Acoustics BULLETIN

VOL 29 No6 Nov/Dec 2004

2004 Autumn Conference report

Vibration modelling in buildings
Low-frequency noise criteria for concerts
BBC Birmingham's new home
Institute Code of Conduct revised

Institute of Acoustics

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Contents

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.

Dear Members

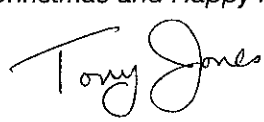
The Institute marked its thirtieth anniversary year at the Autumn Conference dinner on 6 October and I am pleased to record a successful event, enhanced by the presence of our guest of honour Dr Leo Beranek. In addition to his invited address, in which he presented his authoritative analysis of concert hall design, Dr Beranek's willing accessibility to our membership at the conference made this a very special occasion in the Institute's calendar. This Acoustics Bulletin contains reports of recent meetings, which I hope will encourage members who weren't able to attend to swell the numbers at future meetings.

In collaboration with one of our Sponsor Members, the Industrial Acoustics Company, we announced the launch of a new award intended to raise the profile of the inventiveness and skills of acoustical engineers, with particular emphasis on their early career stage. Conditions of entry and nomination forms for the Young Persons Award for Innovation in Acoustical Engineering will be available from the Institute office and the web sites of the Institute and IAC. I look forward to this award taking its rightful place among our existing range of medals and awards. Do read the summary on page 77 of the new Register of Members for 2004/5, and if you know a deserving candidate for any of our medals or awards please put pen to paper and nominate them.

The emphasis of our new award is on young engineers, and this reflects recent Council discussions where we have been considering ways of improving contact with our younger members, and indeed to encourage others to join us. For example, the Institute's new web site will include improved communication features, and from 2005 we will for qualifying students be waiving the fee for the Student Member grade, so as to encourage interest and participation from the younger age groups. Council would welcome feedback and suggestions in this regard, so don't hesitate to contact me or Hilary Notley, the current Young Members' Representative, with your constructive criticisms and suggestions. Hilary's contact details will be found on page 26 of the Register of Members under the RAF Centre of Aviation Medicine.

Spring 2005 will be election time so don't forget that nominations for members of Council, including the Young Members' Representative, are welcomed from the membership at large. Volunteers for our other standing committees would also be gratefully received at any time. For further details contact Roy Bratby at the office.

As Yuletide festivities will soon be upon us, I wish you all a Merry Christmas and Happy New Year.

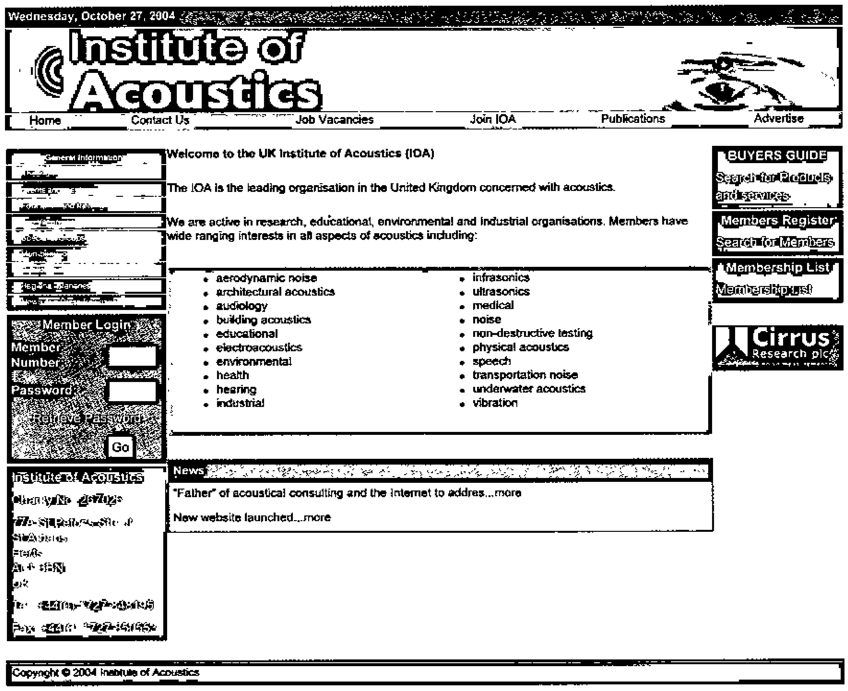


Tony Jones
President

Acoustics on the Net

IOA to launch new website

Obtaining information from the internet is now second nature to most of us. Indeed it's the first place that many go to when they need product details or contact addresses or phone numbers. The expectation for accessible information has increased dramatically over the last couple of years, and has led to a redesign of the IOA website to try and meet today's needs. The new site aims to continue to provide easily accessible information that is up to date and relevant to both members of the Institute and the general public. At the same time we are recognising the move away from paper-only copies of directories to on-line content, that enables quick and easy up-dating of information.



What's new?

Some of the changes will be obvious immediately, whilst others occur behind the scenes to enable the Office staff, specialist groups and the like to upload information directly. Changes include:

- On-line version of the Register of Members - with members able to log-in and update their personal details, and access member-only content;
- On-line version of the Buyers Guide - with manufacturers able to update their entries and ensure that the latest information is presented;
- Ability to order publications on line; and
- Areas for regional branches and specialist groups.

The site has been restructured to enhance accessibility to information including: job vacancies; events and meetings section; and membership information.

What's next?

There are a number of planned additions to the site, such as the ability to apply for membership fees on-line, which will be phased in over the next few months.

Where is it?

The address is www.ioa.org.uk.

When's the launch date?

We hope that the new site will be up and running by the beginning of December.

What do you think?

If you have any comments about the new site, or improvements that could be made, then please let us know.

Dr Matthew Ling
Chair Publications Committee
e-mail: Matthew@quiet.org.uk

NEW MEMBERS

At Council on 14 October 2004 the following were elected to the membership grades shown

Fellow
Boulter N J

Member
Anderson A S
Chan D B
Clamp G E
Dalziel J T
Dodson A
Downey O R
Ellerton D P
Fineschi F
Ip C W R
Karatsovis C
Kinghorn C L
Lau S K
Leung K F
Leung Y T
Lui W K
Meers S D
Morgan N A
Scott C L
Wahlstrom J J E
Williams C H
Williams D P
Wong Y W

Members are asked to encourage their colleagues to consider the benefits of membership of the Institute

Details and application forms for all grades of membership are available from:
The Institute of Acoustics,
77A St Peter's Street, St Albans,
Herts AL1 3BN
Tel: 01727 848195

From DAT to DISK

IOA seminar on Recording Sound for playback or analysis

15 February 2005 - Royal Society, London

The Institute of Acoustics (IOA) is holding a one-day meeting on 15 February 2005 at the Royal Society, London covering the often-misunderstood techniques behind the recording of sound or vibration for later analysis. Applications may include the monitoring of nuisance complaints by Environmental Health, engineering problem solving, product design, quarry blasting and demolition among others.

The morning session offers papers from an impressive array of leading industry experts, who will delve into this 'black art' to bring a little 'clarity' to the issues. The afternoon is split into two seminar sessions covering recording techniques and playback respectively.

In parallel to this, two of the speakers will be taking 15-minute 'surgeries' where delegates are invited to bring along their own equipment for specific advice and guidance. Book early to guarantee a slot! A number of manufacturers of equipment will also be on hand for advice and information.

Issues to be addressed during the morning will be wide and varied including comparisons of various recording systems, pitfalls and successes of differing media and calibration of recording devices and systems. There are also papers on the application of recording systems, common problems of using recording systems, data analysis from recorded sound and quality issues of recording for differing applications.

Booking forms are available from the Institute of Acoustics by calling 01727 848195 or by visiting the web site at www.ioa.org.uk

Limited exhibition space is also available on a first come, first served basis.

For further information contact: Linda Canty, IOA - tel: 01727 848195; email: linda.canty@ioa.org.uk website www.ioa.org.uk
Or: Simon Bull, Castle Group (Meeting Organiser) tel: 01723 584250 email: sales@castlegroup.co.uk website www.castlegroup.co.uk

IOA CONFERENCE REPORT

Sonar Signal Processing

This conference, on 14 and 15 September 2004, was the sixth in the series on *Sonar Signal Processing*, of which all but one took place at Loughborough University, and was held in tandem with the conference on Bio-Acoustics, held on 16 September. The programme reflected important and rapid advances being made in array processing, high resolution techniques, synthetic aperture sonar and image processing, and was augmented by three invited keynote presentations and five invited papers. All papers were subject to refereeing, which helped maintain a high technical standard.

Professor Tom Curtis (CurtisTech) gave the first invited keynote presentation, *Sonar technology - past and current*, which described the huge advances in signal processing power over the past forty years and their impact on practical sonar systems. This set the scene for a set of papers on arrays and array processing techniques, including the second invited keynote presentation by **Dr Paul Hines** (DRDC, Canada), entitled *Measured performance of a superdirective line array under non-ideal conditions*.

The afternoon included a set of poster presentations, previewed using 'quad' slides (a single slide for each poster, identifying objectives and key results, and used by the session chairman to introduce each poster).

The second day began with the third invited keynote presentation, *Synthetic Aperture Sonar: the past, the present and the future,* in which **Professor Peter Gough** (University of Canterbury, New Zealand), highlighted the development of what is now one of the hot topics in sonar signal processing. This was followed by presentations covering further aspects of synthetic aperture sonar, including fast factorised back-projection processing, waveform coding and design, and object classification in sonar imagery.

The conference proceedings are available on CD-ROM: *Proceedings of the Institute of Acoustics*, Vol.26, Pt.5, 2004; ISBN 901656 64 0; ISSN 1478-6095.

Professor Hugh Griffiths FREng, FIOA
Conference Chairman
University College London

Symposium on Bio-Sonar Systems and Bio-Acoustics

The third Bio-Sonar Symposium, held at Loughborough University on 16 September, was arranged jointly with the Sonar Signal Processing conference, because it was felt there would be many potential delegates with an interest in both topics. Through another innovation contributions were encouraged from non-underwater fields, and particularly from those working with bat echolocation. Both these new developments proved to be successful but, sadly, the occasion was marred by the loss of Dave Goodson, one of the prime movers behind this conference series, who died earlier this year.

Thus, the meeting began with a session devoted to remembering Dave's contribution to the Bio-Sonar conferences, and to marine bio-acoustics in general.

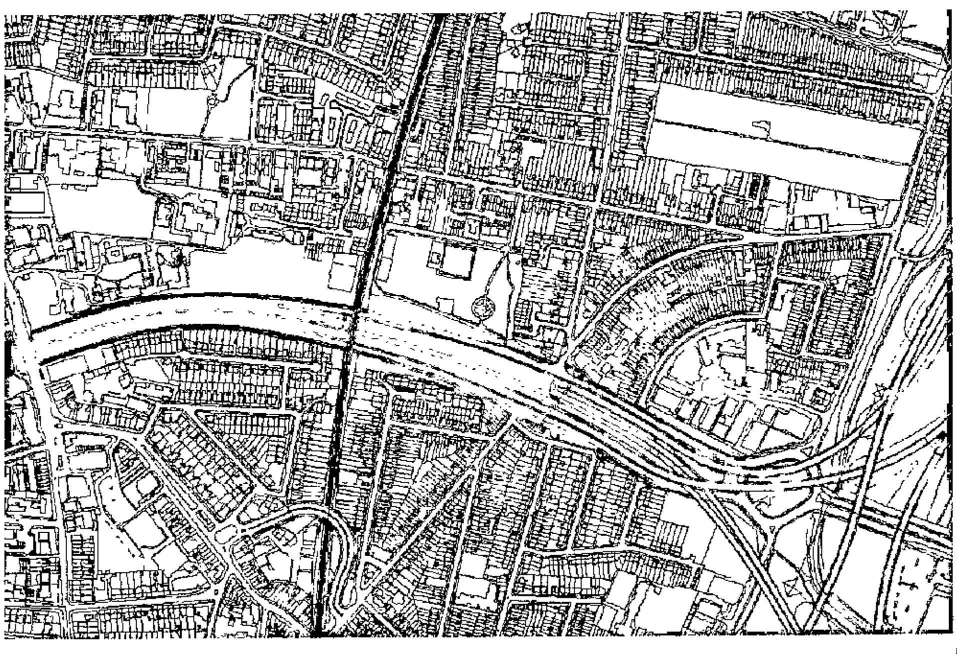
Following a thoughtful introduction from **Professor Bryan Woodward** of Loughborough University, the first presentation was an invited paper by **Whitlow Au** (Hawaii Institute of Marine Biology), reviewing research into the sonar of the harbour porpoise, one of Dave's key interests. This was followed by **Peter Dobbins** talking about biomimetic sonars based on dolphin echolocation, and describing work he and Dave had undertaken together.

The coffee break then gave delegates a chance to view posters on killer whale response to whale watchers and horseshoe bat receiving directivity. This was followed by sessions devoted to modelling biological sonar, the environmental impact of underwater sound, data capture and analysis for bio-acoustic signals and, finally, bio-mimetics, the application of nature's solutions to man-made systems.

Overall, there was an interesting and varied assortment of papers, with some sixteen presentations making it a satisfyingly full day and attracting delegates from the USA and Canada, Israel, Germany, France and Belgium, and, of course, throughout the UK.

The conference proceedings are available on CD-ROM: *Proceedings of the Institute of Acoustics*, Vol. 26, Pt. 6, 2004; ISBN 1 901656 65 9, ISSN 1478-6095.

Peter Dobbins FIOA
University of Bath



NW Branch meeting

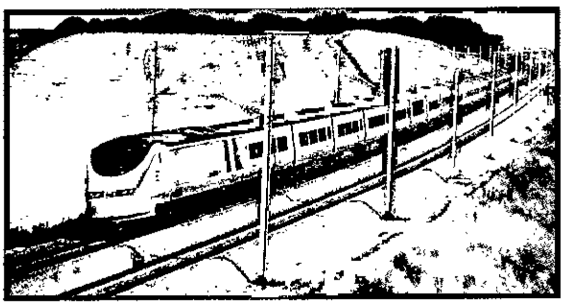
The Channel Tunnel rail link

Some statistics from **Richard Greer**, Noise and Vibration Manager of Rail Link Engineering (RLE) with 14 years of 'chunnel' experience, opened our September meeting.

Section 1 runs from Folkestone to Waterloo and is 75km in length, permits speeds up to 300kph and was constructed 1998-2003. There exists some 37km of noise barriers and 5km of low-vibration track.

Section 2 (running north of the river to St. Pancras) is 33km long, permits speeds up to 230kph, has 5km of noise barriers, 45km (including some double-track sections) of low-vibration track and was started in 2001. Completion is anticipated in 2007. It is worth mentioning that Richard is on part-time - formerly full-time - secondment to RLE from Arup. RLE itself is a consortium of Halcrow, Bechtel, Systra and Arup.

This construction is the UK's first high-speed railway and as such presented many new issues to be overcome. As may be expected, noise was a major public concern, as was the contentious route selection, involving a lengthy consultation process. The largest Environmental Impact Assessment (EIA) took place, resulting in a new acoustic acronym - NEWT - Not Environmentally Worse Than - having nothing whatsoever to do with alcohol consumption.



The Noise and Vibration management objective was to comply at 'reasonable cost and minimum risk'. The combination of 'cost' and 'risk' in the one phrase might beg the question, was the 'risk' one of safety or finance? Of course, it would undoubtedly be the former.

Part of the brief was to work openly with all interested parties, including no less than 18 local authorities, on an ongoing basis.

Much empirical data had to be replaced with specially formulated finite and boundary element modelling from some 10,000 measurements. Aspects of noise and vibration and speed had to be predicted, air and ground borne.

The siting and styling of noise barriers/bunds was considered, especially in light of the fact that some bunding created 'positive' financial returns, since the noise objective became achievable without the need for special barrier manufacture and construction whilst eradicating any need for the expense of earthwork disposal off-site. Subsequent landscaping proved appealing to the public and even allowed some return of land for agriculture.

Absorptive timber barriers were purpose designed and, as with many other acoustic aspects of the project, were innovative and cost-saving at the same time. Low level barriers were designed for viaducts, saving on costs both for the barrier itself and, indeed, the viaduct construction.

The whole job must have been an administrative nightmare consisting of a 75km building site spread across 18 LAs over five years, having Section 61 consents throughout. LAs and contractors had to agree Best Practicable Means (BPM) as opposed to the more popular CATNAP (cheapest available technology, narrowly avoiding prosecution).

Even track and ballast systems had to be redesigned to minimise vibration and ground borne noise. Sleeper support systems were specially designed and had to take account of freight as well as high-speed passenger traffic.

Tunnel works and their impact on, primarily, residences was another major consideration.

Nothing was to compromise RAMS - reliability, availability, maintainability, safety - (shouldn't that really read 'SRAM', *ie.* putting the safety first?).

A special rig having a hydraulic ram with an exciter was constructed to ensure that systems would function within RAMS under extreme loading conditions. Pads and boots were bespoke designs, optimising dynamic stiffness and acoustic stiffness, to meet these newly created demands. A remarkable 18dB improvement over existing long-established designs was achieved.

St. Pancras' 7km of rails terminate on the 1st floor level, below which lies a vast hitherto underused undercroft. It was decided that this space could be utilised for various additional purposes, including offices, Customs and Excise, Immigration, etc. All of which required careful acoustic design to reduce noise and vibration intrusion.

Incidentally, section 2 includes a small link from St. Pancras to the West Coast main line, thereby finally linking the southeast, the 'chunnel' and Europe to the hub of the UK, viz. the Northwest of England!

Further issues involved ventshaft fan and air motion noise (not to exceed L_{A90} by more than 5 dB), tunnel airflow noise, bridging of other lines and other points coming thick and fast throughout Richard's delivery. A question session also followed the main talk.

Clearly, a great deal of work and effort has gone into this project to achieve the required outcome. Innovation and improvements to existing design will, no doubt, set the criteria by which future rail projects are constructed both here and abroad, ensuring lower noise and vibration will ensue.

Richard is to be thanked for a very detailed and informative talk, coupled with the usual excellent hospitality of Arups.

Peter N. Greenhalgh MIOA
NW Branch Committee

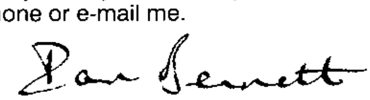
Editor's Notes

Ian F Bennett BSc CEng MIOA
Editor

The 30th anniversary dinner, at the 2004 Autumn Conference, was a genuinely memorable event. The opportunity to hear Leo Beranek was a powerful 'pull' for those thinking of attending the meeting, and our distinguished guest speaker did not disappoint his acolytes. His informed and entertaining discourse on the design of concert halls reminded me why I became interested in acoustics in the first place, and it is amazing to think that when I began working in an acoustical laboratory all those years ago, the great man was already into his sixties. As Tony Jones said when introducing our newest Honorary Fellow, at some stage in our careers we have all had to 'see what Beranek says about it', and reached for The Book. Those who were able to exchange a few words with him in Oxford discovered more than a knowledgeable enthusiast: he is a modest and courteous man who was genuinely delighted to be there. I mean no disrespect when I echo the sentiments of several fellow delegates: 'what a nice bloke'.

Because several Institute meetings have taken place recently, this issue of the *Bulletin* may seem rather overloaded with 'Institute Affairs'. I make no apology for this, as it is the main function of your favourite acoustical magazine to keep members informed about what is going on. As will be realised, *Reproduced Sound 20* immediately followed the *Autumn Conference* in the usual way, and our special correspondent John Tyler was there, but we are holding over his report on 'Improving the listening experience' until the New Year.

Copy for the January/February 2005 issue should reach me before Christmas, please. As always, do not hesitate to offer technical contributions, technical notes, or other articles, so that we can fit them into our broad 'contents plan' for next year. I am always ready to discuss your ideas - just phone or e-mail me.



Ian Bennett
Editor

Code and Rules of Conduct for Members of the Institute of Acoustics

Agreed by Council on 15 July 2004 for implementation from 1 January 2005

Preamble

In the Articles of Association of the Institute of Acoustics ('the Institute') there is a general requirement for members to be bound to further the aims of the Institute to the best of their abilities. The standing of the Institute is enhanced if its members are not only well qualified, but also have a professional commitment to a standard of excellence in their work and in their dealings with other people.
A Code of Conduct, designed to embody broad ethical principles, is necessarily drawn up in general terms. The Rules of Conduct indicate the manner in which members are required to conduct themselves in most situations. For situations not specifically encompassed by the Rules, the principle to be followed is that, in any conflict between a member's personal interests and those of the wider community, the latter should take precedence.

Code of Conduct

All members of the Institute shall at all times:

- ❑ so order their conduct as to uphold the dignity and reputation of the profession and of the Institute and of its members and officers
- ❑ safeguard the public interest in matters of safety, health and the environment
- ❑ exercise their professional skill and judgement to the best of their ability
- ❑ discharge their professional responsibilities with integrity, honesty and diligence

Definitions

The definitions set out below apply throughout these rules.

For the purposes of these Rules:

'members'	includes a member or members of any class referred to in the Bye-Laws.
'employer'	includes client.
'complainant'	is the member or non-member originating the complaint.
'defendant'	is the member against whom the complaint is made.
'Council'	is the Council of the Institute of Acoustics.
'Officers'	are the Honorary Officers as defined in the Articles of Association

A RULES OF CONDUCT

For clarity, these Rules have been grouped into the principal duties which all members should endeavour to discharge in pursuing their professional lives.

A1 Professional competence and integrity

A1.1 Members shall avoid undertaking work which is beyond their capabilities. Therefore members shall undertake to:
✱ upgrade their professional knowledge and skill;
✱ maintain adequate awareness of technological developments, procedures, standards, laws and statutory regulations which are relevant to their field either by involvement in the Institute's Continuing Professional Development Scheme or by any other appropriate means.

A1.2 Members shall not knowingly act for a client for whom other members are acting in the same matter until either:
✱ the first contract has been determined by the client; or
✱ the other member has consented to them acting.

A1.3 Members approached by a client and asked to give an opinion on the work of other members shall seek an assurance that the first members are aware of the second members' involvement.

A1.4 Members shall not maliciously or recklessly injure or attempt to injure whether directly or indirectly the professional reputation of others, whether they are members or not.

A1.5 Members shall show proper regard for the sanctity of data. In particular members will:
✱ not knowingly alter, manipulate, fabricate or misrepresent data.
✱ ensure that primary data used in any publication or report are available in a form that would allow for independent scrutiny and that sufficient details of any experiments, by which the data were derived, are available to allow others to replicate such experiments.

A1.6 If members are co-authors rather than primary authors of reports and publications then they should establish and agree the extent of their professional responsibility for the validity of the work with the primary author.

A2 Public interest

A2.1 Members shall not do anything, or permit anything under their authority to be done, of which the probable and involuntary consequences would, in their professional judgement
✱ endanger human life or safety; or
✱ expose valuable property to the risk of destruction or serious damage; or
✱ needlessly pollute the environment except when legally authorised to do so.

A2.2 In their work, members shall respect all relevant laws and statutory regulations. However, the Institute is not competent to judge the legality of any action nor to resolve disputes concerning non-technical aspects of any contract.

A3 Duty to Employers and Clients

A3.1 When discharging their professional duties members shall:
✱ satisfy themselves as to their scope, obtaining in advance any necessary clarification or confirmation, and shall not accept professional obligations which they believe they have not sufficient competence or authority to perform;
✱ accept responsibility for all work carried out by them, or under their supervision or direction, and shall take all reasonable steps to ensure that persons working under their authority are competent to carry out the tasks assigned to them and that they accept responsibility for work done under the authority delegated to them;
✱ give advice that is objective and, as far as practicable, reliable and take all reasonable steps to ensure that the person who over-rules or disregards their advice is aware of the possible consequences;
✱ disclose to their client or employer any benefits or interests that they may have in any matter in which they are engaged on their behalf;
✱ neither communicate to any person, nor publish any information or matter not previously known by them or published in the public domain, which has been communicated to them in confidence by a client or employer without the express authority of that client or employer;
✱ not offer, give or receive any inducement (financial or otherwise) to or from a third party in return for the introduction of clients or professional assignments without making such action known to the client;
✱ safeguard any funds or other resources managed for the benefit of any person and shall avoid any misrepresentation, whether financial or professional, of their own worth or that of their employer.

