Vol 40 No 2 March/April 2015

ACOUSTICS BULLETIN

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plus... **Wind turbine noise – progress to date, and where to next?**

Government report: noise an increasing nuisance in the UK

Hope Bagenal and Wallace Clement Sabine: a legacy in letters

Institute of Acoustics

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The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society. The Institute of Acoustics is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels.

The Institute has over 3000 members working in a diverse range of research, educational, governmental and industrial organisations. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of acoustics is equally wide, embracing such aspects as aerodynamics, architectural acoustics, building acoustics, electroacoustics, engineering dynamics, noise and vibration, hearing, speech, physical acoustics, underwater acoustics, together with a variety of environmental aspects. The Institute is a Registered Charity no. 267026.

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Conference programme 2015

15 April
Organised by the IOA
The art of being a consultant
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19 May
Organised by the IOA
BS 4142: 2014 workshop
London

8 July
Organised by the Musical Acoustics and Speech and Hearing Groups
Hearing impairment and the enjoyment and performance of music
London

7-9 September
Organised by the Underwater Acoustics Group
Seabed and sediment acoustics: measurements and modelling
Bath

27-30 September
Organised by the Galpin Society in association with the IOA
Musical instruments in science and history
Cambridge

15 October
Organised by the IOA
Acoustics 2015
Harrogate

29-31 October
Organised by the IOA with support from the French Acoustical Society (SFA)
Auditorium acoustics
Paris

10-12 November
Organised by the Electroacoustics Group
Reproduced Sound
Moreton-in-Marsh

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

Dear Members

Welcome to the latest issue. I recently had the pleasure of attending the bi-annual Groups and Branches (G&B) one-day meeting in St. Albans. It struck me that almost two years before I was standing in the same venue for a two-day meeting on strategy, to set and prioritise our future initiatives. The G&B meeting ensured that we as an organisation communicated to the Chairs and Secretaries of the G&B the status of key initiatives and shared with one another the goals of each group. The purpose is to ensure that we create another channel of communication to spread the information and receive feedback from you, the members. The day went well and we had a number of good discussions, but what became evident was that there was not enough time for all groups to present and that every two years is far too long an interval; so going forward we will plan to rectify both.

On the issue of the development of our strategy, our next key task will be to complete the education review. The goal is to identify the success of education so far and how we build on this, identify what is required in future for existing and future members and how we meet these needs, and from this, what we will require in terms of infrastructure and resources to meet the challenge going ahead.

Our promotion to students and our student e-magazine (*Sound Bites*) is proving successful and is bringing in more potential acousticians to the fold. We have over the last three issues had 1,100 unique visitors with 1,989 magazine views, viewing 6,131 pages in total. This has translated into increasing our student membership significantly (now currently over 280 members), who are a mixture of full-time acoustics students and those studying 'overlap' subjects such as audio engineering, music technology, etc who have been encouraged to join us via our Facebook and Twitter campaigns.

Despite a few hiccoughs, the website for renewals is working well and ensuring a smooth transition. The response so far is pleasing in a number of areas. I was delighted to forward to a number of corporate recipients, certificates for 25 years of corporate membership and to express my gratitude for their continued patronage. Also at the time of writing, there is almost a 50/50 split among those who have answered the question over whether they wish to opt out of receiving a 'hard' copy of the Bulletin. This issue (March-April) will be the last one posted to all members – those who have opted out of a hard copy will be informed by email on publication of each subsequent issue when it is available, for viewing/downloading in the members' section of the website. (It cannot be emailed to members because of the very large file size). Also in this issue there is a full report regarding the renewal of our Engineering Council licence for another five years and our excellent track record in assisting members in becoming registered as Chartered and Incorporated Engineers.

We have had a number of letters regarding wind farms and to clarify our position we have now a statement on our website.

Two points to note for the immediate future:

1. Although they are still many months away, planning for Acoustics 2015, Auditorium Acoustics and RS 2015 is already well under way.

2. Do you wish to serve on the IOA Council? The date of the 2015 AGM is still to be finalised but is likely to be in June. The formal notice of elections letter calling for nominations for the six vacancies due this year will therefore probably be sent to members in late April. The election will once again be via electronic voting and is provisionally planned for late May. We welcome nominations from all disciplines in the membership. If you are a Corporate member and would like to stand, you will need the support of five Corporate members to endorse your application. You will be asked to email your request to stand along with the written endorsements of five Corporate members in May. Each Corporate member is only allowed to support one candidate for each vacancy.

William Egan, President

BB93: a full guide to the key changes between the 2003 and 2014 versions

By Andy Parkin and Jack Harvie-Clark

Finally, after many years and countless hours deliberating content, the second official incarnation of BB93 was published in December 2014, just before Christmas. This document is a means of compliance with Part E4 of Building Regulations and immediately supersedes the 2003 edition. The forerunner to BB93 2014 was the Priority Schools Building Programme Output Specification v1.7, which this document also supersedes. Practically, if a school contract has already started using one of the previous documents it is likely that they will carry on being used, unless there is a cost-neutral or cost-negative impact.

Writing a new guidance document is always a challenge. The authors spend many hours debating particular points: perhaps a value of sound insulation, or a measurement descriptor. Once the authors are happy (or have at least a consensus view) on the content, it is then sent out for consultation. The consultees are generally experts and well experienced in the field of the document, but have not been party to the previous discussions and it is for this reason that consultation responses open various cans of worms that it had been hoped had been packed away on the shelf. And so it has been with BB93, which is why there are some significant – even surprising – variations between the final document and PSBP.

To get a full appreciation of the new document we recommend that it is read in full. Too many times documents are ducked in and out of, which can lead to readers missing vital content or context.

It has been documented on a number of occasions the reasons why BB93 has been revised. Essentially, the 2003 version had become superseded by newer methods of teaching and learning (e.g. greater reliance on technology, pupils using many spaces for solo research or work in small groups, etc.). Procurement methods have also changed (bear in mind the 2003 edition pre-dated Building Schools for the Future), with a greater emphasis now on refurbishment and material changes of use. There were also some sections of the 2003 edition that, on reflection, we had got wrong and did not work in practice as well as was intended.

So, without giving the reader an excuse for not reading BB93 2014 in full, the list below is a summary of some of the key changes to the 2003 version and PSBP:

- Scope and application: BB93 was previously arranged into Sections, with Section 1 being the design targets and subsequent parts being design guidance on how to comply. BB93 2014 is the equivalent to the old Section 1 (owned by DfE), with the guidance document currently being finalised by a joint IOA/ANC taskforce and due for publication in June 2015. This is very much in line with the Government's policy to reduce the amount of legislation and red tape.
- Speech intelligibility: the 2003 edition included speech intelligibility in open plan spaces as part of Building Regulations compliance, with sign-off being given by Building Control. This was never straightforward, due to a combination of factors including the fact that speech intelligibility is not specification cited in Approved Document E (unlike IANL, RT and sound insulation), and that Building Control are not sufficiently informed or trained to make a valued judgment over the results they were presented with. Speech intelligibility has therefore been taken out of Building Regulations compliance and is now covered by Schools Premises Regulations (SPRs). This does not come without its problems, however, as there is no official "police" of the SPRs and unless a Technical Advisor is available to offer a peer review of an open plan design then there is a risk that designs may not be implemented in practice or, in the worst situation, may not be correct.
- Similarly to open plan, operational noise levels (i.e. from classroom equipment such as projectors, etc .) are not covered by Building Regulations, but are by SPRs
- The perennial problem of when BB93 actually applies has been addressed. Obviously, all newly built schools need to comply, but what about refurbishments, or change of use from an office to a school (a common pattern for Free Schools)? A comprehensive table in the front of BB93 2014 sets out what applies and when.
- The subject of material change of use and refurbishment is elaborated on further, with an entire set of standards for such situations, clearly laid out alongside new-build criteria.
- Alternative Performance Standards (APS): these have been the cause of abuse since 2003 when they were first introduced. There appears to be a fundamental misunderstanding of what an APS actually is: it is not a derogation (one cannot choose simply to not comply with Building Regulations!), but it is a method of proposing an alternative performance for compliance, based on particular operational or educational grounds. Unfortunately there was previously no limit to how different an APS could be to the BB93 targets, leading to some particularly questionable designs; this is no longer the case, as APS values can be no lower than those set out for refurbishment/change of use.
- Common exceptions, not APS: there are some design features of schools so common that they were listed as an APS on almost all projects. These included factors such as serving hatches between kitchens and dining rooms, interconnecting doors

BB93 changes address sound absorption issues

between classrooms etc. Instead of having to list out APS for these common design features, which varied from project to project and consultant to consultant, a common set of exceptions is listed with separate performance criteria to be used.

- Children with hearing impairment: under BB93 2003 the only provision for more stringent acoustic conditions was for classrooms designed *specifically* for children with hearing impairment. In most schools there was never such a case and these values have been to varying extents and with varying success. This definition has now been broadened/clarified to apply to *Teaching space intended specifically for students with special hearing and communication needs*, with examples given on when this would apply.
- Frequency ranges for SEN reverberation time: in the original BB93 2003 there was an extended frequency range for the T_{mf} in rooms for the hearing impaired. This was downgraded shortly after publication to a recommendation only. The expanded application of these more stringent requirements (e.g. for SEN as well as hearing impaired) once again includes an extended frequency range.
- Finished and unfurnished rooms: BB93 2003 required design parameters to be met and tested to demonstrate compliance in rooms without any furnishing in place. The logic behind this was that it was the most likely state that schools would be handed over in, and to prevent any benefit from furnishings being used to achieve compliance although they may not be permanent fixtures and could be changed at a later date. However, as most classrooms tend to be regularly shaped boxes (often almost square) and have plane walls and soffits, in their unfurnished state they can be non-diffuse and do not have the same physical reverberation times as they would when under use (with chairs, tables and people) which is, after all, when compliance is the most important. Conditions therefore now need to be achieved with the benefit (or otherwise) of furnishings in place, both at design and testing stages.
- Rain noise: when the 2003 edition was written there was no universally recognised standard for rain noise in place. Values for rain noise exceedance were later added into BREEAM but have only now been added into BB93.
- Ventilation and noise: BB93 2003 pre-dated BB101 (indoor air quality, encompassing ventilation control and thermal comfort) and, as such, did not contain a definition of "adequate ventilation". BB101 permitted BB93 IANLs to be exceeded by 5 dBA when natural ventilation was used, but this was still not clear as there were differences of opinion over what constituted "natural" ventilation. This has now been clarified, with BB93 containing definitions of natural, mechanical and hybrid; indoor CO_2 and thermal comfort conditions to be met with specific noise levels; upper noise limits for purge vent conditions; and a guide to what external noise levels are likely to lead to required IANLs under varying ventilation conditions. One of the most prominent consultation questions was to ask whether a clear statement could be given in relation to what external noise levels corresponded to various window or ventilation opening conditions; in short the answer is "no", as so many factors come into play (e.g. window area, number of windows, opening type and direction, opening distance etc.) that it is not possible to make such definitive statements that apply to all cases.
- Airborne sound insulation: some of the performance values have been tweaked based on experience and feedback, with the activity/tolerance matrix being rationalised, but the most profound difference is the metrics used. BB93 2003 introduced $D_{nT(Tmf,max),w}$ which, although sounding complicated, was actually straightforward. During the document evolution we passed through D_w (essentially a $D_{nT,w}$ where $T = T_0$) and $D_{nT,w}$ (where $T_0 = 0.5$s). What we have ended up with is a reversion to $D_{nT(Tmf,max),w}$ but with the facility to use D_w when commissioning, providing the measured T_{mf} is lower than the design value. This permits situations where the in-situ level difference, D_w, achieves the numerical value of sound insulation, $D_{nT,w}$ although if the actual reverberation time is much lower than the design upper limit (quite common, especially where Class A ceilings are installed), the standardised parameter, $D_{nT(Tmf,max),w}$ does not comply.
- Impact sound: BB93 2003 required impact transmission criteria to be achieved with no floor finishes in place, in line with residential standards. However, as it is so unlikely that pupils or staff would remove floor finishes altogether, it is now permitted for such finishes to be taken into account in designs.
- Corridor walls: BB93 2003 contained airborne sound insulation requirements for doors, ventilators and partitions between a classroom and corridor. But what about glazing? When is a vision panel a part of the door and when it is an observation window? Did glazing have to provide R_w 40 dB attenuation? To clarify the situation and to allow for varying proportions of materials and room elevations, a composite sound insulation value is now included.
- Reverberation targets: how many people designed secondary school classrooms to a T_{mf} of 0.8 seconds ? This was actually not compliant with BB93 2003, as the requirement was for a T_{mf} *less than* 0.8 seconds. Values have now been changed to be *less than or equal to* listed values.
- Sports halls: there have been many problems designing to the Tmf values for sports halls under BB93 2003. There were even more profound issues achieving these in practice in spaces where there was no linear decay of sound and absorption was not uniformly distributed. To avoid some of these problems, a new deemed to satisfy condition is given that includes stipulations for type and coverage of absorption. The "requirement" to test for compliance is now removed also, with compliance demonstrated by design only.
- Pre completion testing: this remains outside the scope of Building Regulations and can still only be strongly recommended. Many procurement routes (e.g. BSF, Academies Framework and PSBP) contractually require testing however, as do BREEAM credits Pol 05 and Hea 05.

So, a number of changes have been made to the original 2003 document, resulting in a much improved and more user-friendly document. Not all decisions that have been made will be to universal approval; this is inevitable and the best that can be hoped for is for a consensus view across a cross-section of experienced practitioners. And, if you do not like the decisions that have been made then do not just sit on the sidelines but get involved and help out with the process! A core committee of consultants has been involved in the development of this document since 2008, giving theirs and their companies' time for free. Helpful comments and corrections are always welcome, as in the final edits there are inevitably some typos that creep in. The committee would welcome offers of support in producing *The Guide* to accompany the performance standards in BB93, and future guidance to benefit our industry.

A precautionary point: BB93 2014 was released somewhat (and ironically) in a hurry before Christmas. This first publication contained a number of errors that had arisen during the publication process, which have since been pointed out and rectified. The latest version at the time of writing (at https://www.gov.uk/government/publications/bb93-acoustic-design-of-schools-performance-standards) is v17 dated 3 February 2015. It is therefore advised that the DfE website is visited frequently to check for amendments.

So to finish, a big thank you to all who have helped out in the process that has culminated in the revised BB93: to the ANC Schools Committee and those others who have been involved along the way. The next steps are finalising and publication of the Guidance document and amendment of the ANC Good Practice Guide for schools testing (as referenced in BB93 and BREEAM); these documents will be launched and showcased at a joint ANC/IOA event in Birmingham on 24 June, in the morning before the ANC awards and dinner in the afternoon/evening, to which all are welcome and encouraged to attend.

Andy Parkin (a.parkin@cundall.com) is Acoustics Partner at Cundall, Chairman of the ANC and Chairman of the ANC Schools Committee. Jack Harvie Clark (jack.harvie-clark@apexacoustics.co.uk) is Managing Director of Apex Acoustics, an ANC Board member and a member of the ANC Schools Committee.

The ear and hearing: a tutorial for acousticians

By Ian Campbell

It was nice to see an IOA meeting with the "House Full" notice on the website a few days before the scheduled date; we indeed had a full house for this half-day tutorial where four experts from the medical side of acoustics gave us an educational and entertaining view of the state of the art from their perspective. The typical acoustician knows all about how sound behaves up to the point where it disappears into the "black hole" of the auditory meatus but is very concerned about the physiological and psychological reaction that it produces. The objective of this tutorial was to provide an update on what goes on between these two points and to review what can be done when it goes wrong.

The basic concepts of audiometric testing and the construction of the hearing pathways were outlined by Annalies Bockstael from the Audiology Department of the University of Ghent. This covered the peripheral, central and neural functions with discussions of the various test and diagnostic procedures that may be used. It is normal to rely on feedback from the patient but there is a lot that can be done when this is not possible or reliable. Her comments on the balance between loss of auditory sensitivity and the introduction of distortion on understanding prompted some discussion on the use of speech audiometry. The follow on session led by Oliver Brill went into the cochlear mechanics where the critical conversion of sound waves to neural information takes place. The discovery of the acoustic echo by David Kemp in London in the 1980s opened up the whole new field of hearing testing that has found widespread application with new born babies as well as with uncooperative subjects. The actual source of the echoes was discussed as well as the relative merits of transient and distortion product emissions in the diagnosis of pathology.

After the break the subject matter moved on to the remedial actions that are available to those with impaired hearing and or comprehension. Graham Frost described the development of the hearing aid from simple ear trumpets to the modern binaural multi-channel digital hearing aids. These devices can have their amplitude and frequency response tailored to the patients hearing loss. A frequently cited problem encountered by hearing aid users is associated with speech in noisy environments and this is addressed by providing improved directional response by the use of dual microphones and dynamic analysis of the input to match the aids performance to the acoustic climate. For severe losses frequency shifting and dynamic compression algorithms are now being developed; the performance of the digital aid is now so comprehensive that it is knowledge of the patient's needs and reactions that is the limiting factor. The discussion following this session covered signal to noise and undiagnosed problems as well as a description of an iPhone app that effectively provides a self-configurable hearing aid that the subject can programme to suit themselves. The final session by Brad Backus from Audio3 and Oticon Medical covered the new field of cochlear implants. The original understanding of their function was obtained from cadavers but now it is possible to examine the inner workings on live subjects our understanding has advanced significantly. The way in which the outer hair cells provide gain and improved frequency discrimination show this to be a truly remarkable feat of evolution. The introduction of electrical neural stimulus to the cochlear can be a considerable benefit to patients with sensory neural hearing loss. The number of frequency channels is limited to around 20 which is only about 1% of those in a normal ear but demonstrations run during the meeting showed that speech discrimination is quite good and some appreciation of music was even possible. Brad completed his presentation with some practical demonstrations and animations related to the ear and hearing including the McGurk effect that showed how we coordinate our eyes and ears in determining what we actually comprehend is not always what we hear.

Oliver Brill

Left to right: Annalies Bockstael, Graham Frost and Brad Backus

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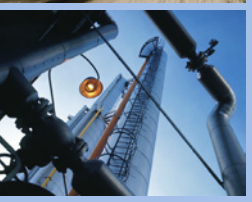

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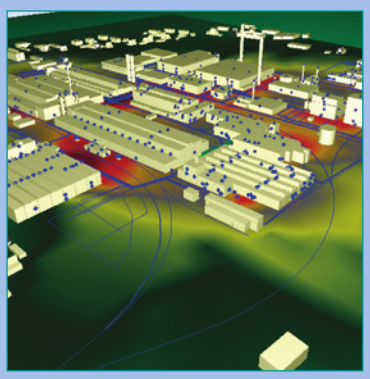
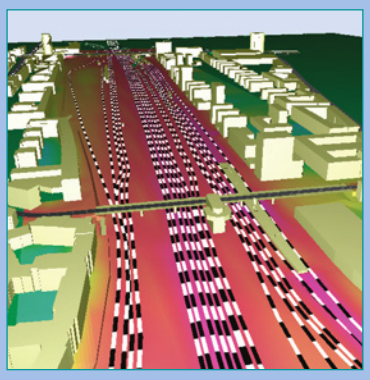


Prediction and detailed analysis of noise at industrial facilities



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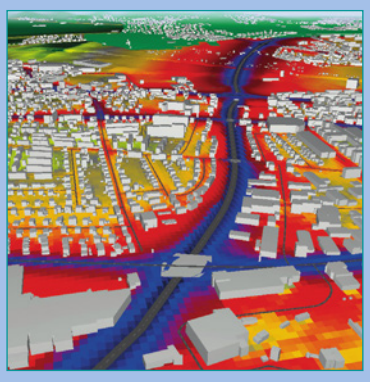

Calculation of noise maps for cities of any size

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Institute re-awarded Engineering Council registration licence for five more years

The Engineering Council has renewed the Institute's licence to offer registration at Chartered and Incorporated Engineer levels for a further five years.

The approval follows a visit by four members of the Council's Quality Assurance Committee to the IOA office in St Albans last October to review the application with Richard Perkins, Chairman of the Engineering Division, Peter Wheeler, Engineering Manager, Jim Glasgow, an Engineering Division committee member, and Allan Chesney, Chief Executive.

As part of the process, they inspected several professional review files of candidates seen over the past five years and the Institute's *Policy and Procedures Manual*, which sets out the assessment protocols used for interviews and decisions.

Richard Perkins said: "We are very pleased that the Council has given our registration procedures a clean bill of health for another five years, which reflects the hard work that goes on behind the scenes by the support staff and the committee to helping candidates through the process.

"The IOA is regarded as an exemplar for similar sized institutes, where candidates are provided with individual support tailored to their needs. The IOA should be proud of this achievement, and candidates reassured that they will get the support they need."

He added: "Candidates should also be aware that a mentoring scheme exists for those without colleague support in their organisations. The IOA will endeavour to put candidates in touch with an experienced engineer in a similar field to support them through the process."

Details of how to apply for registration can be found at www.ioa.org.uk/engineering or by emailing acousticsengineering@ioa.org.uk. Here are profiles of three recent successful candidates.

Jorge D'Avillez

URS, CEng

Jorge D'Avillez

I come from a recording engineering background which started in New York, where I studied sound engineering and audio technology at the Institute of Audio Research.

As a freelance recording engineer, I worked alongside established musicians of different genres, from classical to world music. I then diversified into multimedia, working in the cinema industry for clients such as Walt Disney and 20th Century Fox, supporting and recording language dubbing of animated movies.

In 2005 I left the music/multimedia industry to further my studies, enrolling on the acoustics science course at University of Salford from where I graduated with a first class honours degree.

In 2008 I joined URS to undertake research (in collaboration with Loughborough University) for my doctoral programme (EngD) to develop a prediction method for railway vibration. And since I've been there I've got involved in building acoustics and, among other things, I've also designed public announcement/voice alarm (PA/VA) systems for a number of large public spaces, such as airport terminals and rail stations, as well as being involved in vibration analysis.

I see the CEng as a great opportunity to raise my professional profile. Given the CEng requirements, I believe that a holder of such accreditation demonstrates the ability in applying sophisticated technical skills within commercial environment. The benefits to the company are that clients will often insist of chartered status for certain rolls and higher profit margins can be achieved where chartered status attracts higher staff rates. Because CEng registration is a unique process, contrasting individual attainments with the Engineering Council requirements, I relied on the IOA to guide me through.

Edward Crofton-Martin

Able Acoustics, IEng

Edward Crofton-Martin

I came to acoustics from a music production background and have an MSc in Music Information Technology from City University, London.

I started my career at Capita Symonds before joining Addiscombe Environmental Consultants, where I worked on a wide range of projects, with the majority being rail and infrastructure related. At Able Acoustics my work mainly consists of: noise control for construction/demolition sites, noise and vibration assessments in support of planning applications and expert witness work for legal proceedings."

I took the individual route to registration as I have a non-accredited degree. This required me to demonstrate a wide range of competencies and the IOA Continuing Professional Development (CPD) plan helped me to achieve this. To make the most of this I started with a critical assessment of my strengths, limitations and project experience to create a plan for attaining my own required goals.

