Vol 36 No 5 SEPTEMBER/OCTOBER 2011

ACOUSTICS BULLETIN

in this issue... Cross-talk attenuation with natural ventilation

plus... Subjective evaluation of acoustics in Jazz clubs

Ceiling case study inspired by a historical scale model

Instrumentation corner: Weather effects on outdoor microphone windshields

Institute of Acoustics

ACOUSTICS BULLETIN

Vol 36 No 5 SEPTEMBER/OCTBER 2011

Contacts

Editor:
I F Bennett CEng MIOA

Contributions, letters and information on new products to:
Ian Bennett, Editor, 39 Garners Lane, Stockport, SK3 8SD
tel: 0161 487 2225
e-mail: ian.bennett@ioa.org.uk

Advertising:
Enquiries to Dennis Baylis MIOA,
Peypouquet, 32320 Montesquiou, France
tel: 00 33 (0)5 62 70 99 25
e-mail: dennis.baylis@ioa.org.uk

Published and produced by:
The Institute of Acoustics,
77A St Peter's Street, St Albans,
Hertfordshire, AL1 3BN
tel: 01727 848195
fax: 01727 850553
e-mail: ioa@ioa.org.uk
web site: www.ioa.org.uk

Designed and printed by:
Point One (UK) Ltd.,
Stonehills House, Stonehills,
Welwyn Garden City, Herts, AL8 6NH
e-mail: talk2us@point-one.co.uk
web site: www.point-one.co.uk

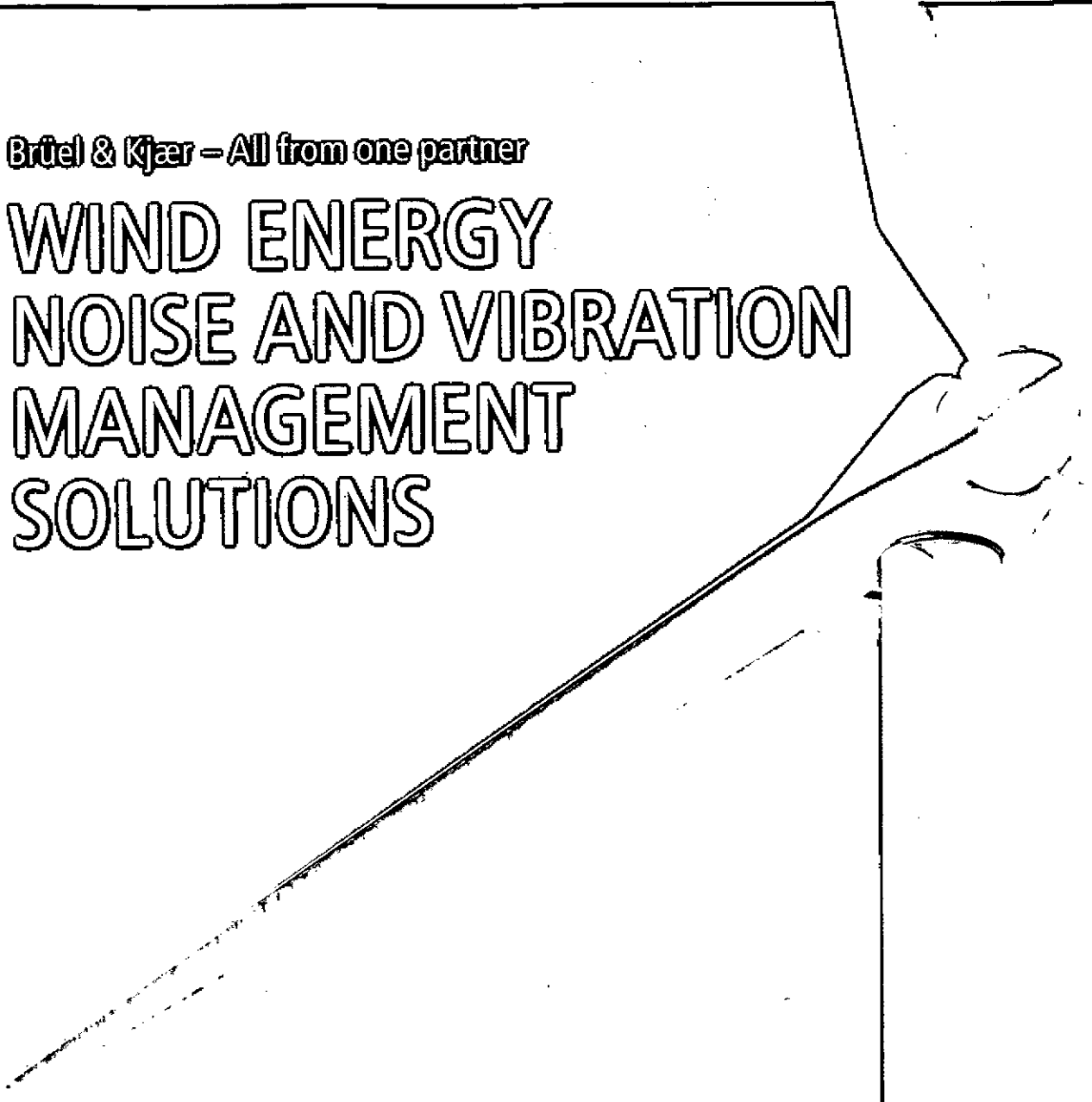
Annual subscription (6 issues) £120.00
Single copy £20.00

Contents

Front cover photograph: The cover picture is an interior view of the London Academy, a naturally ventilated 'green' building. We acknowledge the assistance of Mach Acoustics, who provided their services to the project, for the photograph which fits in with the Technical Contribution in this issue. This reviews how ventilation air can be persuaded to pass naturally through an educational building without the ingress of extraneous noise.

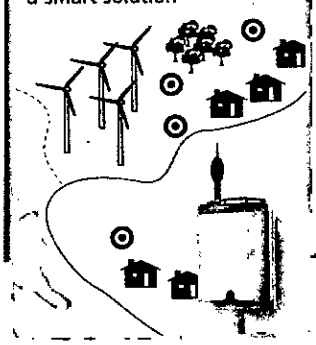
Brüel & Kjær – All from one partner

WIND ENERGY NOISE AND VIBRATION MANAGEMENT SOLUTIONS



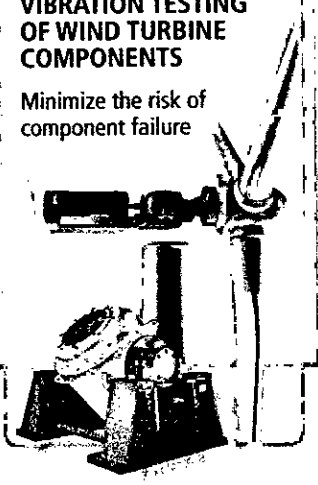
WIND FARM NOISE MONITORING

Optimize your outputs with a smart solution



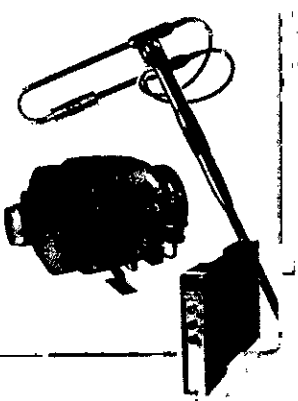
VIBRATION TESTING OF WIND TURBINE COMPONENTS

Minimize the risk of component failure



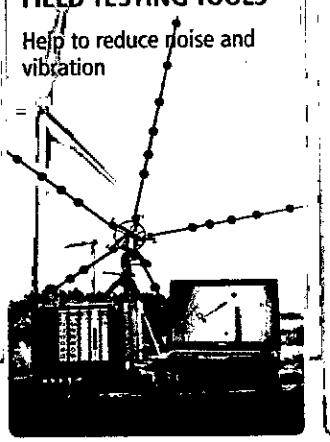
WIND TURBINE GEARBOX TESTING

Avoid costly downtime



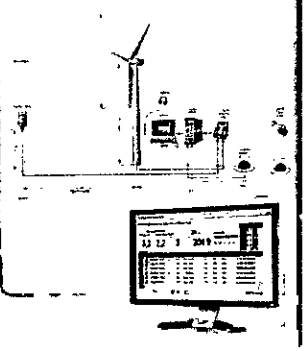
FIELD TESTING TOOLS

Help to reduce noise and vibration



SOUND POWER DETERMINATION ACCORDING TO IEC 61400–11

Ensure your noise measurements are up to standard



www.bksv.com/WindEnergy

BN 1010–11

United Kingdom: Bruel & Kjaer UK Ltd. · Jarman Way · Royston · Herts · SG8 5BQ
Telephone: +44 (0) 1763 255780 · Fax: +44 (0) 1763 255789 · www.bksv.co.uk · ukinfo@bksv.com
HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com
Local representatives and service organisations worldwide

Brüel & Kjær

creating sustainable value

Dear Members

Looking at the programmes for the Institute's conferences this autumn, I'm most looking forward to a visit to a mausoleum. This might seem an unlikely highlight for an acoustics conference, but the Hamilton Mausoleum used to be in the Guinness Book of Records for having the longest echo in a room. The visit is part of Acoustics 2011 in September, a new shape to the autumn conference as it is being organised by four of the specialist groups to give a diversity of subjects relevant to our industry.

***'May you live in interesting times'** is a phrase often misattributed, but wherever it comes from, this curse certainly captures my mood at the moment. My predecessor puts it down to presidential mid-term blues, but there do seem to be an unprecedented number of complex issues being dealt with by the Institute.*

A little over a year after the election of the Coalition at Westminster, we are now seeing the consequences of the Government's desire for deregulation and localism. As I write, the Institute is negotiating with the Department of Energy and Climate Change about how to draw up guidance based on the Hayes McKenzie report on wind farm noise (http://tinyurl.com/3fxbdrw). I think having the Institute of Acoustics directly involved in the process is a positive step forward, addressing objective 1 in our Business Plan which is 'Influencing the acoustic agenda'. But it is not without risks given the political sensitivities about wind farm noise. It was good to see that noise remains a serious issue in the CLG's new simplified planning guidance (http://tinyurl.com/3bnbzr8), even if the grammar and wording are slightly strange. BB93 and school acoustics continues to rumble on and we are hoping for a Ministerial statement in the autumn. Beyond Westminster, the Institute has also had to respond to the new Building Regulations in Scotland. We have drawn up an accreditation scheme for sound insulation testing in Scotland; details of this were sent out in the last e-bulletin and are reproduced in this issue.

Do you remember the year Eric Cantona kung-fu kicked a Crystal Palace supporter? Or when Nick Leeson brought down Barings Bank? It seems a long time ago, but that was the year that IEMA (the Institute of Environmental Management and Assessment) and IOA started attempting to draw up agreed Guidance on Environmental Noise Assessment. Trying to get a process which will complete this guidance in the next six months is another issue.

And of course there is the ongoing worry about finances. Understandably, conference attendance has fallen because of the economic conditions, and this is having an impact on the Institute's finances. As well as Acoustics 2011, the Institute also has a conference on underwater noise problems in October, and of course there is Reproduced Sound in November. Somewhere among this diverse range of subjects there should be something to interest you and keep your CPD records up to date.

Trevor

Trevor Cox

PRESIDENT

Meeting report

Emerging Government planning policy: What does it mean for practising acousticians?

Opening address by IOA President Prof Trevor Cox

A workshop was organised by the Environmental Noise Group on Tuesday 24 May 2011 at the University of Salford. A capacity audience packed the Boardroom at University House to hear the President's opening remarks. Prof Cox began by saying that the new government was trying to change a huge amount of legislation that regulated environmental noise issues, and that the Institute of Acoustics (IOA) was trying to influence this process. Whilst Environmental Protection UK (EPUK) has decided that schools will be their main concern, it is still unclear what the IOA will be doing to influence the development and application of acoustic policy in government. In revamping the planning system the government is aiming to streamline the process and address the sustainability agenda. At the same time, the intention is to give local people more say. The new planning system could radically change the context of environmental noise assessment and, potentially, the way in which IOA members are required to undertake noise assessments. This matter was the topic of this workshop.

PRESENTATIONS

Keynote speech: emerging planning guidance

The keynote speaker, Stephen Turner of Defra, went straight to the heart of the matter with a briefing on noise in emerging planning guidance. Bearing original paper copies, starting with the Wilson Report, he described the development of government noise planning policy over 50 years through eight key documents, leading to the latest stage in evolution, the Noise Policy Statement for England 2010 (NPSE). Stephen explained that, by describing clear policy vision and aims, the NPSE provides the necessary clarity and direction to enable decisions to be made regarding what is an acceptable noise burden to place on society. He went on to reveal that all tiers of Government, public authorities and other bodies should have regard to the NPSE — at national, regional and local level — whenever any policy is being developed or decision is being made that could directly or indirectly affect the noise environment. Aspects of the NPSE are already to be found in a range of documents including adopted Noise Action Plans for roads, railways and agglomerations; draft Energy National Policy Statements; and the Scoping Consultation document on sustainable aviation.

Stephen identified three things that the NPSE ought to achieve:

1) The application of the NPSE should mean that noise is properly taken into account at the appropriate time;
2) The application of the NPSE should enable noise to be considered alongside other relevant issues and not just considered in isolation;
3) The NPSE provides the necessary clarity wherever current policy is unclear or ambiguous or where there is doubt about the intended outcome.

In concluding, he said that we were now awaiting the outcome of the National Planning Policy Framework (NPPF). It is significant that planning professionals, local authorities, community groups and members of the public will have an opportunity to shape the new Framework. A draft NPPF document will be put out to public consultation later in 2011, and it is important, said Stephen, that the IOA contributes to shaping this new Framework.

NPSE: What does it mean?

The next speaker, Dani Fiumicelli of AECOM, built on some of the main themes of the keynote speech with his presentation 'Noise Policy Statement for England — What does it mean?' Dani described the NPSE as a short, tiered document. It separates policy from technical advice, which in principle allows more rapid changes to how noise is managed as knowledge about impacts develops, without the need to go back and review policy. However, said Dani, the lack of a Technical Appendix could be a cause for concern, as application of the policy could become piecemeal if different decision making bodies chose different targets, or interpreted existing guidance differently. Whilst concluding that 'NPSE is good', he stated that it needed a companion guide for a cost benefit analysis, and could do with supporting technical guidance in a form that can evolve with time.

The Environment Agency in England and the H3 rewrite

In his presentation, 'Environment Agency Revised Guidance — Filling the gap', Tony Clayton described how the Environment Agency in England is currently reviewing and rewriting its Horizontal Guidance for Noise (H3). He said that the updated guidance will be consistent with the aims of the NPSE, not least because the NPSE is largely consistent with the fundamental principles of the Environmental Permitting Regulations. Tony discussed the aims of the NPSE and some implications of the policy for industry regulated under an Environmental Permit administered by the Environment Agency. Some (perhaps deliberately) contentious suggestions by Tony stimulated strong opposing opinions, amicably expressed, not least the suggestion that one implication of the NPSE could be that all noise control solutions start with the initial design objective of achieving 10dB below background. In response to questions from the floor on consultation of the revised H3, he said 'our ultimate aim is that they will be signed up to by IOA, preferably through the Environmental Noise group (ENG)'.

Geoff Kerry and the University Acoustic Test Laboratories

A tour of the University Acoustic Test Laboratories was provided during the lunch break by a Past President of the Institute, Geoff Kerry. The tour of world class facilities with a knowledgeable veteran acoustician and experienced guide was a treat even for those already familiar with the facilities at the University of Salford. It was also generally welcomed as it presented the opportunity for a leg-stretch after the confinement of a packed room, and not least to escape from the racket of the student bar where the lunch had been served.

PAN and TAN from Scotland

Phil Abbott, perhaps best known for his work on CRTN, was the speaker immediately after lunch with 'PAN 1/2011 + TAN = Holistic approach to planning and noise in Scotland'. Standing in for Bernadette McKell of AECOM, Phil described how advice on noise for planning in Scotland is slightly different from that in England: it is 'more holistic'. Reiterating a theme seen in Tony Clayton's presentation, he explained how this meant that acousticians should be involved as early as possible in the planning stage. Phil outlined the PAN and TAN, where PAN (Planning Advice Note) provides the advice and TAN (Technical Advice Note) provides the technical guidance. PAN 1/2011 focuses on noise issues relating to planning and is free from technical issues. This allows the technical guidance to be updated without having to review noise advice. The philosophy of the approach is to provide a consistent framework for assessing noise, and includes both quantitative and qualitative assessment. However, following some lively exchanges, the overriding comment from delegates working in consultancy was that PAN 1/2011 is currently leading to a great deal more work that the client does not always appreciate.

OPEN DISCUSSION

Views of EPUK

An open discussion to inform the IOA ENG response to Government consultation followed. John Dunsdale started the discussion with a short but clear statement in which he 'wore three different hats' representing Environmental Protection UK, the views of the regional

continued on page 8

Delegates at the Workshop at the University of Salford including standing: David Waddington (Chairman), Geoff Kerry (Tour guide), Linda Canty (IoA) and Trevor Cox (President)

David Waddington (Chairman), Tony Clayton (Environment Agency)

Stephen Turner (Defra) with an original print copy of the Wilson Report

Delegates on a tour of the University of Salford Acoustic Test Laboratories with Geoff Kerry (Past President)

Left to right: Tim Dice (Defra), David Waddington (Chairman), Stephen Turner (Defra)

Delegates in the Transmission Suite of the University of Salford Acoustic Test Laboratories with Geoff Kerry (Past President)

Emerging Government planning policy: What does it mean for practising acousticians? - *continued from page 6*

management of the Environment Agency, and the views of an officer from Oldham Council. John suggested that the new push on the use of higher grade tyres may change road contact noise. He highlighted how legislation now allows small gatherings with music between the hours of 8am and 12 midnight, and that this could result in a lot of unhappy people. In particular, he noted that the Environment Agency has made much progress working with localism rather than 'with a big stick', and that this was perhaps a useful model for the IOA and government for the future.

Additional work due to PAN

Whilst it was not disputed that the non-prescriptive measures are more thorough, the additional work required may not be appreciated by the client, although it is the client that is required to pay for it. This should be made clear to anyone commissioning a noise survey: they needed to understand the reason for increased fees and work hours. This was an unwelcome development at a time when there was a fees 'squeeze' in the private sector.

Wind farm assessment

Although not a specific topic of the presentations, some strongly opposing views were brought out regarding wind farm and wind turbine noise assessment. On the one hand it was argued that ETSU-R-97 published by the UK's Department of Trade and Industry [DTI] in 1996 was old, often misunderstood and widely misapplied. It was suggested that EPUK and the IOA needed to work on this to update and educate. On the other hand, it was maintained that ESTU-R-97 was meant for large-scale developments and not small turbines. Some specialists saw no problem with this guidance document when applied correctly.

Objectivity of noise impact surveys

One goal of the revised H3 guidance, according to Tony Clayton of the Environment Agency, was to encourage the production of more objective reports. This is a matter of efficiency, since there are costs and delays for both the operator and the Environment Agency when reports have to be returned for further work. Ultimately these costs are borne by the operator through increased application and subsistence fees. One aspiration was that the noise impact survey could satisfy both planning applications and permit applications. In response, one view from consultancy was that it remains the role of the consultant to present the best case on behalf of the client, thus acting as an advocate rather than an enforcement officer.

Cost benefit analysis and technical guidance

It was suggested that emerging government policy was to monetise noise through cost benefit analysis (CBA) as seen through macro effects on health, costs of productivity loss, and the cost of quiet areas. However, CBA is not new to acoustics: the acoustician will often compare micro effects in the costs of barrier options against the reduction in decibels. There was some call for technical guidance to be provided for the NPSE. The challenge here would be to reach a consensus on content. However, much work had already been performed on the PPS24 Companion Guide, including information on source/receiver assessment. It was suggested that this could be used as a starting point if needed.

Noise limits

Some concern was expressed about the elimination of fixed noise limits from government policy and guidance. On the other hand, it was argued that people can be seduced by numbers that are not established on the basis of robust scientific research, but are actually often produced arbitrarily. In any case, when speaking with magistrates and ministers, it was suggested that it is far better to avoid numbers, since general qualitative descriptions are more widely understood.

Closing summary

In his closing remarks, the chairman Dr David Waddington of the University of Salford summarised the opinions expressed during the workshop as follows.

1. The challenge
   - There is a varying quality of reports submitted;
   - The IOA would like to promote objectivity and competence through policy and technical guidance.
2. Numbers
   - There are arguments for and against the use of fixed noise limits.
3. Cost Benefit Analysis
   - Could perhaps be better termed Relative Benefit Analysis;
   - Micro effects such as 'noise barriers' were addressed;
   - Macro effects such as '2dB in levels around the world' were discussed.
4. Support for the NPSE was expressed by the IOA Workshop membership.
5. Technical guidance to support NPSE would be appreciated:
   - This might best be produced by a funded IOA/government partnership.

Tim Dice, Deputy Head of the Environmental Noise Policy team at Defra, attended to hear the discussion and provide points of clarification where necessary. Feedback from delegates indicated that the event was a very successful way of influencing new policy development and reflected well on those involved in organising the day.

Last Chance - Book Now For Acoustics 2011 - Glasgow

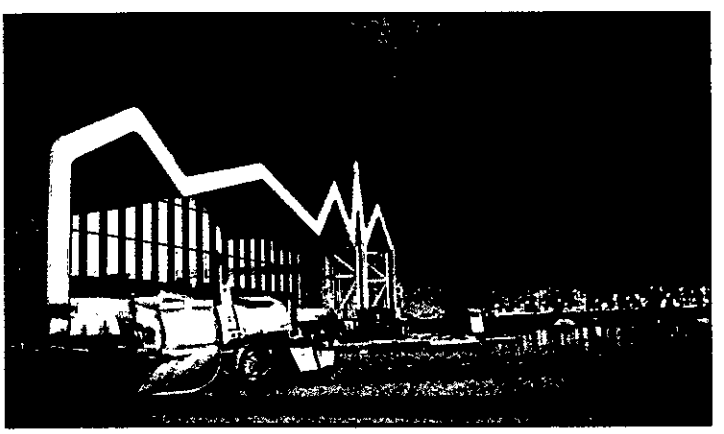
A new decade - a new reality: Rethinking acoustic practice for the austerity decade

14 and 15 September 2011, Crowne Plaza, Glasgow.

Glasgow may be famous for its diehard football fanaticism (Rangers, Celtic), earthy comedians (Billy Connolly), musicians (from Lonnie Donegan to Franz Ferdinand), renowned architects (Charles Rennie Macintosh), and even recent Prime Ministers (Gordon Brown), but as a designated European City of Culture, it boasts a rich mix of buildings – old and new alike – offering tantalising insights from the acoustics perspective.

This September, Glasgow hosts Acoustics 2011 - a 'must-attend' conference for anyone connected with acoustics.

With eminent speakers from universities and leading-edge organisations, a packed programme covering diverse themes in acoustics, workshops, and a super choice of tours to intriguing nearby venues, with high quality facilities and accommodation at Glasgow's Crowne Plaza, the event promises to be a highlight in the acoustics calendar.



Organised by the Institute of Acoustics' specialist groups for Building Acoustics, Environmental Noise, Noise and Vibration Engineering, and Measurement and Instrumentation, the event features experts in their respective fields.

Acoustics 2011 programme

Full programme details can be found at **www.ioa.org.uk/events,** but this overview provides a flavour of Acoustics 2011.

The Conference begins with a welcome reception (evening, Tuesday 13 September 2011) with Seb Jouan of Arup Acoustics presenting work undertaken (with demonstrations) in the new Arup DDS SoundLab.

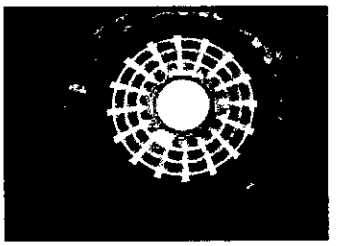
Day one (Wednesday 14 September 2011) sees subject themes ranging from the acoustic design of schools (R W B Stephens Medal lecture), designing buildings inside out, 'driving a wedge - through sound' to the re-use of a redundant building as a dance and musical theatre rehearsal centre (Spiers Locks Studios, Glasgow), to hospital noise.

Automotive-related presentations include methods for characterising the contribution of airborne noise routes for vehicle sound quality, the effect of structural-acoustic coupling on the active control on noise in road vehicles, prediction of vehicle pass-by noise, and automotive NVH and real world fuel economy effects of system interactions.

The workshop addresses the revision of CIBSE guides on noise and vibration, while other presentations will cover: managed services for construction site noise and vibration; MEMS microphones based measuring instruments, ETSU-R-97 and the significance of impact; the move from prescription to PAN 1-2011; innovative concert noise monitoring (modern instrumentation to improve efficiency); 'what you can get away with for 90% of the time'; innovative techniques for sound measurement (Smart Noise Monitor Duo).

Intriguing tours

Day two (Thursday 15 September) sees a choice of tours with visits to nearby venues, all offering additional acoustics perspectives.



These venues include the Hamilton Mausoleum, which is renowned for the longest-lasting echo of any building worldwide. The visit includes practical measurements of reverberation time. Alternatively, delegates can see the newly-built £74 million Riverside Museum, and Museum of Transport. This is a project unique to the UK, reflecting Glaswegian life via transport related exhibits and replica streets through history.

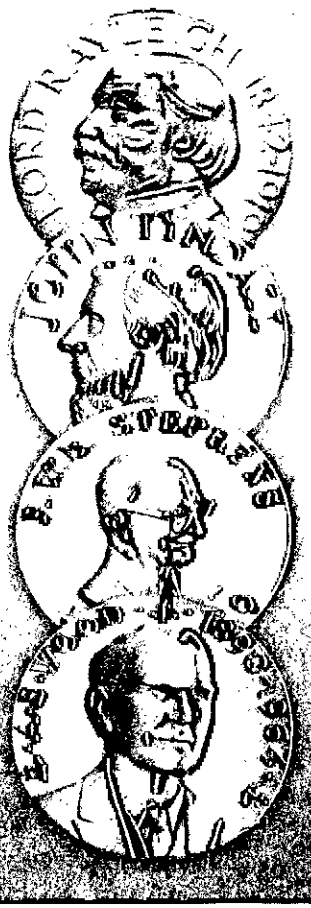
Delegates are certain to enjoy experiencing the Linn factory. Producing high quality hi-fi products for 40 years, Linn is one of Scotland's most important independent precision engineering companies, designing and manufacturing music and home theatre systems. The visit features listening to the newest Linn systems, hearing from the senior acoustic engineer and learning about the 'Tune Dem' philosophy (if it sounds better, it is better).

There's more...