A4 Conflicts of interest

A4.1 Where a conflict arises or may arise between the members' own interests and those of any of their associates and the interests of a client, the members must:
✱ disclose to the client as soon as practicable the possibility of the conflict;
✱ inform the client that neither they personally nor their firm or company can act or continue to act for the client unless requested to do so having first advised the client to obtain independent professional advice; and
✱ confirm to the client in writing the above position.

B COMPLAINTS PROCEDURE

B1 Preamble

B1.1 Any person or persons, whether members or not, may originate a complaint under the Code and Rules of Conduct against
✱ a member or members; or
✱ Council or any of its Committees; or
✱ an officer or officers of the Institute acting in an official capacity.

B1.2 Council or any of its Committees may originate a complaint against a member whose actions may be against the interests of the Institute, such actions may include being judged bankrupt or being convicted of a serious criminal offence.

B1.3 Any person who wishes to bring a complaint or information relating to alleged improper conduct or breach of the Institute's Code and Rules of Conduct should contact the Chairman of the Membership Committee who will follow a defined procedure.

B2 Procedure to deal with complaints

B2.1 In the event of a complaint or the bringing to his/her notice of information relating to alleged improper conduct or breach of the Institute's Code and Rules of Conduct, the Chairman of the Membership Committee shall inform the defendant that a complaint has been received.

B2.2 The Chairman shall appoint from the members of the Committee a member or members to carry out an investigation into the facts of the complaint and to report those findings to the Chairman.

B2.3 If the complaint is against the Chairman, Council shall appoint a substitute to act in his/her place in all matters concerning the complaint.

B2.4 If the Chairman considers that there is no case to answer or that the matter is outside the competence of the Institute to pass judgement, the case may be dismissed at this stage subject to any resubmission by the complainant. However, a report shall be made to Council.

B2.5 If the case concerns legal or contractual matters, consideration shall be deferred until such matters are concluded.

B2.6 If there is a case to answer then a meeting of a Disciplinary Panel shall be convened; the Panel shall comprise, where reasonably practicable, all members of the Membership Committee apart from those members who have a direct interest in the case.

B2.7 The Panel shall consider all the evidence and any other submissions from both parties and may call for further submissions or evidence from elsewhere and thereafter shall report those findings to the Chairman.

B2.8 In exceptional circumstances and subject to the direction of Council an Investigating Tribunal comprising three members of the Institute of long standing who are not members of the Membership Committee may be appointed to consider the case and to report to the Disciplinary Panel. Such exceptional circumstances may include the situation in which the complaint is against the Membership Committee, in which case Council shall act as the Disciplinary Panel.

B2.9 The Panel may refer the case back to the Tribunal if it considers that further clarification is necessary to resolve the case.

B2.10 The Chairman of the Membership Committee shall report the findings to Council which shall either refer the case back to the Membership Committee for further consideration or confirm the findings and determine the appropriate course of action.

B2.11 If the complaint is upheld, Council may recommend that the member or members should:

B2.11.1 be expelled from membership; or

B2.11.2 be suspended from membership for a defined period; or

B2.11.3 be reprimanded; or

B2.11.4 suffer any other penalty appropriate to the particular circumstances.

B2.12 Council shall arrange for all interested parties to be informed of the decision and the proposed penalty, and may, at its discretion and subject to any appeal, publish the results.

B3 Appeals

B3.1 Either party may appeal against the decision of Council. If an appeal is raised, Council shall appoint an Appeals Panel of three members chosen from members of the Institute of long standing with experience in the relevant field who have not been concerned in the earlier stages of the case.

B3.2 The Appeal Panel shall reconsider the evidence already presented, shall call for further submissions from the parties and may seek further evidence from elsewhere.

B3.3 The decision of the Panel shall be final and binding, subject to confirmation by Council, except that where dismissal from or suspension from membership is considered to be appropriate the member has the right of appeal to a General Meeting as defined in the Articles of Association.

B3.4 If a member holding Engineering Council registration through the Institute of Acoustics is served with notice of expulsion [Articles of Association 4 (6)] the member shall have the right of appeal to the Senate of the Engineering Council. Such an appeal will be conducted in accordance with the procedures set out in the regulations of the Engineering Council. Such an appeal shall, however, only be able to relate to procedural issues concerning the hearing of the case by the Institute of Acoustics, and shall not be a rehearing of the case.

B4 Service of Notices and Documents

B4.1 Any notice required or permitted to be given by either party to the other under these Procedures shall be in writing addressed to that other party at its registered office or principal place of business or such other address as may at the relevant time have been notified pursuant to this provision to the party giving the notice.

B4.2 In proving service by post it shall only be necessary to prove that the communication was contained in an envelope which was duly addressed and posted in accordance with this clause.

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Tel 01727 848195 Fax 01727 850553 Email ioa@ioa.org.uk Website www.ioa.org.uk

Environmental Noise

Ian F Bennett CEng FIOA reviews the Autumn Conference, held at the Oxford Hotel, Wolvercote, on 6-7 October 2004

Once again, this year's IOA Autumn Conference took place in the Oxford Hotel's Cranmer Conference Suite. Only two years old, the venue again proved that modern, flexible accommodation is the key to a successful conference: the papers were delivered and the Conference Dinner took place in the same room, rapidly transformed by the hotel staff between 17:30 and 18:00 (and back again in time for the next morning's mental exertions).

Although there was no snappy subtitle to the conference, its theme was environmental noise, with papers on topics ranging from noise mapping through issues of planning and noise to entertainment noise. As always, the organising committee allowed itself considerable leeway in defining what 'environmental noise' might include, and the conference was none the worse for it.

Central to the entire event was the 30th anniversary dinner, attended by several past presidents and our special guest - a man known to acousticians the world over.

Day 1 focused on EU-wide standards for noise modelling

'Harmonoise': Development of a State-of-the-art Source Model for Traffic Noise opened proceedings on the first day of the conference. Presented by *Greg Watts* (TRL), the session was chaired by *John Hinton*. Greg's paper described the development of a state-of-the art prediction method for the source module of the European 'Harmonoise' traffic noise model which is part funded by the EC, DfT and DEFRA. This allows prediction in third octave bands from 25 Hz to 10kHz as a function of vehicle speed and acceleration in three vehicle categories.

The main vehicle classes for which data are available relate to light passenger and goods vehicles, medium heavy vehicles including two-axle buses, and heavy goods vehicles including large buses with more than two axles. The model separates rolling noise and propulsion noise and sets their effective source heights above the road surface for light and heavy vehicles. The model includes corrections for road surface type, temperature and the directivity of these sources. The paper referred to tests carried out at TRL to determine source heights and outlined the remaining work which will be carried out in the follow up project, 'Imagine'.

Next came *Hans van Leeuwen* and *R Nota's* paper, **'Harmonoise': Noise Predictions and the New European Harmonised Prediction Model.** Both authors are with *DGMR Consulting Engineers*, The Hague, Netherlands. The assessment and management of environmental noise has become a hot issue. This has become even more the case since the European Commission issued a Directive on noise, which describes what to do when developing a noise policy. This first action is to investigate the existing situation. Noise annoyance or noise levels need to be quantified. Taking measurements would seem to be a logical way of doing this, and such measurements appear to be more straightforward than calculations in the eyes of the public. Nevertheless, in most member states the standardised methods state a general preference for calculation as the way of assessing environmental noise levels.

At present, there is in Europe a lack of harmonised methods of sufficient accuracy for the prediction and assessment of noise from roads, railways and industrial sites. The available national methods were compared and evaluated, and some results were available in the literature. The conclusion of the evaluation of the European Commission's noise steering group was that none of the available methods was sufficient to satisfy the Directive's requirements.

Improved and Harmonised Methods for Community Noise Prediction by *Paul de Vos* looked at the European Projects 'Harmonoise' and 'Imagine'. Paul is now with DHV Environment and Transportation, but the work covered by his paper was conducted when he was working for AEA Technology Rail BV in Utrecht, Netherlands.

Under the European Directive on the Assessment and Management of Environmental Noise, 2002/49/EC, it is an obligation for EU Member States to produce strategic noise maps and noise action plans for major roads, railways, airports and agglomerations. The prediction methods to be used for the first mapping operation, to be concluded in 2007, will differ significantly from one country to another, even though they will all express the noise levels in terms of the harmonised indicator L_{den}. From 2012 harmonised prediction methods will have to be used.

The 'Harmonoise' project, which was started in 2001 and will soon be finalised, was intended to develop such methods for road and rail traffic noise. In order to be accepted by the community of end users, the new methods would have to represent an improvement with respect to the best of the existing models. Reliability and accuracy were qualifications that would particularly appeal to scientists, whereas engineers wanted the methods to be straightforward and easy to use, software manufacturers would want them to be well defined and versatile, and politicians would value reproduceability. The 'Harmonoise' methods were developed as a result of the joined efforts of 17 partners, representing the best of European scientists. They produced methods to assess and describe the acoustic behaviour of cars and trains under a wide variety of operating conditions in pure physical terms, ie. in third octave bands and including directivity of the sound power levels.

The minimum number of weather classes required to describe the average sound propagation over a long period of time (typically one year) had been derived. A unique set of experimental data had been collected, that was used to validate the calculations and was available for others to extend and use the dataset. A reference method had been developed using highly scientific methods for the assessment of sound propagation through a turbulent atmosphere.

As a consortium, the methods were probably more reliable than any existing methods with respect to their ability to predict the 'real' long term average L_{den}. Ease of use was not the first priority, but for large scale noise mapping it was certainly possible to accept lower single point accuracy, such as by using default and average input data instead of detailed local data. A cruder and less accurate method is easier to handle, without losing too much accuracy in the overall result (eg. to determine the number of people over a certain noise level on a national scale).

'Imagine' will apply 'Harmonoise' methods to aircraft and industry

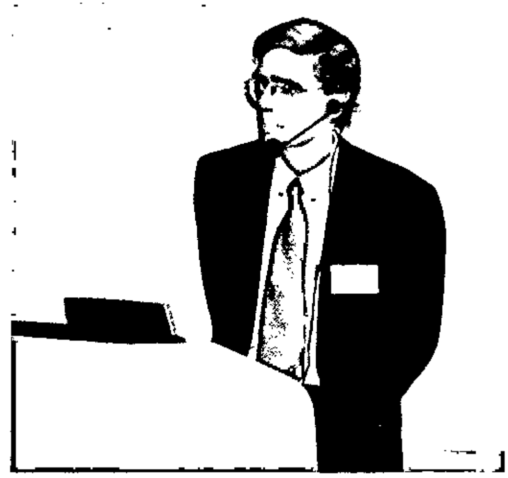
The follow-up project 'Imagine' was started late in 2003. It would extend the 'Harmonoise' methods to application for aircraft noise and industrial noise and will enhance the general applicability of the road and rail methods to any local situation anywhere in Europe. For aircraft noise, the step towards a non-integrated model, where noise creation and noise propagation are described separately, represented a big change and intended improvement. The 'Imagine' project would also develop and provide practical guidelines for the use of geographical information systems, both for the storage and supply of input data and for the further elaboration of output data. The application of measured data in noise mapping operations (the general practice in many cities today) would be addressed. Finally, the project looked ahead to noise action plans, particularly in urban situations, in that it intended to combine (road) traffic demand and flow models with noise prediction models, making it easier for local authorities to develop and assess different noise mitigation scenarios. The author particularly wished to express his gratitude to all the colleagues and friends in more than 25 partner organisations throughout who had contributed to the work, and would continue so to do.

'Imagine': Rail Noise Sources was then presented by *Rick Jones* (AEA Technology). The EC Directive 2002/49/EC relating to the assessment and management of environmental noise stated that: *'Common assessment methods for the determination of L_{den} and L_{night} shall be established by the Commission...'*. As such common methods were not yet in place, the first round of noise mapping required by the Directive in 2007 would be carried out either with appropriate national methods, or with EC-recommended interim methods. The development of common assessment methods had commenced, however, with the expectation that they would be available in time for the 2012 round of mapping. This process was being carried out via the EC 5th Framework 'Harmonoise' project and the 6th Framework 'Imagine' project.

This paper described the current activity of the Rail Noise Sources work package of 'Imagine', together with the earlier associated work within 'Harmonoise'. The process of defining source characteristics and methods by which these characteristics may be measured was begun within 'Harmonoise'. In 'Imagine' this process was being taken forward by further refining practical techniques for rolling noise assessment, developing and validating a traction noise model, building a source term database, and acquiring measured data across Europe to populate that database. Rick's paper outlined the progress to date and showed how the objectives of the Work Package would be met through the project's life.

There followed a lively open discussion forum in which issues raised by the morning's presentations were dissected, and the debates continued in various groups, albeit on a less formal basis, over lunch.

R W B Stephens Lecture



Greg Watts gives the R W B Stephens Medal lecture

The first event of the post-luncheon session, chaired by *Colin Grimwood*, saw presentation of the **R W B Stephens Medal 2003** to *Greg Watts* of TRL, who then gave the first afternoon paper. This was the R W B Stephens Lecture: **Reducing Traffic Noise Disturbance**, in which Greg outlined a number of TRL studies funded by the Department for Transport and Highways Agency. These had sought to gain a better understanding of how vehicle noise was generated, propagated away from the highway, and was perceived by the listener, with the aim of limiting noise disturbance.

The studies included rolling noise, where the influences of road surface texture, tyre design and sound absorption had all been examined. The means of reducing noise by novel design of barriers and earth mounds at the carriageway edge were also reviewed, together with the influence of gaps in the barriers, ground conditions and meteorological effect. The importance was highlighted at various points in the paper of developing appropriate ISO and CEN standards as well as UN-ECE and EC regulations. The paper then considered how useful were modelling techniques such as the boundary element method, full scale testing and roadside measurements. Finally, reference was made to a number of studies which had sought to relate the subjection reaction of listeners to the physical measures of noise.

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London mapping and noise strategies

Next, *Roger Thompsett* (Atkins Noise and Vibration) presented **The London Road Traffic Noise Map**. Produced by Atkins on behalf of DEFRA as part of the government's ambient noise strategy, the London noise map was officially launched on 14 September 2004. It was the largest of its kind yet produced in the UK, covering an area of 1,650 square kilometres with calculation points placed on a 10-metre square grid. As papers on its method of production had previously been presented at Institute of Acoustics and other conferences, this one described some of the initial findings of the map, how it could be accessed, and the ways in which it was already being put to use. Roger also made some suggestions for further work.

Alan Bloomfield (Greater London Authority) then presented his paper, written jointly with his colleague at the GLA, *Max Dixon*, on **Implementing the Mayor of London's Ambient Noise Strategy**. An important issue facing London was the way in which action plans to control ambient noise could best be formulated and implemented in a large and administratively complex city. This took place in the context of a previous lack of overall strategic planning for ambient noise. The Mayor's noise strategy - the first city-wide noise strategy in the UK - was a key development and provided a comprehensive set of techniques, policies and proposals to tackle ambient noise. The challenge now was to turn these into practical plans which could mobilise the resources for action.

The action plans required by the EU Environmental Noise Directive would need to consider the impacts of new developments in a wider context than was current practice, and this paper placed the Noise Strategy in the context of UK and European policy, explaining the proposed first steps to begin the implementation process. It identified the need to develop pilot projects to demonstrate the possibilities, especially where the more novel and innovative ideas were concerned.

Practical initiatives in the management of transport noise, such as the use of quieter road surfaces, had to be pursued against a background of intense competition for investment, while the promotion of good 'sound-conscious' urban design was essential if higher densities and more mixed use were to succeed fully. Noise mapping would have an important role to play in prioritising action, though qualitative aspects could not be overlooked.

Merseyside attitudes to noise

In an interesting and apposite juxtaposition, *Paul Bassett's* paper on **The Merseyside Noise Study** described the results of a large scale noise and attitude survey carried out in the Merseyside region during 2003. The research work was carried out by Hepworth Acoustics Ltd, by whom Paul is employed, with assistance from Wood Holmes Group and Entec, on behalf of Merseytravel and the five Merseyside local authorities. The research was commissioned to provide information to assist with the future development of an environmental noise strategy and noise action plan for the Merseyside region.

A total of 1,170 attitude surveys had been carried out, ten in each local government ward within Merseyside. In addition, 24-hour noise measurements had been carried out at 90 locations across Merseyside to provide information about the range of noise levels in the area. Some preliminary noise mapping had been undertaken at 15 locations backed up by 15 further 24-hour noise measurement surveys. Paul discussed the findings of this work and made comments on the steps required towards formulating a noise action plan for Merseyside.

Stuart Smith (Wood Holmes Group) then presented a companion paper, **Merseyside Ambient Noise Study: Noise Attitude Survey 2003**. As mentioned by Paul Bassett, the Merseyside local authorities and Merseytravel commissioned Wood Holmes Group to conduct a noise attitude survey on Merseyside in 2003, as part of the Merseyside Ambient Noise Study. Little was known about local attitudes to noise, and indeed this perception study was the first of its kind to concentrate on one specific geographical area in order to produce data at the local authority level.

The questionnaire used was largely based on that used in the DEFRA national survey (the National Noise Attitude Survey conducted by BRE in 1999), so that local data could be compared with the national benchmark. All 117 wards on Merseyside were surveyed, 10 interviews being obtained

an attentive audience for the technical presentations per ward from 10 randomly-selected clusters of households. The total sample size was therefore 1170, this being representative of populations within each local authority by age, gender and socio-economics. All interviews were conducted face-to-face in the respondents' homes, and complied with the Market Research Society Code of Conduct. Stuart reported the key findings of the survey in his paper, but more detailed findings were available on-line at www.merseysidenoisestudy.org.uk

To summarise both Paul Bassett and Stuart Smith's commentaries, the results of both the public perception survey and the noise monitoring had demonstrated that environmental noise was an important quality-of-life issue on Merseyside. When asked what factors had a negative effect on their quality of life and the area in which they live, Merseyside residents placed noise as the fourth most important factor, behind litter and graffiti, crime and personal security, and traffic congestion. About 45% of those surveyed said that noise was a problem at least some of the time. This means that more than 340,000 people across Merseyside may have their home lives spoilt by environmental noise.

The public perception of noise as a significant environmental issue was supported by the results of the noise measurements. Measured noise levels had been compared with World Health Organisation guidelines for daytime and night time levels of noise likely to cause disturbance, and 48% of the 90 locations surveyed had noise levels greater than the WHO daytime guideline; 70% of the locations exceeded the WHO night-time guideline. Whilst concern had of course been expressed elsewhere about the practicality of achieving the WHO guidelines at all residential properties within the UK in the foreseeable future, the figures indicated that environmental noise levels across much of Merseyside were indeed at levels where disturbance could be caused.

Transportation noise was the major constituent of residents' noise exposure, and road traffic noise was by far the dominant component of the transportation noise experienced by residents. Apart from traffic, the main sources of noise causing bother, annoyance or disturbance (in that order) were people's voices (neighbours and on the street), barking dogs, burglar alarms, parties, audible TV or music from neighbours, children's voices, doors banging and DIY.

Wednesday's programme concluded with the 30th Anniversary Dinner, which neccessitated rapid re-organisation of the room, including Dr Beranek's stereoscopic visual aids

Planning and noise issues were aired on Day 2

Thursday morning's session, chaired with the usual aplomb by *Ian Flindell*, began with **The Revision of Planning Policy Guidance Note PPG24: Planning and Noise** by *Paul Freeborn, Stephen Turner* and *Colin Grimwood*, all with Casella Stanger. PPG24 was the primary guidance in England for planning issues involving noise. Similar guidance existed in Wales in the form of (Technical Advice Note) TAN11, and in Scotland, (Planning Advice Note) PAN 56.

PPGs were intended to set out the government's policy on different aspects of planning. PPG24 gave local authorities in England guidance on the use of their planning powers to minimise the adverse impact of noise, and local authorities were required to take its content into account in preparing their development plans. It covered both noise-sensitive and noise-producing developments. The Office of the Deputy Prime Minister (ODPM) had responsibility for planning and hence all PPGs came under that department's ownership. The ODPM had stated its desire to revise all the PPGs with the intention of making them shorter and more policy-focused. PPG24 was currently under review and this paper described the process of that review, together with some of the work that had been, and was currently being, carried out in connection with that review.

Next, *Bernard Berry* (Berry Environmental Ltd and a past president of the IOA), presented a **Review and Analysis of Published Research into the Adverse Effects of Industrial Noise, in Support of the Revision of Planning Guidance**, which he had carried out with *Nicole Porter*, an independent consultant. Their paper summarised a review and analysis of published research into the adverse effects of industrial noise, in support of the revision of planning guidance. The work had been funded by DEFRA and the Environment Agency.

It had been considered that the current review of PPG24 being led by DEFRA would benefit from a deeper understanding of the impacts of industrial noise on humans and in particular the potential for it to cause adverse impact in the community. The study had therefore been commissioned to investigate the effects of industrial noise.

The aims of the project were: *(a)* to gain a better understanding of potential disturbance and impact on amenity by industrial noise, which would assist in the

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review of PPG 24; and *(b)* to investigate the reported relationship between industrial noise and people's response.

The objectives of the study were: *(a)* to review existing published literature on industrial noise impacts on humans, excluding noise at work; and *(b)* to highlight possible relationships between reported adverse effects and factors such as the types and acoustic characteristics of noise, geographical location and demographic profile.

The main work tasks were to review examples of the application of PPG24, to review and analyse key literature on the effects of industrial noise, to take an overview of the non-auditory effects of industrial noise, and to consider the design of any future industrial noise surveys.

Next, **Noise Levels in High Density Urban Developments** were discussed by *Sarah Radcliffe* (P Brett Associates) and *Nicole Porter*, in a paper which *Ian Flindell* also co-authored. The current government guidance in PPG24, Planning and Noise advised against the granting of planning permission for residential development in areas which had been deemed to be excessively noisy according to a

R W B Stephens' grandson explores road traffic noise with Dr Beranek

defined system of noise exposure categories. For example, PPG24 advised that for residential properties likely to fall within Noise Exposure Category C: 'Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise'. That advice was, of course, even more prescriptive for outdoor noise levels higher than those within Noise Exposure Category C.

Notwithstanding that advice, there appeared to be a growing number of modern high-density urban developments where planning permission had been granted, despite being sited in areas subject to existing high levels of road traffic noise and general street noise. In addition, there was little or no evidence that prospective and new occupiers had in any way been put off by the supposedly high levels of external noise. The most important factor here appeared to be that high levels of external road traffic and general street noise which might be considered unacceptable in long-established residential areas did not seem to be of major concern to people who wished to live in modern high-density urban developments, where the perceived benefits were presumably more significant than the noise.

The fundamental problem which needed to be overcome was that in many urban areas throughout the UK, the best available sites for new residential development were adjacent or nearby to major roads and important transport interchanges. This could be a particular problem where previous commercial and industrial sites (so called brown-field sites) became available for possible residential development. There was a fundamental conflict between the advice given in PPG24 and the increasing demand for high density residential development in areas of existing high population density.

Sarah discussed the topic in detail, referring to a survey of existing residential developments subject to high noise levels carried out by Peter Brett Associates and Ian H Flindell and Associates during summer 2003. Nicole then looked at some of the noise environments in which several of the developments had been constructed, and encouraged the delegates to become 'estate agents' and value some of the apartments concerned. Most surprising was probably a central London apartment costing well over £1.5m in an ambient noise level of 72dB(A).

Mike Fillery (Scott Wilson) then presented a paper on **The PPG24 Questionnaire**, co-written with *D Leversedge* (Capita Symonds). As part of the review of PPG24, The Department of the Environment, Food and Rural Affairs (DEFRA) and through it the Devolved Administrations of the Scottish Executive, the National Assembly for Wales, and the Department of the Environment in Northern Ireland, had let a contract to examine how PPG24 had worked in practice. In particular it aimed to look at how effective PPG24 and other sources of noise guidance had been in assisting the formulation of Development Plans and in exercising Development Control. The paper reported on the finding of a questionnaire that was sent out to all Planning Authorities in England in December 2003, and on follow-up interviews that were carried out between February and April 2004.