As a small business owner, the importance of an effective CPD plan becomes far more immediate as there isn't the same level of opportunity to receive mentoring that is available when working for a larger company, but by subcontracting to larger consultancies, attending seminars organised by product providers and other professional bodies as well as direct involvement with local working groups, it is possible to overcome this hurdle. I have also found the IOA exam books and distance learning notes are very helpful for anyone wanting to stay sharp, and membership of the British Standards Institute is also important as it allows members to receive regular updates on changes to current guidance.

One of the things I found out early on is that CPD is not limited to the technical requirements for the immediate role, but that it extends to cover other operational requirements such as commercial management, health and safety, leadership, sustainability and quality systems.

For me, registration as an Incorporated Engineer has been the most significant and rewarding step in my career so far, because it is a mark of recognition, across an ever increasing range of disciplines, that your peers have recognised your abilities and I would thoroughly recommend it to anyone who may be considering applying.

Kezia Lloyd

WSP, CEng

Kezia Lloyd

I graduated from the University of Auckland, School of Engineering in 2007 after which I started at Norman Disney and Young in Auckland as an acoustic consultant.

In 2009 I moved to the United Kingdom and took up a position

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P10

with Buro Happold in Bath where I gained broad international experience. I then moved to Sydney, Australia to join a new acoustic team being developed for WSP's Asia Pacific region. I am now a senior engineer and am responsible for the acoustics design of Sydney based projects throughout the Asia-Pacific region.

I have led the acoustic design for some significant projects in the region and am currently working on notable projects such as the 67-floor Greenland Tower, Sydney's tallest residential tower, Park Hyatt Hotel, Auckland and the Viet Capital Centre in Ho Chi Minh City.

Being chartered has always been a career goal of mine since university where the importance of the registration was emphasised. Whilst living in the UK I became aware of the Institute of Acoustics where the internationally renowned Engineering Council UK competencies are made applicable to acoustic engineers.

The IOA process enabled me to gain chartership from Australia using video conferencing with the Engineering Council. This was most applicable to my discipline and career path, providing the most recognition within my peer group.

John Bowsher receives Award for Services to the Institute

John Bowsher (second left) is pictured at his home in Kent after receiving his Award for Services to the Institute from Simon Kahn, Education Committee Chairman (far right). Also pictured are Keith Attenborough, Education Manager, and Hansa Parmar, Education Administrator.

John has made major contributions to the educational activities of the Institute over a long period, becoming deputy chief examiner for the Diploma in Acoustics and Noise Control in 1986 and chief examiner from 1988 to 2000. After retiring as chief examiner, he was responsible for the typesetting, proof reading, printing and distribution of IOA examination papers until stepping down at the end of 2014.

Talks held to reverse decline in workplace noise course numbers

By Keith Attenborough, Education Manager

In last autumn's examinations for the Certificate of Competence in Environmental Noise Measurements there were 95 passes from 105 candidates at 12 accredited centres. This is fewer than for the presentation last spring/summer but, nevertheless, the demand for the course remains buoyant.

Only four accredited centres offered the Certificate of Competence in Workplace Noise and Risk Assessment this autumn. There were 17 candidates, of whom 13 passed. The demand for this course remains low, but, as a result of exploratory discussions, a draft agreement between the British Occupational Hygiene Society (BOHS) and the IOA concerning collaboration including, the mutual recognition of course qualifications, is under consideration.

There were nine passes on the Certificate of Competence in Building Acoustics Measurements at the only presently active accredited centre, Southampton Solent University.

Nineteen out of 25 candidates passed the Certificate of Proficiency programme in Anti-Social Behaviour (Noise) in Scotland. Although again this year the course was delivered only by Bel Educational Courses, Strathclyde University has confirmed its interest in running the ASBA and Environmental Noise Certificates subject to sufficient numbers of candidates.

Antisocial Behaviour Act 2004 Noise Measurements

Bel Educational Noise Courses

Bell C
Campbell C T
Carney C J
Crossett J P
Doubleday A P
Forsyth S
Graham N
Hamill P
Henderson P
Henderson C
Jackson J L
Makey C
McColm D
Muir W
Muncie A S
Munro J
Pickett G
Robertson A
Vallely S B

Building Acoustics Measurements

Southampton Solent University

Babariya S
Barry S J
Ford B J
Hima B
Madzima M
Parr N
Rahman M
Scott S
Zelba M

Environmental Noise Assessment

Bel Educational Noise Courses

Andrew C

University of the West of England

Buchan T D
Gardner N A
Kershaw R
McCandlish L R
Murphy J
Penny K G
Shire N J

Colchester Institute

Boot A K
Khanom F
Ludlow J
Malik I
McConnell R I W
McDonnell T
Oddi J C J
Sherratt M J
Stambrow R
Tice H W V
Toyer M
Walls S
Wicks G

University of Derby

Brumby G
Conley A
Cowie M
Cozens J F
Craig I
Dawyd B
Ellerton T
Farr K E
Fell S A
Hamilton K

Hobson R C
Marsden D
Parkes R J
Richards S
Shipley M A
Taylor A S
Walker L L
Ward A

EEF Sheffield
Butterworth D
Cousins P I
Kay N J
Kirton P
Parry N M

Leeds Beckett University
Murphy L E

Liverpool University
Allen M
Caton J H
Churchman S A
Corcoran M
Curtis F
Eacott L
Hall R
Howells D A
Kulkarni T
Laycock A M
O'Connor P
Richardson L
Taylor C
Walsh M E

London South Bank University
Cross D
Evans D
King R
Morrison I
Postoyko S
Skalecki S
Starr H E
Warner E

Moloney & Associates
Foley M M
Hamilton M
McCullough E C
McKeon R
O'Mahony S

NESCOT
Charlesworth R
Gordon A D
Hambelton W
Joyce J
Mathieson C S
Quartermab L
Rioperer J L

Shorcontrol Safety Ltd
Gacquin T
O'Shea T

Southampton Solent University
Babariya S B
Elliott J A
Hance C L
Hance G J
Martin R
Parr N
Peters L
Ross D

University of Strathclyde
Critchon D
Fisher D
Ford M
Granizo N
Hrubesova L
Parsler L

Workplace Noise Risk Assessment

EEF Sheffield
Mosley A D
Temple K M
Tormekpey R

Leeds Beckett University
Kavanagh A
Morris A J
Pourreza R

Moloney & Associates
Guy R
Kiely S
O'Connell M
Surgenor S A

Shorcontrol Safety Ltd
Fitzsimons O
Keane S
McDonagh J R

Project titles for 2014 Diploma in Acoustics and Noise Control

The following are the titles for projects submitted for the 2014 IOA Diploma in Acoustics and Noise Control.

Derby University

Acoustics performance of louvres
Schools acoustics
Noise exposure in a cross fit facility
Attenuation provided by open windows
Speech Intelligibility in open plan offices
Review of BS5228
Acoustic performance of floor mats
Occupational noise assessment
Speech indelibility in the bar
STI modelling and assessment
Measurement and prediction of quarry noise
Loudness of TV adverts
Partition sealing method in testing suits
Road traffic noise control methods
Assessment of model aircraft noise
Noise exposure of travelling salesman

NESCOT

Investigation into a modern open-plan work environment
Assessing the Noise impact of demolition and construction work at Hogarth Car Dock
An investigation into the effect of noise from children playing outside a HE College
An investigation into industrial fan noise
Testing the modern motorcycle silencer 'The dB Killer'

Leeds Beckett University

Exhaust gas noise: is it possible to predict and control effectively?
The effect of wet roads on road traffic noise
The hemisphere and parallelepiped methods for deriving sound power
The effect of standing water on road traffic noise and frequency distribution
The acoustic environment of public swimming pools
Assessment of nightclub workers' exposure to noise
Manufacturer noise emission data for hand-held motor-operated electric drills
Audibility and performance of offshore public announcement and alarms systems
The room acoustics of a modern open plan office environment
Generation of a pressure field and measurement of low frequency response for measurement microphones
An assessment of low frequency noise
Wind turbine viability study: ETSU compliant noise assessment
Noise in relation to planning for change of use form an office to a hotel
Prediction of noise assessment levels from a redesigned factory unit P14

P13

The noise impact assessment of a football field for a proposed skate park

Headphone noise leakage, design and levels

Southampton Solent University

Automotive recreation and hearing loss

Assessment of shooting site using the CIEH Guidance

Comparison study of transportation noise prediction models

Investigation into the acoustic measurement of stethoscopes

Noise mapping and remote live monitoring for outdoor music events

Noise emissions from cattle grids in relation to vehicle speed

Design and build of a transfer function type impedance tube

London South Bank University

The assessment of noise nuisance from motorsport at Dunsford Park

Assessing the suitability of Chapelfield Gardens, Norwich as a location for outdoor events using computer aided noise abatement software (CadnaA)

Comparison of manufacturer's data for sound reduction index and abs

Improving the reverberation time of the Aldeburgh music room

A review of the Good Practice Guide for the application of ETSU R 97

An investigation into the acoustic performance of splitter silencers

Investigation into the robustness of the CIEH 2003 methodology for clay pigeon shooting

Improving the acoustics of a university tea room

An investigation of noise arising from dry cleaning operation and affecting residential dwellings

The development of a small scale sound transmission suite

An investigation into the noise nuisance caused by idling buses

DL St Albans

Verification of Cara room acoustics software by comparison with real acoustic room measurements

The effect of wet roads when undertaking CRTN measurements

Towards the design of a fractalised acoustic shell

An investigation into the attenuation properties of recreational headphones

The performers' acoustic space – creating a concert hall stage in a practice room

Acoustic problems associated with opening a modern wine bar

Small recording studio control rooms for use in schools

Frequency analysis of musical instruments using a FFT analyser

The noise impact of domestic air source heat pump systems in rural areas with low background noise environments.

A study of the accuracy of computer-based acoustics measurement systems

DL Edinburgh

Acoustics within the Glasgow Barrow Land Ballroom

An investigation into internal acoustic environment of the open plan offices at the East Neighbourhood Centre

The effect of changing floor coverings on the impact sound insulation performance of separating floors

Improving the acoustic characteristics of a community hall

Comparison of noise levels from single stage and multistage music festivals and evaluation of licence conditions from T in the Park

A study into the effectiveness of a noise barrier at a multiple use games area (MUGA)

Turbo trainer noise – an assessment of noise control strategies

DL Bristol

Variation in road traffic noise

The effects of disrepair on impact noise emissions from public multi-use-games-area hardware

An investigation into noise generation and noise reduction solutions for a roslor dry blast machine

Investigation into the effect of different types of car roof bars on noise in the cabin

An investigation of the effectiveness of windshields at reducing wind noise for environmental measurements.

Noise attenuation of a blender

DL Dublin

An assessment of the potential planning implications for development of wind power in Ireland, due to the currently proposed changes to the Wind farm noise limits levels, as proposed by the Department of Environment, Community and Local Government, December 2013

Low frequency wind farm noise – a review of the literature and a case study

Acoustics in our schools: a study of where we are in Ireland in comparison with the UK

Develop an acoustic policy for primary substations for an electrical utility

An investigation into the use of ultrasound to reduce sludge volumes at a pharmaceutical plant

An assessment of the limitations of noise standards when applied to motor sport noise

Acoustics into the future: a fascinating celebration of 40 years of the IOA

Southern Branch report

By David Yates

In a joint meeting with the University of Southampton's Institute of Sound and Vibration Research (ISVR), the Southern Branch invited all those with an interest in acoustics in the south to a half-day event at the National Oceanographic Centre in Southampton.

Approximately 75 people attended and were treated to a fascinating half day with short presentations on a wide variety of subjects. The presentations included:

- Zoe Bevis of ISVR: *Localising small arms fire: investigating the acoustic characteristics of a gunshot*
- Alan Saunders of Clarke Saunders Associates: *British Airways east and west base ground running pens, Heathrow*
- David Elliot of ISVR: *The audibility of comb-filtering due to cinema screens*
- Lee Davison of Southampton Solent University: *Variation in tone presentation by pure tone audiometers: the potential for error in screening audiometry*
- Arthur Marker of ISVR: *Perceptual evaluation of a superdirective TV loudspeaker array for hearing impaired listeners*

Peter Rogers (centre) Branch Chairman, with Arthur Marker (left) and Richard Redwood (right)

- Andrew Bullmore of Hoare Lea Associates: *Wind turbine amplitude modulation (AM) noise*
- Graham Parry of ACCON UK: *Validation of the pipe in pipe vibration software model to determine ground-borne noise and vibration levels above construction tunnels and the determination of end corrections for different train operating scenarios*
- Benoît Bergés of ISVR: *Experimental insight on enhanced sound transmission from water to air at low frequencies*
- Richard Redwood of Industrial Noise Reduction: *Can an earphone protect your hearing? (answer – probably not!)*
- Nikhil Banda of ISVR: *Investigation of capillary wave formation on water streams with internally propagating ultrasound.*

Prizes were decided by the committee and were awarded to Andrew Bullmore (third place) for presentation style and the fascinating content of his presentation, Richard Redwood (second place) for the application of practical science and Arthur Marker (first place) for the potential real world application of his research.

The attendees were also treated to a tour of the National Oceanographic Centre and offered an insight into its research.

After the presentations, the attendees were offered a glass of wine and refreshments before taking part in a very enjoyable pub quiz.

Zoe Bevis

SRL throws opens its doors to Eastern Branch members

By Martin Jones

Our first regional meeting of 2015 saw us visit the headquarters of SRL who kindly opened their doors, for what has become a regular branch fixture. Nigel Chandler opened the meeting for SRL and discussed the interesting history of the organisation. Matt Barber then led a tour of the various aspects of their laboratory facilities, including the highly impressive reverberation chamber. The diversity of acoustic laboratory tests that are regularly undertaken was certainly an eye opener.

Following the laboratory tour, we thawed out and were then treated to a highly interesting talk on the vibration analysis and prediction work undertaken by Dave Clarke, and his team, on the Crossrail temporary train lines. The unique nature of the subject matter and project meant that all design recommendations had to be plotted in two calculation formats to give the best available verification of the data. In conclusion however, the project has been a huge success thus far, so congratulations must go to the team.

Sound insulation and noise reduction in buildings – an introduction to BS 8233:2014

London Branch report

By Nicola Stedman-Jones

Simon Kahn, Technical Director, Mott MacDonald, gave a presentation to London Branch on *Sound Insulation and Noise Reduction in Buildings – an introduction to BS 8233:2014*.

In February 2014, British Standard (BS) 8233:1999 Sound insulation and noise reduction for buildings – Code of practice was superseded by BS 8233:2014 Guidance on sound insulation and noise reduction for buildings. Simon, who was on the committee responsible for reviewing BS 8233, outlined what had and had not changed, why the changes had been made and answered any questions on the new standard.

The standard provides guidance on the design of buildings to achieve internal acoustic environments appropriate to their functions. It addresses the control of noise from outside the building, noise from plant and services within the building and room acoustics for non-critical rooms.

The main changes reflect: changes to the legislative framework; changes to building regulations; the withdrawal of numerous individual planning guidance and policy statement documents, including those specifically relating to noise, such as Planning Policy Guidance 24: Planning and Noise (PPG 24); the publication of various new documents, including the Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and the National Planning Practice Guidance – Noise (NPPGN); and the publication of specialist documents for specific sectors, such as healthcare and education.

It was noted that two typographical errors had been identified in the new standard. In section 0 Introduction, second paragraph, the word 'not' had been missed and the paragraph should have read: "Note The standard is not intended to be used routinely where noise sources are bought to existing noise-sensitive buildings".

In section 8.4.5 Windows, paragraph 8.4.5.2 double-glazed units, the word "unlikely" is incorrect and the paragraph should have read: "A double-glazed unit is likely to perform better than a single pane of mass equivalent to the thicker pane of the sealed unit, and should be used in a frame with good seals to realize its full insulating potential."

The branch would like to thank Simon for joining us and WSP for providing the venue.

The branch committee always welcomes new ideas and suggestions for presentations, so if you have one, or may even like to give a presentation yourself, please contact Nicola Stedman-Jones at stedmann@rpsgroup.com or nathan-nicola@talktalk.net

Midlands Branch reports

By Kevin Howell

An introduction to expert witness work

A large audience gathered at Atkins in Birmingham for a joint meeting with the Birmingham Branch of the Royal Institution of Chartered Surveyors (RICS) to hear a presentation by Mark Thomas of Thomas Sands Consulting. Mark has worked as a quantity surveyor for 40 years and is an experienced expert witness and an adjudicator in construction disputes. He explained what an "expert witness" is, although it is a term that he dislikes as it suggests that you are an expert at being a witness! He much prefers the term "technical witness". Mark described the development of the role through a number of court cases going back as far as 1554. He then described the role of giving "opinion evidence" to a court or tribunal, which is distinct from that of a lay witness or witness of fact who is present to state what they themselves saw or heard. The qualities required are honesty, professionalism, impartiality and truthfulness, and the witness must be currently active in the relevant field. Mark made the distinction between impartiality and independence. The witness may not necessarily be independent of the parties in dispute but their evidence must be impartial, and their overriding duty is to assist the court or tribunal. Mark described the process which an expert witnesses should follow starting with the pre-trial duties including preparation of their reports and the exchange of reports and discussions with any other expert witnesses to identify the areas of agreement and dispute. He also covered the expected behaviour and duties when giving evidence at the tribunal. The talk was a whistle-stop tour based on a course which Mark usually takes more than six hours to cover. It was an extremely informative, entertaining and, to some extent, cautionary presentation leaving no-one in doubt about the challenges of being an expert witness but also the personal fulfilment and benefits that may ensue.

IOA 40th anniversary event: noise impact assessment guidance

An audience of almost 90 gathered at Derby University to hear Graham Parry of ACCON UK present the Environmental Noise Impact Assessment Guidelines recently published by the Institute of Environmental Management and Assessment (IEMA). It was a joint meeting with IOA Central Branch and the Derby Branch of the RICS and also included many current students from the Derby IOA Diploma course. The attendance was a record for the branch and a fitting way to celebrate its 20th anniversary as well the IOA's 40th.

Graham has 42 years' experience in acoustics and environmental consultancy and in 2011 was tasked with completing the writing of the IEMA guidance which had been in progress through working groups for some considerable time. Graham began by outlining the scope of the document and went on to describe the detail of the guidance and the important elements to be taken into account in any noise impact assessment. He described the different methodical approaches available, the need to identify and consult with all the appropriate stakeholders and the essentials for preparing a clear and comprehensive report. Methodologies are not prescriptive and practitioners may use whatever methodologies and procedures they feel most appropriate, but must justify clearly why that is the case. Graham's presentation style and humour made for an extremely enjoyable presentation. A busy question and answer session followed. The issue of how to deal with the uncertainty inherent in such assessments was raised and Graham said that this is an area with which everyone is struggling at the moment and it needs much more work. It was suggested this might be a suitable project topic for some of the current Diploma

students. Another question raised the issue of how far back do you look for the baseline. For example, if a site has a history of being noisy but very recently has become quieter which baseline do you take? Graham said you must justify your choice, or possibly assess both and compare the outcome.

Afterwards there was an excellent hot buffet and opportunity for networking and convivial conversation. A specially labelled Anniversary Special Reserve beer had been prepared and each attendee was invited to take a bottle home with them.

Good vibrations: the acoustics of stringed musical instruments

We returned to Derby University for our final meeting of an excellent year. Heather Billin, the meeting organiser and musician, had publicised the meeting amongst her musical contacts and the audience of more than 60 included many musicians as well as students from the world famous Newark School of Violin Making. We were treated to an excellent presentation and demonstrations by Bernard Richardson from the School of Physics and Astronomy at Cardiff University. Bernard began by outlining some of the history of stringed instruments and the different classes into which they are divided. He then went on to discuss the vibrations of guitars and violins and the many factors that govern their sound quality. He explained the science of the vibrations of single strings through to the complex vibrations of an instruments wooden body. He showed how lasers and computer analysis can help us to understand what characteristics are required for a really good instrument. This extremely enjoyable talk was illustrated by 'live' table top demonstrations as well as laser generated images, computer simulations and a good dose of humour.

This meeting was preceded by the branch's annual meeting. As a further celebration of the 40th anniversary, a cake in the form of a sound level meter (sponsored by Mike Breslin of ANV Measurement Systems) was enjoyed by those staying on at the end of the meeting.

A special presentation was made to Kevin Howell and Andrew Jellyman who are stepping down from the committee. Both have been active members of the branch since it started and have been committee members for many years. The Chairman, Paul Shields, would like to record a special thanks to them for all their work and service to the branch and the Institute.

The committee would like to thank our three presenters, Mark, Graham and Bernard for their excellent presentations, and Atkins Birmingham and Derby University for again hosting us so well.

Bernard Richardson

Members prepare to eat the SLM cake

Government report: noise an increasing nuisance in the UK

Increasing numbers of UK residents are bothered by noise, according to a recently published major Government survey.

Defra's National Noise Attitude Survey 2012 shows that there was an increase since the previous survey in 2010 of between 11 and 17 per cent (depending on the noise source) in the proportion of people surveyed who feel they are to some extent adversely affected by the most common sources of noise (aircraft, construction, neighbours and road).

In general, nearly half those surveyed (48 per cent) said their home life was to some extent adversely affected by noise.

And in the 12 years up to 2012 noise nuisance has moved up from ninth to fourth place in a list of 12 environmental problems and is now rated broadly similar to air quality in people's list of environmental concerns.

The main sources of noise that upset people are, in order of importance, road, neighbours/other people nearby, aviation and construction.

The findings are based on detailed interviews with nearly 2,750 people across the UK.

Other findings include:

- People living in homes built before 1919 tend to report more negative responses to road traffic noise and increased use of quiet areas compared with those in homes built between 1961-1990
- Younger and older people are less likely to respond negatively to noise compared with mid-aged adults.

In the executive summary the report, it states: "Noise is an inevitable consequence of a mature and vibrant society.

"For some the noise of city life provides a desirable sense of excitement and exhilaration, but for others noise is an unwanted intrusion that adversely impacts on their quality of life, affecting their health and well-being.

"Furthermore, the cost of noise pollution in England from road traffic noise alone is estimated to be between £7 billion and £10 billion per year, so this is an issue of some importance."

Steve Mann / Shutterstock.com

Noise nuisance near your home? App's the way to report it

Residents in the London borough of Croydon can now report noise nuisance to their local authority via an app.

Croydon Council has upgraded its app, My Croydon, to include a decibel meter which measures noise and tells the user whether it is loud enough to be classed as a nuisance.

If it is, the app will request more information, such as what category the noise falls under, for example anti-social behaviour, barking dogs or car alarms, as well as approximate location.

The new reporting function is currently being tested, and residents are being asked to provide any feedback on any technical issues they may be having.

So far more than 6,000 people have downloaded My Croydon, which allows residents to report a wide range of other problems including abandoned vehicles, blocked drains, flying tipping, illegal street trading and potholes.