Following a workshop concerning the principles of reverberation time measurement, the presentations continue with: Sky Harlequin 1 – acoustic design of natural ventilated TV studios; acoustic design of water features for the built environment; EIA and significance of impact; human response to vibration in residential environments; reverberation enhancement for music practice rooms; from Salford Docks to Media City.

The programme then sees speakers discussing building technology innovations in housing to deliver cost-effective low carbon solutions; the revision of calculation of road traffic noise (CTRN) and the Matrix

continued on page 10



Institute of Acoustics Medals & Awards Programme 2012

The Institute of Acoustics annually honours people whose contributions to acoustics or to the Institute have been particularly noteworthy. The medals and awards programme has evolved over the years and is now quite wide ranging in its acknowledgment of academic achievement, practical engineering applications and innovations, student achievement and contributions to the Institute and to the world of science and technology.

The medals and awards programme is overseen on behalf of Council by the Medals and Awards Committee, which is chaired by the President. Nominations may be made at any time either on standard forms available through the Institute's office or by writing direct to the President.

For more information or to download a nomination form, please visit the IOA web site:
http://www.ioa.org.uk/medals-and-awards/

2012 nominations deadline is 15th January 2012

Acoustics 2011 - Glasgow - *continued from page 9*

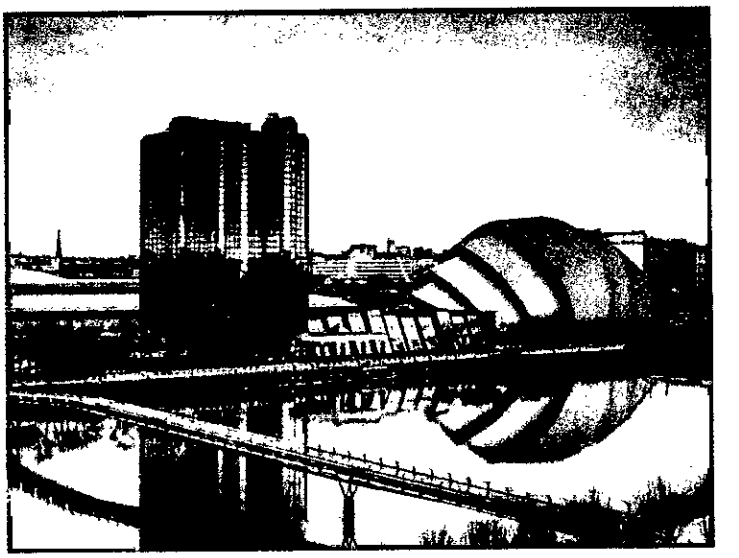
(time to reload or revolution?) and EIA (how the Matrix approach developed).

Be there

Kevin Macan-Lind, IOA's Chief Executive says that Acoustics 2011 surely has to be a *'must-attend'* event, so I urge members to book their places now – there is still time. The conference encompasses a wealth of fascinating acoustics issues with presentations from excellent speakers – experts in their respective fields. In these times of difficult economic conditions, the conference theme – ***'A new decade - a new reality: rethinking acoustic practice for the austerity decade'*** – is so relevant to us all working in acoustics. We must be flexible and adapt to changing marketplace needs and the impact of ever-tighter budgetary constraints.

Acoustics 2011 information

For more details concerning the programme and to register email: **linda.canty@ioa.org.uk** or **visit www.ioa.org.uk/events.**



Scottish Building Regulations

Bob Craik. Accreditation for sound insulation testing

The Scottish Government has recently introduced new Building Regulations which will involve more extensive testing. Testing must be carried out by individuals who have been accredited by a professional institution as competent to undertake the testing. The Institute of Acoustics has been named as a suitable accrediting institution and therefore the Institute has been developing an accreditation scheme over the past few months. This has recently been approved by Council. Testers have until October 2011 to become accredited.

There are two parts to the scheme. One is the observation of the applicant undertaking a sound insulation test. The other is a review of various documents. These two parts can be undertaken in either order.

Members who wish to apply for accreditation through the IOA scheme should send the appropriate documents to Kevin Macan-Lind at the IOA head office for consideration. This can be done either by post or e-mail to **kevin.macan-lind@ioa.org.uk.** The first meeting of the Accreditation Board, at which cases are considered, was expected to be in August, with further meetings to be held as required.

Any member wishing to be kept informed of the dates of Accreditation Board meetings and deadlines for submission of documents should notify Head Office, who will maintain a mailing list.

The Institute will require a number of members to act as test observers. Any suitably qualified and experienced member who is willing to act as an observer should please notify Head Office.

Prof R J M Craik, Deputy Principal (Learning and Teaching), Heriot-Watt University

Accreditation Scheme

***Information for Applicants and Criteria for Accreditation* Background**

The Scottish Government has recently brought in new Building Regulations which came into force in May 2011. A key feature of the new Regulations is that there will be extensive testing of completed buildings to ensure compliance with the new standards, and a there is also a new requirement that these sound insulation tests should be undertaken by accredited individuals. Sound insulation testers must be accredited from October 2011.

The Guidance notes state that

> *Testing should be carried out by persons who can demonstrate relevant recognised expertise in acoustics for sound insulation testing. This should include membership of a professional organisation which accredits its members as competent to both test and confirm the results.*

The IOA has established an Accreditation Scheme to accredit its members within the meaning of the Scottish Building Regulations.

Overview of the Scheme

The IOA Scheme is designed as a scheme to accredit members of the IOA as competent within the scope of the Scottish Building Regulations to carry out sound insulation testing and to confirm results. The Scheme is open to individual members and in determining competence there is no consideration of any management systems that the individual may operate within. In this respect the Scheme is a 'personnel certification' scheme rather than a 'management system certification' scheme. This is a significant difference between the IOA Scheme and the ANC and UKAS schemes, both of which are also acceptable within the terms of the Scottish Building Regulations.

The Accreditation Scheme will make judgements about the competence of the individual as required by the Scottish Building Regulations. In certificating an individual the IOA is confirming that the individual has the knowledge and skills to undertake testing. The Scheme does not confirm that each individual test will be carried out in accordance with the Regulations (as it is not a management certification scheme). Therefore it is important that accredited members are required periodically to re-confirm their adherence to the Professional Conduct requirements of the IOA requiring individuals to operate only within their areas of expertise and to conduct their business professionally at all times.

As the IOA Scheme is a personnel certification scheme the competence is judged on the skills and knowledge of the individual and therefore the technical knowledge and skills of the individual are much more important in the IOA Scheme than in schemes that rely on management systems for the assurance. For this reason accreditation will only be given to members who have Associate Member grade or higher, and it is normally expected that accredited members will hold a Corporate Member grade. In either case, members will need to demonstrate evidence of technical knowledge in the area of sound insulation.

The Accreditation Scheme is being introduced at a time when there has

continued on page 12

Scottish Building Regulations - *continued from page 10*

been extensive testing in Scotland for some 30 years and there are therefore many experienced testers. It is understood that it is not the intention of the Scottish Government that the requirements within the new Regulations should be a barrier to suitably experienced testers continuing in their profession. Therefore the IOA Scheme has been developed to enable its members to present a wide range of evidence in support of their case, recognising that testers may not have retained historical evidence in anticipation of this being required for such a future scheme.

Criteria for accreditation

The criteria of the accreditation are that the individual member is competent to undertake and report on sound insulation tests as set out in the Scottish Building Regulations, and the judgement of the Board will be against the definition of the Regulations. The IOA Accreditation Scheme will not require more of members than is required to fulfil the requirements of the Regulations.

The judgements will be based on

- technical knowledge of sound insulation;
- ability properly to undertake a sound insulation test;
- ability to analyse and report on the results.

A variety of evidence may be submitted by an individual, some examples of which are listed in Table 1. The Board may extend the guidance in the table as cases are considered.

In all cases there must be observation of a sound insulation test by a suitably qualified person. The Observer must be a Member or Fellow of the IOA and should provide by way of a letter to the Institute

- A brief paragraph of the Observer's knowledge and experience and hence suitability to be an Observer;
- The date and location of the test;
- Confirmation that the test was carried out in accordance with the relevant British Standards and Scottish Building Regulations;
- Either a description of the test method or a copy of the test report containing the test method.

The expectation is that the test should be carried out in a real test situation. Applicants should check in advance before undertaking tests in other environments such as in a laboratory.

It is the intention of the Board to identify a list of Institute members willing and able to observe tests. However, in the start-up phase and in the interests of speed and efficiency applicants are invited to nominate individuals who are willing to observe a test. Nominations are subject to approval by the Board and normal rules of independence apply. For example, the observer should not be from the same company, two individuals should not mutually observe, etc.

Criteria for accreditation	Examples of evidence that might be included with the Case
Technical knowledge	Degree in relevant subject, IOA Diploma with Building Acoustics Module, Specialist short course on sound insulation. Experiential learning detailed in the Case possibly assessed through interview
Ability to undertake a sound insulation test	The preferred evidence is • Three test reports of airborne and impact sound insulation, of which one should have raw data and detailed methodology of the test procedure (if the methodology is not included in the report). Equipment and calibration information should also be provided, and • Report by an IOA nominated observer of the applicant undertaking a test
Ability to analyse data and to report	Evidence might also include • Significant relevant experience • Completion of a specialist short course

Table 1

Examples of evidence to be submitted in support of an application to the Accreditation Board

In addition to these formal criteria, applicants for accreditation must confirm their commitment to the IOA's Code of Conduct on Professional competence and integrity including the requirement to maintain professional competence over time and an obligation to act in areas only where the individual has professional competence.

Case

The Case should be sufficient to provide the Board with the evidence required and must include both certificated evidence (usually as attached papers) as well as a narrative outlining experience. Experienced members, who can demonstrate through formal qualifications and test reports, knowledge of sound insulation testing will probably have a narrative Case that is 1 to 2 pages long. Less experienced members are expected to provide more detailed cases perhaps up to 6 pages.

The Case must make clear any testing, analysis or reporting presented in the Case that was not undertaken by the applicant.

Period of accreditation and reaccreditation

Members who are accredited by the IOA Scheme will normally be accredited for a period of three years.

Members who have been accredited as competent to undertake sound insulations tests are expected to retain their knowledge and skills and hence be eligible for re-accreditation if they can confirm that they have

- Maintained up-to-date technical knowledge;
- Maintained competence in sound insulation testing;
- Maintained familiarity with the relevant sections of the Scottish Building Regulations and associated guidance;
- Adhered to the rules of the IOA regarding professional conduct;
- Provided a sample of recent reports and raw data.

The IOA may withdraw accreditation from any member who breaches the professional conduct requirements.

Process for applying and considering applications

Individuals who wish to be accredited shall submit a formal Case with supporting evidence to the IOA Head Office for consideration by the Accreditation Board. The IOA Head Office will distribute the papers to Board members.

The Board will reach its decision on the basis of the submitted evidence but may choose to defer a decision if there is insufficient evidence provided and request further evidence. This will typically take the form of (a) further written evidence, or (b) a report from an interview with the applicant or (c) a report from a nominated individual who has observed the applicant undertaking a sound insulation test. These additional activities are particularly designed to enable members who may only have limited written evidence to become accredited.

Members may submit a Case without having a report on an observed sound insulation test. In those cases the Board will consider the Case as submitted but the accreditation decision will only be taken after receipt of a suitable observer's letter.

The Board has delegated authority from the IOA Council to agree to accredit an individual (within the meaning of the Regulation).

Decisions shall be reported to Council and members who are accredited shall have their name added to the list of accredited members held by the IOA and shall receive a letter of Accreditation from the IOA. It is planned that the list of accredited members will be published on the IOA web site in the future.

Fee

The application fee shall be set by Council and shall be reviewed annually. The principle underpinning the setting of the fee shall be that the fee shall be no more than is sufficient to cover the cost of the Scheme. This is consistent with the principles set out in the 'Provision of Services Regulations 2008'. The fee for 2011 will be £250.

If an interview or test observation has to be organised by the Board then an additional charge will be made.

Meeting report: North-west branch

Geoff Kerry
Workshop on the use and abuse of BS.4142

As the first of a proposed series of workshops to discuss basic acoustic matters, as suggested by members of the north-west branch, the meeting held on 23 November 2010 took the form of a question-and-answer session on BS.4142.

To enable the discussion to get to the heart of members' queries and concerns quickly, and with only an hour or so available, it was obvious that a little homework had to be done beforehand. Accordingly the branch secretary, Paul Michel, undertook a preliminary exercise whereby he e-mailed branch members with a number of questions on BS.4142 and invited responses. These were then collated and the chairman for the evening, Past President Geoff Kerry, introduced a selection of topics by asking those questions and revealing the responses received to date before inviting discussion.

The approach appeared to work because most of the members attending were both able and very willing to join in. What followed was a very lively set of discussions under the headings of BS.4142 scope, measurement, and rating and assessment. All too soon the chairman had to close the meeting but he did so by reminding members that the section in BS.4142 on 'reporting' lists items that 'shall' be reported, which in standards-speak means such items have to be reported in order to comply fully with the standard. He suggested that a critical look at the list would explain why!

Comments made by many members after the event suggested that it was a very useful meeting, particularly the sharing of ideas and information, but most of all because it provided a forum where members could informally and without ridicule place ideas on the table for discussion.

The branch committee thought it worthwhile to publish* the outcomes of this exercise in the form of a series of questions and bullet points under the topic headings. There are questions, and some of the answers to questions, but the discussion generated many more and not all of them could be answered. Perhaps others could pick these up and answer or comment, and perhaps EH1/3 could take all into account when the time comes for BS.4142 to be revised.

Thanks are owed to both Peter Sacre and Paul Michel, and to other members of the branch committee, for the effort they put into setting up the meeting. Grateful thanks are offered to Arup Acoustics for hosting the event.

* *Copies are available from the branch secretary, Paul Michel, email* **pm@noisecontrols.co.uk**

Apology

The article Young Persons' Award for innovation in acoustical engineering 2011 on pages 18 and 19 of Acoustics Bulletin volume 36, number 4 (July/August 2011) gave the impression that it had been written by Georgia Zepidou herself. In fact, her name appeared as the Award winner, not the author. This was a formatting error for which the Editor takes full responsibility, together with the typographical errors which were also entirely his.

The article was compiled from more than one source, and we apologise sincerely for any embarrassment caused to Ms Zepidou or her colleagues.

IOA Membership committee - New members

The following were accepted by Council on 30 June 2011 for membership of the Institute of Acoustics in the grades mentioned, following the recommendations of the Membership Committee on 5 May 2011.

Fellow
Canham, R H
McKenzie, A R

Member
Atha, J
Cassidy, M
Cooke, A
Cooper, T N
Daniels, D
Doherty, D F
Dolbear, G J
Evans, G B
Frisby, A P
Hesnan, D T
Hubbard, P
King, P S
Kingston, D P
Lachmann, M
Leung, M H
Mackenzie, R K T
Marshall, S E
McKane, M J
Medley, A P
Mycock, H
Ngoka, O C
Noon, M P
Rattigan, I G
Roberts, S N
Runcie, P M
Slade, J E L
Smith, N C
Theobald, P D

Associate
Ashford, C
Barry, P
Bertelli, M F
Blunnie, D
Byrne, S F
Camilleri, C
Dearing, M P
Duff, D
Elbourne, E
Elsey, K B
Gardner, P J
Gressner, B R
Harrison, D
Kontesidou, E
Lambert-Porter, R
Large, S
Lloyd, KKC
Pimlott, M
Quested, C G
Reeve, G J
Shearman, A J
Shellard, N T
Shikotra, J K
Van Der Merwe, M E
Waddell, S D P

Affiliate
Caruana, G
Cryer, S
Matthews, G

Technician
Law, D
Lee, E
North, J
Smith, A M
Whydle, S

Student
Brown, T
Dainton, R L A
Kaplanis, N
Koufoudakis, E
Linstead, S
Nayar, A
Newman, R J

The two new Sponsor Members ratified through Council 30 June 2011 are as follows:

Waterman Energy, Environment and Design Ltd
South Central
11 Peter Street
Manchester
M2 5QR
www.watermangroup.com

Screens At Work/Acoustics at Work
27 Rookwood Way
Haverhill
Suffolk
CB9 8PB
www.acousticsatwork.co.uk

Engineering Division news

Engineering Council fires up IEng promotional campaign

Following a preparatory phase involving research, discussion and careful planning, the Engineering Council's (EngC) promotional campaign for its Incorporated Engineer (IEng) professional qualification is now well underway. The campaign has been developed together with the Professional Engineering Institutions (PEIs) toraise the profile of IEng, as well as increasing awareness and understanding of its value to individuals, employers, the profession and society as a whole.

At their request, one of the first priorities has been to involve existing IEngs. As the EngC research has shown how much IEng registrants value their professional qualification and the role it plays in recognising their competence, commitment, and professional standing within the engineering profession, all existing IEng registrants have been sent, through their institution, a special 'logo' designed especially for use with their email signatures. This shows the message 'I am proud to be an IEng' which, as suggested by the research, reflects the pride felt by those who manage to qualify.

Other creative materials and messages have been developed for use in a variety of channels, all based on the same 'I am' theme, which makes strong, clear links between being a professional engineer and being an IEng.

Jon Prichard, CEO of the Engineering Council, says that despite being the professional level at which many practising engineers work, Incorporated Engineer is currently under-represented on the register. At the end of 2010 there were around 238,000 professionally registered engineers, with approximately 188,000 of these holding Chartered Engineer (CEng) status, 36,000 with IEng status and 14,000 registered as technicians.

From research, it was known that a large number of practising engineers had the relevant standards of knowledge and competence to be eligible for IEng, but a large number had not applied, in the main due to the current lack of awareness an understanding.

IEngs are skilled professionals, working in a range of positions across every sector of engineering, and can be defined through their competencies. UK-SPEC describes these as:

> *Incorporated Engineers maintain and manage applications of current and developing technology, and may undertake engineering design, development, manufacture, construction and operation. Incorporated Engineers are variously engaged in technical and commercial management and possess effective interpersonal skills.*

Although the focus of this project is on raising the awareness and profile of IEng as the valuable professional qualification that it is, both to individuals and their employers, it is not intended in any way to be to the detriment of the other levels of registration. The campaign is purely setting out to ensure that the value of registration as an Incorporated Engineer achieves the recognition and standing similar to that which is enjoyed by those with CEng status. It is also desirable to dispel some of the myths that seem to surround IEng, manyof which were based on misconception and prejudice. In addition, it is important to note that IEng is not only a valuable standalone professional qualification but also part of a progressive structure. Some of the activities have therefore been designed to promote Engineering Technician (EngTech) and CEng registration at the same time.

The Engineering Council holds the national registers of Engineering Technicians (EngTech), Information and Communication Technology Technicians (ICTTech), Incorporated Engineers (IEng) and Chartered Engineers (CEng). It also sets and maintains the internationally recognised standards of competence and ethics that governthe award and retention of these titles. By this means it is able to ensure that employers, government and wider society – both at home and overseas – can have confidence in the skills and commitment of registrants.

To apply for the EngTech, ICTTech, IEng or CEng titles an individual must be a member of one of the 36 engineering institutions and societies currently licensed by the Engineering Council to assess candidates, including the Institute of Acoustics. Applicants must demonstrate that they possess a range of technical and personal competences and are also committed to keeping these up-to-date, and to behaving in a professionally and socially responsible manner. For more information visit: **www.engc.org.uk** or **ioa.org.uk/engineering**

Meeting report: London branch

Alan Bloomfield.

An unusual meeting of the London Branch took place in June 2011 when Claire Shepherd and Max Dixon invited around 40 attendees to take part in one of two soundwalks.

In recent years there has been an increasing recognition that addressing environmental noise levels alone is not always sufficient to improve quality of life. In many cases, the acoustic environment as perceived and understood by people in a particular context – the soundscape - plays a key role. One tool that can be used to assess soundscape quality and how it might be improved is to walk around an area consciously listening to the various sounds and judging their positive or negative contributions.

The evening began with short introductions by Claire and Max into the concepts behind the process and some suggestions of how participants could get the most out of the soundwalks. The meeting then split into two groups to be led by Claire and Max around routes they had planned to demonstrate the wide variety of sounds that can be experienced even in a busy city like London.

On returning from the walks a lively discussion was held and it was clear that all had found the experience stimulating. Although road traffic noise was inevitably the dominant source in most locations, a surprising number of other sounds, including church bells, the breakout of voices and music from within buildings and the conversations of pub goers, were widely observed. Subjectively, on one of the walks at least, noise from buses was felt to be a key negative factor. This led to a discussion about how it might be improved both in terms of sound level reduction – for example by improving engine compartment insulation – and subjectively, by adjusting the frequency spectrum.

Overall, those present felt the exercise was a great success and many suggested making soundwalks an annual feature in the branch calendar. This success was without question due to the considerable time and effort put in by Claire and Max to prepare the routes, as well as their wide experience of soundscape issues, and the branch would like to thank them again for the hard work that made the evening so enjoyable.

New faces on Council

Stephen Turner stands down

The March Council meeting was the last one - for a while at least - for Paul Malpas, Peter Rogers and Jo Webb as they had decided not to stand for re-election as ordinary members on Council.

The President thanked them for their efforts and then gave a special vote of thanks to Stephen Turner who, after eight years as an ordinary member and six years as vice-president, groups and branches was standing down. He is now head of the Technical & Evidence Team, Noise and Nuisance, at Defra. Geoff Kerry replaced Stephen in that role at the AGM in July. Stephen received a bottle of champagne to mark the occasion.

New faces on Council following the AGM are Anne Budd, Robin MacKenzie, Graham Parry and David Watts (all ordinary members).

Stephen Turner and Trevor Cox

Instrumentation corner

Richard Wright and Guillaume Goulamhoussen. Effects of weather on outdoor microphone windshields

Introduction

Microphone systems used for long-term outdoor noise monitoring are exposed to constant risk of damage from rain, corrosion and mechanical damage. Such systems are generally required to fulfil the specifications in IEC 61672-1 and are periodically verified to IEC 61672-3. However, owing to the practical limitations of test laboratories, such periodic verification does not typically include free-field testing of the entire microphone system including the windshield. Instead, a standard procedure is to inspect the components and replace any that show clear signs of wear. Conditions encountered by outdoor systems in their everyday use affect measurements in ways that may not be appreciated by users. In particular, temporary conditions such as rain and ice would probably not be observed during periodic verification.

Test methods

Tests were carried out in a simulated free field system developed by Cirrus Research to carry out automated directional response tests to IEC 61672.

Conclusions were drawn about two standard styles of windshield:

- Type A: 'conventional' cylindrical type, consisting of 40 dpi foam in an open cavity shape with a wall thickness of 7mm (Figure 1);
- Type B: spherical type of diameter 80mm, consisting of solid 80 dpi foam with ultra-violet resistant and hydrophobic (water-repellent) treatments (Figure 2).

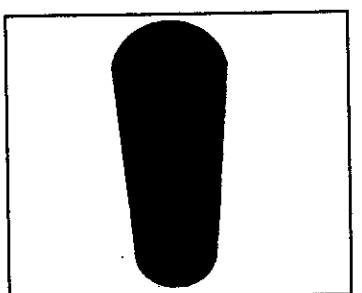


Figure 1: Type A windshield: conventional cylindrical type

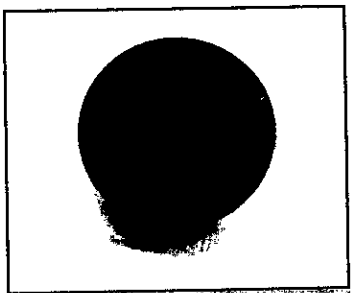


Figure 2: Type B windshield: spherical type of diameter 80mm

Rainfall was approximated by spraying water from above, while 'damp' conditions were simulated by leaving the wet windshields to drain naturally at room temperature for several hours. The frozen state was achieved using a climate chamber to cool wet windshields rapidly to -30°C immediately prior to testing.

Effects of water

When sprayed with water to simulate rain, type A absorbed up to 70g of water, whereas the hydrophobically treated type B absorbed only 4g.

Frequency responses for windshield A are shown in Figure 3. It can be seen that the wet and damp effects are similar up to 10kHz, but at higher frequencies they are markedly different.

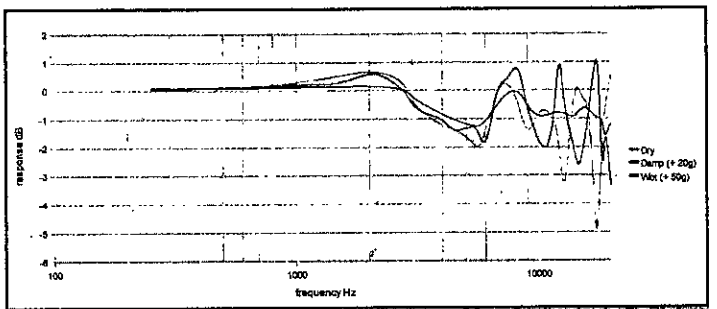


Figure 3 Influence of rainwater on windshield A

Frequency responses for windshield B are shown in Figure 4. It can be seen that this type shows a steadily increasing attenuation at higher frequencies when dry, but this characteristic could easily be corrected using a digital filter in the sound level meter. The deviations due to rain are within approximately 3dB in the worst cases, at frequencies above 10kHz.

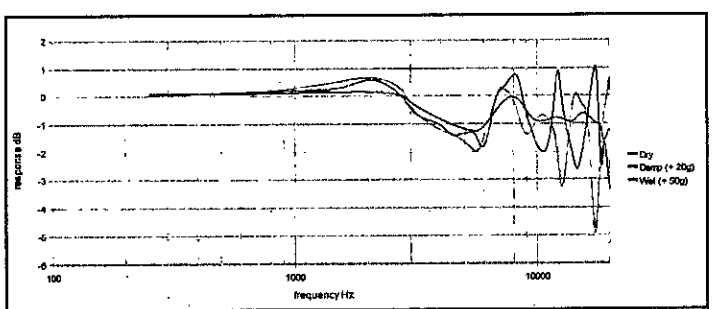


Figure 4 Influence of rainwater on windshield B

Effects of ice

Two weather scenarios were considered: firstly, when the windshield is soaked in rain, then frozen — a situation common in rainy climates where the night-time temperature drops below 0°C; and secondly when the side of the windshield builds up a coating of hard snow due to deposition in blizzards with strong winds.