The findings gave a snapshot of the current usage of PPG24 and other guidance in both forward planning and in development control. The perceived strengths and weakness of the guidance provided valuable food for thought and the many suggestions for topics that should be included in the revised document indicated a continuing need for authoritative guidance on noise in planning. Overall, PPG24 was apparently well understood and widely used, but it needed to be updated to match other developments in government policy and social change.

Before lunch on the second day, a discussion forum on PPG24 was chaired by Ian Flindell. The discussions are reported by Sarah Radcliffe elsewhere in this issue of the *Bulletin*.

2004 Rayleigh Medal Lecture

The afternoon session was chaired by *Ken Collins* and began with the presentation of the **2004 Rayleigh Medal** to *Alan Cummings*, from the Department of Engineering, University of Hull. Alan then gave his medal lecture, **Duct Wall Breakout: Friend or Foe?** Acoustic breakout from ducts was a result of sound radiation from elastic or acoustically permeable porous duct walls, with solid or fluid motion in the walls excited by an internal sound field. There were various situations in which breakout noise could be a problem. For example, sheet metal HVAC ductwork passing through ceiling voids above internal building spaces could radiate noise into the occupied spaces beneath and thereby create disturbance to whoever was present. Even if the noise propagating internally within the duct was broadband in nature, the radiated noise might have significant (usually low-frequency) narrowband components related to structural resonances in the duct walls, and this could exacerbate the intrusiveness of the breakout component.

Despite the importance of breakout noise in HVAC acoustics, it was not studied in any detail until the late 1970s. Before that date, Allen had given a simple analysis of noise transmission both out of, and into, a duct in a reverberant space (which was only really applicable at high frequencies), Webb had given a good general account of breakout, and Sharland had briefly discussed the significance of breakout in HVAC ducts, including Allen's breakout formula. Since the breakout sound transmission loss of duct walls (apart from those of circular cross-section) was usually lowest at low frequencies and the internal sound power spectral density normally increased with falling frequency, breakout noise in HVAC ducts was predominantly a low frequency problem. It often sounded subjectively like a 'rumble'.

Acoustics - a journalist's perspective

Noise Management Magazine's **View of Acoustics and Acousticians**, which promised to be a controversial topic, was presented by an admitted non-acoustician - its editor, Jack Pease. The magazine was a business-to-business newsletter issued ten times a year and serving the 'noise' industry. It was launched towards the end of 1999 following requests from readers of an air quality newsletter for a similar news briefing covering noise.

Until its launch, noise professionals had relied on learned journals and similar publications. Some of these were peer reviewed and had editorial boards, and by their very nature tended not to focus on news. By contrast, *Noise Management* was written by non-technical journalists whose aim was to deliver news more quickly and in a more digestible format. The key philosophy behind the magazine was one of independence and impartiality, reporting on the industry rather than necessarily speaking for it.

The IOA organising committee for this conference had felt that there was value in recounting observations on the profession gleaned from that reporting. Was the industry 'normal'? How did it present itself? Did the industry make use of the press, and how could the industry use the press to its advantage? What were the pitfalls of dealing with journalists?

All these questions, and related topics, were covered in a brief but interesting non-technical presentation by Jack Pease, who was editor, reporter-in-chief, copy-writer and manager of the entire publication [he has my sympathy - *Ed.*]. He could not disclose the circulation of his publication, although he admitted to 'several hundred', but he was well aware that each copy was read by about half a dozen different people on average. He pointed out that with a publication appearing ten times a year, and going to print a matter of hours after its completion, he was able to carry up-to-date news items which other publications, including *Acoustics Bulletin*, could not.

The Effectiveness of Statistical Parameters for the Assessment of Amplified Music by Dipesh Patel, Environmental Health Officer with the London Borough of Brent, and co-written with *R Vasudevan* of NESCOT, was the first paper of the final session. The use of objective criteria for the assessment of neighbour noise had historically been avoided by enforcement agencies. For the first time, the Noise Act 1996 introduced a requirement for the use of objective criteria in assessing neighbour noise, but the resource implications resulting from employment of these criteria had led to only sporadic use of the legislation: a review of the implementation of the Noise Act carried out in 2001 and 2002 had found that only a handful of local authorities used the powers. Section 42 of the Anti Social Behaviour Act 2003 had provided an amendment to the Noise Act 1996 allowing local authorities to monitor, and take action against, night noise offences using the powers of the Act without providing a full seven-nights-a-week service.

A night noise offence was assessed by the use of a measurement protocol developed by the Building Research Establishment. Following field tests, recommendations had been submitted to the (then) Department of the Environment (DoE).

Noise emitted from the offending dwelling was to be measured as a continuous $L_{Aeq,5min}$ within a 15-minute period. The underlying noise level was then determined, being a level that was not exceeded for any 0.6s period within a window of between 1 and 5 minutes. This equated to the parameters $L_{A99,1min}$, $L_{A99.5,2min}$, and $L_{A99.8,5min}$. The recommendation was also made that the measurement protocol be kept under review and consideration be given to the use of C-weighting and shorter (125ms) L_{eq}.

The final paper was **Environmental Noise at Rock Concerts**, by *Chris Beale* (SSE Hire Ltd), a touring and event hire company active in the UK and France. The company had long experience of outdoor sound reinforcement, particularly at rock and pop events. His paper gave a practical view about the installation of sound systems at outdoor rock concerts, and the special considerations that must be given when using line array loudspeaker systems, particularly in respect of environmental noise control. It was important to remember that with no advance knowledge of the weather conditions when a sound system was specified, it was usually impossible to rectify problems post-production and installation. In other words, the contractor had to make the best of what was available. Other factors such as temperature, atmospheric pressure, humidity and audience absorption (ie. audience numbers) contributed to the sound levels achieved in practice, but the most important issue was invariably imposed by the limits of production resources, coupled with the effect of wind on the output some distance from the loudspeaker arrays.

It may validly be concluded that the installation of line array loudspeaker systems in a manner which provided predictable environmental noise control characteristics depended on one overriding requirement: rigging height and plenty of it! A rock show on a relatively flat site say 150m deep should be rigged with the arrays 30 to 35 metres above ground level. This maximised audience satisfaction, and means that environmental constraints could more reliably be achieved.

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Just 500m from the conference venue, 220-year-old technology at Wolvercote Lock, Oxford Canal

Environmental Noise

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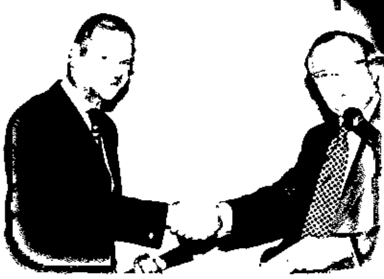
Awards

The main event following the 30th Anniversary Dinner on the Wednesday evening was the award of an Honorary Fellowship to *Dr Leo Beranek* (reported elsewhere). The Association of Noise Consultants also took the opportunity to present its two annual awards for the best Diploma project and the best paper at a conference. These were presented by Rupert Thornely-Taylor, President of the ANC, to *David Blackstock* and *Stuart Colam* respectively.

An Honorary Fellowship was presented to *Dr John Walker* by his former mentor, and past president of the IOA, Dr Peter Lord. Awards for Services to the Institute were presented by the current president, Tony Jones, to *Peter Sacre* and *Stephen Chiles*.

Rupert Thornely-Taylor (pictured right) presents the ANC award for Best Paper at an Institute Meeting to Stuart Colam



Rupert Thornely-Taylor presents the ANC award for Best Diploma Project to David Blackstock

Non-delegates programme

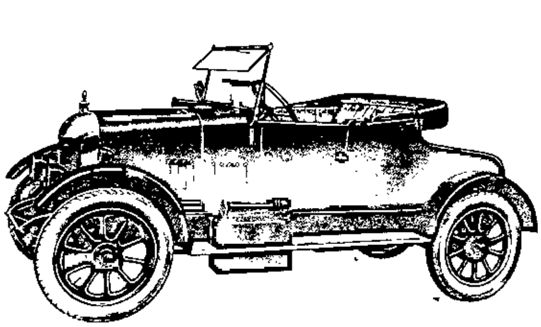
In the beginning - well, around the year 912 when the Thames was but a ford - the Saxons, with their oxen, passed through to the other side and that settlement became known as Oxenford. Today we know it as Oxford; the Seat of Learning; the City of Culture; the City of Dreaming Spires, with gardens, meadows and riverside walks.

Our group joined a party of visitors at the start of a two-hour walking tour through the streets and colleges of the city. We assembled in Broad Street and were told it was the very spot where the martyrs, Cranmer, Latimer and Ridley, principal figures in the sixteenth century Reformation, met their untimely heroic deaths.

Winding our way through the narrow back streets, students on bicycles were beginning to take hold as they returned to their colleges after the summer break. We were, however, fortunate enough on this walk to enter Jesus College and Trinity College - architecturally beautiful down to the finest detail, and, just a small sample that was repeated ... repeated ... and repeated, 37 times.

Some famous sons have passed through: politicians, poets, preachers, authors, actors, philosophers and scientists. Such names as Wolsey, Gladstone, Gaitskell, Attlee, Eden, Macmillan, Foot, Heath, Wilson, Clinton, Elliott, Lewis, Betjeman, Galsworthy, Wren, Wilde, Wesley and Wyclif, 'Carol', Hayley and Lawrence (of Arabia), to name but a few, and all have doubtless studied from some of the seven million books in the Bodleian Library.

Each college is autonomous financially with a self-governing body. We must therefore not lose sight of the philanthropist who gave of his money freely, a young teenager who had the vision to repair racing bicycles then developed an interest in cars. With his mechanical mind he built the Morris Oxford, subsequently opening premises at Cowley. Yes, it was William R Morris, later to become Lord Nuffield, whose gifts of money benefited the Radcliffe Infirmary and the Wingfield Orthopaedic Hospital, to name but two. His greatest gift was the establishment of Nuffield College in 1937. In total he gave away approximately £30 million during his lifetime.



This 1924 Morris Oxford would have cost the princely sum of £260.00 brand new

Oxford's medieval gems of mellow golden stone are endearing. They have inspired writers, and provided the location for popular films and television series from Colin Dexter's Inspector Morse to Harry Potter's Hogwarts Hall.

Leaving the city behind for another day, we headed out into the countryside for our planned visit to Blenheim Palace. It is the home of the 11th Duke of Marlborough and was the birthplace over 100 years ago, of the great statesman Sir Winston Churchill. The palace was a gift from a grateful monarch: this year marks the 300th anniversary of the Battle of Blenheim. Within this elegant building we saw gilded staterooms with a magnificent collection of famous tapestries, paintings, sculptures and fine furniture.

Blenheim Palace

Outside we wandered through the formal gardens and into the parkland landscaped by Capability Brown. In nearby Woodstock there was a welcome cup of tea and a stop at the village of Bladen, the burial place of Churchill. Accompanying us was our guest speaker Leo L Beranek and his wife, who were particularly moved by this day especially having known Sir Winston in life.

Aware that there is more, and so much more to see in terms of discovering Oxford and its surrounds, I recall the familiar words 'This is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning.'

Doreen Bratby

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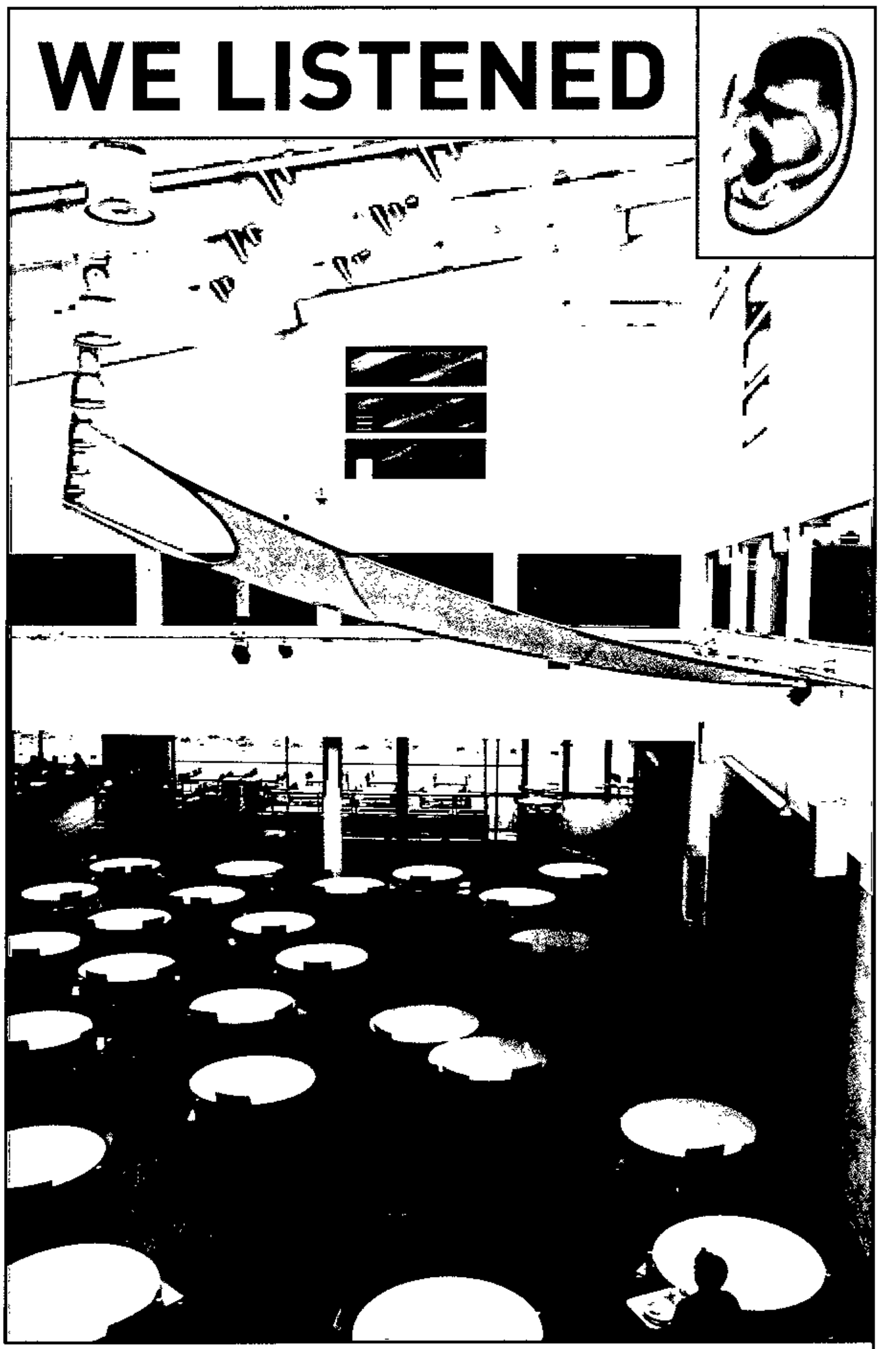

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PPG24 discussion session

Report compiled by Sarah Radcliffe, Nicole Porter and Ian Flindell

In accordance with current policy issued by the Office of the Deputy Prime Minister, PPG24 (Planning and Noise) is being reviewed and revised. DEFRA, with the assistance of its advisers, Casella Stanger, is leading this review which will turn PPG24 into a new Planning Policy Statement (PPS). On the second day of the Autumn Conference papers were presented on this issue, followed by a discussion session to cover the topics raised in more detail

Prior to the discussion session, *Sarah Radcliffe* and *Nicole Porter* presented a paper which they had written with *Ian Flindell* entitled **Noise Levels in High Density Urban Developments**. This questioned the validity of the advice to local planning authorities contained in the current version of PPG24 to refuse permission for new residential developments in higher noise areas. The paper showed that the current guidance is not always followed and there is often high demand for expensive properties in noise climates for which PPG24 advised that 'Planning permission should normally be refused' (defined as Noise Exposure Category D).

This paper, together with several others, sparked off a 90-minute discussion chaired by Ian Flindell about PPG24 and how the proposed new noise PPS should work. The key points of the discussion are detailed below under topic headings, and some suggestions are outlined for a more pragmatic method of assessing noise with respect to planning. There was a general consensus that the IOA should become more involved in the development of the new PPS.

○ Different limits for different areas

The discussion started by raising the question of whether planning guidance should focus on either external or internal sound levels as a basis for decision making. Many contributors felt that internal sound levels were intrinsically more important, notwithstanding that most current guidance focused on outdoor sound levels. Even the indoor bedroom noise levels in the WHO Guidelines for Community Noise had been derived from outdoor measurements by subtracting an assumed outdoor to indoor sound level difference of 15dB from the external noise level.

The concept of having different sets of noise limits for new dwellings, one set of internal noise limits for inner city developments and a set of external noise limits for suburban or rural developments was then raised, stimulating a considerable amount of debate. It was generally acknowledged that while the idea had some merit, the practical difficulties involved in implementation were probably insurmountable.

○ Individual choice

There was some discussion about the general issue of whether government should impose noise limits on places where people are permitted to live, or whether this could be left to individual choice. A few contributors expressed a view that regulation can help to prevent less affluent people from being forced to live in noisy areas because they cannot afford otherwise, but there was no consensus on this issue. It was generally felt to be significant that regulations to prevent people being exposed to noise levels likely to damage their health would be more easily justified than regulations intended merely to prevent annoyance.

○ Timing of the PPS with regard to the European Noise Directive

The question of whether this was the correct time to be revising/replacing PPG24 was raised as the Noise Action Plans required under the European Noise Directive would surely need to be in the replacement. Would it be better to wait and incorporate the Noise Action Plan into the PPS?

○ If NECs were to be retained in the new PPS then the units would need to reflect noise mapping (L_{DEN} as opposed to L_{Aeq}) in terms of time of day

NECs could be part of the noise mapping exercise and the Noise Action Plan could be part of the new PPS. Noise maps could be used to indicate areas which did not have a noise problem and areas which clearly did. There would then be a middle zone where noise may or may not be an issue and advice would be required.

The point was then made that perhaps we should not wait till the Noise Action Plan was submitted to sort out the PPS, as the noise mapping exercise was unlikely to tell us anything that we did not already know and we needed to move the issue forwards without waiting for future developments that may or may not happen.

○ Should NECs be retained as a helpful annexe to the PPS?

It was suggested that NECs could be useful in sequencing a site and that they should not be removed from the PPS, but downgrading them to an informative Annexe to the document could be a good approach.

○ Set criteria for new sources?

When a new noise source is introduced to an area, there were far fewer guidelines on acceptable levels than when a new noise-sensitive use was brought to an area. The idea that the PPS should cover new noise sources as well as noise-sensitive development was suggested.

○ WHO guidelines

Concerns over the use (or misuse) of the values set out in Guidelines to Community Noise were then expressed. The quoted levels that were often taken as limits were actually observation threshold levels at which the lowest observable effects occurred. It was also pointed out that having a firm limit was not a sensible approach otherwise an imperceivable difference of only 1dB could make a difference between approval and refusal.

○ Creeping residential

New dwellings could be constructed near to transportation noise sources and if the residents were not happy then there was little they could do about it after the event, other than sell up to someone who was less

Issues raised by PPG24 sparked off a 90 minute discussion

concerned about the noise. However, when new dwellings were built near to industry or pubs then if the residents complained, there was always a possibility of serving Notices which might eventually lead to unexpected costs for that industry, and in more extreme cases it was even possible that the industry could be closed down. This must be examined and catered for in new PPS. We have all been concerned about creeping background noise levels, but we should also become more aware of the possibility of 'creeping residential' from unfairly imposing excessive noise control or noise management costs on existing industrial or commercial sites .

❍ Proposals for the Noise PPS

It was agreed that the main body of PPG24 had a few comments that the audience did not fully agree with, but the bulk of the text was helpful and user-friendly. The main area of contention was the use of NECs. It was interesting that out of nearly 100 delegates, not one person said they were fully in agreement with the NEC approach for all situations.

The main area of potential for confusion was in trying to define the difference between NECs B and C. It was therefore proposed that three categories be considered in an informative Annex which would not have the same status as the rest of the document, but was there to offer guidance to acoustic consultants, environmental health officers and planners. The three categories would be:

- ❑ *where the noise levels were clearly not a problem;*
- ❑ *where the noise levels were extremely high, which either imposed a serious health risk or were too high to be mitigated;* and
- ❑ *An 'in-between' category where mitigation may be required to give satisfactory internal noise levels.*

There was a great deal of support for the ideas presented in the paper by Nicole Porter, Sarah Radcliffe and Ian Flindell. This suggested that the current guidance in PPG24 - that planning permission should not normally be granted in areas exposed to NECs C and D - did not appear to be justified in specific cases where the high noise levels were an unavoidable consequence of development in an otherwise highly desirable location.

It was also proposed that there should be more information and guidance on situations where new noise sources were introduced to noise-sensitive areas.

❍ Future action

This brief article is intended as a stimulus for further discussion before establishing a working group to prepare a more considered IOA response to the current proposal for a PPS on planning and noise. If you have any comments on the above, or indeed any other relevant views, please contact Sarah Radcliffe at PBA sradcliffe@pba.co.uk or tel: 01823 350203.

Tony Jones (right) and Leo Beranek deep in conversation

The 30th Anniversary Dinner

was an opportunity for our guest speaker, Dr Leo Beranek, to share his accumulated wisdom on concert hall design with a rapt audience

Dr Leo Beranek thanked the Institute for the award of Hon FIOA, and acknowledged his new professional acquaintances on this side of the water. He then proceeded to entertain and fascinate his rapt audience for half an hour with what he modestly called "a few remarks about concerts halls". This proved to be a distillation of his accumulated wisdom on hall design, aided by stereoscopic visual aids, courtesy of two overhead projectors.

First he described the design and construction of the Boston Symphony Hall, which was opened in 1901 and is widely regarded as having the most satisfactory 'acoustic' of any large concert hall in the world. It was based to begin with on the old Leipzig Gewandhaus (destroyed in World War II), with a passing glance towards the Musikverein in Vienna, and was designed and built within an amazingly short timescale of 20 months. The architect appointed on behalf of the Boston Symphony Orchestra was Charles McKim, and the very rapid construction programme was necessary because the orchestra's previous home, the Boston Old Music Hall, was sold to new owners who gave them just two years' notice to quit.

The Boston Hall, whilst it is a conventional 'shoe-box' hall like the nineteenth-century European halls in Vienna and Leipzig, was innovative in several respects, not least because it was the first concert hall benefiting from an acoustical consultant. He was one Wallace Clement Sabine (*Acoustics Bulletin Vol.27 no.4*) but apparently the work did not take him very long, so he never received any fee!

Reining in the architect

From early in his talk, Dr Beranek had his audience of acousticians firmly on his side. I felt this was not entirely unconnected with some rather disparaging remarks about architects, since he saw it as the acoustical consultant's responsibility to limit some of the more disastrous flights of fancy to which architects are prone. Apparently Sabine was having similar problems until he met McKim, the project architect, whom he was able to convince within a matter of hours that he knew what he was talking about. The dimensions of the Symphony Hall were kept within reasonable bounds, and Sabine's work on reverberation time and room acoustics enabled him to achieve excellent sound quality in the finished hall.

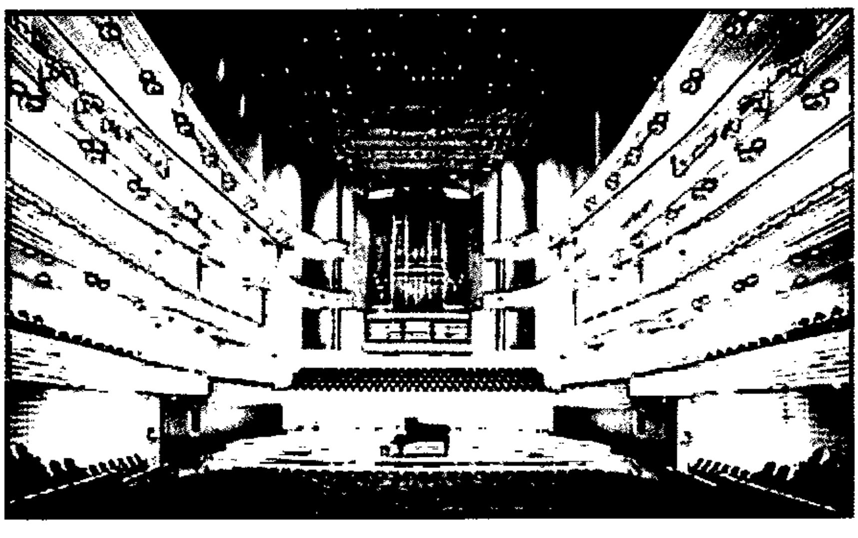
Our guest then went on to discuss the basic principles of concert hall design for non-acousticians (no formulas, as he put it) which as a practising acoustical engineer I nevertheless found enlightening: from the audience reaction it was obvious that most of us felt the same way. He spoke about the importance of correct reverberation time: for a large symphony concert, this should be in the range 1.8 to 2 seconds with the audience present. Chamber music benefited from a rather shorter reverberation time of between 1.5 and 1.7 seconds, and opera needed slightly less again. He also described the all-important first reflection of sound, which should preferably be from a wall, hence the popularity of shoe-box halls.

