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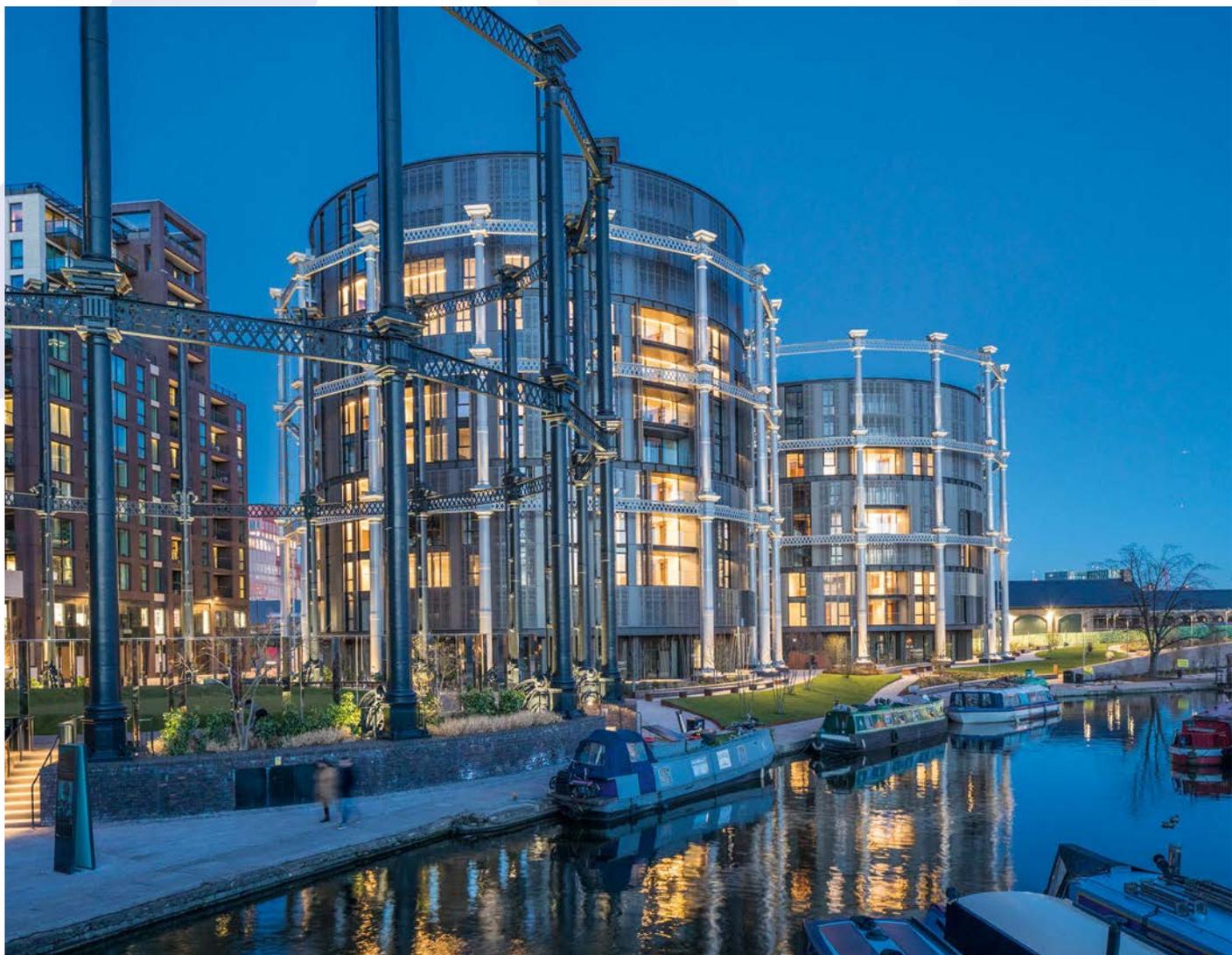
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How to design acoustically comfortable spaces for teaching

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Contacts

Publisher

Juliet Loiseau

Contributions, letters and information on new products to:

Nicky Rogers

Email:

nicky@warnersgroup.co.uk

Tel: 01778 391128

Advertising:

Dennis Baylis MIOA

Email: dennis.baylis@ioa.org.uk

Tel: 00 33 (0)5 62 70 99 25

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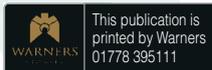
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ACOUSTICS BULLETIN

Acoustics Bulletin Volume 49 No 2 March/April 2023

Cover image: The real-world performance of buildings is under closer scrutiny. But the part that the technical discipline of acoustics plays in supporting both people-centric and planet-conscious design outcomes is not always fully appreciated, yet we know that the role of acoustics impacts on multiple levels. The active curation of soundscapes can positively impact on human health, wellbeing and social cohesion. (Kings Cross image courtesy of John Storock) Page 29



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Technical articles review procedure

All technical contributions are reviewed by an expert identified by the IOA Publications Committee. This review picks up key points that may need clarifying before publication, and is not an in-depth peer review.

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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, electroacoustic, 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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Dear Member

The topic of my letter is 'regulation and enforcement'. This has been prompted by notable events, and the contents of some articles in this issue of *Acoustics Bulletin*.

Almost inevitably, those two words will prompt instant reactions. What reaction is prompted will depend on circumstances, what is being regulated and enforced, or indeed, what has failed to be regulated and enforced.

As I write this letter I watch with horror, the aftermath of the earthquakes in Turkey and Syria. I also listen to a risk management expert being interviewed. Why are so many buildings suffering instant and total collapse? He replies that it's not just the magnitude of the earthquake, or that the building design standards are inadequate. *A significant factor is that the building codes are not effectively enforced.*

The Grenfell Tower Inquiry Phase 1 Report Overview observes that there are already grounds for thinking the current regime for testing the combustibility of materials may be *neither as rigorous nor as effectively enforced as it should be* and that concerns extend to *the adequacy of the regulations themselves, the quality of the official statutory and non-statutory guidance currently available, the effectiveness of the tests currently in use, and the arrangements for certifying the compliance of materials.*

The 2008 financial crisis was primarily caused by deregulation in the financial industry that permitted banks to engage in hedge fund trading with derivatives.

Regulatory controls and robust enforcement are often seen as overbearing and unnecessarily restrictive, and we can all think of circumstances in which this has indeed proved to be the case. However, the above examples demonstrate that, when there is a lack of effective enforcement of good regulatory controls and standards, the outcomes can be catastrophic.

I suppose what we all want is for our safety, health and wellbeing to be protected, but at the same time, wish to be free from unreasonable restrictions on how we want to live, work and spend our leisure time. This is not easy, as frequently a balance between benefits and harms has to be considered. I would commend two of the articles in this issue which deal with issues related to this. In *Health and wellbeing (ambitions for a better built environment)*, Barry Jobling observes that *human-centred design solutions aren't always the best choice for the planet and, conversely, achieving net zero carbon and other planet-conscious objectives can result in negative outcomes for building users.* An example of balancing competing harms can arise in the design of schools where sustainability targets and policies can dictate a large open-plan teaching space which may compromise children's learning outcomes.



Elena Prokofieva looks at related challenges in her technical contribution *How to design acoustically comfortable spaces for teaching.*

For those of us active in the field of acoustics, we are only too aware of the wellbeing benefits of sounds in nature and the performing arts, and the misery, harm and health impacts of excessive noise and vibration.

I hope we can all agree that what is required are:

- standards derived from robust research on health and wellbeing impacts (positive and negative) associated with sound, noise and vibration;
- statutory controls and guidance based on such research;
- adequate provision for proportionate enforcement, and
- accountability which ensures health and wellbeing outcomes are effectively achieved.

Alistair Somerville, IOA President

Engineering Division



The IOA Engineering Division will support you through the process to help you become one of almost 229,000 registrants that hold international professional recognition.

**By Blane Judd BEng
FCGI CEng FIET FCIBSE,
Engineering Manager**



All professional engineering institutions who hold an Engineering Council license to offer professional registration, work to the same standards and are regulated by the Engineering Council to make sure the process is fair and equitable across all licensed bodies.

Applications remain slow but steady; we just had one candidate ready for the interview in February. We are expecting our Engineering Council Liaison Officer, Malcom Carr-West, to sit in on more interviews in the future. We try not to make the process too intimidating by having lots of people on screen, but it is the best way for us to demonstrate to the Engineering Council that we adhere to the requirements of our license. Occasionally, we invite observers to sit in on our interviews when they are undergoing training to be interviewers of the future. If you have been through the process and

would like the chance to become an interviewer, we would love to hear from you.

We still get some candidates who, once they have paid their invoice, then ask what the next steps are. These are all clearly laid out in the guidance, so please study it as it will tell you what documents are needed and which items need to be endorsed by your sponsors. It also explains what to do if you cannot find IOA members to act as your sponsors.

When you first approach us about becoming registered, we send you the guidance document, it is important that you read this together with UK SPEC as some reports do not initially address the competencies. We are always ready to comment on the content of your professional review report prior to submitting the final draft and we will always comment on submissions and ask for re-drafted versions, but to avoid an iterative process, try to include evidence that shows you have the underpinning knowledge related to the projects you have submitted. For example, if you have selected a particular software to conduct modelling, explain why you chose it, what the shortfalls are, what results you were expecting and how you validated the outputs. These are all part of the A and B competencies and will save you having to do several rewrites.

Emma Lilliman has completed the housekeeping and some of you will have been asked if you still intend to go through the registration process. There are a couple of reasons for this. Firstly, we are now interviewing using the Engineering Council UK SPEC version 4 which is available from their website here: <https://www.engc.org.uk/ukspec>

and secondly, we have been asked to avoid keeping old data which we do not intend to use.

Neil Ferguson still helps us with academic equivalence support for those candidates who do not have recognised qualifications. You can check for yourself if your qualifications meet the required specification by visiting the Engineering Council website <http://www.engc.org.uk/courses>. But please don't panic if your specific qualification is not listed, as we can still help you through the process using individual assessment (see later in the article).

We hold several interview events through the year, depending on the number of candidates we have coming forward for registration. Our next set are scheduled for 14 and 15 June 2023. If you are interested in taking the next step to becoming a professionally registered engineer, email us on acousticsengineering@ioa.org.uk sending a copy of your CV, copies of certificates and transcripts of your qualifications. It is important that we have all of your further and higher education certificates, not just your highest attainment.

There are two routes to registration:

The **recognised qualification** route, if you have achieved the required learning outcomes through recognised qualifications in acoustics. Qualifications which provide the required level of knowledge and understanding are for IEng and accredited Bachelor's degree and for CEng an accredited integrated Master's degree or a combination of accredited Bachelor's and Master's degrees (see table on next page).

Recognised qualifications

Incorporated Engineer (IEng) One of the following:	Chartered Engineer (CEng) One of the following:
An accredited Bachelor's or honours degree in engineering or technology	An accredited Bachelor's degree with honours in engineering or technology, plus either an appropriate Master's degree or engineering doctorate accredited by a licensee, or appropriate further learning to Master's level*
An accredited Higher National Certificate (HNC) or Higher National Diploma (HND) in engineering or technology started before September 1999	An accredited integrated MEng degree
An HNC or HND started after September 1999 (but before September 2010 in the case of the HNC) or a foundation degree in engineering or technology, plus appropriate further learning to degree level	An accredited Bachelor's degree with honours in engineering or technology started before September 1999
A National Vocational Qualification (NVQ) or Scottish Vocational Qualification (SVQ) at level 4 that has been approved by a licensee, plus appropriate further learning to degree level*	Equivalent qualifications or apprenticeships accredited or approved by a licensee, or at an equivalent level in a relevant national or international qualifications framework†
Equivalent qualifications or apprenticeships accredited or approved by a Licensee, or at an equivalent level in a relevant national or international qualifications framework†	

* See: www.engc.org.uk/ukspec4th for qualification levels and HE reference points.

† For example, UNESCO's International Standard Classification of Education (ISCED) framework.

The **individual assessment** route, for applicants who do not have the recognised qualifications and who will have an individual assessment of their qualifications and any other relevant learning such as: formal academic programmes, in-employment training and experiential learning self-directed learning. In many instances, it is

likely to be a combination of some or all these options.

Remember we are here to help you get through the process and advice and support is offered to every candidate personally.

For **individual assessment**, the Institute accepts several courses from certain academic centres in relevant subjects, such as audio

technology, as being equivalent to accredited courses for the purposes of EC registration, without the need for further assessment.

The Institute recognises the IOA Diploma course and the several Master's courses linked to it as providing evidence if you are looking to gain CEng registration. You could also offer a PhD qualification, depending upon the content of the associated taught element. We can also offer support for registration via a 'technical report' route, if you do not have the relevant qualifications to help you demonstrate you are working as a professional engineer in acoustics. If you need to follow the technical route, we will discuss this with you before you embark on that process.

Election process

The election process is overseen by the Institute's Engineering Division Committee, which is made up of volunteers from the membership. They represent the ever-growing number of members holding EC registration and provide the essential peer review process that affirms that you are at the appropriate level for recognition as an Engineering Council Registered Professional Engineer.

Our video explains how members can gain professional recognition and Engineering Council registration through the IOA.
<https://www.ioa.org.uk/video/recognising-your-professionalism-0>

Engineering Council successful candidate

The Engineering Council is the UK regulatory body for the engineering profession. It holds the national registers of Engineering Technicians (EngTech), Incorporated Engineers (IEng), Chartered Engineers (CEng) and Information and Communications Technology Technicians (ICTTech).

It also sets and maintains the internationally recognised standards of professional competence and ethics that govern the award and retention of these titles and the IOA is pleased to announce that Tom Hills has attained the standard required for admission to the national register.

Tom has an MEng (Hons) in Acoustic Engineering from the University of Southampton and is currently a Senior Associate at Hoare Lea. Speaking of his recent qualification, Tom said: "I have always aspired to gain the recognition of the Engineering Council, but have always found the excuse of being too busy to do it. During lockdown, I set myself the goal of achieving the recognition and set aside time to get the paperwork and evidence together.

"One of the biggest challenges was getting across the key bits of information succinctly within my PRI report. A couple of the best bits of advice I was given during the process was "to focus on the engineering on the project that demonstrates that I am operating at a Chartered Level rather than spending too much time scene setting", but also "what expertise am I trying to demonstrate that

are not just something anyone could do by following the relevant Standard". This helped to change my mindset when writing my PRI report to ensure that I kept the readers and interviewers interested, but also helped me focus on the key message of my PRI report.

"I would recommend that anyone else looking to gain registration has a mentor who is already registered. I found that having another pair of eyes to look through everything was so helpful in the evidence I produced and helped to focus what message I was trying to convey. This was also helped by the IOA who also reviewed and commented on my evidence prior to being invited to interview.

"For young engineers who want to gain registration in the future, I would recommend making yourself familiar with the competencies now, because it is never too early to start looking at putting your evidence together. Having in mind what the competencies are and building up the evidence as you go through your career can make the whole process much easier when it comes to producing your evidence and PRI report." 



Right: Tom Hills

IOA 2023

Events for

Organised by the Building Acoustics Group
Building Acoustics Sustainably: Practical Considerations
 18 April 2023
The Building Centre, London

Organised by the Early Careers Group and UKAN+
The Art of Being a Consultant
 20 April 2023
The Little Ship Club, London

Organised by the Early Careers Group and UKAN+
The Art of Being an Acoustician
 21 April 2023
The Little Ship Club, London

Organised by the Measurement & Instrumentation Group & Building Acoustics Group
The Story of (Document) O
Compliance with Approved Document O and other Measurements in Building Acoustics
 29 June 2023
Building Compliance Testers Association (BCTA), Loudwater, Bucks

Organised by the Underwater Acoustics Group
5th International Conference on Synthetic Aperture in Sonar and Radar
 6-8 September 2023
Villa Marigola, Italy
<https://www.ioa.org.uk/civicrm/event/info?reset=1&id=718>

11th International Conference on Auditorium Acoustics
 28-30 September 2023
SNFCC, Athens Greece
<https://auditorium2023.org>

Acoustics 2023
Institute of Acoustics Annual Conference, Exhibition and Dinner
 16-17 October 2023
The Guildhall, Winchester
<https://www.ioa.org.uk/civicrm/event/info?reset=1&id=750>

Organised by the Electroacoustic Group
REPRODUCED SOUND 2023
Audio accessibility – the ingredients for success
 14-16 November 2023,
The Bristol Hotel, Bristol

For up-to-date information visit www.ioa.org.uk

It's time to renew your membership

Your membership expired 31st December 2022 and renewals will be issued from mid-January 2023

Membership of the IOA enables professional recognition and greater influence in shaping the world in which acousticians work and live.