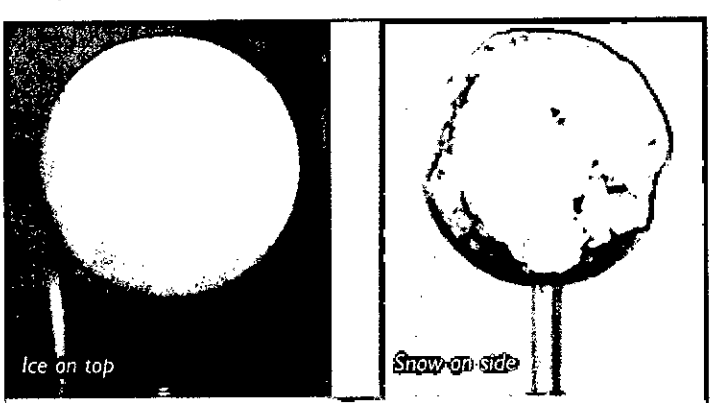


Figure 5 Cold weather problems

The frequency response for the horizontal plane (90° incidence) with ice on top is shown in Figure 6. Even after correction of the dry response of the windshield, the effect of ice is to exceed the tolerances in IEC 61672-1, particularly at around 4kHz.

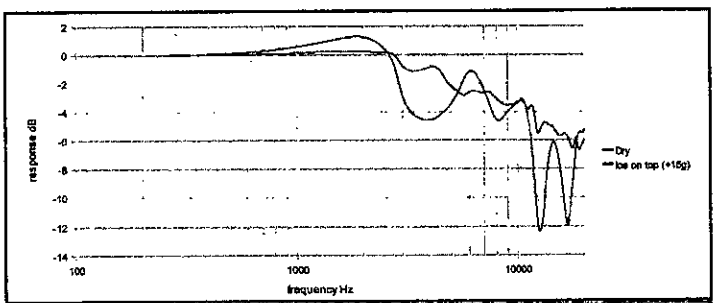


Figure 6 Influence of ice on top, windshield B

The effects of a build-up of snow and ice proved greater, as would be expected, with deviations of up to +5dB and greater than -20dB from a flat frequency response.

The polar response at selected frequencies in the 'packed snow' scenario is shown in Figure 7. Note that the ice patch was oriented so that it was directly facing the loudspeaker near the 180° position.

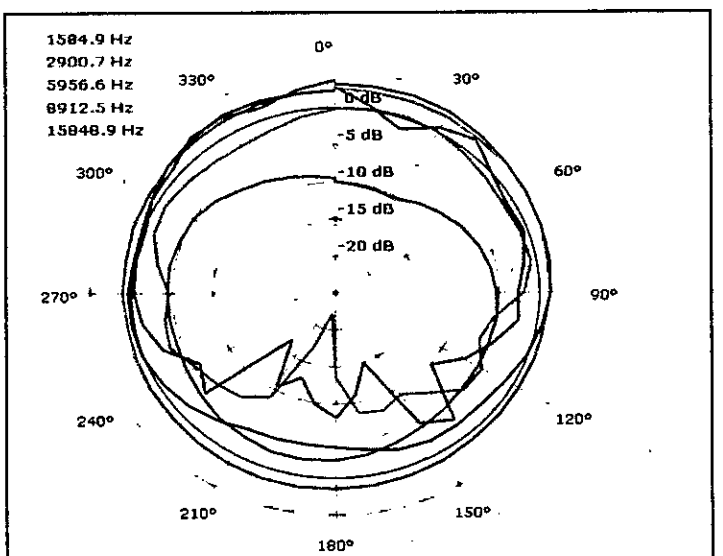


Figure 7 Type B, ice on side

Deviations of more than 10dB occur at different angles, not simply when the ice patch is facing the direction of incident sound. The differences between 0° and 360° results are due to changes between the start and end condition of the ice, as it melted slightly during the test.

Mechanical damage

Damage to outdoor windshields is often encountered, for example from birds and small animals picking pieces of foam from the windshield, presumably to use for nesting material. Such damage was simulated by cutting a conical section from a windshield of type B. This resulted in deviations of the magnitude of +2.5dB and -2.0dB compared with the reference level.

Conclusions

Rain soaking into the windshield has a complex effect on the frequency and directional responses, with the potential to move the system

continued on page 18

Effects of weather on outdoor microphone windshields
- *continued from page 17*

response outside acceptable limits. These effects are less pronounced on hydrophobically treated spherical windshields than on non-treated open-cavity windshields. Ice crusts on windshields have marked effects on the responses.

Sufficient care should be taken to record meteorological conditions and to interpret measurements accordingly in locations prone to heavy rainfall and freezing. The windshield may exhibit significant response deviations that vary over time during the drying process for several hours after rain has stopped.

Physical damage to the foam also affects the responses, but to a lesser degree than rain and ice.

The tests also concluded that wind-induced noise tends to decrease as windshield diameter increases. It is possible that weather, damage and ageing effects are also lower on larger devices.

Richard A Wright MIOA and Guillaume Goulamhoussen are with Cirrus Research plc.

This article is based on excerpts from a paper submitted for publication at Internoise 2011, Osaka

Meeting report: Midlands branch

Kevin Howell. Kevin Howell. An introduction to Public Address systems and intelligibility

The Atkins offices in Birmingham provided the venue for the 13 April 2011 meeting when Jorge D'Avilles of URS/Scott Wilson presented studies that he had carried out into the design of the public address (PA) system for a new railway station.

Jorge described the parameters that determine whether a spoken message is intelligible to the listener. It became clear that although the PA consultant is charged with designing an effective PA system, almost none of the parameters that will determine its effectiveness are under his control. The hearing acuity of the listener and the clarity of articulation of the speaker are things that the system designer cannot control. It is hoped that he can influence directly the sound level and quality of the PA announcements and the number, distribution and orientation of loudspeakers, but even these are likely to be compromised by cost constraints, practical installation issues and health and safety and aesthetic requirements. To ensure suitable background noise levels and reverberation characteristics for him to work with, the designer needs the opportunity to influence the design of the spaces and the surface finishes. However, many of these issues are determined well before the PA design is considered.

Jorge described the anatomy of hearing and masking effects and the relevance of the delay times when listeners can hear more than one loudspeaker. He explained a number of the subjective and objective methods he considered for assessing speech intelligibility, with reference to a number of relevant BSI and ISO standards, and some of the pros and cons of each in relation to his work.

Jorge modelled the railway station in question which will have a 122m long platform, 19m wide and a roof 14m high. Initial modelling determined that 85 loudspeakers would be required to cover the area, a mixture of ceiling and 'totem' mounted. However, the model based on calculations of sound pressure level and speech transmission index (STI) showed there to be some areas of very poor intelligibility. He considered a number of options before negotiating with the design team for a significant increase in the area of absorptive surfaces. A rerun of the model showed improved STI and sound pressure levels. Jorge demonstrated the effects to the audience by presenting an auralisation simulation. As a parting shot he mentioned that although the station announcements would be in English, 30% of people in London are not native English speakers. There appeared to be no way to take this into account!

The branch committee gives many thanks to Jorge for his interesting presentation and to Atkins for making us welcome once again at their offices.

The assessment of noise from small wind turbines

On 19 May Dani Fiumicelli of AECOM gave a very interesting talk about small wind turbines to a large audience from the Midlands branch at the offices of URS/Scott Wilson in Nottingham. The presentation was similar to the one that Dani previously presented to the Eastern branch, as already reported in Acoustics Bulletin. Thanks are offered both to Dani and UPS/Scott Wilson.

Meeting report: Midlands branch

Kevin Howell. Midlands branch - Hi-fi myths busted

The 30 March 2011 meeting of the branch saw Mike Swanwick present to a large audience at the Arup Campus in Solihull. Mike has degrees in electrical and electronic engineering and applied acoustics but his interest in presenting this topic derives from his amateur role as a sound and recording engineer and a lifelong enthusiasm for listening to good music on a good sound system.

When listening to music on a sound system everyone hears something different because we have different hearing acuity and different tastes and preferences for how the music should sound. However, if the subjective element is put to one side it is possible to be objective about how accurately the sound system reproduces the source material. This subject is littered with rules of thumb, rumours and myths and there have been many confusing and nonsensical arguments regarding the choice, installation and listening pleasure of domestic sound systems. The aim of the talk was to show what can go wrong and how to optimise the performance of both high-end and budget hi-fi systems. It is important to recognise that a system will only sound as good as the weakest component will allow it to. Generally CD players and amplifiers are very capable modules but some components are always potentially problematic including loudspeakers, signal wiring, loudspeaker wiring and mains power distribution.

Mike explained a great deal of the physics, terminology, standards and specifications concerning various components of a hi-fi system. These included electrical and acoustical amplitude, line level, power, impedance, efficiency, maximum power transfer theorems, loudspeaker sensitivity matching, frequency and wavelength, resonance, resistivity and materials, analogue and digital cables, power cables and power distribution, noise/hum/distortion, loudspeaker design including horns, loudspeaker cables, loudspeaker stands, and room acoustics. That was quite a list! During these discussions he considered their relevance to the performance and enjoyment of your hi-fi system. In so doing he debunked a number of myths and false claims that may be encountered from time to time from manufacturers and salespersons concerning the precise specification of particular components. There were a surprising number of issues that relate to cables. Mike's presentation was packed full of detail and supported by a hand-out. It is clearly not possible to do justice to such a comprehensive presentation in this brief report. Thanks to Mike for his presentation and to Arup for hosting the meeting.

Meeting notice

BOHS Autumn Scientific Meeting

The British Occupational Hygiene Society (BOHS)'s 2011 Autumn Scientific Meeting, to be held at the Leeds Metropole Hotel, Leeds, on 14 and 15 November 2011, is now open for booking. Entitled Research, Practice, Competency — keep up-to-date the day-and-a-half programme covers important and current occupational and environmental health and hygiene issues, and the keynote speaker is Chris Snaith, Head of Occupational Hygiene at the Health and Safety Executive (HSE).

The varied line-up includes technical presentations and workshops. The technical sessions will encompass research, including the latest measurement methods for isocyanates, and Porpadet, a potential portable detector for airborne asbestos; practice, with real-life occupational hygiene case studies and survey results; and competency, taking in proficiency schemes, fit testing and OSHCR. Practical workshops will take place on report writing, sampling strategies, practical monitoring and control for nanoparticles.

There will be plenty of networking opportunities, and an exhibition running alongside, ensuring that this is a not-to-be-missed event where technical and professional knowledge and hands-on skills can be enhanced.

The cost, which includes VAT, lunches on both days, an exhibition drinks reception and refreshments, is just £180 for BOHS members or £240 for non-members, and online booking is available via the BOHS Event site: **http://www.bohs.org/events/.**

The web site is **www.bohs.org.**

Meeting report: Yorkshire and North-east branch

Dave Daniels.

A meeting of the Yorkshire and North East Branch was held on 9 June 2011. At the meeting, Kirill Horoshenkov tendered his resignation from the post of secretary. Kirill explained that his involvement over the years had given him great pleasure, but with his increasing IOA activity in the Technical Committees, felt that he should stand down. On behalf of the branch, chairman Dave Daniels thanked Kirill for the hard work he had put in over the years: in many ways the Yorkshire and North-east branch has survived because of his involvement. For the interim, the chairman will combine both activities, but several members at the meeting expressed an interest in becoming involved. This will be discussed and put to the next meeting, which it is hoped will be in September 2011.

The meeting was followed by a presentation by Dr Joe Venor of ESI UK Ltd on *An overview of vibro-acoustic simulation methodologies*. The presentation was very well attended and members found it a particularly interesting treatment of a fascinating subject.

Dr Venor outlined the use of various vibro-acoustic techniques for the prediction of noise and vibration levels in applications as diverse as automobile NVH, aerospace, white goods design, and sound in buildings. He indicated the uses of finite element, boundary element and statistical energy analyses and provided illustrations of the use of 'VA One' for noise and vibration prediction. He then demonstrated some basic noise simulations of simple structures to enable the audience better to understand the benefits that can be derived from vibro-acoustic simulation modelling. This showed how key design considerations taken early in the design cycle before prototyping can reduce expensive reworking costs.

New face at St Albans

IOA appoints new administrator

We welcome to head office Hazel Traynor, the Institute of Acoustics' new administrative assistant.

Hazel previously worked as a bilingual commercial secretary in Paris for an international industrial company, where she spent over 20 years dealing with French, German and Austrian mother companies manufacturing large industrial recycling machinery.

She says she is overjoyed with the prospect of working closely with the members of the Institute and has already found that the members feel a great honour in being part of such an organisation. She already feels part of the team and is looking forward to assisting members and informing them of all future events.

Away from work Hazel is an enthusiastic cook, loves to travel to France and often returns to her home town of St Andrews in Scotland.

Hazel can be contacted at **hazel.traynor@ioa.org.uk** or on **01727 848195.**

Meeting report: North-west branch

Paul Michel. - A historical account of the sound level meter

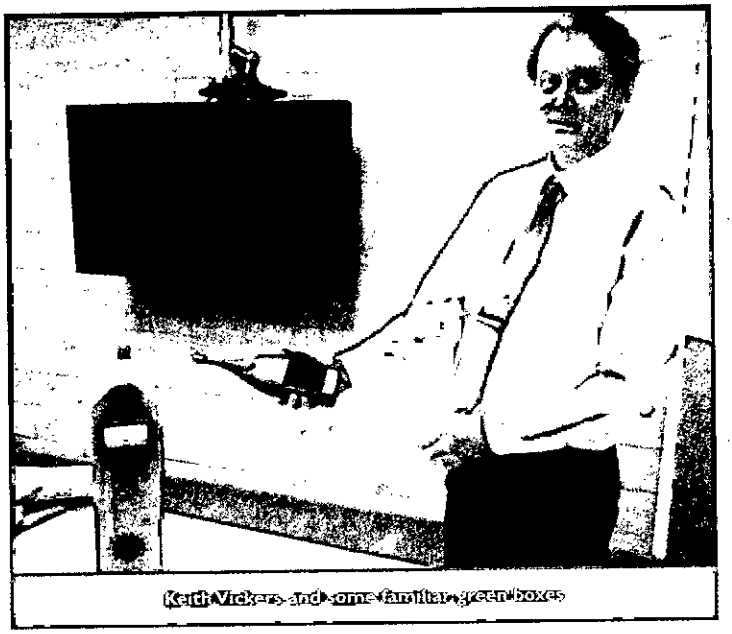
On 10 February 2011 the North-west branch was taken on a trip through time by Keith Vickers from Bruel & Kjaer with a presentation entitled A brief history of the sound level meter, which illustrated the significant changes that this instrument has undergone over a relatively short period of time. Using examples from the Bruel & Kjaer range, Keith illustrated the dynamic relationship between functionality, electronics and measurement standards which had unfolded since the early days.

The sensing elements in early microphones were made from Rochelle salt (potassium sodium tartrate), which meant that they were very unstable even with careful storage and handling, gradually becoming more sensitive with age. Moving from apothecary to engineering, Bruel & Kjaer was able to develop a condenser microphone which was stable by using materials with matched coefficients of thermal expansion and novel diaphragm attachment. The result is that modern standards require precision microphones to be robust enough such that a 1 metre drop test results in a sensitivity change of less than 0.1dB.

The company was officially formed in November 1942, which accounts for the familiar green colour used on their equipment, this being a Danish military colour paint acquired courtesy of the Danish Army. Both company founders already had experience of building measurement equipment, one being a standing wave tube that was in production for 50 years from 1944.

In 1960 production began of sound level meter type 2203 which was the first hand-held transistorised meter, whose conical shape (apparently likened to a gin bottle) was intended to avoid errors from reflection. As a cutting-edge instrument it had a linear display of 20dB, no overload indication, a crest factor of 5dB and included A, B, C and Linear frequency weightings. The instrument was fitted with a one-inch microphone (which, for those who know about early microphone standards, meant 23.77mm and not 25.4mm). Another memorable feature for some might be its weight: the unit without the additional octave filter set weighed in at 3kg.

Various accessories could be used with this meter, including the level recorder type 2301 which originally put B&K on the global map in 1949. That instrument continued for many years, with type 2307 being introduced in 1972. The attachment of an appropriate accelerometer to the sound level meter meant that vibration measurements could also be undertaken. Fortunately, B&K also produced a range of such devices, as in 1943 they produced their type 4301, which was the world's first charge accelerometer.



Keith Vickers and some familiar green boxes

The sound level meter was compliant with the emerging IEC 651 standard, or more accurately, that standard was based on what the meter could achieve. This instrument continued in revised form for 21 years, gaining features such as a hold function (useful for analogue displays) and a peak detector. The last iteration was model 2218, which was the first integrating sound level meter. By this time the instrument's capabilities included an 80dB dynamic range, direct reading of SEL, a 50dB logarithmic display and an accuracy of plus or minus 0.5dB for crest factors up to 20.

continued on page 22

The World's Biggest Noise Map.

SoundPLAN 7 was chosen for the world's biggest noise map, the railway noise map of all Germany.

Although SoundPLAN is already the most flexible and one of the fastest programs of its kind, version 7 represents another big step forward for noise control software. This version introduces the new calculation core employing SoundPLAN's Dynamic Search scanning method. It is now possible to calculate huge noise maps with complex geometry using modern simulation standards.

SoundPLAN Version 7.0

Incredibly Fast

The new dynamic search method makes it the fastest noise control software on the market to our knowledge.

Incredibly Accurate

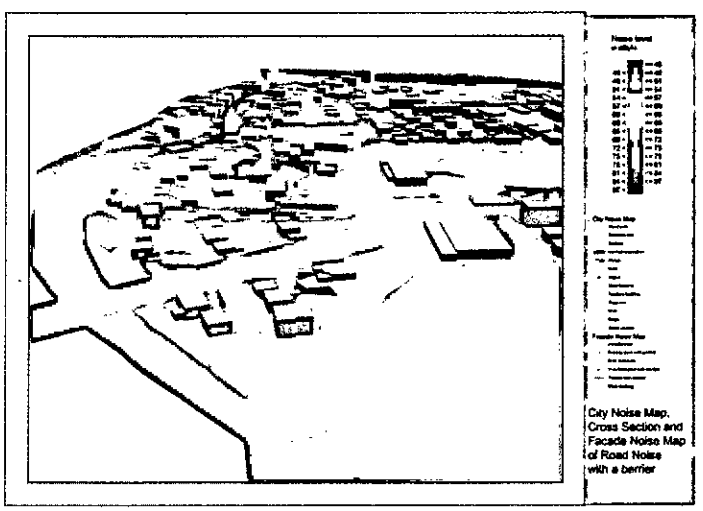
Mesh maps, hot spots, dynamic search and extensive testing for utmost accuracy according to 50+ standards.

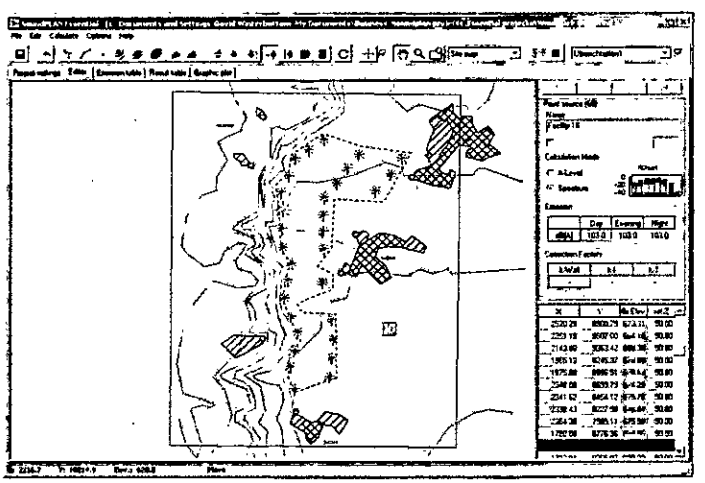
Incredibly Useful

Stunning Graphics are easy to use. Spreadsheet for multiple results and automation of analysis such as DMRB. Documentation with advanced formatting. User definable templates and much, much more.

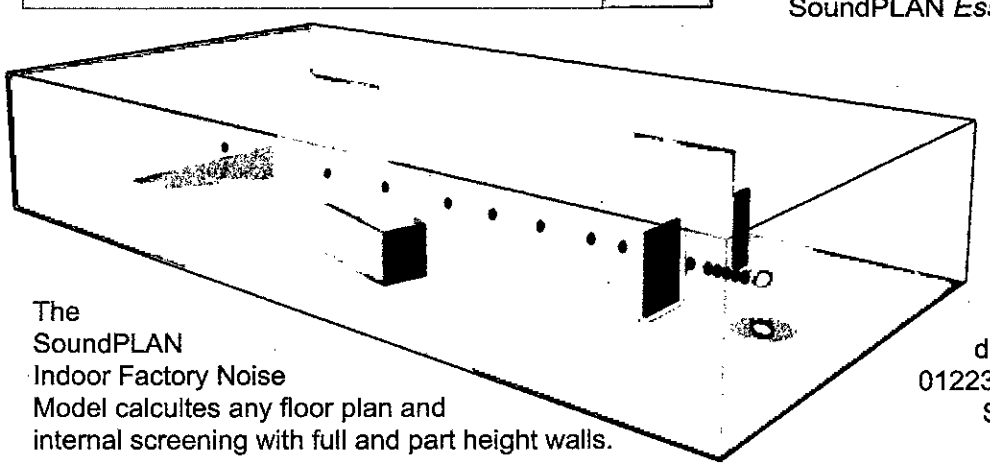
Incredibly Popular

Nearly 5000 users in 50+ countries. Used by governments, consultants and researchers. Available in European, Asian and soon Arabic languages.





SoundPLAN *Essential* is a compact version for occasional users and less complex projects with a very competitive price.



The
SoundPLAN
Indoor Factory Noise
Model calcultes any floor plan and
internal screening with full and part height walls.

Contact us for a demo CD

UK & Ireland Distributor
David Winterbottom
SoundPLAN UK&I

david@soundplanuk.co.uk
01223 911950 / 07050 116 950
Skype david.winterbottom
www.soundplan-uk.com

SoundPLAN

a historical account of the sound level meter - *continued from page 20*

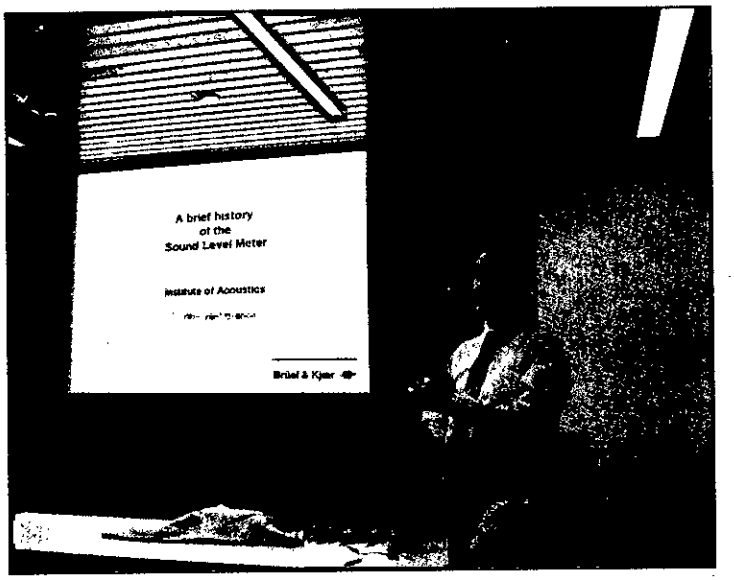
The second generation of B&K meters appeared in 1982 with the 2230. This met IEC 804 and Type 1 IEC 651 standards, with A, C Linear and 'All-pass' frequency weightings: by now, half-inch microphones were the norm. The following year, type 2232 was introduced, which was based on a programmable platform and included features such as internal storage and direct reading of L_n. Many modules were available for this meter which allowed measurements of infrasound and ultrasound, Zwicker loudness, human vibration, etc and this carried on in production for over ten years.

Standards relating to electromagnetic compatibility now required some changes and in 1993 the next generation of meters began with the type 2236 (this time bearing a certain resemblance to a Vosene bottle, ah, the memories!). This integrating meter now had parallel detectors so that rms and peak values could be obtained simultaneously, and featured an RS232 interface for communication.

Bearing a certain family resemblance, the type 2260 was introduced in 1994: this gave dual channel digital signal processing on PC platform. As its predecessor, the instrument was no longer simply a sound level meter but could host many applications including FFT analysis, building acoustics and sound intensity measurement.

Another ten-year gap led to the launch of type 2250 which includes the facility to save data to CF/SD memory cards, voice recording for annotation, and a variety of software options. The dual-channel type 2270 hand-held analyser carries on the tradition of the 2260 in terms of functionality, and now also includes features such as a LAN interface and an integrated camera for the 'Facebook generation'. The advances in storage capability mean that there is less need to decide in advance what parameters must be measured as any redundant data can be ignored once the measurement is complete.

Largely as a consequence of advances in electronic engineering, sound level meters over the last 50 years have progressed from static single function laboratory devices that required cosseting, to small lightweight devices which effectively encompass several laboratory instruments and enable measurements to be made in the fields of environmental acoustics, building acoustics, FFT analysis, vibration analysis and more. Present-day meters with many features including small size, low weight, capacious data storage and wide dynamic range are designed to make the measurement process more foolproof, and they meet the design philosophy of 'easy, safe and clever'. However, there will always be a need for the operator of such a device to understand what he or she is doing and why, if the results of the measurements are to be of value and interpreted correctly.



Forthcoming conferences

Advance notices

ICEM 15

A symposium on vibration and structural acoustics measurement and analysis, in conjunction with the 15th International Conference on Structural Mechanics (ICEM15) will be held at the Faculty of Engineering, University of Porto, Portugal, from 22 to 27 July 2012. Details can be found at http://paginas.fe.up.pt/clme/icem15.

Papers are solicited in the following areas:

- Experimental testing in vibration and structural acoustics
- Material systems and technologies for noise and vibration control
- Passive/semi-active/active control techniques
- Piezoelectric and viscoelastic damping technologies
- Shape/position and fluid flow control
- Nonlinear dynamics and vibrations
- Vibration-based structural health monitoring/evaluation and damage prognosis
- Machinery noise/vibration and diagnostics
- Reciprocating machinery and rotor dynamics
- Experimental modal analysis
- Modelling of the damping and dynamics of complex systems
- Noise and vibration on high-speed trains and railways
- Structural acoustics of musical instruments
- Applications and case studies in structural acoustics and vibration.

Extended abstracts of two full pages are required for the CD-ROM: there is no length limit for papers themselves. A sample abstract is available at the above web site, which may be used as a template. Extended abstracts are due on 30 November 2011, and those accepted will appear in a book to be made available to delegates of ICEM15 during the event.

For additional information, contact either Dr Cesar M A Vasques, **cmav@fe.up.pt**, tel +351-22 957 87 10, or Prof J F Silva Gomes, **sg@fe.up.pt**, tel +351-91 725 89 50.