Other factors to be borne in mind included achieving sufficient volume of sound at the most distant seats, getting a satisfactory bass response by using massive walls, ensuring a reasonable degree of intimacy between performers and audience, and diffusing the sound by means of irregularities in the boundaries of the hall. These were all achieved, some of them by accident, in the design of the Boston Symphony Hall. For example, the walls turned out to be very thick in order to achieve the necessary degree of fire protection, and the inclusion by McKim of niches and ornate plasterwork, in imitation of the European halls he admired, broke up the otherwise plain surfaces and benefited the sound quality.

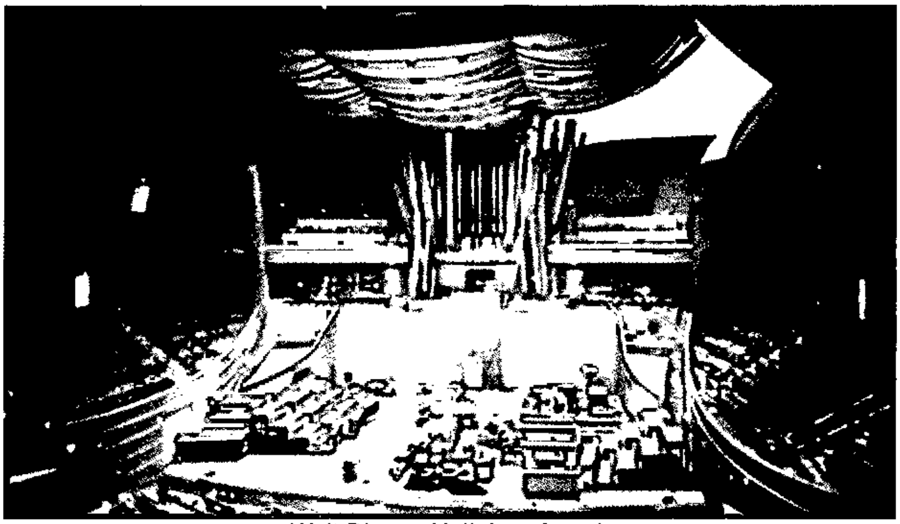
'Shoe-box' and 'surround' halls compared

Dr Beranek then looked at some modern halls in order to compare and contrast current thinking on shoe-box halls and 'surround' halls. The latter had an advantage in that it was possible to get the audience closer to the orchestra, but the price of intimacy could be a loss of sound quality. He showed slides of the interiors of four halls: the Lucerne (KKL) and Tokyo concert halls, which are both shoe-box shaped (although the latter especially is cunningly disguised by a triangular ceiling profile), and the Waterfront Hall, Belfast and Walt Disney Hall, Los Angeles, both of which are surround halls.

All four had been built within the last ten years, and he had attended concerts which enabled him to select



Lucerne (KKL) Concert Hall



Walt Disney Hall, Los Angeles

the best seats in the house for sound quality - and most importantly, for appreciation of the music. He described where the acousticians, and especially the architects, had got it right. One example was the movable doors and curtains around the sides of the Lucerne Hall, which allowed the reverberation time to vary from 1.5 seconds to 2.3 seconds, giving the hall more versatility. He modestly indicated a few points where he might have done things differently: the Waterfront Hall came in for criticism because he found it difficult to get sufficient lateral reflections in most seats.

I was left with the overriding impression that the driving force behind this eminent acoustician was his genuine love of good music, and that he was quietly proud of his contribution to the greatest of the performing arts.

Dr Leo Beranek's presentation was acknowledged by prolonged and enthusiastic applause from an appreciative audience. A minute's ovation may not seem very much by party political standards, but in my experience it is unprecedented at Institute of Acoustics conferences. He is rightly held in great regard by all those involved in acoustics, and as several people were heard to say, he's such a nice bloke!

Ian F Bennett, Editor

Special thanks are owed to Bob Lorenzetto of ANV, who was able to record the entire evening's speeches and presentations at a moment's notice, using no more than a Rion sound level meter, and provide me with a CD the following morning - IFB

Rayleigh Medal 2004

Professor Alan Cummings

After obtaining an external London University honours degree in Physics and Chemistry at Sunderland Technical College in 1965, Alan obtained an MSc and a PhD in Building Acoustics at the University of Liverpool for work on models for the transmission loss of single and double panels. In 1968 Alan obtained his first job in the USA working with the prestigious consultancy, Bolt, Beranek and Newman Inc. in New York. He returned to the UK in 1969 to be leader of the Acoustics Group at the Gas Council Midlands Research Station in Solihull. This was followed by a post-doctoral appointment at ISVR from 1972 to 1974 during which Alan started his interests in combustion noise, duct acoustics and aerodynamics.

Alan's first teaching appointment was in 1974 as Principal Lecturer at the Polytechnic of the South Bank (now South Bank University). In 1980 he returned to the USA to be Associate Professor of Mechanical Engineering at the University of Missouri in Rolla. At Rolla, Alan obtained research grants for work on high amplitude acoustic absorption of perforated plates, low frequency noise radiation from air conditioning ducts, design methods for duct mufflers at high amplitudes, the acoustical properties of porous materials in mean flow, the acoustics of the grinding process and active noise control in ducts. The grants were funded by a variety of sources ranging from Monsanto to the US National Science Foundation. He became full Professor at Rolla in 1984.

In 1987 Alan came back to the UK to be British Aerospace Reader in Mechanical Engineering at the University of Hull. In 1988 he obtained a grant from British Gas for work on resonance in fully premixed burners and this was followed in 1989 by two grants from SERC (now EPSRC) for research on duct acoustics. The second grant funded a Visiting Fellowship for Jeremy Astley who is now Professor of Computational Acoustics at ISVR. A Teaching Company Scheme and an EC grant in 1992 were for research in silencer acoustics and a further EC grant in the same year was for basic research on aircraft interior noise. In 1993 Alan obtained an EPSRC grant for research on the propagation of high amplitude sound in flexible porous materials. Alan became Professor of Mechanical Engineering at Hull in 1995.

Since 1996, Alan has received five more research grants from EPSRC, a DTI/LINK grant and an EC BRITE-EURAM grant and supervised associated research on modelling sound generation and propagation in fluid machinery systems, computer aided design of silencers, combustion noise and the nonlinear structural behaviour of fibrous materials. Also, he has been co-investigator with Keith Attenborough on EC and US Army supported research concerning sonic booms and sound absorbing structures for blast noise respectively.

Alan has published seventy-seven papers in peer-reviewed journals as sole or joint author. These include seminal contributions on attenuation, noise breakout and active control in ducts and many important and pioneering papers on the acoustics of porous materials and perforated plates including the effects of mean flow, behaviour at high sound intensities. Alan's 60 publications in conference proceedings include a distinguished lecture at the Inter-Noise conference in 1990 in Gothenburg, Sweden.

He is a Fellow of the Institution of Mechanical Engineers and the Institute of Acoustics. He was awarded the higher doctorate, Doctor of Engineering, by the University of Liverpool in 1987.

Alan has managed also to combine his non-academic enthusiasms and pursuits with his scientific career. In 1972 he published a paper in *Applied Acoustics* on the 'Acoustics of a cider bottle' and in 1997 he published a paper entitled 'Cycling into the wind' in the *European Journal of Physics*. He is a widely known and respected scientist and engineer with exceptionally broad experience in academia, consultancy and industry. For his distinguished academic and professional contributions to Acoustics, the Institute is pleased to award Alan Cummings the **Rayleigh Medal for 2004**.

RWB Stephens Medal 2003

Professor Gregory Robin Watts

Greg Watts was awarded a first class degree in Physics from the University of Manchester. This was followed by an MSc in Ergonomics from University College, London and then a PhD in Ergonomics from Birkbeck College, London.

Greg has developed enormous experience of noise, vibration and safety research at the Transport Research Laboratory. He has been involved in assessing the subjective effects of aircraft noise, modelling sound propagation, improving noise control by barriers and examining the generation and propagation of traffic noise and vibration and their effects on people and buildings.

He contributes widely to a diverse range of committees. Currently his work with ISO involves the development of standards for the measurement of sound absorption of road surfaces, vehicle noise test procedures and the assessment of tyre noise. He was, until recently, chairman of the CEN committee on noise barriers and the corresponding BSI committee and chairman of the CEN committee considering anti-noise devices.

From 1998 onwards Greg has made an invaluable contribution to the *Harmonoise Project* for the EC, which involves the development of state-of-the-art noise prediction models for transport noise throughout Europe.

The Rev. Harold Stephens (son of R W B) presents the R W B Stephens Medal to Greg Watts

Greg has published widely in the field of noise and vibration and in 2000 was appointed a visiting professor in Transport Acoustics.

For his outstanding contributions to transport acoustics, the Institute of Acoustics is proud to award the **R W B Stephens Medal** to Greg Watts.

Honorary Fellowships

Dr Leo L Beranek

Dr Leo L Beranek (left), receives his Honorary Fellowship (HonFIOA) from the President

It is a great honour for members of the Institute of Acoustics to have Leo Beranek in their midst today. We are particularly delighted that he is with us to celebrate the thirtieth anniversary of the founding of the Institute of Acoustics.

All of our members, whether young or old, have been influenced by the work of Leo in some way or another. The oldest members will be familiar with his vital laboratory work during World War II where he improved communication systems in military aircraft. This then led to his seminal work on the control of noise from jet aircraft in civilian aircraft fleets. Most of us can recall poring over his excellent textbooks on acoustics and noise control in our attempts to come to grips with acoustical principles and practice. Consultants in architectural acoustics will have studied in microscopic detail the plans and sections of the fifty-four concert halls he published in 1962. The youngest acousticians, together with architects and musicians, are regularly referring to his latest book on auditoria, published only last year.

Leo has not only inspired generations of acousticians through his publications, but as a founder member of Bolt, Beranek and Newman he created an acoustical consulting company that became synonymous with acoustical excellence throughout the world. One of the key strengths of the company under his direction was the investment in bright young people and the readiness to put research ideas into practice and thereby push forward the boundaries of knowledge. One such idea was concerned not with acoustics but with computing, and how computers can communicate, and this created the foundations of what we now know as the internet.

Throughout his career Leo has lent his sustained support and directing skills to scientific societies and civic organisations. To name but a few: he has been president of the Acoustical Society of America; president of the Audio Engineering Society; charter president of the Institute of Noise Control Engineering; and vice-president of the Boston Symphony Orchestra.

Leo continues to inspire us today as a very active consultant in the design of concert halls and opera houses. In recent years he has had a major influence on auditorium work in Japan and has been closely involved with more than half a dozen major halls in Tokyo and beyond.

For his outstanding contributions to leadership, his publications and his inspirational work in acoustics, the Institute of Acoustics is proud to award an **Honorary Fellowship** to Dr Leo Beranek.

Dr John Gerard Walker

John Walker studied physics at the Royal Military College of Science at Shrivenham and was awarded a London University external degree with honours. He commenced his research work at the Royal College of Advanced Technology at Salford and submitted a thesis entitled 'A circumaural earphone for audiometry' for which he was awarded a PhD, again externally by London University.

In 1967 he moved to the Institute of Sound and Vibration Research at Southampton University and began developing his career as an educator, organiser and researcher in the fields of transportation noise, acoustical measurements and physiological and psychological acoustics.

As an educator, he contributed to the teaching for the ISVR Master's and Bachelor's degrees and the several short advanced courses delivered to practitioners from many countries of the world. He is also known for his authorship, together with colleagues, of important texts on acoustics such as 'Noise Pollution' and 'Fundamentals of Noise and Vibration'. He has just finished work with Frank Fahy on the revised edition of 'Advanced Applications in Acoustics, Noise and Vibration'.

John Walker accepts his Honorary Fellowship

John is probably best known internationally for his work on railway noise. His early research work with Jim Fields on the subjective response to railway noise laid the foundations for the regulatory and legislative framework on railway noise assessment. He was instrumental in starting the International Workshops on Railway Noise and has been on the organising committee since its inception. The workshops have grown in size and importance year on year and the most recent, very successful, event was held in Buxton only last month.

Within the Institute, John has most recently served as Deputy Chief Examiner for the Diploma.

John's main outdoor hobby has been cricket, as a player and coach, and he has worked with the Hampshire Youth team. He has travelled the country, recently revisiting his old haunts in Lancashire and playing alongside old friends at Salford. John is also an active Austin 7 enthusiast, owning two cars.

John is respected in the international acoustics community for his scholarship and dedication to his work. For his sustained contributions to research on transportation noise and the organising and teaching of acoustics courses, the Institute of Acoustics is proud to award an **Honorary Fellowship** to John Gerard Walker.

Awards for Services to the Institute

Peter Edward Sacre BSc MSc CEng MIMechE MIOA

Peter obtained a BSc degree in Physics and Electronics at Chelsea College in 1971 and went on to obtain an MSc in Acoustic and Vibration Technology in 1972. He joined the Institute of Acoustics in 1974, the year of its formation.

After a short period working on a temporary basis with Rupert Taylor & Associates, Peter started his professional career in early 1973 as a sales engineer with Par Acoustics Ltd. From 1974 to 1979 he was an acoustic engineer and project engineer with Wimpey Laboratories where he carried out research for the development of prediction techniques used in BS5228 *Noise Control on Construction and Open Sites*. In 1980 he ventured to Australia to work on road traffic and construction noise and vibration for the Main Roads Department in Perth, moving on in 1981 to work as an acoustic consultant for Wilkinson Murray in Sidney. In 1983 he returned to the UK as a consultant at Sound Research Laboratories and in 1985 rejoined Wimpey Laboratories to run their acoustics team as Principal Consultant. From 1988 to 1994 Peter worked as an associate acoustic consultant for BDP Acoustics, setting up the London office before making a move to Manchester. A further move in 1994 saw him back at Sound Research Laboratories, this time as Executive Consultant at the Wilmslow office. In 2000 he teamed up with Kevin Worthington as a director of Acoustic and Engineering Consultants Ltd.

During his career, Peter has amassed a vast range of expertise in areas such as occupational noise and noise induced hearing loss, transportation noise, industrial processes, quarries and landfill, firing ranges and leisure

Peter Sacre (left), receives his award for services to the Institute from the President

buildings. He has experience in architectural design and planning projects associated with a wide variety of building types. Peter has written and presented a number of papers and was a contributing author to the popular reference book *Acoustics and the Built Environment*.

Peter is a Member of the Institute of Acoustics, a member of the Institute of Mechanical Engineers and a Chartered Engineer. Following his move to the Manchester area he became an active member of the North West Branch of the Institute and joined the branch committee. He was elected chairman in the early 1990's, a role which he has cherished ever since. He is, in fact, the Institute's longest standing Branch Chairman. He introduced the local rule that all committee members should stand down at the end of each year but somehow he always finds himself back at the helm at every AGM. In his role as chairman he has been able to enhance the reputation of the North West Branch as one of the more active of the Institute's branches and he has always ensured that the branch has a full and varied annual programme.

The Institute is indebted to Peter for his contribution to the acoustics profession at local level and wishes to acknowledge its gratitude by presenting him with the **Award for Services to the Institute**.

Stephen Gordon Chiles BSc CEng MIOA

Stephen Chiles achieved a first class honours degree in electro-acoustics from the University of Salford, which included a placement at the Royal Air Force where he worked on aircraft environmental noise and occupational noise projects. On graduation in 1996, he joined Arup Acoustics as an Assistant Acoustic Consultant where he gained experience working on the design of a variety of building projects, including a period in Hong Kong. Following a brief spell at WSP Environmental in 1998 Stephen joined Fleming and Barron as an Acoustic Consultant where he has been fully involved in their acoustical design projects for buildings for the arts.

Stephen's involvement with the Institute of Acoustics started in 1994 whilst a student at Salford, and as a voluntary assistant he was only too happy to apply himself to the hundred and one odd jobs that need to be done to ensure the smooth running of the meetings. Since then he has been a regular attendee and participant at more or less all the Institute's major conferences.

Stephen became an Associate Member of the Institute in 1996. His interest in building acoustics, together with his evident commitment and innate organisational skills, soon resulted in his election to Secretary of the Building Acoustics Group in 1997. In that role he has been involved in the organisation of several Institute meetings and in contributing to and co-ordinating the Institute's responses to the consultation process for important regulations and codes of practice, a recent example being *Building Bulletin 93*. By 1999 Stephen had achieved his MIOA and a year later he had fulfilled the requirements for Chartered Engineer. Around this time the Institute's Council decided to co-opt a representative of young members and Stephen was the obvious candidate, so he was duly appointed to serve on Council in this capacity for the 2001/2 session.

Whilst in London he was a regular attendee at the evening meetings of the Institute's London Branch and of the Audio Engineering Society, represented Fleming and Barron on the Council of the Association of Noise Consultants and completed a spell as the ANC's Honorary Secretary.

In 2000, Stephen decided to further his professional development by taking a research assistantship at the University of Bath where he has been investigating sound behaviour in proportionate spaces and auditoria, leading to the award of a PhD.

Sadly for the Institute, the lure of 'proper' mountains has enticed Stephen to the other side of the world to pursue his leisure activity of paragliding and next month he will be making his way to New Zealand where he will no doubt continue to commit himself wholeheartedly to the next phase of his career development and to the benefit of any organisation with which he associates himself.

It is therefore with great pleasure that the Institute of Acoustics records its indebtedness to Stephen Chiles for his sustained assistance with the running of the Institute by presenting him with the **Award for Services to the Institute**.

Base isolated buildings

Modelling for the prediction of isolation performance

J P Talbot

Base isolation of buildings is well established as one of the most effective means of limiting the disturbance caused by ground-borne vibration from sources such as roads and railways. The technique involves inserting isolation bearings between a building and its foundation in order to reduce the internal levels of perceptible vibration and re-radiated noise. Either laminated rubber bearings or steel springs may be used, as illustrated in *Figures 1 and 2*.

No standards currently exist specifically governing the design of base-isolated buildings. In practice, design strategies are based on past experience and appropriate models. This article is concerned with the specification of those models and, in particular, the need for an appropriate foundation model.

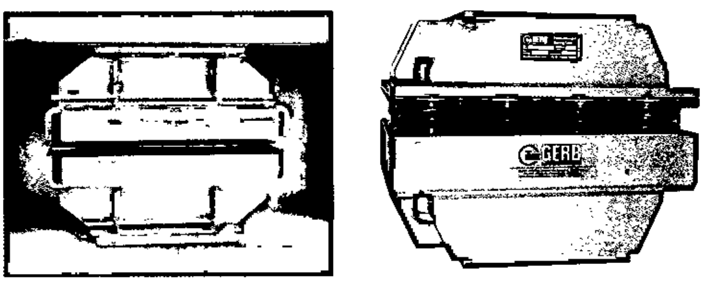


Figure 1: Base isolation bearings are available as either laminated rubber bearings or steel springs (courtesy of CDM, Belgium and GERB Schwingungsisolierungen GmbH & Co, Germany)

Some initial models

The single-degree-of-freedom model

The single-degree-of-freedom (SDOF) model serves as a useful introduction to the principles behind base-isolation, as illustrated in *Figure 3*. The model was originally used by Waller when describing Albany Court, the first base-isolated building constructed in the UK (1). This, together with its inherent simplicity, has probably resulted in the model's popularity. The building is represented by a rigid mass supported on a spring-damper element to represent the isolation bearings. Ground-borne vibration is represented by an imposed displacement amplitude X at the base of the spring-damper. The resulting motion of the building is described by the displacement amplitude of the mass Y.

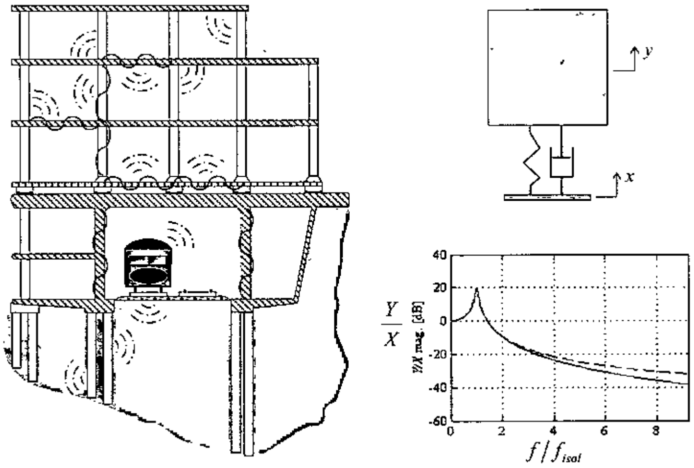


Figure 3: The principles of base isolation may be introduced by the single-degree-of-freedom model

The precise expression describing the variation in the ratio Y/X with frequency depends on the nature of the damping element (2) but the essential features are the same in all cases: (1) the bearings act to amplify low-frequency vibration, and this is greatest at the resonance frequency – commonly referred to as the *isolation frequency*; (2) the bearings are only effective for frequencies greater than $\sqrt{2}$ times the isolation frequency, above which the isolation improves with frequency; and (3) damping acts to limit the resonance amplitude but reduces the isolation performance.

These features of the SDOF model suggest some guiding design principles but the model is too simplistic for making any useful predictions of isolation performance. One of the primary limitations is that it only represents half the system in question: the ground and the building's

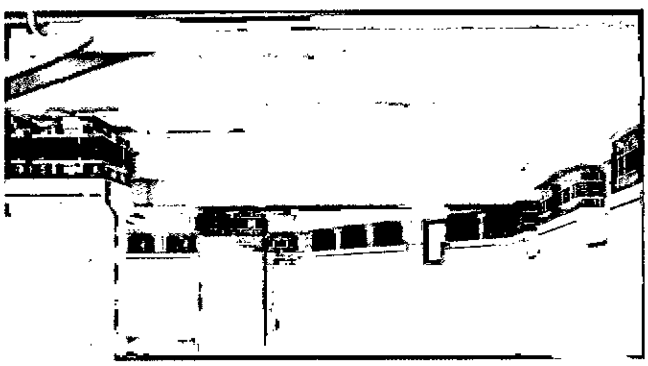


Figure 2: A typical base-isolated building in the form of a multi-storey office (courtesy of GERB Schwingungsisolierungen GmbH & Co, Germany). The entire building is isolated from its foundation by spring bearings located in the basement

foundation are ignored. Soil-structure interaction effects are therefore unaccounted for. The following section considers one of these effects, which may be termed the *added-mass* effect.

The added-mass effect

Consider the model shown in *Figure 4,* which combines the SDOF system with a foundation model based on a rigid footing of zero mass bonded to the surface of an elastic half-space.

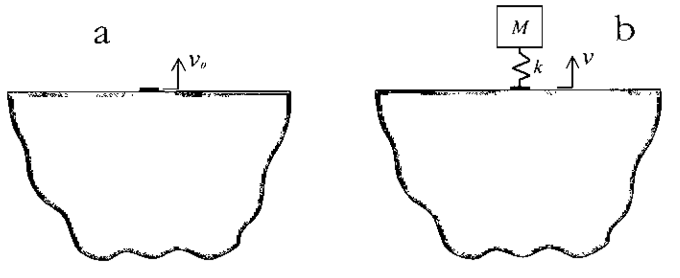


Figure 4: A base-isolated building model based on a SDOF system founded on a rigid massless footing bonded to the surface of an elastic half-space. Prior to construction of the building (a) the footing moves with amplitude v_0; following construction (b) this becomes v.

