laid a 20m length of the surface extending across the full width of the road apart from smoother strips at each side for the benefit of cyclists. Both sites were in residential areas with an existing accident problem. TRL monitored the effect of the surfaces on vehicle speeds and noise levels, and interviewed local residents.

The results, when compared with a plain road surface, indicated that there was little change in the measured exterior noise levels, and a survey of residents showed that generally there was little additional noise annoyance indoors even at distances within 25m. Overall mean traffic speeds were reduced slightly with a reduction in the proportion of vehicles travelling at higher speeds and a general downward trend in the speed profile. It is too soon to assess any effect on accident statistics at the sites.

It was obvious from the demonstration at TRL that the aims in designing *Rippleprint* were achieved. The internal noise generated in the vehicles was sufficient to alert drivers and the external noise as assessed at the trackside was little different from the noise generated by the adjoining normal asphalt surfaces.

It is worth pointing out that this project is a good example of successful co-operation between government, scientists, industry and local authorities, to the ultimate benefit of the general public.

Readers requiring fuller information on this surface can obtain copies of the TRL Report 545 'Development of a novel traffic calming surface – Rippleprint' from the TRL Library and Information Unit (Price £40).



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Sir Isaac Newton

Isaac Newton was born in the manor house of Woolsthorpe, near Grantham in Lincolnshire. According to the calendar in use at the time of his birth he was born on Christmas Day 1642, but the correct Gregorian calendar date is 4 January 1643 (the present-day calendar was not adopted in England until 1752.) He came from a family of farmers but never knew his father, also named Isaac, who died three months before his son was born. Although he owned property and animals and was quite wealthy, Isaac the elder was uneducated and illiterate.

When the famous son was two years old his mother, Hannah Ayscough, married Barnabas Smith, the vicar of North Witham church, in a nearby village. The young child was then left in the care of his grandmother Margery Ayscough at Woolsthorpe. He was treated as an orphan and seems not to have had a happy childhood. Margery's husband James Ayscough was never mentioned by Isaac in later life, and left him nothing in his will, written when the boy was ten years old. Isaac evidently felt bitter towards his mother and his stepfather: when examining his sins at age nineteen, he listed: 'threatening my father and mother Smith to burn them and the house over them'.

On the death of his stepfather in 1653, Newton lived in an extended family consisting of his grandmother, mother, one half-brother and two half-sisters. Shortly afterwards he began attending the Free Grammar School in Grantham. Although it was only five miles from his home, he lodged with the Clark family at Grantham. He seems to have shown little promise in academic work, and his school reports described

him as 'inattentive' and 'idle'. Since she was by now a lady of reasonable wealth and property, his mother decided that her eldest son was the right person to manage her affairs and her estate. He was taken away from school, but soon showed that he had no talent for estate management.

William Ayscough, an uncle, decided that the youth should prepare to enter university, so having convinced his mother, Isaac was allowed to return to the Free Grammar School in 1660. This time he lodged with the headmaster, Stokes, and although he had previously revealed little academic promise, Isaac must have shown some of those around him that he had potential. There is evidence of Stokes' persuading Hannah to let him enter university, and more comes from Isaac's list of sins: he was apparently guilty of "... setting my heart on money, learning, and pleasure more than Thee ..." so he must have had a passion for learning.

Nothing is known about what he learnt in preparation for university, but he almost certainly received private coaching and a good grounding, although there is no evidence that he learnt any mathematics. Anecdotes abound about the mechanical ability he displayed at school: he is supposed to have been unusually skilful in making models of machines, clocks and windmills. These stories may simply have been fabricated later by those who felt that the most famous scientist in the world ought to have shown some prodigious talent!

Newton entered his uncle's old College, Trinity College Cambridge, on 5 June 1661. At 21 he was older than most of his fellow students but, despite his mother being financially well off, he entered as a sizar - a student who received an allowance toward college expenses in exchange for acting as a servant to other students. Yet, there is some ambiguity in his position, for he seems to have associated with 'better class' students rather than other sizars. Some sources suggest that Newton had Humphrey Babington, a distant relative who was a Fellow of Trinity, as his patron. As well as fitting well with what is known, it would mean that his mother did not subject him to unnecessary hardship, as some of his biographers claim.

'If I have been able to see further, it was only because I stood on the shoulders of giants' - Sir Isaac Newton

Newton's objective was a law degree. While instruction at Cambridge was dominated by the philosophy of Aristotle, there was some freedom of study. The mechanics of the Copernican astronomy and Kepler's *Optics* attracted him. He kept a notebook entitled *Quaestiones Quaedam Philosophicae* (Certain Philosophical Questions) which is a fascinating account of how Newton's ideas were already crystallising in around 1664. The text has a Latin heading meaning 'Plato is my friend, Aristotle is my friend, but my best friend is truth'.

It is less clear how Newton was introduced to the more advanced mathematical texts of his day. His interest may have begun in the autumn of 1663 when he bought an astrology book at a fair and found that he could not understand the mathematics inside. Attempting to read a trigonometry book, he found that he lacked the necessary knowledge of geometry and so decided to read Barrow's edition of Euclid's *Elements*. The first few results were so easy that he

almost gave up but he '... changed his mind when he read that parallelograms upon the same base and between the same parallels are equal'.

Newton read this and many other major works of mathematics including Wallis's *Algebra* and his first original mathematical work seems to have come from his study of this text. Newton devised his own proofs of Wallis's theorems writing: 'Thus Wallis doth it, but it may be done thus ...'.

Newton was elected a scholar on 28 April 1664 and received his bachelor's degree in April 1665. If his scientific genius had not yet emerged, it did so suddenly when the University closed that year because of the plague, and he had to return to Lincolnshire. Within less than two years, and before his 25th birthday, Newton began revolutionary advances in mathematics, optics, physics, and astronomy.

He laid the foundations for differential and integral calculus, several years before its independent discovery by Leibnitz. His 'method of fluxions' was based on his crucial insight that integrating a function is merely the inverse procedure to differentiating it. Taking differentiation as the basic operation, Newton produced simple analytical methods that brought together many techniques developed to solve apparently unrelated problems such as finding areas, the lengths of curves, tangents, and the maxima and minima of functions. Newton's *De Methodis Serierum et Fluxionum* was written in 1671 but was not published until John Colson produced an English translation in 1736.

When the University of Cambridge reopened in October 1667, Newton was elected to a minor fellowship at Trinity, and in July 1668 to a major fellowship. In July 1669 Barrow, his professor, sent Newton's text *De Analysi* to Collins of London, writing that Newton '...brought me the other day some papers, wherein he set down methods of calculating the dimensions of magnitudes like that of Mr Mercator concerning the hyperbola, but very general; as also of resolving equations; which I suppose will please you; and I shall send you them by the next.' Since Collins corresponded with all the leading mathematicians of the day this should have brought quick recognition. Barrow resigned the Lucasian chair in 1669 and recommended that Newton be appointed in his place.

Newton's first work as Lucasian Professor was on optics and this was the topic of his first lecture course begun in January 1670. He had reached the conclusion during the two plague years that white light is not a simple entity, as everyone thought. The chromatic aberration in a telescope lens convinced Newton otherwise: when he passed a thin beam of sunlight through a glass prism a spectrum of colours was formed. He argued that white light is really a mixture of many different types of rays which are

refracted at slightly different angles, and that each different type of ray produces a different spectral colour. Newton was led by this reasoning to the erroneous conclusion that telescopes using refracting lenses would always suffer chromatic aberration. He therefore proposed and constructed a reflecting telescope.

In 1672 Newton was elected a fellow of the Royal Society after giving them a reflecting telescope. He also published his first scientific paper on light and colour in the *Philosophical Transactions* of the Royal Society. Although the paper was well received, Hooke and Huygens took exception to Newton's attempt to prove by experiment alone that light consists of the motion of small particles rather than waves. This did nothing to improve Newton's attitude to the publication of his results. He was always pulled in two directions for although he craved fame and recognition, he feared criticism, so the easy way to avoid being criticised was to publish nothing. Nevertheless, his corpuscular theory reigned until the wave theory was revived in the 19th century.