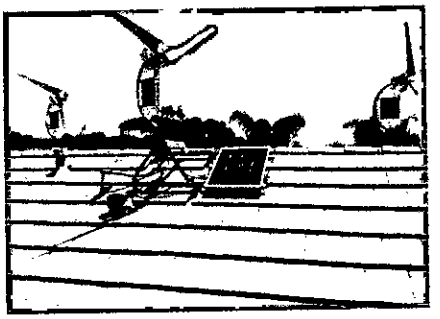
ICSV19

The 19th International Congress on Sound and Vibration (ICSV19), sponsored by the International Institute of Acoustics and Vibration (IIAV) and Vilnius University, will be held from 8 to 12 July 2012 at Vilnius University in Vilnius, Lithuania. Vilnius is the historical capital of Lithuania, dating back to the 14th Century, and has been awarded the status of World Cultural Heritage Site by UNESCO. The University is one of the oldest universities in Eastern Europe and the friendly atmosphere of the modern city will, say the organisers, mesmerise you and leave you with unforgettable memories.

Theoretical and experimental research papers in the fields of acoustics, noise, and vibration are invited for presentation. Participants are welcome to submit abstracts and companies are invited to take part in the ICSV19 exhibition and sponsorship. For more information, please visit **http://www.icsv19.org.**

Meeting report: North-west branch

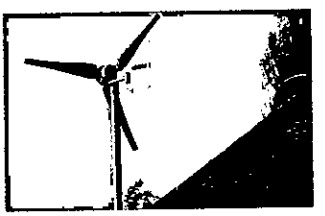
Paul Michel. Structure-borne sound and vibration from building-mounted wind turbines



The talk was given by Professor Andy Moorhouse of the University of Salford. He was part of a team funded by the DCLG, DECC and DEFRA with the aims of researching vibration from micro-turbines and developing a prediction method for their structure borne vibration and noise.

The source level depends on wind speed, direction and turbulence and its propagation on the turbine, mast, building construction and layout.

The number of possible variables was already mounting and the prediction methodology work was divided into the source, the mounting, and the building propagation. Criteria included structure borne sound, tactile vibration, building damage and rattling.



Source characterisation included long term monitoring of test turbines using vibration sensors on the mast, a radio speed monitor for the blade velocity, and assessment of the wind speed, direction and turbulence. This created 4TB of data and demonstrated just how variable the wind and blade speed were. From this the velocity in operation and frequency response functions of the mast supporting the turbine were used to calculate the blocked forces at the turbine. It was found that the rotor speed gave a more useful relationship to blocked forces than the impossibly variable wind velocity.

The mounting properties of poles of different lengths and roof mounts were examined and their transmissibility in x, y and z directions obtained.

Measurements of transfer functions for solid brick, cavity brick and stone dwellings were made. Solid brick transfer functions seemed reliable but cavity brick much more variable, with much less attenuation for the cavity brick further from the source.

Finally case studies were made of complete installations and the prediction methodology compared with findings. It was noted that there could be an audible whine but no tactile vibration or rattling.

The study found that micro wind turbines can be characterised, and that the source strength depended on wind speed and not turbulence. The mast properties could be significant and the attenuation through the building relatively small. Sound levels varied from 29 to 45 dB(A) with an audible whine, but vibration levels were barely perceptible and there was no danger of vibration damage. The prediction method worked as well as could be expected.

The talk gave a fascinating insight into how a complex and highly variable problem can be broken down into workable parts and useful prediction methods obtained. Further information may be found on the web, including DEFRA and the University of Salford sites, the above being only a sample. Thanks to Andy for his presentation and to Arups for the venue.

Sticker

Members, look out for your free IOA car/window sticker inside this issue of Acoustics Bulletin!

Institute of Acoustics

www.ioa.org.uk

Subjective Evaluation of Acoustics in Jazz Clubs

A G Sotiropoulou, A Savvopoulou, G Karagiannis and G Tzouvadakis

INTRODUCTION

Research in acoustics during the last three decades has been focused on the formulation of design principles for auditoria for classical music. The latest electronic atonal music has also been studied and led to specific design proposals for the interior architecture of auditoriums for this music genre (Stockhausen, 1958). On what concerns contemporary music genres, acousticians were not interested in most of the music genres of the Twentieth Century (pop, rock, jazz) until very recently. It has been observed that the design of auditoria for all music genres is based solely on the principles of classical music and thus follows empirical rules.

Jazz music, which is the subject of the current study, is one of the music genres, the beginning of which was accompanied by great prejudice concerning its social roots. Today prejudice no longer exists, owing in part to the worldwide popularity of jazz music. We talk about a type of music which is not addressed to big crowds, as is classical music, nor to listeners who prefer the energy and the characteristics of pop or rock music. It could be said that in terms of audience size, jazz music is similar to chamber music.

The current study aims to attain a thorough understanding of the elements that affect both the acoustics of spaces designed for this music genre and its perception by the listeners. On-site measurements of objective parameters of sound followed by subjective evaluation experiments carried out in two case studies allow us to draw valuable conclusions about the factors affecting the acoustic performance of jazz clubs. This is intended to contribute to the evolution of technical know-how on the construction of jazz auditoria.

LITERATURE REVIEW

Auditorium acoustics

The current scientific knowledge on the construction of auditoria is focused on classical music and is summarised by the existing literature about the proposed design principles and techniques. Extensive research on classical music and sound in general (Beranek1962, Marshall1967) has established some criteria (Table 1) which have the form of suggested value ranges for the objective parameters of sound, namely the reverberation time, the early decay time, the clarity index, the early lateral fraction and the sound pressure level. Concerning contemporary music, recent studies have focused on objective parameters measured within existing spaces for popular music. The scope was the formulation of design principles for this music genre (Larsen 2004). In terms of subjective acoustic evaluations, the introduction of binaural recordings (1975) in existing concert halls demonstrated the design priorities for concert hall listening (Hawkes and Douglas 1971, Cremer and Müller 1982). Additionally, the roles of the orchestration, the musicians and the audience on the quality of sound inside an auditorium, have been the subject of early studies (Hawkes and Douglas 1971) and more recent work (Dammerud and Barron 2008, Yong Hee 2007) which offered further insight into the parameters that affect the quality of sound.

Organ music	>2.5
Romantic classical music	1.8-2.2
Early classical music	1.6-1.8
Opera	1.3-1.8
Chamber music	1.4-1.7
Drama theatre	0.7-1.0

Table 0

Recommended occupied RT values

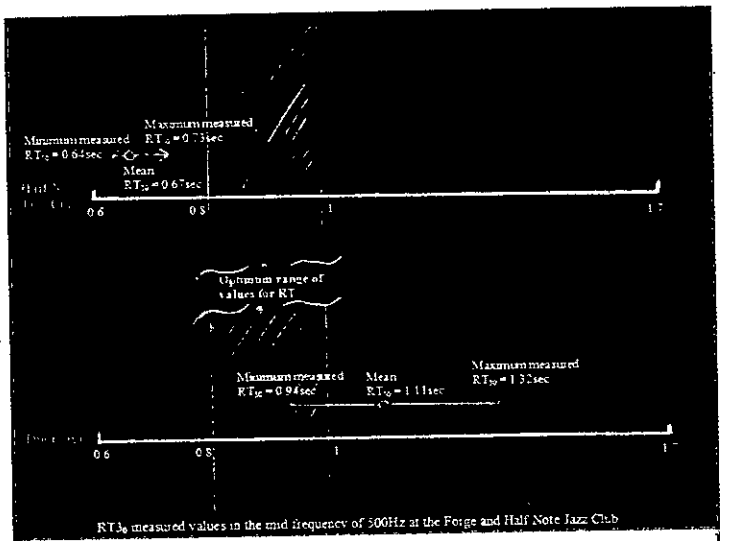


Figure 0

Graphic representation of the obtained values of RT30 inside our case studies in relation with the criterion for the optimum values

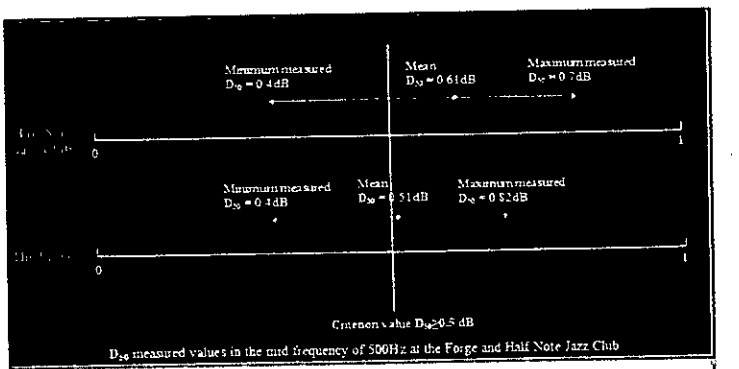


Figure 0

Graphic representation of the obtained values of D50 in relation with the criterion of the optimum values

considered in the analysis of the physical measurements obtained and on the design of the present experimental study.

Physical criteria of sound

Extensive research since the turn of the last century has identified the parameters that are considered to play a vital role in the control of the acoustic performance of a space (Beranek 1962). Nine studies sum up the early scientific research on the objective measures of acoustics, namely Sabine (1900), Thiele (1953), Beranek (1960), Shroeder (1965), Marshall (1967), Hawkes and Douglas (1971), Reichardt et al (1974), and Cremer and Muller (1982).

All the above studies shared the notion that the control of five objective measures is most important for the design of concert halls, namely the clarity index (C80, dB), the Early Decay Time (EDT, seconds) the sound pressure level dB, the early lateral fraction (Lf) and the reverberation time (RT, seconds). Each of these measures is quantified through functions introduced by Sabine, Reichardt, and Barron and Marshall. It has been understood that auditoria for classical

continued on page 26

Subjective evaluation of acoustics in Jazz clubs - *continued from page 24*

music since 1985 have been constructed using successful precedents as a reference. However as far as contemporary popular music is concerned, no design principles have been formulated up to now in a way that could offer criterion values for all the above objective measures.

Acoustic perception of audience

An audience's perception of music, especially classical music, has been explored in order to achieve a further understanding of all the parameters that determine the acoustics of a space. The already well-known criteria for optimum acoustics in auditoria for classical music emanated from experiments based on interviews with musicians who evaluated the acoustics in 54 auditoria. Other studies applied semantic differentials and required from audiences to evaluate several live concerts through questionnaires. According to Barron (2009) it was widely admitted that the previously mentioned objective measures affected various subjective measures of sound. The results are illustrated in Table 2. A qualitative and summarised interpretation of the correlations of these criteria with the physical criteria of sound, which incorporates the findings of other studies (Sotiropoulou and Flemming 1995) is illustrated on Table 3.

Overall the idea that the 'clarity' of sound, the 'sound intensity', the 'tonal quality', the 'spatial impression' and the 'proximity' are the basic parameters that influence the quality of music heard inside a concert hall, was the common conclusion in all the above subjective experiments.

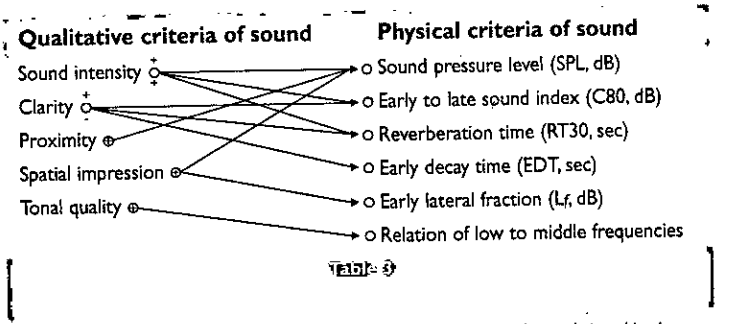
As far as the acoustic experience of jazz auditoria is concerned, the first completed experiment using an audience to evaluate recorded jazz music was conducted by Sotiropoulou, Karagiannis and Poulakos (2007). This study underlined the most important criteria for the perception of this music genre, which are tonal quality, clarity, body and proximity.

Other subjective experiments

The understanding of human perception has been studied in the past

Subjective quality	Objective measure
Clarity	Clarity Index (C_{80})
Reverberance	Early decay time (EDT)
Intimacy	Sound strength (level)
Source broadening	Early lateral fraction and strength
Loudness	Sound strength and source-receiver distance

Important subjective qualities and objective measures related to them (Barron, 2009)



Correlation of qualitative with physical criteria of sound as were obtained via subjective experiments (Sotiropoulou 1996 cited Barron 1993, Sotiropoulou and Flemming 1995, Barron 1988, Lehman and Wilkens 1980)

citing Rubenstein 1986, Spearman 1971).Processing of the data obtained was by factor analysis. The first of those experiments (Spearman 1970) aimed at attaining an understanding of people's dexterities in mathematics, vocabulary and art. Other similar experiments looked at the function of the automatic nervous system and of the feelings (Cattell 1957). Under this perspective, Rubenstein in 1986 studied man's curiosity, using a sample group of several high school students. The suitability of the factor analysis as a method for the processing of the collected data from the above experiments has been tested since its introduction to the social sciences by Charles Spearman, Cattell and Bartlett. They have introduced several criteria for the tests made within factor analysis, in order to ensure the validity of the results based on the size of the sample.

AIMS OF THIS STUDY

Wider study

The present experiments and measurements are parts of a wider study which anticipated the proposal of design principles for a jazz club through a scientific methodology. The overall study includes on-site measurements of acoustic parameters in selected jazz clubs (ongoing process), subjective evaluation experiments implementing different audiences in jazz clubs (completed) and a comparison of the results from both studies.

Current study: Physical measurements

The principal aim of the comparison through on-site measurements of two spaces designed for the same type of music with similar occupant densities and patterns was to investigate the possibility, that a set of parameters (materials, geometry, sizing of the various building elements) affects the acoustics of these auditoria. At a second stage the interpretation of possible similarities and/or differences and an attempt to identify their source was expected to provide valuable conclusions in terms of the choice of materials and/or geometry of both spaces.

Subjective evaluation experiment

The subjective evaluation experiment at a first stage sought the parameters that affect a jazz audience's perception and at a second stage the extraction of a smaller number of factors which could interpret the relations between those parameters. The aim was an accurate approximation of the studied variables by the factors obtained, in order that the factor analysis results would be reliable. A

comparison of the results with those from past researches was made in order that useful conclusions could be drawn for the perception of jazz music.

CASE STUDIES

For this study two spaces were chosen: the Half-note Jazz Club in Athens, and the Forge, one part of the Caponata multi-purpose space located in Camden Town, London. Tables 4 and 5 present some of the characteristics of these auditoria.

The subjective evaluation experiment was completed with the participation of audiences of different cultural backgrounds which evaluated one concert in each of those spaces (56 people in the Half-note Jazz Club, and 21 in the Forge).

METHODOLOGY

Literature review

The first stage of this study was the completion of a literature review as it was described above. At the next stage a selection of case studies was made against a criterion that they host a significant proportion of the jazz gigs organised in each city. The architectural studies of both spaces along with their design briefs were thoroughly examined. In addition, personal communications with the sound engineers and part of the design teams of both spaces contributed to the understanding of the basic aims of each space. At this point the research team became sufficiently familiar with the level of acoustic design applied in these spaces.

Physical measurements

The room acoustic parameters measured at 14 locations inside the Half-note Jazz Club, and 13 positions inside the Forge, were the reverberation time T30 (seconds), the Early Decay Time, the Early to Late sound index (C_{80} dB), the Early to Total sound index (D_{50} dB). The procedure and the equipment used in both cases complied with the

Half Note Jazz Club	
Use of space	Jazz music concerts
Construction	Result of a conversion of an older house in 1990 (Architectural study: G. Tsokas)
Physical characteristics	Surface area F=76.5m², volume V=382m³, capacity 180 people. Indicative reverberation time values RT_{500} = 0.67sec, RT_{1000} = 0.72sec. No acoustic design principles have been applied.

Table 4

Technical characteristics of 'Half Note Jazz Club'

The Forge	
Use of space	Jazz pop and ethnic music concerts
Construction	Part of the multipurpose space of Caponata which is an all day coffee-bar restaurant (Architectural study: Burd Haward Architects, Max Fordham, Arup)
Physical characteristics	Surface area F=84m², volume V=530m³, capacity 160 people. Indicative reverberation time values RT_{500} = 1.11sec, RT_{1000} = 1.16sec. Adequate acoustic design which took into account the basic design principles of auditoria. For the Forge, an environmental design of high standards has been made. The aim has been the construction of the first naturally ventilated auditorium.

Table 5

Technical characteristics of 'The Forge'

continued on page 28

Subjective evaluation experiment

Factor analysis was been conducted separately for each case study. After the varimax rotation of the initial table of factors, each of the bipolar rating scales and variables appeared with high score on one single factor, as shown in Tables 8 and 9. The latter led to a better interpretation of the results. Values of factor scores that equal the standard error are excluded from the tables.

Factors	Associated scales	Factor loadings	% of Variance
1. Proximity	Live-Dead	0.82	23.7
	Near-Remote	0.79	
	Near-Distant	0.77	
	Brilliant-Dim	0.74	
	Poor-Rich	-0.63	
2. Clarity	Clear-Noisy	0.81	22.12
	Clear-Dull	0.75	
	Preferred-Not preferred	0.74	
	Clear-Blurred	0.74	
	Dark-Bright	-0.70	
	Coloured-Dark	0.67	
	Full bodied-Thin	0.58	
3. Tonal Quality	Smooth-Harsh	0.83	19.99
	Gentle-Harsh	0.81	
	Harsh-Velvety	-0.78	
	Smooth-Rough	0.72	
	Smooth-Sharp	0.67	
	Loud-Silent	-0.63	
	Cool-Warm	-0.57	

table 8

Obtained factors at Half Note Jazz Club

Factors	Associated scales	Factor loadings	% of Variance
1. Proximity	Smooth-Harsh	0.95	32.01
	Harsh-Velvety	-0.95	
	Gentle-Harsh	0.86	
	Smooth-Rough	0.81	
	Clear-Noisy	0.79	
	Smooth-Sharp	0.72	
	Coloured-Dark	0.65	
	Full bodied-Thin	0.58	
2. Clarity	Coloured-Dark	0.58	30.50
	Clear-Dull	0.93	
	Brilliant-Dim	0.88	
	Near-Remote	0.84	
	Dark-Bright	-0.72	
	Clear-Blurred	0.72	
	Live-Dead	0.71	
	Preferred-Not preferred	0.57	

table 9

Obtained factors at The Forge

continued on page 30

Subjective evaluation of acoustics in Jazz clubs - *continued from page 27*

requirements of ISO 3382. Suitable equipment from Brüel and Kjaer (images 1 and 2) and the DIRAC and WinMLS software packages were used for the measurements and the results analysis.

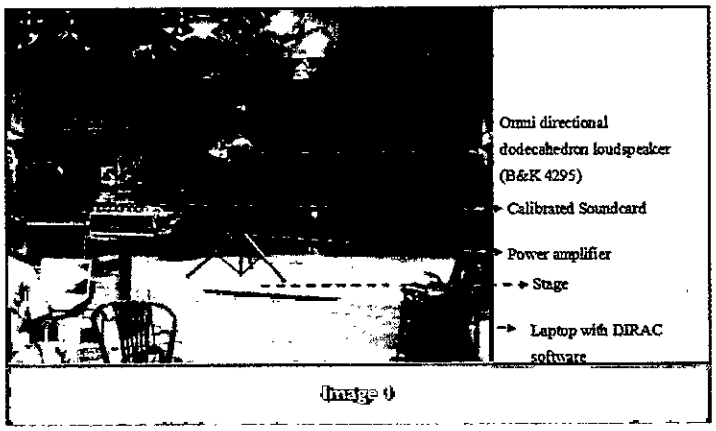


Image 1

Configuration of measurement equipment for The Forge

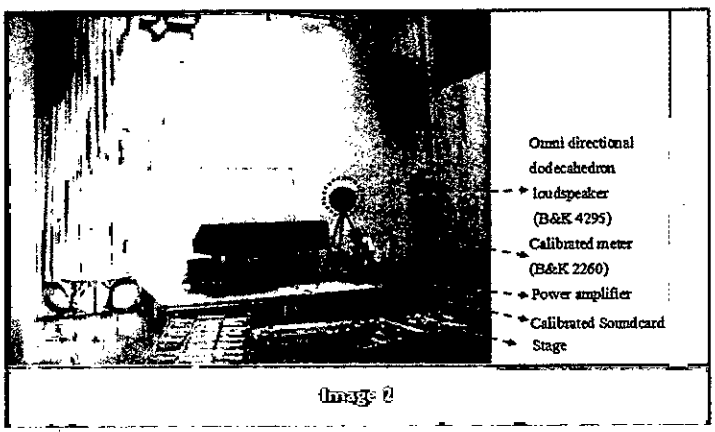


Image 2

Configuration of measurement equipment for Half Note Jazz Club

At the next stage, a mathematical analysis of the results obtained via DIRAC software attempted to identify possible issues which the design of those spaces failed to address. Valuable conclusions were drawn about the acoustic quality of the case studies and the spatial characteristics that could affect quality, based on the qualitative criteria of sound and their proven correlations with physical criteria, as defined in the literature review (Table 3).

Subjective experiment

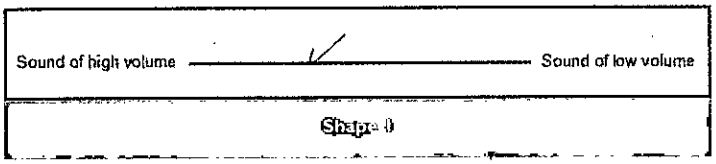
The subjective evaluation experiment was completed in the following stages:

- **(a)** Synthesis of questionnaires from rating scales selected to show high scores in the factors extracted at the experiment conducted for recorded jazz music
- **(b)** Distribution of the questionnaires to the audience
- **(c)** Factor analysis of the data obtained
- **(d)** One-way analysis of variance, in order to test whether the seat location of each listener had a statistically significant impact on the factors
- **(e)** Evaluation of the results and extraction of conclusions.

Synthesis of questionnaires

As was realised during the literature review, studies preoccupied with the understanding of perception had been implementing the semantic differential method, according to which perception is measured using semantic rating scales. For the present experiment we applied continuous bipolar rating scales of the form shown as Shape 1. The line represents a continuous evolution from one pole to the other. These poles are named as opposite adjectives which describe the same variable. Equal distances on this continuous line represent equal quantitative changes of the subjective variable being measured.

Each of the listeners was expected to place a mark on the bipolar scales at any distance from the poles. This mark would represent an evaluation of the quality of the sound that was heard. At a further stage the scales were numbered from 0 to 1 and thus all the answers were translated into numerical form. The questionnaires included questions regarding the age, sex, seat position, and familiarity of each listener with the specific music genre.



Shape 1

Bipolar semantic rating scale

Data processing

The processing of the data obtained from the questionnaires was done by factor analysis and the use of SPSS software. The number of factors that best describe the data was based on the criterion of a scree test as was formulated by Raymond Cattell (Darlington 2005). In order to achieve a better approximation and interpretation of the data from the extracted factors, a varimax rotation was made of the original table of factors obtained via factor analysis.

Then, in order to ascertain whether the different seat location of each listener affected the results, a one-way analysis of variance was completed. This checked the following two hypotheses:

H0: the seat of each listener affects the extracted factor;

H1: the different seat of each listener has no impact on the extracted factor.

Finally the team relied on the Kaiser-Meyer-Olkin criterion (Table 6) in order to confirm the suitability of factor analysis as a method for the processing of the data.

KMO = 0 factor analysis is unsuitable for this sample	
0.5 < KMO< 0.7	mediocre results
0.7 < KMO< 0.8	good results
0.8 < KMO< 0.9	great results
0.9 < KMO< 1	superb

Table 6

KMO criterion

RESULTS- DISCUSSION

Physical measurements

The results of the on-site measurements inside the two case studies are summarised in Table 7, organised in three frequency ranges, low (63 – 125 Hz), middle (500Hz - 1kHz) and high (2 – 4 kHz).

	Physical measurements											
	T30(sec)			EDT(sec)			C80(dB)			D50(dB)		
	Frequency											
Half Note Jazz Club	Low	Mid	High	Low	Mid	High	Low	Mid	High	Low	Mid	High
	0.62	0.69	0.68	0.71	0.7	0.68	6.36	5.49	6.32	0.64	0.61	0.64
The Forge	0.86	1.13	1.07	0.84	1.21	1.12	4.05	2.65	2.46	0.5	0.49	0.46

Table 7

T30, EDT, C80, D50 values as they were measured in the two case studies

Subjective evaluation of acoustics in Jazz clubs - *continued from page 29*

Taking into account the qualitative characteristics of the bipolar rating scales included in each factor, three factors were labelled:

1. Clarity
2. Tonal quality
3. Proximity

After realising that common factors had been extracted in both subjective experiments, it was decided to combine the data and conduct a new factor analysis. The results after the varimax rotation of the initial table of factors are illustrated in Table 10.

Factors	Associated scales	Factor loadings	% of Variance	Cumulative
1. Clarity	Dark-Bright	-0.80	35.34	35.14
	Clear-Dull	0.78		
	Clear-Blurred	0.78		
	Coloured-Dark	0.78		
	Preferred-Not preferred	0.74		
	Clear-Noisy	0.70	17.1	52.44
	Full bodied-Thin	0.65		
2. Tonal Quality	Smooth-Harsh	0.85		
	Gentle-Harsh	0.83		
	Harsh-Velvety	-0.83		
	Smooth-Sharp	0.73		
	Smooth-Rough	0.71	8.55	60.98
	Cool-Warm	-0.52		
3. Proximity	Near-Distant	0.84		
	Near-Remote	0.83		
	Loud-Dead	0.83		
	Brilliant-Dim	0.67		

Table 10

Obtained factors with an increased sample including data by both auditoria

The one way ANOVA led to the results shown in Table 11. In the last column it can be seen that for each factor the significance value is greater than 0.05. Therefore the null hypothesis H0 can be accepted, and H1 rejected, the conclusion being that the listener's seat location does not have any statistically important impact on the three independent factors.