Assume that, prior to the construction of the building, a ground vibration field exists which causes the footing to move vertically with a harmonic displacement amplitude v_0. If the SDOF model is used in the absence of a foundation model, as in *Figure 3,* this is the value that would be used as the displacement input *X*. However, following the construction of the building, the footing amplitude is known to become v. This may be expressed as the superposition of the original amplitude and that due to the force *f* applied by the SDOF system:

$$v = H_f f + v_0 \quad (1)$$

where H_f is the driving-point displacement frequency-response function (FRF) of the footing on the half-space, as given by Johnson **(3)**.

Equilibrium of forces ensures that an equal but opposite force acts on the base of the SDOF system and compatibility of displacements ensures that this also moves with amplitude v. Therefore, for the building:

$$v = -H_b f \quad (2)$$

where H_b is the displacement FRF of the building according to the SDOF model **(2)**. Eliminating *f* from *Equations 1 and 2* enables the ratio of the final footing amplitude to that prior to the construction of the building to be expressed as follows:

$$\frac{v}{v_0} = \frac{H_b}{H_b + H_f} \quad (3)$$

For v/v_0 to approach unity, that is, for the construction of the building to have negligible effect on the response of the footing, $H_b > H_f$. This is equivalent to saying that the dynamic stiffness of the isolated building – which is the inverse of the displacement FRF – must be much less than that of the foundation.

Equation 3 is plotted against frequency in *Figure 5* for the cases of a 5 and 15 Hz isolation frequency (representing the typical range of practical isolation frequencies). An 'infinitely stiff' bearing corresponding to an unisolated building is shown for comparison. Typical parameter values are chosen to represent the building and the ground: mass of building = 10^5kg; shear modulus of soil = 200MPa, with a shear wave speed of 316ms^{-1}; and footing radius 0.5m. Nominal damping loss factors of 0.05 are assigned to the spring and the half-space.

At low frequencies, two resonances dominate the behaviour of the model. The resonance of the SDOF system on its foundation occurs first, leading to amplified 'post-construction' vibration levels, followed by the resonance of the mass on the spring, at which the high dynamic stiffness of the SDOF system constrains the foundation resulting in the anti-resonances in the curves. At higher frequencies, the dynamic stiffness of the SDOF system tends towards the static stiffness of the spring and, since this is much lower than the dynamic stiffness of the foundation, the effect of the SDOF system becomes smaller.

It is clear from these results that $v \neq v_0$, that is, the

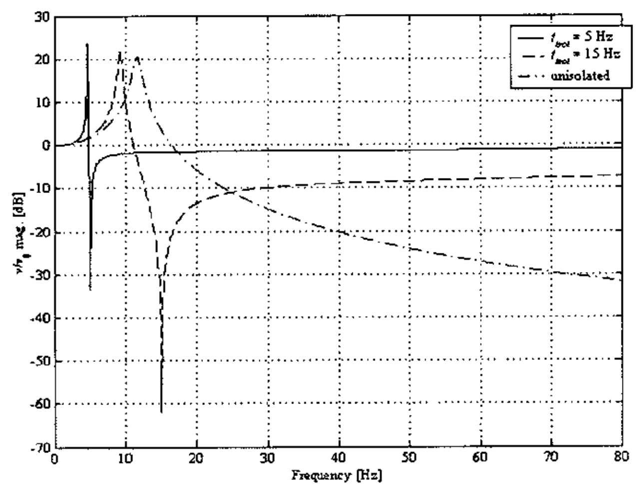


Figure 5: Soil-structure interaction of a base-isolated building as predicted by a SDOF building model founded on a footing bonded to the surface of an elastic half-space. The ratio of the final footing amplitude v to that prior to the construction of the building v_0 is shown for different isolation frequencies

pre- and post-construction vibration levels can be quite different over the frequency range of interest. Clearly, the only way of accounting for this effect is through an appropriate foundation model and an appropriate representation of the vibration source.

It is instructive to replace the rigid-mass representation of the building with an elastic column of height *L*, cross-sectional area *A*, Young's modulus *E* and density ρ,

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as illustrated in *Figure 6*. If H_b is replaced with the corresponding FRF for the column **(2)**, Equation 3 gives the results illustrated in *Figure 7*. The parameter values for the spring, footing and half-space remain the same as before while those of the column are as follows: L=30m;

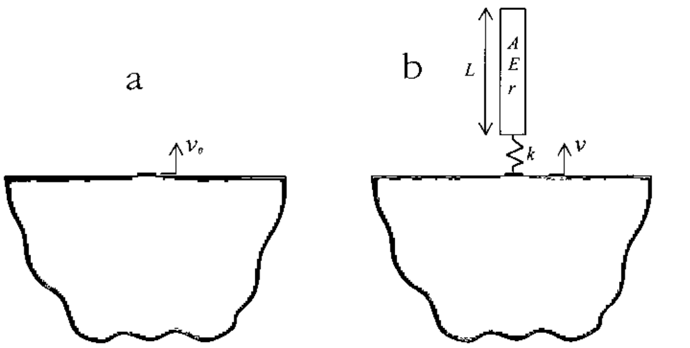

Figure 6: An elastic column model of a base-isolated building. An elastic column is founded on a rigid massless footing bonded to the surface of an elastic half-space. Prior to construction of the building (a) the footing moves with amplitude v_0; following construction (b) this becomes v

E=10 GPa, with a nominal damping loss factor of 0.01, and ρ=2400kg/m^3, representative of concrete; and A=1.39m^2 such that the overall mass of the column is the same as that of the SDOF model.

The primary effect of the building's flexibility, as modelled by the elastic column, is to superpose a series of resonance and anti-resonance peaks on the response of the foundation. The first point to note is that these resonances act to reduce the isolation efficiency. Clearly, any building model that treats the building as rigid will over-predict isolation performance – a conclusion that is supported by more comprehensive building models **(4,5)**. The second point is that the mean response remains the same as if the building was rigid, indicating that the constraining effect of a building is primarily an 'added-mass effect' due to its inertia, rather than its stiffness.

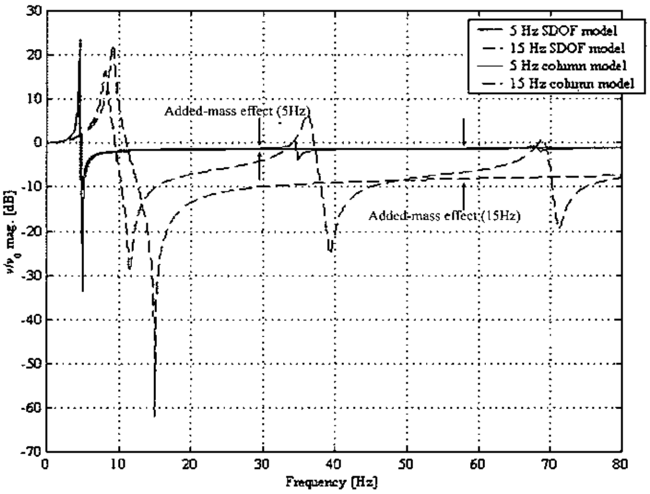

Figure 7: Soil-structure interaction of a base-isolated building as predicted by a building model consisting of an elastic column on a spring, founded on a footing bonded to the surface of an elastic half-space. The ratio of the final footing amplitude v to that prior to the construction of the building is shown for different isolation frequencies, along with the results of Figure 5 for comparison

These results replicate similar behaviour that has been observed in practice. Newland and Hunt **(6)** present measured data that support the idea of an added-mass effect. Their data show decreasing vibration levels at the pile-cap level of a foundation as the construction of the building progresses. The results also replicate behaviour observed experimentally by Sharif **(7)**, in that the improved decoupling of the building from its foundation achieved with a lower isolation frequency limits this added-mass effect, resulting in higher post-construction vibration levels of the foundation than if the building was not isolated. Note that this latter effect highlights the inadequacy of describing isolation performance in terms of vibration levels above and below the bearings: the performance of a soft isolation is exaggerated by greater vibration amplitudes beneath it.

The added-mass effect is just one example of why a building's foundation must be considered when predicting isolation performance. In practice, the foundation and surrounding ground not only provide the transmission path from the vibration source but they also act as a sink of vibration propagating in the building. The foundation is therefore an essential component of any model.

Modelling for the prediction of isolation performance

The initial models help to illustrate some of the limitations of the SDOF model and indicate some of the essential behaviour of base-isolated buildings that must be included in more comprehensive models. This section proposes a modelling process by which predictions of isolation performance may be made, along with suggestions of how this may be implemented in practice.

The modelling process

As with the initial models, it is most efficient to formulate base-isolated building models in the frequency domain. This is because the response, particularly that due to railways, is of sufficient duration for steady-state conditions to be achieved. The assumption of linearity is also valid given the low strain amplitudes involved. With this in mind, irrespective of the particular methods employed, the following modelling process is proposed for the prediction of isolation performance. The entire process must be followed for each frequency of interest.

1) Calculate the foundation's frequency-response function (FRF) matrix $\mathbf{H}_f^{\prime}$. This relates vectors $\mathbf{u}_{bf}$ and $\mathbf{f}_{bf}$ containing the displacement and force amplitudes at various locations, or *nodes*, on the building-foundation interface.

2) Assemble a vector $\mathbf{u}_{bf0}$ containing the displacement amplitudes at nodes on the building-foundation interface in the absence of the building. This represents the input to the final model. By considering equilibrium of forces and compatibility of displacements, the generalised form of Equation 1 may be found, which gives the displacements of the building-foundation interface in the presence of the building:

$$\mathbf{u}_{bf} = \mathbf{H}_f^{11}\mathbf{f}_{bf} + \mathbf{u}_{bf0} \quad (4)$$

3) Calculate the building's FRF matrix $\mathbf{H}_b$. This relates

displacement and force amplitudes at nodes throughout the building model. Because the forces acting on the building are equal and opposite to those acting on the foundation, and no other external forces are assumed to act on the building, $\mathbf{H}_b$ may be partitioned according to whether nodes lie on the building-foundation interface or elsewhere in the building:

$$\begin{bmatrix}\mathbf{u}_{bf}\\ \mathbf{u}_b\end{bmatrix} = \begin{bmatrix}\mathbf{H}_b^{11} & \mathbf{H}_b^{12}\\ \mathbf{H}_b^{21} & \mathbf{H}_b^{22}\end{bmatrix}\begin{bmatrix}-\mathbf{f}_{bf}\\ 0\end{bmatrix} \quad (5)$$

where $\mathbf{u}_b$ contains displacements at nodes other than those located on the building-foundation interface. Eliminating $\mathbf{f}_{bf}$ from Equations 4 and 5 gives:

$$\mathbf{u}_{bf} = \left[\mathbf{I} + \mathbf{H}_f^{11}\left[\mathbf{H}_b^{11}\right]^{-1}\right]^{-1}\mathbf{u}_{bf0} \quad (6)$$

This is the generalised form of Equation 3, which allows the interface displacements in the presence of the building to be calculated from those in its absence.

4) The final stage is to calculate the building-foundation interface forces using Equation 5:

$$\mathbf{f}_{bf} = -\left[\mathbf{H}_b^{11}\right]^{-1}\mathbf{u}_{bf} \quad (7)$$

These may then be used to calculate the remaining building displacements:

$$\mathbf{u}_b = -\mathbf{H}_b^{21}\mathbf{f}_{bf} \quad (8)$$

Depending on the intended use of the model, a variety of methods may be used to implement each of the above steps. Some of the most common methods are described below.

The building model

Any building model should represent, to some degree, the mass, stiffness and damping of the building's primary structure. As the column model indicates, the vibration modes of a building can result in a significant reduction in base isolation performance. Building models should therefore account for the essential dynamic behaviour of a building's floors and columns, and the dynamic coupling between them.

The finite-element method (FEM) **(8)** is now the most widely used numerical technique for engineering analysis and is a natural choice for modelling vibration of buildings. It has the advantage of being readily available commercially and may provide the most efficient means of generating comprehensive three-dimensional models. However, the FEM usually employs modal analysis and care must therefore be taken to ensure an adequate number of elements are used for the required accuracy over the frequency range of interest.

An alternative to the FEM is the dynamic-stiffness method **(9)**. This is computationally efficient and particularly suited to producing two-dimensional portal frame models, although it may also be extended to three dimensions. The method is based on the analytical solutions of Euler beam theory and that describing an elastic bar. It is therefore exact within the limitations of the theory.

As with the initial models, it is common practice to consider only vertical motion of the building: the horizontal component of ground motion is generally neglected on the assumption that the building's inherent

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flexibility in this direction provides sufficient isolation. However, there is theoretical evidence to suggest that this may not always be the case **(5)** and it is increasingly recognised that the structural elements at the base of a building exhibit a combination of vertical, horizontal and rotational motion. It is therefore recommended that all three primary modes of deformation of an isolation bearing are accounted for, as illustrated in *Figure 8*.

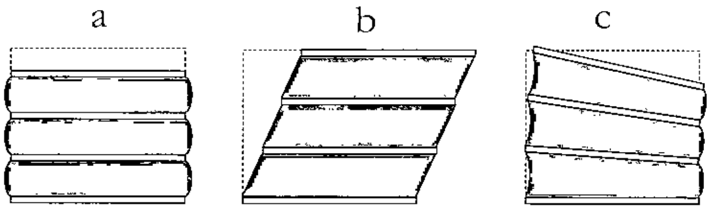

Figure 8: The three primary modes of deformation associated with an isolation bearing: (a) vertical compression, (b) horizontal shear and (c) rotation

The foundation model

The foundation model used to illustrate the added-mass effect is a simple footing model for which an analytical solution exists. Foundations are rarely as straightforward and numerical methods are usually required instead. When modelling the semi-infinite extent of the ground, domain methods, such as the FEM or finite-difference method **(10)**, suffer from a fundamental problem. The element mesh should extend towards infinity but in practice must be curtailed at a certain distance. The resulting artificial boundary leads to spurious wave reflections that can distort the solution. A simple solution to this problem is to use models large enough that insufficient wave energy reaches the model boundary. This approach is usually impractical given the computational requirements of the models. A solution available in some commercial FEM codes is to use non-reflecting boundaries or so-called infinite elements **(11)**. These help account for wave radiation to infinity but only approximately due to the difficulty of accounting for the different wave-types.

One technique ideally suited to the modelling of ground-borne vibration is the boundary-element method (BEM) **(12)**. In contrast to the FEM, the BEM requires the discretisation of only the domain boundaries, rather than the full domain. The governing equations are automatically satisfied and the radiation of waves to infinity is automatically accounted for. As with the FEM, if necessary, the BEM enables the representation of different soil strata and inhomogeneous soils through the use of multiple BEM domains and appropriate fundamental solutions.

Representing the vibration source

In the modelling process outlined above, the vibration source is represented by the vector $\mathbf{u}_{bf0}$. This contains the displacement amplitudes at nodes on the building-foundation interface in the absence of the building. The advantage of expressing the input in this way is that it need only be defined once, even if several different building designs are subsequently modelled. $\mathbf{u}_{bf0}$ may be calculated using the foundation model, excited by either an incoming vibration field or an explicitly modelled source such as an underground railway tunnel. Alternatively, the displacements may be specified to represent a known distribution of vibration levels across a particular site.

Example case study

As an example application of the modelling process defined above, this article concludes with a summary of a particular case study. This concerns a new building that is to be constructed above an underground railway. Experience with an existing building on the neighbouring site indicates that base isolation is necessary if the new building is to fulfil its intended function. Here, attention is focussed on the use of *side-restraint bearings*. The intention is to support the *retaining walls of the basement cavity* off the primary building structure, the aim of the side-restraint bearings being to minimise any 'short-circuiting' of the base bearings. The objective of the modelling presented here is to predict the effect of the side-restraint bearings on the overall isolation performance. Further details may be found in **(13)**.

Overview of model

The building has a uniform repeating structure and a slab foundation in a substantially uniform soil. For this comparative study, a two-dimensional model is therefore deemed adequate, as illustrated in *Figure 9*.

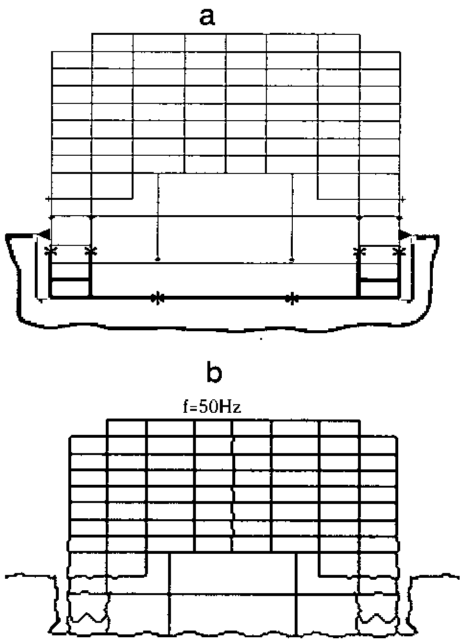

Figure 9: A two-dimensional model for investigating the effect of side-restraint bearings: (a) the building is represented by a portal frame, isolated from a boundary-element representation of the ground by six base bearings (*) and two side-restraint bearings (▶); (b) the response of the building at 50 Hz to a buried harmonic force applied below the foundation slab

The building is modelled using the dynamic stiffness method, which represents the primary structure as a series of coupled Euler beams and elastic columns. A finite-element model would fulfil the same function provided care is taken to ensure an adequate number of elements are used. The isolation, which is designed to give an isolation frequency of 3.5Hz, consists of six base bearings and two side-restraint bearings. Each one is modelled by three linear springs to account for its vertical, horizontal and rotational stiffness, as illustrated in *Figure 8*.

The slab foundation is coupled to a boundary-element representation of the ground, and the excitation from the underground railway is represented by a buried harmonic force. This is the simplest means of generating an incident vibration field that has the essential characteristics of the pressure and shear waves generated in practice.

Results

Following the modelling process outlined earlier, the response of the building model may be calculated with and without isolation in place. The isolation performance may therefore be calculated for a system employing only base bearings and one with the addition of side-restraint bearings. Here, power-flow insertion gain **(4, 5)** is used to provide a single measure of the average isolation performance throughout the building:

$$\mathrm{PFIG} = 10\log_{10}\left(\frac{\overline{P}_{isol}}{\overline{P}_{unisol}}\right) \quad (9)$$

where $\overline{P}_{isol}$ and $\overline{P}_{unisol}$ are the total mean vibrational power flows entering a building in the isolated and unisolated cases respectively. The principal behind PFIG is that the mean vibrational energy entering a building drives all internal noise and vibration, and therefore a reduction in PFIG is guaranteed to reduce internal levels. PFIG has clear advantages over performance measures based on vibration amplitudes because it accounts for multidirectional vibration at multiple inputs and is insensitive to the spatial distribution of vibration levels within a building.

Figure 10 shows the variation with frequency in the PFIG

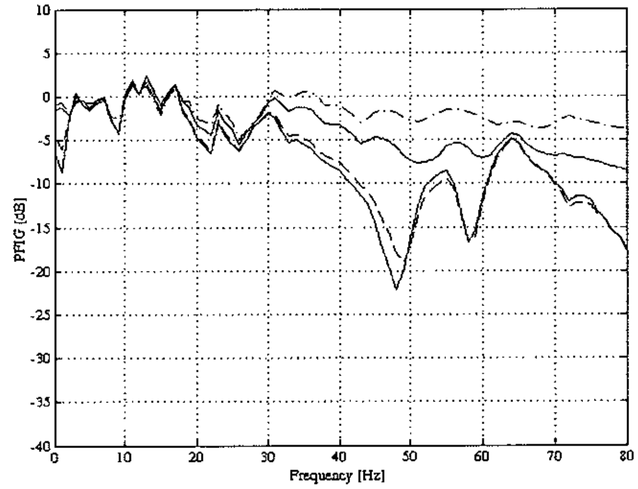

Figure 10: The effect of side-restraint bearings on the power-flow insertion gain of a base-isolated building. The results correspond to side-bearing stiffnesses of 1.00 (chained), 0.30 (solid) and 0.10 (dashed) times the stiffness of the base-bearings. The case corresponding to no side-restraint bearings is shown bold

when the dynamic stiffness of the side-restraint bearings is varied from 1.00 to 0.30 and 0.10 times the stiffness of the base bearings. In this example, as a spatial average, the isolation performance is limited below approximately 18Hz due to local vibration modes of the building and foundation. Above 30Hz, the effect of the side-restraint bearings is significant and minimising the stiffness of these bearings maximises the overall isolation performance. In this example, it appears that the side-restraint bearings are ideally located to deliver additional vibrational power to the building, and this outweighs any benefit from power leaving the building to be dissipated in the soil.

Conclusion

Appropriate models are essential for guiding the effective design of base-isolated buildings. While simple models suggest some guiding principles, these are often too simple for making any useful predictions of isolation performance.

It is hoped that the modelling approach described here will lead to better predictions of isolation performance and more effective designs.

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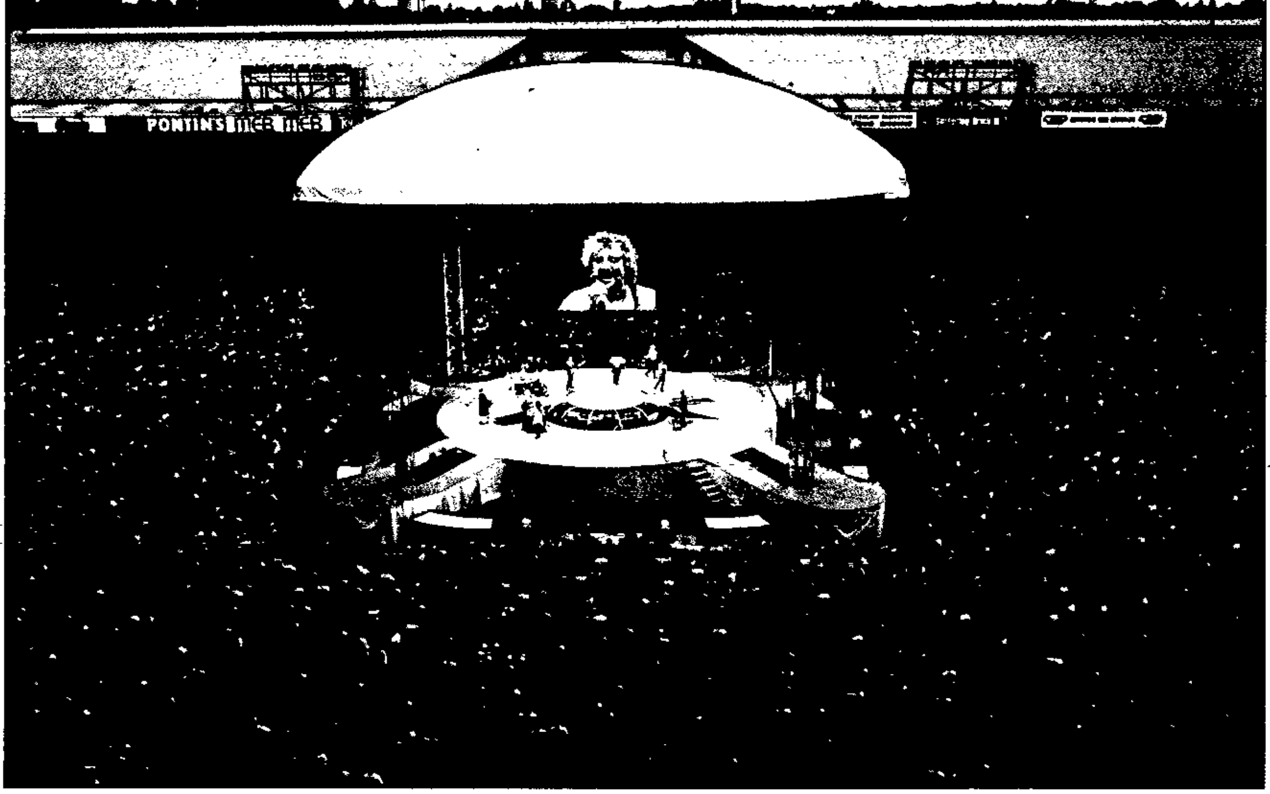

Rod Stewart in concert at Villa Park

Low frequency noise criteria for concerts

Robert Peirce

In recent years it has become noticeable that more local authorities are imposing low frequency noise criteria at outdoor concerts, although the majority of events still do not specify low frequency noise limits. At events where the licence conditions provide low frequency noise criteria the limits vary from 'impossible to achieve' and therefore either tend to be ignored or can prevent the event from taking place, to noise limits that only apply when low frequency noise complaints are received.