Please contact us for more information or download demo versions
www.soundplan.eu

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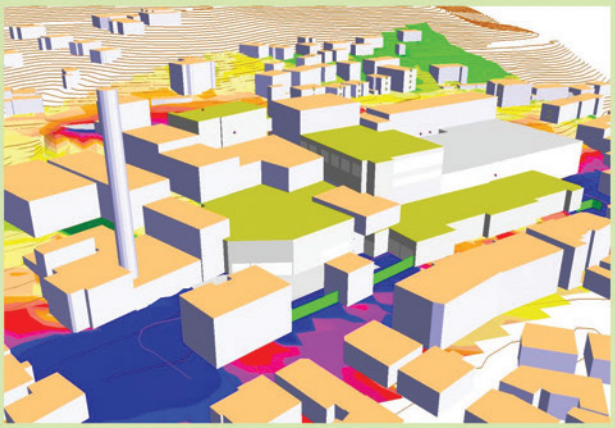
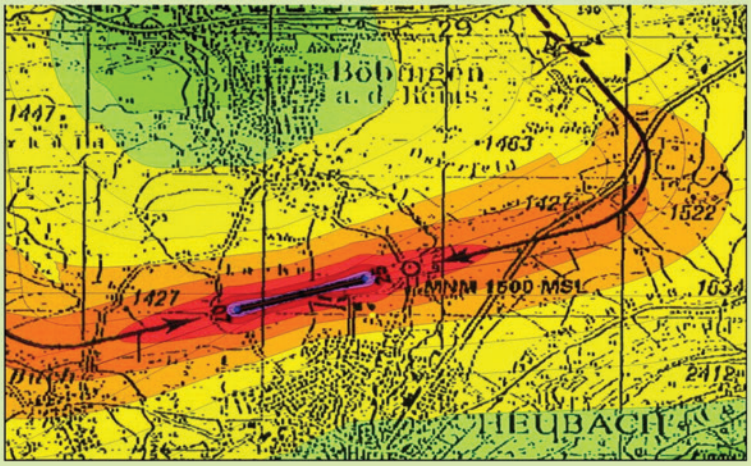
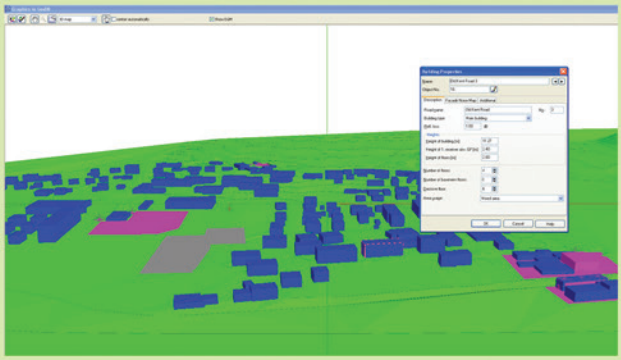
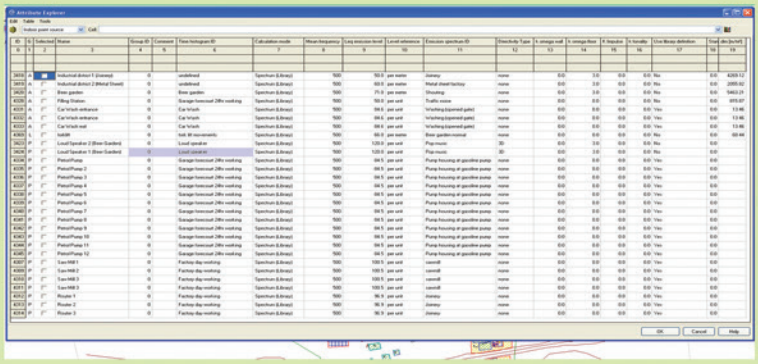




Stunning, easy to use Graphics.





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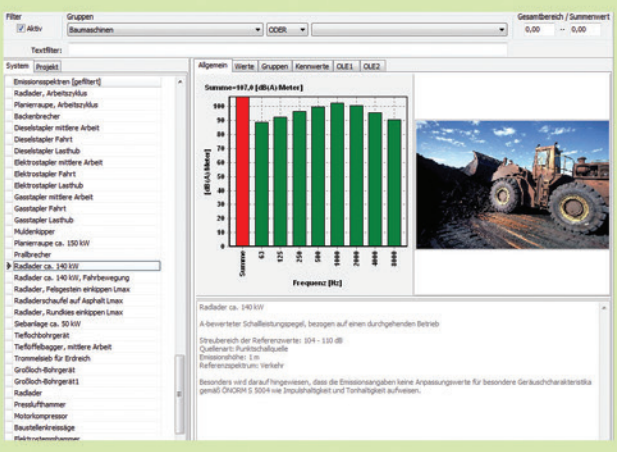
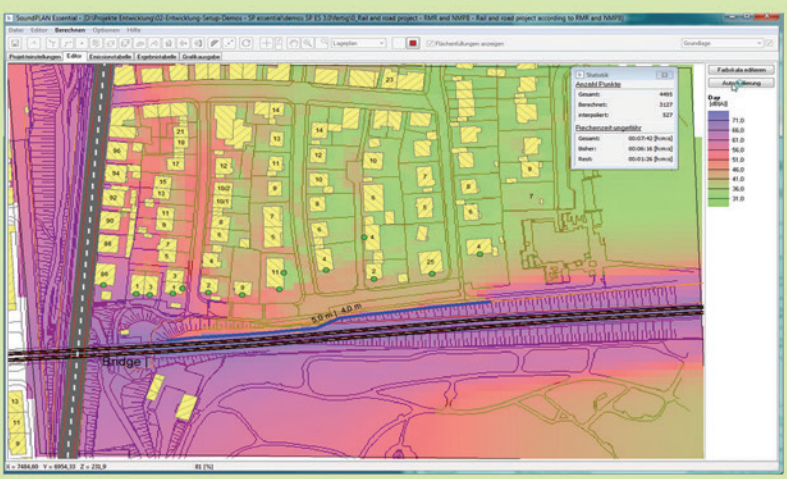




Reference Library now included.

Government seeks new ideas for road noise barriers

Fresh, new pioneering ideas are being sought for innovative noise barriers, the Highways Agency has announced.

The Agency has engaged three suppliers who bring different skills that will deliver its ambition to produce cost effective noise barriers which may offset production and installation costs by generating electricity.

This trial will focus on the M40 initially, but could be rolled out on future projects.

The Highways Agency, working in partnership with the M40 Chiltern Environmental Group, Wycombe District Council and South Oxfordshire District Council, is supporting product developments that can be installed at sites on the M40 and potentially other parts of England's strategic road network.

The project will run in three phases, the first phase is a feasibility study where it has invited suppliers to submit outline proposals. Entrants whose outline designs best meet the brief will next be invited to prepare submissions for approval in principal and then detailed design. The final phase will be to construct a prototype.

The barrier proposals will be evaluated by the partnership. Successful solutions identified for the second phase will be announced in the spring.

Launch of app that can monitor traffic-noise exposure

A new mobile phone application can help monitor traffic-noise exposure.

The app, 2Loud?, can measure indoor night-time noise exposure and, given large-scale community participation, could provide valuable data to aid urban planning, say researchers.

In an Australian pilot study, nearly half of participants who used the app found that they were exposed to potentially unhealthy levels of night-time noise.

Exposure to noise pollution can have serious health effects. Disturbed sleep in particular can lead to cardiovascular problems, such as high blood pressure and heart disease, and the WHO recommends that night-time noise exposure should not exceed 40 dB(A).

Overall, around one third of the EU's population is thought to be exposed to noise pollution severe enough to cause health effects. To address this problem, the Environmental Noise Directive1 (END) was established. The END requires EU Member States to create day and night-time 'noise maps' for major roads, railways and airports, to assess the number of people disturbed by noise.

However, mapping night-time noise, particularly indoors, can be difficult and expensive, especially on a large scale. This study examined how existing consumer technology and community participation could help to improve monitoring.

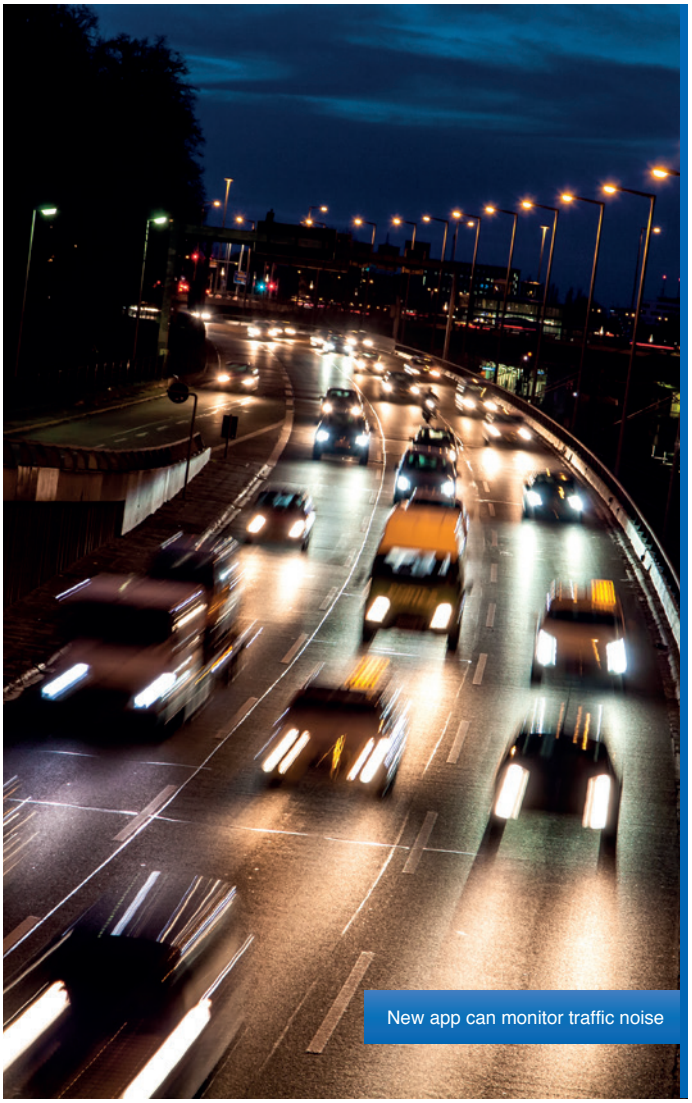
The researchers developed 2Loud? to measure indoor exposure to traffic noise. It records background noise and uploads the data to a server which can then be accessed by the researchers. The key frequencies for traffic noise were then extracted from the data and their loudness analysed. The app was calibrated against a sound meter to ensure accuracy of the recordings.

The application was distributed to 27 residents, living close to highways in Boroondara, Australia. The participants recorded night-time indoor noise using their mobile phones over a period of seven weeks.

More than 1,000 hours of noise readings were gathered during the study. Indoor night-time noise recordings ranged from 23.2 to 58.5 dB(A), with an average of 40 dB(A). Overall, 45% of the monitored areas were exposed to potentially unhealthy noise levels (greater than 40 dB(A)).

Importantly, these results also show that it is possible, through community participation and existing technology, in the form of mobile devices, to collect reliable real-world data on noise levels and exposure from within homes.

In the EU, environmental noise, especially traffic noise, has often received lower priority than other forms of pollution, yet its associated costs are estimated to be at least 0.35% of the EUs GDP (around 45 billion Euros in 2012).



New app can monitor traffic noise

Reducing these costs and the health effects of noise will require targeting areas where noise pollution is especially bad in densely populated areas.

If deployed on a larger scale, a mobile phone measurement and community participation approach could be used to provide inexpensive data to aid in the planning and management of healthier urban environments, the study suggests.

This report is based on one that first appeared in *Science for Environment Policy*.

Acoustic tweezers used to manipulate cell-to-cell contact

Sound waves can precisely position groups of cells for study without the danger of changing or damaging the cells, according to a team of researchers who are using surface acoustic waves to manipulate cell spacing and contact.

"Optical tweezers are the gold-standard technique in the field," said Tony Jun Huang, professor of engineering science and mechanics at Penn State in the US. "They can trap two cells in place, but because of their high power they tend to affect the integrity of cells, and sometimes damage them".

Acoustic tweezers use the same low-power acoustic waves as those used in existing ultrasound machines, so they are gentle and can preserve cell integrity.

The researchers are manipulating cells so that they can look at direct contact between two cell membranes or precisely control and maintain a variety of distances between cells and determine how cells communicate.

"The value of acoustic tweezers for studying cell-to-cell information transfer is their ability to separate the cells to a precise distance or to bring them to a predetermined contact," said Stephen J Benkovic, Evan Pugh Professor and Eberly Chair in Chemistry. "Optical tweezers can do this to some extent but suffer from heating of the sample."

The acoustic tweezers device that the researchers envision is no larger than a cell phone and can achieve a throughput of thousands of cells. By altering the acoustic field, the cells can be precisely manipulated without damage. Because the acoustic tweezers operate in a vertical channel that holds the cell-containing liquid, the researchers can trap the cells in suspension or allow them to settle onto the surface of the substrate.

The researchers place four acoustic sources on opposite sides of the substrate. When opposing devices send out surface acoustic waves, they set up a grid of nodes where the sound pressure cancels out. Cells become trapped at those nodes. By modulating the power and frequencies of the acoustic sources, the researchers can manipulate the number of cells and also their position. Two cells can be moved to touch each other or to almost touch each other with a variety of separation distances.

The cells can also be positioned in patterns including lines of multiple cells, daisy-like clumps of cells or even triangles of cells.

This article is based on one that first appeared in *EurekaAlert*

New acoustic technology enables ultra-fast steering and shaping of light beams

A team of engineers has developed a new acousto-optic device that can shape and steer beams of light at speeds never before achieved. The new technology will enable better optical devices to be made, such as holographs that can move rapidly in real time.

The research has been led by Bruce Drinkwater, Professor of Ultrasonics at the University of Bristol, and Dr Mike MacDonald at the University of Dundee.

The array consists of 64 tiny piezo-electric elements which act as high frequency loudspeakers. The complex sound field generated deflects and sculpts any light passing through the new device. As the sound field changes, so does the shape of the light beam.

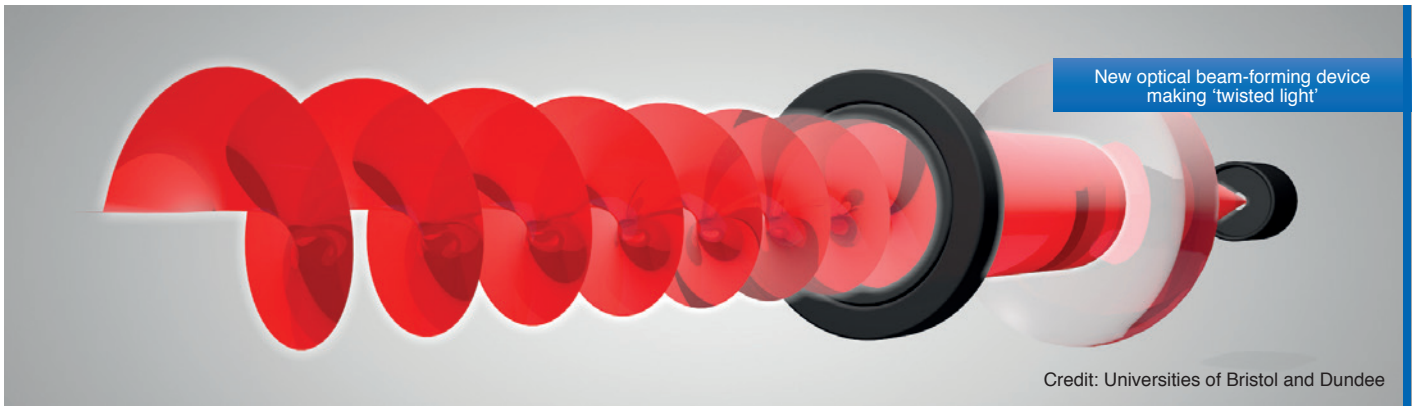
Professor Drinkwater from the Department of Mechanical Engineering said: "This reconfigurability can happen extremely fast, limited only by the speed of the sound waves. The key advantage of this method is that it potentially offers very high refresh rates – millions of refreshes per second is now possible. This means that in the future laser beam-based devices will be able to be reconfigured much faster than is currently possible. Previously, the fastest achieved is a few thousand refreshes per second."

The advancement will enable reconfigurable lenses that can automatically compensate for aberrations allowing for improved microscopy and a new generation of optical tweezers that will make them more rapidly reconfigurable and so allow better shaped traps to be produced.

Dr MacDonald, Head of the Biophotonics research group at the University of Dundee, explained: "What we have shown can be thought of as a form of optical holography where the hologram can be made in real time using sound. Previous attempts to do this have not had the level of sophistication that we have achieved in the control of our acoustic fields, which has given us much greater flexibility in the control we have over light with these devices.

"The device can potentially be addressed much more quickly than existing holographic devices, such as spatial light modulators, and will also allow for much higher laser powers to be used. This opens up applications such as beam shaping in laser processing of materials, or even fast and high power control of light beams for free space optical communications using orbital angular momentum to increase signal bandwidth, as shown recently by a demonstration in Vienna."

Professor Drinkwater added: "The number of applications of this new technology is vast. Optical devices are everywhere and are used for displays, communications as well as scientific instruments."



New optical beam-forming device making 'twisted light'

Credit: Universities of Bristol and Dundee

Loss of healthy life in UK due to noise exposure valued at £1 billion

Exposure to environmental noise levels above recommended levels results in 1,169 cases of dementia, 788 strokes and 542 heart attacks every year in the UK alone, new research suggests.

Valuing a year of healthy life at £60 000 (€74,000) means that these health impacts together have a "cost" of £1.09 billion (€1.34 billion), the study's authors conclude.

Exposure to noise pollution is a widespread problem – in 1996 the European Commission estimated that 20% of the EU population were likely to suffer negative impacts to their health or well-being because of noise. In the UK, a government study estimated that 54% of the population was exposed to day-time noise pollution above recommended levels of L_{Aeq} 16hr 55 A-weighted decibels – a unit which measures sound in a way similar to the human hearing system, averaged over a 16-hour period.

Environmental noise has been linked to a number of different health problems including high blood pressure. This can, in turn, increase the risk of other health problems, such as heart disease or stroke.

For this study, the researchers set out to evaluate how exposure to day-time noise above recommended levels affected the prevalence of abnormally high blood pressure and associated health complications of the UK population. They focused on three health problems most strongly associated with high blood pressure: heart disease, stroke and dementia (vascular dementia and Alzheimer's disease).

To estimate levels of noise pollution, 1,160 sites were monitored across the country between 2000 and 2001. These data were then combined with information on UK residents, as factors such as age can influence health risk. The researchers then calculated the added health problems that were predicted as a result of the noise pollution exposure for groups of different ages or sexes and multiplied this by the number of people in each group.

The results suggested that exposure to noise levels above recommended levels resulted in an additional 1,169 cases of dementia, 788 cases of stroke and 542 cases of heart attack in the UK over the course of a single year.

To calculate the cost of these health impacts the researchers used "quality adjusted life years" (QALYs). The QALY takes into account quality of life by assessing not only the total number of years of life, but also how many years might be spent coping with a non-life threatening illness. For example, an individual who lives for 70 years but only has 60% of full health would have 42 QALYs.

Using a standard government figure of £60,000 (€74,000) for the "value" of a single year of healthy life, the researchers calculated that the health impacts of exposure to noise above LAeq 16hr 55 A-weighted decibels cost £1.09 billion (€1.34 billion), with dementia accounting for 44% of this figure.

The researchers note that these are intangible, or invisible, "costs" arising from loss of a healthy life (see standard figure above), rather than the wider costs to society, such as healthcare. If these latter costs were to be included, the figures are likely to be substantially higher; for instance, previous research has estimated that 99% of the costs of dementia are associated with healthcare and informal care and only 1% with loss of healthy life.

This article is based on one that was published by *Science for Environment Policy*

New tool will predict wind farms' impact on tranquillity of surroundings

Academics at the University of Bradford are pioneering a method that could be used by planners to measure the impact of developments such as wind turbines could have on the tranquillity of the surrounding area.

The method involves establishing the level of tranquillity of a location based not only on noise levels but also visual amenity, such as the existing landscape, and establishes a "footprint".

The method then predicts the impact on that footprint and how

Tool will predict wind farms' impact

it might be reduced by a development and at what distance the development would have to be sited for the original tranquillity enjoyed by people to be restored.

The importance of tranquil spaces in providing health and wellbeing benefits has recently been recognised in the National Planning Policy Framework and the threat to them from development research into tranquillity mapping. The framework states that planning decisions should aim "to identify and protect areas of tranquillity that have remained relatively undisturbed by noise".

The study – led by Professor Greg Watts and assisted by Dr Rob Pheasant at the university' s Centre for Sustainable Environments – combined a number of techniques, including noise measurement software and photographic surveys, to demonstrate the feasibility of producing contour maps of tranquillity.

Professor Watts said: "Using contour maps it will be possible to identify quality tranquil spaces and regular updates to the maps will enable external threats to be identified and action taken.

"Defining a tranquillity footprint has in the past been difficult due to the lack of a prediction method that takes into account both acoustics and visual factors in a precise and quantifiable manner.

"However, our tranquillity rating prediction tool (TRAPT) has the potential to help planning authorities and conservationists quantify the impacts of new developments."

To test the formula, researchers collected data in and around a wind farm near the university, at Ovenden Moor in Calderdale, comprising 23 turbines and were able to plot a hypothetical contour map.

The TRAPT technique has been used before, but only for assessing city and country parks for tranquillity, with the predictions being validated using a questionnaire of park visitors.

New material has ability to control acoustic waves

Engineering researchers at the University of Missouri have developed a material that has the ability to control acoustic waves, creating possible medical, military and commercial applications with, they say, the potential to greatly benefit society.

Guoliang Huang, associate professor of mechanical and aerospace engineering in the College of Engineering, said: "Methods of controlling and manipulating subwavelength acoustic and elastic waves have proven elusive and difficult; however, the potential applications – once the methods are refined – are tremendous.

"Our team has developed a material that, if used in the manufacture of new devices, could have the ability to sense sound and elastic waves. By manipulating these waves to our advantage, we would have the ability to create materials that could greatly benefit society – from imaging to military enhancements such as elastic cloaking – the possibilities truly are endless."