In 1675 Hooke claimed that Newton had stolen some of his optical results. Although the two men made their peace with an exchange of polite letters, Newton turned away from the Royal Society and delayed the publication of his optical researches until Hooke had died in 1703. Newton's *Opticks* appeared in 1704. It dealt with the theory of light and colour, and with investigations of the colours of thin sheets, 'Newton's rings', and the diffraction of light. In order to explain some of his observations he had to use a wave theory of light in conjunction with his corpuscular theory. An argument with the English Jesuits in Liège over his theory of colour led to a vitriolic exchange of letters and what appears to have

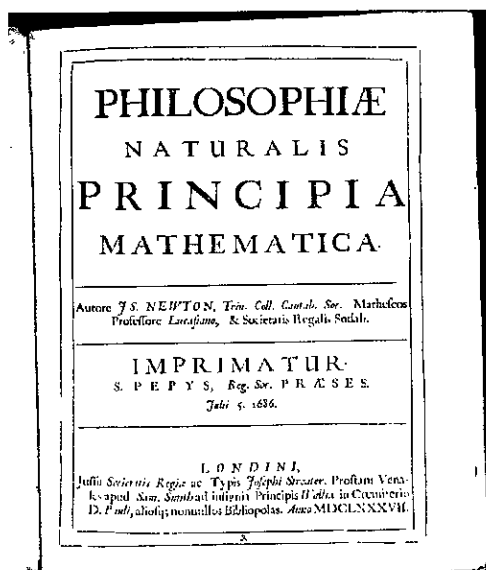
been a nervous breakdown in 1678.

Newton's most famous achievement was probably his work in physics and celestial mechanics, culminating in the theory of universal gravitation. By 1666 Newton had formulated early versions of his three laws of motion, and had discovered the law giving the centrifugal force on a body moving in a circular path, but he did not understand the mechanics of circular motion correctly.

In 1684 Edmund Halley asked Newton what orbit a body followed under an inverse square force, and Newton replied that it would be an ellipse. However, he only gave a proof of the converse theorem that if the orbit is an ellipse the force is inverse square (the proof that inverse square forces imply conic section orbits is sketched in the second and third editions of the *Principia*, but not in the first edition). Halley persuaded Newton to write a full treatment of his new physics and its application to astronomy.

Over a year later (1687) Newton published the *Philosophiae naturalis principia mathematica* or

continued on page 36



The Principia is recognised as the greatest scientific book ever written

Sir Isaac Newton

continued from page 35

Principia as it is always known. This is recognised as the greatest scientific book ever written. **Book I** states the foundations of the science of mechanics, developing upon them the mathematics of orbital motion round centres of force. Newton identified gravitation as the fundamental force controlling the motions of the celestial bodies, but never found its cause. To contemporaries who found the idea of attractions across empty space unintelligible, he conceded that they might prove to be caused by the impacts of unseen particles. **Book II** inaugurates the theory of fluids: Newton solves problems of fluids in movement and of motion through fluids. From the density of air he calculated the speed of sound waves.

Book III shows the law of gravitation at work in the universe: Newton demonstrates it from the revolutions of the six known planets, including the Earth, and their satellites. Comets were shown to obey the same law, and in later editions he added conjectures on the possibility of their return. He explained tidal ebb and flow and the precession of the equinoxes from the forces exerted by the Sun and Moon. All this was done by exact computation. This work made Newton an international leader in scientific research, but the continental scientists did not immediately accept his ideas.

After suffering a second nervous breakdown in 1693, Newton retired from research. The reasons for this breakdown have been discussed by his

biographers and many theories have been proposed: chemical poisoning as a result of his alchemy experiments; frustration with his researches; and problems resulting from his religious beliefs. Newton himself blamed lack of sleep but this was almost certainly a symptom of the illness rather than its cause. There seems little reason to suppose that it was anything other than depression, a mental illness he must have suffered from throughout most of his life.



Trinity College, Cambridge, where Newton studied, gained his bachelor's degree and was appointed Lucasian Professor

Newton decided to leave Cambridge to take up a government position in London, becoming Warden of the Royal Mint in 1696 and Master in 1699. However, he did not resign his positions at Cambridge until 1701. As Master of the Mint, adding the income from his estates, he became a very rich man. However, he made a strong contribution to the work of the Mint, leading it through a difficult period of recoinage and being particularly active in measures to prevent counterfeiting.

In 1703 he was elected president of the Royal Society and was re-elected each year until his death in 1727. He was knighted in 1705 by Queen Anne, the first scientist to be so honoured for his work. However the last portion of his life was not an easy one, dominated in many ways with the controversy with Leibnitz over who had invented the calculus.

Newton was modest, diffident, and a man of simple tastes. He was angered by criticism or opposition, and harboured resentment; he was harsh towards enemies but generous to friends. In government, and at the Royal Society, he proved an able administrator. He never married and lived modestly, but was buried with great pomp in Westminster Abbey.

He had found science a hotchpotch of isolated facts and laws, capable of describing some phenomena, and predicting only a few. He left it with a unified system of laws, that could be applied to an enormous range of physical phenomena, and used to make exact predictions.

'Nature and Nature's laws lay hid in night:
God said, Let Newton be! and all was light'.
- Alexander Pope

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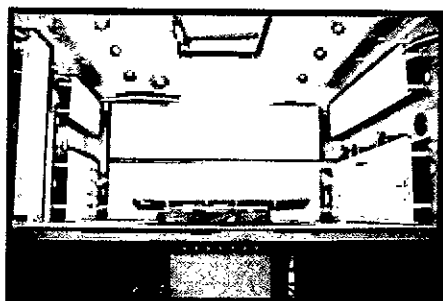
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Commons Debates

16 October 2002

Shoeburyness firing ranges

Mr John Whittingdale (Maldon and East Chelmsford): Hundreds of constituents have approached me about the disturbance caused to them by the activities at Shoeburyness. According to figures that I obtained from the Minister, the number of official complaints received is running at just below 1,000 each year. Does my hon. Friend agree that that is only a small fraction of the actual number of complaints? I have often had reports of people who have been unable to get through on the complaints telephone number - and it is not very widely publicised. Furthermore, ten times that number will not be aware that there is an official line on which they can register a complaint.

Mr Gale: My hon. Friend is absolutely right. We know from general parliamentary experience that most people do not complain. However, walk down the high street in any of the towns along the north Kent coast that I have mentioned - I am sure that the same is true in Essex - and people will ask, 'Did you hear the bang?' My own home is nine miles inland from the coast. On a good day - or a bad day, depending on how one cares to think about it - we can hear the explosions, and they shake our house.

So what can be done? My hon. Friend the Member for North Essex is the shadow Secretary of State for Defence; my hon. Friend the Member for Maldon and East Chelmsford is on the board of visitors of the military corrective training centre at Colchester; my hon. Friend the Member for Canterbury has had a distinguished career with the Territorial Army and I am a postgraduate of the Parliament and armed forces scheme. I have also served as parliamentary private secretary to two Ministers of State for the Armed Forces. I hope that we may claim that, collectively, we are reasonably well informed. We recognise that at all times and never more than at present our armed forces need the best support and facilities available, that ordnance must be tested and that munitions must sometimes be disposed of. However, we are not satisfied that the densely populated Thames estuary is the best or most suitable site for the location of what is clearly a necessary facility. Having discussed the matter some months ago with the Minister, who received me most courteously, I am not even sure that he believes that Shoeburyness is any longer the right location.

We have a real and unacceptable problem and I believe that the Minister accepts that. We have a military need that must certainly be provided for and we all accept that. We have an opportunity. The government has embarked on a review of all its defence

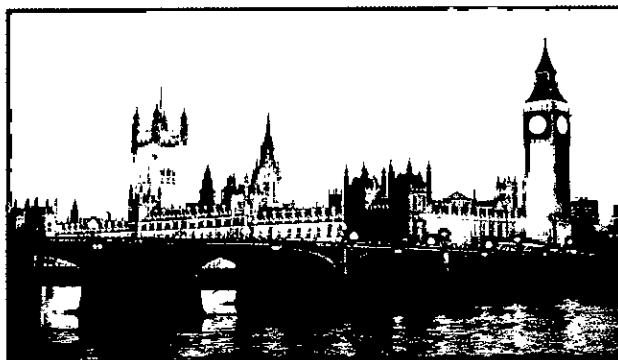
estates to determine value for money and to establish whether there are ranges and sites that could be better used militarily or returned to public use for development or recreation.

On behalf of my colleagues and our constituents, I ask the Minister simply to give an undertaking. Will he take the window of opportunity afforded by the review to consider an alternative location that will allow QinetiQ, owned by the government, the Carlyle group or whichever preferred bidder finally takes on the job, to provide for the vital needs of our armed forces while at the same time removing from both banks of the Thames estuary an unacceptable environmental intrusion that has persisted for far too long?

Sir Teddy Taylor: I hope that the Minister will appeal to my hon. Friend to disengage from what I regard as an irresponsible, irrational and damaging campaign.

plain fact is that most of the complaints have nothing to do with Shoeburyness at all.