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Approved Membership Applications

The Membership Committee reviewed 90 application forms on 19 January 2023 at their meeting held at the IOA HQ as well as 10 through the fast-track route for non-corporate applications. 21 corporate applications have recently been approved by the Council following the recommendations of the Membership Committee. The Committee saw 58 new candidates joining the IOA, 40 of whom were Diploma students. The remaining applications came from members upgrading. The IOA also welcomed a new Institutional Subscriber.

FIOA

Douglas Manvell	Matthew Hyden
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MIOA

Matthew Bevington	Josh McLelland
Ka Wai Chan	Jamie Newton
Claire Derbyshire	Lawrence Norman
Adam Dixon	Peeravich Panlertkitsakul
Josh Evans	Emily Sharpe
Jack Florentine	Yanjie Shen
Nick Jenkins	Mark Thompson
Matt Jones	James Thurston
Claire Lomax	George Xanthoulis
Reid Malster	

AMIOA

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Shams Ahmadi	Joel Mahay
Nilav Babariya	Sean Mansfield
Sudeep Balasubramanian	Kira Marshall
Andrew Beverley	Howard Master
Nuvin Boyjonauth	Warren Meyer
Jason Bradshaw	Hauke Moxon-Riedlin
Richard Cain	Krzysztof Mrozek
Luke Coffey	Stephen Panneer Selvam
Edwin Egbuonu	Charlie Pearson
Benjamin Evans	Anthony Pilotti
Leonardo Fernandez Rodriguez	Ollie Platts
Lewes Gage	Thomas Price
Marianne Garrett	Aileen Rahilly
Joshua Hale	Anoop Rajan
Sky Hawkins	Darcy Reddin
Andrew Hayes	Danny Robinson
Matt Hayes	Fraser Roskilly
Peter Higgins	Amy Royal
Jordan Hill	Mohamed Shafeeque
Ben Hobbs	Keith Stalker
Emma Howard	Ian Tan
Alex Jang	Faye Thompson
Tomos Jenkins	Siu Wai Tsui
Peter Kahn	Vando Valente
David Kendal	Phoebe Webber
James Lennon	Jack White
William Lewis	Aidan Willis

TechIOA

Hugo Evans	Sam Frankcom
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Affiliate

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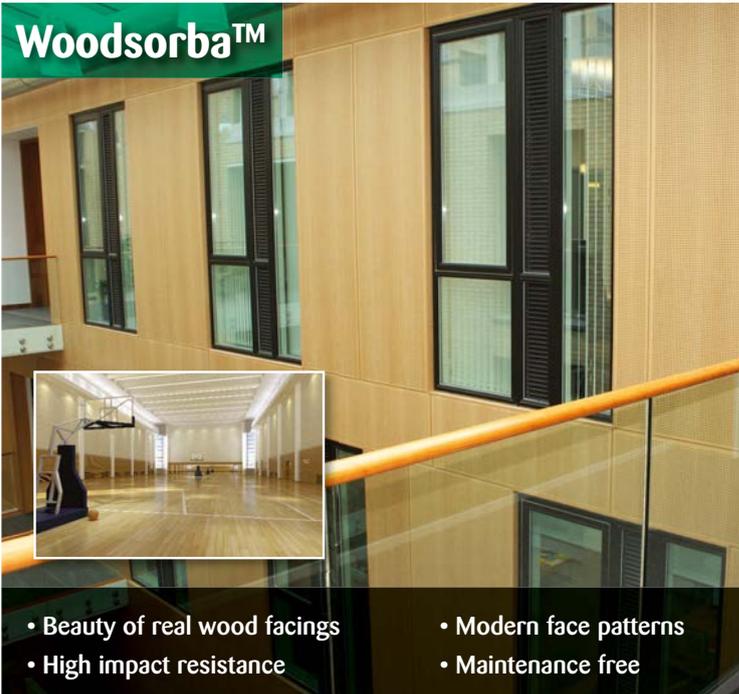
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IOA education and training news



The IOA offers professionally recognised courses for those interested in working in any aspect of acoustics and, as a result of new accreditations and reaccreditations last year, more centres in the UK will be delivering the IOA certificate courses in 2023.

**By Helen Davies,
IOA Education Officer**

A full list of accredited centres is on the relevant course page on the IOA website (training tab) and any of these centres should be contacted directly for information on course dates, delivery methods and course fees.

Certificate courses typically run for five days onsite; once in the spring and the other in the autumn, with a practical assessment and a written examination on the final day. However, some centres may only run one sitting per year and offer a slightly different format.

Also, subject to acceptance of the arrangements by appropriate management committees, and a sufficient number of candidates, certificate centres may be able to deliver bespoke courses onsite on request.

Holders of certificate courses may apply for Tech IOA membership (further details are available from membership@ioa.org.uk).

Subject to recruitment, the IOA will be offering the following Certificate courses in 2023:

- **Certificate of Competence in Workplace Noise Risk Assessment (CCWNRA):**
Examination dates:
3 March and 29 September

- **Certificate of Competence in Building Acoustics Measurement (CCBAM):**
Examination dates:
21 April and 3 November

- **Certificate Course in the Management of Occupational Exposure to Hand Arm Vibration (CCMOEHAV):**
Examination date:
21 April

- **Certificate of Competence in Environmental Noise Measurement (CCENM):**
Examination dates:
19 May and 6 October

- **Certificate of Competence in Irish Building Acoustics Measurement (CCIBAM):**
Examination date:
10 March.
(For enquiries and to book a place on this CCIBAM course please contact info@soundtestingireland.com)

Other courses

Subject to recruitment, a Certificate of Proficiency in Technical Report Writing course is due to run for two days w/c 27 March, to be followed by an online viva after a submission of a technical report. An Advanced Certificate in Report Evaluation is being developed. Subject to sufficient progress, this course will be run in June. For more information and/or to book a place contact education@kpacoustics.com

IOA Diploma 2023-24

Enquiries and expressions of interest in studying the Diploma at an accredited centre or via tutored distance learning for academic year 2023-24 are welcome. Application and registration forms for distance learning will be made available in March 2023.

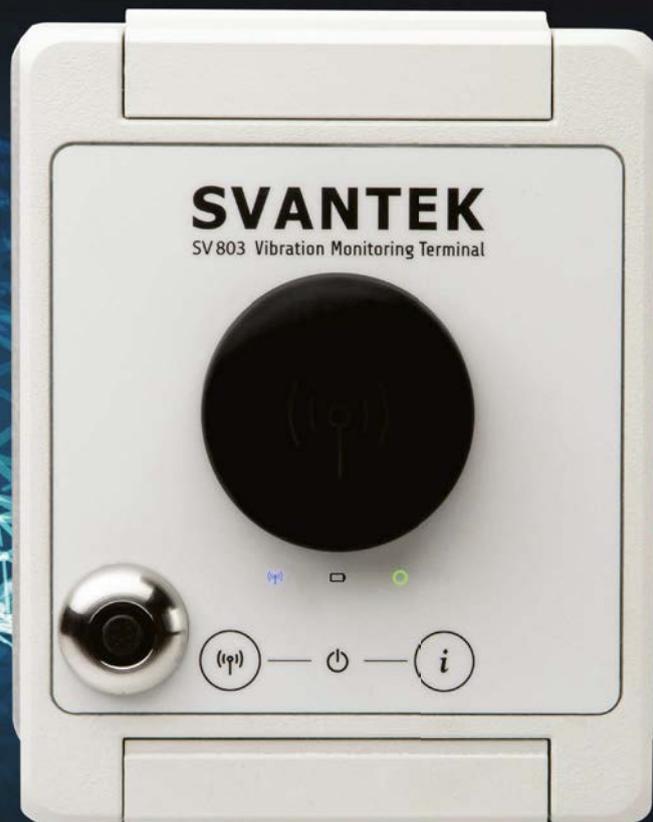
We are delighted to confirm that the University of Derby will resume offering the Diploma in 2023-24, along with KP Acoustics Research Labs and London South Bank University.

Refer to the accredited centres list on the IOA website Diploma page (<https://www.ioa.org.uk/diploma-acoustics-and-noise-control>) for contact details of your required centre and enquire directly for more information on course dates, delivery and course fees.

You can also approach the IOA Education team via education@ioa.org.uk 

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Heroes wanted!

Consider a career in acoustics and save the world

Heulwen Peters discusses the importance of engaging young people by highlighting the role acoustics plays in making the world a better place.

By Heulwen Peters

Wonder how many school children would feel more enthusiastic about a career in acoustics if we could promise that? That the work they would do as an acoustician will make a meaningful difference to people's lives. That it will improve people's living conditions and provide and protect habitats for wildlife. That it will support people's health and healing, and provide technology that better connects people to their environments, whatever their aural response.

Hopefully you're thinking, "but that's exactly what we do!"

STEM activities are back in force in schools across the country. The 2022/2023 academic year is the first full year where extra-curricular activities are 'back to normal' and this has meant the return of in-person STEM fairs and acousticians coming in to work with pupils.

A future better by design

Most STEM ambassadors will be familiar with the traditional 'science experiment' approach for children. But more than ever, how we deliver STEM content to pupils (who might be anywhere from ages four to 18) must be tailored to answer the concerns and questions young people have. How do we reduce our global environmental impact? How can we improve living conditions for people around the world? How can we reduce human impact on wildlife? *How do we make the world a better place?*

The UN Environment Programme (UNEP) Frontiers' report published in 2022 identified three emerging issues of environmental concern, and the first of these was noise. Within the report a huge amount of focus is given to soundscapes, the health effects of noise on humans, and the impact of noise on animals.



Above: The UN's first concern, the soundscape, lends itself well to STEM work, with all ages and abilities of children able to take part in sound walks

Today's acousticians are developing the tools and solutions to these problems, but tomorrow's acousticians will be instrumental in making the future inherently better for humans and wildlife by design.

Bringing environmental discussions into IOA's STEM work can increase engagement with pupils, particularly those who lean toward 'save the world' careers and are intimidated by the traditional tropes of engineering. It can also help STEM organisations feel more able to incorporate acoustics into the wider STEM discussions and events – many of which are now focused on climate change and the environment.

STEM in practice

So, what do the STEM activities look like in practice? As a discipline, acoustics is inherently about improving people's lives so it's not difficult to find opportunities to enter the discussion. The UN's

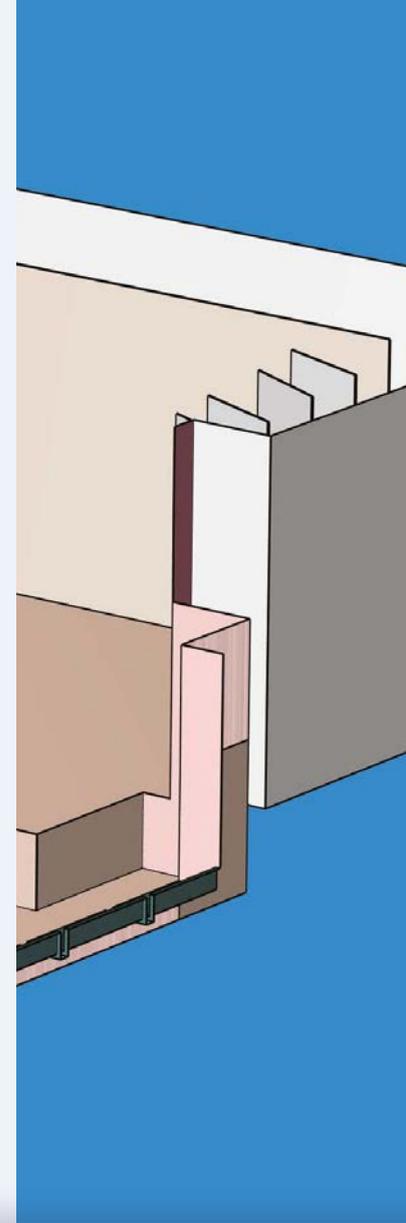
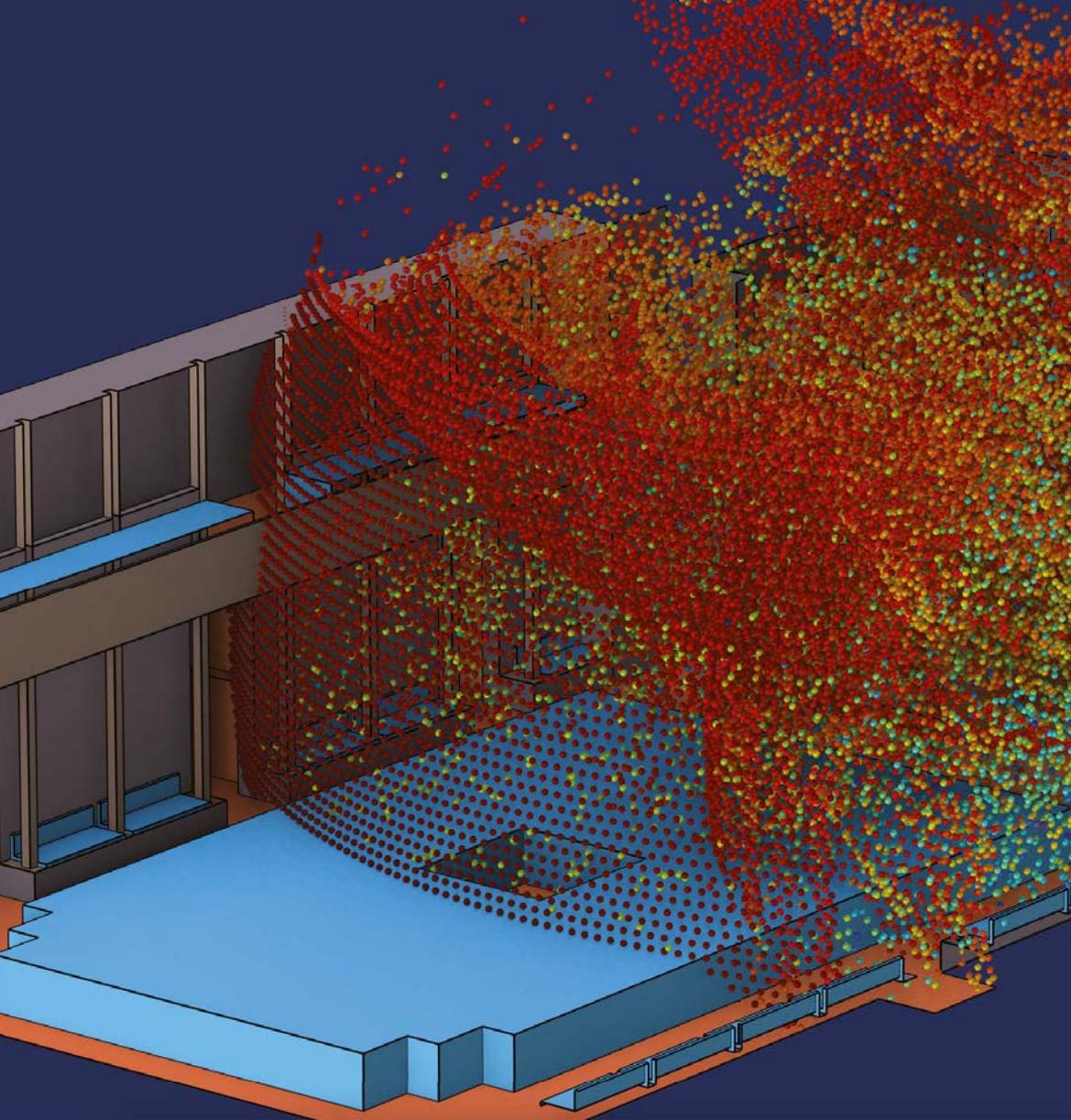
first concern, the soundscape, lends itself well to STEM work, with all ages and abilities of children able to take part in sound walks. It can open discussions about aural diversity and aural response, or about tranquillity and how different each person's experience is.