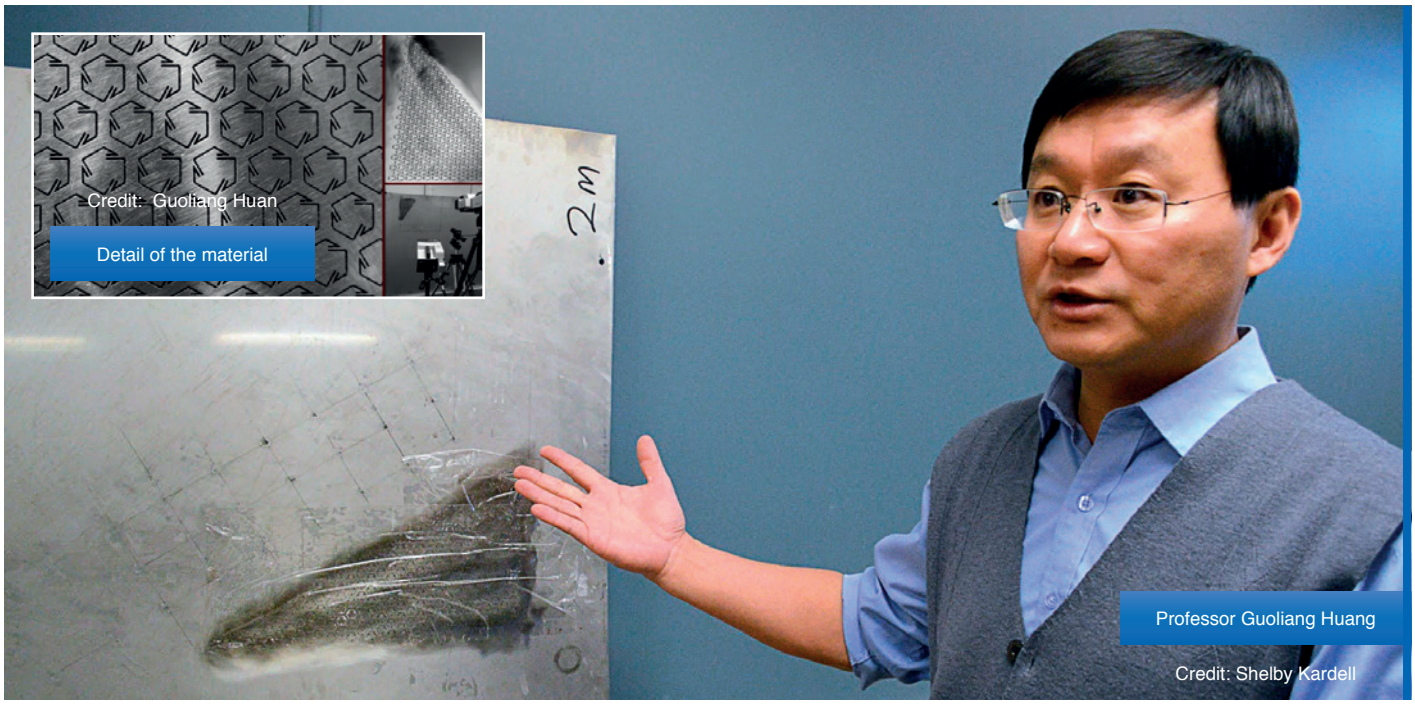
In the past, scientists have used a combination of materials such as metal and rubber to effectively 'bend' and control waves. Huang and his team designed a material using a single component: steel. The engineered structural material possesses the ability to control the increase of acoustical or elastic waves. Improvements to broadband signals and super-imaging devices also are possibilities.

The material was made in a single steel sheet using lasers to engrave "chiral", or geometric microstructure patterns, which are asymmetrical to their mirror images (see photo). It's the first such material to be made out of a single medium. Professor Huang and his team intend to introduce elements they can control that will prove its usefulness in many fields and applications.

"In its current state, the metal is a passive material, meaning we need to introduce other elements that will help us control the elastic waves we send to it," Professor Huang said.

"We're going to make this material much more active by integrating smart materials like microchips that are controllable. This will give us the ability to effectively 'tune in' to any elastic sound or elastic wave frequency and generate the responses we'd like; this manipulation gives us the means to control how it reacts to what's surrounding it."

Going forward, Professor Huang said there were numerous possibilities for the material to control elastic waves including super-resolution sensors, acoustic and medical hearing devices, as well as a "superlens" that could significantly advance super-imaging, all thanks to the ability to more directly focus the elastic waves.



Aero firm fined £50,000 after workers diagnosed with Hand Arm Vibration Syndrome

An international aerospace company has been fined a total of £50,000 and ordered to pay more than £2,500 in costs after 13 employees were found to be suffering varying degrees of Hand Arm Vibration Syndrome (HAVS).

The Health and Safety Executive (HSE) prosecuted Vector Aerospace International Limited, of Gosport, Hampshire, under the Control of Vibration at Work Regulations 2005 after investigating reports that workers were being diagnosed with the condition.

In total, 13 cases emerged of employees who had worked at the same site for between five and 45 years. Two of them were diagnosed at Stage 3 – showing the most severe and painful symptoms.

Portsmouth Magistrates were told that Vector Aerospace, which has a workforce of some 2,700 internationally and 1,100 at Gosport, had surveyed the tools being used by workers in 2007. At that stage they had taken the decision that no controls were needed.

As a result, and despite later reviewing their risk assessment, that error was not identified and the recognised risks of vibration from the use of around 1,600 tools by 400-450 employees on the site was never controlled. The absence of mitigating measures for the workers led to some being exposed to vibration levels likely to have exceeded the legal limits.

HSE also found that the staff on site using such tools had not been provided with any information or training about the risks posed from the work they were carrying out. The 13 cases were identified in 2013/14 after improved health surveillance was eventually introduced.

New study finds 'green' walls can cut residential noise intrusion

Green walls, designed so they are covered in vegetation, could help cut the amount of noise that enters buildings, a new study has found.

In laboratory tests, researchers found that a modular green wall system reduced sound levels by 15 decibels (dB). This leads them to believe that it is a promising sound reduction device that could improve quality-of-life for city residents.

The Spanish study, carried out under the EU-funded SILENTVEG project1, conducted laboratory tests on green walls' acoustic properties. Its aim was to help predict their sound insulation performance in the real world. The design of green walls can affect their sound insulation properties.

The type of plant grown can also have a big effect. In this case, the study focused on a modular green wall system, which is composed of compartments or boxes attached to a vertical frame and is the most widely used system.

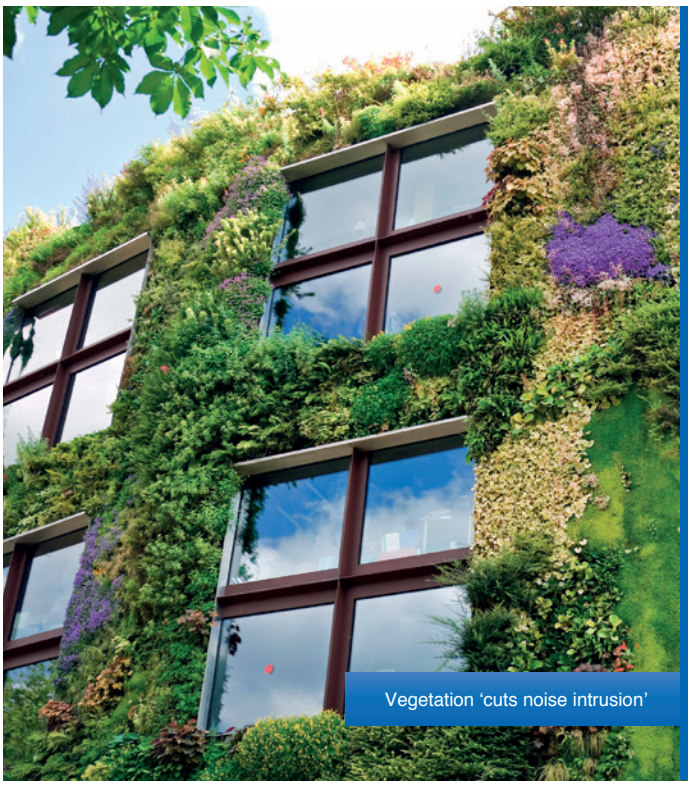
The boxes in this study were made of recycled plastic and filled with coconut fibre, acting as "soil". They were all planted with Helichrysum thianschanicum, a popular shrub for gardening in the Mediterranean region, with an average height of 40 cm.

The researchers placed 10 of the boxes, totalling 2.4 m2 in area, onto a wall which separated two rooms. They emitted noise in one room at frequencies ranging between 100 hertz (Hz) and 5 000 Hz, and then measured the reduction in noise levels in the neighbouring room caused by the green wall. The green wall reduced noise levels in the neighbouring room by an average of 15 dB.

The researchers note that this reduction is quite low compared with other solutions; thermal double-glazing can reduce noise by 30 dB, for example. A sound barrier made from two layers of plasterboard, separated by a wool-filled cavity, can reduce noise by 70 dB. Nonetheless, they believe it still has good potential to help cut noise levels in urban buildings and could be used effectively in public places, such as hotels and restaurants.

Furthermore, if its design was improved by sealing the joints between the boxes, then it could reduce noise by an extra 3 dB. The other benefits of green walls, such as increased biodiversity, visual attractiveness, air purification or climate regulation, also make them an attractive option. This experiment considered noise that is transmitted directly through a wall, but in a realistic situation noise bounces off different surfaces and can be transmitted indirectly through a number of routes. Therefore the logical next step in this research would be to test the green wall on actual building façades, the study's authors say.

To further improve their understanding of the wall's basic acoustic properties, the researchers also investigated how much sound a green wall can absorb. In this experiment, they placed the green wall (this time 10 m2 in area) on the floor of a room in which sound was emitted, again at frequencies of 100–5 000 Hz. The wall was calculated to have a 'sound absorption coefficient' of 0.40, i.e. it absorbed 40% of the sound.



Vegetation 'cuts noise intrusion'

Are motorways the best spot for wind turbines?

Wind turbine noise can be detected at low levels, even when it is heard alongside motorway traffic noise, a study has found. It is possible for louder motorways to drown out turbine noise, however. The participants in this listening experiment could easily detect wind turbine noise, but only once they knew it was present in recordings of environmental noise.

Public annoyance with wind turbine noise is rising with the increasing number of turbines installed. Previous studies have suggested that people are more annoyed by wind turbines than other sources of environmental noise, such as road traffic, even if they are equally as loud. Research has also indicated that masking turbine noise with other sounds could reduce annoyance.

This Belgian study adds to the body of research into turbine noise. Motorways have been proposed as good locations for turbines, partly because the traffic could help conceal turbine noise. Fifty people participated in a listening test in which they were asked to identify and detect wind turbine noise when heard alongside traffic noise. None of the participants held negative attitudes towards wind energy, and only one was particularly familiar with turbine noise.

The researchers first played recordings of noise at realistic indoor sound levels (40 A-weighted decibels (dBA)) to participants while they read at leisure in an otherwise quiet room. At this stage, the participants did not know the true purpose of the study or that they were going to be played recorded noises.

There were four types of recording: pure wind-turbine noise, pure motorway noise, combined motorway traffic and wind turbine noise, and combined local road traffic and wind turbine noise. Motorway noise was continuous, whereas local road noise was intermittent and individual vehicles could be heard driving past.

The researchers asked participants to rate how annoying they found the noise recordings, without telling them what the recordings actually were. Participants considered local road traffic recordings much more annoying than motorway and turbine recordings. There was little difference in annoyance levels for motorway and turbine recordings, whether in isolation or combined.

When asked to name what they had heard, nearly all participants correctly identified road traffic noise. Just under half said they had heard wind turbines. A number of incorrect answers were given, including air traffic (48% of respondents) and sea waves (28%).

In a second stage of the experiment, the researchers explored how loud traffic noise would have to be in relation to turbines, to mask their noise effectively. The participants were asked to deliberately listen for turbines in recordings, which had an overall volume of around 40 dBA, but with varying ratios of turbine and traffic noise.

At this stage, the listeners easily detected turbine noise in combined recordings, now they knew it was present. Those who detected it most easily tended to be the same people who had rated it as annoying in the first part of the experiment.

Listeners started to detect turbine noise when it was 23 dBA quieter than accompanying motorway noise. The turbine noise's acoustical energy was thus 200 times lower than the motorway's. In contrast, turbines could be detected at all volumes when combined with local road traffic, which suggests that road traffic is not suitable for masking turbines.

The researchers caution that the study was small-scale and short-term; some patterns they observed here might be different if they had conducted a long-term study.

This article is based on one published in *Science for Environment Policy*

Finnish research team examines the human effect of wind turbine noise

A Finnish research team is examining the effect of wind farm noise on people.

It says that despite the fact that people exposed to such noise may suffer physical and psychological symptoms, not much is known about the link between noise and the way in which it is experienced. Its aim therefore is to combine empirical knowledge and physical measurement data.

The study, by the South Karelian Institute of Lappeenranta University of Technology (LUT), will not only measure decibel levels but also try to analyse what kind of noise wind farms generate.

Sari Janhunen, one of the researchers, said: "Simultaneously with the noise, we also measure wind, which means that we can combine the wind data with the volumes and characteristics of the perceived noise. In the future, it might be possible to use this data in the planning of wind power plants."

The study is being carried out in two municipalities with wind farms. In both locations the nearest settlements are between 500 and 800 metres from the farms.

The municipalities were selected on the basis of strict criteria. The aim was to find areas where wind turbines based on the latest technology were used. The wind farms also needed to have existed long enough for residents to have experience of living near them.

The study began with a questionnaire to 1,600 people which asked about their noise experiences and factors concerning health and well-being.

The study will also measure and record sound pressure levels of the wind farms. Residents living nearby will also keep a noise observation log and the end of the study they will also be interviewed.

"With the responses, we will be able to analyse how people perceive wind power noise in their own areas of residence compared with other sources of environmental noise in the vicinity," said Ms Janhunen.

According to a new decree proposed in Finland, the daytime level of outdoor noise produced by wind farms should not exceed 45 decibels and at night it should not be more than 40 decibels.

"If it becomes necessary to restrict the level of noise generated by wind power plants, the amount of energy produced by them will also be reduced. The aim is to produce information that could be used in the development of wind power plants so that while the production could be maximised, the environmental impacts could be minimised," Ms Janhunen concluded.

Hope Bagenal and Wallace Clement Sabine: a legacy in letters

By Fiona Smyth

The 'father of architectural acoustics' and the 'human tuning fork'

The 13th of April has proven to be a noteworthy date in more than one year. Handel's Messiah premiered on that date in 1742, Samuel Beckett was born on that date in 1906, and a little over 100 years ago, a Harvard professor of physics penned a detailed letter in response to a set of queries from a young architectural student in London. The Harvard physicist was Wallace Clement Sabine (1868-1919), often referred to as "the father of architectural acoustics". His correspondent was Philip Hope Edward Bagenal (1888-1979), a young man destined to become Britain's first independent acoustic consultant and who became known by his contemporaries as "the human tuning fork". The chain of correspondence initiated in the spring of 1914 between Sabine and

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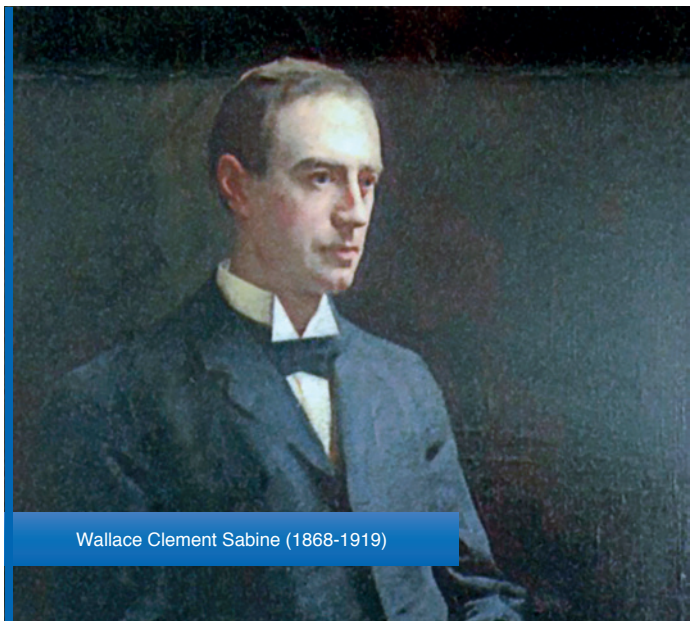
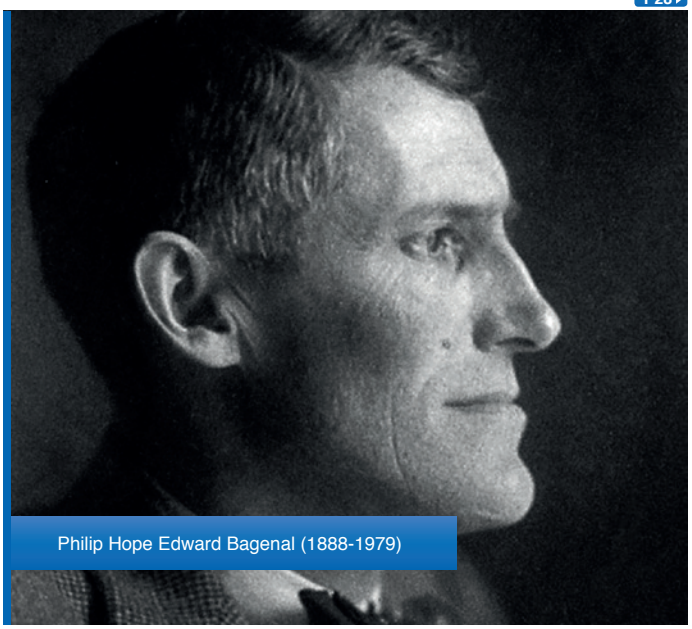


Wallace Clement Sabine (1868-1919)



Philip Hope Edward Bagenal (1888-1979)

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Bagenal represents the first contact between the two men and it was to prove formative and immensely productive.

Neither Sabine nor Bagenal require much by way of introduction to acousticians. Sabine, born in 1868, redefined the course of architectural acoustics through his work in Harvard at the turn of the 20th century. His work on reverberation time, although widely-published in architecture and physics journals in the US, was not widely circulated in Britain until after the outbreak of the First World War. Bagenal was among the first in England to encounter Sabine's published work, to apply it within architectural practice, and to engage with it as a foundation for furthering research in architectural acoustics. Bagenal's was a remarkable career which spanned from the instigation of the first independent British acoustic consultancy in 1919 until his final acoustic project, undertaken in 1972 at the age of 84. The hallmark of his work can be heard, if not seen, in most of the major civic and ecclesiastic buildings constructed in Britain throughout the middle of the 20th century.

Much of Bagenal's early formative thinking in acoustics was shaped by correspondence with Sabine. This article relates the story of the letters exchanged in the spring of 1914 between two noted acousticians from either side of the Atlantic. It charts the beginning of Bagenal's career as an acoustician and his formative interaction with Sabine.

Science and 'something of a revelation'

Bagenal first encountered Sabine's work in 1912. Earlier that year the Royal Institute of British Architects (RIBA) had introduced a number of changes to its final examination syllabus.[1] Chief among these was the introduction of a research thesis. The thesis could be on one of three topics. Two of these topics, historical architecture and design including decoration, were standards in architectural education at the time. The third topic, science as applied to building, was new and its scope essentially undefined. It was up to the student to identify a scientific issue that would be relevant to the profession. Recommended texts on the topic of science fell largely under the umbrella of what was termed "sanitary science and hygiene". These texts related almost exclusively to heating, lighting, ventilation, and drainage. No texts on acoustics were included on the list. Despite this, Bagenal was determined to write his thesis on architectural acoustics. However, researching and defending the topic was not straightforward.

The RIBA architectural library at the time retained only one professional handbook on architectural acoustics. That text, *Acoustics of Public Buildings* by T. Roger Smith, provided little solid guidance for the student (or practitioner) of architecture. The book described acoustics as "confessedly obscure" and acknowledged quite frankly that it was an unpredictable aspect of design and construction.[2] The text was also one of only two books which had been available to Sabine when he was undertaking his research at Harvard. Neither Sabine nor Bagenal had found it particularly helpful, Sabine citing it some years later as being not "very definite either in … data or … recommendations".[3]

At the time of Bagenal's research, Sabine's work on reverberation time had not yet become mainstream in Britain. Indeed Sabine's notebooks in Harvard suggest that he intended to meet with publishers in London in the summer of 1914 with a view to bringing his work into circulation on this side of the Atlantic.[4] The only article by Sabine that was readily available in 1912 was an entry in an architectural encyclopaedia.[5] Bagenal's encounter with this article was a turning point in his research. The article was the first he had seen to introduce quantifiable aspects to the '"confessedly obscure" subject, and he was intrigued. In his subsequent correspondence with Sabine, Bagenal described encountering the article as "something of a revelation".[6]

Bagenal had initially based his acoustic research on observations, studies of music and surveys focusing on particular architectural sites in London. Sabine's article both elucidated the topic, and confirmed that it could be scientifically addressed. However, finding more information was to prove challenging.

Bagenal's thesis was due to be submitted in the summer of 1914. From the time of his first encounter with Sabine's article in 1912, he was to search the London libraries for two years in pursuit of more information. His search came to fruition in early 1914 when he located an American journal, *The Brickbuilder*, in the library of the London Patents Office. To his great delight, the January edition of that journal featured an in-depth article by Sabine entitled *Building Material and Musical Pitch*.[7] The article was complete with affiliation from which contact details could be extrapolated. Bagenal wrote immediately to Sabine with a series of questions prompted by his thesis research. Sabine responded at length, and in effect, acted as external supervisor to that thesis.

In their letters, Bagenal and Sabine discussed music and the Gregorian modes, significant acoustic sites in London, use of the reverberation time formula in the imperial rather than metric system, and the possibility of calculating reverberation time for individual notes, as opposed to octaves, of the musical scale. They also discussed a planned visit by Sabine to London that summer.

Meanwhile, in his letters, Bagenal wrote of his renewed interest in architectural acoustics.[8] He completed his thesis and submitted it for examination in May 1914.[9] Only three theses submitted that year were on the topic of science as applied to building, and of the nine thesis examiners, just one was assigned to that topic.

Bagenal defended his thesis on acoustics in the same week that Arch-duke Franz Ferdinand of Austria was assassinated in Sarajevo. The thesis defence proved complicated. Within the RIBA, acoustics had been little dwelt upon since Smith's book, and new developments in the area had not been recognised. Bagenal met with some opposition from his examiner.

Not only had the science of architectural acoustics advanced in the interim, but terminology had also changed. The concept of reverberation, as it was described in Smith's book, bore little resemblance to the scientifically defined reverberation time that had emerged from Sabine's work. Reverberation was portrayed in the 19th century text as a negative and unquantifiable influence. It was variously described as a combination of "smothered echo" and "an overdose of resonance", and ascribed to negative influences such as "bad proportion" and "defects" in materials. The general recommendation for reverberation was avoidance where possible in every type of building with the sole exception of "public places of mercantile resort".[10]

Given Bagenal's difficulty in locating Sabine's copies of published work, it seems unlikely that his RIBA examiner, who was not an expert in acoustics, would have encountered it. Three theses were relegated that summer, amongst them Bagenal's work on acoustics.[11]

The disappointment of the thesis defence was soon overshadowed. The examination results were announced in the *RIBA Journal* at the end of July.[12] Within a week of their publication, England had declared war on Germany. On 6 August Bagenal enlisted with the RAMC and commenced training the following Monday.[13]

In light of the political situation, it seems unlikely that Bagenal and Sabine's plans to meet that summer in London came to fruition. Sabine and his family had travelled to Europe as scheduled. However, when war was declared in early August, their original plans were disrupted.[14] It seems that Sabine arrived in London, just as Bagenal left to begin his RAMC training at Aldershot.