Shoeburyness is a desperately important facility. It is one of the world's leading test stations that serves the MOD and other allied defence organisations in vital testing and security. It is also used for the decommissioning of dangerous explosives, which otherwise could kill or maim civilians. It is the custodian of 8,000 acres of beautiful land, and manages its site of scientific interest standards at the highest level. It also contributes to the local economy, with 380 people working there. The environmental test centre is also based there, in which live munitions are environmentally tested and safely disposed of. All munitions have to undergo environmental testing before they can be accepted into service. Because of the huge area, the range offers the



Extracts are provided by
Rupert Taylor FIOA

FROM HANSARD

Of course we know that there is noise from Shoeburyness - I live a mile from there myself. Of course I know that my house shakes. I know that we undertake dangerous work there, but let us get across some of the facts.

First, how valid are all the complaints that we hear from the hon. Gentleman? The government has spent a lot of money on two surveys, as he well knows, and there is a third survey about to come because of all the complaints. What did the surveys, which were by independent people, actually find? They found that some 80% of the complaints received about noise and vibration were not related to Shoeburyness in any way. Only one in five of them was related to Shoeburyness. It seems that some were associated with explosions at the Ministry of Defence range at north Yantlet in north Kent, and others were from sources that could not be identified. Secondly, what about the number of complaints? Are people marching in the street? There are about 2.5 million people in the area. A tiny number, about ten people, have sent in 256 complaints. The total is less than 1,000. As regards the volume of noise, we should bear in mind that the monitored levels give readings for Shoebury of about 1.5 mm per second or less, and a maximum of 1.7 mm. By comparison, a quarry is allowed 12 mm. Although I appreciate the real complaint, of which I am well aware, the idea that it is something extraordinary is ridiculous. The

opportunity for the Army to carry out explosive ordnance demolition training, and that helps to prepare the forces for dealing with unexploded bombs. If the hon. Gentleman thinks that it is irrelevant, we should remember that one vital task carried out in Shoebury related to work on the Rolls-Royce Olympus engines following the tragic Paris airport crash of Concorde. Shoebury was involved in the testing of those engines, and the aircraft are now flying again.

I am well aware that we often get complaints from constituents about many things. I am aware of the complaints about the noise from Shoebury, because I live about a mile away, and I know what the position is. The situation honestly reminds me of those who call me on my mobile and say, 'Will you do something about these telecom masts, Mr Taylor? It's an outrage.' We have to face up to our responsibilities. Shoebury provides unique facilities, and many tests have taken place.

I am sure that the Minister will announce today that there will be another test, but does he accept the fact that the tests already carried out by independent people showed that most of the complaints were a load of codswallop and had nothing to do with Shoeburyness at all?

Mr Nigel Beard (in the Chair): Order. May I remind the hon. Gentleman of the need to leave time for the Minister to respond?

Sir Teddy Taylor: I shall, therefore, sit

continued on page 38

FROM HANSARD**Commons Debates***continued from page 37*

down and allow the Minister to respond. I hope that he will say what I have said: the complaints are ones that we should not take as seriously as presented.

The Parliamentary Under-Secretary of State for Defence (Dr Lewis Moonie): I shall do my best to reply to the points raised in the time left to me. Were I to set out to build a new test and evaluation range, I probably would not build it at the mouth of the Thames. However, we have been using that range for 150 years, and there are several reasons why QinetiQ and the MOD feel that they have no option but to carry on using it. Shoeburyness is one of the world's leading test sites and delivers services that make a vital contribution to national security. We are all agreed that our armed forces must have safe, effective and reliable weapons and equipment to do their job. The comprehensive testing regime to which all munitions entering, or already in, UK service are subjected is designed to ensure that they are as safe as possible. Some of that testing, particularly on the larger calibre weapons, can be done only at Shoeburyness because it is the only site in the UK that is big enough to conduct those activities.

The primary role of Shoeburyness is the testing and demolition of ordnance and explosives. Testing comprises accident simulation and environmental attacks

on weapons to assess their safety and suitability for services, and proof firing of munitions to prove by sampling that they meet the specification that we require. Trials work is undertaken to determine weapon effects on structures and equipment and equipment vulnerability to various weapons. The weapons tested may be manufactured for UK or other NATO services. Shoeburyness also undertakes work to ensure that protection of national assets remains viable against attack by an aggressor using ever more sophisticated weapons. Occasionally, testing is conducted on the types of weapons that potential aggressors or terrorist organisations might use.

Disposal by detonation is undertaken on obsolete items if it is unsafe or otherwise inappropriate to break them down for disposal in any other way. I have no doubt that hon. Members have seen the kilns that we use for that. We try to conduct that part of our work with little noise pollution. I shall now address the cost of the activity in Shoeburyness in environmental terms, in particular noise and vibration. QinetiQ is not exempt from noise legislation as some local residents believe, nor is it flouting the law with the scale or the number of detonations. Health and safety legislation sets a maximum acceptable level of noise pollution at 130 decibels, weighted for the audible range of the human ear. The decibel scale is logarithmic, which, as

hon. Members know, means that roughly every increase of 3 decibels is a doubling in power. QinetiQ has a self-imposed noise limit of 125 decibels at the range boundary, which is well within the law.

The noise level limit is managed through the use of meteorologically based computer prediction equipment and through six monitors that provide real-time measurements from selected sites in north Kent and Essex. There is also a single monitor on site. If predictions show that activity is likely to exceed the limit, it is prevented from going ahead. However, a few safety tests are undertaken during

the year that are lengthy and once started cannot safely be stopped. If unpredicted changes occur to the weather conditions, thus affecting noise propagation through the atmosphere, the resulting impact on local

communities may marginally exceed the limit. Similarly, there have been a very few occasions on which, for national security reasons, a trial has been undertaken regardless of the QinetiQ imposed noise limit.

During the past year, some 35,000 individual explosive and gunfire events have taken place at Shoeburyness. The total number of complaints of noise nuisance and alleged damage to property during the most recently measured 12-month period was 919. Of those, 326 were from Essex, 103 were from the immediate vicinity of the site and 484 were from north

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Kent. Of the 919 complaints, 253 came from ten individuals. It being reasonable that a single significant event is liable to generate several complaints, it is a fact that well over 97 per cent of Shoeburyness demolition and explosive test activities generate no complaints at all. Furthermore, during one study period, there were regular recordings of complaints that related to sound and vibration levels at times when the site was either shut down for the weekend or closed for the evening. That may be difficult for hon. Members to accept, but it is true.

The MOD recognises that there can be implications from trials activities and the facilities management contract, placed upon QinetiQ as the site operator, expects it to manage activities in a manner that reduces the impact of generated noise. QinetiQ conducts its detonation activities within the statutory and site imposed limits and there has been no significant increase in either scale or frequency of such detonations during the past few months. The site manager has arranged for residents to visit, which has proved popular and useful. Many visitors have consequently declared a better understanding of what is going on. Independent reports are being conducted to determine whether there is any correlation between the site's

activities and the ground shock being experienced by residents in Essex and Kent. There is no clearly demonstrable link, but a more comprehensive

study will be carried out to try to prove conclusively what effects our activities have. In conclusion, I recognise people's concerns. I say in mitigation that Shoeburyness performs a valuable function, and, where we can, we try to move the noisiest activities to areas where they will cause residents fewer problems.

31 October 2002

Fireworks

Mr David Crausby (Bolton, North-East): What steps she is taking to improve firework safety.

The Parliamentary Under-Secretary of State for Trade and Industry (Miss Melanie Johnson):

On 15 October I announced a package of measures to address the problems caused by fireworks. The measures are designed to cut down on the problems of noise and nuisance as well as to reduce accidents.

Mr Crausby: I thank my hon. Friend for that reply. Does she agree that the menace caused by fireworks increases year on year, and will she consider legislation, not voluntary codes, to restrict severely the retail sale of fireworks, which causes so much distress, particularly to the elderly?

Miss Johnson: It was, and is, because I recognised the problems caused in communities by the illegal use of fireworks on the streets, often by teenagers, that I announced this package of measures. We need to see how effective the measures are in reducing problems. We are making

air bombs illegal, introducing fixed-penalty notices, tackling the co-ordination of intelligence and encouraging councils to take steps. Many people thoroughly enjoy fireworks each year, and we need to strike the right balance to be effective.

18 November 2002

Licensed entertainment

Siobhain McDonagh (Mitcham and Morden): What studies her Department has made of the noise implications of the reform of licensed entertainment for residents living near licensed premises.

The Minister for Tourism, Film and Broadcasting (Dr Kim Howells): We have made several such studies.

Siobhain McDonagh: Whatever the reply was, Mr Speaker, does the Minister agree that, although it is important to introduce sound insulation so that residents who live close to pubs can lead good lives, it is important that the new licensing legislation increases the amount of live music in Britain?