We can also talk about the effects of noise on the animal kingdom. This could take the form of quizzes asking them to identify the oil drill vs the whale song, or thought experiments on how wildlife populations might be affected by a planted acoustic bund vs a concrete barrier.

And of course, some of the experiments and activities we already run with pupils can be reframed, to make pupils think more about how the real-world impact of these engineering principals.

Our STEM work can and should show future acousticians that we really do make a real difference to the world around us and improve it for all. 🌍

If you have any ideas on how best to demonstrate the importance of acoustics to the environment, please let us know at STEM@ioa.org.uk



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IOA Early Careers Group

The IOA Early Careers Group (ECG) is gathering momentum and has several important events coming up, especially the Art Of Being A Consultant and Art Of Being An Acoustician conference, that will be of particular relevance for acousticians at the early stage of their career.

By Josie Nixon



Above:
Josie Nixon,
Chair of the IOA
Early Careers Group

IOA ECG has joined up with UKAN+ Early Careers (EC) Specialist Interest Group (SIG) to create a special two-day conference; *The Art of Being a Consultant and The Art of Being an Acoustician*. The event will be held at the Little Ship, London on 20 and 21 April 2023. The conference is aimed at acousticians across academia, consultancy and research and it will be a great chance to learn soft skills, hone your craft and network.

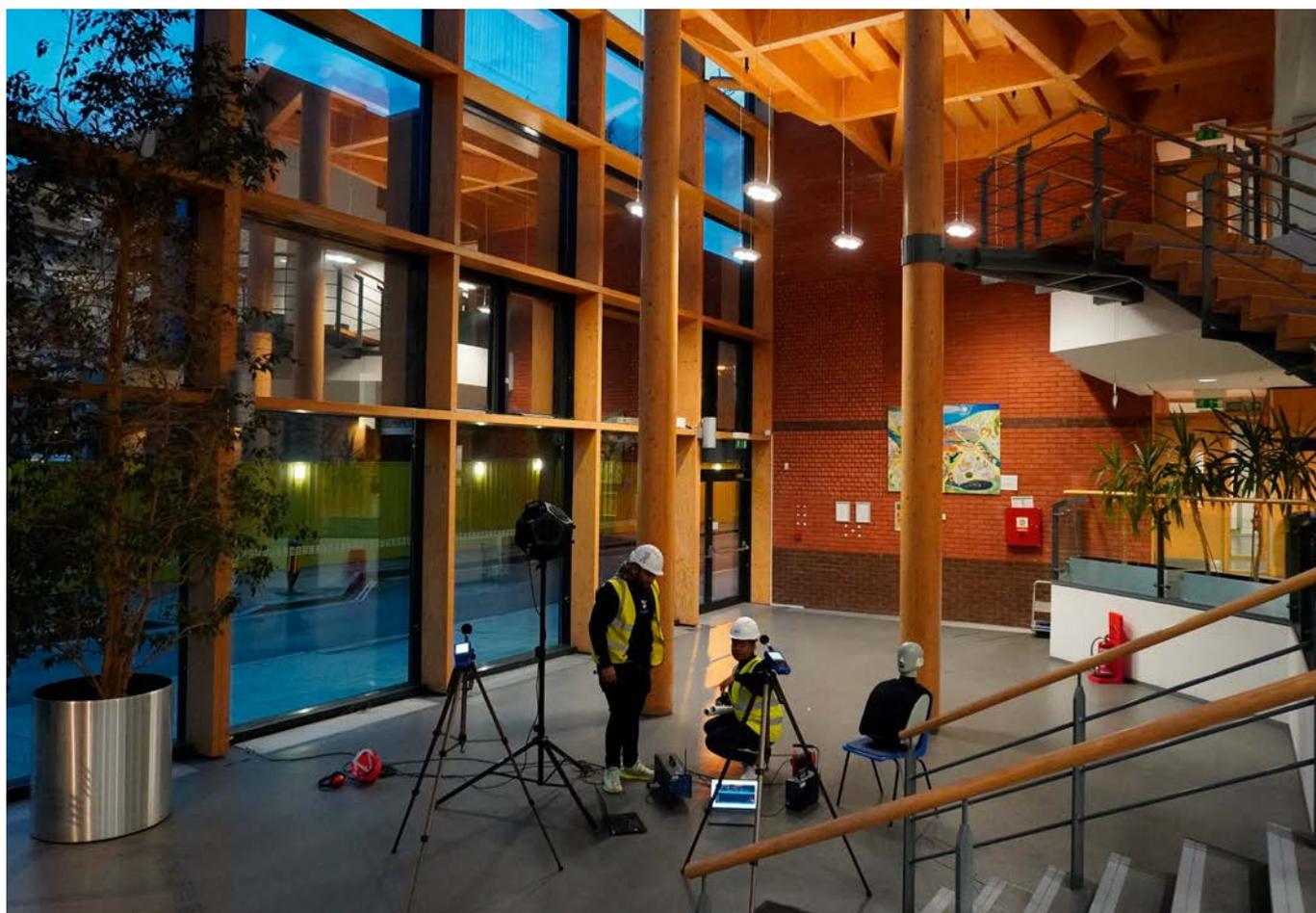
The first day, *Art of Being a Consultant*, will be aimed at future acousticians looking to join, or who have recently joined the acoustic consultancy world. The second day, *Art of Being an Acoustician*, will be aimed at acousticians remaining in acoustic academia and research. If you haven't already signed up, then head to the IOA event webpage and register now for the event! www.ioa.org.uk/events

Below:
The Art of Being a Consultant conference is aimed at future acousticians like these LSBU students (Image courtesy of Luis Gomez-Agustina)

Recent webinars

IOA Early Careers Group webinar on wind turbine noise from Richard Carter, Bow Acoustics
By Diogo Pereira (BAP)

As an expert with more than 15 years' experience within the field of wind turbine noise, Richard Carter, from Bow Acoustics delivered a presentation to the ECG on 18 January to give an overview of the discipline, mainly within the



planning process. Wind turbines have been shrouded in controversy and are not without their challenges to overcome this stigma, deserved or otherwise. The webinar was very well attended by more than 80 people, with a full Q&A session at the end of the presentation, that could certainly carry on for plenty more hours (days...?).

The presentation covered the main guidelines for the assessment and rating of noise from wind farms (ETSU-R-97 and IOA GPG), background survey requirements (wind conditions, data collection), data analysis, predictions and assessment.

With vast experience in this area, Richard cautioned the early career audience for some many variables that may influence the assessment such as early engagement with the Local Planning Authority being essential, ongoing and able to impact variables such as number and position of measurement locations (if needed), being aware of tall vegetation noise, wind shear, time synchronising all the data, checking the influence of wind direction and making sure to roughly know how long the soils take to dry!

The webinar gave our members a sneak peek into the world of wind turbine noise assessment and will certainly be incredibly useful for everyone (and especially early career practitioners) working in this area. The webinar has been recorded and will be available to view on the IOA Branch & Group videos webpage.

The ECG webinars working group members would like to thank Richard for the great presentation. Keep an eye out for the next webinar!

ECG Representatives

Our ECG Representatives will be introducing themselves over the next few issues of the Acoustics Bulletin and we start in this issue with Ashley Leiper, Daniela Filipe, James Stokes and Aaron Tomlinson.

Ashley Leiper, IOA Scottish Branch ECG Representative

Ashley is a noise analyst at a renewable energy developer. He joined the ECG in 2021 as the Scottish Branch Representative with a view to getting involved in IOA activities and expanding his

professional network. Working across both committees led Ashley to get involved in organising ECG and Scottish Branch events at Inter-noise 2022, held in Glasgow. This included working with Tomasz Galikowski (the past ECG chair) organising the sold out joint branch social event at Platform, as well as an impromptu speed-networking event at a train ticket machine!

Daniela Filipe, Building Acoustics Group ECG Representative

Daniela is an acoustic engineer with over 10 years' worth of experience in building acoustics, specialising in the refurbishment of historic buildings and in science and research facilities. She joined the Early Careers Group Committee in late 2019 as the rep for the IOA's Building Acoustics Group.

Early in 2020, Daniela was part of the original ECG's working group responsible for organising monthly webinars. The intention of the working group and webinars was to help support junior engineers throughout the uncertain times of the pandemic, particularly those that may have been affected by redundancy or the furlough scheme. The ECG webinars are still going strong, now under the initiative of other members who you will get to meet in future issues of Acoustics Bulletin.

Being involved with the IOA committees has given Daniela the opportunity to meet other professionals with extraordinary experiences and backgrounds.

James Stokes, Gyms Group ECG Representative

James is a senior acoustic consultant with more than eight years in the industry, specialising in building acoustics, with expertise in gym acoustics and residential design. He joined the ECG in 2019, in the newly formed role of representative of the Gyms Group, which has been developing a consolidated guidance document for gym assessments, for which James authored a chapter. This will be formally published in March 2023 – so don't forget to look out for it!

Aaron Tomlinson, South-West Branch, ECG Representative

Aaron has been working in the acoustics industry for eight years, having started his first day on the job with only the weekend separating his last exam at Salford University! This classic pathway into consultancy is well supported by the IOA in many respects. So, as soon as the opportunity arose Aaron began helping out at the Institute, working closely with Allan Chesney on the soundBites e-zine while at university and for the first few years of his career. When Aaron moved to the south west, he volunteered for the IOA Southwest Branch as a young member in 2021, paving the way into the ECG. Aaron has since helped organise webinars, presentations and social events for the group, alongside a diverse and UK-wide team of friendly acousticians. 🌐

The ECG is open to all members of the Institute (both corporate and non-corporate) who shall normally be under 35 years of age or within first five years of their career. The group is always keen to hear from members and non-members alike. To join the Early Careers Group, to find out more information or to voice your concerns, visit <https://www.ioa.org.uk/early-careers-group>

Reproduced Sound 2022: Auralisation and Personalisation – Beyond Reality, Bristol, UK, 15 – 17 November 2022

The 38th annual Reproduced Sound conference, organised by the IOA's Electroacoustics Group (EAG), took place in Bristol last November. The conference represents the cutting edge of modern audio and acoustics in an informal environment that allows consultants, manufacturers, contractors, end users, academics and students to mingle and share insights and information.

By Adam Hill

Organisation of the conference was led by **EAG Chair, Keith Holland**, supported by the 11 committee members and the IOA's **Linda Canty**.

Complete audio-visual support was provided by EAG committee members, John Taylor and Andrew Horsburgh (d&b audiotechnik, UK), along with students; Lestyn Lewis,

Justas Jodkauskas, Duncan Towler and Ben Edge from dBs Institute of Sound & Digital Technologies, Bristol. d&b audiotechnik have generously provided technical support for Reproduced Sound for many years, to the great benefit of the conference.

The conference was held both in person at the Bristol Hotel and online. There were 89 delegates (78 in person and 11 online), representing a healthy balance between industry and academia.

PRE-CONFERENCE ACTIVITIES

Reproduced Sound often includes a special event the evening before the conference opens, consisting of a more informal talk and demonstration from members of industry or academia.

This year's Tuesday evening session was co-organised with the IOA's Southwest branch. Two talks were presented on the intersection between acoustics and art. Locally based, internationally [P20](#)

Below: Conference delegates enjoying the first day of Reproduced Sound 2022



Sound Masking

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Open plan offices benefit from Sound Masking



Cellular offices achieve better speech privacy with Sound Masking

Sound Masking is a cost effective solution to the problem of improving speech privacy in today's modern office environment. Best installed during office fit out but often installed as retrofit, Sound Masking from AET has improved the office environment for many international companies throughout Europe over the last 20 years.

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Sound Masking is also known as sound conditioning or white noise systems



known artist, Luke Jerram, provided a presentation on how his work has used sound to communicate ideas, including videos of his street pianos project *Play Me I'm Yours*, *Sky Orchestra*, an orchestra playing from balloons floating over various cities at dawn, *Aeolus*, an acoustic wind pavilion that toured National Trust properties before finding a permanent home at Airbus in Filton, *Palm Temple*, commissioned for Sky Arts and a giant waterslide installed on Park Street in Bristol.

This was followed by acoustician, and Southwest branch committee member, Tamazine Leighton-Crawford, giving a talk about her music compositions and acoustics work. This included playing sections from and discussing the composition of her loop pedal experiments for cello, her electroacoustic composition *Les miniatures en Suisse*, based on soundscape recordings from the Swiss Alps, and her cello and djembe drum piece *Energy*, that was selected to be played as part of the Spirit Medley at the Birmingham 2022 Festival Commonwealth Games.

Both talks were followed by lively Q&A sessions.

CONFERENCE – DAY 1

The first formal day of the 38th Reproduced Sound conference was launched by EAG Secretary, Bob Walker. After a brief introduction to the IOA and the EAG itself, Bob expressed how glad he was to see so many new faces in the room and that this year's programme was sure to be of interest to all in attendance. Bob was acting as Chair of the Conference in the absence of EAG Chair, Keith Holland who was unable to attend this year. IOA President, Alistair Sommerville, expressed his gratitude to the EAG for organising this conference, noting how much he enjoys the Reproduced Sound atmosphere and the wide range of subjects, each demonstrating very broad impact globally.

Peter Barnett Memorial Award – Glenn Leembruggen

This year's Peter Barnett Memorial Award recipient was Reproduced Sound regular, Glenn Leembruggen (Acoustic Directions, Australia). The citation was delivered by Glenn's long-time collaborator, David Gilfillan. David gave a brief overview of Glenn's career,

including studying under the supervision of Richard Small at the University of Sydney and working during the industry's transition from analogue to digital. David emphasized Glenn's drive to fully understand all system elements, which inevitably has led to excellent system designs. Alongside Glenn's commitment to furthering the science and engineering of electroacoustics, he has demonstrated a continued commitment to educating both in formal university settings and beyond. It's for these, and many other, reasons that Glenn is a much-deserving recipient of the Peter Barnett Memorial Award.

After Alistair presented Glenn with the award, Glenn presented his talk, *Standing on the Shoulders of Giants*, but began by expressing his thanks to the IOA for putting on Reproduced Sound for so many years. He has met countless amazing and inspiring individuals over the years, many of which are included in his talk's list of 'giants' who have previously received the Peter Barnett Memorial Award.

In order to invent something new and useful, first principles P22

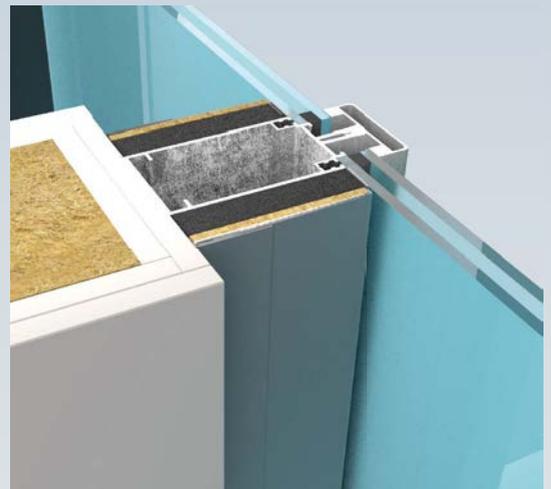
Below: Glenn Leembruggen (centre) receiving the Peter Barnett Memorial Award from IOA President, Alistair Somerville (right). The citation was presented by David Gilfillan (left)



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Right:
Prathmesh Thakkar
presenting his
paper on room
correction systems



knowledge of all relevant subjects is absolutely necessary. In virtually all cases, Glenn's overarching goal has been to produce a direct sound field with great fidelity, minimising detrimental late arriving energy. This focus was instilled in Glenn from some of the 'giants' he encountered early on in his career, either directly or indirectly, including Richard Small, Neville Theile, Sigfried Linkwitz, John Vanderkooy and Richard Waterhouse.