Low frequency noise from concerts is a difficult area to control due to both the dominance of these frequencies within the music spectrum and the difficulties in attenuating noise at low frequencies. Another major difficulty is persuading sound engineers (especially those of large touring bands) to change their frequency spectrum shape, which is part of their artistic interpretation. A useful analogy is to consider an artist being commissioned to undertake a painting. If you request that the artist reduces the size of his canvas (compared to a sound engineer being asked to reduce the overall noise level) then the artist would normally be happy to comply. However, if you suggest to the artist that different shades of colour should be used in the painting (similar to asking the sound engineer to reduce the low frequency content of the music) then the artist is likely to decline the request (a sound engineer would use more agricultural language).

As a result of the inconsistencies that have been observed in low frequency noise criterion at various recent concerts this article aims to:

- *Consider existing guidance provided within the Code of Practice on Environmental Noise Control at Concerts* **(1)**;
- *Review recent licence conditions for concerts;*
- *Discuss recent concert experiences;* and
- *Provide a revised low frequency criterion for outdoor concerts*

The low frequency noise limits discussed within this article only apply to daytime concerts that finish before 2300 hours. These limits are not intended to apply to all night events where more stringent noise criteria are required.

Existing low frequency guidance at concerts

The Code of Practice **(1)** provides a footnote to Guideline 3.4 regarding low frequency noise, which states that:

'**1.** *It has been found that it is the frequency imbalance which causes disturbance. Consequently there is less of a problem from the low frequency content of the music noise near to an open air venue than further away.*
2. *Although no precise guidance is available the following may be found helpful (Ref 8): A level up to 70 dB in either of the 63Hz and 125Hz octave frequency band is satisfactory: a level of 80 dB or more in either of those octave frequency bands causes a significant disturbance.'*

The Ref 8, discussed above, is *A study of Low Frequency Sound from Pop Concerts 1993* **(2)**. The conclusions of this interim study are summarised below:

- At open air venues, the increase over background 'A' weighted criterion works well at minimising complaints near to the venue.
- The 'A' weighted criterion can underestimate annoyance at greater distances from the venue (in excess of 2Km) as the mid to high frequency energy is quickly attenuated with respect to low frequency and the expectation of people living some distance from the event being that the concert should be inaudible.
- Sound pressure levels in excess of 80 dB in the 63 Hz or 125 Hz octave bands recorded in excess of 2 km from the concert, are likely to give rise to complaints of low frequency noise. Levels below 70 dB are likely to be acceptable.

Another method of assessing low frequency noise is to assess against the existing levels, whereby increases in the 63Hz or 125 Hz octave bands of the order of 20 dB are likely to give rise to low frequency noise complaints.

The Ref 8 paper **(2)** clearly states that these conclusions refer to low frequency noise at distances greater than 2 km from a venue. It is unfortunate that this distance has not been included in the guidance notes in the Code of Practice as this has led to many low frequency noise limits being based on incomplete information. According to discussions with members of the Noise Council, it was never the intention that the low frequency notes shown in the Code of Practice were to be used as the basis for Licence conditions, but rather were just guideline values.

Review of low frequency licence conditions

The main reason for producing this article is the inconsistency and variety of low frequency conditions at concerts. This issue has for many years been dealt with on a 'complaints' basis during the concerts but more local authorities are now imposing conditions.

The following examples of low frequency noise conditions have been used to indicate the different approaches of local authorities. While the names of local authorities and venues have not been included, the anecdotal evidence from these events is considered to add value to the debate. The limits shown in *Table 1* apply at 1m from the façade of the nearest noise sensitive property unless stated otherwise.

It should be noted that the majority of outdoor concerts work successfully for all concerned parties (bands, venue operators and local residents) without a low frequency criterion.

Table 1

Venue Description	Low Frequency Criterion	Number of events and finishing time	Complaints Information	Comments
Large open park in the middle of a city centre	L_{Amax} 70 dB (63 and 125Hz octave bands) for 10 seconds	Generally 2 to 3 per year. Events finish between 2230 to 2300 hours	Only 1 or 2 complaints per event	It was immediately apparent that the low frequency noise limit was unachievable without seriously affecting the audience expectations. A compromise was reached whereby the low frequency content was reduced when considered to be 'excessive' by the Local Authority (at a level around 85 to 90 dB in the 63 Hz octave band).
Park in city centre	71dB (63 and 125Hz octave bands) with no time period	1 per year and finished at 1930 hours	No complaints	It was observed that the traffic noise levels at the nearest residential property to the venue was 78 dB in the 63 Hz octave band even before the music started.
Dedicated outdoor concert venue	$L_{Ceq(15 min)}$ 102 dB at perimeter of the audience area	Only one event this year, which finished at 1800 hours	No complaints	No major bands have played at the venue since the new low frequency limit has been included in the conditions
Large park in city centre	maximum level of 70 dB at 63 and 125 Hz octave bands	Generally between 2 to 3 per year. Finish between 2230 to 2300 hours	Around 4 complaints per event	The low frequency limit is not enforced although it is exceeded
Large park in city centre	$L_{eq(15 min)}$ 80 dB Lin	1 per year finishing at around 2130 hours	No more than 2 complaints	Observations at the events indicate that this venue needs an 85 dB low frequency noise limit to be viable and at previous concerts there are little or no complaints at a level of 85 dB
Large park in city centre	$L_{eq(15 min)}$ 80 dB Lin in the low frequency 1/3rd octave bands	One-off 2 day event finishing at 2200 hours	3 to 4 complaints on each day of the event	The low frequency noise guidance level was around 85 dB on day 1 (generating 4 complaints) and was around 80 dB on day 2 (generating 2 complaints). There was an audience of around 10,000 people on each day.
City Centre Stadium in urban area	70 dB at 63 and 125 Hz octave bands	1 show per year, finishing at 2230 hours	No low frequency noise complaints	The low frequency noise levels were 85 to 87 dB in the 63 Hz octave band at the nearest residential properties with no complaints.
City Centre Stadium in urban area	75 dB in the 63 and 125 Hz octave bands (this is an ad-hoc limit rather than a noise condition)	2 events this year, finish at 1900 hours	Only 1 noise complaint this year	There is no time period for the low frequency noise limits as the existing noise levels from planes and road traffic are often above the music noise limit.

Proposals for low frequency noise limits at concerts

The following issues need to be considered in setting low frequency noise limits at outdoor concerts:

A limit of 70 dB is often unachievable (especially in urban areas) and if enforced would prevent concerts at many existing venues (both the audience and sound engineers would consider the noise experience to be unsuitable) as bands and audience would not return to venue.

Generally the low frequency limit is dominated by noise in the 63 Hz octave band. Sound control should be concentrated on this octave band and one option would be to concentrate on the third octave bands.

The approach that works successfully at most existing outdoor venues is to react to low frequency noise complaints and reduce the low frequency noise content based on community reaction.

Obviously the location of the venue and the nearest residential properties influences whether the low frequency limits are achievable. A higher limit is often needed in urban areas (where there are higher background noise levels and often closer residential properties to the venue).

The measurement time period is critical. If sound control is to be achievable then time is required to get the low frequency noise levels reduced to within acceptable levels. The dynamics of songs (some need to be loud, some quiet) also need to be considered if the performance is not to be adversely affected. Limits with no time period (or minimal periods) do not allow time to 'control' or reduce the low frequency content. A time period that reflects the 'A' weighted limit of 15 min (as recommended in the Code of Practice) is considered to be appropriate.

The number of events per year and the time that the

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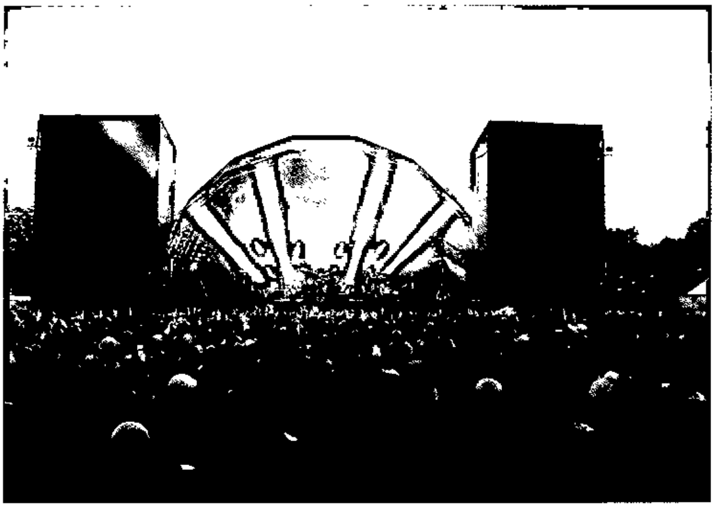
It should be noted that the majority of outdoor concerts work successfully for all concerned parties (bands, venue operators and local residents) without a low frequency criterion



Low frequency noise criteria for concerts

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event finishes also affects the 'tolerance' of the local community.

The 'A' weighted limit in the Code of Practice is 65 or 75dB(A) and this is normally dominated by low frequencies, therefore a limit of 70dB in the 63 Hz octave band is of course going to be exceeded. An alternative way of looking at this is that by meeting a low frequency limit of 70 dB the 'A' weighted limit would need to be 5 to 10dB lower.

An example of correlation between the 'A' weighted levels and the low frequency levels at concerts is demonstrated in *Figure 1.*

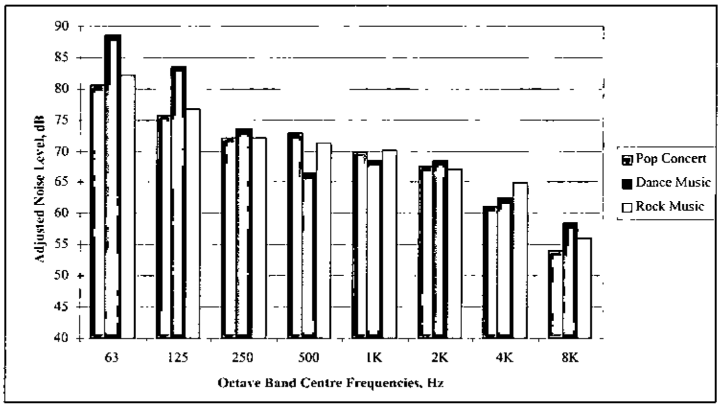

Figure 1: Adjusted concert noise spectra such that overall noise level is 75 dB(A)

The spectra shapes for a rock concert, a pop concert and a dance music event, when adjusted such that the overall 'A' weighted level is 75 dB(A) indicate that in the 63 Hz octave band the corresponding noise level is 81 dB for pop, 89 dB for dance and 82 dB for rock. It follows that any low frequency noise limit below 81 dB in the 63 Hz octave band at the pop or rock concert would have affected the sound engineers ideal frequency spectrum shape. For the dance music event the impact of a low frequency noise limit in the range of 70 to 80 dB would have had a significant effect on the audience expectations for low frequency noise.

The third octave band spectrum for the rock concert is shown in *Figure 2.* This example indicates the dominance of the 40, 50 and 63 Hz third octave bands. This third octave band spectrum shape has been replicated at other similar concerts.

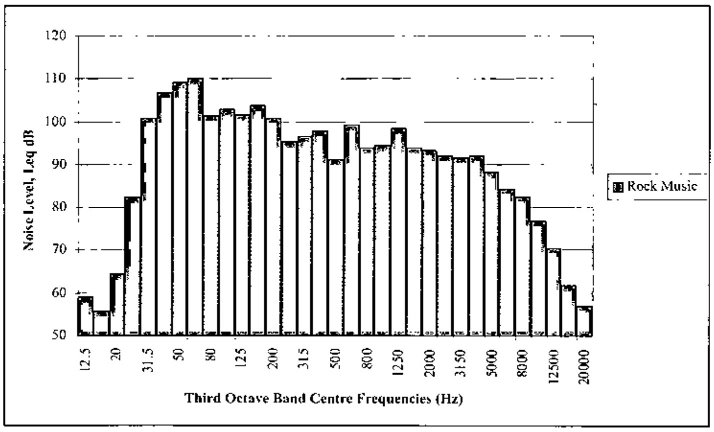

Figure 2: Third octave band noise levels at the mixer location for a rock concert

Setting the sound for a concert at The Dome

Based on all of the issues that are discussed above and our experience at controlling noise at concerts the following guidelines are proposed for further discussion and debate. The noise level measured 1m from the façade of any noise sensitive premises and measured in the 40, 50, 63 and 80 Hz third octave bands should be in the following range:

a) $L_{eq(15\,min)}$ 75 to 80 dB Lin for rural areas

b) $L_{eq(15\,min)}$ 80 to 85 dB Lin for urban areas

A range of limits has been provided as all venues should be considered as individual cases and the number of events per year and the finishing time should also be considered when setting a low frequency noise limit.

Conclusions

Recent experiences regarding noise control at outdoor concerts indicate that the Code of Practice guidance for low frequency noise needs to be updated. This would help to provide a more consistent approach for local authorities wishing to set low frequency licence conditions.

A reasonable balance is required between the sound experience of the audience and the impact on local residents. In some recent cases the low frequency noise levels within the venue have been significantly reduced to meet the licence conditions, affecting the enjoyment of tens of thousands of people due to minimal or even no noise complaints.

At venues that have worked successfully for many years without either a low frequency noise criterion or low frequency noise complaints, it is considered that no change is required. Where local authorities consider that a low frequency noise limit is required to protect the local community then it is hoped that consideration of the guidelines detailed above will provide a more consistent and realistic approach to low frequency noise conditions for concerts.

References

1 Code of Practice on Environmental Noise Control at Concerts, The Noise Council, 1995
2 Griffiths J, Staunton J, Kamath S S, A Study of Low Frequency Sound from Pop Concerts, *Proc.IOA Vol 15 Part 7 (1993)*

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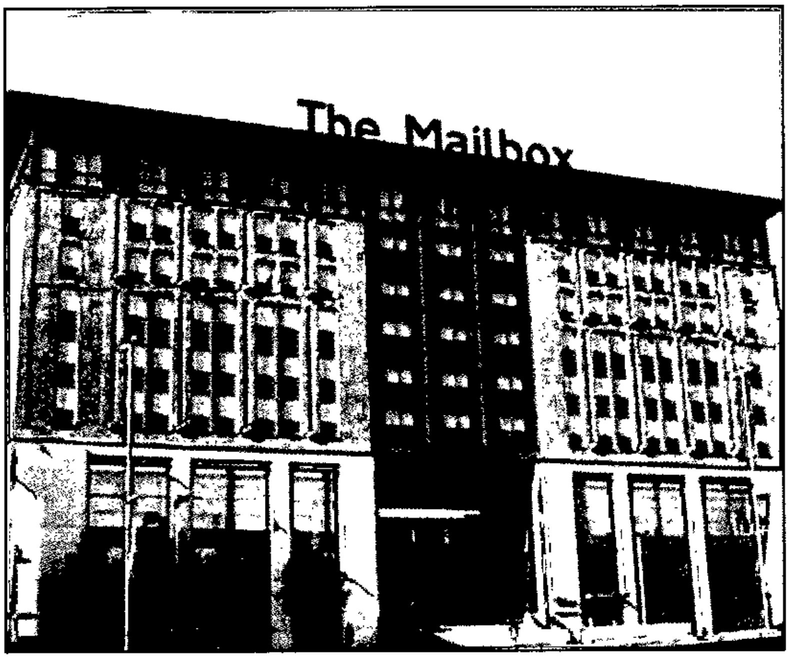
The Mailbox

BBC Birmingham's new home

meeting the stringent acoustic and aesthetic criteria demanded by this sophisticated broadcasting facility



BBC Birmingham's move, after 33 years at Pebble Mill, to new premises at The Mailbox is the first of a series of high profile BBC property developments to be completed. The Mailbox is a large mixed use development, formerly a 1960s postal sorting office, in the centre of Birmingham.

In February 2001, The Building Design Partnership was appointed to create a distinctive presence in the development which would attract and welcome the public while providing the best possible accommodation for BBC programme makers. The 9300m^2 project incorporates integrated broadcasting (radio and television), technical support, and general office activities, with a public atrium creating a focus and providing views into live broadcasting studios.

BDP's design solution was to create a dramatic four-storey entrance space at the heart of the plan linking the entrance, located in the main shopping concourse of The Mailbox, with the broadcasting accommodation at all levels. Whilst the partnership's involvement with the existing building was mainly internal, the opportunity was taken to modify the façade to increase the areas of glazing and, in particular, to provide a picture window. This was designed both to advertise the BBC's presence in The Mailbox and to provide an open aspect to the south-west. The open aspect improved the quality of internal natural light and reinforced the visual link to the public canal-side space.

When they enter through the BBC 'shop front' which features a coffee bar and shop, visitors will see into the local radio studios at the lower level and the drama studio at the upper level, with the activities of the open plan offices, TV studio and editing suites fully visible through the full-height glass screen beyond.

The offices are arranged over two levels, the higher being formed by suspended mezzanine floors or gondolas, floating within the double-height open-plan space and thereby substantially increasing the available floor area. The gondolas use a highly innovative design very like the wing technology used in lightweight aircraft. They create a structure which is inherently stable but at the same time provides integrated continuous service voids through which fresh air, power and data cabling can be distributed into the office spaces.

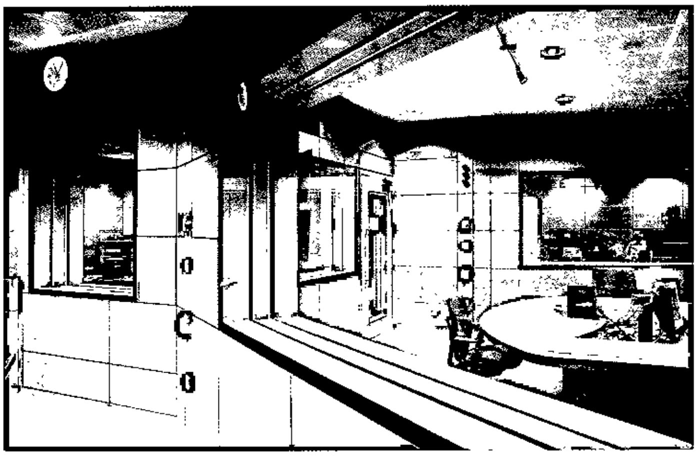
Cooling is provided by chilled beams mounted at high level above the ceilings, with chilled ceiling panels under the gondolas. This system is low energy, possible through the availability of free cooling using canal water.

The studios are built using a modular and lightweight construction devised by IAC, and are designed to a very high acoustic standard. BDP provided the architect, interior designer, structural engineer, environmental engineer, lighting designer and acoustic consultant.

Design consultants IDEA produced the furniture layouts for the open-plan offices, which introduce a variety of vivid carpet colours to highlight particular features of the space and to delineate circulation routes. Proposals were also made for a series of state-of-the-art audio-visual and interactive displays for the entertainment of visitors in the public areas.

The acoustic design of the facilities is of particular interest to readers of *Acoustics Bulletin*. IAC has designed and built modular studios, control rooms, editing suites and voice booths for many of the world's leading broadcast, post-production and sound recording organisations, often to very demanding technical standards and very tight timescales. The company has over 30 years' experience in broadcast

continued on page 36



Studio 1, part of the English Regions Suite: looking through the larger window to Asian Operations while the open door gives onto the Main Operations Room. IAC designed and installed the complete studio using the Moduline modular panel system, into which are fitted its acoustic doors, windows and wall panels

The Mailbox

BBC Birmingham's new home

continued from page 35

and audio studio design and, apart from the BBC, its clients include BskyB, Channel 4, ITN, Reuters, NBC, CBS, RTE and TF1.

In one of the biggest studio projects the company had ever undertaken, IAC designed and installed 27 state-of-the-art digital studios for the BBC at The Mailbox. Intended to bring broadcasting back into the heart of the community, the building also houses hotels, shops, restaurants and apartments. Public access to the facility was a core element of the project and this presented particular design challenges to the team of professionals commissioned to work with the BBC.

IAC began to design and install the studios in January 2002, working to very stringent acoustic and aesthetic criteria. Opened on 9 September 2004 by the Princess Royal - who had also opened Pebble Mill Studios in 1971 - The Mailbox is one of the world's most sophisticated broadcasting facilities.

Three criteria defined acoustic specifications

The acoustic specification was based on three criteria defining airborne noise reduction, reverberation time, and impact isolation.

The toughest airborne noise criterion (in third-octave bands, and designated 'Z+5') required 41dB airborne sound reduction at 50Hz and as much as 85dB at 1.25kHz and above. The lesser 'Z' specification was imposed for windows and lobby door-sets. In many cases this specification was exceeded by more than 10dB: for example, 97dB was achieved through the drama window at 2kHz. An IAC wall achieved 52dB at 50Hz and 103dB at 8kHz.

The reverberation times within the studios were also specified in third octave bands and had to be matched very closely. In some studios the average reverberation time had to be achieved with a tolerance of only 0.1s. The individual reverberation times in each third octave band were not permitted to be less than 80% of the average, or greater than 120% of the average, with a bass rise allowance of 200% of the average reverberation time. In order to tune the studios to these specifications and still present the aesthetic finishes preferred by the BBC, a 100mm tuning cavity was included between the modular walls and the finishes.

In some instances the impact isolation was required to achieved L'_{nTw} values of less than 10dB - less than the background noise level criterion and thus barely measurable. In most of the studios the L'_{nTw} criterion was 25dB, which the floating floors and Moduline studio construction could comfortably meet.

The city centre location brought challenges of site access for heavy construction plant, while the low weight-loading capacity of the building itself meant that a lightweight solution was the only way the broadcasting studios themselves could be built. Radio City Liverpool has five studios constructed from the Moduline system at the top of a 52m concrete stalk, and this was the lightweight answer the architects needed. Each component is acoustically-rated, and the walls, floors and ceilings in all 27 studios at The Mailbox are built using the system. Acoustic panels 100mm thick are fitted with high-performance doors and windows, internal tuner panels and acoustic plaques.

As they are self-supporting, the walls did not have to be full height between floor slabs, and this meant that a space could be left above the studios for a service void. The design team could also be confident that the strict acoustic criteria could be achieved, as over a number of years, both laboratory and field tests have been conducted to assist with the ongoing development of the system.

The studios range from control rooms and editing rooms, voiceover booths, radio broadcast studios and post-production suites, to a full-scale state-of-the-art TV studio. Each acoustically-sensitive area was designed using a room-within-a-room approach. Typically an inner chamber has a floating floor supported on anti-vibration mountings: concrete floors were used for the television studios and drama suite, while a flooring system of modular acoustic panels was used for the others. For drama recordings, sound quality is paramount, and BBC engineers apparently prefer the floor to be carpet on concrete because it sounds more realistic than carpet on panel floors.

The offices are arranged over two levels, the higher being formed by suspended mezzanine floors or gondolas, floating within the double-height open-plan space

BDP Picture copyright Nick Guttridge

This view from Studio 1 looks into the Talk Studio

The key benefits of the design are its low weight, its predictable acoustic performance, and the fact that it can be demounted. The floating floor supports the inner walls and roof, to give the best possible airborne and structural sound isolation. All the outer structures consist of walls and a roof built on the existing floor substrate. The acoustic doors - all being IAC's standard Noise-Lock range with twin magnetic seals - are integrated into the structure and all ironmongery and vision windows are custom-designed.

All acoustic windows in the project feature a flush-fitting frameless detail with glass up to 32mm thick, and many have low reflectivity. For the first time in 30 years, Birmingham's public will be able to view BBC radio in action. A novel viewing window has been placed between the BBC foyer and shop, and two radio studios: the novelty is that it is one window outside and two inside. Externally it is 4m wide and 1m high.