Dr Howells: We believe that our proposed legislation will create many venues for live music in this country. For the first time, there will be a proper review of licences that are sought and granted. It will include the views of residents who sometimes have to put up with loud music.

Nick Harvey (North Devon): Although I welcome the Government's moves to sweep away arcane licensing laws, I urge them to make their new measures deregulatory, and not replace those that they are removing with a load of new bureaucratic regulations.

On noise, would not it be better for police and environmental health officers to be told when licensed premises opened rather than acquiring all the information through the licence?

Dr Howells: We believe that our proposed legislation is deregulatory and will do away with much red tape and bureaucracy, allowing for a premises licence that will enable the licensee not only to sell alcohol but to provide entertainment. That is a major plus for the music industry and I support it wholeheartedly.

28 November 2002

Air transport consultation

Mr George Osborne (Tatton): I welcome the decision to extend the consultation across the whole country. Developments at Manchester airport such as a third runway or a fourth

terminal would further blight the lives of people whom I represent. May I urge the right hon. Gentleman to make a virtue of necessity and ensure that, when he makes a decision about where airport expansion will take place, that decision will be accompanied by a series of measures to protect people from excessive aircraft noise, pollution and the misery of night flights?

Mr Darling: The environmental impact of extending airport capacity will be taken into account. The consultation documents make that clear.

WRITTEN ANSWERS

26 September 2002

EU Committees

Angus Robertson: To ask the Secretary of State for Trade and Industry when the EU Committee for the Approximation of the Laws of the Member States Relating to Noise Emission in the Environment by Equipment for Use Outdoors is next due to meet; whether representatives of the Scottish Executive (a) have been and (b) are members of it; and if she will make a statement.

Ms Hewitt: The Noise Committee met on 16 November 2001, and is next due to meet on 6 December 2002. The UK is normally represented by two officials from the Department of Trade and Industry. The Scottish Executive is regularly consulted on, and is fully involved in discussions, at official and Ministerial level, with the Department on the formulation of EU policy which touch on matters which fall within the responsibilities of the Scottish Executive.

26 September 2002:

Noise complaints

Mr Heath: To ask the Secretary of State for Environment, Food and Rural Affairs how many and what proportion of noise complaints were caused by acoustic or non-amplified music being played in pubs, bars or nightclubs in (a) 2000, (b) 2001 and (c) 2002; and if she will make a statement.

Mr Meacher: Data on UK noise complaints are not collected specifically for acoustics or non-amplified music being played in pubs, bars or nightclubs. However, figures are available for the number of noise complaints resulting from commercial and leisure activities that were reported to Environmental Health Officers in England and Wales. This category includes pubs, bars, nightclubs, food premises, retail stores and sporting pursuits.

continued on page 40

year	commercial and leisure noise complaints per million population	noise complaints (all categories) per million population	commercial and leisure noise complaints as % of total
2000-01	1,038	7,081	14.7
1999-2000	960	7,091	13.5
1998-99	836	6,111	13.7

The corresponding figures for 2001-02 are expected to be available later this year.

FROM HANSARD

WRITTEN ANSWERS

continued from page 39
17 October 2002

Aircraft noise

Mr Djanogly: To ask the Secretary of State for Transport to what extent airports have powers to restrict aircraft use by reference to engine noise levels.

Mr Jamieson: Restrictions on aircraft use by reference to engine noise levels must be compatible with the recommended standards and resolutions of the International Civil Aviation Organisation, and with the relevant directives and regulations of the European Union, in particular Directive 2002/30/EC on rules and procedures relating to operating restrictions at airports. Subject to these constraints, and to the airport's licence conditions, an airport may restrict the access of aircraft on noise grounds, either absolutely or subject to conditions, provided it does so in a non-discriminatory fashion.

21 October 2002

Alconbury Airfield

Mr Djanogly: To ask the Secretary of State for Transport what areas and how many people will be exposed to different amounts of aircraft noise (a) at night in (i) 2015 and (ii) 2030 and (b) in 2030 based on an average six hour day in connection with the proposals relating to Alconbury airfield contained in the Department's Consultation, *The Future Development of Air Transport in the United Kingdom (South East)*.

Mr Jamieson: The South East and East of England Regional Air Services study

(SERAS) analysis included illustrative examples of night-time noise footprints for all airport options. The approach adopted is set out in paragraph 6.9.4 of the SERAS stage two appraisal findings report and the results of this work, relevant to the Alconbury option, are presented in paragraphs 12.8.3 and 12.8.4.

These indicate that, using the 90dBA SEL (sound exposure level) footprint for the noisiest aircraft envisaged operating at night, between 300 and 10,600 people might be contained within the footprint - subject to airport operation. The numbers of people affected with this option by different amounts of aircraft noise (daytime) was not assessed at 2030.

20 November 2002

Aircraft noise

Tom Brake: To ask the Secretary of State for Transport what (a) discussions his Department has had or plans to have and (b) representations have been received by his Department with regard to the past and potential future impact of (i) changes in noise levels permitted from individual

aircraft and (ii) changes in the size of aircraft upon (A) past increases and future total passenger and freight numbers and (B) past and future (1) economic, (2) environmental and (3) social impacts.

Mr Jamieson: The full information requested is not readily available and could be obtained only at disproportionate cost. The assessment of options for the future of UK aviation contains information on economic, social and environmental impacts.

This information is set out in the national airport consultation documents published in July 2002. A complete set of those documents and supporting material is available in the Libraries of the House.

Tom Brake: To ask the Secretary of State for Transport what discussions his Department has had or plans to have, and what representations have been received by his Department with regard to the past and potential future impact of compensation and noise insulation schemes being made available to householders near airports; what assessment and research has been made by his Department, or is planned, of the past and potential future impact of compensation and noise insulation schemes being made available to householders near airports; and what compensation and noise insulation schemes are available to householders near airports; what the total level of compensation and financial support has been in each year since 1992; what plans there are to change the nature of the schemes.

Mr Jamieson: The government considers that providing for the effective management of the impacts of airport development will be a key element of a sustainable airports policy. Indeed, this is identified as one of three central issues in the current consultation document, *The Future Development of Air Transport in the United Kingdom*. The document includes proposals for

a range of measures aimed at controlling or mitigating local impacts - including the effects of noise from aircraft - and, where that is not possible, providing adequate compensation. The government is seeking consultees' views on those proposals and inviting other ideas for dealing with this issue. We will study carefully what consultees say in their responses when we come to take decisions for the White Paper next year.

The SERAS study considered the economic costs of aircraft noise, based on observed impacts on property prices. The results are presented in paragraph 14.31 of the consultation document, which is available in the Libraries of the House along with all the SERAS technical reports. In terms of the current position on compensation and noise insulation schemes, I refer the hon. Member to the

answers given to my hon. Friend the Member for Hayes and Harlington (John McDonnell) on 15 October 2002, and to my hon. Friend the Member for Newcastle upon Tyne, Central (Mr Cousins) on 25 April 2002. Information on costs paid under noise insulation schemes is not kept centrally.

The Office of the Deputy Prime Minister has published a series of five booklets, entitled *Compulsory Purchase and*

Compensation, which are available free.

Tom Brake: To ask the Secretary of State for Transport what UK legislation covers the maximum level of noise from aircraft (a) registered, (b) landing and (c) flying through airspace in the United Kingdom;

and what plans there are to amend the legislation.

Mr Jamieson: Noise certification requirements are prescribed by the International Civil Aviation Organization (ICAO), under Annex 16 Volume I of the Chicago Convention. The *Aeroplane Noise Regulations 1999* (SI 1999 No. 1452) and the *Air Navigation (Environmental Standards) Order 2002* (SI 2002 No. 798) transpose these requirements, certain European aircraft noise Directives, and noise certification requirements for microlight aircraft developed by the Civil Aviation Authority, into UK legislation. Taken together, this legislation requires noise certification of most types of civil aircraft taking off or landing in the UK. Civil aircraft overflying UK airspace without taking off or landing in the UK are unlikely to cause significant noise nuisance. EU Regulation 1592/2002 establishes with effect from 28 September 2003 the new European Aviation Safety Agency (EASA). Article 15(l)(h) of that Regulation will confer on EASA a duty to issue environmental certificates, which currently is the responsibility of the Civil Aviation Authority for UK-registered aircraft. Future measures, such as those required to implement the ICAO Chapter 4 requirements for new types of jet aircraft from 2006, will be taken in this context. Detailed arrangements will be determined in due course.

In addition, departure noise limits are specified by Notice under s78 of the 1982 Act for Heathrow, Gatwick and Stansted airports. Some other UK airports apply their own operational noise limits.

3 December 2002

Motorways

Mr Gordon Prentice: To ask the Secretary of State for Transport if he will make a statement on the cost per mile of using a noise absorbing surface on motorways.