ANOVA

		Squares	df	Mean Square	F	Sig.
REGR factor score 1 for analysis 1	Between Groups	15.012	12	1.156	1.221	.304
	Within Groups	34.988	37	.946		
	Total	50.000	50			
REGR factor score 2 for analysis 1	Between Groups	11.707	13	.901	.870	.589
	Within Groups	38.293	37	1.035		
	Total	50.000	50			
REGR factor score 3 for analysis 1	Between Groups	9.856	13	.758	.699	.752
	Within Groups	40.144	37	1.085		
	Total	50.000	50			

Table 11

One way ANOVA results

The test according to Kaiser-Meyer-Olkin criterion gave the results shown on Table 12. According to this criterion (Table 6) and based on the value of KMO that was obtained (Table 12), the results of the factor analysis are 'good' and the implemented method of factor analysis was appropriate for the purpose of this study.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling		.755
Bartlett's Test of Sphericity	Approx	890.114
	df	190
	Sig.	0.00

Table 12

Value of the index Kaiser-Meyer-Olkin for the whole sample of the subjective evaluation experiment

Discussion: Physical measurements

The analysis that follows is based on the proven correlations between the qualitative criteria of sound and the physical acoustic ones as were identified through the literature review (Table 3). The criteria for the evaluation of the obtained results, are the following:

(i) 0.8 < RT (frequency averaged) < 1second (Larsen 2004)

(ii) D_{50} = 0.5dB (Barron 1993)

(iii) Bass ratio < 1 second is not a disadvantage (Larsen 2004)

As it can be seen in Table 7 and Figure 4 the average values of each parameter in every frequency range meets the above criteria for listening to popular music (including jazz). A thorough study of the results shows that these criteria were also met individually in almost all chosen locations within the spaces tested. Whenever this was not the case, it is expected that the presence of an audience during concerts, which would offer a high level of absorption, would mitigate the higher values at the level of criterion (i). In both case studies the higher T30 values at the middle and high frequencies (500Hz - 4kHz, Table 7) suggest that these spaces may be perceived as 'harsh' and 'glassy' in tone (Brooks 2003).

The evaluation of the C80 values obtained (Table 7) was based on criteria suggested by Campanella (1995) and Noack (2005). C80 is a measure of the degree to which the individual sounds stand apart from one another. Furthermore it has been established that high positive values mean the space is non-reverberant, meaning that the music can be expected to be heard clearly. Regarding the early-to-total arriving sound energy ratio (D50), although it is employed to explore clarity of speech in this case (Table 7, Figure 5), the values obtained for both the spaces studied were close to the optimum value of 0.5. The large positive values of both parameters suggest that a large proportion of the direct sound energy will arrive at the audience within the first 50ms. This is reasonable because in both case studies there were reflective surfaces close to the seating area.

Subjective evaluation experiment

With the completion of the subjective evaluation experiments in both auditoria it can be concluded that identical factors have been extracted. This outcome is positive especially since the two spaces had different reverberation time values and the two audiences had different cultural backgrounds. The fact that in the case of the Forge, the 'proximity' factor was not extracted is explained by the higher volume and dimensions of the space, which caused an absence of the feeling of proximity. The presence of the bipolar scale 'coloured – dark' in both factors extracted at the Forge indicates that some people interpreted the sound they heard as one 'absent of darkness' and thus as a clear sound, and some people judged the factor as 'tonal quality'. As far as the qualitative characteristics of the extracted factors are concerned, it can be deduced that both audiences interpreted 'tonal quality' as a measure of smoothness of sound, 'clarity' as a measure of fullness, and 'proximity' as a measure of liveness of sound. The 61% of the variation that is explained by the three independent factors (Table 10) that were extracted at the final stage is a positive result since in the case of categorical data, as were those in this study, a percentage greater than 50% is regarded as 'good'. This means that the three independent

factors are important in perception, a conclusion which is very useful to engineers since they tend to design such spaces based partly on public opinion.

At this point it is crucial to state that although there were differences in the measured values of objective parameters, subjectively they were not identified by the audiences. Assuming that the factor 'tonal quality' was associated with the spectral balance of RT (EDT) and given that the latter varied between the two auditoria, a significant difference in this factor would be expected in terms of the sign of factor scores of the associated rating scales. However the results do not confirm this. Finally as the correlation of subjective 'clarity' with C80 was established (Table 3), it can be concluded that the indication of 'harshness' that the measured C80 values provided was confirmed by the fact that the perception of clarity of sound in both auditoria was profound and perceived as a harsh sound. The extraction of the factor 'clarity' confirms the latter.

Conclusions

With the completion of the first set of measurements and both the subjective evaluation experiments it can be confirmed that live and recorded classical and jazz music are perceived in common ways. The indications about the acoustic qualities of the selected spaces, as they were given by the results of on-site measurements, are confirmed by the qualitative interpretation of the associated scales to three independent factors. In addition the extraction of the factors 'clarity', 'tonal quality' and 'proximity' supports the view that there are common subjective acoustic factors for jazz listeners who belong to distinct cultural backgrounds (that is, British and Greek). This allows engineers to seek universal design principles for jazz clubs.

This article first appeared as a paper presented at the 8th International Conference on Auditorium Acoustics, Dublin, Ireland 20 to 22 May 2011.

A G Sotiropoulou is with the School of Architecture & School of Civil Engineering, Technical University of Athens

A Savvopoulou is with Bartlett School of Architecture, University College London, and the School of Architecture, Technical University of Athens

G Karagiannis is with the School of Architecture, and G Tzouvadakis the School of Civil Engineering, both at the Technical University of Athens

REFERENCES

1 Arup Acoustics (2006), *Noise survey report*, London Borough of Camden

2 Barron M (1988) *Subjective study of British symphony concert hall* Acustica, 66, 1-14

3 Barron M (1993) *Auditorium Acoustics and Architectural Design*, E&FN Spon Publishers

4 Barron M (2009), *Then and now – how concert hall design of the 1960s and '70s compares with the present*, available at: http://opus.bath.ac.uk/

5 Beranek L (1962) *Music, acoustics and architecture*, John Wiley, New York

6 Berg J, Rumsey F *Systematic evaluation of perceived spatial quality*, AES 24th International Conference on Multichannel Audio

7 Burd Haward Architects (2006) 3-7 *Delancey street, 3-4 Delancey Passage NW1, planning report*'. London Borough of Camden

8 Cattell R B (1966) *The Meaning and Strategic Use of Factor Analysis cited in: Handbook of Multivariate Experimental Psychology*. Chicago: Rand McNally

9 Cattell R B, (1957) *Personality and Motivation Structure and Measurement*. New York: World Book Company

10 Darlington R B (2005) *Factor Analysis* accessed in: **www.psych.cornell.edu/darlington/factor. htm**

11 Dammerud and Barron M (2008) *Concert hall stage acoustics from the perspective of performers and physical reality* Proceedings of the Institute of Acoustics, 30 Pt. 3, 26-36

12 Douglas H (1971) cited in Dammerud and Barron M. 2008 ' *Concert hall stage acoustics from the perspective of performers and physical reality'* Proceedings of the Institute of Acoustics, 30, Pt. 3, 26-36

13 Hawkes R J and Douglas H (1971) *Subjective acoustic experience in concert Auditoria* Acustica, 24, 235-250

14 Kaiser H (1958) *The varimax criterion for analytical rotation in factor analysis*, Psychometrika 23

15 Kaiser H (1970) *A Second Generation Little Jiffy*, Psychometrika, 35

16 Larsen W N (2004) *Acoustics in halls for rock Music*, Joint Baltic-Nordic Acoustics Meeting 2004, 8-10 June 2004, Mariehamn

17 Marshall A H (1967) *A note on the importance of room cross-section in concert halls* Journal of Sound and Vibration, 5, 100-112

18 Max Fordham (2006) *Stage E Services Report*, London Borough of Camden

19 Noack B (2005) *Variable Acoustics Making it happen electronically*, Live Sound International

20 Rubenstein (1986) *An item-level analysis of questionnaire-type measures of intellectual curiosity*, Cornell University

21 Schroeder M R, Gottlob D, and Siebrasse K F *Comparative study of European concert halls: Correlation of subjective preference with geometric and acoustic parameters*, J.Acoust. Soc. Am. 56,

22 Stockhausen K (1958) στο *Living electronic music* Emmerson S. Ashgate Publishing Ltd 2007

23 Soulodre G A (2006) *Can Reproduced Sound be Evaluated using Measures Designed for Concert Halls?* In: 'Spatial audio and sensory Evaluation techniques, Guildford, Audio Engineering Society, UK, 2006 April 6-7

24 Spearman C (1970) *General intelligence. Objectively determined and measured*

25 Tsokas G, *personal communication Μάιος-Ιούνιος 2009*

26 Sotiropoulou A (1996) *Εμβάθυνση στο σχεδιασμό χώρων ακρόασης ομιλίας και μουσικής*, Athens: NTUA Press

27 Sotiropoulou A, Karagiannis Y, Poulakos G, Tzouvadakis Y (2007) *Subjective evaluation of the acoustics of Jazz Auditoria: Multidimensional description of evaluations* Proceedings of the Institute of Acoustics

28 Yong H K, Chun Ki S, Yong Jin J (2007) *Evaluation of stage acoustics in concert halls by investigating performers' preference* 19th International Conference on Acoustics 23-27 September 2007, Madrid

An Assessment of Cross-talk Attenuation with Natural Ventilation

Ze Nunes and Andrew Rickard.

Introduction

Cross ventilation is one of the more effective ways of naturally ventilating a building. Cross ventilation is typically in one of two forms. In one, the air passes through an openable vent in the facade of a building and then through a vent within a partition wall into an atrium or circulation space. In the other, the air is taken out of a cellular space through a ventilation stack. The main drawbacks of cross ventilation are the risk of acoustically compromising the corridor walls and the compromises caused by ventilation stacks interconnecting two or more spaces. To overcome these problems, cross-talk attenuators are used.

This article looks at the performance of the walls concerned and the information is supplemented by the results from earlier work which indicates the on-site performance of these walls. The result of this assessment is a practical specification for cross-talk attenuators considering the on-site effects of doors.

The article also proposes down a test method for measuring the effective $D_{n,v,w}$ of a ventilator or opening on site. The $D_{n,v,w}$ of the NAT vent attenuator is then discussed.

Cross ventilation

Cross ventilation is a highly effective method of ventilating a building (Figure 1). The drawback of this type of ventilation is often a reduction in floor area as a result of using chimneys (Figure 1(c)). The alternative has the potential to compromise the acoustic separation across corridor walls. A subtle but important advantage of cross ventilation is reduced building cost, which is achieved by a lower floor-to-ceiling height than is required for single-sided ventilation (Figure 1(a)). Single-sided ventilation typically requires a floor-to-ceiling height of two to two and a half times the depth of the vented space. Cross ventilation has almost no restraints on the height of the vented space.

A common simple method of achieving cross ventilation is to place a cross-talk attenuator within the corridor wall (Figure 1(b)). This wall is used because the acoustic performance of the partition has already been compromised by the presence of a door.

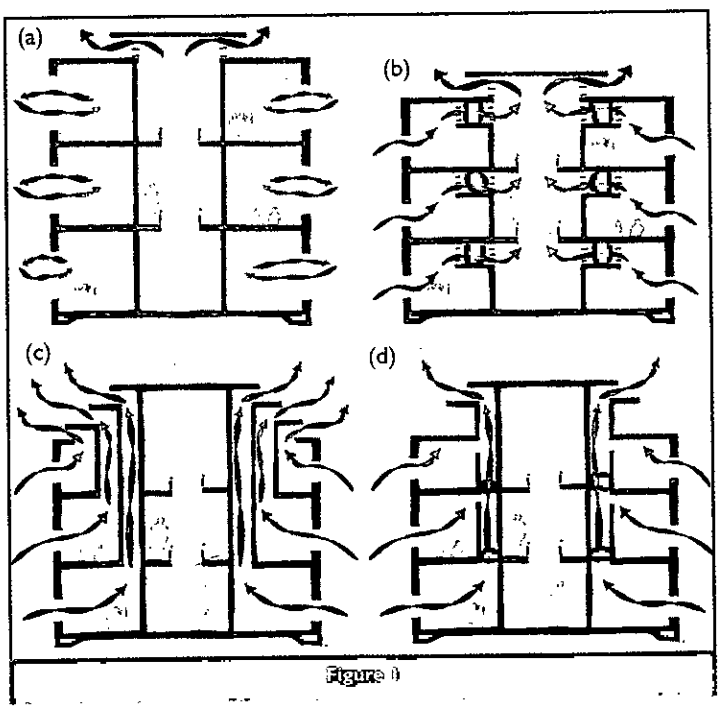


Figure 1

Illustration of natural ventilation types

Ventilation through chimneys is an alternative to venting through corridor walls. When ventilating more than one floor, independent chimneys are often used such to maintain acoustic privacy between vertically stacked spaces. On the other hand, attenuators can be placed within the chimney stack, removing the need for multiple chimneys (Figure 1(d)).

Performance standards for corridor walls

Because of the difficulties in measuring the acoustic separation across walls between cellular spaces and circulation areas, the acoustic performance ratings of these walls, doors and ventilators are almost invariably specified as laboratory tested sound insulation values. Common performance requirements are:

- Partitions including glazing 40dB R_w
- Doors 30dB R_w
- Ventilators 39dB $D_{n,e,w}$.

Using these values within a composite sound transfer calculation based on typical classroom dimensions shows that the sound insulation provided should achieve 37dB D_w, a value that can vary depending upon the size of the partition and other factors.

Acoustic rating of doors on site

MACH Acoustics [1] investigated the sound insulation across corridor walls at a number of schools. Measured data collected from these various sites showed an on-site performance of corridor walls ranging between 25 and 33 dB D_W. Table 1 provides a summary of measured levels across corridor walls.

Subjective quality	minimum	maximum	mean
Corridor to classroom	25	33	29
Classroom to corridor	26	34	31
Theoretical insulation		37	

Table 1

Comparison between on-site sound insulation levels of corridor walls and theoretical values, dB Dw

MACH Acoustics concluded that the difference between the theoretical value of 37dB D_w and the on-site levels of 25 to 33 dB was mainly because site constraints degraded the acoustic performance on site, whereas the laboratory test conditions had no such constraints.

It is generally expected that owing to flanking transmission and site constraints, a 5dB difference is seen between the laboratory-rated value for a partition and its on-site performance. A reduction of 6 to 12 dB is often assumed for a folding partition.

Doors contain moving parts and four edges, which can be difficult to seal acoustically. Doors that are often used must be light and easy to open. The variations in site installation and the fact that the slab under the door threshold of often not completely flat are factors contributing to the reduced acoustic performance of doors compared with expectations. When there are a large number of doors on site, it is perceived as too difficult and expensive to spend time ensuring that doors are fully sealed.

As a result, it is often found that the on-site performance of an acoustic door rated at 35dB R_W is typically 6 to 12 dB lower than its laboratory rating.

The effects of doors on ventilators

A 6 to 12 dB reduction in the acoustic performance of a door will compromise the overall acoustic performance of the corridor wall by approximately the same amount.

. ventilator has no moving parts and the installation of such a
:t is relatively easy, it would be expected that little or no
.on in the performance of the vent would be experienced on
-ovided that all flanking paths are dealt with. It follows that
rading the performance of the ventilator by 5dB will have little
effect on the combined sound insulation of corridor walls.
:tors in these applications can therefore be specified at a
of 34dB.

ıing and measuring $D_{n,e,w}$

is conventionally used to rate cross-talk attenuators used as
ıtors within a cross ventilation system. To determine the $D_{n,e,w}$ of
ıtilator, two reverberation chambers are required and the
ıtor must be smaller than $1m^2$ in cross-section. This section
:ses how to establish the on-site effective $D_{n,v,w}$ of the ventilator.

140-10 and $D_{n,e,w}$ applied to large cross ventilators

40-10 provides a laboratory method of measuring the airborne
l insulation under diffuse field conditions for small building
ents, in which $D_{n,e,w}$ levels are used to rate ventilators. It is
rtant to note that this standard excludes windows and doors and
: elements with an area greater than $1m^2$.

n designing and installing cross-talk attenuators, vents often run
ull length of a corridor wall and as such can be many metres long.
face area of these ventilators is often larger than $1m^2$. Despite this
ventilators used in combination with cross ventilation with areas equal to and much larger than $1m^2$, are still specified by means of a $D_{n,e,w}$ level. This is seen to be incorrect.

In practice when developing a product it is necessary to undergo a series of design changes and design iterations. ISO 140-10 [2] offers a cumbersome method of testing ventilators, since the attenuators have to be installed into a high performance wall.

In order to test ventilators and provide a more 'real-life' assessment of their performance, a site based test procedure has been developed and presented here. The method is based on testing the acoustic performance of a corridor wall including a vent, then repeating the procedure with the vent fully blocked. A substitution method is then used to provide the effective $D_{n,v,w}$ of the vent.

Effective $D_{n,v,w}$ of a vent for cross ventilation

$D_{n,e,w}$ and $D_{n,v,w}$ are defined as sound pressure level differences across the ventilator. The sound pressure level difference is normalised to $10m^2$ of acoustic absorption, the definition given in ISO 140-10. The equation for $D_{n,v}$ is:

$$D_{n,v} = L_1 - L_2 + 10\log(A_0/A),\ dB$$

Where;
A_0 is the reference absorption area (for a laboratory, $A_0 = 10m^2$)
A is the total absorption area within the receiving room on-site.

continued on page 34

An Assessment of Cross-talk Attenuation with Natural Ventilation - *continued from page 33*

The acoustic performance of the ventilator is estimated by undertaking two tests, firstly with the vent open and secondly with the vent closed.

It must be noted that the value of $D_{n,v,w}$ obtained in this way will provide a worst case result. Improvements in accuracy can be obtained by over-boarding or acoustically sealing the door by taping up all the gaps around it. The effect of this process is to provide a more accurate representation of the vent, and will provide a higher rating than if the door were not taped and/or is poorly sealed. The purpose of blocking the natural ventilation attenuator is not to ensure that there is a 10dB difference between the cross-talk and other elements, as in the case of an R'_w but rather to find the effective contribution of the sound pressure level within the receiving room, so that a substitution method can be used to calculate the acoustic performance of the vent.

Proposed on-site test method for walls between cellular spaces and a corridor or atrium

ISO 140-4 [3] does not strictly apply when testing from or to a large space such as a corridor or atrium to a cellular space such as an office or classroom. ISO 140-14 [4] attempts to overcome some of the shortfalls in ISO 140–4, by providing guidance on measurements between one or more complex spaces.

According to ISO 140-14, geometrically complicated spaces should be used as the source room, meaning that tests should be made from circulation zones to cellular spaces. This requirement was met during the test procedures described here.

When testing to ISO 140-14, a virtual room is set up against the test partition, if the source room is very large. When testing next to an atrium this is not possible, as there is insufficient floor space for the loudspeaker and measurement locations. It can also be difficult or impossible to adhere to this advice in corridors, being long narrow spaces.

The method described in Section A.4.2 in ISO 140-14 is therefore proposed. This measures doors between a corridor and a room, but the 'test area' was altered slightly to include the partition and full length of the vent. This is also appropriate when measuring corridor partitions.

Two loudspeakers where used, simultaneously playing uncorrelated noise and placed between 1 and 1.5 metres either side of the common partition, each a similar distance away from the partition. Loudspeakers were placed facing each other, so the sound field was not diffuse. If the loudspeakers were to face away from the partition, some colouration of the sound field may occur particularly at the higher frequencies. The sound power impinging on the wall would not then be equal across the spectrum and over the length of the partition. Instead, a direct field is incident on the classroom door, partition and vent and although according to the standards this is not ideal, it is thought to be a more accurate portrayal of real life scenarios, such as students walking past. Importantly, it is also a method which allows for repeatable testing across almost all cases seen on site.

Measurements in the source room were carried out using of a continuously moving microphone. The path spanned the length of the common partition at a distance of between 0.5 and 1 m. Measurements in the receiving room consisted of five fixed positions as recommended in ISO 140-4. Rating of results was performed in accordance with ISO 717-1 [5].

Attenuation of speech frequencies: the NAT vent attenuator

The overall aim of the research undertaken to date has been to develop an attenuator with exceptional acoustics and cost performance, enhancing the feasibility of natural ventilation. The result of this work is the development of a new form of attenuator known as the NAT vent attenuator. The principle of this attenuator is to maximise the acoustic performance by specifically designing it with natural ventilation in mind. An example is shown in Figure 2.

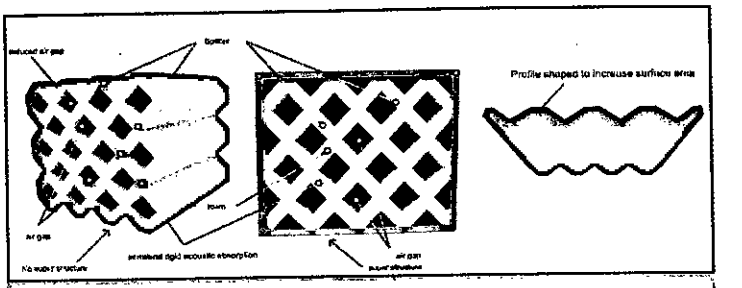


Figure 2

the NAT vent attenuator

Figure 3 shows how this attenuator is assembled.

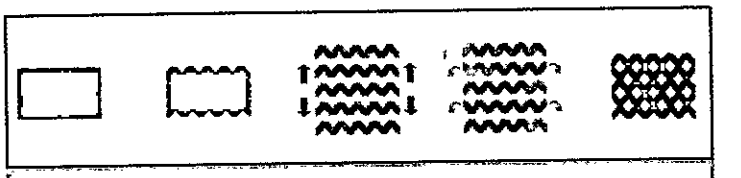


Figure 3

Construction method used to assemble cross-talk attenuator on site

Natural ventilation uses very low air speeds, meaning that the splitter size and air gaps can be considerably reduced, boosting the acoustic performance of the attenuator. Significant acoustic benefits have also resulted from the increase in the surface area of the absorber. This has been achieved through the use of a honeycomb splitter. The material used to form the NAT vent attenuator was selected to maximise the acoustic absorption and minimise the direct sound transmission through the attenuator. The graphs in Figure 4 illustrate the effects of some of the design changes implemented.

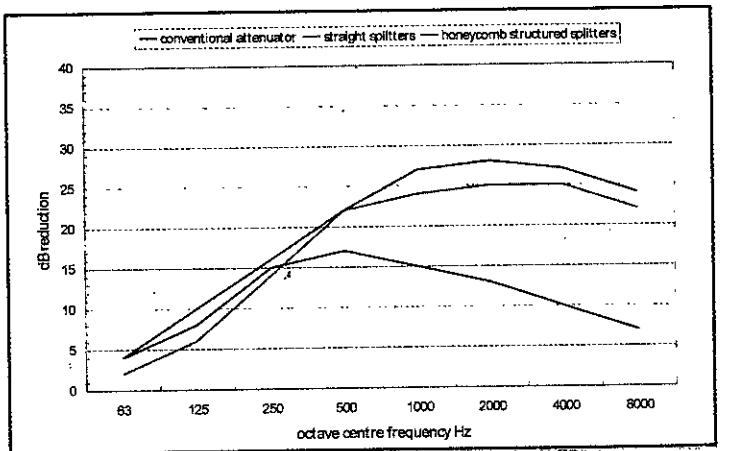


Figure 4

Comparison of NAT vent with conventional attenuators.

NAT vent installed in the facade of a building

One of the key features of the NAT vent attenuator that it can be easily tuned to provide cross-talk attenuation for cross ventilation, but it can also be incorporated into the facade of a building so as to enhance the acoustic resistance of the facade.

This area of work along with a more detailed description of the product was covered in [6].

Pressure drop though the NAT vent attenuator

The pressure drop through the ventilator is an important factor: if the pressure drop is too high, the airflow through a building will be

:ed resulting in the building (or occupants) overheating. The key egarding pressure drop across the NAT vent attenuator is the ionally low air speed. At air velocities of around 1ms-1 and the pressure drop is not linear, since momentum effects govern resistance across the unit rather than just viscous losses. In a ıtional system, viscous losses dominate and therefore pressure are conventionally found by extrapolation. Conventional ds of calculation will therefore over-predict the pressure drop at w rates usually seen in naturally ventilated buildings.

g the pressure drop is also difficult and prone to errors, again se of the very low air speeds. Pressure sensors and other nent are less accurate at these speeds so the level of confidence : results is low.

er to assess the pressure drop through the NAT vent attenuator, mputational Fluid Dynamics (CFD) method was used. This les a more accurate representation of pressure drop as well as ling results for a range of flow rates of interest (Figure 5). The s from the CFD model indicate that pressure drops are typically ıan 1 Pascal.

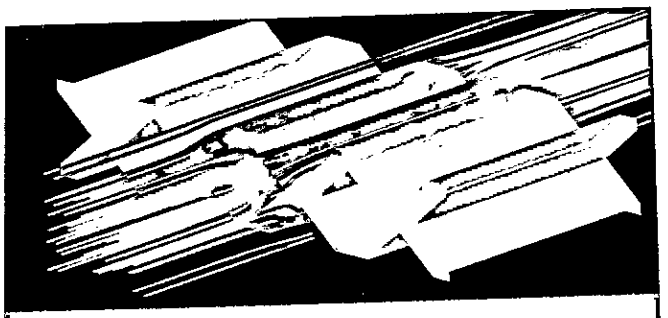


Figure 5

Image of flow tubes used in CFD pressure drop modelling

Acoustic performance

The acoustic performance of the NAT vent attenuator is dependent upon many factors. This part of the article provides typical performance examples.