Glenn explained that in many instances the equipment or software that he needed for a particular project simply didn't exist or was unavailable to him. This resulted in Glenn regularly developing his own equipment and software, based on key publications from the 'giants'. This approach led to work in extending the practical limits of measurement procedures and ultimately defined a regular focus in Glenn's career; steered

loudspeaker arrays. Inspiration in this and related areas came from more 'giants' including Don Davis, Evert Start, Don Keele, Peter Mapp and David Griesinger.

Glenn carried on by highlighting many case studies from his work in government buildings and courtrooms. Key to much of this work was finding solutions in consultation with the architects, as it is of little use to operate in isolation from other key stakeholders in projects. Glenn highlighted past projects in recording and control rooms, inspired by the work of Philip Newell, Keith Holland, Bob Walker and Glyn Adams.

It was clear from Glenn's talk that he is still very busy with new and exciting projects. He emphasised that speech intelligibility quantification, primarily using STI, doesn't pick up frequency response problems which is a big issue. He also detailed more recent

efforts to improve sound system performance (in terms of musicality and intelligibility) through the use of signal decorrelation methods, such as those from Malcolm Hawksford and Adam Hill.

A lively Q&A session followed Glenn's talk, although Bob Walker noted that it was a problem that Glenn wasn't available as an audience member to ask questions, as he regularly does for the other presentations. There was no shortage of questions, however.

Session 1 – Room acoustics (Chair, Bob Walker)

Analysis of acoustic room correction systems

The first paper of the conference was presented by Prathmesh Thakkar (GP Acoustics, UK), which was a continuation of the research he presented in his paper at Reproduced Sound 2021. In this talk, he went through a method to quantify a small room's low frequency response, principally focusing on room modes and decay. This led to details of an investigation into room mode EQ versus room/system correction. Prathmesh used illustrative figures and animations to demonstrate his findings, highlighting the benefits of appropriate subwoofer placement and limited modal EQ. Questions from the audience covered issues with EQ on the direct sound, benefits of room modes and possible benefits of asymmetrical room configurations.

Acoustic characterisation of an Edwardian bathhouse

The room acoustics session continued with a paper presented by Pedro Novo (Max Fordham, UK) detailing his work on the measurement and reproduction of the acoustics in an Edwardian bathhouse for use with an operatic performance. The impulse response measurement procedure was detailed including information on how a 14-loudspeaker system was implemented for playback. Care was taken to consider acoustic intimacy by inspecting reflection direction and timing as well as interaural cross-correlation. Questions focused on whether the use of instruments in addition to voice was considered and the effect an audience might have on the space's acoustics.

Acoustic design of a control room for recording and teaching

The paper session was concluded with Glenn Leembruggen (Acoustic Directions, Australia), who was presenting a case study on a recent project involving a control room for recording and teaching. Glenn linked back to his earlier presentation by highlighting some of the core direction of this work was influenced by Philip Newell's non-environment concept as well as Bob Walker's work on controlled acoustic image design. Glenn covered the challenges of the project (both in design and measurement), noting that Walker's past observations of problematic console reflections held true in this instance. Overall, Glenn was able to demonstrate a successful design, most evident in the testimonials from the client and regular users of the space.

Session 2 – Signal processing, immersive audio and spatial sound (Chair, Mark Bailey)

Loudspeaker matrix arrays

Following lunch, the second session of the conference began with Evert Start (Holoplot, Germany), who was presenting his recent work in developing loudspeaker matrix arrays. Usefully, Evert began by covering array and wavefield synthesis fundamentals, leading to a discussion on inverse wavefront shaping where the sound field doesn't converge to a point behind an array. Additionally, Evert highlighted the importance of a well-defined spatial phase function to allow for greater array efficiency. The talk was concluded with a detailed look into the possibility of simultaneous sound fields being reproduced from a single matrix array. The audience had many questions for Evert, mostly focusing on the system's limits and practicality.

Lister preference of reverberation in live music recordings

Ken Liston (Nottingham Trent University, UK) delivered the second paper of the session, detailing his recent investigation into listener preferences of post-production reverb applied to live music recordings. The goal was to provide live recording realism to allow people to experience virtual concerts, noting that many live recordings fall far short of the standards expected of studio recordings. Ken's work included measurements of an empty music venue to determine the natural reverb of the space and then used this (as well as artificial reverb) to test 90 undergraduate students to see what they preferred to be applied to a relatively dry live recording. It was shown that preferences were largely dependent on the musical content where there was some interesting further research to carry out in this area.

Virtual bass for cross-talk cancellation systems

The third paper of the session was delivered by Ben Scott (University of Southampton, UK), detailing his undergraduate research on the application of virtual bass to soundbars. The soundbars under inspection were relatively small, lacking in adequate physical low frequency output, but capable of delivering focused beams of sound to listeners to ensure good spatial audio. Ben decided to inspect the performance of nonlinear device (NLD) virtual bass, where results showed that it helped to enhance low frequency rating as well as spatial immersion. Questions from the audience focused on how the system avoids perceptual high frequency distortion as well as clarifying a few of the finer details of the work.

Audio source localisation using complex-valued neural networks

The session was concluded with a presentation from Vlad Paul (University of Southampton, UK), which was a continuation of his research on neural networks detailed at the past few Reproduced Sound conferences. In this installation of the work, Vlad looked into the use of complex-valued multilayer perceptrons (MLP), where traditionally real and imaginary components would be handled P24

Gym Acoustics Guide Launch

Wednesday 29th March
15 Hatfields, London SE1 8DJ

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 - Planning conditions
 - Legislative framework
 - Good practice in testing
 - Vibration
 - Prediction methodology
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separately, resulting in a larger neural network. In this instance, cross power spectrum (CPS) was investigated for source localisation, with 2D and 3D microphone arrays simulated. While there were some promising early results, it is clear that more work is needed in this area to exploit the potential of this idea, including improved efficiency.

Session 3 – Psychoacoustics, subjective assessment and auralisation **Chair, Ludo Ausiello**

The Arup Experience Lab

The final session of the day was kicked off by Calum Ferreira (Arup Acoustics, UK), detailing the development and current applications of the Arup Experience Lab. The lab makes use of an ambisonics system alongside a (minimum) 4K resolution curved screen (that is acoustically transparent), with 3D glasses as an optional extra. The system can playback reality captures, 3D models and mixed reality and uses motion tracking to adjust perspective. Calum included a detailed description of how content is captured and/or generated, focusing on a few common use cases. There were many questions from the audience focusing on the acoustics of the lab, calibration of the ambisonics systems and how to handle reflections in the recordings.

Hearing degradation – a personal account

The paper session continued with a presentation by Reproduced Sound regular, Philip Newell. In his talk, Philip detailed his personal experience with hearing degradation, which has happened over time, but not quite as he had expected. He shared the results from a series of hearing tests, which highlighted significant inconsistencies. What was evident was the expected high frequency roll-off, characterised as an observed 'dullness' in studio monitors. This has impacted Philip's ability to critically listen to recordings or systems, where he has also found that increases in reverb reduce intelligibility. The presentation was extremely well-received by the audience, where Philip was applauded for being so candid with his own experience of hearing degradation. This is clearly

an important topic that requires a more open and honest discussion.

Using cognitive psychology and neuroscience to inform sound system design

The final paper of this session was delivered by Jon Burton (University of Derby, UK) detailing his PhD research which focuses on how to practically achieve the same live event experience for all audience members, with a particular focus on open air events. The question really is whether sound engineers understand what an audience wants. Jon's work dives into the subconscious response for clues, focusing on three themes: hearing/feeling, hearing/seeing, and hearing/pleasing. Jon described an early investigation looking into preferred listening levels at large-scale live events, where it appeared that background noise levels (due to the audience) might play a key role, but it's unclear where the ultimate drive for hitting a certain level at popular music events comes from. Further research is required before any conclusions can be formulated.

Electroacoustics Group AGM

The annual general meeting of the Electroacoustics Group (EAG) was held after the final paper session of the day. The meeting was chaired by Bob Walker (in the absence of EAG Chair, Keith Holland). Bob gave an overview of the activities of the group over the past year, the central focus being the organisation of this conference. Bob expressed thanks to the committee members for their efforts with the conference planning and specifically thanked John Taylor for his leadership on the technical side of the conference delivery. Discussions were held regarding potential new EAG members as well as the possibility of a new EAG Chair.

Conference reception and dinner

Reproduced Sound's reception and dinner were held at the Mud Dock Cafe. Delegates enjoyed an evening of networking and catching up with each other. EAG committee member, Mark Bailey, carried on the tradition from Keith of reading a poem after dinner, by reciting a piece he had written about the conference. He also gave specific thanks to all of the EAG committee members, as well as the IOA's Linda Canty, who had all worked so hard in putting this conference together.

CONFERENCE – DAY 2

Session 4 – measurement and modelling **(chair, Glenn Leembruggen)**

Validation of matrix array electroacoustic models

Day two of Reproduced Sound was kicked off by Mert Aslanturk (Holoplot, Germany), who picked up the discussion on loudspeaker matrix arrays started by co-author Evert Start on day one. Mert detailed the challenges of modelling such arrays, especially as they are capable of producing 15 beam shapes simultaneously. Additionally, the model must be capable of scaling up to allow for larger arrays. To validate the model, over 15,000 impulse response measurements were taken with a lower analysis limit of 80 Hz due to the floor reflection. A variance of 1.6 dB was observed between the measurements and simulation results. There were many questions from the audience, indicating quite a bit of interest in the technology.

Novel level detection methods for digital audio

The session continued with Reproduced Sound veteran, Jamie Angus (University of Salford, UK), who presented a paper on methods to resolve the issue of sampled signals misrepresenting the true level of analogue signals. In the worst-case scenario, a sampled bandlimited impulse could possess an error in peak detection that could cause clipping during normalisation. Jamie demonstrated applications of upsampling as well as quadratic interpolation and how these can reduce the magnitude of error. Ultimately, in the digital domain, what you see is not always what you get, due to these issues in accurately capturing the true analogue signal level.

Designing acoustically comfortable spaces in schools

The final paper of the session was on acoustics in school teaching rooms, presented by Elena Prokofieva (Edinburgh Napier University, UK). Elena stressed the importance of good acoustics in classrooms, especially for students with special needs. She gave a detailed analysis of the Royal Institute of British Architects (RIBA) stages of work and where within this process input from acoustic



Above:
Evert Start
answering
questions from
the audience
on loudspeaker
matrix arrays

consultants is appropriate. Ultimately, it was clear that acousticians need to be involved in the concept and technical design stages of work to avoid issues further along in the project. This was supported by examples from a number of projects Elena had previously been involved with. (See more from Elena on page 52 of this issue).

Session 5 – Loudspeakers (Chair, John Taylor)

Metric based development of acoustic lenses and waveguides

The fifth session of the conference, on loudspeakers, began with a presentation from Lewis MacDonald (University of Salford, UK) on design optimisation of waveguides. Lewis focused on two standard metrics: flare and stretch. In turn these metrics were used to equalise the acoustic path length using corrugations and adjustments to thickness. This was demonstrated using a sine shaped waveguide with FEM. Lewis showed that the model with pathlength equalisation and

area correction gave the lowest range of SPL at the exit surface.

Proceedings of the extreme steering committee

David Gilfillan (Gilfillan Soundwork, Australia) presented the final paper of the session focusing work toward a steered loudspeaker array in the range of 250 Hz-12 kHz. The motivation for this work was to improve a ceiling speaker system in a government building. The primary challenge was balancing the trade-off between transducer spacing (for high frequency steering) and size (for low frequency output). David went through the evolution of the design, highlighting four prototypes, where accurate steering up to 9 kHz has been achieved to date.

Diversity presentation and discussion (Chair, Mark Bailey)

The morning was concluded with Mark Bailey (Harman Professional, UK) leading a session on diversity in the industry. To recap, Mark reminded the audience that last year's takeaway message was

“you can't be what you can't see.” There had been a good deal of progress since the conference in 2021. To highlight this, Mark shared an example presentation targeting 13-14 year olds which illustrated potential career paths in acoustics to assist students in identifying appropriate GCSE subjects. Care was taken to ensure there was a diverse range of people highlighted in the presentation.

This prompted a very engaging and useful conversation between the delegates. Perhaps it needs to be made clearer where to start in the industry? What are the typical entry-level jobs? It was stressed that in addition to getting young people interested, it is vital to inspire enthusiasm in the teachers, as they are the ones who play such a vital role in guiding students to potential career paths. As before, Mark invited anyone in attendance to reach out to him or the IOA to get involved in this initiative. It is important to the future of the industry and will benefit us all, if successful. [P26](#)

Session 6 – Events, installations, live sound, venues (Chair, Paul Malpas)

Critical analysis of sound level monitoring methods at live events

The first session after lunch started with Adam Hill (University of Derby, UK) presenting a paper on the current state of affairs regarding sound level monitoring at live events. This drew together research carried out over the past five years, very closely linked to recent AES and WHO publications. At present there is little consistency in how sound levels are monitored and managed at live events across the globe. Aspects of sound exposure at live events that aren't in the direct control of the sound engineer were explored, such as audience participatory noise (which Adam showed could increase overall exposure by nearly 2 dBA over the duration of an event) and venue acoustics (which has been shown to cause event levels to increase by 2-3 dBA). Adam highlighted essential future research in this area, some of which is already underway.

ABBA Voyage:

Object-based mixing meets acoustic enhancement

The paper session concluded with a joint presentation from Frederic Roskam and Julian Laval (L-Acoustics, France). They presented the application of a 'shared reality' system with immersive sound and object-based mixing, ABBA Voyage. As the application was in a purpose-built arena, there was a good deal of flexibility regarding the venue acoustics and system design. The room was made to be as acoustically dead as possible, but the reverberation time was artificially increased at key points during the show to facilitate audience engagement. The idea is that interactivity reinforces immersion into the experience. Questions from the audience followed, asking about specifics of the room acoustics as well as the calibration process for the sound system.

Session 7 – System design (Chair, Adam Hill)

Comparison of SPLmax using AES75 and multitone distortion methods

The final paper session of Reproduced Sound 2022 started with James Hipperson (Funktion One, UK) presenting a study into SPLmax measurements using various methods including the recently released AES75 standard. James put forward the argument that looking only at power compression to characterise loudspeaker nonlinearities is insufficient and that modulation distortion with a multitone stimulus is also likely to be instructive. In any case, at present there are inconsistencies in reporting of SPLmax on datasheets, resulting in difficulties comparing loudspeakers. James presented results of a study where he tested two loudspeakers for SPLmax using three methods: AES75, total modulation distortion threshold (TMD) and pseudo-IEC 60268-21. Certain limitations of the AES75 and IEC methods were



highlighted, where the novel TMD method showed promise with a more transparent representation of the amount of distortion present (1% or 5% in this implementation) in the measurements for SPLmax. Questions came from the audience, indicating interest and support for the work.

Guitar manufacturing measurements, a practical live demo

The final paper of the conference was delivered by Ludo Ausiello (Portsmouth University, UK). Ludo's presentation was a continuation of a series of Reproduced Sound presentations he's made over the years focusing on the optimisation of acoustic guitar performance. Again, Ludo asked why is there no data available on acoustic instrument performance? He came prepared for this session with equipment to show real-time measurements, demonstrating the feasibility of fine-tuning the structure of a guitar to meet a given specification. Ludo explained that the challenge now was how to involve manufacturers as well as customers in this process. The audience responded to the presentation with questions surrounding the measurement system and its capabilities of learning more about the physics of an acoustic guitar.