Mr Jamieson: I have asked the Chief Executive of the Highways Agency, Tim Mathews to write to my hon. Friend. Letter from **Ginny Clarke** to Mr Prentice, dated 3 December 2002:

I have been asked by the Transport Minister, David Jamieson, to reply to your

recent Parliamentary Question about the cost per mile of using a noise-absorbing surface on motorways.

The cost varies considerably depending on site specific issues such as:

- ☐ the overall size of the contract;
- ☐ whether the existing surface is to be planed out and to what depth, or overlaid;
- ☐ the thickness of the material to be laid and the number of layers;
- ☐ whether the work is to be carried out during the day or at night, re-opening the carriageway during the day;
- ☐ the complexity and duration of the traffic management necessary; and
- ☐ whether it is necessary to resurface the hard shoulders or carry out adjustments to other road items.

The cost per mile for surfacing laid on both carriageways of a dual three-lane motorway would be expected to range between £200,000 and £450,000. These costs are for the quieter surfacings currently being used on the trunk road network in line with government policy. They do not include the cost of porous asphalt for which no recent prices are available. Based on past experience however, this would be considerably more expensive; we estimate perhaps £600,000 to £700,000 per mile.

9 December 2002

Aircraft numbers

Tom Brake: To ask the Secretary of State for Transport how many aircraft departed from (a) Heathrow, (b) Gatwick and (c) Stansted airports in each month since December 2000, broken down by aircraft type; and which are exempt from noise limit standards announced on 18 December 2000.

Mr Jamieson: 22 individual aircraft, which were given specific exemptions from the Chapter 2 phase out provisions in the EC Directive 92/14, were also given exemptions from the new daytime noise limit (94dBA L_{max}) announced on 18 December 2000 and introduced on 25 February 2001. The exemptions applied until 31 March 2002.

During this period the actual number of departures by relevant aircraft was: Heathrow – nil, Gatwick – 2 (both in January 2002), and Stansted – 2 (one in March 2001, one in January 2002). All these movements were by DC8F-55s; none exceeded 94dBA at the relevant noise monitor, even though exempt from that limit.

Book Reviews

Measured Tones: the interplay of physics and music (2nd Edition)

by Ian Johnston

Publisher: Institute of Physics ISBN: 0750307625

Anyone who has wondered how many Stradivarius violins exist, why a saxophone is a woodwind instrument, why the harmonics of a piano string are slightly sharp, why a didgeridu only plays two notes, what the sound source is in a Hammond organ or why Leon Theremin 'disappeared' for 50 years, will find the answers to these and many more questions in this book, which seeks to answer the most fundamental question of all: what is music? But it is much more than a book about the physics of musical instruments. It is a long, historical journey through the development of physics and music and explains how they influenced one another. This journey puts the development into the religious, social and cultural contexts of the times and includes, along the way, potted biographies of many famous scientists, composers and instrument makers.

A wide range of subjects is covered including astronomy, wave theory, electricity, acoustics, electronics and information theory and the section on psycho-acoustics explains the latest theories of consonance. The explanations of the workings of musical instruments cover brass, woodwinds, strings, percussion, electronic instruments and the human voice. The music theory ranges from the early development of scales, through blues and atonal music to computer-composed music (including an interesting flow diagram for a 'banal tune maker' from 1956).

The author, writing in the first person, uses an easy to read, almost chatty style. His explanations are simple and clear and, apart from a few elementary formulae, he manages this without the use of mathematics. More detailed explanations are given in a series of appendices. The ability to read music notation is not essential but will make the examples easier to follow and the reader needs no previous knowledge of acoustics. The subjects are consequently not covered in any great depth, so anyone qualified in acoustics will learn little new about acoustics but will gain a fascinating insight into music and musical

instruments. Similarly, musicians would gain a basic understanding of the physics behind all stages of the production of music and the psycho-acoustics behind the 'hearing' of music.

The layout of the book is good and the text is complemented by useful, clear diagrams and illustrations. It is produced on good quality paper and is sturdily bound in paperback. It is well indexed and includes a bibliography. Anyone wanting a preview can download the first three chapters (85 pages) in pdf format from the IOP web site at www.iop.org.

Graham Rock MIOA

Measurement and assessment of groundborne vibration

Association of Noise Consultants (£30.00)

This book was prepared by a working group of seven members of the Association of Noise Consultants, who are specialists in vibration and have extensive experience in the subject. The introduction states that 'The document is intended to provide guidance and advice...', and it certainly does meet this key intention.

The book is well laid out in three parts covering background information, measurement and assessment to assist the reader in evaluating problems when the earth moves! There are appendices covering damping, transmission, prediction and reduction of vibration as well as ones on standards and legislation. Although very well written and readable it could have benefited from a few more illustrations.

It covers many aspects of vibration but, understandably, pays particular attention to railway vibration and groundborne noise. A wider discussion of road traffic vibration and blast-induced vibration would have been useful. The book is well researched and draws on many national and international references. Practical examples, albeit mainly on railway vibration, are included.

The guidelines are a very welcome aid to assist in the interpretation and understanding of BS.6472:1992 Guide to the evaluation of human exposure to vibration in buildings (1 to 80 Hz) and should form compulsory reading to anyone working with the difficulties of BS.6472.

The publication runs to some 166 pages but the A5 format necessitates the use of small fonts in some of the flow charts, although that may be the reviewer's ageing eyesight! At a cover price of £30.00 it does represent good value for money, especially considering the combined expertise of the authors. As many readers know, BS.6472 is currently being reviewed and it is understood that these guidelines will also be reviewed when the new version is published. If this document has set the standard then the revised version should be eagerly awaited and will undoubtedly help many in the field keep their sanity.

Keith Horton MIOA

Recycled acoustic absorbents: egg crates

All practising acousticians will have been asked at some stage of their career how rooms can be 'soundproofed' at zero cost. For all those who wondered how effective the usual layman's solution for increasing acoustic absorption might actually be, here are the results of a test carried out at the Riverbank Laboratories in March 1988. Mean third-octave absorption coefficients for cardboard egg crate nominally 50mm high, average weight 0.73kgm⁻³ mounted directly onto solid backing.

Frequency Hz	100	125	160	200	250	315	400	500	630	800	1.0k	1.25k	1.6k	2.0k	2.5k	3.15k	4.0k	5.0k
α	0.00	0.01	0.00	0.07	0.07	0.07	0.13	0.44	0.73	0.74	0.61	0.52	0.46	0.48	0.58	0.59	0.69	0.82

School Acoustics

Commonwealth Conference Centre, London

Stephen Chiles and Ian Bennett report from the IOA-led seminar on BB93 draft proposals



The chair requests a show of hands to demonstrate views on a technical point

In response to a request made by the IOA, the draft section 1 of BB93 was issued for public consultation. The consultation period lasted from 17 September to 10 December 2002. This meeting was held on 15 October 2002, mainly to inform people about the proposals in BB93, but also so that they could air their views before the **Building Acoustics Group** responded to the consultation. The Institute's formal response will be available on the IOA web site together with the initial response to an informal consultation in August 2002. The first speaker was **Richard Daniels**, Department for Education and Skills (DfES) - the man responsible for *Building Bulletin* 93. He explained the progression of various acoustics guidance documents for schools issued by the government since 1976. He then explained the recent significant change that, in April 2001, the exemption of schools from the Building Regulations ended, although since that date there have still been no acoustic requirements for

schools which building control bodies would have to check. With implementation of the new *Approved Document E* in July 2003 there will be a reference to *Building Bulletin* 93, which will form the acoustic requirements for schools that building control bodies should enforce. Richard also detailed the relationship of BB93 to the *School Premises Regulations 1999* and *Planning Policy Guidance 24*. A number of case studies focusing on recent school buildings and refurbishments were presented, which demonstrated good design features and well-designed integration of acoustics and natural ventilation systems. He ended by showing that, although the acoustic criteria in BB93 do represent enhancements over the previous guidance (*Building Bulletin* 87), there is substantial investment being made by government for schools, which should enable these better standards to be achieved. This all fits into the overall 'School of the Future' programme to improve education. The next speaker was **Adrian James** from

Adrian James Acoustics, who explained that as well as himself, the DfES had been assisted by a number of acousticians in the preparation of BB93: Arup Acoustics (Raf Orlowski, Sam Wise), Bickerdike Allen Partners (John Miller), BRE (Carl Hopkins, Robin Hall), City University (David Canning), OPDM (Les Fothergill), and the English Cogger Partnership (Nigel Cogger). He went on to explain the major changes since BB87, starting with the most significant which is a reduction of classroom ambient noise levels from 40dB $L_{Aeq,1hr}$ (including activity noise from neighbouring spaces in the school) to 35dB $L_{Aeq,30mins}$ (excluding school activity noise). Various other changes to ambient noise levels were also discussed. It was noted that the intermittent noise limit had been changed from 55dB $L_{A01(lesson)}$ to 55dB $L_{Amax(fast)}$. The continued use of D_w as opposed to $D_{nT,w}$ was also discussed. For airborne sound insulation between spaces Adrian discussed the merits of the

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new table format for the requirements and drew attention to the major change that classrooms are now considered to have 'low' noise sensitivity rather than 'medium' in BB87. Most of the sound insulation requirements have changed and there are no longer separate criteria for spaces catering for the hearing impaired. The strategy for walls and doors to corridors has changed with the recognition that field testing is not practical so laboratory values have been specified. For the first time, impact sound insulation requirements have been introduced. Finally the minor changes to the reverberation time targets were presented.