Figures 6(a) and 6(b) show the results of the following tests:

Figure 6(a): NAT vent installed and open, compared with NAT vent installed and blocked with board, door not sealed

Figure 6(b): NAT vent installed and open, compared with NAT vent installed and blocked with board,

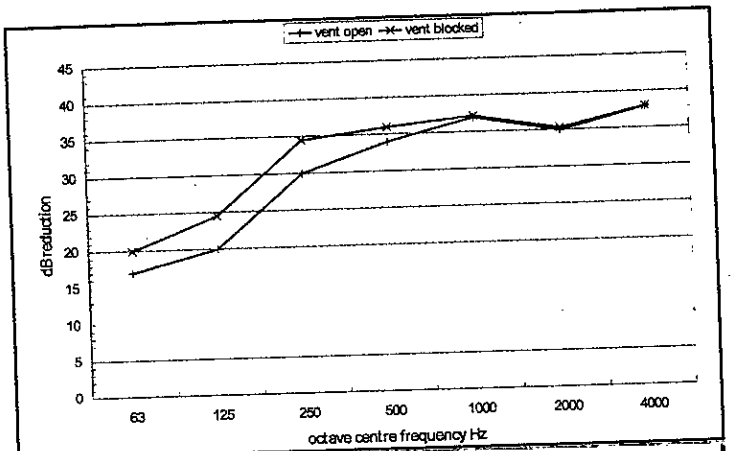


Figure 6(a)

Comparison of tests, door not sealed

continued on page 36

An Assessment of Cross-talk Attenuation in Line with Natural Ventilation - *continued from page 35*

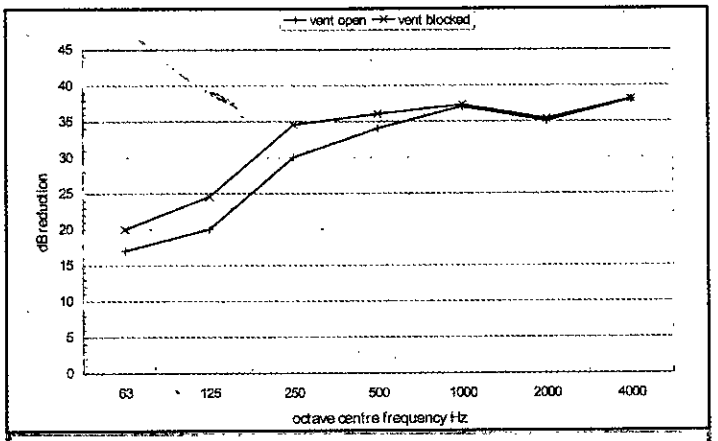


Figure 6b

Comparison of tests, door sealed

door sealed with tape

Comparison of the results for an unsealed door with a sealed door shows that the performances below 500Hz are approximately equal. Above 500Hz the performance of the unit in the sealed door starts to improve, by as much as 5dB above 2kHz. This is a very typical response of doors within the programme of schools tested. Within this test programme it was also seen that there was no significant difference above 1kHz whether the vent was blocked or unblocked.

These results indicate that the high frequency performance of the NAT vent is very good in comparison with that of the door, confirming that the door is the limiting factor for this partition at and above 1kHz.

$D_{n,v,w}$ of the NAT vent

To assess the effective on-site $D_{n,v,w}$ of the ventilator, a substitution method was used to determine the acoustic performance. This calculation is based on site test data with the vent opened and blocked off, the door remaining unsealed. The sound insulation data (rows 1 and 2 of Table 2) are presented in terms of $D_{nT(Tmf,max),w}$. The calculation to determine the $D_{n,v,w}$ is shown below.

This calculation starts with the octave band levels $D_{nT(Tmf,max)}$ for an open and closed vent. From here, the nominal receiver room (L2) level is determined by subtracting the measured levels from a nominal 100dB source level across the spectrum (rows 3 and 4). The calculated contribution from the open vent is then determined as shown in row 5. This is then used to determine the effective sound insulation of the open vent by subtraction from the nominal 100dB source. The resultant values are given in row 9.

To show that the calculated normalised contributions for the vent are correct, the dB sum of this figure is been added to the $D_{nT(Tmf,max)}$ for the blocked vent, row 8. This figure equals the measured nominal receiver room level for the open vent. It can therefore be seen that the calculated vent contribution is correct.

The calculated sound insulation for the vent was based on a $D_{nT(Tmf,max)}$ for a primary school (Tmf 0.6 seconds). To obtain the effective $D_{ne,w}$ the absorption is corrected from the receiver room absorption to 10m² sabines. Rows 10 and 11 apply this correction to obtain row 12.

The results of the above calculations show that the 1000mm long NAT vent attenuator used in combination with cross ventilation achieves 42dB $D_{n,v,w}$.

Scaling the NAT vent attenuator for different sizes

It is conventional to scale the acoustic performance of a ventilator by the two equations given below. Equation [1] is more conventionally used when multiple vents are being installed into a partition, but where information is lacking, equation [2] is used.

$$D_{n,v,w} = D_{n,v,w} - 10\log(N) \quad [1]$$

$$D_{n,v,w} = D_{n,v,w} - 10\log(A1/A2) \quad [2]$$

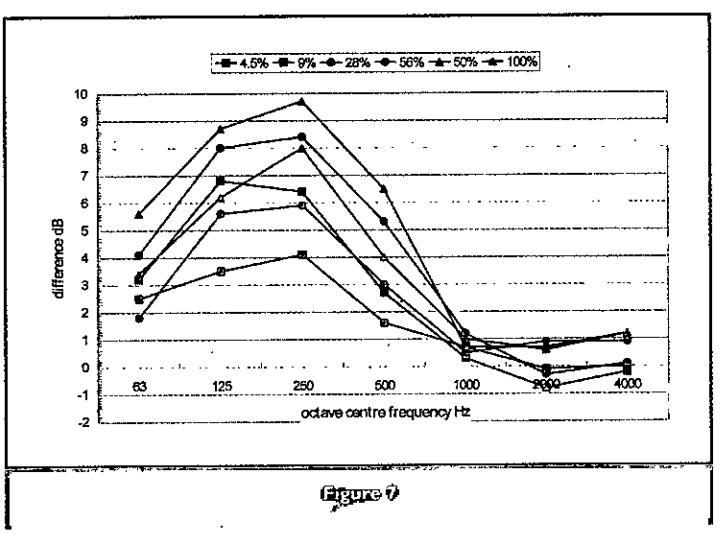


Figure 7

Difference in D_w for different openings

		125	250	500	1k	2k	4k
1	$D_{nT(Tmf,max)}$ vent blocked 42dB D_w	34	39	40	42	42	45
2	$D_{nT(Tmf,max)}$ vent open 41dB D_w	28	35	39	42	42	45
3	vent blocked: nominal L_2 100dB minus row 1	66	61	60	58	58	55
4	vent open: nominal L_2 100dB minus row 2	72	65	61	58	58	55
5	L_2 vent only (calculated)	71	62	52	45	45	45
6	antilog row 3: vent blocked nomimal L_2	3.7E+06	1.3E+06	9.8E+05	6.2E+05	5.9E+05	3.5E+05
7	antilog row 5: L_2 vent only (calculated)	1.3E+07	1.6E+06	1.6E+05	3.2E+04	3.2E+04	3.2E+04
8	combined: vent blocked nominal L_2 and L_2 vent only (calculated)	72	65	61	58	58	55
9	contribution from vent 49dB D_w	29	38	48	55	55	55
10	absorption within classroom (0.161*8*7.5*2.9/0.6)	47	47	47	47	47	47
11	A_0/A where A_0 is 10m2	-7	-7	-7	-7	-7	-7
12	$D_{n,e,w}$ of vent 4m by 0.2m	22	31	41	48	48	48

Table 2

Substitution calculation for $D_{n,v}$

Where N is the number of units, A1 is the face area of a ventilator with a given $D_{n,e}$ and A2 is the face area of a second ventilator of equivalent type and length.

Through site testing it has been found that equation [2] tends to overestimate the change in acoustic performance of the NAT vent attenuator.

NAT vent attenuator opened by different amounts

The results presented here show the differences in DW when the volume control damper (VCD) on a large 4m^2 face area attenuator is adjusted. Owing to the size of the attenuator, two VCDs were used to control the NAT vent attenuator: the VCDs could be independently operated. The graph in Figure 7 shows the level differences at each open position. The blue lines indicate tests made with one vent open, and the red lines indicate that both vents were open, doubling the open area.

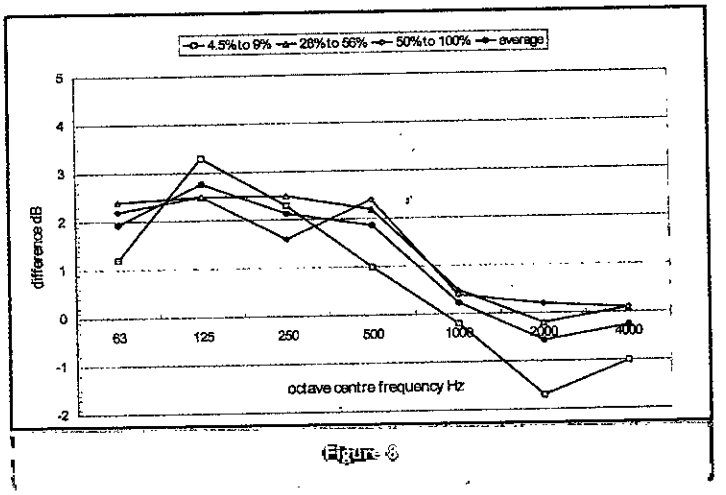


Figure 8

Average change in Dn,v for doubling of face area for the NAT vent attenuator

The results in the region of 1kHz and above are similar (±1dB) and do not show a variation with opening vent size. This shows there is little difference between the open vent and a closed vent at these frequencies. The NAT vent attenuator thus has a good high frequency performance, as found before.

There is a peak in the low-frequency to mid-frequency range, showing that the majority of sound transmitted through the vent is unsurprisingly in this frequency region. The face area of the vent has the greatest influence.

At 63Hz, all results indicate a low performance but they also begin to converge. This may suggest that other elements have more effect on the sound separation across corridor walls than the VCD.

The graph in Figure 8 shows the measured differences between NAT vent attenuators with a doubling of area. The average differences are shown by the red line. The average level difference between 63Hz and 500Hz is in the order of 2 to 3 dB per doubling of frequency. Above 500Hz the level differences change only marginally.

This shows that for a doubling or halving of the face area the change in performance of the attenuator is only 1dB $D_{n,v,w}$. The following scaling factor can therefore be used:

$$D_{n,v,w} = D_{n,v,w} - 3.33\log(A1/A2) \qquad [3]$$

Where A1 is the face area of a tested NAT vent attenuator with a given $D_{n,e}$ and A2 is the face area of a second attenuator.

Note that equation [3] is based upon the performance of the NAT Vent Attenuator and therefore cannot be transferred to other ventilators.

Ze Nunes MEng MIOA and Andrew Rickard MEng AMIOA are with MACH Acoustics

e-mail: ze@machacoustics.com; andrew@machacoustics.com

continued on page 38

An Assessment of Cross-talk Attenuation with Natural Ventilation - *continued from page 37*

References

[1] Nunes Z An overview of on-site test results of classroom corridor walls, including the effects of doors, glazing and ventilators post-BB93, Proceedings of IOA, 2008.

[2] BS EN 20140-10:1991 Acoustics - Measurement of sound insulation in buildings and of building elements - Part 10: Laboratory measurement of airborne sound insulation of small building elements.

[3] BS EN ISO 140-4:1998 Acoustics - Measurement of sound insulation in buildings and of building elements – Part 4: Field measurements of airborne sound insulation between rooms.

[4] BS EN ISO 140-14:2004 Acoustics - Measurement of sound insulation in buildings and of building elements – Part 14: Guidelines for special situations in the field.

[5] BS EN ISO 717-1:1997 Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation.

[6] Nunes Z Acoustic attenuators designed specifically for natural ventilation, controlling noise break in as well as cross-talk across partitions, InterNoise 2010.

A Ceiling Case Study, Inspired by an Historical Scale Model

B F G Katz, O Delaroziere and P Luizard.

A scale model of a portion of the Abbaye de St-Germain-des-Pres, conserved in the Musée des arts et metiers in Paris, exhibits a somewhat unique ceiling design, with exposed beams forming a type of spider web pattern. This design allows for a large flat span to be constructed using only small length beams. Historical and acoustical research efforts were launched in parallel to investigate this interesting structure. Did it exist, or was the 1:25 model, constructed in 1884, an architectural and structural study exercise? The room has been reputed by some to be the location of the 1792 Revolutionary Tribunal in Paris. The form visually resembles a Fresnel lens. Could this design have an acoustic function? This study presents measurements performed in the historical scale model as well as numerical simulations based on the model's geometry. Results show a consistent trend with the ceiling acting as a focusing element. Various historical elements are also presented, collected from various sources from more than a century ago. Parallels of the architectural concept are also drawn with other historical designs, as well as a modern architectural design study.

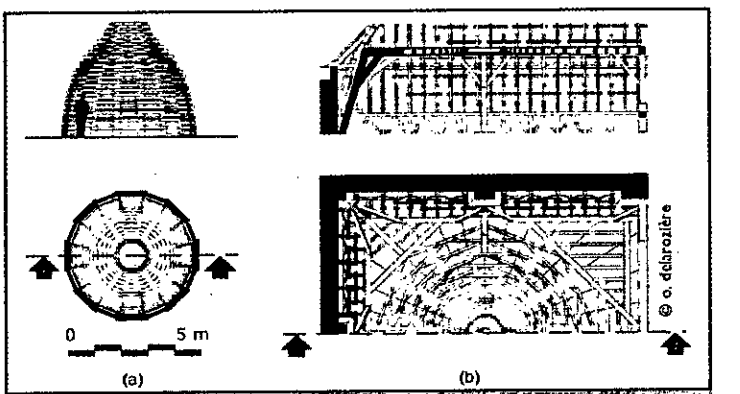


Figure 1

Section and reflected plan of (a) Woodstacker stacked lamella timber cupola, Champ-au-Beau, France, 2010, and (b) the roof frame of St-Germain-des-Prés, Musée des arts et métiers inv 10979

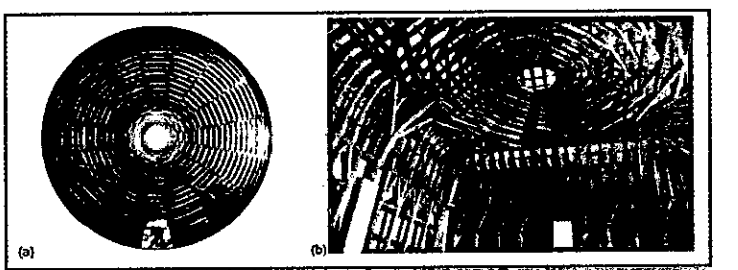


Figure 2

Interior photograph of (a) Woodstacker stacked lamella timber cupola and (b) 1:25 scale model of the roof frame of St-Germain-des-Prés. Dimensions 640 × 800 × 840 mm

CREATION AND HERITAGE

This study is part of a more general project concerning the understanding of the acoustics within a very special type of structure, which is at the core of the architectural and artistic project called 'Woodstacker'[1], launched in 2004. This new building system, based on stacked laminated timber structures, showcases contradictory acoustics phenomena in lamella ceilings. In the early 1930s lamellar timber structure like those of F Zollinger were used for public rooms (churches, exhibition halls, sport halls, etc) because of their good acoustic properties[2] combined with their flexibility. Zollinger developed a system called Zollbau which was widely used in Europe and America for arched roofs. The visible wooden lamellas of the structure were supposed to diffuse sound and reduce reverberation time (see [2], p63). In the Woodstacker system, the special geometrical pattern of the lamellas seems to focus the sound more. The result is a passive amplification at particular positions within the structure. This phenomenon, which can offer interesting perspectives in some cases like small auditoriums or home studios[3], needs to be better understood and managed for future uses. The architectonical type of structure under study is a solution to a geometrical problem of how to cover a large area by stacking small pieces of wood without the use of glue or nails. The result is a bottle shape three-dimensional rose window figure (see Figures 1(a) and 2(a)). In search of the origins of that building system, it was found in French carpentry treaties that the construction principle was intended to be used for polygonal ceilings since the 18th Century. As far as we were able to ascertain, no examples of such a construction remain. The recent discovery of a lamellar polygonal ceiling model of this type (Figure 1(b), Figure 2(b) and Figure 7(b)) in the collections of the Musée des arts et métiers, Paris, offered an opportunity to study this acoustic phenomenon and with it a novel approach in the use of historical models for retro-engineering the past in order to inform the future. This modest study is intended to be the starting point of a work aiming to link art, science and heritage.

HISTORICAL INVESTIGATIONS

A 19th Century model

The model at the centre of this study entered the collection of the Musée des arts et metiers in 1884. It was considered to be a reduced scale model of a roof frame à la Philibert de l'Orme. In reality the model consists of a combination of two different frames. One is a round arched roof frame à petit bois, a lamellar timber framing system

developed by the French architect Philibert de l'Orme (c1514-1570), first published in 1567[4]; the second is the polygonal ceiling under study.

These two structures form the extrados and intrados of a very particular cupola. Prior to this study, very little was known about this object, with the museum exhibit label stating simply:

> *«Charpente de l'abbaye de Saint-Germain-des-pres, XVI9 siècle. Modèle realisè au 1/25 realisé par B Minard, 1884. Inv 10979».*

Was it an unbuilt architectural project? A master construction carpenter's work of art? The model of an historical building?

In a letter found in the museum archives, Beloni Minard (1830-?), the carpenter and author of the model, explains that this work, shown at the French Central Union of the Decorative Arts in Paris in 1884 was a model of a building which belonged to the Abbey of Saint-Germain-des-Pres which was destroyed to make way for the Boulevard Saint-Germain in 1875[5]. The date and location appeared to be correct as the final phase for the opening of the Boulevard Saint-Germain in Paris was decided in 1874 by the post-Hausmanian administration. Fortunately, the destruction works were followed up by Theodore Vacquer (1824-1899), inspector of the Service historique de la ville de Paris, and a report of the Société de l'histoire de Paris et de l'Ile-de-France, dated 14 December 1874[6] confirmed the existence and location of this impressive building as well as providing the reference of a journal article which included images of this construction.

A French revolutionary tribunal room?

This article entitled «Le tribunal de l'abbaye»[7] (literally the Abbey's tribunal) in Le Monde Illustre, written by Auguste Lepage (1835-1908) is richly illustrated with three art prints which represent, in a very realistic manner, the roof frame and the 'so called room where should have been held the revolutionary tribunal', Figure 3(a). This title made reference to the bloody events of September 1792 where a thousand supposed counterrevolutionary people (priests, aristocrats etc), confined in the military prison of the Abbey close to this room, were quickly judged and executed by the French «regime de la Terreur».

Unfortunately, this designation of 'tribunal' was unfounded because, as Theodore Vacquer mentioned in December 1894, the building probably did not exist at the time[6]. It is still unclear what this spectacular room 13 metres square with a ceiling height of 10 metres was used for, but the testimony of the very special sensation this place gave to its visitors leaves us wondering what the acoustic ambiance inside could have been like.

> *To this room vested to meditation and prayer are linked bloody memories. It is there that was sitting the famous court presided over by the usher Maillard, during the September 1792 massacres [...]. Massive pillars supported a roof frame, which was a wonderful construction. This frame, rounded in a dome shape was made from Spanish chestnut, no nails were used and the thousand pieces that composed it were only fixed up by pegs [...]. This wonderful frame [...] is going to be dismembered and transformed into firewood. Should we not have transported it to one of the buildings constructed by the State or the City and avoid the destruction of a truly remarkable work?'*

No one took up the challenge to conserve this framework. It was destroyed in 1875 and it was not until 1884 and the eighth exhibition of the French Central Union of the Decorative Arts that it was reborn in the form of a reduced scale model, under the signature of Beloni Minard. This model was presented at the exhibition along with plans which were also fortunately conserved in the Musée des arts et metiers.

ACOUSTICAL STUDIES

A series of acoustical studies was performed on the framework in question. These studies were performed in several stages of increasing complexity: 2D simplified ray tracing, 3D particle tracing, 3D

continued on page 40

A Ceiling Case Study - *continued from page 39*

numerical room acoustic simulation, as well as measurements in the actual scale model.

Digital models

Without the high accuracy of Minard's work it would have been impossible to rebuild this room digitally. In a way, Minard's work functions as a facsimile of architecture[11] and the computer model is a final attempt to rehabilitate this building. A rendering of the complete numerical model is presented in Figure 3(b). Simplified surface models were done for acoustical simulation purposes. In the early phases of the study, the true height of the ceiling had yet to be determined, so the ceiling height was adjusted to conform to that of the scale model in all numerical simulations. Discovery and inspection of the drawings and actual model shows that the cross-section size of the framework elements is 7 × 7 mm at the centre, increasing to 13 × 13 mm at the edge (see Figure 1(b)). This equates to 17.5 cm to 32.5 cm at full scale, or one wavelength at 1960 to 1086 Hz respectively.

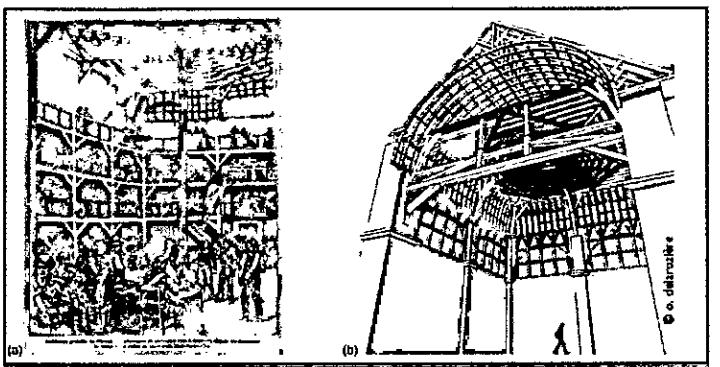


Figure 3

(a) Legend translates as 'Likely restitution of the revolutionary court in September 1792 at the Abbey', reproduced from Lepage [7] p384. (b) Numerical model based on plan and scale model from Beloni Minard. Highlighted elements indicate those used in the acoustical model study

2D simplified ray tracing

From the computer architectural reconstruction, a section was cut through the axis of the structure, as shown in Figure 1(b), and the beam elements were identified. The simplified section of the model was then used in a simplified geometrical ray tracing algorithm (2Draytrace, developed in the MatLab environment) to examine the effects of the presence of the exposed ceiling frame. The ceiling height was adjusted to conform to that of the scale model. Results of this simulation, shown in Figure 4, indicate a focusing effect of the ceiling beams for a central source position. Additional examples showed similar results for eccentric source locations, with the return paths following the source position.

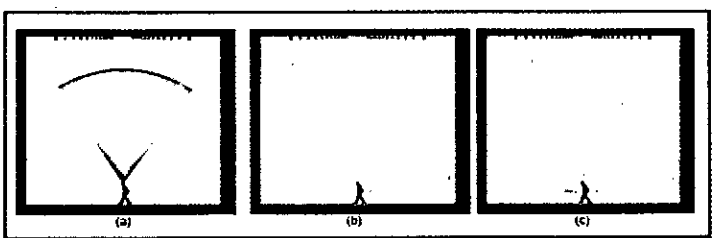


Figure 4

Simplified 2D ray tracing visualisation showing (a) incident ray paths, and reflected ray paths for (b) flat ceiling and (c) the exposed ceiling beams

3D ray tracing

Inspired by these initial results, a similar study was performed using a 3D ray tracing visualisation approach. The 3D geometrical model was analysed with CATT-Acoustic using the time trace option. All surfaces other than the ceiling under study were considered to be perfectly absorbing. The results, as shown in Figure 5, are similar to those found in the 2D study, with a focusing return effect very evident to the source position.

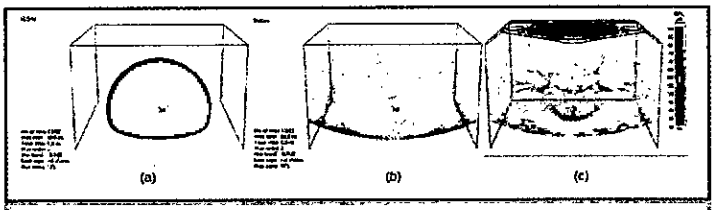


Figure 5

Time tract 3D ray trace visualisation (99822 rays, 0.5s time step) at time step (a) 16ms, and 55ms for (b) flat ceiling and (c) exposed ceiling beams

3D room acoustics analysis

Encouraged by the results of the simplified analysis visualisation methods, the model was then used for a full impulse response analysis using the same acoustic conditions so that only the ceiling was considered as contributing acoustically. Owing to the overall absorptive nature of the model, essentially a suspended ceiling in a free-field, the majority of room acoustical parameters are not pertinent and are difficult to interpret. However, as inspection of Figure 5 indicated, at the time of arrival of the reflected energy from the exposed ceiling frame on the order of over 50ms, the clarity parameter seems a viable choice for examination. The parameter C50 is a ratio of the early energy (up to 50ms) to the late reverberant energy (from 50ms onwards), used to evaluate the clarity of speech[8]. The results of this comparison are shown in Figure 6. While the absolute C50 values are not really relevant, because the rest of the architecture is absent from the simulation, the differences between the two ceiling models are clear. The arrival of the focussed ceiling reflections from the exposed beams, with significant energy, is sufficient greatly to affect speech clarity in the space.

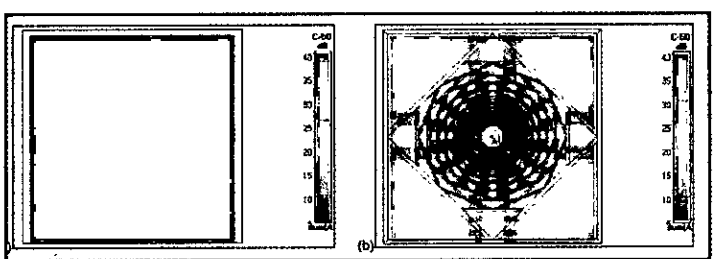


Figure 6

Numerical prediction of C50 (A-weighted sum), 1000000 rays (adapt), 1000ms, for (a) flat ceiling condition and (b) exposed ceiling beams

Additional studies of this nature with the inclusion of the other acoustical surfaces in the room would be beneficial in understanding the perceived acoustics of the space. At present, the function, outfitting and occupation of the room is still under study and it would therefore be premature to make any additional suppositions about the room's architectural acoustic design.

It is finally noted that the authors understand that this type of investigation, examining the acoustic effects of small surface in a non-diffuse sound field, is not what the chosen software was intended to be used for, and that this study is using the tool in a very extreme case. Nonetheless, the different numerical studies seem to offer results that are not counter-intuitive.

Physical model

In an effort to examine further the acoustical impact of the ceiling structure, and in order to avoid the potential effects of numerical simulation approximations in this extreme case study, it was decided to

continued on page 42

AUTOMOTIVE ENGINEERING OPPORTUNITIES WITH BENTLEY MOTORS IN CREWE, CHESHIRE

Fircroft represent Bentley in the recruitment of roles in

- CHASSIS AND POWERTRAIN
- WHOLE VEHICLE
- ELECTRICAL
- STYLING

CURRENT VACANCIES

We are currently recruiting for a variety of roles including NVH, Acoustic and Powertrain Engineers and Alias Digital Modellers.

ABOUT BENTLEY

Bentley are the definitive British luxury car company, dedicated to creating and crafting the world's most desirable high performance cars.

ABOUT FIRCROFT

Fircroft is one of the leading technical recruitment agencies in the UK.

With turnover of over £400 million we were the highest ranking technical recruitment agency in the Sunday Times Top Track 250 in 2010.

STEVEN LOWTHER
Recruitment Manager Automotive Clients, Fircroft
Thomson House, Birchwood Park,
Risley, Warrington, Cheshire, WA3 6GA
For information email bentley@fircroft.com, call + 44 1925 255 470 or
visit **www.fircroft.com/bentley**

FIRCROFT

A Ceiling Case Study - *continued from page 40*

attempt to make acoustical measurements in the actual physical scale model. The use of scale models for acoustical research has been a common practice in acoustics for many years[9,10]. The results can be interpreted in parallel to those from the numerical simulations.