Conference close

Reproduced Sound 2022 was formally closed by Bob Walker. He expressed his gratitude to all the presenters. The papers were interesting and informative, resulting in a wonderful conference. He thanked the EAG committee, the technical crew from d&b audiotechnik and dBS, and to the conference delegates. We hope to see you all again this year! 🍷



Left:
Bob Walker,
EAG Secretary,
concluding
Reproduced
Sound 2023

IOA Bursary Fund update: Meet Jeremy

The IOA has allocated a small pot of money for members to attend acoustics related training and activities and to provide some financial help to carry out acoustics-related STEM activities.

By Reena Mahtani, Chair of the Bursary Fund

The autumn round of the Bursary Fund closed for applications in October 2022 with two applications received before the deadline.

One of the applications went back to the author for clarifications, and once resubmitted, it was unanimously approved by the review panel:

Below:
Jeremy Leung



Meet Jeremy Leung. He was awarded £1,000 funding in the autumn to cover IOA Diploma fees. This is what he says about the application process and the motivation behind his application.

“I applied for the bursary fund to alleviate my financial hardship when enrolling on the IOA Diploma course as well as studying for my MMus in Music Technology at Utrecht University of the Arts (HKU) in parallel. I found the application process well thought out to pinpoint the overarching aim of the objectives to benefit the awardee as an individual as well as the acoustics society as a whole.

“I knew upfront it [was] going to be hard work to undergo both postgraduate level studies at once. Still, I find it extremely rewarding and [it] helps me connect the dots between the theoretical and the

applied. Again I’d like to send my thanks to the board members for supporting my studies and hope I can be a great advocate for the IOA Diploma programme.”

The second application in the autumn round of funding was sadly refused. Please note that we cannot approve applications where, if employed, the funding is proposed to be used towards training in the same field of acoustics. For example, a consultant working on underwater acoustics would get funding for training on architectural acoustics, but not for training related to underwater acoustics.

We wish the best of luck to Jeremy in his studies and, as part of his agreement to receiving the bursary award, we will be hearing more from him as he concludes his academic phase.

If you or someone you know could benefit from financial assistance from the Institute, please consider submitting an application for the spring round of funding, which opened for applications on 15 February 2023 and **closes on 31 March 2023**. There is more information on the website, and if you have any questions, please feel free to send us an email to ioa@ioa.org.uk. Good luck! 🍀

A sound strategy - ambitions for a better built environment

The real-world performance of buildings is under closer scrutiny. But the part that the technical discipline of acoustics plays in supporting both people-centric and planet-conscious design outcomes is not always fully appreciated, yet we know that the role of acoustics impacts on multiple levels.

By Dr Andrew Bullmore, Director, Hoare Lea

First and foremost, our buildings increasingly need to support improved human outcomes. There is not one decision-maker or leader on this planet who isn't at the mercy of human emotions, problems and desires.

Human experience is not just at the heart of good design, it is good design, and good acoustic design is key to bringing buildings to life for people. This imperative is coming into increasingly sharp focus, most recently through the immediate need for resilience against COVID, the need to futureproof against the extremes of climate change and the flexibility to accommodate ever-changing user expectations. It may not be immediately obvious, but all these factors have acoustic implications.

Sitting alongside the focus on human-centred design is the need to be guided by doing right by our planet. The situation demands change. We can either be part of this change, or we can watch it happen without us. The climate emergency has squarely focused minds on the need to reduce the carbon associated with buildings (embodied or operational). If essential climate emergency trajectories are to be met buildings will need to be constructed and operated with operational energy use approximately 60% smaller than has traditionally been the case, with material circularity also becoming increasingly relevant. Again, the delivery of successful acoustic outcomes has implications on achieving targets for both embodied and operational carbon, and circularity.



Above: Windows need to variously connect occupants with, and isolate them from, the building's external environment

Our work and our industry have so much to contribute. We have so much power to design a better future. Crucially, however, we understand that human-centred design solutions aren't always the best choice for the planet and, conversely, achieving net zero carbon and other planet-conscious objectives can result in negative outcomes for building users. But balancing this tension is where we excel and where our problem-solving culture can shine. The work that we do is at the interface of this tension, and we dissect that by helping to find real, applicable solutions.

Sound falls into two distinct categories: physical sound and perceived sound. Ultimately it is the perception of sound that matters in delivering a better built environment in terms of human outcomes. It is therefore only right we should start with perceived sound as our primary driver in designing buildings that we can proudly declare to

be 'acoustically high performing'. However, to deliver such human outcomes with confidence, while simultaneously delivering better outcomes for the planet, requires an intimate appreciation of the underlying science.

Human health and wellbeing

The clear starting point for considering the acoustics of a high performance building lies in the comfort and wellbeing of its users. Somewhat perversely, however, except for buildings such as auditoria or recording studios for which acoustics is their prime function, this is where good acoustic design should be 'silent'. Building users should be immersed in an environment that is subconsciously conducive to them feeling and delivering at their very best. Whether this is relaxing at home, working in an office, teaching, learning or researching in an academic establishment, [P30](#)

recovering or providing care in a medical establishment, or whatever the building's prime function may be, it should be taken as read that the very highest performing buildings should provide an optimally designed acoustic environment as standard.

In the above, human outcomes are considered at two levels. The first is the direct impact of indoor environmental quality on human health and wellbeing. In this regard sound is one of the key indoor environmental factors needing to be considered (not forgetting that vibration also falls within the technical discipline of acoustics). Poorly controlled acoustic environments can lead to disturbance, annoyance, and stress leading to raised blood pressure, even at relatively low amplitudes, while exposure to higher levels of sound can cause direct and irreversible damage to hearing.

The second human outcome is the degree to which the acoustic environment promotes productive output. In this context 'productivity' may be defined quite differently for any given space or building typology. As an extreme example, the prime function of a bedroom is to enhance sleep, whereas promoting sleep in a teaching environment would be the least desirable outcome.

Fundamental acoustic design considerations which acoustic designers take for granted as leading to improved human outcomes include the control of:

- sound levels in rooms, be this from noise sources within the building itself such as ventilation systems or the intrusion of external noise, typically from transportation sources;
- reverberant sound build-up within rooms;
- sound transmission between adjacent internal spaces; and
- sound transmission through the building façade.

However, there are some sectors and building types where acoustics should no longer remain a 'silent' partner to good design, but instead should 'shout' the presence of the highest quality acoustic design to become front and centre of the building users' thoughts. For such developments it is essential that the

aspirations and needs of the user are fully explored and understood. Obvious examples are buildings where the reproduction of sound is their prime function; buildings such as concert halls, auditoria, sound and film recording studios, etc. There exists, however, a multitude of less obvious building typologies where acoustic design is fundamental to the functionality of the building. In the science and research sector, for example, there is an ever increasing demand for facilities having the ultra-low noise and vibration environments required for undertaking sub-atomic scale measurements. At the other extreme, the space industry is developing new facilities for the testing of propulsion systems and their payloads, both of which involve the generation and control of ultra-high levels of noise and vibration.

Regardless of the extremes concerned, these are all design tasks whose successful delivery demands an understanding of the fundamental physics of acoustics behind the design principles required to drive real-world outcomes.

These outcomes also increasingly demand that acoustics is considered in tandem with other technical disciplines to ensure that truly holistic outcomes are delivered.

Before leaving the topic of human outcomes, it is also worth noting that our scientific understanding of the pathways to human perception of sound is evolving. Traditionally, acoustic specifications have been based around the concept of sound amplitude, often expressed as a single numerical decibel limit. These limits have largely been derived from social surveys which have sought to aggregate the typical subjective response at a community level from the self-reported response of multiple individuals. However, it has long been acknowledged that the response to the same sound stimulus from individual to individual can vary widely. Equally large variations in response can similarly occur even for the same person when exposed to the same sound stimulus but across different contextual settings. Now, a combination of advances in non-invasive neuroscience coupled with the analytics of large data sets using machine learning techniques is beginning to provide much greater insight into the complexities of human sound perception.

Soundscapes

This insight is beginning to emerge as new fields in acoustics, including the study of soundscapes. This emerging field is seeing the derivation of entirely new objective metrics for describing sound environments, with some of these metrics beginning to account for context, including interactions between the senses and especially visual cues. Perhaps most significantly for the delivery of future high performance buildings, this enhanced knowledge of human response to sound will allow the active curation of sound environments (soundscapes) specifically designed to improve comfort and wellbeing. In so doing the traditional reliance on designing according to sound levels, with assumed level-driven boundaries between what is considered to be an acceptable versus an unacceptable level of sound, will become a contextualised spectrum of impacts to be more finely managed.

Planet-conscious design

With sound and vibration both being physical triggers for evoking human senses, it's easy to appreciate how good acoustic design would naturally lead to improved human outcomes. It is not, perhaps, so immediately apparent as to the part played by acoustic design in helping to deliver high performance buildings which directly address the need for planet-conscious outcomes. However, acoustic design very much has its own part to play in this respect.

As far as high performance buildings are concerned, planet-conscious design can broadly be classified into three main areas:

- energy and carbon;
- material resource; and
- biodiversity.

Controlling both sound and vibration to acceptable levels in the built environment generally requires some form of physical intervention, and any physical intervention will have associated with it some degree of material resource usage and therefore the potential for embodied carbon. Some physical interventions also have associated with them the potential to be directly responsible for operational carbon. **P32**



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Interventions

One common example of an intervention with both embodied and operational carbon is the inclusion of in-duct acoustic attenuators, as are commonly used to reduce ventilation system's fan noise to acceptable levels in the rooms served by those systems. However, one consequence of an acoustic attenuator's ability to reduce sound energy is the introduction of additional resistance to air movement, thereby increasing the electrical energy required by the fan(s) driving the system. Depending on the electrical carbon intensity at the time, increased energy consumption by fans equates directly to increased carbon emissions. There is then also the energy used to manufacture, deliver, and install each attenuator, plus the embodied carbon in the materials used.

Another common example of a physical intervention includes the specification of additional materials in partition, floor and façade make-ups to enhance their resistance to the transmission of sound and vibration. Again, this involves the manufacture, delivery, and installation of additional construction materials, plus the associated embodied carbon of those materials.

An acoustically high performing building is one which strikes the appropriate balance between delivering the acoustic performance required for positive human outcomes whilst being mindful of the resultant environmental impacts from the design interventions required to achieve those outcomes. This need for balance may well lead to an interesting shift in the approach to acoustic performance specification.

To further elaborate, it is commonly accepted that a difference of 3 dB is subjectively the smallest perceptible change in sound level under practical, real world conditions.

The question therefore needs to be what environmental benefits a potentially imperceptible relaxation in target sound criteria of 1 dB, 2 dB or even 3 dB could have through a reduction in the required performance of any sound and vibration control intervention. These environmental benefits would result from the savings in materials/energy required to implement lower-performing interventions. Individual gains may only be small, but cumulatively the benefits could be significant, especially when considered on a global-scale.

Added to the above is the prospect that compliance-led acoustic design based solely on the specification of target dB criteria may, of itself, be moving into a new era. This change will emerge from the previously mentioned research into soundscape design and our greater understanding of the subtleties of human's reactions to the characteristics and context of the sound environments to which they are exposed.

Building technologies

While still highly relevant, the foregoing examples assume a business as usual approach to delivering beneficial acoustic outcomes. However, the world we live in today is anything but 'usual'. Rapid advances are occurring across a whole range of building technologies, including digital enablement, materials, manufacturing and approaches to

both off-site and on-site construction. Research is simultaneously leading to advances in our underlying scientific understanding of both physical acoustics (in particular, the acoustic properties of materials) and human response to sound, while technology is enabling ever more sophisticated numerical modelling to be performed. If ever there was a time to take a step back from the norm and take a more holistic, outcomes focused, approach to delivering truly sustainable buildings, then surely that time is now.

Building construction hasn't fundamentally changed for decades. To this day buildings rely primarily on the delivery of materials to site where construction workers craft a basic shell, with multiple trades subsequently attending site to fit out and modify that shell to deliver the building to its required, typically compliance driven, specification. However, the emergence of design tools integrated with factory-based modern methods of construction (MMC) means this traditional approach no longer needs to remain the status quo. In this transformation the more radical the thinking, and the greater the emphasis placed on achieving truly holistic outcomes across both human-centric and planet-conscious spheres of influence, the better.

Window design

We shall use here the window as an example of how taking a more outcomes focused, systems-thinking approach to design, and making use of modern technologies, could provide far-reaching benefits. The aforementioned outcomes-focused approach needs to start with the

Right:

The active curation of soundscapes can positively impact on human health, wellbeing and social cohesion (Image courtesy of John Storock)



most fundamental of questions: what basic functions does a window serve?

First and foremost, windows provide a connection between a building's occupants and their natural habitat of the outside world. Whether open or closed, clear glass allows daylight and warmth in and views out. When open, windows provide an even greater connection by providing a conduit into buildings for fresh air for ventilation, thermal comfort and for the sounds of nature. It is hard to argue that any of these attributes can deliver anything other than beneficial human outcomes.

However, such a connection with the external environment isn't always desirable. At night, for example, we often wish to shut out artificial light from road traffic or streetlights, as well as prevent views from outside to in. We address these issues by adding opaque coverings to windows in the form of internal curtains or blinds, and shutters which can be either internal or external. During the day, solar gain through windows may also result in internal spaces overheating. Again, this is addressed using blinds, curtains, or shutters, or possibly via external solar shading.

Also, what if the act of opening a window doesn't allow in fresh air or the sounds of nature, but instead opens a conduit to poor external environmental conditions such as the low air quality and excessive noise that frequently exists close to roads? The 'solution' in such cases is to keep windows closed, or to provide permanently sealed windows which ensure that poor external environmental conditions are kept out. But this action introduces the need to provide a means of ventilating the internal space. This action requires the introduction of some form of forced system. Whether such systems are local or central they come with attendant energy requirements, potentially leading to improved human-centric outcomes at the cost of poorer planet-conscious outcomes. The need to additionally provide some form of cooling to the internal space, again with attendant energy requirements, is also becoming an increasingly critical issue. This is due to a combination of the increased occurrence of climate change-induced

temperature extremes and the need to provide better insulated buildings to accommodate new thermal technologies such as heat pumps.

User control

The complex balance between human-centric and planet-conscious outcomes is further complicated by the traditionally perceived human benefit of affording building users some degree of control over their internal environment, including their ability to open and close windows and/or the associated window coverings. This must now be considered in the context of the energy and emissions associated with such control, including impacts on the effectiveness of the ever increasing complexity of ventilation, cooling and heating strategies.

Based on the above, even the humble window has a host of (often competing) outcomes to deliver on behalf of building occupants. Not least, windows need to variously connect occupants with, and isolate them from, the building's external environment. Specific considerations have thus far included: daylight; views; light pollution; privacy; sound; ventilation; air quality; heating; cooling. Other design considerations include security, fire safety, façade access, etc.

The question the acoustics community is presently asking itself is whether the design of the high performance building of the future could benefit from acoustic designers taking a step back to look at the issues from a systems perspective, and not just in isolation but in tandem with engineers and designers from other technical disciplines.

When we talk about adopting a systems thinking approach to the issue at hand, we need to consider the window as an integral part of a system which includes not just the whole of the building's façade, but also the building's ventilation, its thermal management systems, its control strategies and last, but by no means least, its occupants.

Modern Methods of Construction

Recent advances in Modern Methods of Construction (MMC), including the multiple benefits to be gained from off-site factory production environments, opens the possibility of better integrating

multiple outcomes within the design and construction of the fundamental building structure itself. Focusing on acoustics here, complete façade elements (including any windows) could be delivered to site with a guaranteed composite sound insulation performance. These façade elements could include integral features such as controllable ventilation paths with built-in acoustic attenuation to control the ingress of external noise and the egress of internal noise. Current developments in acoustic metamaterial technology could revolutionise the form such acoustic attenuation would take, as could future developments in active noise control. The integral ventilation paths would no longer have to rely on the windows and could therefore also include integral air movement devices, possibly powered by built-in energy harvesting elements also integrated into the façade itself. These façade-integrated ventilation paths could equally host thermal transfer and air filtration components. All of this could be made possible by the façade being manufactured under closely controlled factory conditions, as opposed to being constructed under variable on-site conditions. The associated environmental benefits of reductions in energy, embodied carbon and waste in both manufacture and construction, plus greater material traceability and circularity, could be significant. Equally significant would be the guarantee of such precision manufactured units delivering better installed performance in all regards, including human-centric outcomes.