A session followed with questions being directed to **Richard Daniels, Adrian James, Nigel Cogger, Raf Orlowski and Les Fothergill**. Several issues were raised including the question of whether widespread use of acoustically rated doors in schools was a practical requirement, particularly in terms of operation by primary school children and cost.

At this point and throughout the meeting the chairman (**Bob Craik**) requested a show of hands on issues as they arose to help him gain some feeling for the views of

noise levels outside the school (mainly from road traffic noise, this being London), then by measuring the levels inside classrooms from the usual sources found there, and finally by simple questionnaires for teachers and pupils. The study compared the noise levels with SATs results for relevant classes, in order to investigate the correlation between noise levels and achievement. Good correlations were found, with the older children (Y10) being more susceptible to disturbance from outside the classroom. The prevalence of throat infections and voice damage in teaching staff were also investigated. Further work is ongoing, the intention being to look at secondary schools, and schools outside London.

David Canning of City University, London, then spoke about the problems facing pupils with special educational needs (especially hearing-impaired children) when they are integrated into mainstream classrooms in line with government policy. He examined the issues of masking noise levels and reverberation times, and asked if a more appropriate criterion could be found to address the particular difficulties of the hearing impaired, such as speech intelligibility.



David MacKenzie presents his paper

fighting 'our' corner in the Design and Build team. Her methods depended on getting the right advice at the right time, understanding the issues, resolving the conflicts and getting the details right, and then ensuring the quality of the construction. School designers had to bear in mind the possible needs of different users of the building, since schools are no longer used exclusively for the education of the young.

The final speaker was **David Smith**, a member of the RICS Building Control Forum and a practising surveyor for 40 years. He outlined the ways in which building control bodies (not now the exclusive preserve of the local authority) could ensure that new buildings in general, and schools in particular, were designed and constructed to the required standards. He advocated the development and use of Robust Design Standards (RSDs) which have been used in other fields (notably thermal insulation) and suggested that the IOA should be involved in their development (if not actually driving the process). The question of funding inevitably raised its head.

A further question and answer session followed, which was mainly directed at David Smith as a representative of his profession. The chairman then put some further matters to the vote, in order that he could adequately reflect the feelings of those attending the meeting.

Thanks are due to the authors and the Building Acoustics Group, especially Bob Craik for chairing the day and the organisers Stephen Chiles and Adrian James.

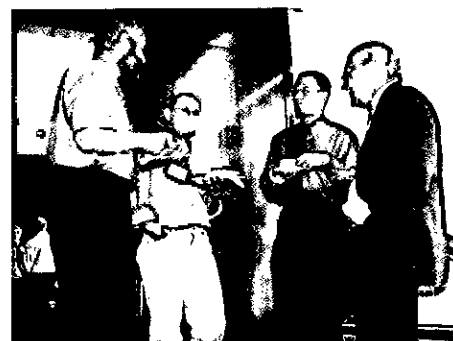


Discussions continued over lunch, with Bob Craik defending Scottish rights

the IOA membership. Where there was a clear majority these views will be generally recorded in the formal IOA response, which also takes into account other opinions received by the Building Acoustics Group. The third speaker was **David O'Neill** of Fleming and Barron, who explored whether or not the new BB93 would adequately address the difficulties posed by the use of BB87. He examined several issues which have been of particular concern in his practice, and wondered if Building Control Officers would have the means and the experience adequately to assess whatever information was submitted to them during the design and construction of a new school. The problems created when sports halls were used for examinations were highlighted, and some thought was needed about how (or indeed if) a gymnasium should be designed to meet the tighter acoustic criteria implicit in the use of the room for exams.

Bridget Shield of South Bank University then presented a study which has been going on for the past eighteen months into the effects of noise on children and teachers in the classroom. A number of primary schools in three London boroughs had been studied, first by surveying the

After the usual excellent lunch laid on by the Commonwealth Conference Centre, the conference reconvened to hear a paper by **David MacKenzie**, Herriot-Watt University, on the acoustics of primary school classrooms. He showed pictures of newly-built 'standard' school designs in Scotland, and described the horror stories of open-plan classrooms housing hundreds of pupils. This prompted a rather heated discussion about why open-plan classrooms are still built at all, since they were manifestly unable to fulfil the requirements of BB87 let alone BB93. David went on to discuss the problems of schools built down to a price, rather than up to a quality, and questioned the architectural fashion for large quantities of glass (which increase reverberation). He also dealt with the conflicting requirements of natural ventilation and external acoustic insulation. The next presentation, led by **Georgina Frank** of Bovis Lend Lease, gave an insight into the contractor's perspective. As an architect she felt somewhat intimidated by the acoustician's usual hostility towards her profession, but nevertheless explained her understanding and desire for good acoustics in new and refurbished schools. She assured the meeting that she was



Candidates for the IOA certificate of competence in crockery - juggling

Business rates income to help tackle noise nuisance

The Greater London Assembly has highlighted the current recruitment crisis among EHOs as one of the main causes of increasing environmental noise in London. It has called on local government to lobby for an increased share of business rates to deal with noise nuisance.

In a response to the mayor's draft noise strategy, the GLA environment committee wants local environment funds to be established to address problems of late night noise from pubs and clubs. Funding would be raised through the uniform business rate with money from the entertainment industry ring-fenced for noise nuisance (central government at present takes over 90% of business rates, and the remainder goes directly to local authorities). Raising funds through the entertainment licence system is also under consideration.

To meet a particularly pressing need, funds could be diverted to help with the recruitment crisis. At present there are insufficient EHOs and London residents are missing out as a result. It may be necessary to fund more apprenticeships or help with student fees, according to the chair of the GLA environmental committee.

One of the central recommendations of the mayor's draft noise strategy for dealing with mixed usage in city centres was for boroughs to create entertainment management zones (EMZs). In these areas where people live in a high density mixed-use environment, policing, licensing, planning transport, and environmental health issues would all be

considered. The mayor also wants to see planning applications for housing within an EMZ accompanied by noise mitigation measures. This already happens as a matter of course in other urban centres, notably Manchester.

Examples of possible policies include a suggestion by Greenwich LBC that new noise sources in EMZs should not increase the existing ambient level. Any new noise source would have to be 10db below the current background level. Another strategy would be to object to the renewal of alcohol licences for pubs with ongoing noise problems.

The assembly recognises that it would

be unfair to expect councils to establish EMZs without financial support. Lack of communication between interested parties such as police, EHOs and traders is also highlighted as a cause of noise nuisance. The new trend for cafes and pubs with fully open shop fronts means they are much noisier than conventional venues. The GLA wants more communication between local authorities and venue owners at an earlier stage, giving noise nuisance a higher priority. In its recommendation to the mayor's noise strategy, the Chartered Institute of Environmental Health called for more education on the use of natural ventilation to reduce the need for air conditioning equipment, another source of ambient noise.

Noise risks to pub and club employees and customers

The Health and Safety Executive has warned that owners of pubs and clubs should be given more education about the risk to their staff and clientele from high noise levels. Research published by the HSE reveals that there is definite potential for harming employees, although it is not possible to estimate how many people are at risk of developing impaired hearing. The research has prompted the Executive to consider joint action with other government organisations and employee groups.

Any action would have to address two issues. The first was protecting the hearing of those at work, for which there is already legislation and guidance which employers should follow, and applies as much to pubs and clubs as it does to a factory. The second

is protecting the public from the same risks. The research is calling for initiatives to alert pub customers and clubbers that they may be damaging their hearing by going to places that play loud amplified music. Staff should be 'buffered' from noise by restricting the time they spend in the noisiest areas, should get more education about hearing loss, and get into the habit of wearing hearing protection. The EU noise directive about to come into force will give member states three years to implement legislation reducing action levels from 85dB(A) and 90dB(A) to 80dB(A) and 85dB(A) respectively. Permissible peak levels will be reduced from 140dB to 87dB(C). The music and entertainment industry is expected to be given a two year transitional period to abide by the new legislation.