The scale model under study is only a portion of the actual building, arranged so that the different frame constructions can be inspected. Two of the four walls are absent. In addition, the ceiling material which would be above the exposed framework was not obvious. Finally, as was determined at the end of the study, after examining all the archives the scale model construction represents only the upper portion of the building, and the actual floor level would have been lower.

In order to conform to the numerical studies, and to focus attention solely on the acoustical effect of the ceiling frame, all non-ceiling surfaces were acoustically treated. Each wall was covered with acoustic foam, including the two open side walls. The floor was covered with an absorbing blanket. A clear plastic panel was installed above the framework to provide a closed ceiling. A cardboard panel was fitted to the underside of the framework to represent the flat ceiling comparison condition.

Impulse response measurements were obtained along the centreline of the ceiling, with the source placed at the centre of the framework structure, as was the case in the numerical studies. The source was a 10mm diameter dome tweeter (excluding the surround) directed towards the ceiling, and power amplifier (Samson Servo 120a). Four microphones (DPA 4060) were used with a multi-channel audio interface (RME Fireface 800) at a sample rate of 192kHz. While this equipment is not usually considered standard measurement grade, the different elements had previously been found to have significant performance above audible frequencies and outperformed more traditional measurement configurations in terms of signal-to-noise ratio. A signal-to-noise ratio of 60dB was easily attainable in this measurement set-up. In addition, this study concentrated on frequencies pertinent relative to the beam size. In the model, the beam depth is comparable with one wavelength at 25kHz, or 1kHz at full scale.

The four microphones were spaced at 10mm intervals on a single movable support. The microphone array was positioned using a graduated guide to ensure the correct spacing throughout the measurement, starting at a distance of 40mm from the source axis (see Figure 7). A total of 24 microphone measurement positions were used, spanning the half-width of the model. Converting to full scale dimensions, this equates to positions from 1 metre to almost 7 metres from the source. Impulse response measurements were made using in-house all-scale measurement software (IRA, developed in the MatLab environment). Measurements were made using the exponential sweep-sine excitation method.

In order to isolate the acoustical effect of the ceiling from other elements of the model, the impulse responses (IR) were windowed after correction for air absorption as a function of temperature and relative humidity was applied. For each IR, the direct sound

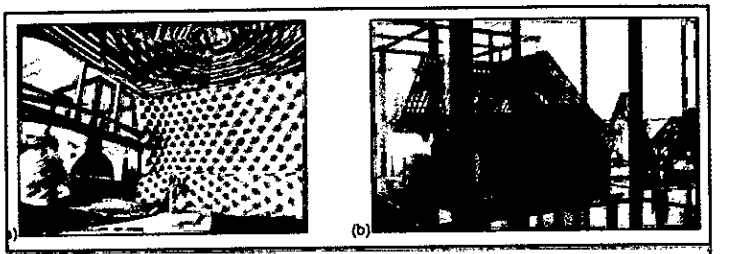


Figure 7

(a) View of interior of scale model, microphone array and source being prepared for acoustical measurements showing the installation of added acoustic damping materials. (b) View of the exterior of the same model.

arrival time t_0 was detected using a relative threshold of -3dB (threshold level relative to the maximum IR). Inspection of the measurement series resulted in the observation that no reflections arrived within the first 0.9ms. The longest possible reflection path from the source to the ceiling and the further microphone was measured and was equivalent to 3.2ms, resulting in a windowing of the responses from (t_0 + 0.9ms) to (t_0 + 3.2ms). Windowed responses were then filtered in third-octave bands. Results for frequency bands 800 to 1600 Hz are shown in Figure 8 for the flat ceiling and exposed framework conditions, with levels normalised to the nearest flat ceiling condition position. A fifth-order polynomial fit is shown for both conditions, as well as a linear fit for the flat ceiling condition. The results for the flat ceiling condition are close to linear. It is noted that this analysis examines only the energy of the ceiling reflection component and not the direct component. The direct distance to the source is thus not the propagation distance of the reflections and a $1/r^2$ behaviour would not be expected from these values. It is clearly evident that there is reinforcement close to the source in the exposed framework condition, with the strongest effect in the 1kHz band. The focusing effect drops off rapidly, with adjacent sound pressure levels exhibiting lower sound pressure levels when compared with the flat ceiling condition. This seems reasonable, as the total energy must be conserved, and the focused energy must come from somewhere. Finally, at the border

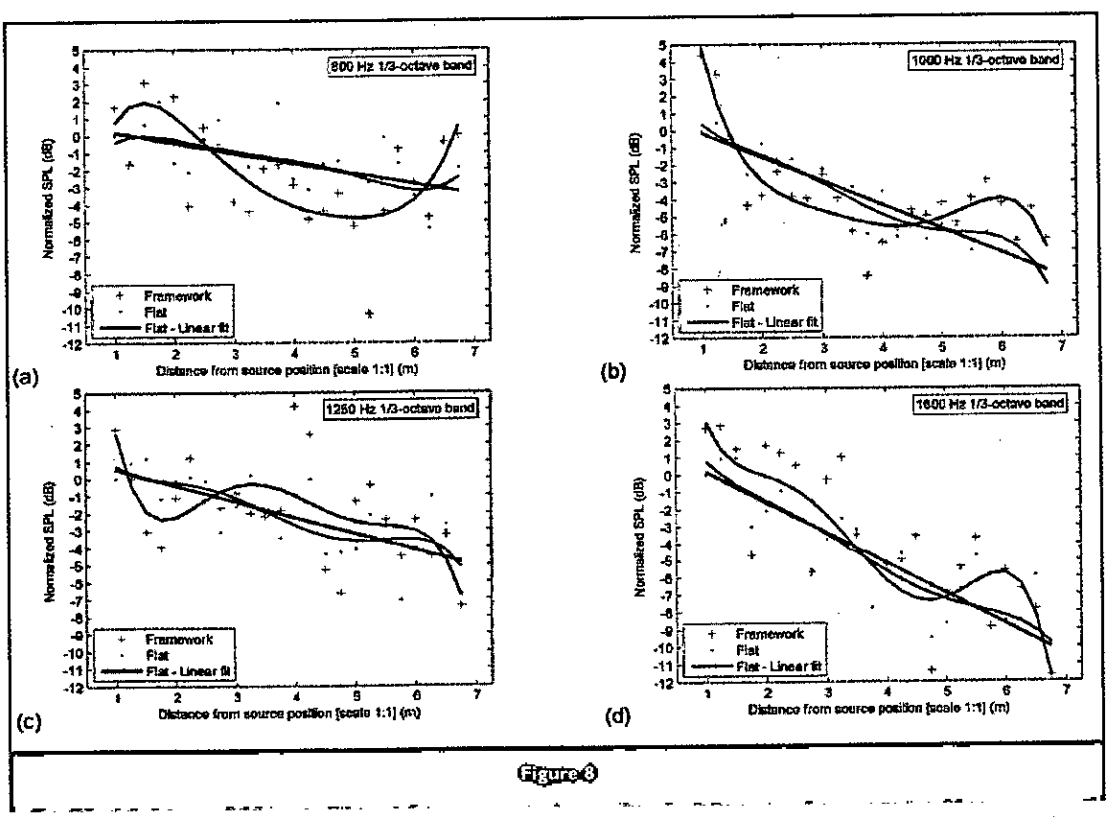


Figure 8

Measured normalised sound pressure levels in third-octave bands for exposed framework ceiling beams and flat ceiling conditions. Fifth-order polynomial fits are shown for both, as well as a linear fit for the flat ceiling. Data scaled to scale 1:1 values.

positions located near the wall, an increase in sound pressure level is observed for both conditions relative to the linear fit model of the flat condition. These end effect results, and the measurement variability, may be due to edge effects near the added wall absorption, the ineffectiveness of the absorption used, the fact that some transverse structural elements were left exposed (see Figure 7(a)), effects due to other ceiling elements not included in the numerical model (see Figure 3(b)), or the source and microphones being less than ideally omnidirectional at 25kHz.

CONCLUSION

Through the use of numerical modelling and measurements, this study attempted to bring new life both to the model and the history of the building it represents. Focusing on the acoustical aspects of the somewhat unique architecture, both numerical models and the actual 19th Century model were studied using modern methods, revealing prominent focusing effects for frequencies whose wavelengths are comparable with the various beam cross-sections.

The authors hope that this virtual restoration of a 'living' carpentry masterpiece of a 19th Century museum will contribute to finding new means to conceive future works, such as new lamella structures like Woodstacker. The authors hope that they have participated, in some way, to the dream of the carpenter Beloni Minard, and other contemporary people, to restore this building of an architect still to be determined. This study is dedicated to these artists.

B F G Katz and P Luizard are with LIMSI-CNRS, Orsay, France

O Delaroziere is Architect and Curator at the Musée des arts et métiers, Paris, France

This article is closely based on a presentation given at Auditorium Acoustics, Dublin, in May 2011.

REFERENCES

1. O Delaroziere, 'Woodstacker', *Architectures autrement: habiter le monde*. 46-51. Brussels, Archives d'Architecture Moderne (2005)
2. Marchand, *'Charpentes en lamelles', Architecture d'aujourd'hui*, 11, 63. Paris (1938)
3. I de Maison Rouge, 'Olivier Delaroziere + Woodstacker' *Archistorm: Architecture et musique*. 22, 52-53. Paris (2006)
4. P de *l'Orme, Nouvelles inventions pour bien bastir et à petits fraiz*. (1567).
5. B Minard, *'Note a l'attention d'un juré d'exposition', Musée des arts et métiers, dossier d'oeuvre inv. 10979*. (c1890).
6. *Société de l'histoire de Paris et de l'Ile-de-France, 'Séance du conseil d'administration tenue aux archives nationales le 14 décembre 1875', Bulletin de la société de l'histoire de Paris et de l'Ile-de-France*, 165. Paris (1875)
7. A Lepage, *'Le tribunal de l'abbaye'. Le Monde Illustré, 19e année*, 974, 373-376 (1875)
8. ISO Standard 3382-1:2009. *Acoustics — Measurement of room acoustic parameters – Part 1: Performance spaces.* International Standards Organisation (2009)
9. M Barron, *'Auditorium acoustic modelling now'*, Applied Acoustics, 16, 279-290 (1983)
10. M Barron, *'21 years of acoustic scale model testing'*, Proc Institute of Acoustics, 16(3), 67-80 (1997)
11. O Delaroziere, *'Camera Tectonica: hypotheses pour un facsimile d'architecture', in Utopia instrumentalis: facsimilés au musée, Les cahiers du musée de la musique, Musée de la musique, Cité de la musique* (in preparation) (2011)

Industry update

Broadband absorbers at Gayton Swimming Pool

Remedial acoustic treatments are not always easy. Structural considerations, aesthetic requirements, and the conditions of use of the building can make the task of finding a solution almost impossible. This was the challenge in a brand new swimming facility, Gayton swimming pool, in Littleover near Derby.

Based on the success of similar treatments in other pool halls (such as the Gugl in Linz) the acoustic design consultants for the scheme, Atkins Global, recommended a solution using the versatile Broadband Body Absorbers (otherwise known as 'the cubes') from ANS (Anti-noise Systems), part of Recticel.

With an existing reverberation time of over three seconds it was calculated that the desired condition could be achieved with just over 30 of the 400mm cubes. The cubes are manufactured from lightweight acoustic foam inserted into a specially manufactured fire-resistant cover and offer excellent acoustic absorption properties with a load of less than 0.7kg each.

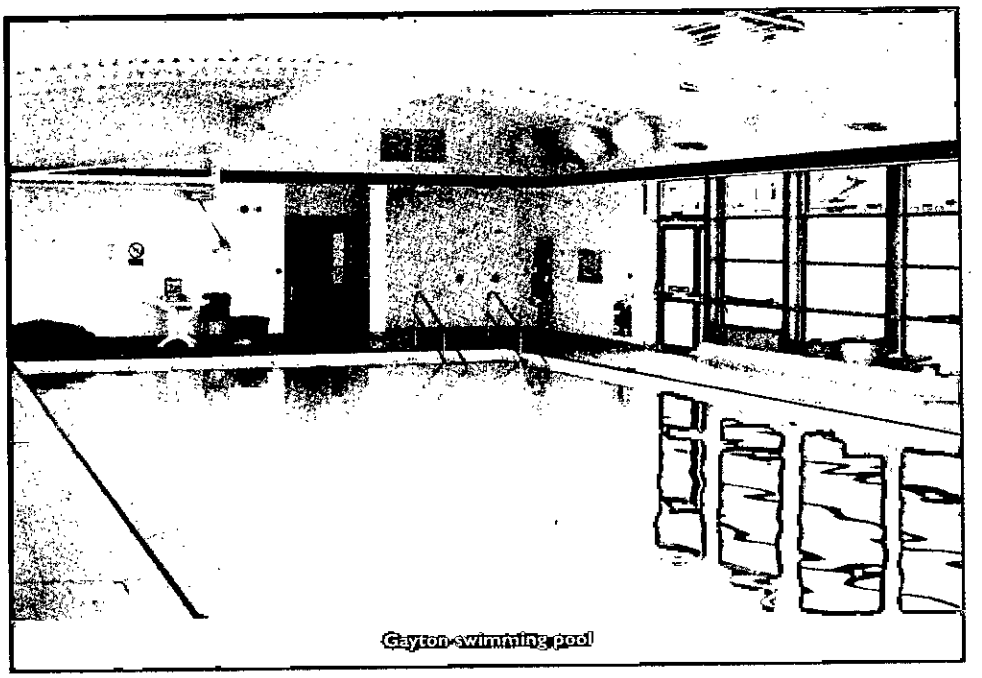
Every absorber comes with adjacent loops already attached for easy fixing with hooks or lines, and the absorbers are available in a range of bright colours to suit most applications. The fabric covers can also be removed from the cubes and washed: washing does not affect the acoustical or fire-retardant properties. The cubes proved to be easy to install, taking just a few hours to position them all in the building.

Project manager for A and S, Andy Sulin, commented that the installation was quick and easy, and the white colour selected complemented the ceiling space.

Recticel is a manufacturer and supplier of technical foams to a wide range of industries. The Recticel Group is one of the world's largest manufacturers and converters of polyurethane foam supplying the sports, acoustic, industrial, retail automotive and filtration markets. The company has established itself as an innovative market leader with a heavy focus on research and development with IDC (€10m International Development Centre). It works in partnership with customers to develop new products for specific market areas, whilst also satisfying customers' needs through a diverse range of existing products.

A and S Enterprises is a family-owned construction and building services company based near Burton upon Trent. Gayton swimming pool is part of a development completed by Derby City Council and is operated on behalf of the council by Gayton Pool Ltd, a subsidiary of the Lonsdale Swimming & Sports Trust, a registered charity. Gayton pool is operated with trained lifeguards certificated to National Pool Lifeguard Qualification standards by the Royal Life Saving Society.

For further information contact Chas Edgington at Recticel on **01536 402345** or **email edgington.chas@recticel.com**

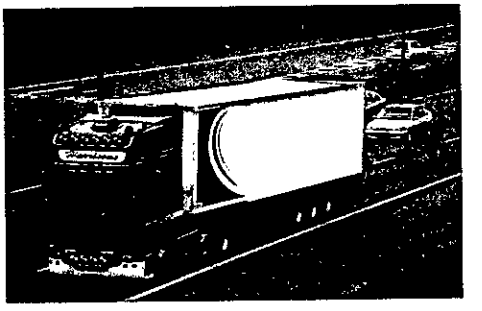


Gayton swimming pool

Government backed trials show quiet night-time deliveries work

The realisation of the environmental, economic and road safety benefits of delivering goods out-of-hours has taken a significant step forward with the results of the Quiet Delivery Demonstration Scheme (QDDS) trials, announced at the Chartered Institute of Environmental Health in London during a conference attended by Transport Minister Mike Penning.

Developed by the Freight Transport Association (FTA), the Noise Abatement Society (NAS) and the Department for Transport, and managed by Transport and Travel Research (TTR), the QDDS saw six trials take place at retail outlets across England in 2010. Stores in Dorset, West Sussex, Staffordshire, Walsall, London and Berkshire looked to illustrate the potential benefits from curfew relaxations for quiet deliveries, while still protecting local residents' sleep.



Background to curfew relaxation for quiet deliveries

HGV movements in urban areas are often constrained during night-time and/or weekend periods by local regulations put in place to avoid noise impacts. Restrictions are imposed by local authorities to protect residents from noise and other nuisance during the late evening and early morning.

However, they have the effect of increasing the number of deliveries that have to be scheduled during peak traffic conditions, thereby increasing traffic congestion and carbon emissions, and reducing air quality in the areas concerned. The restrictions also increase the road safety risks for vulnerable groups such as schoolchildren and cyclists by concentrating freight traffic into the hours when such users are competing for road space.

Delivery restrictions can also create particular difficulties for retailers who need early morning deliveries, for example to ensure that fresh produce is available on the shelves in time for store opening hours. If such night-time or out-of-hours delivery restrictions could be relaxed or removed where appropriate, there are significant potential benefits for society, primarily from reduced congestion. To realise these benefits, retailers need to work in close co-operation with local authorities to agree the conditions under which the authorities would be prepared to relax or remove delivery restrictions.

Local authorities would need to ensure no adverse noise impacts prior to relaxing or changing regulations, to establish a clear trigger for the reversal of any relaxation, and to provide for independent verification that the agreed conditions were being respected.

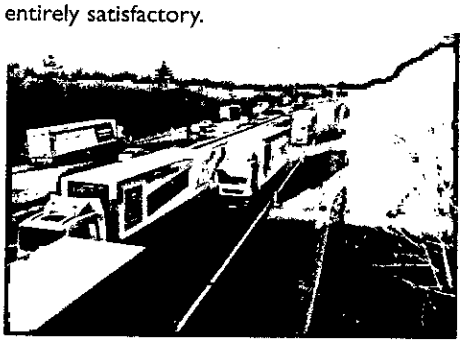
It is envisaged that curfew relaxation would apply only to retailers respecting agreed working practices developed in partnership with the local authority and only within a prescribed area and/or delivery site governed by the local authority.

If successfully embedded, the main long-term benefits of curfew relaxations for the retail sector and wider society in England would be: reduced congestion and better journey time reliability; noise reduction through vehicle technology and improved working practices; lower CO2 emissions (lower fuel consumption through reduced congestion); improved air quality through reduced emissions (through reduced congestion), and; improved local road safety (through the removal of HGVs at peak periods of use by vulnerable groups)

The trial process

Retailers were asked to adopt a consistent methodology, which included engaging with both local authorities and residents, installing noise monitoring equipment, introducing a 'driver charter' and a rigorous site assessment to reduce noise, and to compare and analyse the results before and after each trial.

Four of the six trials were fully completed, while two have been delayed by factors and planning restrictions beyond the control of the QDDS. Encouragingly, as well as evidence of improved fuel consumption, no residential complaints were logged in two of the completed trials and where nominal complaints were raised in the remainder, swift, remedial action was found to be entirely satisfactory.



Reaction

Transport Minister Mike Penning said this showed that by following proven methodology shop owners and supermarkets could receive deliveries out-of-hours without being a nuisance to residents. Less congestion, better air quality and safer roads meant a win-win situation. He looked forward to seeing more examples of retailers and local authorities working together to explore the mutual benefits of quiet deliveries.

The FTA backs night-time deliveries as a key to mitigating some of the expected disruption to the supply chain caused by the 2012 Olympics, when there will be more freight to deliver and less time in which to deliver it.

Natalie Chapman, FTA's Head of Policy for London, said that the six case studies were invaluable in the future development of a framework through which quiet night-time deliveries could be rolled out successfully and on a case-by-case basis. These trials really showed the essential role retailers must play in engaging with their local authorities and residents to demonstrate the benefits of out-of-hours deliveries.

Retailers did not want to disturb residents, who were also their customers, and by providing real solutions the trials had come up with more than just a compromise – it had been shown that journey times, fuel economy and air quality, as well as stock turnaround, could be improved without affecting the rights of local residents to a good night's sleep.

Gloria Elliott, Chief Executive of the Noise Abatement Society, said that the QDDS trials were a significant landmark on the journey to achieving the ultimate goal of out-of-hours delivery without disturbance. Given the significant health and environmental gains to be made, it was critical to establish feasible and sustainable quiet out-of-hours delivery practices with increased investment from industry and positive co-ordinated input from Local Authorities. Doing so would also reduce daytime disturbance and enable quieter deliveries to become accepted as the norm. Introducing quiet delivery practices now, under strict guidelines and independent monitoring, ensured that the public would be protected throughout.'

The view or download a copy of the full results visit **http://www.dft.gov.uk/publications/quiet-deliveries-demonstration-scheme/.**

Freight Transport Association

The FTA represents the transport needs of UK industry. Its membership is made up of manufacturers, retailers, logistic companies, hauliers and organisations in the public and private sectors. The Association's interests are multi-modal and in addition to consigning 90% of freight carried on rail and over 70% of sea and air freight its members operate in excess of 200,000 goods vehicles, approximately half the UK fleet of commercial vehicles. FTA's 14,000-plus members form one of the largest leading trade associations in the UK.

Noise Abatement Society

The objective of the Noise Abatement Society, a UK Registered Charity, is to raise awareness of, and find solutions to, noise and related pollutants such as light disturbance and air pollution. Its work helps to relieve the physical and mental distress and ill health which noise and related pollutants can cause, and which may affect public health, productivity, the quality of life and marine and wildlife. The Society was established in 1959 by John Connell OBE who successfully lobbied the Noise Abatement Act through Parliament in 1960, establishing noise as a statutory nuisance for the first time in the UK. For further information see **www.noiseabatementsociety.org.**

National Policy Statements for Energy

For use by the Major Infrastructure Planning Unit

On 18 July 2011 the House of Commons debated and approved the six National Policy Statements for Energy (NPSs). On 19 July 2011 Chris Huhne, Secretary of State for Energy and Climate Change, designated the NPSs under the Planning Act 2008.

The energy NPSs set out national policy against which proposals for major energy projects will be assessed and decided on by the Infrastructure Planning Commission. In future, if the changes to the Planning Act 2008 set out in the Localism Bill are enacted, they will also be the primary documents for the new Major Infrastructure Planning Unit (within the Planning Inspectorate) to use in its examination of applications for development consent, and for Ministers when making decisions.

Designated energy NPSs are aimed at ensuring that there is a planning system that is rapid, predicable and accountable. Planning decisions will be taken within the clear policy framework set out in the NPSs, making these decisions as transparent as possible.

The six energy NPSs designated on 19 July 2011 are on the subjects of:

EN-1 Overarching energy

EN-2 Fossil fuel electricity generating infrastructure

EN-3 Renewable energy infrastructure

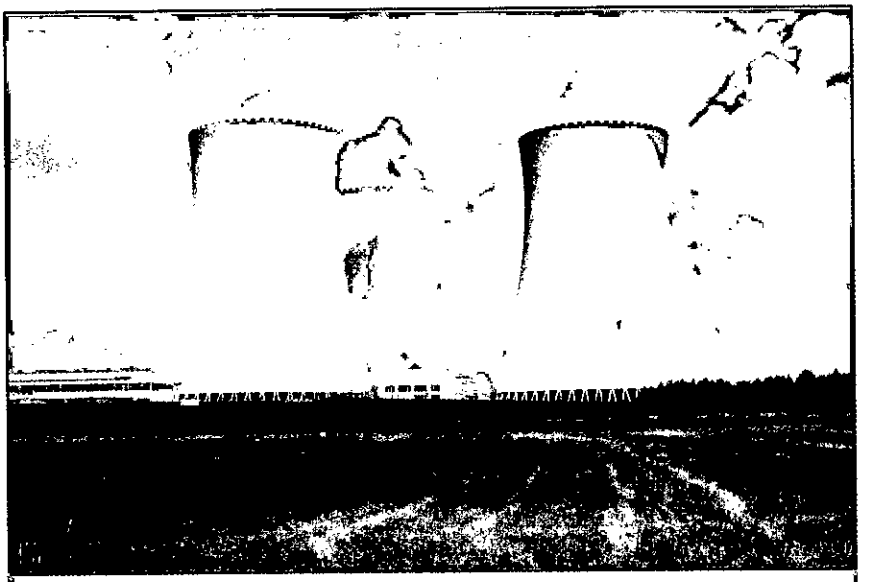
EN-4 Gas supply infrastructure and gas and oil pipelines

EN-5 Electricity networks infrastructure

EN-6 Nuclear power generation

The Renewables NPS (EN-3) requires that proposals for renewable energy infrastructure should demonstrate good design in respect of, inter alia, mitigating impacts such as noise. Appropriate distances should be maintained between wind turbines and sensitive receptors to protect amenity: the two main impact issues that determine acceptable separation distances are visual amenity and noise. Noise (and vibration) are considered in paragraph 2.7.52 of the NPS and the section that folllows. Most significantly, the use of ETSU-R-97 The assessment and rating of noise from wind farms is sanctioned by the NPS although there is a proviso that account should be taken of the latest industry good practice. This would seem to include the Acoustics Bulletin Agreement from March/April 2009 (vol.34 no.2).

Where the correct methodology has been followed and a wind farm is shown to comply with the ETSU-R-97 recommended noise limits, the Infrastructure Planning Commission (IPC) may conclude that it will give little or no weight to adverse noise impacts from the operation of wind turbines

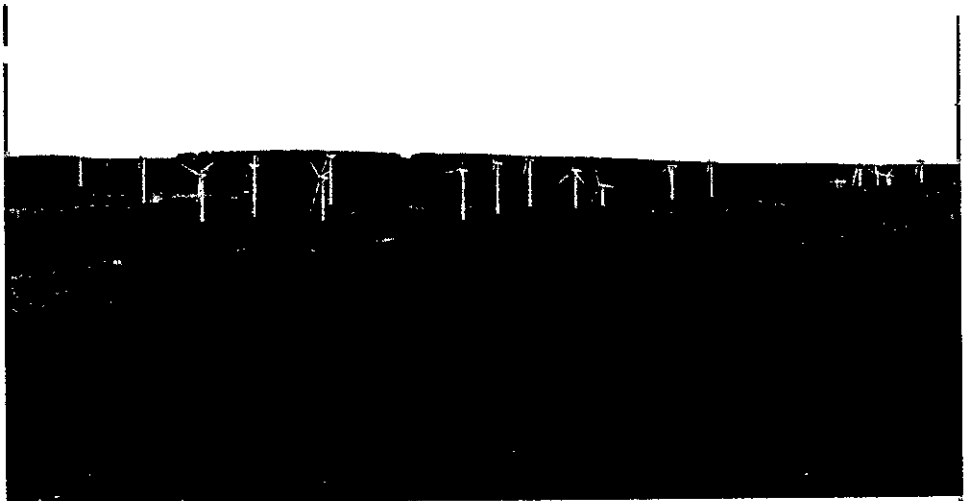


NPS EN-2 is on fossil fuel energy generation

The Nuclear NPS (EN-6) lists the eight sites the Government has identified as potentially suitable for the deployment of new nuclear power stations by 2025. Dungeness in Kent and Braystones and Kirksanton in Cumbria have been confirmed as not potentially suitable. The eight sites are: Bradwell, Essex; Hartlepool; Heysham, Lancashire; Hinkley Point, Somerset; Oldbury, South Gloucestershire; Sellafield, Cumbria; Sizewell, Suffolk; and Wylfa, Anglesey.