Meeting aesthetic requirements

With the Mailbox viewed as a flagship building for a 21st century BBC, aesthetic considerations were a guiding factor in the interior design. On all the studio walls are mounted stylish and resilient wood, metal and fabric acoustic plaques. IAC designed them with a stand-off from the walls to accommodate a tuning zone behind, which is filled with acoustic panel absorbers and wrapped glass fibre. The space also accommodates a service void, and any one plaque can be removed should the need arise. The ceilings are finished with sophisticated acoustic metal tiles within a plasterboard perimeter, and most areas are fitted with raised flooring to facilitate the cabling of broadcast equipment. To prevent noise from the ventilation system from compromising the high degree of acoustic isolation the IAC terminal ductwork was also constructed of Moduline panels.

The suite of six radio studios located around an operations room in the centre has extensive glazing between studios. Four visually linked radio studios with a central access corridor and lobby comprise the additional network radio suite, and there are two audio workshops and two small NPA & NCA booths close by. There are two finishing suites and a Foley room, and the dubbing area is made up of two control rooms, two voiceover booths and a machine room.

The drama suite is arguably the most exciting of all the studios. Home to the world-renowned radio UK farming soap *The Archers*, the suite is equipped to make radio drama programmes of the highest quality. It consists of a drama studio, dead room, cubicle, access lobbies and a store. As well as the studio itself IAC supplied fittings for the recording of sound effects: these include carpet and hardwood flooring areas, sinks with running water, and false doors. The space can be subdivided with a heavy curtain, and acoustic windows give onto the cubicle and adjacent corridor.

For the recording of scenes on the farm, the dead room comprises a curving tunnel with the roof and walls lined with foam wedges. This environment provides a particularly low reverberation time simulating the great outdoors, as there are no reflective surfaces whatsoever. If someone speaks while walking down the dead room tunnel, it sounds as if they are walking away from the listener down a country lane.

The state-of-the-art television studio is also impressive. It features scenery-size doors and a full-depth acoustic glass wall giving onto the newsroom. This wall is 3.2m high and 8.5m wide, and incorporates a frameless glass door. The studio control room is provided with patio-style sliding glass doors to a machine room.

Regular design meetings were held throughout the project, to develop the scheme to the BBC's requirements. At IAC's head office a group of project managers and designers supervised the manufacture of a series of components. It took a team of 25 acoustical fitters and three site managers two years to complete the whole project, but the result is a world-class facility for the world's favourite broadcaster.

Further information

More information on IAC's studio products can be found on www.iacl.co.uk or tel: 01962 873000. For details of studio broadcasting equipment contact Mike Hermans at the BBC on 020 8576 7669. The Building Design Partnership can be found at www.bdp.co.uk or tel: 020 7812 8008.

Robust Details and PCT

What do they mean to the house-builder?

This technical note is based on a detailed guidance note on noise issued by the Gypsum Products Development Association (GPDA) primarily aimed at house-builders, but designed to assist all those involved in the design and construction of new and converted dwellings. It sets out the background to the recent changes to Approved Document E of the Building Regulations (England and Wales) in relation to pre-completion testing (PCT) acoustic performance and the response of the House Builders Federation (HBF) in producing an alternative means of compliance - Robust Details (RDs) - in order to reduce the burden of testing on the industry.

Previous site testing and research has shown that separating walls and floors which should be capable of providing satisfactory levels of sound insulation did not do so in practice. The new Approved Document E introduced the concept of PCT to ensure that designed performance is achieved in practice. PCT is a sampling approach and so does not require that all separating walls and floors be tested. Building Control authorities have the power to require pre-completion testing of separating walls and floors as a means of demonstrating compliance with the performance criteria for sound insulation. Building Control should request tests be carried out on a sample size of 10% of dwellings on a development, or 10% of rooms on a residential or hotel project, to check compliance in addition to their normal inspections. Test work is normally carried out at the developer's expense, but where and what to test is to be as directed by Building Control. It remains the developer's responsibility to meet the requirements of Approved Document E for the entire site, not just the walls or floors that are actually tested.

PCT should be carried out on dwellings created by a material change of use and rooms for residential purposes (whether purpose-built or formed by material change of use) on any development on which work on site commenced after 1 July 2003. PCT on newly built houses and flats became a requirement for works beginning after 1 July 2004. In both cases, this is unless the Robust Details (RD) approach is used. Tests should be carried out when rooms either side of the separating element are completed prior to decoration, but without the inclusion of any soft furnishings. Tests are not required on internal walls and floors, or between living spaces and corridors.

The HBF recognised at an early stage that PCT would be a costly burden on house-builders, and was probably unnecessary where a proven acoustic solution guaranteed the ultimate performance. Working with the Office of the Deputy Prime Minister (ODPM) and building materials producers, the Federation has developed a set of practical RDs which have been rigorously tested to ensure that they significantly exceed the new Part E requirements and can thus be granted dispensation to avoid the need for PCT. The public consultation phase of the project, which ended in November 2003, indicated widespread support for the principle of using RDs and the ODPM subsequently approved this approach as a way forward.

Sites for field testing were provided by 58 separate housebuilding companies, and sound insulation tests were carried out on some 1300 dwelling units in just six months. So far 14 different constructions have been tested and meet the performance targets.

Table 1: Robust Details using gypsum products

RD Code	title	gypsum products
Separating walls		
E-WM-1	cavity dense aggregate blocks plastered	13mm gypsum plaster
E-WM-2	cavity lightweight aggregate blocks plastered	
E-WM-3	cavity dense aggregate blocks render and drylining	12.5mm standard wallboard fixed with dabs of gypsum adhesive
E-WM-4	cavity lightweight aggregate blocks render and drylining	
E-WM-5	cavity Besblock Start Performer render and drylining	
E-WM-6	cavity aircrete render and drylining	
E-WT-1	twin timber frame (no sheathing)	two layers of plasterboard total weight 22kgm^{-3}
E-WT-2	twin timber frame (with sheathing)	
E-WS-1	loadbearing twin steel frame wall	
E-WS-2	British Gypsum Gypwall Quiet IWL	
Separating floors		
E-FM-1	precast concrete plank with floating floor	ceiling option 1: metal suspended ceiling 100mm cavity depth lined with 12.5mm standard wallboard
E-FM-2	in-situ concrete with floating floor	ceiling option 2: metal suspended ceiling 75mm cavity depth lined with plasterboard 10kgm^{-2}
E-FT-1	engineered I-joist with floating floor and resilient bar ceiling	floating floor incorporating plasterboard 13.5kgm^{-2} ceiling: benchmarked resilient bar lined with a double layer of plasterboard 23kgm^{-3}
E-FS-1	in-situ concrete on steel profiled deck	ceiling: metal suspended ceiling lined with plasterboard 10kgm^{-2}

Pattern book of solutions

These constructions formed the first pattern book of solutions, which was published by RD Limited on 4 May 2004. The pattern book includes site checklists for each construction and specifies flanking junction details that are integral to the correct installation of these forms of construction.

In order to use RDs the developer must register the site with RD Ltd and must pay a plot registration fee. Details about plot registration can be found at www.robustdetails.com. The plot registration fee will be used to offset the cost of conducting audit testing on the various forms of RD constructions to ensure that the necessary performance is being achieved. Failing RDs will be removed from the pattern book.

In conclusion, there is no obligation to use the RD in preference to the PCT approach, but the following factors should be considered:

- RDs are designed to have higher performance than the constructions described in Approved Document E.
- The RD designs are engineered in part to provide a degree of workmanship tolerance. This may mean more materials are used than would be strictly necessary to provide the required performance with good workmanship. Although this may be regarded as counter to the principles of sustainable development, the benefits in terms of living standards are considered worthwhile.
- RD performance can be enhanced with the use of high-performance acoustic gypsum boards.
- The RD designs are generally more expensive than the constructions described in Approved Document E but the objective of the RD scheme is to remove the uncertainty, delays and costs introduced by PCT. When this is taken into account it is anticipated that the RD scheme will prove cheaper overall.

It is hoped that designers and housebuilders will use the RDs as they exceed the minimum regulatory standard by a comfortable margin and should ensure that the ultimate benefits of the RD project are passed on to the new homes customer.
The effect of noisy neighbours can be one of the main problems experienced by occupants of attached homes. New planning guidance (PPG3) requires a greater density of build on housing sites, driving the industry towards a higher proportion of attached homes (link-attached and apartments) in order to meet the more stringent guidelines. This means, in turn, that more homes will be affected by the need for better standards of sound insulation between one home and another.

Domestic noise complaints have trebled recently

It has been estimated that about four million people in Britain are having their lives disturbed by noisy neighbours, sometimes with tragic consequences. The Chartered Institute of Environmental Health (CIEH) reports that the number of complaints about domestic noise has now reached over 5000 per million of population, and that the total number of such complaints has trebled in recent years.
The 1996 English House Condition Survey indicates that nearly a quarter of households were bothered by noise from traffic, industry or neighbours. A BRE study indicates that about 25% of occupants of dwellings that attained the previous standards for sound insulation rated the insulation as 'poor' or 'very poor'. It is estimated that in new dwellings, as many as 40% of separating floors and 25% of separating walls may fail to meet the current standards.
The best defence against noise must be to ensure that proper precautions are taken at the design stage and during construction of the building. Remedial measures can be expensive and inconvenient particularly after the building has been occupied.

A brief history behind the changes to Part E of the Building Regulations

New Approved Document E of the Building Regulations (England and Wales) dealing with resistance to the passage of sound came into effect in July 2003 and introduced higher requirements for acoustic performance in residential buildings. The Approved Document is one of a series published by the ODPM to provide practical guidance on meeting the requirements of Schedule 1 and Regulation 7 of the Building Regulations 2000.
Approved Document E gives guidance with suggested constructions on how to provide reasonable levels of sound insulation between and within dwellings and other residential buildings (*eg.* hotels, hostels and buildings in which residential care is provided). However these guidance constructions do not guarantee compliance and it was proposed that a sample of properties (1 in 10 on any site) would have to undergo pre-completion testing (PCT) prior to final completion and occupation. This applied to all residential properties other than new homes from 1 July 2003. For new houses and flats the same requirement came into force on 1 July 2004 unless the Robust Details (RD) approach was adopted for the particular development. Robust Details are forms of construction that have been site-tested to demonstrate superior performance to that required by Approved Document E. RDs can be used as an alternative to PCT. Airborne performances are quoted in terms of $D_{nTw} + C_{tr}$ and impact performances in terms of $=L'_{nTw}$

In developing a set of practical RDs, sites for field testing were provided by 58 separate housebuilding companies

Other residential buildings, such as hotels, are also covered by the regulations

Requirements under Approved Document E

Construction	RD individual value		RD mean value		PCT standard	
	airborne (min)	impact (max)	airborne (min)	impact (max)	airborne (min)	impact (max)
Separating walls	47	-	50	-	45	-
Separating floors	47	60	50	57	45	62

Separating wall checklist

The site location, location of the separating wall in terms of block and or plot number, and the house-builder's identity are to be noted. The checklist then includes eight questions, the responses to which should be dated and signed, before the entire document can be signed off by the site manager or agent.

1. Is the cavity width a minimum of 200mm?
2. Are the batt materials (density 33 to 60 kgm^{-3}) a minimum of 50mm thick?
3. Are the insulation batts tightly abutted?
4. Do the lining layers have staggered joints?
5. List the type of gypsum-based board used for the linings, or its mass per unit area (kgm^{-2})
6. Are the lining board joints taped and filled?
7. If kitchen units are mounted on the party walls is there an additional service void?
8. Are the sockets back-boxed with gypsum-based board or equivalent?

Further advice from the GPDA

The Gypsum Products Development Association (GPDA) can be found at: PO Box 35084 London NW1 4XE, tel: 020 7935 8532, web site www.gpda.com
The role of the GPDA is to develop and encourage the understanding of gypsum based building materials and systems. The Association provides a cohesive package of advice and information on all developments affecting the gypsum industry, and communicates it to all aspects of the construction industry. Issues include the latest technical and product developments as well as training opportunities in the industry.

FROM HANSARD

Commons Written Answers

7 September 2004

Road noise

Mr Robathan: To ask the Secretary of State for Transport if he will list planned road resurfacing projects broken down by the number of houses affected by above 68dB of noise that will benefit from noise reduction; and how many of these projects will be financed from the £5 million ring-fenced sum.

Mr Jamieson: In general, priorities for resurfacing sections of the strategic road network are assessed according to maintenance need rather than noise criteria. Detailed information on the numbers of houses exposed to more than 68dB that are expected to benefit from this resurfacing programme is not available.

An assessment of the number of houses exposed to more than 68dB is only made for sites meeting the criteria for noise announced on 22 March 1999 in connection with the £5 million ring-fenced sum. This ring-fenced sum was specifically aimed at funding noise mitigation measures at sites where the noise problems were serious and pressing and where resurfacing with quieter materials could not be justified on normal maintenance grounds.

In the majority of cases, the ring-fenced sum has funded the provision of noise barriers at locations identified on the list published on 11 November 1999. There is only one resurfacing scheme in the 2004-05 programme with funding from the ring-fenced sum. This will deal with the problem identified on M6 junctions 34-35, Camforth and should provide a significant noise reduction for approximately 300 houses currently exposed to more than 68dB of noise.

8 September 2004

A40/M40

Mr Lidington: To ask the Secretary of State for Transport what guidance he has given to the Highways Agency on how to take account, in framing the A40/ M40 management strategy, of *(a)* the environmental impact of the motorway on people living in South Buckinghamshire and *(b)* Wycombe district council's air quality management strategy.

Mr Jamieson: The Highways Agency follows a consistent approach for all route management strategies whereby the problems and issues of a route are grouped under five main categories, one of which is environment. Issues such as noise and air quality are considered within this category.

13 September 2004

Car noise

Chris Grayling: To ask the Secretary of State for Transport what his policy is on maximum noise levels from straight-through car exhausts on customised cars.

Mr Jamieson: Only new cars are subject to maximum noise limits. However, Regulation 54 of the Road Vehicles (Construction and Use) Regulations 1986 does set minimum requirements for the maintenance of exhaust systems and silencers for cars, and other vehicles, in use. This requires that they be fitted with a silencer, that the silencer is maintained in good and efficient working order and has not been altered so as to increase noise.

The Regulations also make it an offence to use a car in such a manner as to cause excessive noise that could have been avoided by the exercise of reasonable care on the part of the driver. It is likely that a straight-through exhaust, whether used on a customised car or any other vehicle, would be in breach of this requirement. Enforcement, however, is a matter for the police.

15 September 2004

M20

Jonathan Shaw: To ask the Secretary of State for Transport if he will ensure that the siting of noise abatement fencing along the M20 between junctions 4 and 5 takes appropriate account of the approval of additional housing in the area.

Mr Jamieson [holding answer 14 September 2004]: It is the responsibility of the local planning authority, Tonbridge and Mailing Borough Council, to consider whether noise mitigation measures should be provided by the developer of sites in their area in line with current guidance on planning and noise.

Currently there are proposals for a noise bund within Leybourne Grange development site near the M20 at Junction 4.

In addition the Highways Agency is carrying out further studies to determine what noise mitigation measures would be appropriate at existing housing sites between Junctions 4 and 5.

4 October 2004

Sustainable development issues

Sue Doughty: To ask the Secretary of State for Environment, Food and Rural Affairs what the most significant sustainable development impacts are which she has identified in relation to the operation of her Department's estate.

Alun Michael: The most significant negative sustainable development impacts have been identified as:

Environmental - Use of land and associated landfill impacts (such as leachate and methane gas production) from waste disposal; use of non-renewable resources; contributions to global warming due to utility use and project management practices; contributions to ground level ozone and greenhouse effects from the use of refrigerants and materials during maintenance of buildings; land take for the development of new properties; atmospheric emissions contributing to global warming associated with business travel, fleet cars and staff commuting.

Social - Impact of landfill on local community from leachate and methane gas production, noise and visual impacts; local and global health impacts associated with air emissions, global warming and volatile organic compounds (VOCs); health, safety and welfare impacts of work practices and procedures.

The most significant positive impacts have been identified as:

Environmental - Reduced air emissions from effective green travel and transport planning; protection of biodiversity through land and ground management; reduced need for landfill and associate emissions due to increased recycling and recovery of materials; reduced use of non-renewable resources through appropriate procurement specification and management.

Social - Reduced health, noise and visual impacts from waste disposal due to increased recycling and recovery of materials; improved staff welfare and health benefits from effective green travel planning.

Economic - Local job creation and improvements to local transport provision resulting from office location, relocation and co-location projects.

'Frustrating' omissions raise questions

I am prompted by the recent article 'Investigating the acoustic properties of vehicle compartments' *(Acoustics Bulletin, Sept/Oct 04)* to ask whether such technical contributions should be subject to independent review prior to acceptance for publication?

In my view, this article contained a number of important omissions and questionable statements (examples listed below), so that I was left somewhat frustrated (technically, you understand!) after reading it.

It may be that some of the work was in an area where I have some experience (experimental modal analysis, general digital measurement and analysis) but, as many readers of *Acoustics Bulletin* are far better qualified than I, similar questions should have gone through their minds too (but they may not have the time to do anything about it). Perhaps the Bulletin Management Board would like to give this subject some consideration? I (and, I would hope, other members) do expect such articles to be technically sound, as reading contributions in areas outside our expertise is part of our continuing education, as well as being of general interest.

Many thanks for your strong editorship.

Mike Croker
Croker Acoustics Ltd

Omissions:

1. Experimental techniques: Where was the response microphone located? Was it at a single location, or was some form of grid or sweep average used?

2. Results of measurements called 'frequency response' with a *y*-axis labelled 'Sound Pressure Level dB (re: 20E-6)' but no units: Was this a normalised response? If so, normalised to what, but if not, what controls were in place to ensure constant excitation?

Questionable statements:

1. 'The model was made out of 12mm thick wood, thus simulating rigid wall conditions': Really? What about the perspex plate?

2. The statement to the effect that external sounds 'could have shifted the resonance frequencies slightly'.

Why not use SI?

Keith Attenborough *(Acoustics Bulletin Sept/Oct 04)* refers to difficulties with the understanding of decibels and errors in *Encyclopaedia Britannica*. This difficulty supports my experience that even many competent scientists and engineers find the decibel difficult. I had a similar problem with *New Scientist* years ago but gave up the discussion when the contact did not seem to understand the need for a reference level. Both parties should have an active interest in getting it right, but maybe they find it incomprehensible. Many users seem to operate by 'rote' with little true understanding.

If it is really that difficult we need to:

a) try harder to explain; *or*

b) consider an alternative approach.

I believe that where space permits, we should also use SI units. This will give help to those endeavouring to understand. To cope with a wide range, suitable prefixes (milli, micro) can be used as normal. Many people understand these much more than the dB. Underwater acoustics suffers even more from these widespread misunderstandings than air acoustics, and I feel it to be very important that the acoustics community addresses this as a serious problem for all.

As an example of the use of SI units, the typical hydrophone sensitivity of -200 dB re 1 V/microPascal can also be given as 100 microVolts/Pascal. I know many *(eg.* B&K) do use this format but I think more encouragement could be given.

As a less well known example, simple spherical sources can be classified by their output in Pascal.metres (a product unit, Pa.m, similar to the N.m used for torque). A sensitivity can then be given as Pa.m/V. A typical commercial 'simple source' will deliver somewhat over 10 Pa.m/V, radiating spherically at frequencies over its operating band. This can otherwise be described as 140 dB re 1 microPascal @ 1 metre per Volt, but may be just given as '140dB'. Whilst the sonar equation parameters (TVR in this case) are very useful, they are often not helpful in conveying clear information, except to the 'cognoscenti'.

In air, 94dBA is a typical loud noise level. By my reckoning this is 1 Pascal (RMS over the whole A weighted band, referred to 20 microPascal). So typical airborne limit levels are quite compatible with SI. Whilst Pascals are appropriate for pressure, the Pascal.metre describes a source. This helps distinguish the otherwise often confused parameters SPL and SL (pressure level versus source level in 'sonar equation' terminology).

Watts and Joules are also very useful for omnidirectional source levels (continuous or transient respectively). However, I note on p 17 of the same *Bulletin* a loudspeaker sensitivity given as '88 dB/W/m'. What does this mean?

Dick Hazelwood
R&V Hazelwood Associates, Guildford
(Underwater Acoustics Group committee member)

'Greening' acousticians

I hope that you are right *(Editor's Notes, Acoustics Bulletin Sept/Oct 04)* in thinking that acousticians have "a relatively advanced appreciation of 'green' issues" - I think it is still the case that we are trained in noise control rather than noise pollution, though I hope the bright new ideas of 'acoustic ecology' will cause us to question a little of what is done! There are many items beyond mobile phones and ink cartridges that can be recycled; perhaps most notably computer equipment. The web sites http://www.wastewatch.org.uk/ and http://www.rei.org.uk/ (among others) give plenty of information. Redundant IT equipment, working or not - of which I suspect we have a fairly regular supply - can be recycled either for refurbishment for use by community projects, or dismantled and the scarce and polluting heavy metals reclaimed rather than being wasted in landfill. Friends of the Earth has plenty of information about recycling various materials. Sometimes it takes a bit of effort (and even expense), but the more people who refuse to waste and pollute, the better the recycling facilities will become.

Oh and please - don't celebrate our 30th birthday with helium-filled balloons. It is a waste of a valuable industrial resource!

The Revd Dr Jennifer Zarek
Hutton, Driffield, East Yorkshire

PEOPLE NEWS

Chilean honour for IOA overseas member

Prof Juan Gallego-Suarez FIOA of the Spanish Instituto de Acústica has been awarded the degree of *Doctor Honoris Causa* by the University of Santiago, Chile, during an investiture ceremony held in the University's Honours Hall.

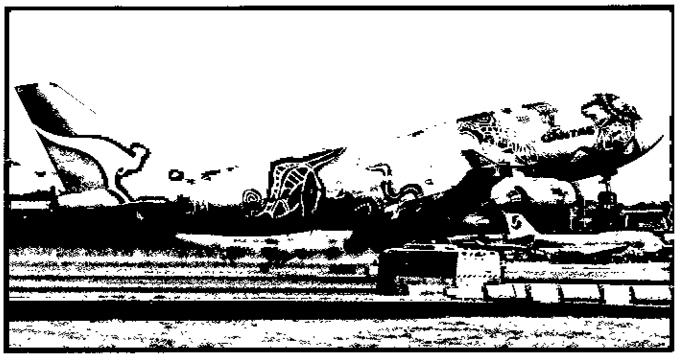
The citation refers to Prof Juan A Gallego-Juarez's: 'world recognition in the area of Physics and in the speciality of Power Ultrasonics, where he has maintained a permanent vocation to promote the subject and its applications'.

It adds that: 'beyond his scientific contributions to journals, conferences and meetings, Dr Gallego-Juarez has made efforts towards a better world through science, understanding and collaboration'. As the citation also states: 'the University of Santiago de Chile has benefited from the constant contribution of Dr Gallego-Juarez to the selection of young researchers as well as to the formation of new laboratories of Ultrasound'.

Professor Juan Gallego-Suarez (centre) after the investiture

Quieter aircraft research projects

Boeing joins 'silent' initiative



Boeing has become the latest company to join the Silent Aircraft Initiative, the Cambridge University-MIT project aimed at developing a new generation of quieter aircraft. Boeing's contribution includes making available some of its advanced software for the design and analysis of aircraft. The software considers aerodynamic, structural, stability, control and mission performance to which noise prediction models will be added.
The company will also offer technical consultation services. Prof Ed Greitzer of MIT said that this would allow them to draw on Boeing's design knowledge and to have students use industry-level tools for the conceptual design and analysis of innovative aircraft designed with noise as the primary consideration.
The initiative was set up in November 2003 with the objective of reducing aircraft noise to the point where it would be imperceptible beyond the perimeter fence of an airport. It brought together academics from Cambridge and Massachusetts along with aerospace companies and organisations.
One of the first projects under the initiative looked at the operation of aircraft rather than new technologies. This included the study of continuous descent approaches that keep aircraft higher and at lower thrust for longer than current procedures, thus reducing noise and fuel consumption (*Acoustics Bulletin* vol.29 no.5).
Researchers from the Institute are also working with graduate trainees from Rolls-Royce to develop a new kind of engine. This three-year project, which began in July, has already resulted in a new aircraft design in which engines will be embedded into the body of the aircraft rather than being mounted on the wings, to help reduce noise transmitted to the ground. By managing the airflow over the wing and into the engine, a much more efficient and quieter propulsion system could be achieved.
The initiative has already absorbed work carried out on two Engineering and Physical Sciences Research Council (EPSRC) projects into noise reduction. The first led to the development of computationally efficient calculations of the noise from helicopter blades moving at high subsonic speeds. The second is looking at a prediction capability for jet noise, which could then be used to assess the incorporation of modifications into jet engines, which might help reduce noise at take-off.