Building intelligence

Also worthy of consideration as part of any new approach to the design, delivery and operation of high performing buildings is the impact that advances in building intelligence, often referred to as smart building technologies, may have. The prudent and targeted deployment of these technologies could simultaneously yield both better human-centric and planet-conscious outcomes.

Again, the concept will be illustrated here using an acoustic example. This example involves the previously referenced need to provide adequate ventilation and cooling to internal spaces [P34](#)

(often via opening windows) while at the same time protecting against the ingress of external noise. Under many practically encountered situations external noise levels are not constant but instead exhibit significant diurnal variations. This is particularly the case with road traffic noise, which is the predominant source affecting buildings. Likewise, acceptable levels of noise in internal spaces may also vary depending on the time of day or night. However, as previously mentioned, the common 'solution' to protecting building occupants against external noise is to include non-openable windows in noise-exposed façades. The problem with this solution is that it removes the option for building occupants to choose natural ventilation via open windows even at those times when the external noise levels are acceptably low. It also removes the option to cool an internal space via fresh air circulation even when that space is unoccupied, in which case the ingress of external noise cannot possibly be an issue as there is no one there to experience it.

Monitoring

A more targeted approach to maintaining the appropriate balance between human-centric and planet-conscious outcomes could be based around evidence provided by sensed data. The real-time monitoring of internal versus external environmental conditions could provide essential information to building users, allowing them to regain control in weighing up the benefits/disbenefits of taking certain actions. For example, the simultaneous monitoring of external and internal noise levels, temperature and air quality could all provide information on which building occupants could take the appropriate action of opening or closing the windows. The same information could equally be employed to drive automated control processes for implementing any ventilation versus noise control strategies. To better engage building users, evidence could simultaneously be provided as to the anticipated benefits resulting from any such automated control, both from an indoor environmental quality and an energy saving perspective.

There also exists the possible sensing of occupancy patterns simultaneous with the monitoring of internal environmental quality, including the acoustic environment, to gather real-world evidence on the degree to which sound contributes to occupants' preferred choice of locations. Such information could usefully inform future acoustic design criteria on the basis of behavioural as opposed to questionnaire-based evidence.

Building performance

As a final thought on a much broader note, no building can be considered in isolation. Rather, every building exists as part of a wider ecosystem.

Even within the boundaries of the building itself, there exists the complex ecosystem comprising the interaction between people and building. These two components cannot be considered in isolation; the performance of a building impacts on the performance of people, just as the behaviour of people impacts on the performance of the building. This bidirectional interaction between building and people has effectively been recognised in the previous discussion about the need to manage the tensions between delivering human-centric and planet-conscious outcomes.

However, when determining what goes to deliver a truly high performing building, consideration needs to extend far beyond the physical boundaries of the building itself, because those physical boundaries are permeable.

Creating 'good' sound environments

First, of course, people move in and out of buildings. In doing so they interact with the spaces between buildings. It is vital that the environments in these spaces encourage walking, cycling and socialising and create meaningful dialogue between individual buildings and the wider built environment. The curation of spaces between buildings in this manner is known to be crucial in creating healthy, vibrant spaces that promote well-being and wider social benefits. Beyond these spaces, people also interact with the transportation networks that open-up wider access to the built environment. Acoustics has its own

part to play in this general arena. Previously mentioned advances in soundscape research are increasing the understanding of what characteristics go to create 'good' sound environments. This understanding will increasingly inform how soundscapes should be proactively designed and managed. However, that is looking more towards the future. In the immediate term acousticians have long played a vital role in managing the transmission of noise across a building's boundaries. This includes both the control of external noise ingress into the building and the control of noise radiation from the building to prevent unacceptable impacts on the neighbouring environment and other buildings.

Second, high performance building design needs to properly account for the movement of resource and materials across buildings' boundaries. This includes incoming resource in the form of electricity, gas, water and other materials and outgoing items including 'products' and waste. In this context the word 'product' is used to define the primary intended output function of the building, be this a physical product in the traditional sense of the word, or educated pupils from an academic establishment, or healthy patients from a healthcare establishment, or whatever.

Carbon, social and environmental impacts

The delivery of a truly high performing building cannot realistically ignore these multiple connections with the wider world. This is particularly the case with the rise of net zero carbon and environmental, social and governance strategies which are increasingly demanding evidence of carbon, social and environmental impacts along the complete supply chain. This is where the expertise of acousticians can not only bring their extensive experience in the building design to bear, but they can usefully call on their wider expertise in specialisms such as the acoustics of energy generation and transmission, of transportation systems (including road, rail and air), and in the impacts of noise not just on humans but also on wildlife, a factor which is becoming increasingly important in managing biodiversity. 🌍



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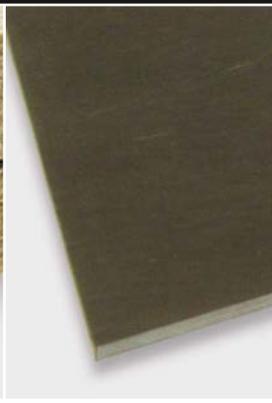
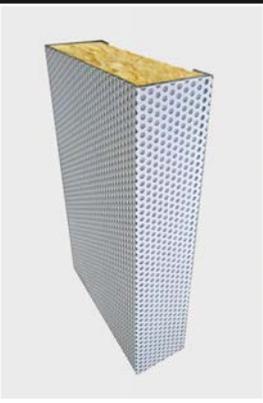
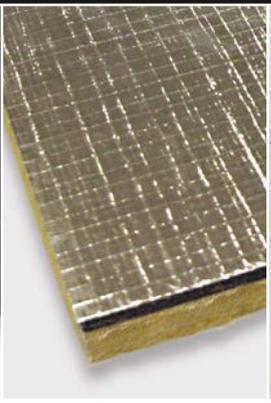
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Printing sustainability statement

The IOA is committed to protecting the planet by minimising the impact our printed material has on the environment. We support and encourage our partners to use materials from sustainable sources and to reduce environmental impacts where practicable.

By Daniel Goodhand, Chair, IOA Publications Committee

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Above:
Warners Midlands Plc

There is no varnish or seal used during the printing process and the magazine is bound using a metal stick which can be recycled.

Currently, all inks used by Warners Midlands Plc are oil-based and there are no plans to switch to vegetable oils just yet; however, an environmental impact study will be undertaken on the introduction of the next sheetfed press due to be operational mid-2024.

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IOA Sustainable Development Task Force: Sustainable events

As we ramp up for another year of acoustics conferences and events, it is important to reflect on the work done in previous events to make these more sustainable.

By Richard Grove, Director | Europe at Inhabit and IOA Sustainable Design Task Force member

Inter-noise 2022, held in Glasgow and with the theme of ‘Noise Control in a More Sustainable Future’, provided the ideal opportunity to look closely at how we might proactively consider sustainability, as well as incorporate sound to create an inclusive event that respects the environment. Following a call by Dr Paul Lepper, the Sustainability Working Group was formed to develop initiatives which could be implemented at Inter-noise, with the aim of informing future acoustics events.

The acoustics industry, including the many and various institutes, associations and trade bodies, hosts events regularly, bringing together people from academia and industry to share knowledge and improve our sound environment. These events naturally create environmental impacts, from travel to and from the event, to participation and consumption at the event, so it is critical that the events we host as an industry consider our impacts.

Four key themes were developed to focus efforts in areas where they would be of most impact:

- 1) Increasing visibility of sustainability in acoustics conferences and events, and vice versa;
- 2) Soundscaping to create comfortable internal environments and respite spaces at the conference;
- 3) Promoting health and wellbeing of delegates through outdoor walks in collaboration with Tranquil City; and
- 4) Promoting sustainable travel to, from and around the conference city.

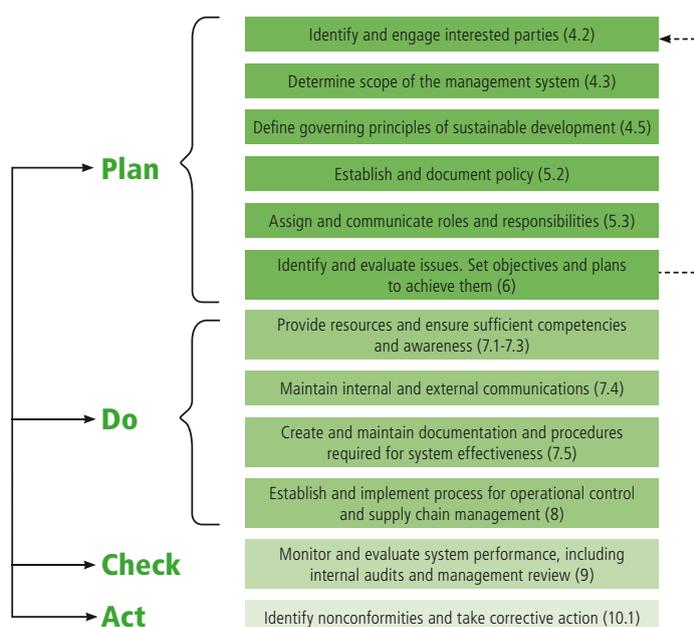


Figure 1 - ISO 20121's event sustainability management system model (the figures in brackets refer to clauses and subclauses in the standard).

Above:
ISO 20121's event sustainability management system model

A sustainable conference

ISO 20121:2012 Event Management Systems – Requirements with Guidance for Use directs the organiser to consider the environmental impact of their event, implementing a ‘plan, do, check, act’ approach. The impacts can be wide ranging and include everything from food sourcing and associated waste management to exhibition stands much of which is usually looked after by the venue. To this end, and as responsible organisers, we should ensure the host venue is implementing sustainable concepts as part of the package, including food and drink, waste management and energy use. Furthermore, the ISO presents

an opportunity for acoustics to be included as part of a sustainable approach to events, encouraging the reduction of acoustic impact as well as the promotion of the positive soundscapes for the benefit of the hosts and delegates.

The Scottish Events Campus (SEC) was an ideal venue, with commitments to net-zero by 2030 and policies in place to deliver on these commitments, establishing a baseline for good practice, and one which the industry should seek to follow as much as possible.

Soundscapes and tranquility

Through collaborations with Tranquil City, an environmental collective whose aim is to transform 



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Left: In collaboration with walking app, GoJauntily, a series of short loop walks and routes to and from the conference were created

urban data into meaningful interventions that benefit people and the planet, alongside the Scottish Soundscapes Competition, Inter-noise 2022 presented the perfect forum to demonstrate and develop our appreciation for soundscapes and the positive impact these can have on health and wellbeing.

The Scottish Soundscape prize, designed and delivered by the Inter-noise 2022 Sustainability Working Group in partnership with The Scottish Wildlife Trust, and exhibited at SEC Glasgow, set a

Below: Providing soundscapes in what was noted to be a highly reverberant space at the Inter-noise venue, gave delegates a space for reflection and respite



specific and ambitious challenge to all UK-based students of acoustics tasking them to create a soundscape which restored wellbeing, was inspired by natural Scotland and re-connected the listener to our natural world.

Significant positive impacts were found through providing soundscapes in what was noted to be a highly reverberant space, providing occupants with an area for reflection and respite.

Taking this outside, Tranquil City conducted a series of interventions, designed to align with UN Sustainable Development Goals 3, 11, 13, and 15, and to encourage active travel to/from the Inter-noise 2022 conference via healthier, greener routes with more positive soundscapes. Implementing their unique geospatial mapping techniques to create the Tranquil City Index map for the entire Glasgow City region, the team have been able to measure of the potential of a location to be good for wellbeing and mental restoration and assess the presence of multiple factors that have been shown to either promote or detract from restorative environments.

In collaboration with walking app, GoJauntily, a series of short loop walks and routes to and from the conference were developed, culminating in a guided walk from the conference to the evening's entertainment in the city centre.

To find out more about these initiatives, you can read the Inter-noise 2022 Legacy Report by scanning the QR code on this page. IOA members who have contact with the International Standards Organisation are invited to develop the initiatives and see if these can be incorporated into future iterations of the ISO.

As we embark on another year of events, we need to ensure that we approach these responsibly both as organisers and attendees, applying sustainable thinking to venue selection, our transport, our behaviours whilst attending the event, and how we can leave behind positive impacts. ©

In the next issue
The Building Acoustics Group present their work in providing guidance on sustainable materials.



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Current parliamentary and policy news

The IOA Parliamentary Liaison Group (PLG) is continuing to work to raise the profile of the importance of acousticians with politicians and policy makers.

Above: The House of Lords Science and Technology Committee have launched an inquiry into the impacts of noise pollution and artificial light on human health

It has been a busy time for announcements, comments, consultations and proposals for regulatory reform around noise. There are plenty of opportunities to raise the profile of acoustics and acousticians, keeping the PLG busy.

House of Lords inquiry on noise pollution

The House of Lords Science and Technology Committee have launched an inquiry into the impacts of noise pollution and artificial light on human health. The committee will explore evidence for claims that unwanted, inappropriate, or excessive ambient noise may have negative impacts on human health. They will also explore the adequacy of existing policy and regulation and options for reform to address any harmful effects identified. Specific questions they are asking on noise pollution include:

- Are the Government agencies, departments or local authorities currently responsible for monitoring and regulating noise pollution appropriately resourced?
- Is there sufficient expertise within organisations charged with regulating or enforcing regulations on artificial noise?
- What role should planning authorities play in determining plans or restrictions on noise pollution? Are the current guidelines on noise pollution set under the Government's advice for planning authorities, or the Noise Policy Statement England, adequate?

- What recommendations would you make for changing government policy on noise pollution?

PLG members are responding to the inquiry, which closed on 3 March 2023.

See the call for evidence (The effects of artificial light and noise on human health – Committees – UK Parliament) at <https://committees.parliament.uk/work/7256/>

Environmental noise regulations added to list of EU laws for review

The Retained EU Law (Revocation and Reform) (REUL) Bill, under which it is proposed to review and potentially revoke laws derived from EU legislation retained post Brexit, is now progressing through the House of Lords. The list of laws (the REUL dashboard) is periodically updated, and in January more laws were added to the list. These include the Environmental Noise (England) Regulations and subsequent amendments which were brought in to cover the implementation of the Environmental Noise Directive in England. If the Bill passes in its current form, this would mean these laws are at risk of being revoked by the end of the year if not reviewed. The House of Lords have reported on the Bill criticising it for removing parliamentary scrutiny of the laws listed, and giving ministers the power to decide if the laws are retained or removed. We reported in the last edition of Acoustics Bulletin on the IOA submission of evidence to the Public Bill Committee outlining

concerns about the potential impact of revoking laws covering noise and vibration on the ability of acousticians to manage impacts. Concerns are also being expressed by health and safety, environmental and consumer protection communities about the potential loss of many protections.

A full list of laws on the list are on the searchable REUL dashboard: (<https://public.tableau.com/app/profile/governmentreporting/viz/UKGovernment-RetainedEULawDashboard/Guidance>)

Impacts of noise recognised in The Lancet

In their January 2023 editorial, the European edition of medical journal *The Lancet* put out a strident call for more attention to be paid to noise pollution. The piece states:

'Noise pollution is dangerous; it has negative long-term impacts on humans, marine life, and terrestrial life and hampers biodiversity.'

As a way forward it proposes *'A better implementation of the Environmental Noise Directive, the main EU law to identify and address noise pollution levels is needed to protect people from harmful exposure to environmental noise.'* The Environmental Noise Regulations for England are on the Government's list of EU Retained Law – laws that could be removed by the end of this year.