Wartime implications

Despite the negative reception accorded his thesis by the RIBA, and the subsequent wartime upheaval, in autumn of 1915 Bagenal's mind seems to have turned again to acoustics. He sent an extract from his thesis to a prominent British architecture journal. The previously ill-received work was published that December, coming into circulation while Bagenal was serving in Flanders.[15] The 1915 war diary for Bagenal's regiment recorded difficult conditions that December, compounded by heavy rain and mud.[16] But Bagenal organised a piano in the billet for the troops,[17] and Christmas for the 27th Field Ambulance arrived that year complete with the "further allotment of baths", clothing, music, and the first work on architectural acoustics to have been published in a British architecture journal in 20th century.

In July 1916 Bagenal was wounded on the Somme. He returned

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to England on a stretcher for treatment at the Eastern General Hospital in Cambridge. It was here, in 1916, that he encountered Alex Wood, a professor of physics who shared his interest in acoustics. Wood had just encountered the work of Sabine that very year (1916).[18] The two men instigated a research partnership and jointly secured a contract with Cambridge University Press to publish a book on architectural acoustics.[19] Although the book was subsequently published by Methuen, it seems that the endorsement of both Wood and the Cambridge University Press was the verification that the RIBA needed. Bagenal's initially-spurned thesis on acoustics was finally accepted by the examining body in 1918, some four years after it was initially submitted for examination. In the same year that Bagenal applied to have his work on acoustics reconsidered, the *RIBA Journal* published its first article by Sabine.[20] It would appear that both the significance of, and advances in, building acoustics were becoming increasingly recognised by the architectural fraternity.

With his new qualification as an associate of the RIBA, Bagenal was offered his pre-war architectural job back. However, he declined in favour of a new position which would allow him time and flexibility to work on acoustics.[21] The site of his first project with the new company (Smith and Brewer) was the Fitzwilliam Museum in Cambridge. Both the flexibility inherent in the position and the location of his project left Bagenal ideally placed to continue his research partnership with Alex Wood.

Through his new employer, Cecil Brewer, Bagenal also became acquainted with the architect Henry Martineau Fletcher, who had just assumed a chair as president of London's Architectural Association (AA) School. Within a year of Bagenal's return to practice, Fletcher had offered him a position on the staff of the AA School, with the promise of office space for consultancy work on acoustics. The first independent acoustic consultancy in Britain was initiated in 1919, followed shortly thereafter by the first lecture course dedicated to acoustics for architects, designed and delivered by Bagenal.

The legacy of the Sabine-Bagenal interaction

Sabine died in 1919. It seems unlikely that he and Bagenal ever had the opportunity to meet in person, but the legacy of their correspondence continued in Bagenal's work, not just in his consultancy but also as a foundation in the design of experiments and laboratories for acoustic work at the Building Research Station which from 1923 onwards went from strength to strength.

Sabine's immediate plans for publication in England had been disrupted by the First World War and his untimely death, but over the next several years, Bagenal was to promote and disseminate Sabine's work in England. Sabine's collected papers were posthumously published in 1922. Bagenal's review of that collection for the *RIBA Journal* opened with the statement that "it is rare that any branch of accurate knowledge owes so much to a single mind as architectural acoustics owes to Sabine".[22] Throughout the next six decades Bagenal's work built upon the principles first annunciated by the Harvard physicist.

In addition to his practice, research and teaching in architectural acoustics, Bagenal published prolifically on that topic throughout his lifetime. The *RIBA Journal* has never, neither before nor since, published the same volume of articles on architectural acoustics as it did when Bagenal was a contributing author.

In 1956 Bagenal received an OBE for services in the field of acoustics. In April 1976, he was awarded an honorary fellowship of the recently-formed Institute of Acoustics. Alongside a brief resume of his work, his IOA citation described him as

"… the most distinguished practitioner of the art and science of architectural acoustics of our age… It is not merely his consulting work which merits the honour we now do him; it is above all, his concern for the beauty of sounds with which he invested the attitude of architectural acousticians in Britain."

Acknowledgements

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Biography

Fiona Smyth trained as an architect in University College Dublin. Her subsequent doctoral work on architectural acoustics was undertaken jointly between the School of Architecture in University College Dublin and the Department of Mechanical Engineering in Trinity College Dublin. Her PhD thesis was awarded the Newman Medal for architectural acoustics in 2014. Prior to completion of her doctoral work, she held a research fellowship at the UCD Urban Institute Ireland and also worked in architectural practice.

References

1. Revised Syllabus of the RIBA Examination, Journal of the Royal Institute of British Architects. 19 (3rd Series) 769-770. (21 October 1911).
2. T.R. Smith, Acoustics in Relation to Architecture and Building: The Laws of Sound as Applied to the Arrangement of Buildings, 2nd ed London: Crosby Lockwood, 2-3. (1895).
3. Letter of W.C. Sabine to F. C. Paton, 1916, Harvard University Archives.
4. Notebooks of W.C. Sabine, Harvard University Archives.
5. W.C. Sabine, 'Acoustics' in R. Sturgis (Ed.) A Dictionary of Architecture and Building, Michigan: The University of Michigan Press. (1901).
6. Letter of H. Bagenal to WC Sabine, 25 March, 1914. See W. Orcutt, Wallace Clement Sabine: A Study in Achievement, Massachusetts: Plimpton Press (1933).
7. W.C. Sabine, Building Material and Musical Pitch, The Brickbuilder, 23 (1), January 1914.
8. Letter of H. Bagenal to A. Hogg, 1 April 1914, Hertfordshire County Archive.
9. RIBA Kalendar, 1914.
10. T.R. Smith, Acoustics in Relation to Architecture and Building: The Laws of Sound as Applied to the Arrangement of Buildings, 2nd ed London: Crosby Lockwood. (1895).
11. Journal of the Royal Institute of British Architects. 22, 615. (July 1914).
12. Journal of the Royal Institute of British Architects. 22, 615. (July 1914).
13. Letter of H. Bagenal to A. Hogg, 6 August 1914, Hertfordshire County Archive.
14. For details of Sabine's travels in 1914, see W. Orcutt, Wallace Clement Sabine: A Study in Achievement, Massachusetts: Plimpton Press (1933).
15. H. Bagenal, Musical Acoustics in the Three Acoustics of London, The Architects' and Builders' Journal, 272-273. (22 December 1915).
16. War Diary for the 27th Field Ambulance,British National Archives, WO 95/1758/2
17. H. Bagenal, Fields and Battlefields, New York: MacBride & Co. (1918).
18. See comments by Wood following lecture delivered by Bagenal/ Published as H. Bagenal, Lecture: Planning for Good Acoustics' in Journal of the Royal Institute of British Architects. 32, 29-43. (November 1924) pp. 29 - 43.
19. Letter of A. Wood to Cambridge University Press, 5 May 1917, Cambridge University Library.
20. W.C. Sabine, Architectural Acoustics, Journal of the Royal Institute of British Architects, 25, 70-77. (1917).
21. Letter of H. Bagenal to A. Bagenal, 13 February 1918, Hertfordshire County Archive.
22. H. Bagenal, Architectural Acoustics: The Physical Relationship between Building and Music, August, Journal of the Royal Institute of British Architects, 30, 573-575. (1922).

Machinery noise: legal requirements for information

By Paul Brereton of the Health and Safety Executive

Introduction

There are currently two European Directives requiring the provision of information on noise when certain equipment, including machinery, is placed on the market. These are the:

- Machinery Directive 2006/42/EC (MD), and
- Outdoor Noise Directive 2000/14/EC (OND).

Both Directives are part of the European system for the removal of barriers to trade by means of applying common harmonised requirements to products in all Member States. Information on the system is given in the European Commission's "Blue Guide" – see Further reading.

The MD sets out essential requirements concerning health and safety. Noise is one of many hazards addressed by the MD. In the case of noise, there are specific requirements to minimise the noise hazard, preferably at source, and to report noise emissions. General requirements of the MD concerning information for safe use apply to noise as they do to any other hazard.

The OND applies to specified outdoor equipment. It protects the environment and all citizens through harmonising the laws of Member States regarding noise emission limits and labelling requirements at the manufacturing stage.

European Directives have to be implemented in Member States through national legislation. For both the MD and the OND the Department for Business Innovation and Skills (BIS) has the policy lead for the relevant UK regulations. These are:

- The Supply of Machinery (Safety) Regulations 2008 as amended (SMR08) and
- The Noise Emission in the Environment by Equipment for use Outdoors Regulations 2001 as amended (NEEEOR).

Enforcement of these regulations is split between a number of UK market surveillance authorities (MSAs). Under SMR08, the Health and Safety Executive (HSE) leads on machinery for use at work and the relevant local authority (Trading Standards in GB) for machinery not for use at work. In the case of NEEEOR, the Vehicle Certification Agency (VCA) is the sole enforcement authority in GB. Further guidance on both Directives, their UK implementing regulations, and the enforcement authorities, is available as listed under 'Further reading'.

Compliance with noise requirements

The MD and OND and their implementing Regulations in Member States impose a number of specific requirements on those placing products on the European market i.e. designers, manufacturer, importers, etc. These requirements must be met before the products are placed on the market.

MSAs, such as HSE, HSENI and the VCA in the UK, are appointed to enforce the requirements. This includes undertaking market surveillance activity to check compliance, to protect the

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interests of product users, and to ensure operation of the European free market. Between 2008 and 2012 the UK participated in a joint market surveillance project looking at the compliance of many machines with the Noise requirements of the Machinery Directive (NOMAD). Machines covered by the OND were also considered.

Reported in 2012, the NOMAD project found that 80% of machines studied failed to comply with these Directives. Some machines had gained a presumption of conformity through use of harmonised standards but were found non-compliant in the NOMAD project. Findings in the UK were consistent with findings across all nine participating Member States. As a result of this work, a NOMAD Task Force was set up in 2012 which included representation of the Commission and Regulators for machinery from Member States. The Task Force is implementing the eight recommendations of the NOMAD report to help duty holders (manufacturers, suppliers, etc.) and other stake-holders improve compliance with the requirements of both the MD and OND.

Essential health and safety requirements of the MD

Under the MD, machinery must be designed to meet all essential health and safety requirements (EHSRs) that apply to the product. These are listed in Annex I of the MD. EHSRs set objectives for safety that must be met, or where that is not possible, take account of the 'state of the art'. For example, EHSR 1.5.8 states "*machinery must be designed and constructed in such a way that risks resulting from the emission of airborne noise are reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source*".

In meeting the objective for health and safety, the general principles of safety integration as set out at EHSR 1.1.2 must be followed according to a hierarchy of:

- Firstly, eliminating or reducing the hazard at source (where possible);
- Secondly, protecting against the hazard taking account of the 'state of the art'; and
- Thirdly, providing information about any remaining hazards.

EHSR 1.7.4 requires certain information for health and safety be provided to users, and at clause 1.7.4.2 specifies the content of the Instructions which must be supplied with the machine. Several of the requirements here relate to noise, depending upon the machine and the circumstances, for example,

(h) where use and foreseeable misuse may cause a noise risk
(j) installation to minimise noise risk
(k) instructions for use to avoid unnecessary noise, including training of operators
(l) information about risks that are not otherwise clear
(m) the protective measures to be taken including, where appropriate, the use of personal hearing protection
(n) may be relevant if the choice of tooling significantly changes the noise risk
(r) the maintenance and adjustments required to prevent unnecessary noise.

Furthermore, noise information required to be declared by EHSR 1.7.4.2(u) is:

- the emission sound pressure level, if it is above 70 dB(A) at a workstation
- the sound power level, if the sound pressure level at a workstation is above 80 dB(A)
- the peak sound pressure level, if it is above 130 dB(C) at a workstation.

Numerous details and exceptions are set out in EHSR 1.7.4.2(u). For example, where the machinery is within the scope of the OND, the sound power level reported must be the "guaranteed sound power level". This is determined and reported according to the OND rather than the measured sound power level and its associated uncertainty value required by the MD. Where the OND applies, the sound power level is required whether or not the emission sound pressure level at a workstation exceeds 80 dB(A).

Sales literature describing the performance characteristics of machinery must contain the same information on noise emissions as given in the instructions (EHSR 1.7.4.3).

Fitting of decals to noisy machines, for example, reminding of the need to wear hearing protection, would contribute to compliance with the general duty to warn of residual risk (EHSR 1.7.2).

Harmonised standards supplementing the MD

More than 700 harmonised standards provide detail on how to

Machinery noise must meet European Directive 2006/42/EC (MD)

meet the EHSRs of the MD. They are the main way for manufacturers to comply although their use is optional, at the manufacturer's choice. Where followed in full, these standards may give a presumption of the product's conformity with the EHSRs of the MD. The presumption of conformity is subject to the standard's scope and any qualifications on its application. Qualifications are specifically mentioned in annexes within the standard, for example Annex ZA. A standard only provides a presumption of conformity after it is listed in the Official Journal of the European Union.

Many standards provide for a presumption of conformity with EHSR 1.7.4.2(u) – reporting of noise emissions. These noise emission values can be used to demonstrate compliance with EHSR 1.5.8 – minimisation of risks from noise. The standards may also help meet other requirements for noise though standards for some types of machine provide more help than others.

If a standard excludes noise from its scope, the manufacturer cannot rely on the standard to gain a presumption of conformity with noise requirements and must justify the product's design in the machine's Technical File (Annex VII of the MD). Where noise is not adequately covered by a standard, or the choice is taken not to follow a standard, either in full or in part, the duty holder will need to pay close attention to the requirements of EHSRs 1.5.8 and 1.7.4.2 and particularly sub-paragraphs (j), (l), (m) & (u) to ensure the noise requirements of the MD are fully met.

Harmonised standards need not be followed (forfeiting any presumption of conformity), but the requirements of the MD (and OND) must always be fully addressed.

Outdoor Noise Directive 2000/14/EC (OND)

The OND applies to 57 types of equipment, which are usually used outdoors. It requires declaration of a guaranteed sound power level, that is, a sound power level that has been derived from measurements and a consideration of the uncertainties in the measured values such that the guaranteed value will not be exceeded.

The OND sets limits on the guaranteed sound power emission for 22 of the 57 equipment types it covers.

The method of measuring the sound power level is set out in the OND for each class of equipment covered – both measurement method and operating conditions during measurement. The method of determining the uncertainty due to variations in equipment production and in measurement of the noise and hence the guaranteed sound power level, is not set out in the OND. The methods that have been selected and used to determine uncertainty must be set out it the machine's technical documentation.

The OND calls on many obsolete standards, for example, ISO 3744:1995. The OND adopts the 6 microphone array of EN ISO 3744:1995 but includes information for a 12 microphone array. It might be expected that the range of uncertainty in measurement using the methods specified in the OND is greater than might be found using current standards.

The duty holder (manufacturer, etc.) is required to mark the guaranteed sound power level on the machine having taken into account the uncertainties due to tolerances in machine production and in measurement of noise. Technical documentation is required to support the measured and guaranteed values reported. Several annexes to the OND set out procedures permitted for collection and reporting of the information.

Member States are under an obligation to collect declared sound power levels and report them to the European Commission. The Commission is obliged to report at least the following information periodically (preferably annually):

- the net installed power or any other noise related value
- the measured sound power level
- the guaranteed sound power level
- equipment description
- manufacturer and/or brand name
- model number/name.

Guidelines for the application of the OND have been drawn up by the Working Group on Outdoor Machinery. Notified Bodies have their own Working Group to agree uniform action on the requirements of the OND.

For the OND, presumption of conformity may be gained by following the procedures set out in the Directive and its Annexes.

Management of workplace noise exposures and risk

Management of risk from workplace noise is a duty of the employer. Requirements are harmonised across Europe under the Physical Agents (Noise) Directive 2003/10/EC (PAND), and implemented in GB by the Control of Noise at Work Regulations 2005 (CoNaWR). The PAND is a Social Provisions Directive and, as such, sets minimum standards to be achieved by Member States.

The CoNaWR require the noise information supplied with machinery to be considered by the duty holder as part of their assessment of the risk from noise and the measures required for its control. Relevant information supplied with machinery might include noise emission values, special information on installing and operating the machine or training required to achieve low noise, maintenance required to sustain low noise, etc. consistent with the requirements of MD EHSRs 1.7.4.2(h), (j), (k), (m), (n), and (r) discussed above.

Common causes of failure to comply with the noise requirements of the MD and OND

Many manufacturers, importers, suppliers, etc. have failed to comply with their duties to report noise information, including noise emission values.

Much appears to be known about the requirement to report noise emissions, perhaps because many standards exist to help duty holders do so. However, less seems to be known about the requirement, from time to time where special measures are needed, to supplement the noise emission information with information about how to minimise the noise risk. For example, noise from a machine may be managed readily for many applications but for other applications the noise could be very high. The machine's manufacturer is required to warn of known high noise applications and of methods for protecting against the noise hazard. Following the manufacturer's advice should help the employer comply with his duties under the CoNaWR. The manufacturer's advice for the employer might include: methods of screening operators from the high noise; special instructions for the operators on how to minimise noise hazard; and the performance required of hearing protection. These are largely, but not exclusively, covered by EHSRs 1.7.4.2(l) and (m).

The noise information supplied in the instructions with some machines is not consistent with the noise test code or safety standard cited in those instructions.

Some noise standards (and sometimes, the OND) can be difficult to follow. Many noise test codes have been adapted from previously existing standards and sometimes this has worked well. But

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there are examples where the purpose of an adopted standard is far removed from the intention of warning of noise hazard and facilitating comparison of machinery noise emissions. In such cases, the information provided is poorly matched to the EHSRs. Such a harmonised standard may, in due course, be disputed and replaced with a more appropriate standard. In the meantime, whilst the presumption of conformity provided by a harmonised standard will continue, machinery manufacturers are advised to check that the requirements of all the EHSRs relating to noise are fully addressed.

Some machines are supplied with information according to only one or other of the OND or MD when both apply. When both the MD and OND apply, all the information required by the MD should appear, with the MD requirement for reporting measured sound power level and uncertainty substituted by the OND requirement for reporting the guaranteed sound power level. Where the OND applies, the method for determining a guaranteed sound power level set out in the OND should be used even if the standard harmonised under the MD includes a method for measuring sound power.

The differences in magnitude between the reported sound pressure level and sound power level can be much smaller or larger than would be expected from theory. This is often due to inconsistencies between the methods used in standards for determining the respective quantities. Control of the noise emissions of a machine can be assessed by comparison of machines using reliable relative magnitudes of either the sound pressure or the sound power. However, if the sound pressure level does not represent likely noise hazard, further information should be provided under EHSR 1.7.4.2(l) sufficient to describe the noise hazard.

Further reading

- DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast). OJEU L157. 9 June 2006. European Commission
- Guide to application of the Machinery Directive 2006/42/EC. 2nd edition. June 2010. General editor Ian Fraser. European Commission Enterprise and Industry
- BIS. Machinery. Guidance notes on the UK regulations September 2009. URN 09/P86
- BIS. The Supply of Machinery (Safety) (Amendment) Regulations 2011. Government Guidance Notes. November 2011. URN 11/1407
- DIRECTIVE 2000/14/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors. OJEC L162. 3 July 2000. European Commission
- Position paper on guidelines for the application of the European Parliament and Council Directive 2000/14/EC on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors. OFFICE FOR OFFICIAL PUBLICATIONS OF THE EUROPEAN COMMUNITIES. L-2985 Luxembourg. ISBN 92-828-6706-4
- Noise Body – Work Group of Notified Body's 2000/14/EC. RECOMMENDATION FOR USE SHEETS (RfUs). European Commission
- BIS. Product Standards. Noise emission in the environment by equipment for use outdoors. Guidance notes on the UK Regulations. First edition. June 2001. URN 01/774
- The 'Blue Guide' on the implementation of EU product rules 2014. ec.europa.eu/DocsRoom/documents/4942
- Report on the "NOMAD" project – A survey of instructions supplied with machinery with respect to noise and the requirements of the Machinery Directive. Prepared by the NOMAD Steering Committee. May 2012. www.hse.gov.uk/noise/nomad-report.pdf

HSE web pages (accessed 30 January 2015):

- http://www.hse.gov.uk/Noise/buy-quiet/
- http://www.hse.gov.uk/work-equipment-machinery/uk-law-design-supply-products.htm#noise-emission-environment-equipment-outdoors
- http://www.hse.gov.uk/work-equipment-machinery/european-community-law-supply-new-products.htm#noise-emissions-equipment-outdoors

Paul Brereton is the Principal Noise and Vibration Specialist Inspector with the Health & Safety Executive. He and his small team provide expert opinion on the reasonable practicability of improving control of exposure to hazardous noise and vibration in workplaces; contribute to European Market Surveillance concerning noise and vibration hazard description and minimisation; and advise on the technical noise and vibration content of HSE guidance.

Sound power levels must be marked on equipment

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Don't deflect the important details of isolation bearing specification

Dense urbanization and increasing transportation needs of people and goods are resulting in a growing need for noise and vibration isolation strategies in buildings. Trains, subways and cars are the primary causes of noise vibration. In addition, more demanding requirements for prestige and premium-priced buildings, are driving the need for higher performance specifications. This is becoming increasingly important, not only for specialist buildings such as concert venues, but for commercial and residential buildings too.

Ashley Haines, Design Manager within Trelleborg's engineered products operation

Noise and vibration isolation bearings installed within the base and body of a building are a key way to dramatically reduce the effects of ground vibration; a primary cause of noise in buildings. However, the industry is currently lacking in specification guidance for these products, as the British Standard (BS 6177:1982) was withdrawn in August 2013. As a result, there is now an absence of regulations in this area.

In order to meet the needs of the industry in these times of development, sufficient standards must be reinstated to define exact specification parameters, so that only the highest performance bearings are used. Ashley Haines, Design Manager within Trelleborg's engineered products operation, discusses rate of deflection; one parameter that isn't always considered in bearing designs. This can be significantly affected by the varying weight distribution of a building and have an impact on the performance of the bearing.

A changing infrastructure

As urbanization and resulting infrastructure continue to grow, construction environments are becoming more complex to build in. Not just in terms of space, access or proximity, but also in the effects this growth has on the behavior of our buildings. Specifically, the vibration caused from traffic and railways which transfers directly through a building's structure, causing noise discomfort throughout.

Therefore, building designs have to incorporate strategies which meet the change in demands from the environment; isolation bearings are one example of this.

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The vibration that passes through the ground and into a building is called a forcing frequency and this vibration will take advantage of any surface, be it a wall or a cupboard, effectively turning it into a speaker to amplify sound. There are specified acceptable levels of disturbance dependent on the function of the building, to ensure that occupant comfort is unaffected and machinery or apparatus works as it should.

There are many types of vibration isolation bearing, built to different specification requirements. Unfortunately, there are also products on the market which are not meeting simple and important performance ideals.

Calling for guidance

The industry previously took guidance from BS 6177:1982, albeit that the standard was over 30 years old, until it was withdrawn last year. The regulation, titled *Guide to selection and use of elastomeric bearings for vibration isolation of buildings*, included design considerations, acceptable level of disturbance, type of bearings, testing and identification of bearings. One factor which it covered, though not in prescriptive detail, was the deflection of bearings.

The regulation stated that bearings are often installed at an early stage of construction and deflect progressively as the weight of the structure comes on to them gradually. The overall static deflection of a bearing is always significant (sometimes amounting to 20 mm or more) so it is important that the distribution of weight both during and after construction be understood appropriately, and due allowance made for changes in the relative levels of any adjacent un-mounted parts of the structure.