Music is Rocket Science!

Professor David Bird from the Physics Department at the University of Bath takes his life in his hands every time he picks up the Treble Violin - the smallest member of the New Violin Family (see Peter Dobbins, 'Physics Makes Music with the New Violin Octet', *Acoustics Bulletin*, pp 12-15, May/June 2003). This new musical instrument is so small, and the pitch so high, that only a space-age material known as 'carbon rocket wire', with a tensile strength nearly twice that of the normal violin E string wire, can be used for the top string. Even so, this wire is close to breaking point that it has been suggested anyone playing this instrument needs to wear appropriate safety equipment!
This is all in the cause of both Art and Science. Peter Dobbins of the Physics Department's Acoustics Group is promoting a concert in the church at Aust, near the Severn Bridge, featuring the latest development in acoustic musical instruments, the New Violin Family, sometimes known as the Violin Octet. The musicians are local to Bristol and Bath, but taking the three top instruments will be David Bird, Dan Wolverson and Frances Laughton, all from the Physics Department, on Treble, Soprano and Mezzo violins respectively.

In rehearsal at Aust Church, left to right, David Bird, Treble Violin, Dan Wolverson, Soprano Violin, and Frances Laughton, Mezzo Violin
(photo: Peter Dobbins)

The concert takes place at 8pm on Saturday 20 November, with an opportunity to view these exciting instruments beforehand, between 5pm and 7pm. There is also a pre-concert talk at 6pm about the physics behind the development of the Octet, given by Peter Dobbins, who is currently Chairman of the Institute of Acoustics Musical Acoustics Group. From 6.30pm, the historic Boar's Head (01454 632278), within walking distance and renowned for its good food, will be offering something special for concert-goers.
This event should appeal to anyone interested in the acoustics of musical instruments.

Further information can be found on the Music in the Church at Aust web site at http://www.aust.music.btinternet.co.uk/

PDA and NAS merger

With effect from 1 October 2004, the East Anglian based consultancy Noise Advisory Service merged with PDA Ltd and now operates as PDA from new premises near Bury St Edmunds. The firm now has significant resources to call upon from the PDA head office in Warrington.
Stephen Grundy, formerly of NAS, is running the new office, which will primarily serve clients in East Anglia and the south.
This expansion reflects the increasing number of contracts won by PDA in the region and enables the firm to respond even more quickly to local enquiries.
Further details: PDA Ltd, Unit 7 Moseley's Farm, Fornham All Saints, Bury St Edmunds IP28 6JY tel: 01284 725873: e-mail stephengrundy@pdaltd.com

UK DAB digital radio sales set to boom

The number of listeners opting for a DAB digital radio is set to increase dramatically, as consumers discover the benefits of more stations, digital quality sound, and interference free listening. That's the conclusion of a five-year DAB digital radio market forecast, released by the Digital Radio Development Bureau (DRDB).

DRDB chairman Ralph Bernard says that as DAB digital radio edges closer to mass-market penetration, and the government moots the possibility of analogue switch-off, the Board felt the time was right to publish this market forecast. Its members were confident that the result was a considered and realistic projection showing that by 2008, DAB digital radio penetration will have reached 29% of British homes.

The report provides a forecast of both market volume and value, broken down by product segment. It also forecasts cumulative volume and household penetration for the period 2004 to 2008. Within five years, it predicts that there will be more than 13 million DAB digital radios in UK homes, up from around one million at the end of 2004. The annual market value in 2008 is expected to be almost £500 million across all product segments, compared with the anticipated 2004 market value of around £90 million.

Biggest growth areas

The biggest growth is expected to come in products such as boom-boxes, hi-fi systems and clock radios, with sales of new 'memory radios' also expected to grow over the five-year period. Boom-boxes (portable radios generally fitted with FM/DAB/CD and sometimes a cassette player, with built-in loudspeakers) will jump from a market worth £8m in 2004 to £48m in 2008, while hi-fi systems will grow from £12m in 2004 to £127m in 2008. The value of the clock radio market will increase from under £5m in 2004 to £31m in 2008. The new memory radio market, which means devices allowing listeners to pause, rewind and record live radio, will grow from £5m in 2004 to £32m in 2008.

In terms of volume (no pun intended), around 71,000 DAB boom-boxes are expected to be sold in 2004, but the number will grow to 637,000 in 2008. Hi-fi systems see the biggest growth with annual sales increasing from 62,000 in 2004 to 952,000 in 2008. Sales of clock radios with DAB, and memory radios, will increase tenfold by 2008.

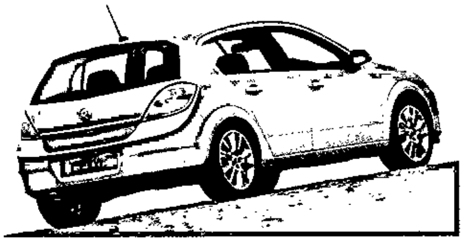
DAB in the car

However, the biggest growth over the next few years will be in the number of people listening to DAB digital radio in their cars. It is expected to result largely from an increase in factory-fitted units by major car manufacturers: the expected 3,000 units this year will become 645,000 units in 2008.

The five year forecast was produced by the DRDB and Digital One, (the national commercial DAB digital radio multiplex operator) and was independently audited by strategy advisors Oliver and Ohlbaum Associates. It combines a knowledge and prediction of future manufacturer, retailer and consumer behaviour with historical data from GfK, which measures sales of electrical goods in the UK.

The figures within the forecast have the backing of many leading manufacturers, including Sony, Philips, Sharp, JVC and Sanyo who believe them to be a credible set of achievable targets. The forecast is designed to help manufacturers and retailers plan their product ranges. It will also allow broadcasters to plan investment and future market strategies, and help government to assess the uptake of DAB digital radio and so look at a potential switch-off schedule for analogue radio.

Footnote: A radio campaign supporting the arrival of the Vauxhall New Astra SXi Digital car was launched on 6 September 2004 and ran for four weeks across more than 200 analogue commercial radio stations, including national, local and regional. The 40-second and 20-second advertisements were also broadcast on DAB-only commercial stations where listeners at home were likely to appreciate the advantages of DAB Digital Radio in their cars. The special edition Vauxhall was the first mass market vehicle to offer DAB Digital radio as standard and appeared in showrooms from 22 September. Other vehicles in the Vauxhall range are now becoming available with a similar option.



Vauxhall Astra leads the mass in-car DAB revolution

Research to bring sound improvements

EC's 5m project will harness latest technology to aid those with hearing difficulties

A new European Commission funded research project, HEARCOM, aims to bring marked improvements to hearing services and communication technologies for around 82 million deaf and hard-of-hearing people across Europe.

RNID, the largest charity for deaf and hard-of-hearing people, is participating in the project by contributing user trials and evaluations, as well as guidance on best practice. The results will herald future initiatives such as 'do-it-yourself' hearing tests, improved text displays for railway stations, on-line resources for audiologists, and on-line advice services for patients.

The aim of the project is to ensure that those who are deaf or hard-of-hearing can benefit from the latest technological developments. The project draws on Europe's best expertise in audiology, acoustics, speech technology, and information and communication technology, to break down barriers and allow deaf people to participate more fully in society.

Over five years some £5 million will be invested in the HEARCOM project across Europe. The projects include:

- assessment of hearing;
- tools to reduce adverse conditions in communications acoustics;
- improved hearing aids and prescription systems;
- assistive technology;
- on-line services for hearing aid users and audiologists; and
- improved telecommunication technologies.

Further information about the HEARCOM project is available from Sherylin Thompson at RNID, tel: 020 7296 8138, e-mail: sherylin.Thompson@rnid.org.uk

HSC looks to the future

To mark the 30th anniversary of the Health and Safety at Work etc Act (HSWA), the Health and Safety Commission (HSC) held an open meeting at London's Mermaid Conference Centre, where, for the first time, its business was discussed in full view of the public.

The HSWA resulted in the creation of the HSC. Working with others in the health and safety system in Great Britain, the HSC and Health and Safety Executive (HSE) have seen and contributed to major advances in reducing injuries and ill health including established occupational diseases.

Throughout that time, consultation with industry, unions, local government and other stakeholders has been a core principle of the way the HSC/E works and the open meeting was an opportunity for that relationship to develop further.

Among issues discussed were the recently published HSC Strategy; the Hampton Review; and science strategy.

A new booklet focusing on the future was also launched at the meeting. This assesses how HSC has evolved over the past 30 years as industry in Britain has changed, and also looks ahead at the new challenges it faces. Copies can be downloaded from www.hse.gov.uk

During the afternoon, breakout sessions allowed attendees to debate a number of issues with Commissioners and HSE officials on topics such as the implementation of EU directives, HSC's role in public protection and HSC's intervention strategy and working with other regulators.

As Bill Callaghan, Chair of the Health and Safety Commission, said: "The meeting provided an opportunity to open our work to ordinary members of the public and those dealing with health and safety on a day to day basis. It was an opportunity to get our vision across to a range of organisations. We want to see health and safety as a cornerstone of a civilised society and, with that, to achieve a record of workplace health and safety that leads the world."

Casella CEL

Measuring noise at the Port of Dover

Passengers using ferries, cruise ships and marina facilities at the Port of Dover, together with staff working at the terminals and residents living close by, are benefiting from the port authority's health, safety and environmental policies designed to reduce noise pollution.
To help them with the task, the Health and Safety and Environmental departments are using a *CEL-450* noise measurement meter from **Casella CEL**.
The instrument, which has a single measurement range of 140dB to effectively remove range adjustment measurement errors, is being used by Steve Pinfold, assistant port safety officer, to monitor noise levels from ships entering and leaving the port, trucks and other traffic arriving and departing, inside and outside workshops, and from the ongoing development works that have become a feature at Dover as the port maintains its position as the busiest roll-on-roll-off ferry terminal in Europe.
As he explains: "We monitor noise and air quality in partnership with the local authorities. This equipment gives us the opportunity to compile in-depth records in-house that will be extremely useful in our discussions with customers and the many companies that operate within the port, to help ensure the welfare and safety of everyone at the port.
"The fact that the 450 is a hand held instrument enables us to take sound readings anywhere in the port - a most useful asset for us," he added.

Assistant safety officer at the Port of Dover, Steve Pinfold, using the CEL-450 noise monitor from Casella

The CEL-450, which features a simple point and shoot operation with an easy-to-use menu structure, produces a time history of the noise levels at a selectable time interval down to 10millisecond for speedy frequency analysis.
Further details: Rebecca Williams, tel: 01234 844100 fax: 01234 841490 email: rebeccawilliams@casellagroup.com

Bruel & Kjaer

500 products on new transducer selection guide CD-ROM

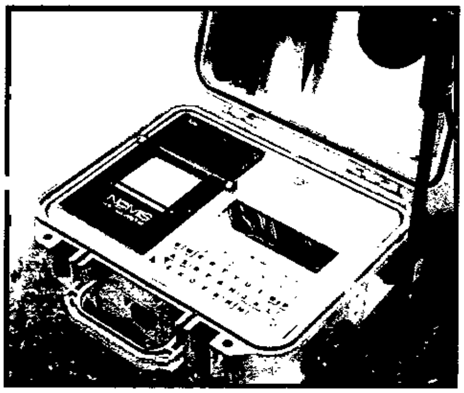
A new version of the free interactive **Brüel & Kjær/ENDEVCO** *Transducers and Conditioning Catalogue and Selection Guide CD-ROM* has been released. Packed with useful data, the interactive CD-ROM is designed to enable engineers to quickly browse or search the entire transducer range, featuring up to 500 different products.
An interactive specifications comparator allows easy comparison of product specifications such as frequency ranges, standards, temperatures and other parameters. Product searches can be performed more easily, enabling the large number of Adobe Acrobat formatted product data sheets to be located and printed more quickly.
The Guide is sectionalised to feature acoustic transducers, conditioning amplifiers, pressure transducers, vibration transducers as well as customised products.
An interactive *Selection Guide* helps engineers to choose an appropriate product to meet an engineer's specific measurement needs. Another useful element is inclusion of the popular Brüel & Kjær/ENDEVCO *Microphone Handbook* plus lecture material and data about the basics of acoustic transducers, vibration transducers and conditioning amplifiers as well as a library of technical documents in Adobe Acrobat format.
Useful company background information is also included in the Guide as well as direct connection to the ENDEVCO and Brüel & Kjær web sites.
Further information: Nicola Parker, tel: +44 (0) 1438 739000 fax: +44 (0)1438 739099 email: ukinfo@bksv.com website: www.bksv.co.uk

Cirrus Research

Simple sound level meter

A new simple sound level meter, designed to ensure quick, reliable noise measurements, is now available from **Cirrus Research plc.** The *CR:262* has been designed to meet requirements of the safety officer who needs an accurate measurement tool but also an instrument that can be picked up and used without having to go through a complicated setup procedure, or reading a long manual.
Just three button pushes are needed to calibrate, start and stop a measurement, making the unit an ideal tool for users who need simple noise measurements. The CR:262 can be supplied as a complete kit including all the accessories needed for a noise survey. If data logging and PC download capabilities are desired, the instrument can be upgraded to allow up to 100 separate measurements to be stored in its memory.

Further details: James Tingay, tel: 01723 891655 fax: 01723 891742 email: james.tingay@cirrusresearch.co.uk www.cirrusresearch.co.uk



Accudata

Seismograph hire available

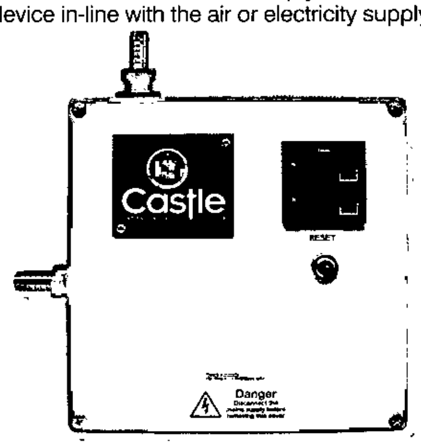
Accudata, the UK distributor for Nomis, one of the world's largest manufacturers of seismographs, provides sales, hire, service and technical backup, including calibration, for the entire range of Nomis instruments.
The *Nomis NS5400* is a data-logging seismograph with built in high-speed printer, designed to measure ground-borne vibration from piling activities and civil engineering works and provides all the information necessary to enable compliance with British Standards (BS:7385 Parts 1 & 2 and BS:5228 Part 4).
The NS5400, supplied with software, download lead, calibration certificate and manual, is available for hire with next day delivery.
Accudata also has *Type 1* data logging sound level meters available for hire. Supplied with weatherproof case, tripod and weatherproof microphone housing. Leaflets and technical specifications are available at www.accuadataltd.co.uk or tel: 01773 513222

Castle Group

Automatic trigger time for HAVS surveys

New from **Castle Group Ltd**, *Tool-Timer* is the latest product to help companies overcome some of the problems associated with the measurement of Hand-Arm Vibration. The proposed new UK 'Control of Vibration at Work' Regulations, which must be in force by February 2005, require the assessment of daily vibration exposure to employees. To do this involves the assessment of 'trigger-time' and this is what this device is designed to measure automatically.

The measurement of the vibration levels from hand-held power tools is now a fairly well prescribed process and can be carried out with reasonable repeatability. The problem still remains, however with the observation of 'trigger-time' and this can lead to large errors in a risk assessment. This is where the *Tool-Timer* comes into its own. Simply connect the device in-line with the air or electricity supply and the built-in timer will give you the actual operation time of the tool.

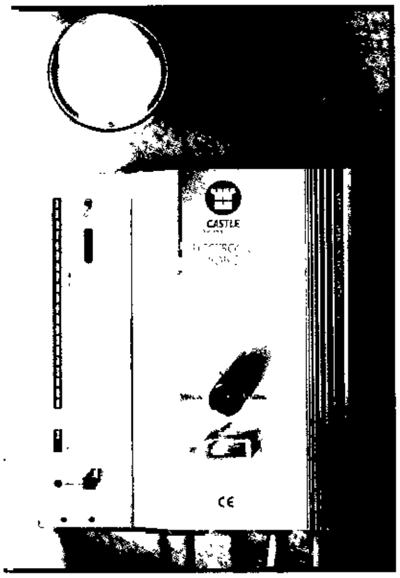


Traditionally, you would have to rely on asking an operator how long they use a tool for. Alternatively, and to overcome the problems associated with this, you would have to get onto the shop floor with a stop-watch! The *Tool-Timer* eliminates the need for this and, as a result, can lead to huge time-savings as well as greatly improved accuracy. Built to withstand the rigours of almost any industrial setting, it is simple to use and does not impede the use of the power tools being assessed. Used in conjunction with a Castle GA2001 Hand-Arm Vibration meter, the resulting daily exposure figure will be given directly on the screen avoiding the need for any 'head-scratching' calculations.

Dreaming of an Orange Christmas?

Complaints of noise disturbance from people living near night-clubs often results in the intervention of environmental health officers, and can lead to the loss of an entertainment licence if the noise is not controlled. **Castle Group** suggests as a solution to this problem, the *Electronic Orange*, which is a sound level switch that interrupts the mains supply to amplification equipment.

Should the sound level switch be allowed to go above a pre-set value, a warning light will illuminate to alert the operator to reduce the volume. Allowing the warning level to be exceeded by a certain amount will result in the power being cut, resulting in an embarrassing pause and a more careful DJ!



Other features include a three-colour LED bar graph display showing the varying sound level, and external switching which allows the power to be cut when doors or windows are opened. There is also anti-tamper circuitry, which prevents the unit from being overridden.

There is a choice of 'A' weighting or 'B' weighting characteristics (the latter for more effective bass control). Outputs for remote analogue or digital displays are available.

Further details: Karen Archer or Dianne Hamblin, tel: 01723 584250 fax: 01723 583728 email: sales@castlegroup.co.uk web: www.castlegroup.co.uk

Institute Diary 2004/5

7 December
CCWPNA Examiners & Committee
St Albans

9 December
Council
St Albans

14 December
CCENM Examiners & Committee

13 January 2005
Meetings
St Albans

1 February
Research Co-ordination
London

8 February
Diploma Tutors & Examiners & Education
St Albans

15 February
Measurement & Instrumentation Group: From DAT to DISK
The Royal Society, London

17 February
Membership
St Albans

24 February
Medals & Awards
St Albans

24 February
Executive

1 March
Engineering Division
St Albans

3 March
Publications
St Albans

10 March
Council
St Albans

21 – 22 March
Underwater Acoustics Group: Sonar Transducers and Numerical Modelling in Underwater Acoustics
NPL, Middlesex

22 March
Diploma Examiners Meeting
St Albans

22 April
CCWPNA Examination
Accredited Centre

13 May
CCENM Examination
Accredited Centre

19 May
CCWPNA Examiners & Committee

20 May
CMOHAV Examination
Accredited Centre

26 May
Publications
St Albans

2 June
Membership
St Albans

7 June
CCENM Examiners & Committee

9 June
Meetings
St Albans

14 June
CMOHAV Examiners & Committee

16 - 17 June
Diploma Examinations

21 June
Research Co-ordination
London

23 June
Distance Learning Tutors & Education

28 June
Engineering Division
St Albans

30 June
Executive
St Albans

14 July
Council
St Albans

9 August
Diploma Moderators Meeting
St Albans

15 September
Membership
St Albans

29 September
Medals & Awards & Executive
St Albans

6 October
Diploma Tutors & Examiners & Education
St Albans

7 October
CCENM Examination
Accredited Centre

13 October
Council
St Albans

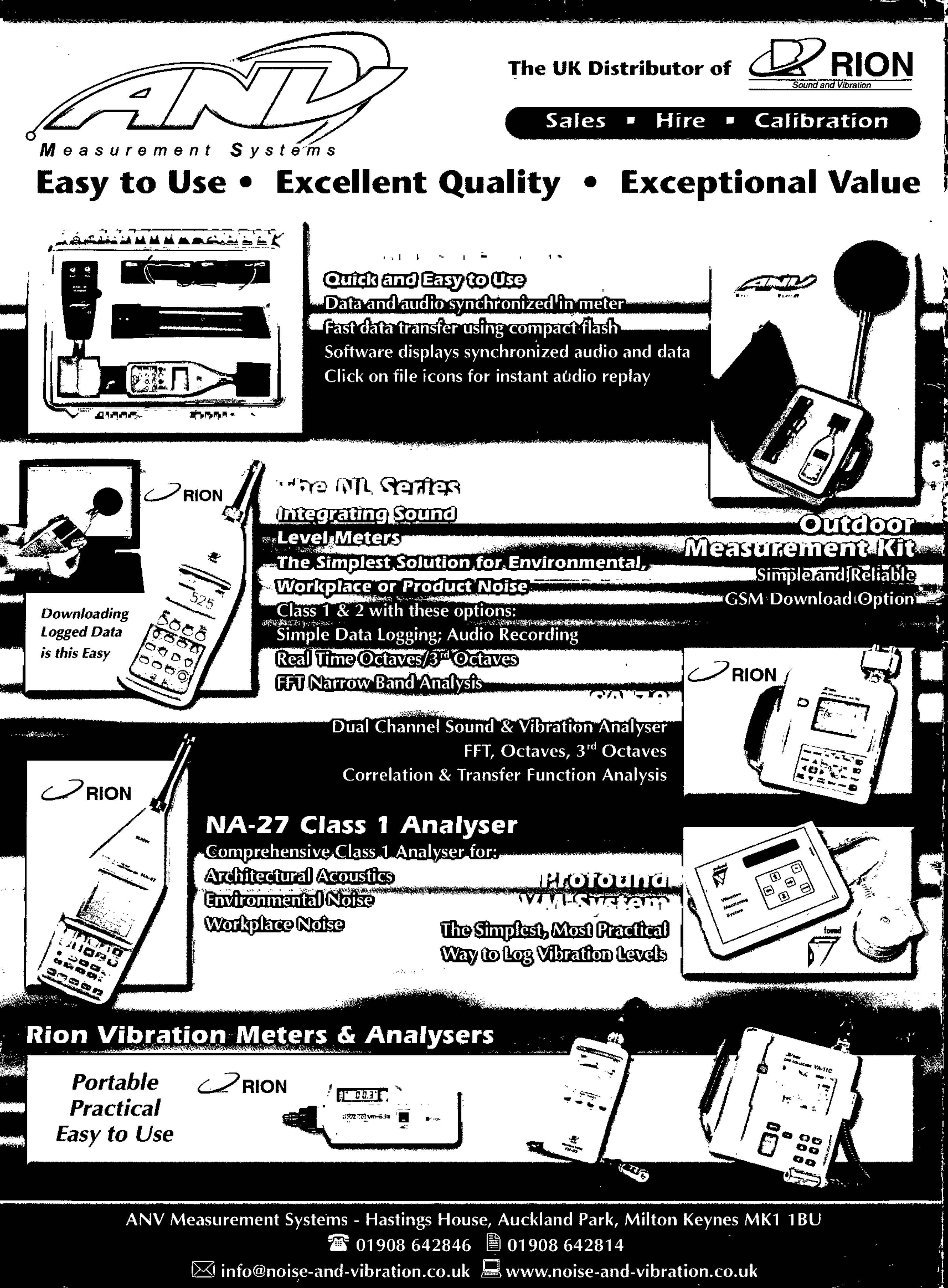
18 October
Engineering Division
St Albans

25 – 26 October
Measurement & Instrumentation Group: Autumn Conference 2005
Oxford

27 October
Membership
St Albans

4 - 5 November
Electroacoustics Group: Reproduced Sound 21
Oxford

ADVERTISERS INDEX



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FFT Narrow Band Analysis
Outdoor Measurement Kit
Simple and Reliable
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FFT, Octaves, 3rd Octaves
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