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Government tackles noisy neighbours through tougher building regulations

In a move to deal with the misery of noisy neighbours, the government is demanding more robust building standards to improve soundproofing in new homes and schools. As members will be well aware, steps to protect sound privacy are included in recent amendments to Part E of the Building Regulations, which come into effect next year. Official guidance on the amendments was published just before Christmas. Announcing the new guidance on Part E of the Building Regulations dealing with resistance to the passage of sound, **Christopher Leslie MP**, the Minister responsible for Building Regulations, said that too many people experienced noisy neighbours, whether late night parties, or loud television. This could have a significant impact on quality of life. It is also one of the issues councils get the most complaints about. At a time when the construction industry is being encouraged to build to greater densities, this matter is even more important. This was why the Office of the Deputy Prime Minister was publishing official guidance on new amendments to the Building Regulations. The amendments and guidance are claimed to improve standards of sound privacy between homes, and improve the sound insulation of walls and floors within the home, as well as between rooms in hostels, hotels and residential homes. The scope of Part E of the Building Regulations extends beyond separating walls and floors in houses and flats, to deal with reverberation in the common parts of blocks of flats, and also acoustic conditions in schools.

The new requirements will come into force on 1 July 2003. *Guidance in the Approved Document to Part E* refers to the introduction of a sampling procedure, known as pre-completion testing (PCT), which checks that builders are achieving the higher performance standards in new homes. PCT for new houses and flats will come into force on 1 January 2004. This later date gives the House Builders Federation time to develop Robust Standard Details (RSDs) for constructions that perform consistently well, and so would not require regular testing. Should the House Builders Federation successfully satisfy the Building Regulations Advisory Committee on the practicality of the RSD approach, the government will consider further amending the Building Regulations to allow new houses and flats using RSDs to be built without Pre-Completion Testing. Separate amendments dealing with fire safety will bring Part B of the Building Regulations in line with new European Standards.

The amendments to Part E of the Building Regulations are being made through two Statutory Instruments: 2002 No. 2871 and 2002 No. 2872, which were laid before Parliament on 25 November 2002.

The new Approved Document is available on the ODPM website at <http://www.safety.odpm.gov.uk/bregs/brads.htm> or from the Stationery Office, PO Box 29, Norwich NR3 1GN tel: 0870 600 5522, fax: 0870 600 5533, e-mail: book.orders@theso.co.uk. A *Regulatory Impact Assessment* in relation to these Regulations was also published, and is available on the ODPM website at: <http://www.safety.odpm.gov.uk/bregs/brpub/02.htm>. Guidance on the use of beam and block separating floors is not included in the new Approved Document because in the past the performance has been marginal. However, the manufacturers have embarked on a development programme to improve performance, and it has shown promising results. **Ian Carling**, Secretary to the Beam and Block Association, tel 01666 825 568 should be consulted for the latest information. (e-mail: ian@iancarling.demon.co.uk)

ESI Group acquires controlling stake in VASci

ESI Group, a provider of virtual prototyping and manufacturing systems, has acquired a controlling stake in Vibro-Acoustic Sciences (VASci), a US-based company producing digital simulation software for high-frequency noise and vibration engineering. The company's AutoSEA software enables users to simulate vibro-acoustic phenomena and predict design performances. Its main markets are the aerospace, rail and automotive industries.

Users can model the acoustic and vibration behaviour of complex structures such as vehicle body-in-white: noise and vibration engineering becomes part of the design process performed on the virtual prototype, instead of waiting for a physical prototype. For more information on ESI Group, visit www.esi-group.com and for Vibro-Acoustics Sciences, www.vasci.com. **ESI UK contact:** Tony Busvine, tel : +44 (0) 1865 338007 fax: +44 (0) 1865 338100.

PEOPLE

Adrian Passmore



After graduating in 1992 from Salford University with an Electroacoustics degree, Adrian joined Subacoustech Ltd, specialists in underwater acoustics research, where he worked on long-term

projects for the defence and petrochemical industries. The work included propagation modelling and active and passive noise control.

In 1997 Adrian joined Sound Research Laboratories as a Noise Consultant based at the London office. He project-managed a wide range of architectural and building acoustics projects including hotels, law courts, and mixed-use developments. Adrian was promoted to Senior Consultant in 2000 and also gained Corporate Membership of the Institute of Acoustics.

Between 2001 and 2002 he worked for Spectrum Acoustic Consultants and assisted in developing their new London office, before joining *Arup Acoustics* at their London office

in October 2002 as an Acoustic Consultant specialising in building acoustics.

Adrian has a working knowledge of Italian, enjoys travelling, and spends his free time playing guitar, cinema going, and cooking. He is a keen sportsman and keeps fit by swimming and regularly going to the gymnasium

Mike Fillery



After twenty-three years at the University of Derby, Dr Mike Fillery has left the world of teaching and research for full-time acoustic consultancy with the *Symonds Group Ltd*, based in the Manchester

office. This is not such a big jump as it may appear, since Mike has been active as a noise consultant for over ten years, working partially through the University of Derby consultancy services but mainly through his own independent company, Sound Advice Noise Consultancy.

Mike said he was excited about joining the team. His wide experience in environmental noise assessment will complement skills already within the group. Symonds is very strong in the leisure and entertainments field

and his expertise in the control of motor racing noise will add to the team portfolio.

Throughout his career Mike has been very active within the Institute, having been Secretary for the Midlands Branch since 1995 and a regular contributor to conferences. As current Chairman of the Education Committee, he has assisted in the modernisation of IOA courses and expansion of the Institute's education programme. He is very hopeful that he will find time to continue with these roles into the future.

Steve Phillips

Steve Phillips of TRL Ltd has transferred to Brussels to take up a three-year appointment as Secretary-General of the *Forum of European National Highway Research Laboratories* (FEHRL). The move resulted in some changes to the operations of the Environment Group he has led for some time. Marie Taylor has taken over his group management activities and can also transfer enquirers to the most appropriate member of the group.

FEHRL was founded by TRL in the 1980's to coordinate research activities in the highways sector throughout Europe. It plays an important role in advising the European Commission and national bodies on research priorities, harnessing the talents of its 25 members which include TRL, BAST (Germany) and LCPC (France). The web site is at www.fehrl.org.

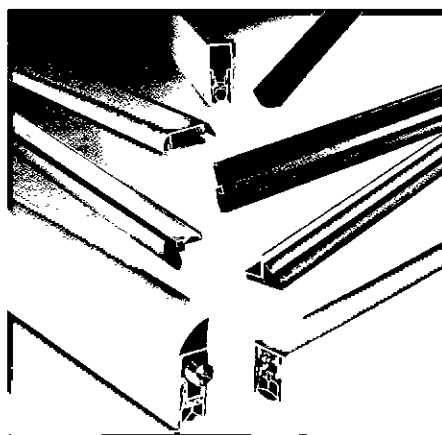
Lorient Polyproducts**Acoustic sealing solutions**

Modern construction designs frequently call for the incorporation of door seals to provide fire, smoke or weather protection. Many applications will also require doors to contribute to the acoustic performance of a building compartment, but few companies provide acoustic data on these applications.

Lorient Polyproducts already offers acoustic test evidence on many of its products, but has now reinforced its commitment to providing acoustic sealing solutions by testing even more product combinations. The tests included several products from the company's well-established range of fire and smoke seals, in combination with brand new products recently added to the *Integrity* range of architectural seals. Many combinations gave acoustic ratings as effective as a fully caulked door – the theoretical maximum performance achievable. The tests were undertaken at Sound Research Laboratories Ltd, a UKAS approved laboratory. All tests were undertaken in accordance with BS EN ISO 140/3: 1995 *Methods of measurement of sound insulation in buildings and of building elements*.

The comprehensive test programme addressed three different types of door assembly. These included standard, non-fire rated leaves; FD30S and FD60S equivalents, and specialist acoustic constructions. Double leaf as well as single leaf configurations were evaluated.

Without any seals at all, both the fire rated and non-fire rated door assemblies were capable of an R_w performance of only 22dB. When fully



caulked, however, this increased to an R_w of 33dB, and nearly half of the different seal combinations tested were able to match this theoretical maximum performance.

The specialist acoustic doors achieved a fully caulked rating 40dB R_w . A combination of an IS8010Si automatic threshold seal together with Lorient's *Batwing* retrofit smoke seal produced an impressive result of 37dB R_w , an improvement of 14dB over the uncaulked rating. Several other product combinations matched this result.

Full details of the acoustic test results are available from the Lorient Technical Department.