Where individual bearings or mounting systems are incorporated at significantly different levels, precautions should be taken to ensure that loading is imposed on both the bearings and the structure in a manner that does not introduce unacceptable stresses. Allowance should also be made for any additional deflections that may occur due to creep or as a result of wind loading during the life of a bearing.

However, the British Standard failed to go into detail about the bearing's performance when placed under stress, leaving the industry to decipher it for themselves; sometimes with negative consequences.

What does the ideal bearing specification look like?

All buildings and structures are subjected to ground vibration, or forcing frequencies, which cannot be stopped, but can be manipulated. The amount of vibration coming into a building can be controlled, but a full understanding of the right processes is required to do this efficiently.

Firstly, an acoustic consultant will assess the site where the building is to be constructed, to establish the forcing frequency. The bearing manufacturer must then use this information to ensure that the natural frequency at which the building on its bearings vibrates, is at just the right level. This has to be considerably less than the forcing frequency, making the ratio between the two as big as possible. As an absolute minimum, the ratio must be no less than 1.41, otherwise the bearing will in fact amplify the vibration.

Ideally the ratio should be three. This gives a transmissibility of 0.1, meaning that 90% of the vibrations are detuned. So for the forcing frequency of 30 Hz coming through the ground, a natural frequency of 10 Hz is what we should aim for.

To achieve the desired natural frequency we must control the bearing deflection. This is the distance by which the bearing is compressed by the weight of the building, and we control deflection by specifying precisely the right positioning of the bearing and its stiffness.

However, this is not a value that can be broadly applied to every bearing installed, as the mass of the building differs, meaning that bearings can be placed under different strains depending on its location in the structure. Each bearing must be assessed on the strain that will be upon it, to ensure that they all deflect equally.

It is essential to test each bearing to verify its stiffness characteristics and structural integrity, as once it has been installed, it cannot easily be replaced or rectified.

Raising the standards

Once the performance requirements and desired deflection values for the bearings has been established, the bearing design can be tweaked to suit. A rubber bearing which is designed with steel shim plates inserted within it, will give it structure and strength. This design allows the manufacturer to tune the block of rubber and influence its behavior, so that the performance can be predicted and the calculations met.

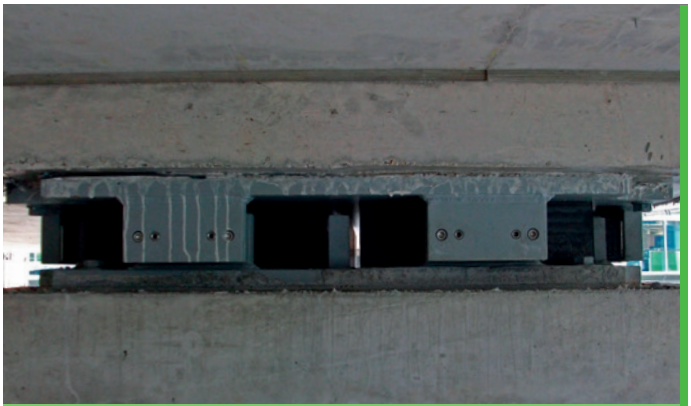
It is only as a result of these processes and techniques, that an isolation bearing will respond the way it is required to when in situ. And it is this sophistication that enables experienced manufacturers to provide rubber bearings which perform to an optimum and competitive level, every time.

Conclusion

Our environment will continue to evolve and develop; couple that with more stringent regulations in the construction industry and building designs must become even more sophisticated. The nature of our infrastructure is that it is built to last, so we cannot allow substandard products and techniques to take hold.

The issue of ground vibrations certainly won't disappear; and given that an installed bearing is extremely difficult to refurbish or replace, it is vital that the industry gets this right first time. The specification of bearings should not be feared, as the scientific principles are simple enough. A reinstated, valuable guidance which details this, will guarantee best practice amongst manufacturers and assurance for architects, contractors and building owners.

Trelleborg's vibration isolation bearing in situ



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How 'loud' is underwater noise compared with air noise?

By Dick Hazelwood, R&V Hazelwood Associates, and Magnus Wahlberg, University of Southern Denmark

This article is based on a presentation made at the IOA 40th Anniversary Conference held in Birmingham in October 2014, but now with much additional material contributed by Magnus Wahlberg.

The concept of "loudness" involves psychoacoustic questions, which need to be answered by the creature involved. Most creatures including humans are ill equipped to compare noise underwater with that in air, but evolutionary forces will have optimised the performance of amphibians in both media. What does the seal feel?

These issues are now of increasing interest to the general public, but in the absence of guidance, comparisons are made using sound pressure levels of sources often at unspecified distances. "A dolphin is as loud as a jet engine" we are told, with no indication that this may be contentious.

Sound pressure levels versus sound intensity levels

Sound pressure levels (SPL) are used in both fluids to measure audiogram thresholds, the decibel level at which signal detection is possible in quiet conditions. Whilst this links well to available instrumentation, the numbers when measured for amphibious creatures differ substantially between air and water.

There are at least two reasons for this. The simplest is that an air borne SPL refers to a 20μPa acoustic pressure which is deemed barely audible by humans in their mid frequency range, whereas 1μPa is used in water. There is also a large difference in acoustic impedance, the ratio between the acoustic pressure (Pascals) and particle velocity (m/s). For water this ~1.5 MPa/(m/s) compared with ~400 Pa/(m/s) for air.

New data shows that these differences are markedly reduced by the presentation of thresholds as intensity (W/m^2) for selected amphibious species. There is much to do if the measurements are to be optimised, but this article provides a physicist's view of biology, aiming to reduce the number of misleading statements now commonly made in the press and on TV wildlife programmes.

How should 'loudness' be assessed?

Dramatic statements made to amaze the public are often more concerned with sound production than with its reception. However, it is at reception where judgements on loudness are made. Perceptions are related to issues of pain as well as the threshold of hearing, but complex trials are more readily mounted for audiometric threshold measurements, with the likelihood of damage being inferred from this.

This is the methodology which lies behind the controversial "dBht" scale used by some environmental researchers [1]. Whilst this overcomes some problems, it requires thresholds to be specified as reference levels for each species. As new research data is acquired, new dBht levels may need to be assigned to the

Is a dolphin as 'loud' as a jet engine?

How much noise does a harbour seal (left) and an elephant seal (right) feel underwater?

same sound.

The dBht scheme has the advantage that its typical levels are much more compatible with those aerial decibel levels available to TV presenters. However, they are not related to S.I. physical units, and are unsuitable as a standard.

An alternative option is to specify the threshold levels as intensity. This is not a new idea, having been used by researchers including Møhl [2]. However, it is necessary to keep reverberation to a minimum, ideally using plane waves for measurements. The difficulties in so doing have led researchers such as Reichmuth et al [3] to present results as SPL, arguing that their use of hydrophones and microphones means that their measurements are more accurately specified this way.

Detection is limited by energy

For an engineer involved with underwater sonar the likelihood of detection is calculated as an energy process, wherein the signal to noise ratio (SNR) is used to assess the probability of detection. A simple case, of practical importance, is a plane wave tone, when the intensity is the mean square of the acoustic pressure p divided by the specific acoustic impedance, the ratio of the pressure to the particle velocity in the direction of the plane wave. For a fluid this is equal to the product ρ·c of its density ρ and sound speed c.

$$I\left[\frac{W}{m^2}\right] = \frac{\overline{p^2}}{\rho \cdot c}$$

Intensity I is the energy flowing in a specific direction, the power flux in watts per unit area measured orthogonal to the flux vector.

In low acoustic noise conditions, the electrical noise at the discriminator stage will be dominated by the internal noise at the first stage of amplification, considered here as simple "white noise" with a flat power spectrum. The transduction of the received acoustic energy into electrical energy is made by a passive device such as a hydrophone, with losses minimised by design. External power, for example from a battery, is then used to increase the signal power, but this process will also create electrical noise. For a good SNR, the amplifier should match the characteristics of the transducer.

Whilst a steady tone occupies a narrow frequency band, and can be assessed by its peak pressure amplitude, the noise is random and can be described as a mathematical pseudo-random sequence, with no defined peak pressure, but giving a steady supply of energy in a defined bandwidth. After applying a band-pass filter, the SNR at the detector is found as an energy ratio, which needs to be greater than unity (SNR> 0dB) for detection of this simple tone. Detection becomes more reliable as the SNR rises.

Analysis of human hearing has adopted similar physical principles, with Fletcher [5] providing some early reasoning, extended by many including Green [6], testing and developing the critical band concept. This showed many parallels with electromechanical systems, as well as significant differences.

The plane wave case can be compared with a reverberant noise condition, perhaps with acoustic noise from all directions, dominating the internal electrical noise. Now the outcome will depend on the directional characteristics of the receiver.

An omnidirectional hydrophone, as typified by a ball hydrophone, will provide a poorer SNR to that of a narrow beam hydrophone aligned with the incoming beam. But how well can the seal perform in these difficult conditions? That will depend on the efficacy of its directional response as well as the distribution of noise.

This uncertainty is a good reason to keep the test conditions quiet and to assess the detection of signals as controlled by the detector's internal noise. This is the methodology of audiometric tests. But to achieve a reproducible result it is also **necessary to keep reverberation to a minimum**. In the ideal zero reverberation condition, the intensity and SPL are linked by equation 1, but otherwise they diverge as the energy circulates. Even at constant input power, the SPL will increase. It is possible to distinguish the direct field which contains the signal from the reverberant field, which reduces coherency. This requires a measurement of the intensity, as whilst the SPL is more readily measurable, it is dependent on the uncertain conditions. Intensity is a better measure of the signal in the presence of confusing echoes.

Managing reverberant conditions

A wave created by the transmission of a short tone burst will be reflected within a closed space. The coherency of the original signal is then degraded by the reverberation. Measurements in tanks can use short pulses to avoid this, often only milliseconds long for the calibration of small transducers, but biological responses are not usually as fast.

A more extreme technique measured continuous noise in reverberant tanks [7]. This used the diffuse reverberant field created continuously by mobile sources such as ROVs (Remotely Operated Vehicles). To calibrate the tank response the direct field of a random noise source was measured at a short range, and its spherical spreading of energy was distinguished from the diffuse reverberant field created. The tank absorption was thus calculated as an area. Similar techniques are used in architectural studies [4] p313.

The diffuse field will add to the SPL as the reverberation continues so that it can become much larger than that of the initial direct field, where the intensity is unidirectional.

There are options for tests to investigate the response of animals to similar conditions, which may indicate a capability to respond to a low intensity level even when the SPL is raised by reverberation.

What effect does this have on aerial acoustics?

Those who devised the aerial SPL reference levels linked the intensity to the pressure level. The standard intensity reference level is 1 pW/m^2 in air. At the same time the standard pressure level was chosen as 20 μPa, so that for an acoustic impedance of around 400 Pa/(m/s), the levels are "nearly equivalent" as

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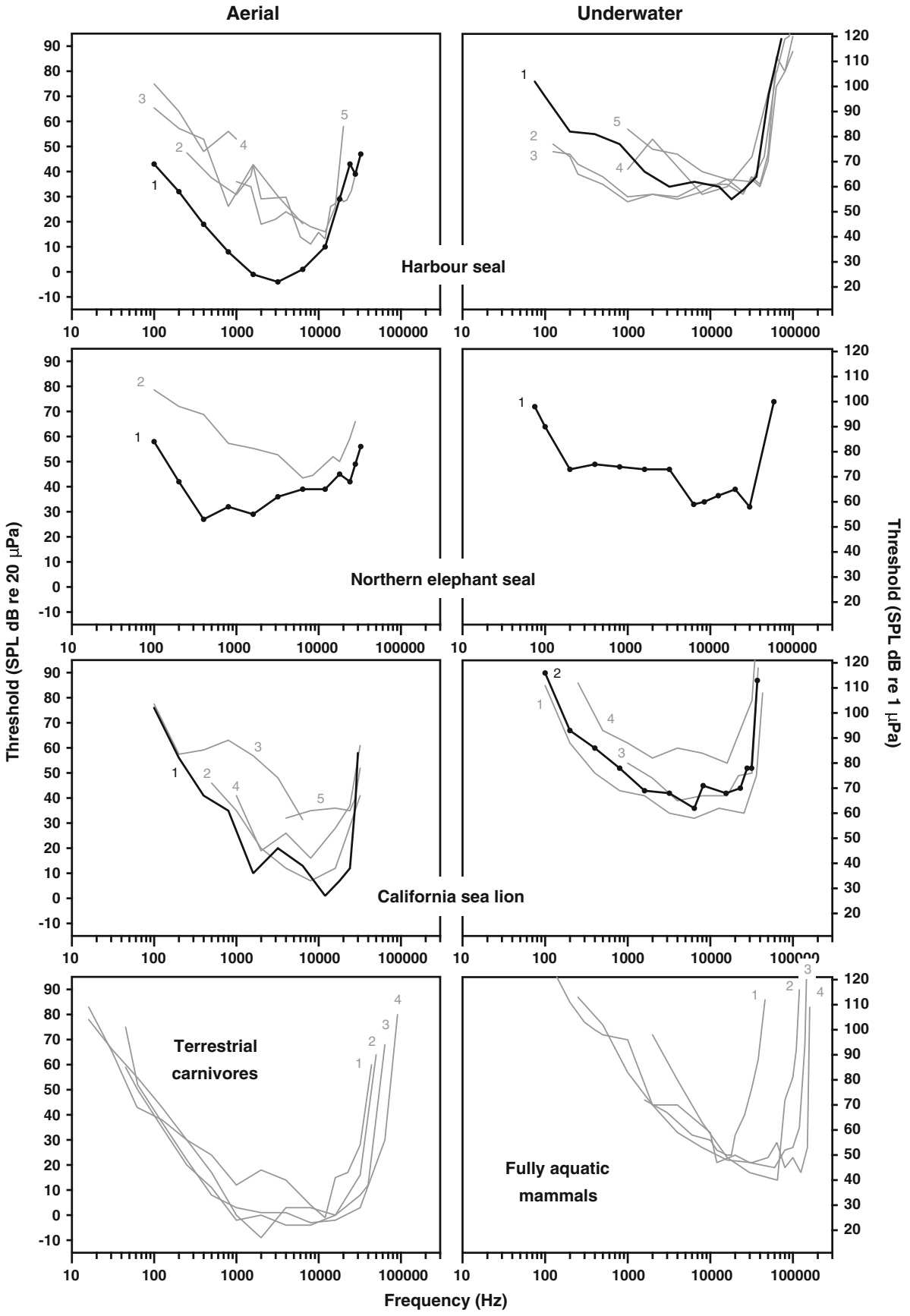

Figure 2

All the plots are against frequency in Hz, but the vertical axes are displaced by 26 dB to account for the different pressure reference levels in air and water. Both harbour seal and sea lion show an approximate further displacement compatible with the effect of the media impedance of 36 dB (ratio of impedances ~4000). If the data were presented as intensity they would overlap extensively.

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discussed by Kinsler & Frey[4] p117. This avoided the problems that have emerged in underwater acoustics.

The same technique could be used for underwater sound but the pressure reference level would have to be ~1225 µPa. There is no prospect of changing the internationally agreed 1µPa reference, but it would be good for researchers to quote intensity levels in dB re 1pW/m², as well as the SPL, given in dB ref 1 µPa, or indeed in Pascals, as appropriate, to reduce misunderstanding.

Biological results

Data from Reichmuth et al [3] has been studied to give approximate dB thresholds in air and in water. See Table 1 and Figure 2.

Animal	Aerial	Underwater	Differences
Harbour seal	-2	55	57
Elephant seal	27	59	32
Sea lion	2	59	57

NB the differences in decibel thresholds are with different reference pressures and media.

Table 1

Other creatures

Some further support has been found in recent work on the cormorant presented at the 40th Anniversary Conference. At about 3 kHz the intensity thresholds measured in air were similar to those measured in water but both at around 50dB re 1 pW/m².(thanks to Sasia Johansen and Magnus Wahlberg.[7]

Figure 3

These were carefully constructed double blind behavioural studies but may not yield the ultimate sensitivities in other conditions. The bird got a fishy reward when it successfully detected a sound or when, after due delay, a whistle was blown. Measurements made in small water tanks are vulnerable to significant errors and it is likely that early results may change as techniques improve. However, such improvements do require considerable research and the support to help this happen.

Relating the source level to the power

Power is a useful underwater source metric, and it can be related to the Lwa power rating used to compare machinery such as air compressors. The power radiated in all directions can be given in watts (W), distinguished from the intensity at the receiver in W/m².

The human A weighting is clearly not appropriate underwater, but an unweighted power rating (Lwu?) presented as a spectral distribution of source output power could be used. The total underwater acoustic power (all frequencies), radiated by a WWII destroyer at speed was calculated by Urick [9] as ~24 watts, from available measurements.

For short pulses, joules (J) are more appropriate as a source rating. Data from Richardson [10] pp181-184 indicates a pulse energy from a bottlenose dolphin (when echo sounding) of only ~ 16mJ. The data taken from Au [11], includes a source level of ~227 dB re 1 µPa·m but only for 100µs, and in a beam only 11° wide. Also this is based on peak to peak pressure measurements and the mean square values will be smaller by about 9dB (9dB, a power ratio 8, is the correction for a sine wave).

This is still a remarkable intensity, equivalent to that of a 50 kW omnidirectional source, and this power may indeed be equivalent to the acoustic power from a typical jet engine.

Urick [9] p75 shows that a steady 1 W omnidirectional source in sea water gives a source level of ~171 dB re 1 µPa·m. A 47 dB increase (227-9-171) requires 50kW output power. However, the dolphin's energy pulse is brief and focused. If the beam were not focused this would require an acoustic energy of 5 J, but for this beam directionality, ~25dB, the acoustic energy required is only ~16 mJ, more compatible with the dolphin's resources.

So how many dolphins does it take to compete with a jet engine?

If loudness is related to averaged intensity, there is >60dB error in public understanding, based on a comparison of SPLs. From a seal's viewpoint it may take over a million dolphins (heard when underwater) to drive it up into the air despite the nearby jet engine!

References

1. http://www.subacoustech.com/underwater-noise/audiograms-and-the-dbht
2. B. Møhl "Hearing in seals" In: R.J. Harrison, R.C. Hubbard, R.S. Peterson, C.E. Rice & R.J. Schusterman (Eds.): The behaviour and physiology of pinnipeds, Appleton-Century-Crofts, New York, pp. 172-195 (1968)
3. C. Reichmuth, M. M. Holt, J. Mulsow, J. M. Sills & B. L. Southall "Comparative assessment of amphibious hearing in pinnipeds" J Comp Physiol 199: 491-507A (2013)
4. L E Kinsler, A R Frey, A R Coppens and J V Sanders, "Fundamentals of Acoustics", 3rd Ed, Wiley 1980
5. H. Fletcher "Auditory Patterns" Rev Modern Physics Vol 12 1940
6. D. M. Green "Detection of multiple component signals in noise" J. Ac Soc Am vol 30, 10 1958 p 904-911.
7. R.A.Hazelwood & S.P Robinson "Acoustic power calibration in reverberant tanks", Proc Inst Acoustics 20 (3) p103 July 1998
8. S. Johansen, O. N. Larsen, J. C. Dalsgaard, L. Seidelin, M. Boström, S.-G. Lunneryd, M. Wahlberg, "In-air and underwater hearing in the great cormorant (Phalacrocorax carbo)" in "The effects of noise on aquatic life". Springer-Verlag. (2015)
9. R J Urick " Principles of underwater sound" McGraw Hill (1983) 3rd ed p344
10. W J Richardson, C R Greene, C I Malme, D H Thomson, "Marine mammals and noise" Academic press (1995)
11. W W Au "The sonar of dolphins"Springer Verlag 1993

Wind turbine noise – progress to date, and where to next?

By Richard Perkins, Parsons Brinckerhoff, and Chairman of the IOA Noise Working Group

In the UK, noise assessments for wind farm developments are undertaken using the methodology set out in ETSU-R-97 'The Assessment & Rating of Noise from Wind Farms' published in September 1996. The Government's Department of Energy and Climate Change (DECC), which has policy responsibility for ETSU-R-97, commissioned a report in 2010 to analyse how noise impacts are considered in the determination of wind farm planning applications, and specifically look at how the ETSU-R-97 methodology was being applied. The Hayes McKenzie Partnership (HMP) undertook the study, and reported back in April 2011. The HMP report highlighted variations and aspects of the methodology that in practice were being misunderstood and incorrectly applied, leading to confusion and uncertainty in the planning process.

The DECC then wrote to the Institute of Acoustics to invite them to take forward (where possible) the recommendations of the HMP Report, and to produce a "Good Practice Guide" (GPG). The IOA accepted the invitation, and appointed a noise working group (IOA-NWG) to produce good practice guidance. The IOA agreed only to consider the technical elements within ETSU-R-97, and not to look at the noise limits which remain a matter for Government.

A review of the available literature and initial drafting led to an 80-page consultation document which was peer reviewed before forming the basis of a formal IOA consultation which ran over the summer of 2012. The working group held two workshops in Dublin and London to discuss the issues raised in the consultation document, and to encourage feedback.

Consideration of the consultation responses led to final drafting, another peer review and the publication of the IOA Council approved GPG on the IOA website on 20 May, and launched at a one day meeting in Bristol on 21 May 2013. Government endorsement from England, Wales, Scotland and Northern Ireland followed shortly after, so the document is now well used in the planning system as "current good practice".

The successful integration of the GPG into the planning system was the direct result of close liaison and collaboration with the respective Government departments. Regular meetings with the Government Oversight Group provided an opportunity to inform on progress and ensure the latest issues causing problems in the planning system, such as wind shear, were captured in the GPG, and swift endorsement was achieved. Whilst some IOA members felt this endorsement was unnecessary, it would be wrong to ignore the way the planning system works, and the weight given by decision makers to endorsed guidance.

The work of the group did not stop there, as there was still the small matter of the production of six Supplementary Guidance Notes (SGN), and what to do about the unresolved issue of amplitude modulation. The IOA NWG continued to draft six SGNs which they consulted on in early 2014, four of which were published in July 2014, and the remaining two in September 2014. As with the GPG, the SGNs were subject to peer reviews before consultation and before final publication, and the IOA have written again to Government to seek their endorsement.

Two meetings were held in March and May 2014 where the subject of amplitude modulation was discussed and debated. The output of those discussions was a recommendation for the IOA NWG to take on the task of refining a metric and methodology with which to quantify AM, which was approved in June 2014. A sub-group of the IOA NWG was formed, and it is hoped that consultation will be underway by the time this Bulletin hits your doormat. More details of the AM work can be found on the IOA website (www.ioa.org.uk).

Last but not least, there is the issue of the ETSU-R-97 noise limits. A sample poll of attendees at the IOA launch day conference revealed that a large majority of attendees feel that the noise limits are too high, particularly the lower limit at night. This feedback has been made to the Oversight Group, who pointed out that the ETSU-R-97 noise limits are guideline maximum levels, and local authorities have the flexibility to set more stringent limits in accordance with their local plans. A summary of the current good practice established in the GPG and the SGN's follows.