Read the full article editorial here: [https://www.thelancet.com/journals/lanepi/article/PIIS2666-7762\(22\)00273-3/fulltext](https://www.thelancet.com/journals/lanepi/article/PIIS2666-7762(22)00273-3/fulltext)

Licensing guidance acknowledges Agent of Change

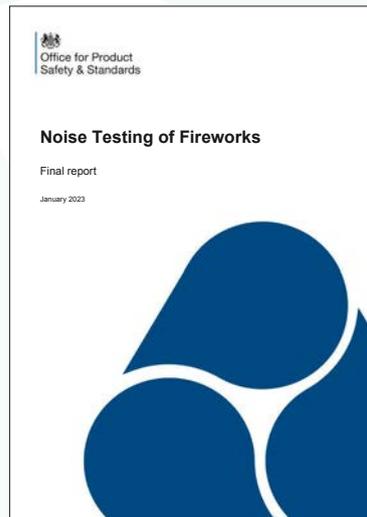
Updated guidance for implementing the Licensing Act 2003 is now available. The revised guidance makes explicit reference to the Agent of Change – the principle in neighbourhood planning which aims to protect existing noise generating operations (e.g. pubs and music venues) from proposals for new noise-sensitive developments, like new homes. This marks a move towards making planning and licensing a more joined up process. It follows on from planning policy recognising the Agent of Change principle in July 2021, and a review of the Licensing Act 2003 by the House of Lords, which resulted in recommendations that the regimes take a more joined up approach.

Peter Rogers, MD of Sustainable Acoustics, who gave evidence to the House of Lords select committee said: “This is a long overdue step which kick starts the process of aligning policy with what is needed to make communities work in a sustainable way.”

Alistair Somerville, IOA President said: “It is absolutely right that planning and licensing authorities cooperate to ensure existing established uses are protected, whether they be residential or licensed music venues. In relation to existing music venues – this means that: if the performance sound levels, intensity of use and neighbourhood activity impacts are considered appropriate, they should not be compromised by any future noise-sensitive development. Planning and licensing decisions must take account of the interests of both residents and those operating businesses, to ensure ‘Agent of Change developments’ are only considered appropriate when mitigation measures can protect both residential standards and the interests of businesses which make such a significant contribution to the life and vibrancy of communities and neighbourhoods.”

See the guidance: <https://www.gov.uk/government/publications/explanatory-memorandum-revised-guidance-issued-under-s-182-of-licensing-act-2003/revised-guidance-issued-under-section-182-of-the-licensing-act-2003-december-2022-accessible>

Report: Testing Consumer Fireworks



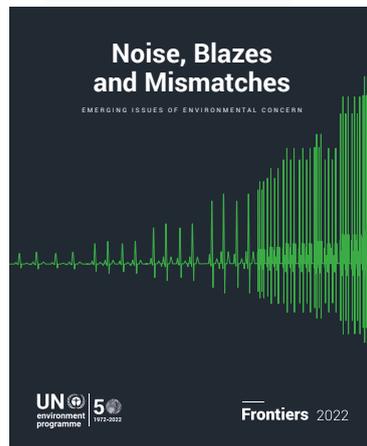
The Office of Safety Standards (OPPS) has published the outcome of noise testing on fireworks sold to the public. Of the 72 fireworks tested, four were measured to be above the

120 dB threshold, and these were battery shot tubes in category 2 and category 3. Testing found wide variability across firework types and categories, so attempting to group fireworks as more or less noisy was found not to be practicable. However, it is possible to indicate a range of noise levels for each firework type in each category.

The report concludes that when fireworks are used by the public, physical effects and environmental variables are unique, so it is not possible to predict with confidence which firework types produce higher noise levels in any situation.

Read the full report: Noise Testing of Fireworks (publishing.service.gov.uk) at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1133630/noise-testing-of-fireworks.pdf

Welsh noise and soundscape guidance welcomed



Following two member consultation meetings, the consensus is the draft Technical Advice Note 11: Air Quality, Noise and Soundscape (TAN 11), makes a positive first step to introducing a soundscape approach to planning. The IOA welcomes bringing together noise, soundscape and air quality as a forward thinking and progressive piece of policy. This approach responds to the call from the United Nations Environment Programme, in their 2022 Frontier report, for policy makers to implement measures that will address the long-term physical and mental health effects of noise pollution. Further, in combining consideration of air and noise pollution, the government in Wales

is encouraging a more sustainable approach to development. It invites a focus on placemaking in addition to traditional noise management approaches, encouraging thinking about soundscape quality and potential interventions to improve it.

While this approach is promising, the IOA would like to see a final guidance note that is clear, and offers sufficient encouragement to developers and local authorities to make sure these progressive approaches are implemented in practice. 🌍

For more information

Draft TAN 11:
<https://www.gov.wales/reviced-planning-guidance-relation-air-quality-noise-and-soundscape>

UNEP: Frontiers 2022
<https://www.unep.org/resources/frontiers-2022-noise-blazes-and-mismatches>

Full IOA response:
https://www.ioa.org.uk/sites/default/files/ioa_wales_response_tan11_noise-and-soundscape_20-1-23.pdf



About the author:
Mary Stevens supports the IOA to bring acoustics to the attention of policy makers.

Dr Richard (Dick) Hazelwood

It is with great sadness that we announce the recent passing of a dear friend and former colleague, Dr Richard Hazelwood.

By Stephen Robinson and Victor Humphrey



Dick studied for his undergraduate degree at Oxford University, where he was at Exeter College, from 1963 to 1966 reading physics. He then went to Reading University for his doctoral studies, and his PhD was awarded in 1970 (optical and structural properties of semiconductors).

He then began an association with Surrey University which is how he came to settle in the Guildford area, marrying and starting a family in 1973. In his youth he was an enthusiastic potholer – at university he was known as ‘the ferret’ for his ability to get through tight spaces. His flair for practical ingenuity extended beyond his scientific work, and he was famous for rigging up obstacle courses for his children’s parties complete with aerial ropeways.

Career

Dick’s professional work turned to underwater acoustics, and he worked first at DB Electronics and then joined Sonardyne International Ltd, where he made significant contributions to the design of their ultra-short baseline transducer arrays, among other projects. Known by his younger colleagues as ‘Dr Dick’, he was a role model for his continued passion for the subject and strong technical knowledge, as well as his energy and enthusiasm.

Dick became a regular contributor at IOA conferences and meetings and was early to appreciate the importance of man-made radiated noise in the ocean, both for its limiting effect on the operation of acoustic technology, and the wider polluting effect on marine life.

After retiring from Sonardyne, Dick worked as a consultant at the National Physical Laboratory, where he co-authored a number of papers and a Good Practice Guide, and where he became active in international standards work with the ISO. Increasingly active in the IOA, Dick served as Secretary of the IOA Underwater Acoustics Group for five years, a role he performed with his usual infectious enthusiasm. He was one of the original members of the Underwater Sound Forum, where he entertained the attendees with his presentations and anecdotes for more than a decade and will be much missed. In his later years, he became a passionate advocate of the study of seabed vibration (ground roll) caused by offshore activities such as construction for marine energy developments. In particular, he became interested in its effect on marine life living on or close to the seabed, co-authoring several key scientific papers on the topic in the last few years, and making significant contributions to the Aquatic Noise series of conferences.

Influence

A mere description of his professional achievements could not do justice to the influence Dick had on his fellow scientists. His sharp mind meant that he had a firm grasp of the fundamentals, never took anything at face value, didn’t shy away from controversy, and had a seemingly boundless energy and curiosity. Dick was one of those rare people who fitted the description of an eccentric scientist. He was passionate about underwater acoustics and was a rich source of

ideas and fascinating descriptions of his previous experiments, and was a great support to many postdocs and PhD/Masters students. He could be a gift to any colleague chairing a session at a conference when a presentation or lecture was followed by an uneasy silence – Dick could always be relied upon to provide a question or two to get the discussion moving.

Memories

Many of us that knew Dick well will have their own favourite memory of him. Perhaps his 2014 TV appearance on Sky News after the loss of Malaysian Airlines MH370 where he carefully and clearly explained the immense difficulty of finding an aircraft flight recorder by tracking the weak signal from its acoustic pinger in the deep ocean (of course Dick had his own ingenious solution to improve things). His colleagues at NPL remember being dragged out for an ‘experiment’ at Pinks Hill above Guildford on a very wet and muddy afternoon to measure the vibration generated by dropping car tyres on to the ground (an early attempt at simulating seabed vibration – not a true seabed, but it certainly felt wet enough). Or perhaps the occasion at a conference in Crete where an early morning earthquake had some of us bursting out of the hotel bedrooms in alarm only to find Dick with his camera taking pictures of the caustics in the hotel’s swimming pool as the water was still sloshing around from the earthquake. Typical Dick, always with an inquisitive scientific mind – his fellow scientists were duly impressed (and humbled).

Dick was a very kind and inspiring colleague who was great fun to talk to at meetings and conferences and his passing is a sad loss to our underwater acoustic community. He will be sorely missed. Although predeceased by his wife and daughter, Dick is survived by his son, Andrew. ☺

'Unbearable' noise claim dismissed

In this article, Dani Fiumicelli considers the case of a businessman who claimed life in his £2.5m apartment was ruined by an 'unbearable' noise described as like 'bubble wrap popping'. He lost his £1m compensation claim after a judge found it wasn't loud enough to disturb his sleep.

Soon after moving in, the claimant complained of his peace being shattered by what was claimed as a loud clicking or popping noise, described by some as being 'akin to popping bubble wrap', which he said ran through the entire flat and woke him when sleeping.

The court heard claims that 'The timing of the noise is intermittent and noise levels vary depending on the time of the year and time of the day,' and 'the noise occurs both day and night. It is loud enough to wake the claimant and his wife when sleeping'. Also, that 'the noise cannot be suppressed or masked and can be heard even if a television or radio is playing in the apartment and irrespective of whether internal doors are closed.'

It was claimed that the noise had caused the occupier 'annoyance, discomfort, distress and loss of amenity' and reduced the value of the apartment by £815,000, making it more difficult to sell or let.

Defending the claim, it was denied that there are any 'defects in the design or construction of the building' and said that the sound is localised and can only be heard at limited times and that 'the noise is a short click akin to popping bubble wrap and which is infrequent.' Also that 'the frequency of the clicking noise increases when it is sunny. The noise is not at a level that should wake up any occupant of the apartment.'

Experts had agreed that the noise which emanated from the building façade was probably caused by thermal expansion of components because of changes in temperature.

Expert evidence

Acoustic consultants gave expert evidence to the court on behalf of the claimant and defendant and a jointly agreed series of calibrated sound recordings, which the judge said were of great benefit, were played at L_{max} 30 dBA, 35 dBA,

40 dBA, 45 dBA and 50 dBA so that the judge might better understand both the nature of the noises and their loudness. The experts considered the noise at 50 dBA L_{max} to be the 'typical highest level that would occur' i.e. the 'typical worst case'. 45 dBA was considered by both experts to be the upper level of regularly occurring events over a typical 24-hour summer period.

Having heard the recording the judge commented that: "As for the loudness of the noise, subjectively I found the recordings at 30 and 35 dBA barely audible and at 40 dBA very quiet. The noises then consisted of an audible click and double click or click/tick when played at 45 and 50 dBA. The sound recordings played to the court were a far cry from anything that could be described as loud noises, a loud bang or loud thud and closest in terms of description to [the defendant's adviser's] comparison of hearing the click of a computer mouse, albeit a little louder at 50 dBA. I therefore accept [the defendant's adviser's] description of the noise as the most accurate."

The acoustic experts differed on how the above levels should be interpreted. The claimant's expert drew parallels with the BS 8223 advice for noise from lifts and the local authority's guidance for noise from gyms. The defendant's advisers referenced World Health Organization's 1999 Community Noise Guidelines and the 2009 Night Noise Guidelines for Europe. The judge preferred the defendant's approach as "the sources of guidance referred to by [the claimant's expert] are particularly stringent, in essence setting limits designed to ensure that no noise is audible from the activities concerned and (unlike the WHO Guidelines) not based on any research studies concerned with the impact of noise on residential occupants of land."

Judge's decision

In her decision the judge provides a thorough examination of the principles of legal nuisance and highlights that "for the noise, the subject of the current action, to give rise to an actionable nuisance it must be such as to materially interfere with the ordinary comfort of the average person living in the apartment taking into account the character of the neighbourhood."

Having heard the evidence, the judge said: "Contrary to [the claimant's] case, I accept [the expert's] evidence that the vast majority of the sounds complained of would be suppressed by a television being on or music playing.

"I have...concluded that the noise complained of is not such as to awaken the average person when sleeping in the apartment, let alone frequently.

"That leaves the question of whether, although the noise is not such as to disturb sleep in any meaningful way, such as to materially interfere with the ordinary comfort of the average person living in the apartment.

"I have concluded that it is not. The acoustic expert evidence demonstrates that most of the sounds emanating from the façade are either inaudible or very quiet."

The claims were dismissed.

The full judgement can be seen at [https://www.bailii.org/cgi-bin/format.cgi?doc=/ew/cases/EWHC/TCC/2022/2760.html&query=\(Noise\)](https://www.bailii.org/cgi-bin/format.cgi?doc=/ew/cases/EWHC/TCC/2022/2760.html&query=(Noise)) ©



Author:
Dani Fiumicelli

The inconvenient truth about models

Cautionary tales of legal claims against acoustical consultants

For obvious reasons this article is worded extremely cautiously and avoids reference to many of the specifics. But there are important issues that need to be highlighted to practicing acousticians, some of whom are falling into deep and dangerous pitfalls; some of which in turn inevitably lead to legal action and professional indemnity insurance claims.

By Ed Clarke, Clarke Saunders



The author has been retained as an expert witness in matters relating to the consideration of, and in some cases pursuit of, negligence claims against other acousticians. The common thread running through all these claims is a disappointing reliance on acoustic modelling software, without the essential underlying practitioner expertise.

The fundamental theme around consultants operating without the safety net of 'reasonable endeavours', a concept which protects us all from negligence claims, is that they stray beyond their competence, experience and understanding. As an industry we should help one another by flagging these dangers with big flashing neon warning signs. And noisy sirens.

It is rare to encounter wilful negligence; where people deliberately set out to mislead,

Above: 3D view from CadnaA city noise map model of Helsinki, over the 'reality' of a Google Earth 3D view. (Image courtesy of Datakustik, Google, Landsat/Copernicus)

cut corners or make reckless recommendations; it is almost universally a question of those 'unknown unknowns'. Perhaps not quite as dangerous as the weapons of mass destruction that Donald Rumsfeld was referring to when he coined the phrase, but pretty dangerous to our careers and reputations nonetheless.

New acoustical consultancy practices are being set up by increasingly junior and inexperienced practitioners. Back in the day it would be unthinkable for a consultant to set up shop until they had several decades of hard-won field experience, management acumen developed at one of the more established firms plus some publications under the belt and elevated industry profile for good measure.

Career profiles are completely different now, a great thing for talented young engineers who have the humility to seek out the

knowledge and understanding they need to acquire and the discipline to make use of it diligently and conscientiously. But it is a minefield for anyone who doesn't take the time to discover what it is that they don't yet know.

Hand calcs are a thing of the past too. My 'hand calcs' now involve an Excel spreadsheet and in-house calculation tools and macros. I could still A-weight an octave band spectrum in my head if I needed to though. But a much greater disconnect between fundamentally 'getting' the underlying acoustics and the results of complex predictions is evident in the problems we have seen when modelling software is relied on heavily, even exclusively.

It seems too easy to be seduced by reliance on 'the model', outsourcing the legwork of really understanding and analysing the underlying physics, and just plugging in some input parameters

and making various adjustments until you get the answer you're looking for.

I'd highlight two complementary aphorisms here: 'Everything is a model' and 'All models are wrong'.

Everything is a model

The Excel-based 'hand calc'; the Calculation of Road Traffic Noise (CRTN) line of sight barrier correction; the loss through an open window; and the output of CadnaA or Sound Plan, Insul or Bastion (CadnaB) – all models. Extend that to our view of the world, colour perception, geopolitics, relationships, how our brains themselves work – **everything** is a model.