Also published on the same date was a finalised Post-adoption Statement which explains how environmental considerations have been integrated into the NPSs; how the Appraisals of Sustainability, the views of statutory consultees and others have been taken into account in preparing them; and why the NPSs set out the development control policies they do rather than any of the reasonable alternatives to them set out in the Appraisals of Sustainability.

Copies of all the designated NPSs, the finalised post-adoption statement and associated environmental statements (Appraisals of Sustainability (AoSs) and Habitats Regulations Assessments (HRAs)) are available at: **www.energynpsconsultation.decc.gov.uk**



Renewable energy infrastructure should demonstrate good design

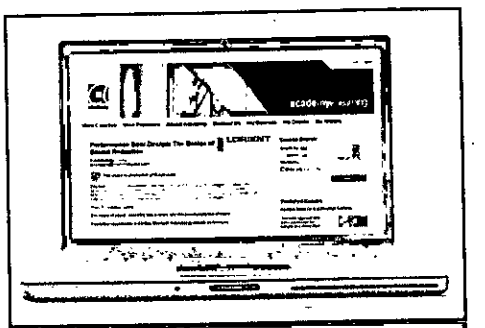
Lorient launches online CPD

with Academy e-learning

Leading door seal manufacturer Lorient is delighted to launch an online continuing professional development (CPD) module Performance door design: the basics of sound reduction.

Developing professional skills and keeping knowledge up-to-date is an ongoing challenge: Lorient's online module offers architects and those in the construction industry the flexibility to learn and claim CPD points whenever they want. The module which is independently certified by the Construction CPD Certification Service can be accessed through Academy e-learning, which is a portal featuring freely-available CPD and e-learning material for the construction industry. It can be found at **www.academy-elearning.co.uk.**

The session considers the nature of sound and the importance of acoustic containment



Lorient's academy-elearning.co.uk

to improve the quality of the built environment, preserving privacy as well as excluding unwanted noise. It also explains regulatory requirements including Approved Document E to the Building Regulations (England and Wales); British Standards that relate to acoustic performance; and effective design of door assemblies for acoustic performance, including door construction and the influence of sealing systems.

In addition to the online service, Lorient delivers both CPDs Performance door design: the basics of sound reduction and The role and performance of fire and smoke resisting door assemblies' in a more traditional face-to-face format, at a designated workplace or venue. If CPD certification is not required, presentations can be tailored to suit a wide variety of audiences, including client companies, building contractors, distributors, construction industry groups and trade associations.

There is a simple free registration process at **www.academy-elearning.co.uk.**

SQuadriga II

Mobile multi-channel front-end and stand-alone recorder

SQuadriga II is the new mobile recording and playback system from HEAD acoustics GmbH that covers a wide range of applications. The measurement system delivers high functionality and mobility owing to key features such as low weight, integrated battery with an operating time of several hours, and a variety of connection possibilities.

The unit is characterised by its versatility, according to Prof Dr Klaus Genuit, founder and owner of HEAD acoustics GmbH. ICP® microphones and acceleration sensors, a binaural BHS I headset, pulse and CAN sensors, an artificial head and other sensors can be connected to the system. This allows for both classical dynamic measurements and static or quasi-static measurements such as brake pressure. Beyond the connection for the BHS I which is used for aurally accurate recordings and playback, SQuadriga II provides six ICP® compatible BNC inputs and outputs. The inputs operate with sampling rates between 8 and 96 kHz and are equipped with selectable high-pass filters, which allow recording without unwanted signal components. In addition, the input sensitivity is adjustable separately for each channel.

The measurement data can be saved on a removable SD card or directly to PC or notebook. The SQuadriga II can be conveniently operated via its function buttons and its touch screen display, as well as via the HEAD Recorder software. Both the channel configuration and the sensor setup can be easily adjusted and saved via touch screen. The system's power is supplied by AC power adapter, USB, car adapter, or built-in battery. The latter can have its mobile operating time extended by adding replaceable batteries.

The built-in rechargeable battery allows the extremely compact SQuadriga II unit to run on its own for several hours. The system operates silently and is ready for use immediately after turning it on.

For even larger measurement tasks with higher channel numbers two SQuadriga IIs can be connected. Furthermore, the unit can be combined with the multi-channel front-end HEADlab. It can be used as an additional signal module of a HEADlab system or together with a HEADlab signal module as a controller.

HEAD acoustics is represented in the UK by AcSoft Ltd of Aylesbury who is a sponsor member of the Institute of Acoustics. Contact John Shelton on **sales@acsoft.co.uk**

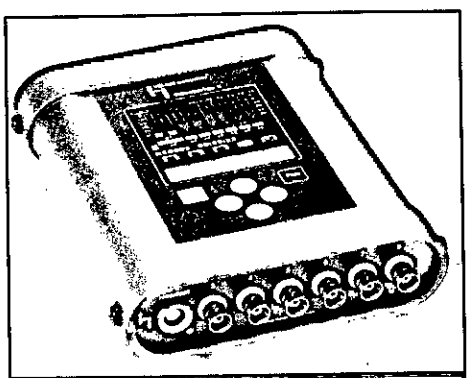


Figure 1: SQuadriga II

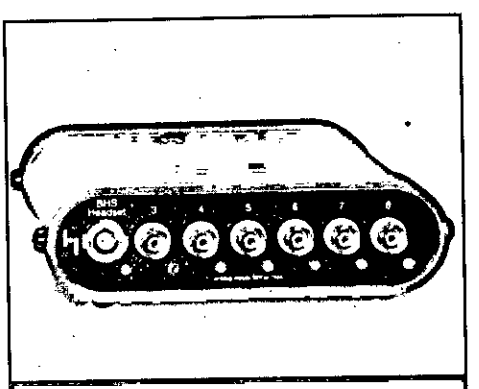


Figure 2: SQuadriga II, front view

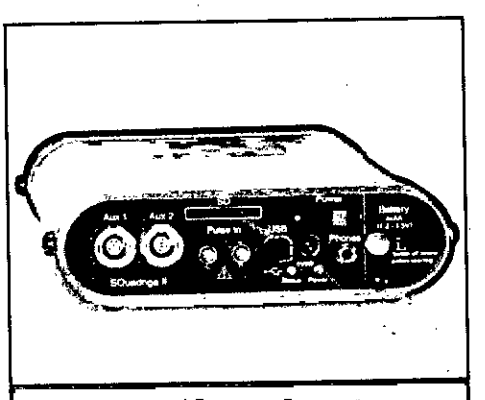


Figure 3: SQuadriga II, rear view

News from Brüel & Kjær

Aircraft noise, construction site noise and technical seminars

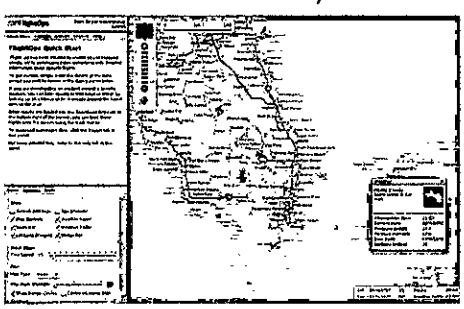
Enhanced flight track monitoring service adds value for airfield operations teams

Brüel & Kjær's FlightOps is a flight track monitoring service that provides airports with timely access to information about where and when aircraft are flying. The information is used for a variety of purposes such as responding to community noise complaints, reacting to and learning from incidents, and collecting valuable summary flight statistics for use with landing fee programmes and to aid future planning decisions.

Recent developments with FlightOps have added the capability to display weather radar image overlays and display real time ASDI data which will assist operations staff with tactical decisions. Weather images enable airfield operations staff to see local weather conditions and judge how these may affect operations at the airport. Weather images are also cpatured for historical replay alongside flight tracks to aid investigation of aircraft flying non standard departures.

ASDI is the Aircraft Situation Display to Industry, a feed of aircraft operational information from the FAA which covers the whole of North American airspace. The ASDI data are used to supplement the flight track data from the local airfield radar delivering flight track data over a wide area and critical information such as the Estimated Time of Arrival. Updated in real time, this information is very effective in helping airfield tactical planning.

Robert Brodecky, head of Brüel & Kjær EMS in North America said that the additional capabilities would enhance the value of FlightOps, particularly in small airfields where this sort of data was not readily available.



Upgraded monitoring system improves noise management

Following an extensive period of research, Austin-Bergstrom International Airport, Texas USA has chosen Brüel & Kjær EMS to supply the airport noise and operations management system (ANOMS).

The airport is known for its proactive community outreach and for making every effort to minimise noise disturbance from aircraft operations. By upgrading the existing noise monitoring and flight tracking system it will be able to take advantage of the superior precision and reliability of Brüel & Kjær's latest model noise monitoring terminals and the integrated features of ANOMS.

Since the airport began using ANOMS in 2004, the system has proven to be a valuable tool for investigating inquiries and complaints, as well as monitoring noise abatement procedures. The upgrade will improve the quality and accuracy of information.

As well as offering a fully integrated noise and operations monitoring system, Brüel & Kjær provides managed services and support for its systems through a dedicated team. Installation of the ANOMS and noise monitoring terminals at Austin-Bergstrom International Airport is already under way.

Construction site noise and vibration monitoring

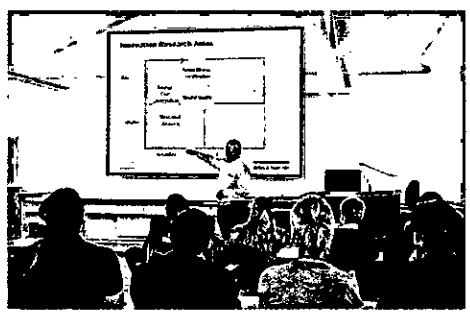
Vibration from large construction projects can present a perceived or significant risk of damage to nearby property. Along with noise, vibration also has the potential to cause nuisance in the community by triggering complaints. If the issues are not managed properly, they can cause delay, increased project cost and potential litigation. To help construction industries overcome this, Brüel & Kjær has launched its Construction Sentinel service which can continuously monitor noise and vibration.

The service operates via the internet so it may be accessed on site, in an office or anywhere there is an internet connection. It sends automatic alerts from noise or vibration exceedances — with all the necessary information — directly to users so that they may immediately investigate.

Construction Sentinel is part of Brüel & Kjær's Noise Sentinel family of subscription services for long-term, unattended outdoor monitoring, making it ideal for continuous monitoring of noise or vibration on large building projects.

With the subscription service, all the day-to-day tasks such as instrument provision, installation, operation, data capture, records management, calibration and fault rectification are handled by Brüel & Kjær, allowing the construction company freedom to concentrate on the project.

Autumn technical sessions and training courses now available for booking



Bruel & Kjaer UK is running another range of technical seminars and training courses during the autumn.

The company's courses range from theory-based introductions to sound and vibration, to practical sessions teaching delegates how to get the most from their tools. This includes the Theory and practice of noise measurements course, which is ideal for anyone new to the fields of noise and acoustical measurements. It is aimed at sound level meter users operating a variety of applications such as noise abatement, product labelling and building acoustics.

There are several more specialised courses designed for users of particular equipment or applications, such as the Vibration testing for engineers course. This two-day session is a practical introduction to the subject of vibration testing, designed to meet the needs of engineers new to the subject, and also acts as a useful refresher course for more experienced users. The course explains how to interpret vibration test specifications and apply them to a test system.

Brüel & Kjær is also running free online training courses, with topics including basic and advanced Type 2250 sound level meter guidance. As the courses are run via the internet, attendees from all over the world are welcome to take advantage of the opportunity to gain inside knowledge, plus helpful tips from the company's experts.

For more information, please contact: **01763 255780** or **ukinfo@bksv.com**

Obituary

Noel Hill (1952-2011)

We were greatly saddened by the news that Noel Hill passed away on 18 July 2011 after a battle with lung cancer. Noel was a valued friend and colleague at Atkins and he was instrumental in establishing and developing the building acoustics section of the business.

Noel had over 30 years' experience in acoustics which started in his native Australia where he worked for Peter R Knowland and Associates, an acoustic consultancy based in Sydney. On moving to the UK in 1988 he worked for Hann Tucker before moving to Moir Hands and Associates in 1992. In 2003 he joined Atkins and worked there until April 2011 when he made the move to Dubai to work for PMK.

Throughout his career he worked on a number of prestigious projects including the Sydney entertainment centre, the Australian National Gallery, Newcastle Arena and more recently the London Olympic venues.

He will be remembered for his professionalism and integrity but above all for his zest for life. Fast cars and motorbikes were a life long interest, an MV Agusta being one of his favourite toys. When in Australia he was the only member of the Sydney Ferrari Owners' Club not to own a Ferrari! Other interests outside acoustics were scuba diving and kart racing.

Noel was always available to help colleagues and often stepped in to assist on challenging projects. He mentored many young acousticians who have developed into fully fledged professionals. I will personally remember him for his hard work, loyalty and his practical approach to acoustical problems.

He leaves a wife, Janice, and two children, Adam and Francesca.

Noel will be greatly missed by his family, friends and colleagues.

Graham Haines

Arup builds theatre consulting expertise

John Seekings appointed to theatre consulting team

Arup is delighted to welcome former Royal Opera House operations director, John Seekings, to its theatre consulting team. In this newly-formed role as a consultant, John will bring his breadth of experience to bear on a wide range of performing arts venue design projects.

Arup's theatre consulting team advises clients on the design of venues and venue technology systems, from movable seating and theatre rigging, to a/v installations and low energy production lighting. Recent projects have included Grand Canal Theatre, Dublin, Victoria Concert Hall and Theatre, Singapore and the Jerome Robbins Theatre at the Baryshnikov Arts Center, New York.

Rob Harris, leader of Arup's Arts and Culture business in the UKMEA said: "With John's extensive technical knowledge of theatre operations and practical experience of the largest-ever opera house reconstruction project, John is uniquely placed to advise clients across the breadth of their technical, programming, planning and procurement challenges. We are very much looking forward to working with him in future years to develop our thinking around the design of performing arts facilities for the 21st century."

John Seekings says he is delighted to join Arup, a firm he has long admired as world leading technical specialists in performing arts venues, and with which he has worked many times over the years at the Royal Opera House and its satellites. John started his career at the Connaught Theatre, Worthing, and from there joined the Royal Opera House (ROH) in 1979 as technical manager. During his 30 years there, he oversaw the redevelopment of the venue during the 1990s. In 1998 he became operations director, responsible for all physical aspects of the company and its buildings including technical, production front-of-house, catering, facilities and IT. He also had responsibility within the ROH for strategic planning, risk management and capital projects.

For more information contact Vicky Maunder, Arup UK Press Office, on 0207 755 6649 or email: vicky.maunder@arup.com.

John Seekings

Letter to the Editor

Philip Newell FIOA. Air change requirements

A theme keeps recurring in Acoustics Bulletin about improving the efficiency and reducing the noise of various types of ventilation systems. I keep wondering just how many of the noise problems are actually precipitated by over-the-top specifications for the required rates of airflow.

I have seen misleading specifications in the advertising literature of reputable companies regarding the required air change rates in a recording studio control room, for example, up to as much as 25 changes per hour. Surely, we change the air to allow people to breathe. When a room is closed, with nobody in it, there is no need to ventilate it (other than now and then, to keep dampness under control etc). If we have a control room in which four people typically work, then we need to change the air at around 40 litres per second (10 per person) irrespective of the size of the room. This figure is even valid for musicians such as drummers, in studios, whose work can be quite energetic during short periods. The 10 litre figure allows for normal breathing, plus an extra allowance for the removal of body odours.

Can anybody explain what the room volume (and hence air changes per hour) has to do with the oxygen consumption and the carbon dioxide production, or BO? If a room of specialised use will hardly ever have more than ten people in it, then it will not require more than 100 litres/s ventilation (which is around 360m3, or just less than half a tonne, per hour). The size of the room has little bearing on this figure, apart from noting that the larger the room, the less ventilation it may need, because it has a greater reserve capacity of air.

I have checked these figures with the Chartered Institute of Building Services Engineers (in conversations initiated by Julius Newell MIOA) who are in agreement with them: yet there are still misleading articles and publicity statements which seem to imply that the CIBSE requires much more.

Other than the removal of smells from certain processes, there is no need to ventilate to the degree often quoted as being required. Reduced flow will generally mean reduced noise, reduced cost, and increased efficiency. If there are some norms requiring more than the necessary airflow, then we have to ask 'why?'

Institute Sponsor Members

Council of the Institute of Acoustics is pleased to acknowledge the valuable support of these organisations

Key Sponsors Brüel & Kjær · CASELLA CEL · Cirrus Research plc

Sponsoring Organisations: ACSOFT LTD • AECOM (formerly Faber Maunsell) • AMS ACOUSTICS • ANV MEASUREMENT SYSTEMS
ARMSTRONG WORLD INDUSTRIES LIMITED • ARUP ACOUSTICS • BUREAU VERITAS • CAMPBELL ASSOCIATES • CIVIL AVIATION AUTHORITY
CMS ACOUSTIC SOLUTIONS LTD • COLE JARMAN ASSOCIATES • DARCHEM • DOORSET GLOBAL SOLUTIONS
ECHO BARRIER LTD • ECKEL NOISE CONTROL TECHNOLOGIES • EMTEC PRODUCTS LTD • GRACEY & ASSOCIATES • HANN TUCKER ASSOCIATES
HILSON MORAN PARTNERSHIP LTD • INDUSTRIAL ACOUSTICS CO LTD (IAC Ltd) • INDUSTRIAL COMMERCIAL & TECHNICAL CONSULTANTS LIMITED
ISOMASS LTD • JACKSONS FINE FENCING • LMS (UK) • MASON UK LIMITED • NOISE.CO.UK • NPL (National Physical Laboratory)
RBA ACOUSTICS • ROCKFON • RPS PLANNING & DEVELOPMENT LTD • SAINT-GOBAIN ECOPHON LTD
SANDY BROWN ASSOCIATES • SCOTT WILSON • SCREENS AT WORK/ACDOUSTICS AT WORK • SOUND REDUCTION SYSTEMS LTD
SOUND & ACOUSTICS LTD • TELENT TECHNOLOGY SERVICES LTD • MUSIC GROUP RESEARCH UK LTD • THALES UNDERWATER SYSTEMS LTD
WAKEFIELD ACOUSTICS • WARDLE STOREYS (BLACKBURN) LTD • WATERMAN ENERGY ENVIRONMENT AND DESIGN LTD

Applications for Sponsor Membership of the Institute should be sent to the St Albans office. Details of the benefits will be provided on request. Members are reminded that only Sponsor Members are entitled to use the IOA logo in their publications, whether paper or electronic (including web pages).

Committee meetings 2011

DAY	DATE	TIME	MEETING
Thursday	8 September	11.00	Executive
Wednesday	14 September	10.30	Membership
Thursday	**22 September**	**11.00**	**Council**
Thursday	29 September	10.30	Diploma Tutors and Examiners
Thursday	29 September	1.30	Education
Thursday	6 October	11.00	Research Co-ordination
Thursday	13 October	10.30	Engineering Division
Thursday	3 November	10.30	Membership
Tuesday	8 November	10.30	ASBA Examiners
Tuesday	8 November	1.30	ASBA Committee
Thursday	10 November	10.00	Meetings
Thursday	17 November	11.00	Executive
Wednesday	23 November	10.30	CCENM Examiners
Wednesday	23 November	1.30	CCENM Committee
Thursday	24 November	11.00	Publications
Thursday	**1 December**	**11.00**	**Council**
Tuesday	6 December	10.30	CCWPNA Examiners
Tuesday	6 December	1.30	CCWPNA Committee

Refreshments will be served after or before all meetings. In order to facilitate the catering arrangements it would be appreciated if those members unable to attend meetings would send apologies at least 24 hours before the meeting.

Meetings Programme 2011

14-15 September 2011
Organised by Building Acoustics Group, Environmental Noise Group, Measurement & Instrumentation and Noise and Vibration Engineering Group
ACOUSTICS 2011
A new decade - A new reality
Rethinking acoustic practices for the austerity decade
Crowne Plaza Glasgow

3-5 October 2011
Underwater Acoustics Group and the Underwater Sound Forum of the Marine Science Co-ordination Committee
Ambient noise in Noise-European seas: monitoring, impact and management
National Oceanography Centre, Southampton

17-18 November 2011
Organised by the Electroacoustic Group
REPRODUCED SOUND 2011 - Sound Systems: Engineering or Art
Thistle Hotel, Brighton

23-27 April 2012
Organised jointly by the IOA and Société Francaise de l'Acoustique
ACOUSTICS 2012
Cite International des Congrès de Nantes, Nantes, France

2-6 July 2012
ECUA 2012
11th European Conference on Underwater Acoustics
Heriot-Watt University, Edinburgh

Please refer to **www.ioa.org.uk** for up-to-date information.

List of advertisers

Gracey & Associates

Sound and Vibration Instrument Hire

ISO 9001 - BSI FS 25913
Setting Hire Standards

We are an independent company specialising in the hire of sound and vibration meters since 1972, with over 100 instruments and an extensive range of accessories available for hire now.

We have the most comprehensive range of equipment in the UK, covering all applications.

Being independent we are able to supply the best equipment from leading manufacturers.

Our ISO 9001 compliant laboratory is audited by BSI so our meters, microphones, accelerometers, etc., are delivered with current calibration certificates, traceable to UKAS.

We offer an accredited Calibration Service traceable to UKAS reference sources.

For more details and 500+ pages of information visit our web site,

www.gracey.com

Campbell Associates

Sonitus House
5b Chelmsford Road
Industrial Estate
Great Dunmow
Essex CM6 1HD

t 01371 871030
f 01371 879106
e hotline@campbell-associates.co.uk
w www.acoustic-hire.com
w www.campbell-associates.co.uk

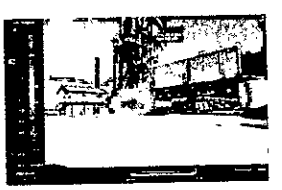
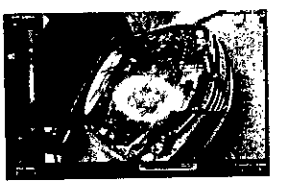
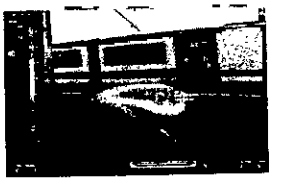
NEW Nor 848 Acoustic Camera

AVAILABLE FOR HIRE

SEEING SOUND

We are pleased to announce the new Norsonic 848 Acoustic Camera with outstanding performance.

- 225 microphones provide incredible resolution of the noise climate you are analysing.
- Battery operated with no signal analysis interface box between the camera and supplied MacBook Pro.
- Quick and easy to set up requiring no expert training or experience.
- Both live intensity plots as well as post processed analysis with the user-friendly software package.
- Includes a Virtual Microphone to enable you to listen to any part of the image in isolation in one click.
- Octave, Third Octave and FFT analysis modes.
- Applications include internal leak detection, environmental source identification and noise reduction in product development.

See more details and demo videos at **www.campbell-associates.co.uk** and follow the links to Acoustic Camera.

The UK Distributor of RION

sales - hire - calibration

AND MEASUREMENT SYSTEMS

Long-Term Monitors

RELIABLE • SITE-PROVEN • QUICK & EASY TO USE

RION Microphone Technology

Pre-polarised microphones are standard on RION meters
No Polarisation Voltage required
Inherently more tolerant of damp and/or cold conditions

RION Outdoor Microphone Protection

Practical, simple and effective
Site proven - years of continuous use at some sites
No requirement for dehumidifier
No complicated additional calibration procedures
Standard Tripod Mount or any 25mm outer diameter pole

AND Weather Resistant Cases

'Standard' supplied with 5 or 10m extension
'Enhanced' with integral steel pole
Gel-Cell batteries give 10 days battery life (NL Series)
Longer battery life, mains & solar options available

RION NL-52 (Class 1) NL-42 (Class 2) & NX-42EX

Overall A-weighted levels upgradeable to octave/third octave logging (early 2012)

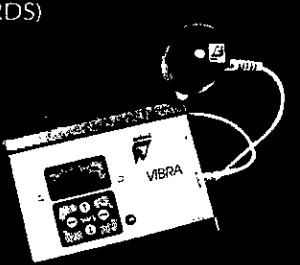
L_{Aeq}, L_{Amax}, L_{Amin}, SEL plus 5 statistical indices
Simultaneously logs 100ms data with processed values
Measures for up to 1000 hours
Uncompressed wav file recording option available

AND Remote Control & Download Software (RCDS)

In daily use on many sites
Download data and control the meter using the GSM Network
See the meter display in 'Real Time' across the GSM Network
Send alarm text messages to multiple mobile phones
Automatically download up to 30 meters with Auto Scheduler (ARDS)

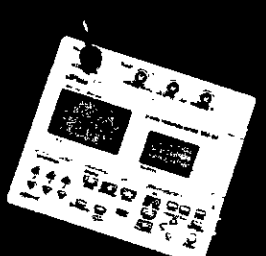
RION NA-28 (Class 1)

- Octaves & Third Octaves
- Audio Recording Option



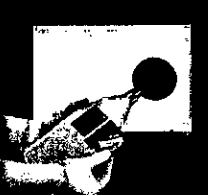
Vibra/Vibra+

- Logs PPVs for up to 28 Days
- Designed for Construction & Demolition
- Sends Alarms and Data via GPRS (Vibra+)



RION VM-54

- Measures and Logs VDVs
- Perfect for Train Vibration
- FFT Option Available



RION Data Handling

- You can always get the data from a RION
- Data stored as CSV files on memory cards
- Specialist download leads/software not needed

01908 642846 info@noise-and-vibration.co.uk www.noise-and-vibration.co.uk