The scope of the GPG considers all wind turbine developments above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published. This does leave smaller developments without formal guidance, for which a number of regional policies appear to be filling the gap, although many of the principles covered in the GPG would still apply.

The presentation of the GPG includes text and graphics, with numbered summary boxes at the end of each section. The GPG notes that it represents good practice as of the date of publication, and does not exempt further advances from being used. It is anticipated that a regular review of this document will be undertaken, and a new version produced when significant changes have occurred. Updates can therefore occur without the need for lengthy legislative procedures.

The ETSU-R-97 assessment procedure consists of the following steps:

- Predict noise levels from all turbines (existing and proposed) at the nearest receptors
- Determine a study area
- Identify potentially affected properties
- (If required) Undertake a measurement survey consisting of simultaneous measurement of background noise levels at representative properties with wind speed and direction at the proposed turbine site
- Analyse the data to remove rain affected and atypical data, and derive the noise limits for the scheme
- Update noise predictions and assess compliance with the noise limits for a candidate turbine, and provide design advice if compliance with the limits is considered unlikely.

The GPG notes that the main purpose of the procedure is to set out the noise data required, and the subsequent analysis needed to allow a decision maker to make an informed decision. Experience has shown time and time again that engagement of all of the relevant parties (decision makers, developer and local residents) at an early stage of a project and continuation of that engagement throughout the project is desirable. Engagement should be viewed as an ongoing process.

ETSU-R-97 considers turbine noise levels from the proposed, consented and existing wind turbine(s)at any property below 35 dB L_{A90} at up to 10 m/s wind speed (10 metre standardised wind speed) to be acceptable, so "study areas" for background noise surveys (and noise assessment) tend to use this as a benchmark. However, when establishing the baseline noise climate, there should be no influence from any existing turbines.

The selection of monitoring locations requires a number of factors to be taken into account, such as the presence of atypical noise sources, access, the use of proxy sites, and capturing the range of different climates around the wind farm site. Decision makers can help with this process, but as a minimum should be informed of the measurement plans to avoid later debate. A well-constructed and documented survey methodology is vital to reduce uncertainties in the assessment process.

The GPG recommends that the equipment should comply with Class 1/Type 1 of the relevant standard(s). Type 2 is not

recommended. Whilst most other surveys would avoid windy situations, it is necessary to consider measurements in high wind conditions for a wind turbine, and therefore it is vital that an enhanced microphone windscreen be used. The GPG notes that standard windshields of a diameter of less than 100 mm cannot be relied upon to provide sufficient reduction of wind noise in most circumstances.

The placement of the equipment is also a critical part of the methodology. ETSU-R-97 requires measurements be made in amenity areas between 3.5 and 20 metres from a dwelling, and this remains current good practice. The measurement position should permit measurement of background noise levels judged to be typical/indicative of the area around the associated dwelling and any other dwellings for which the measurement location will serve as a proxy. The influence of noise from local sources should be taken into account when selecting measurement locations.

The GPG considers that three methods of wind speed measurement may be adopted:

a) Direct measurements at hub height using either:
   i. A met mast carrying one or more anemometer(s) at the proposed turbine hub height.
   ii. A SODAR or LIDAR system (installed in a suitable location) to determine hub height wind speed directly, or at the two nearest heights to allow hub-height wind speed to be derived using an exponential profile.
b) A met mast lower than hub height, but carrying anemometers at two different heights: these are then used to calculate the hub height wind speed, using an exponential profile.
c) A met mast carrying anemometer(s) at a height of 10 metres (with wind shear corrections to be determined).

Methods a) and b) are preferred. Method c) is only advised if the other methods are not justifiable in terms of costs. A recording rain gauge should ideally be deployed to identify noise data affected by rainfall. The GPG notes that measurement intervals for wind speed, noise level and rainfall should be synchronised, and care should be taken to align different time references and the logging protocols between equipment.

The survey duration is determined entirely by the requirement to collect sufficient valid data over an adequate range of wind speeds. For pitch-regulated turbines, data should cover the range of wind speeds between cut-in and the speed at which maximum sound power level is achieved. SGN 1 describes the Data Collection process in more detail.

ETSU-R-97 requires that a number of filtering processes are undertaken before the wind speed vs. background noise relationship can be derived. The first is temporal. ETSU-R-97 only considers amenity hours (defined as 18:00 – 23:00 hrs Monday – Sunday, 13:00 – 18:00 Saturday and 07.00 to 18.00 Sunday) and night-time hours (defined as 23:00 – 07:00 weekday and weekend). The next filtering step is to identify the presence of noise sources which are not common to the representative measurement locations and neighbouring noise sensitive properties, and remove them from the data, using a review of time histories and scatter plots. Finally, data directly affected by rainfall, or when rainfall has resulted in atypical levels should be removed, and where appropriate, clear dawn chorus effects should be removed from night-time data. Rush hour traffic in the night period where it is a significant feature in the noise environment should be left in if it occurs routinely.

ETSU-R-97 states that noise levels should be plotted against wind speed to determine the prevailing background noise levels at a measurement position. The order of regression analysis to use (linear to fourth order) will depend upon the nature of the noise environment. Directional analysis of prevailing background noise levels may be necessary in specific circumstances, where a wind farm is located upwind of a receptor but a significant contributor to the background noise environment is downwind of the receptor in the same wind conditions.

The complete ETSU-R-97 noise limit for each property is obtained from a combination of the respective fixed limit and the derived relative limit (prevailing background curve + 5 dB). The day amenity noise limits have been set in ETSU-R-97 on the basis of protecting the amenity of residents whilst outside their dwellings in garden areas. The daytime amenity noise limits are formed in two parts: Part 1 is a simple relationship between the prevailing background noise level (with wind speed) with an allowance of +5 dB; Part 2 is a fixed limit during periods of quiet. ETSU-R-97 describes three criteria to consider when determining the fixed part of the limit in the range of 35 dB to 40 dB L_{A90}, all of which should be considered. They are:

1. the number of noise-affected properties
2. the potential impact on the power output of the wind farm
3. the likely duration and level of exposure.

The rationale for a choice of this limit, or factors which would assist the determining authority in this respect should be set out in the assessment, but the GPG does not consider these areas further as the consensus was that this was ultimately a material planning consideration, and therefore outside the terms of reference.

ETSU-R-97 indicates that for the protection of sleep of occupants within buildings an external free-field level of 43 dB LA90 is appropriate when background noise levels are low. When background noise levels are sufficiently high, then the noise limits are set to the prevailing background + 5 dB, in the same manner as that used for the amenity hours. SGN 2 describes the Data Analysis process in more detail.

Immission prediction

Estimates of the likely noise impact at the nearest receptors are required in any planning situation, and this must be reliable and robust. The general study of outdoor noise propagation has received extensive attention in the past, but there has also been additional research undertaken specifically on the subject of wind turbine noise propagation in recent years and since the publication of ETSU-R-97.

Several recent studies focused on the application of engineering methods to the prediction of noise from wind turbines. Wind turbines are elevated large sources, and calculations are often required at distances of 1 km or more, which may fall outside of the stated scope of well-recognised standards such as ISO 9613-2. The range of meteorological conditions which need to be considered are also more varied and significant than for many other applications.

The outcome of this research has demonstrated that the ISO 9613-2 standard in particular, which is widely used in the UK, can be applied to obtain realistic predictions of noise from on-shore wind turbines during worst case propagation conditions, but only provided that the appropriate choice of input parameters and correction factors are made. In particular, the use of "soft-ground" factor should be avoided, and the full theoretical effects of terrain screening will usually not be achieved.

The GPG notes that whilst some of the source documents for sound power levels may be confidential, numerical values of the source data should be clearly set out in any assessment and it is good practice to reference the data sources used, and that predictions should be based on octave band frequency data whenever available. SGN 3 describes Sound Power Data in more detail.

However, whilst the ISO 9613-2 standard is currently regarded as good practice, a number of factors need to be used to ensure a realistic estimate of immission level can be obtained. The GPG notes that:

- Equation 9 of the standard should be used to calculate ground effects; if no representative spectral data can be obtained, A_{gr} = -3 dB should be used and the air absorption rate corresponding to the 250 Hz octave band;
- A ground factor of G=1 should not be used;
- With the exception of propagation over large bodies of water or in urban areas, it is recommended to use a ground factor of G=0.5, in combination with emission levels which include a margin of uncertainty;
- A receiver height of 4.0 m, and atmospheric conditions of 10°C and 70% humidity should be used.

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- Topographic screening effects of the terrain (ISO 9613-2, Equation 12) should be limited to a reduction of no more than 2 dB, and then only if there is no direct line of sight between the highest point on the turbine rotor and the receiver location.
- A further correction of +3 dB should be added to the calculated overall A-weighted noise level for propagation across a concave ground profile.

Predictions made using the ISO 9613-2 standard relate to "worst-case" conditions. When considering cumulative noise impacts, the effects of propagation in different wind directions can be considered. Any such direction attenuation factors, if used, should be clearly stated in any assessment. Similarly the effects of wind shear should be taken into account, and stated in the assessment. SGN 4 describes Wind Shear in more detail.

Cumulative assessment

ETSU-R-97 states at page 58, "*...absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question...*" During scoping of a new wind farm development the GPG states that consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary. Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary.

In the presence of an existing wind farm, the GPG considers that suitable background noise levels can be derived by one of the following methods:

- switching off the existing wind farm during the background noise level survey (with associated significant cost implications)
- accounting for the contribution of the existing wind farm in the measurement data e.g. directional filtering (only including background data when it is not influenced by the existing turbines e.g. upwind of the receptor, but mindful of other extraneous noise sources e.g. motorways) or subtracting a prediction of noise from the existing wind farm from the measured noise levels
- utilising an agreed proxy location removed from the area acoustically affected by the existing wind farm/s; or
- utilising background noise level data as presented within the Environmental Statement/s for the original wind farm/s (the suitability of the background noise level data should be established).

Amplitude modulation research is under way

The underlying principle of ETSU-R-97 requires that the background noise levels at any given location must be correlated with the wind speeds measured on the wind farm site of interest. Where a systematic difference exists between the wind conditions on the two sites, then a correction will need to be applied, meaning that the derived background noise curves for the two sites will be different.

Whenever a cumulative situation is encountered, the noise limits for an individual wind farm should be determined in such a way that no cumulative excess of the total ETSU-R-97 noise limit would occur. The GPG goes on to consider a number of methods to be used when considering cumulative impacts, which include strategic planning, negotiation, and cumulative noise limits.

Other aspects

The GPG includes a list of reporting requirements for a robust noise assessment report, but stops short of providing prescriptive templates. A sample planning condition is provided in the GPG, but with a caveat that legal advice should be sought when applying it. No good practice on how to deal with excessive amplitude modulation was found, but the AM working group is now actively working on a metric and assessment methodology. Post Completion Measurements are covered in SGN 5.

It is considered by many acousticians in the UK that the increased fixed night time limit relative to the daytime one is open to question, and that whilst most sites are constrained by the day time limit, some developers are now designing sites to take advantage of the higher limits allowed at night. Few would argue that this is what the original authors of ETSU-R-97 had intended.

At the GPG launch meeting in Bristol in May 2013, a show of hands revealed that most delegates were in favour of the IOA considering the issue of the ETSU-R-97 noise limits. This mirrored a number of the responses received to the GPG consultation. The IOA will no doubt discuss this matter further before deciding what action (if any) to take, although as this is ultimately a matter for Government, a considered response will be needed.

The IOA has published a Good Practice Guide and six Supplementary Guidance Notes to supplement the use of ETSU-R-97 in the UK when assessing wind turbine noise. It is a significant step forward for the industry, and will level the playing field. Work is currently ongoing on how to predict and assess excessive amplitude modulation.

References

1. Hayes McKenzie Partnership Ltd. Report on "Analysis of How Noise Impacts are considered in the Determination of Wind Farm Planning Applications" Ref HM: 2293/R1 dated 6th April 2011
2. Institute of Acoustics - Terms of Reference
3. Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' May 2013
4. Institute of Acoustics - The GPG can be found at http://www.ioa.org.uk
5. Bullmore, J. Adcock, M. Jiggins, M. Cand, Wind Farm Noise Predictions and Comparison with Measurements. Proc. Wind Turbine Noise 2009 Conference, Aalborg Denmark, June 2009.
6. Søndergaard, B. Plovsing, Prediction of noise from wind farms with Nord2000, Part 1 and 2, Proc. Wind Turbine Noise 2009 Conference, Aalborg Denmark, June 2009.
7. T. Evans and J. Cooper, Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms, Proceedings of ACOUSTICS 2011, 2-4 November 2011.

Consortium to provide environmental services for Crossrail 2

A consortium comprising Mott MacDonald, Temple, ERM and WSP (referred to as MTEW) has been appointed by Transport for London (TfL) to provide environmental and sustainability services for Crossrail 2. These will include noise impact assessments.

The scheme will create a new high frequency, high capacity rail line with shorter journey times between south-west and north east London and will also serve some destinations in Surrey and Hertfordshire using the existing National Rail network.

MTEW has been charged with developing a robust sustainability and environmental framework for the scheme and work with the other appointed consultants to embed consideration of these aspects in the development and selection of options.

The consortium will also work closely with stakeholders to produce a report on environmental aspects setting out the initial findings of the work and the further environmental assessment work required in the subsequent development of the scheme.

Wakefield Acoustics acquired in a £4 million management buyout

Wakefield Acoustics, a specialist industrial acoustic engineering business, has been acquired in a £4 million management buyout (MBO).

Lee Nicholson, who has become managing director, said: "We have ambitious plans for the business, which include developing and broadening the product range, consolidating our two current manufacturing facilities into a new facility in 2015 and delivering significant sales growth.

"Additional senior sales and engineering resource was recruited in 2014 to support these growth plans."

The other members of the MBO team are Finance Director Paul Hebden, Operations Director Kevin Dawson and Sales Director Rob Lomax. Previous owner Jane Dawson will remain with the business.

Founded in 1980, Wakefield Acoustics designs, manufactures and installs industrial and environmental noise control systems.

Consistent growth in recent years has enabled it to establish a strong market position with leading blue chip engineering companies supplying globally into sectors such as power, oil and gas, water waste and general manufacturing.

Ian Waterfield, investment director at YFM Equity Partners in Yorkshire, which supported the MBO with funding, said: "We are backing a strong business in Wakefield Acoustics.

"2015 will be a busy year for the team with a growing pipeline of business and consolidation of their manufacturing facilities into a new site."

New logo for Campbell Associates as sales and hire arm booms

Campbell Associates has created a new logo as it moves into its 16th year of business.

The news comes as it announced that its sales and hire arm continues to expand. Sales of Norsonic's new generation SLM, the Nor150, are well under way, while there is strong demand for AVA Net, its unattended site vibration system, and version 4.5 of CadnaA noise prediction and planning software has just been released.

Its UKAS calibration laboratory also continues to expand for both one-off and contract customers. Another technician has recently been recruited and it plans to add more services to its UKAS schedule.

CAMPBELL ASSOCIATES
SOUND & VIBRATION SOLUTIONS

The new logo

Its annual charity fund raiser, the Acoustic Cup five-a-side football competition, will be held on 10 June. More information will be announced later, but to register for details and to enter a team contact **john@campbell-associates.co.uk**

The Campbell Associates team

Hepworth Acoustics to become employee-owned company

Staff at Hepworth Acoustics have unanimously accepted the terms of a proposal to enable the company to become employee owned. The current owners, Peter Hepworth and Paul Brown, have agreed to a two-stage sale of the company commencing this year with an initial tranche of just over 50% of the shares being sold to an Employee Benefit Trust (EBT).

As part of the changes, Donald Quinn will take over as Managing Director in April 2015, although Peter Hepworth and Paul Brown will continue as directors, working part-time for the company.

The change in ownership comes about as the company celebrates 25 years in business, and the change is aimed at maintaining a stable management framework for the next 25 years. All nine current employees will continue working with the company.

Current (and future) staff will become majority owners of the company, with the shares held collectively on behalf of employees through the EBT.

Trustees will be appointed to manage the EBT and set up a method of distributing profits to employees. Day-to-day management of the company will remain in the hands of the management team.

Peter Hepworth said: "I am very pleased that agreement has been reached with the staff to take on the ownership of the company. They are people whom I know and trust, and will continue to provide a high quality of service to all of our clients."

Donald Quinn added: "Having joined Hepworth Acoustics almost 10 years ago, I am delighted to have been given the opportunity to lead the company as it enters this exciting new phase, and I am looking forward to working with my colleagues to ensure that we continue to build upon Hepworth's reputation under employee ownership."

Peter Hepworth (left) and Donald Quinn

Canadian-based Blachford Acoustics purchases TMAT Acoustic Technologies

Canadian-based Blachford Acoustics Group, a leading supplier of cab interior systems for heavy truck and off-highway equipment, has bought TMAT Acoustic Technologies, Chesterfield, UK.

TMAT is a major supplier of polyurethane floor mats, headliners and trim for agriculture and construction equipment OEMs (original equipment manufacturers) in Europe. The move, says Blatchford, will allow it "to provide common, coordinated solutions" in both North America and Europe.

Blachford, led by Dr John Blachford, President, has grown significantly in recent years. With the TMAT purchase, the 93-year-old company now has six manufacturing facilities, in Canada, the United States and now the UK.

Dr Blachford said his interest in TMAT originated many years ago. "In 1995 we tried, unsuccessfully, to make a licence agreement with TMAT, because we very much needed to be manufacturing polyurethane mats in North America. We also needed a partner in the UK or Europe.

"Now, finally, we have actually bought TMAT, which has recently become a very successful company. The extent to which TMAT's product line complements ours and our line complements theirs is remarkable, and will result in great opportunities for the growth of both companies."

TMAT will continue to manufacture its products and solutions at its Chesterfield HQ but, will now have access to Blachford's R&D laboratory and testing facilities, which include a large hemi-anechoic chamber equipped with a heavy-duty dynamometer, a reverberation room as well as a chemical/materials lab.

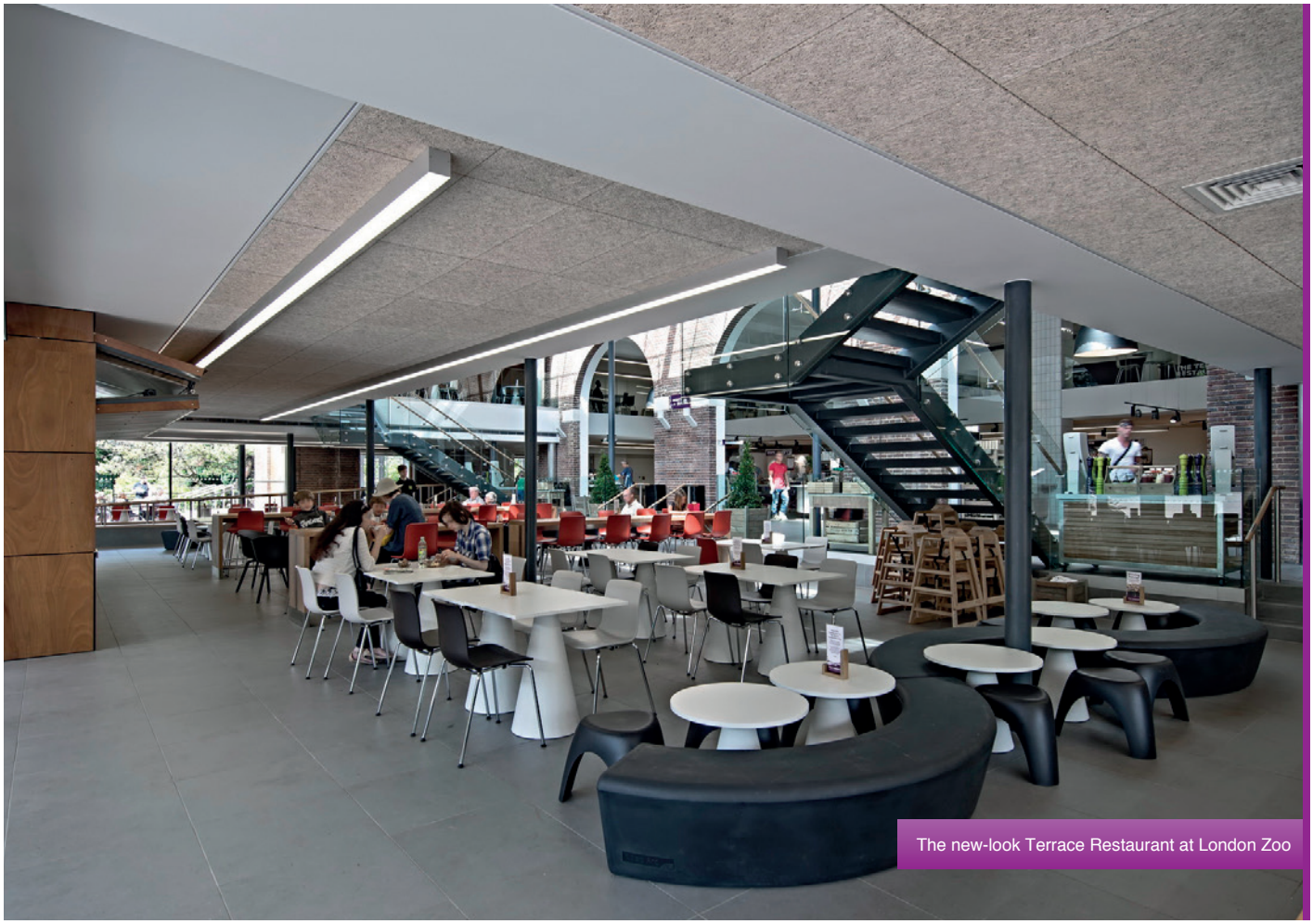
Human feeding time 'roar' at London Zoo kept to a minimum by acoustic panels

Diners' enjoyment at the newly re-modelled and extended Terrace Restaurant at London Zoo has been enhanced by the installation of sound-absorbing panels.

More than 400 square metres of Troldtekt 1200 x 600mm "fine" acoustic panels were specified by architects SHH for the ceilings below the mezzanine floor.

Troldekt said: "With such an abundance of different hard surfaces, coupled with the vocal enthusiasm and chatter from so many visitors and their attendant echoes, it was important to find a sound absorbing solution which would complement the overall design."

For more details call Skanda on **0844 8114877** or **visit www@troldtekt.co.uk**



The new-look Terrace Restaurant at London Zoo

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For a confidential discussion call Jim on 0121 421 2975, or e-mail: j.mcnaughton@msacareers.co.uk

www.msacareers.co.uk/acoustics

'Arresting' experience for consultant Chris in former prison

Acoustics consultant Chris Selkirk faced one of his most unusual challenges when he was commissioned to ensure noise levels at a dance night held in a former prison did not exceed legal limits.

Lancaster Castle, which until recently housed a C-category gaol, is now a popular music venue. In addition to hosting the city's music festival, it is used for "A Wing" club nights when guests party in the old prison wings and cells.

"You would think the castle walls would be able to contain any noise produced by these events," said Chris. "They are incredibly thick and more than 20 metres high, but noise still manages to get out over the top. Because the nearest residential dwellings are less than 30 metres away my task was very challenging."