For a copy of the *Lorient manual Acoustic sealing systems for door assemblies* contact: The Marketing Department, Lorient Polyproducts, Fairfax Road, Heathfield Industrial Estate, Newton Abbot, Devon TO12 6UD tel 01626 834252.

A Proctor Group**Child's play at Gyde House**

Providing acoustic insulation to the Gyde House project in Gloucester was child's play for the **A Proctor Group** of Blairgowrie. During a recent conversion of the former children's home into luxury apartments, *Profloor Microdeck* met the numerical requirements of Approved Document E without drastically raising the floor's height. The product is only 17mm thick, so the crucial floor heights were kept to a minimum, whilst the unique foam technology provided excellent impact insulation.

Profloor Microdeck is one of a range of six acoustic flooring products manufactured by the A. Proctor Group and a British Board of Agreement Certificate means that it can be specified with confidence.

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SOUND & VIBRATION

British Gypsum Sounds good in the classroom

Acoustic performance is an important consideration when designing classrooms. Research indicates that high levels of background noise adversely affect the learning environment. Extensive research has been undertaken throughout the field of acoustics and, as *British Gypsum* brand manager **Jonathan Cherry** explains, good acoustics is not something that can be bolted on to a building. It has to be a prime consideration from the beginning of the project.

From the outset, the designer must consider the various activities and room types, and establish background noise levels and reverberation times for each.



Classroom at St Joseph's School, Pontefract where British Gypsum Voice and Forte tiles have been installed

The rooms are then planned to ensure that their disposition works in relationship with adjacent, upper and lower rooms. Poor room acoustics can compromise the learning potential for young children, especially those with hearing and learning disabilities. A lack of speech clarity and an abundance of background noise create a barrier to learning which encourage children to switch off. This is especially bad for those with hearing aids and or implants, as the devices amplify both wanted vocal sound and unwanted sounds such as reverberation and background noise. Good acoustic design can ensure that pupils hear clearly without distraction, and teachers achieve maximum clarity in their presentations. The Department for Education and Skills has produced a series of guidelines (DfEE Building Bulletin

87) outlining standards for background acoustic tolerance. The bulletin provides a maximum recommended acoustic level for background noise according to room type. The standards vary according to whether the room is the receiving room or the adjacent activity room (generating the noise). A typical standard height classroom of floor area between 30 and 65 m², for instance, is recommended to have a reverberation time of 0.5 – 0.8 seconds, while for a music room this should increase to 0.8 – 1.2 seconds.

As reported elsewhere in this issue, the government is redrafting the Bulletin. The new draft proposes to change the reverberation time measurement to include 2kHz, where it previously only made recommendations in the range 500Hz to 1kHz. These new changes will increase times from the previous 0.5 - 0.8 seconds in classrooms to 0.4 – 0.8 seconds, whilst music room reverberation times will fall into the range 1.0 - 1.5 seconds. The recommendations also now include rooms in nurseries, emphasising the importance of good room acoustic in all learning environments.

Whilst achieving the target reverberation time for a specific room will provide good room acoustics, it can not guarantee perfect speech clarity - which is the level of intelligibility of the spoken word. There are two separate methods of measuring the intelligibility of the spoken word in a room – subjective and objective.

The subjective method is a simple reading and listening test where respondents tick boxes which represent the words they believe that they have heard. The results are assessed and a percentage is then formulated based on the number of correct words heard. The second, objective method, uses a rating index known as RASTI or Rapid Speech Transmission Index. An electronically produced test signal is used to represent the properties inherent in the spoken word, and in place of the respondents microphones are used. The response is then translated into the RASTI determining the levels of speech clarity.

High performance tiles

British Gypsum has developed a new system for increasing voice intelligibility and speech clarity whilst still reducing reverberation times. A new series of tiles in the company's *Arteco* range, Casoprano Nova and Alto, which follow the currently successful *Voice* and *Forte* tiles, have been developed to give high acoustic performance and distinctive design. Whilst still identical in appearance, these

gypsum tiles have been developed with very different performance characteristics, offering respectively high levels of sound absorption and sound insulation to meet varying demands of the multifunctional school environment.

Sound absorption occurs when some or all of the sound energy passes through an absorbent material. Sound insulation, on the other hand, eliminates the excess sound passing from a source to a receiver such as the teacher to the pupils. Although insulation and absorption are different concepts, and good sound absorbers do not necessarily make good sound insulators, there are many instances where the combination of sound absorbers and insulators will increase speech intelligibility. A computer program enables tile combinations to be produced which give near-perfect voice intelligibility. The program allows users to preview the sound quality achieved based on varying different tile configurations. By feeding data including room size and shape, materials used on floors and walls, size and shape of windows doors and other openings, along with the teacher/ pupil location into a computer programme the type and location of the tiles is produced. The program will automatically work out the pattern of the sound insulating and sound absorbing tiles needed to meet recommended reverberation times and provide optimum speech intelligibility. It will also identify the optimum position for the installation of *Arteco Gyptone* boards to reduce noise reflections off the back wall of the room, further enhancing the acoustic environment.

So successful is the appearance of schoolroom design that Jarvis plc, one of the leading PFI schools contractors has generically specified and is already using a combination of British Gypsum's specially designed acoustic systems including wall and ceiling tiles combinations.

Allan McMahon of Jarvis has worked closely with British Gypsum to develop the project specification, and is confident that the integrated wall and ceilings package is the best that is currently available. Initial site testing at schools where the specification has been used shows excellent reverberation times and near-perfect voice intelligibility, giving Jarvis the confidence to roll it out throughout its programme of PFI new-build or refurbished schools. British Gypsum also covers the whole integrated system with a lifetime performance warranty, which is a real benefit in PFI where the long-term performance of the entire building is a major concern.

The Beer Conference

The biggest beer producers in the world met for a conference, and at the end of the day, the presidents of all the beer companies decided to have a drink together at the bar. The president of Budweiser naturally ordered a Bud, the CEO of Miller ordered a Miller, Foster ordered a Fosters, and so on down the list.

Then the barman asked Arthur Guinness what he wanted to drink, and to everybody's amazement, he ordered a cup of tea. "Why don't you order a Guinness?" his colleagues asked suspiciously, wondering if they had stumbled on an embarrassing secret. "Oh, no," he replied. "If you lot aren't going to drink beer, then neither will I."

The Editor welcomes letters for publication

Please send them to:

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Institute Diary 2003

30 January

Engineering Division,
St Albans

4 February

Research Co-ordination,
London

10 February

Diploma Tutors and Examiners
& Education,
St Albans

13 February

Publications Committee,
St Albans

20 February

Membership Committee,
St Albans

27 February

Executive,
St Albans

28 February

Meetings Committee,
St Albans

12 March

Workshop: Assessment of
aircraft noise - are we doing
it right?
Liverpool

19 March

Physical Agents 002,
Licensed for Safety
The European directives on
vibration and noise,
Woodstock, Oxfordshire

20 March

Medals & Awards & Council,
St Albans

26 March

Venues for Sport and
Entertainment,
Manchester

2 April

IPPC: how it should fit with
planning and strategic noise
mapping: What do you think?
Birmingham (provisional only)

8 April

Diploma Examiners Meeting,
St Albans

8 April

Workshop, Design & Build:
Unplugged,
London

8 May

CMOHAV Examiners &
Committee,
St Albans

15-16 May

Spring Conference, IPPC,
PAD(AWR), NCE & NVH:
The 'initial' conference of the
Noise and Noise & Vibration
Engineering group,
Coventry

15 May

Annual General Meeting

2 June

CCENM Examiners &
Committee,
St Albans

5 June

Membership Committee,
St Albans

10 June

Meetings Committee,
St Albans

10 June

Research Co-ordination,
London

17 June

CCWPNA Examiners &
Committee,
St Albans

19 June

Distance Learning Tutors WG &
Education,
St Albans

24 June

Engineering Division,
St Albans

26 June

Publications Committee,
St Albans

3 July

Executive,
St Albans

17 July

Medals & Awards & Council,
St Albans

5 August

Diploma Moderators Meeting,
St Albans

16 September

Meetings Committee,
St Albans

18 September

Membership Committee,
St Albans

25 September

Executive,
St Albans

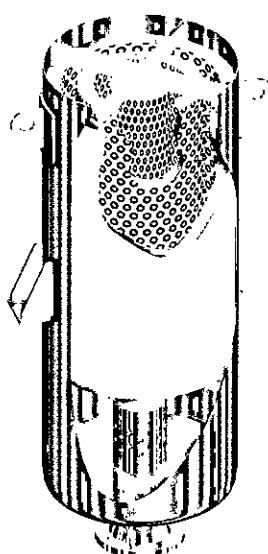
30 September

Diploma Tutors and Examiners
& Education,
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