Chris hired a Cirrus Invictus noise monitor which he stationed near the properties to take continuous Laeq readings at 15 minute intervals throughout the event, with the NoiseHub[2] software enabling him to see those live measurements on his iPad. This allowed him to react instantly by reducing the noise level if and when the need arose.

"I was ensuring the noise levels didn't breach the licensing conditions of the premises on behalf of the organisers," he explained. "At this event they didn't so everyone was happy, particularly the dance guests who certainly didn't want the music turning down."

Dance night at the castle

IAC hits the right note at College of West Anglia's music production suite

Part of new Creative Studios

IAC Acoustics has completed the build of the music production suite known as the Creative Studios at the College of West Anglia.

Marking the first project incorporating its new range of music practice rooms (MusicBox), the suite comprises two control rooms, five rehearsal rooms and a separate voice over booth. It formed part of an overall project involving new facilities for media studies, TV production, editing and other creative arts. I

One of the main hurdles IAC faced was the suite had to be built within what was previously a sports hall. IAC overcame echo and reverberation problems by putting panels in the roof to reduce the ceiling height (and, in turn, echo), and by sitting the rooms on anti-vibration mounts to reduce noise transfer through the host building.

IAC tackled the issue of containing noise in the music practice rooms by installing its Noise-Lock 2 hard panels and Noise-Lock acoustic doors with an acoustic performance of R'w51dB.

To reduce reverberation times in the practice rooms, tuning panels from its Absorbatone range were added to the walls.

For more details go to **www.iac-acoustics.com**

Letter

Claims made in wind turbine report require further assessment

The following item appeared in the Soundbites section of the Institute's *Acoustics Update* newsletter in February.

ABC Online: A pilot study in Australia into wind farm noise and residents' reactions to it has identified a special noise signature that could give new insights for medical research, the study's lead author says. Acoustic engineer Steven Cooper said the study conducted noise measurements of both audible sounds and infrasound, using special microphones, amplifiers and detection equipment. It discovered noise patterns that had not been previously accounted for, which could help future medical research into residents' issues.

Although *ABC Online* reflects the claims made in the report, these claims should be assessed further.

The background to the measurements is that Pacific Hydro, the owner of Cape Bridgewater wind farm, Victoria, Australia, agreed to cover the considerable costs of a detailed and lengthy noise survey at three long-term complaint locations and gave the complainants a free hand to select a consultant of their own choice. Pacific Hydro also cooperated fully in supplying details of the wind farm operational conditions over the measurement period. The complainants chose Steven Cooper for the work. Cooper is an acoustical consultant with a track record of working for opponents of wind farms.

The final report claims new discoveries. However, the wind turbine noise pattern referred to in *ABC Online* is largely the low level infrasound blade tones which combine to give the characteristic, but inaudible, pulses which occur when the blades pass the tower.

The existence of these tones has been known since the NASA work of the early 1980s, but are not significant with modern upwind turbines, as the pulse is of very low level, with components typically in the 50-60dB range at 1 to 5 Hz.

Cooper also claims to have discovered that long term complainants feel "sensations" when experiencing the noise. This is a well known stress-related effect which occurs with a small number of persons. Sensations may also occur when the source is not operating, as shown by Cooper.

The full report is available on the Pacific Hydro website www.pacifichydro.com.au

Geoff Leventhall

Obituary

Andy Wolfindale (1979-2015): Highly talented engineer who gave freely of his time to others

Many IOA members have been greatly saddened to learn of the death of Andy Wolfindale in a road accident in Coventry in January. He was 35.

Andy, who had been a Corporate member since 2010, had been active in the Young Members' Group and served as its representative on the Noise and Vibration Engineering Group.

Below is a tribute from Rupert Poole, a friend and colleague at Jaguar Land Rover, where Andy was Project Lead Engineer in Vehicle Noise and Vibration Engineering.

Andy joined Jaguar Land Rover in 2002 as a graduate engineer on graduating with a first class honours degree in mechanical engineering (MEng) from Loughborough University.

He became a permanent full time engineer in Vehicle Noise and Vibration Engineering in 2004. During the ensuing years he was involved with a number of Jaguar Land Rover projects. He enjoyed powertrain development and took a lead role in the delivery of powertrain sound quality for the Range Rover Evoque.

Four years ago he embraced an opportunity to lead the NVH development on a new vehicle that has yet to be launched. He had a passion to ensure that this vehicle will be a success.

He was determined that the key verification prototype phase would be delivered to the highest possible quality. He worked long hours leading a small team that I can safely say delivered the best prototypes we have ever produced. He set the gold star standard against which others will be judged. His programme achieved a robust engineering sign-off that was on time.

Even though he was working flat-out on programme delivery he always found time for people – be that the graduates he was mentoring towards Chartered status for the Institution of Mechanical Engineering or checking on someone's general well-being. He also found time to write technical papers and organise a seminar for the IOA

This desire to help and share knowledge was typical of Andy's generosity. He was always willing to give more than he took – from work and life in general. He had many interests away from work: church, charity work (at home and abroad), mentoring, political debating with MPs and a range of outdoor pursuits. He had a zest for life and gave a lot more than he took out. As we reflect on Andy's life we can safely say he made a difference that was hugely positive. He led by example and lived to a standard many can only aspire to achieve.

Andy Wolfindale

Further expansion at Ramboll as four more join its UK acoustics team

Ramboll has expanded its UK acoustics operation with the addition of four recruits, who have become part of a15-strong acoustics team based in Cambridge, London, Chester and Bristol.

Lukasz Jakielaszek, who has eight years' acoustic consultancy experience, has specialised in transportation noise. This includes projects such as Crossrail, Thameslink and the East London Line, as well as his Master's thesis on railway noise prediction methods. He also has a wide background in environmental noise, particularly wind turbine and industrial noise, and is currently developing his knowledge of auralisation.

Perttu Laukkanen previously worked as an acoustician and research assistant in Finland specialising in sound systems and studio control rooms, which he undertook prior to finishing his studies in Aalto University, Helsinki. At Ramboll he has been working on school and residential projects in the UK, and expanding the collaboration between the Ramboll acoustics teams in the UK and Finland.

Camilla Nelson is a Masters graduate in engineering acoustics from the University of Southampton (ISVR) where her Master's project examined the sound radiation from shallow shells. As a violinist, she has a keen interest in musical instrument acoustics and the relationship between music and space, which also follows on from her music degree at the University of Cambridge.

François-Xavier Lallemand joined Ramboll as a graduate acoustics engineer after completing a Master's in acoustical engineering at the University of Southampton (ISVR). His Master's project, *The Singing Whale*, examined for the first time the dynamics of baleen whales' vocal cords.

Ramboll Acoustics UK with its Nordic counterparts now forms a 50-strong international group dealing with all aspects of acoustics in the built environment.

Lukasz Jakielaszek

Camilla Nelson

François-Xavier Lallemand

Perttu Laukkanen

Felix Larrieu comes aboard at Apex Acoustics

Felix Larrieu has joined Apex Acoustics in Gateshead as an Acoustic Consultant.

He will be working on a range of projects, including industrial noise assessments, residential facade design, and design for internal sound insulation and control of reverberation for residential, commercial and education buildings.

He undertook an internship at the company last year on completion of his master's degree in mechanical engineering with architectural acoustics specialty from the Université Pierre et Marie Curie, Paris. He has worked on asynchronous STI software development with Acoustique et Conseil.

Whilst at Apex last year Felix carried out research investigating the use of new parameters to describe non-diffuse spaces and contributed to ongoing consultancy projects, including calculation of internal acoustic conditions using CATT-Acoustics and environmental noise modelling.

Felix Larrieu

Vibration added to ANV web-based monitoring system

Online web-based vibration monitoring is now available from ANV

ANV Measurement Systems have added vibration to their web-based monitoring system.

ANV released Live Leq, real time online noise monitoring based on the Rion NL-52, in 2013. Live PPV, based upon the fully DIN 45669: 2010 compliant Profound Vibra+, was released at the end of 2014.

Live Leq and Live PPV are on the same LivEnviro web platform, allowing both live and historic noise and vibration data to be monitored, viewed and downloaded.

Users of Live Leq will find the way in which Live PPV operates very familiar to them, say ANV.

Live PPV posts PPV, dominant frequency and displacement when the dominant frequency is 4Hz or less to the web. Currently the maximum refresh rate is five minutes but the system supports shorter duration measurement times (down to one second).

Live PPV has a very comprehensive alarm capability, says ANV. The limits from BS 5228: 2, BS 7385: 2 and DIN 4150: Part 3 can all be selected. However, in recognition that it is often not possible to measure directly at potentially affected receptors, up to three broadband and up to six frequency-dependent user-defined limits can be set up. Alarms are sent out by e-mail and users can choose whether each individual limit that has been set up is an amber or red alert level. Different limits can be set for up to 24 periods in a day and different limits can be set for each day if necessary.

Current and historic vibration data can be viewed directly, in graphical and tabular formats, on the Live PPV website and downloaded (as a simple csv file that imports directly into a spreadsheet) over the internet from the LivEnviro server, which is a dedicated Raid 10 server in a UK data centre.

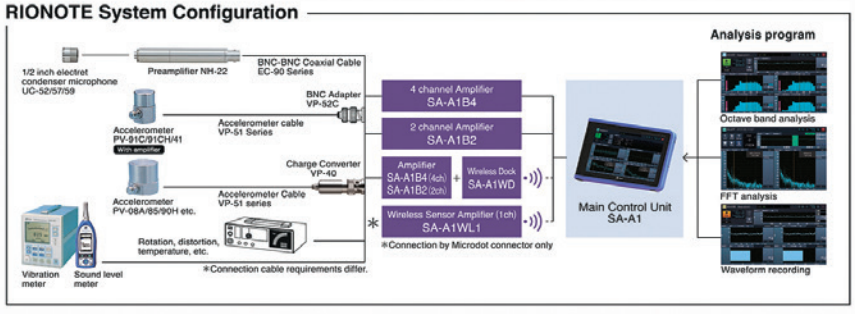
For more information call **01908 642846** or email **info@noise-and-vibration.co.uk**

Rio aims to be a multi-channel measurement platform to Note for Rion

RioNote, Rion's latest product, is a tablet-form multi-channel measurement platform.

Although it has been built "from the ground up" by Rion, the software runs in an Android environment. Applications can be developed to suit the specific needs of a user.

A one, two or four-channel amplifier unit can be housed with the tablet itself for wired connection to sensors. BNC connectors are provided for input and standard 2 mA charge coupled line drive devices are supported.



The RioNote system configuration

Currently up to four four-channel amplifier units can be used with the RioNote via wired connection. However, wireless docks will be available for the amplifiers next year enabling wireless connection up to distances of around 50 metres. There is also a separate taco input which facilitates triggering based upon rotational speed and which will provide the basis of order tracking.

The measurement functions that are currently available are FFT, wav file recording and octave/third octave analysis.

Rion says the RioNote offers an opportunity have a system which carries out very specific measurement functions at a reasonable cost, knowing the measurement data itself is of the highest integrity.

For more details contacts ANV Measurement Systems at **info@noise-and-vibration.co.uk** or **01908 642 846**.

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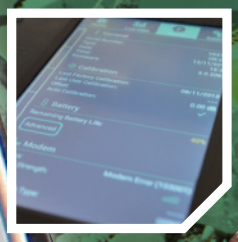

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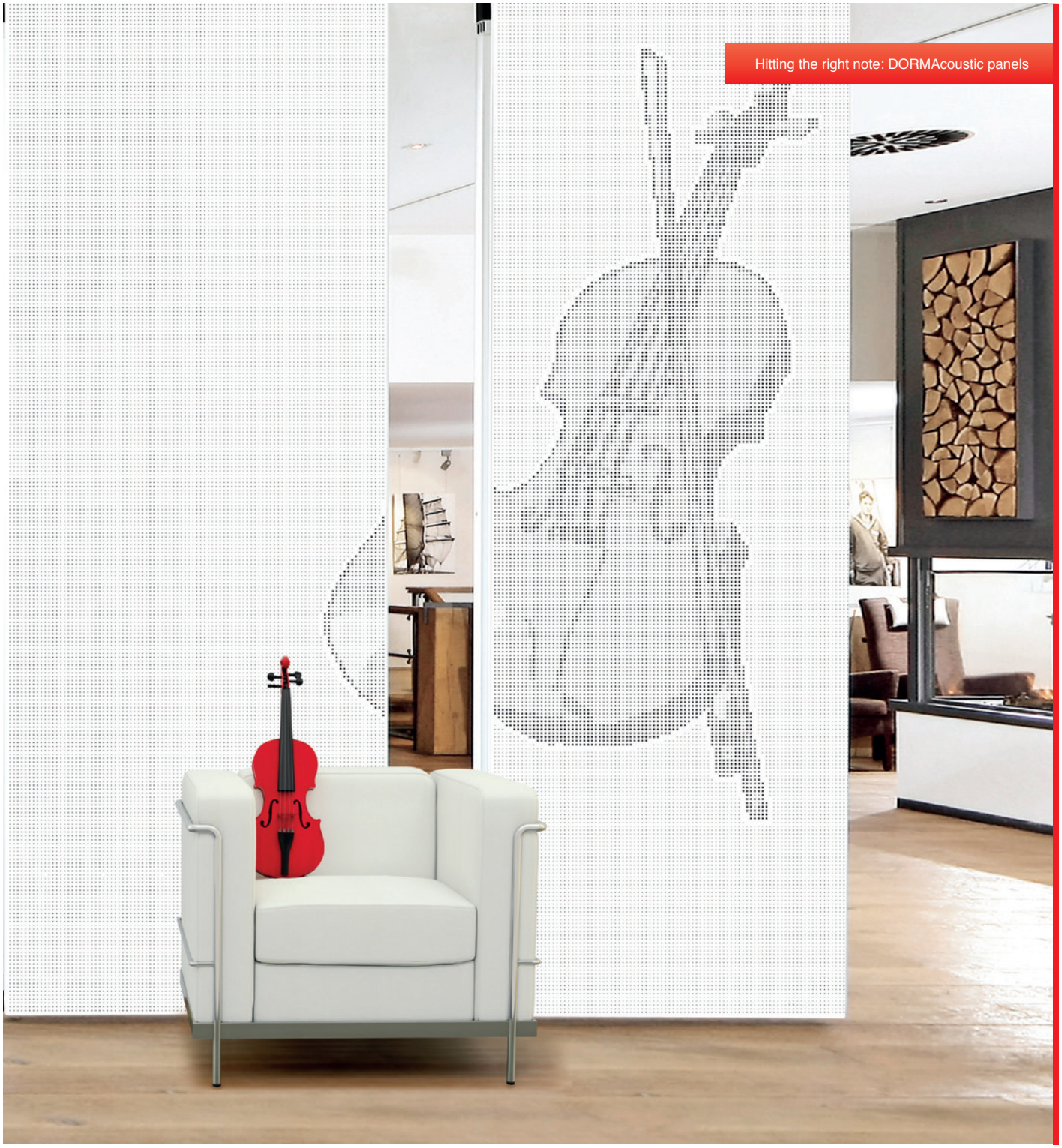
For more details go to **www.style-partitions.co.uk** or email **sales@style-partitions.co.uk**



Hitting the right note: DORMAcoustic panels

New acoustic panel range has got a lotta bottle

A range of acoustic absorption panels made largely of recycled plastic bottles has been launched by Agile Acoustics.

The panels have been designed to work both on the wall and as a temporary desk partition.

A patent has been filed for the design which has been classed by AIRO as having Class A absorption.

The panels are a spin-off from an earlier idea by Agile's sister company, Co2nscience, to sell Stretcher Prints – wall art photographs printed on a soft felt-like material made from recycled plastic bottles.

Stuart Jones, founder of Agile Acoustics and CEO, said: "We have had a tremendous response from the companies that have seen the panels so far."

Agile manufactures the panels in-house at its facility in Bradford and is already on the lookout for larger premises.

Mr Jones said the company was also keen to work with partners, particularly in Europe and the US. "If we had an approach from the right partner we would look to license the system in other territories."

For more details go to **www.agileacoustics.co.uk**

One of Agile's new panels

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Committee meetings 2015

DAY	DATE	TIME	MEETING
Tuesday	3 March	10.30	Diploma Tutors and Examiners
Tuesday	3 March	1.30	Education
Tuesday	5 March	10.30	Diploma Examiners
Tuesday	**10 March**	**10.30**	**Council**
Wednesday	8 April	11.00	Research Co-ordination
Thursday	9 April	11.30	Meetings
Tuesday	14 April	10.30	CCWPNA Examiners
Tuesday	14 April	1.30	CCWPNA Committee
Thursday	30 April	10.30	Membership
Thursday	14 May	11.00	Publications
Tuesday	19 May	10.30	CCHAV Examiners
Tuesday	19 May	1.30	CCHAV Committee
Monday	8 June	10.30	ASBA Examiners
Monday	8 June	1.30	ASBA Committee
Thursday	11 June	10.30	Executive
Tuesday	**16 June**	**10.30**	**Council**
Wednesday	24 June	10.30	CCENM Examiners
Wednesday	24 June	1.30	CCENM Committee
Wednesday	24 June	10.30	CCBAM
Thursday	25 June	10.30	Distance Learning Tutors WG
Thursday	25 June	1.30	Education
Thursday	16 July	11.30	Meetings
Tuesday	4 August	10.30	Diploma Moderators Meeting
Thursday	13 August	10.30	Membership
Tuesday	8 September	10.30	Executive
Tuesday	**15 September**	**10.30**	**Council**
Thursday	24 September	10.30	Engineering Division
Monday	28 September	11.00	Research Co-ordination
Thursday	22 October	11.00	Publications
Thursday	29 October	10.30	Membership
Tuesday	3 November	10.30	CCENM Examiners
Tuesday	3 November	1.30	CCENM Committee
Tuesday	3 November	10.30	CCBAM
Wednesday	4 November	10.30	Diploma Tutors and Examiners
Wednesday	4 November	1.30	Education
Thursday	5 November	10.30	CCWPNA Examiners
Thursday	5 November	1.30	CCWPNA Committee
Tuesday	10 November	10.30	ASBA Examiners
Tuesday	10 November	1.30	ASBA Committee
Tuesday	17 November	10.30	Executive
Thursday	19 November	11.30	Meetings
Tuesday	**1 December**	**10.30**	**Council**

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.

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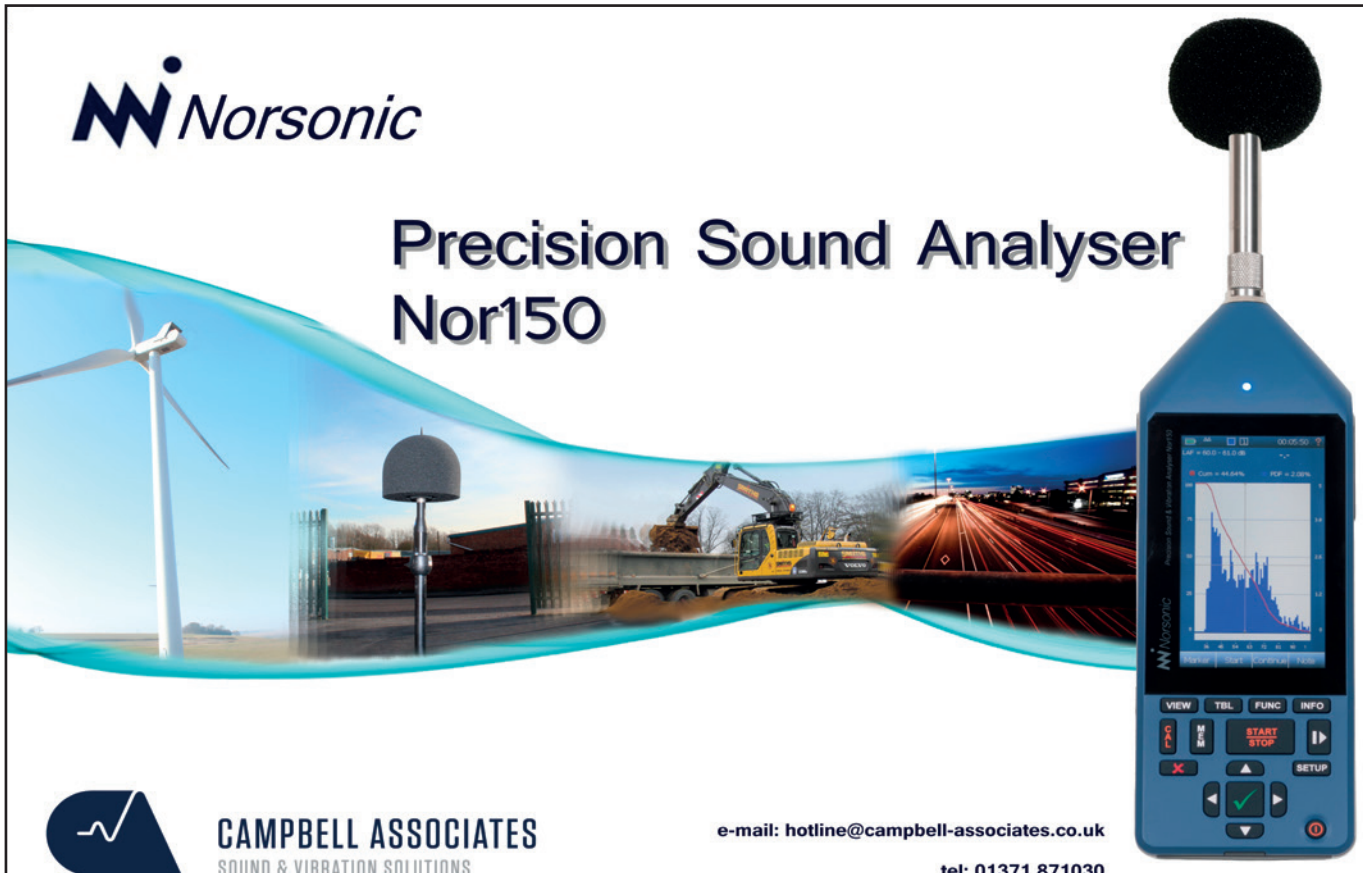

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- See and Download Historic Data
- Grant Controlled Access to Viewers
- IEC 61672 Class 1 Noise Data
- Rion NL-52
- WS-15 Outdoor Microphone Protection
- DIN 45669 Vibration Data
- Profound Vibra+
- Portable and Permanent Enclosure Options

* Maximum refresh rate 1 minute for noise, 5 minutes for vibration

MEASUREMENT SYSTEMS

NNR-03 NOISE NUISANCE RECORDER

- Quick and Easy Installation,
- Quick & Easy Download & Review (Drag & Drop)
- No External Connections
- Wired and Wireless Handsets included
- Removable Memory Card (and data via USB)
- Easily add more memory and/or octaves/third octaves

RIONOTE

- Unique Tablet-Form Multichannel Multi-Function Instrument
- 1 – 16 Channels (wired or wirelessly* connected)
- Options Currently Available – FFT, Octave/Third Octave SLM, Audio Recording, Playback and Post-processing
- BNC/ICP Inputs (use your existing sensors)
- Android Platform – write apps to suit the way you work

* Available soon

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RION Sound and Vibration