When viewed through this frame we start to see each model as one of a number of tools at our disposal to make sense of what the world around us has done in the past and make an attempt at predicting the outcome if a certain route to the future is followed.

An expert acoustician, with a deeper understanding of the physics of wave propagation, experience of the practical implementation of various interventions and insight into the likely level of care with which they are deployed, to name just a few, has more tools available to them than a common mortal (or 'client'). This enables the expert to make recommendations with a level of confidence and surety useful to that client.

Without this level of expertise or craftsmanship, using the whole toolbox of 'models', the role of the consultant is reduced to ownership of a license to a piece of modelling software, and a professional indemnity insurance policy.

All models are wrong

By definition. If they weren't based on some level of approximation or simplification, they wouldn't be called models. If we had all of the input and boundary condition data available to 'solve' a given problem, we wouldn't need to use the term 'model'. But we never do, and hence we have to appreciate that all our work is based on some level of approximation, empirical interpolation and informed estimate. Although more visually compelling, and conveying an impression of 'officialness', there is no reason to assume as a matter of course

that the output from a piece of modelling software is any more valid or accurate in terms of the likelihood of it representing the real-world outcome of a proposed course of action than an empirical interpolation, or a good old fashioned gut feeling estimate.

Turning to a specific, and reoccurring, example of misuse of Marshall Day Acoustics' Insul program (which models the laboratory sound insulation performance of building elements) the common threads of oversimplification, confirmation bias and cognitive dissonance are central to the problems I have encountered.

Oversimplification

Like some other building acoustic prediction tools, Insul includes warnings and caveats about the real-world sound insulation performance of any separating structure being degraded by flanking transmission. It even has built-in estimates of what those limitations might restrict the performance to, based on the type of flanking structure. But these can be turned off, or simply ignored, and often are.

I've also seen a troublingly simplistic approach taken to the very concept of flanking transmission. I suspect this is based on limited experience gained from the world of pre-completion testing (PCT) for building regulations compliance. The logic seems to run like this:

When the test is a 'fail', and it sounds like most of the sound energy is not coming straight through the partition, there's a problem with flanking. Flanking is making it fail, fix the flanking (with an independent wall lining) and everything will be fine.

This approach might work perfectly well in the vast majority of PCT situations, but it does nothing to develop a deeper understanding of sound transmission paths for application to more challenging situations. The result is that flanking transmission is treated as a binary phenomenon – it's either there or not; and if present it can be eliminated with a simple wall lining treatment, and thereafter disregarded. Whereas there is, of course, always a multitude of indirect sound transmission paths which need to be considered very carefully when dealing with more

complex buildings and better performance objectives over different frequency and dynamic ranges. In such situations an assumption that provision for some plasterboard wall linings justifies turning off the flanking estimate in the model could be very dangerous, especially when coupled with incredibly high-performance expectations (spoiler alert!)

Cognitive dissonance

This is when people's behaviours don't align with their values or beliefs. It's the only reason I can imagine for otherwise apparently competent acousticians to 'believe' an acoustic model predicting levels of sound insulation at, or indeed considerably in excess of, the limiting performance of the best sound insulation test laboratories in the world.

Practitioners should, therefore, approach modelled performances promising sound insulation orders of magnitude greater than that which is realistically practicable with appropriate scepticism, in the context of the purpose-built bunker with flanking isolation that comprises a sound insulation test lab.

Somehow the legitimacy assumed from the output of a commercial model can blind practitioners to the clear physical impossibility of the prediction they have made being realised in the real world.

Marshall Day, the developers of Insul, are very aware of the implications of this kind of misuse and Insul already includes clear caveats and health warnings on the use of the software, such as this example from the help file:

Users should be aware of its limitations, like any prediction tool it is not a substitute for test data.

Marshall Day Acoustics' own advice and training to its consultants is that 'these models are all tools that must be used in conjunction with other knowledge, data, and experience to arrive at robust design decisions.'

The key seems to be finding better ways to make these faux pas harder to make inadvertently, but without hampering the clearly useful flexibility of the product and the theoretical models that it implements to support research and 'what-if' type thought experiments and comparisons. **P48**

Confirmation bias

Whether triggered externally by the client directly, or internally by an acoustician's will to deliver an effective solution, the selection of only data points that support an idea or theory (or economic preference) is an extremely risky tendency. Properly considered building acoustics recommendations need to be triangulated against data points from multiple sources; lab tests, previous projects, model predictions, industrial applications and so on.

It is reasonable for our clients to expect us to bring some experience of the likely outcome to the table. Making do with insufficient data, or leaning too heavily on blind optimism does not provide our clients with the level of expertise they need.

Second opinion/peer review

So, what to do if your consultancy practice doesn't have that experience? The glib answer would be that you shouldn't be accepting the consultancy instruction in the first place, as you're operating beyond your area of competence.

But a more collaborative approach might be to seek a second opinion from a specialist in that field, an academic, or simply someone with direct experience of that exact element from a recent project. Obviously, there is going to be a cost and there are issues around liability and responsibility, but these are surmountable. In my experience, clients are refreshingly open to this kind of collaborative approach and don't begrudge additional fees for a little extra surety when the issue is sufficiently critical.

From a personal perspective (other expert witnesses may well take the opposite view) I would rather be consulted at an early stage and collaborate with other acousticians to get the initial advice right, than try to reverse engineer a problematic project after the fact to establish liability.

Calls to action

The software developers at Marshall Day have been keen to engage in discussions on tweaks and improvements they can make in forthcoming releases of Insul to

make it more obvious when users are straying from the normal use case, when their predictions are departing from the central 'safe zone'. Hopefully a similarly receptive response will be forthcoming from other manufacturers who can surely do more to inform users about these dangers.

It is perhaps surprising that, although commercially available software is accompanied by user manuals and guides, there is no higher-level industry guidance available on the use of models, the extent to which it is essential to understand what's going on 'under the hood' and the ability of users to undertake the essential sanity checks and sensitivity tests that provide such helpful protection from the pitfalls described above.

Perhaps we could consider developing this kind of guidance, which would help to raise awareness within the consulting community, and would also provide a level of additional protection for practitioners otherwise struggling to justify the steps they had taken in an attempt to deliver a successful project. 🎯

Enhance your career prospects in acoustics

The IOA runs a range of certificated short courses nationwide, assessing competence in the areas shown. The courses run twice a year at accredited training centres across the UK (courses are held prior to exam dates and usually run for around five days).

To find out more about any of these courses consult the list of centres at: <https://www.ioa.org.uk/education-training> and contact the appropriate centre directly.

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Environmental Noise Measurement



Workplace Noise Risk Assessment



Building Acoustics Measurement



Occupational Exposure to Hand Arm Vibration



Anti-Social Behaviour (Scotland) Act 2004 - Noise Measurements



Courtesy of Luis Gomez-Agustina

BS 4142 submissions to the Environment Agency and adverse weather conditions

The Environment Agency receives BS4142 noise impact assessments in support of permit applications but a large proportion of applicants do not provide weather data alongside their background sound level surveys. This could lead to incorrect conclusions within a BS 4142 assessment.

By Rory Peliza, Technical Advisor in the Acoustics and Air Quality Modelling and Assessment Unit (AQMAU) at the Environment Agency

Section 6.4 of BS 4142 stipulates that weather data should be taken at the same time as background measurements and should ideally be taken at the same location.

As stated in note 2 of Section 6.4, regional forecasts are not accurate enough. If weather data is not provided alongside your background sound level measurements, the Environment Agency is likely to reject the conclusions of the associated report.

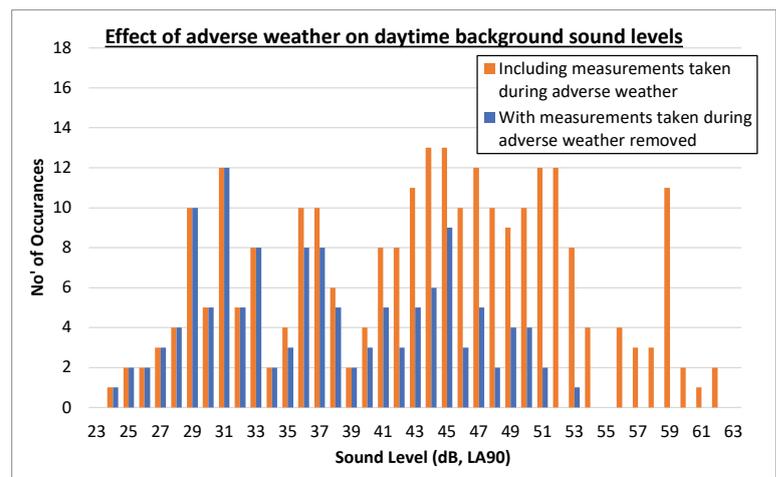
It is well documented that weather conditions can affect measured sound levels by influencing the sound propagation of sound sources¹, or by generating sound by affecting the surrounding environment². Figures 1 and 2 show a real-life example of background sound level measurements which included a period of poor weather and show the effect that the weather can have on measured sound levels.

How weather effects background sound levels, a practical example

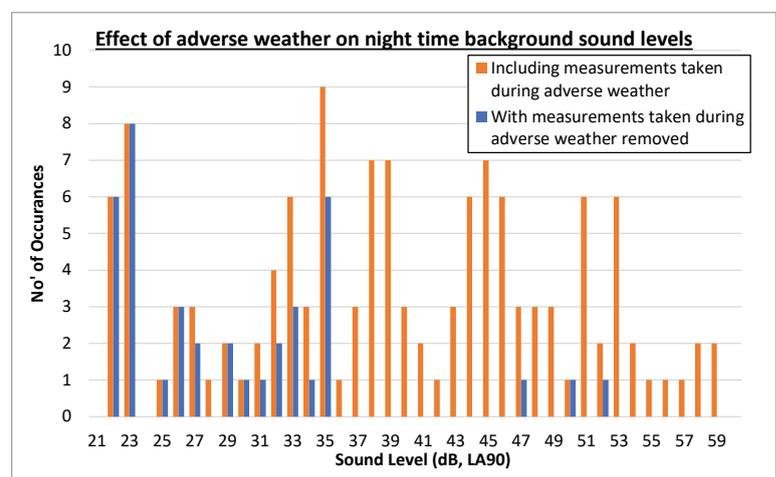
The orange bars within both Figures make up the L_{A90} , 15min histograms including periods of rain and higher wind speeds (>5m/s).

The blue bars represent the resulting L_{A90} ,15min histograms with these periods of adverse weather removed from the data.

Right
Figure 1: Shows the daytime histograms of the measured L_{A90} values as measured including a period of poor weather (orange) and in the case where measurements taken during poor weather (wind speed > 5 m/s or during rain) have been removed (blue)



Right
Figure 2: Shows the night time histograms of the measured L_{A90} values as measured including a period of poor weather (orange) and in the case where measurements taken during poor weather (wind speed > 5 m/s or during rain) have been removed (blue)



In this case the adverse weather has increased the modal L_{A90} sound level by 12 to 13 dB (see Figure 1

and Figure 2 for detail). These results are a practical example showing that weather affects P50

References

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FEATURE

sound level measurements and illustrates just how vital it is to measure and consider weather conditions during a background survey. Ultimately, a background sound level which is elevated due to poor weather is not representative as defined by BS 4142 and could easily lead to incorrect conclusions within a BS 4142 assessment.

The Environment Agency requirements

The Environment Agency guidance³ states that background sound levels should not be derived from measurements that are taken when:

- wind speeds are greater than 5 m/s; and
- there is rain or other adverse weather conditions.

During a background sound level survey a weather monitoring station should be set up nearby, in a suitable location, to measure the weather during the survey.

Time period	Change in measured sound level due to weather conditions (dB L _{A90})		
	Modal Value	Minimum	Maximum
Daytime	+12	0	+7
Night time	+13	0	+9

Above:

Shows the increase in modal, minimum and maximum of measured L_{A90} values due to the influence of weather

The resolution of the weather measurements should be sufficient to allow removal of individual measurements during the background sound level survey when adverse weather conditions are identified. As a minimum

the following elements should be measured:

- wind speed (m/s);
- wind direction (degrees);
- precipitation (mm); and
- temperature (°C). ☉

References

3 <https://www.gov.uk/government/publications/noise-and-vibration-management-environmental-permits/noise-and-vibration-management-environmental-permits>



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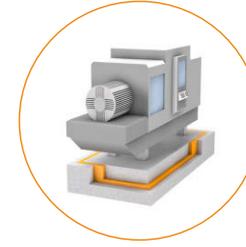
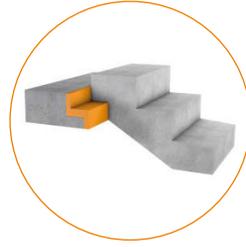
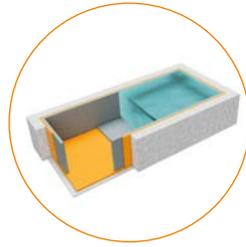
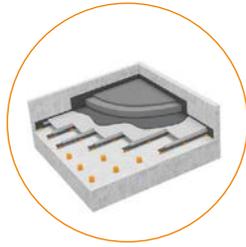
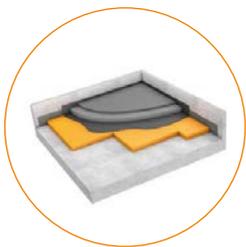
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How to design acoustically comfortable spaces for teaching

Acoustic design of schools is covered in Building Bulletin 93 (BB93) with detailed advice on ambient noise, reverberation time, sound insulation and speech intelligibility to make the teaching and learning spaces comfortable for teachers and pupils.

By Dr Elena Prokofieva, Robin Mackenzie Partnership, Edinburgh Napier University

The design team for a school project is expected to include an acoustic consultant from the design stage to compliance testing.

This article discusses some of the best practices in school classroom design, and offers recommendations on providing the decision making teams with CPDs on room modelling, early site testing, auralization and other methods of analysis to address the acoustic issues.

Every UK region benefits from programmes to improve teaching of children. Evidence collected by the UK Department of Education demonstrates that access to early education is crucial in supporting children to thrive in adulthood and contribute to society. Research has also shown that improving young children's pre-school language skills could boost the economy by up to £1.2 billion over the course of their lifetimes.¹

Up to £180 million of government funding over the next three years will support the sector to focus on children's development in their earliest of years of life and help to address existing recruitment and retention challenges. To be able to deliver education to the pupils, schools have to be built and maintained at the highest standard.

There are currently more than 30,000 schools functioning

in the UK¹. National Statistics showed (in 2021) the proportion of schools in good or satisfactory condition increased from 61.1% in April 2007 to 88.3% in April 2019. The School Estates Statistics 2019 also showed that the proportion of pupils educated in these good or satisfactory condition schools has hit a record of 89.6%, up from 60.8% in 2007.

The government also approves the build of new schools. These new schools are a vital part of the government's plan for education as they increase choice for parents and help to drive up standards across the board.

The Scottish Government will contribute funding of between £220 million and £275 million in partnership with local authorities across the country to replace 26 schools, with a further phase of investment to be announced.² The Scottish Government has been providing sponsorship to several projects to bring together nurseries, schools – including specialist centres for pupils with additional support needs – colleges and universities in multi-purpose campuses for pupils aged from three to 18, with additional facilities that benefit surrounding communities. The first group of projects in this phase could open as soon as this year.

Sustainability request for new schools

Additional requirements set by the governmental regulatory body for any new building, including schools, is to help tackle the climate emergency. This requirement is central to Scotland's new Learning Estates Strategy, with lessons learned from previous education infrastructure projects, informing future construction to create low carbon digitally enabled schools and campuses. Scottish Futures Trust will manage the programme on behalf of the Scottish Government². Sustainability of the school buildings is becoming the key leading target in the school project design and development, as well as its management upon completion.

Use of locally sourced materials and systems, site workers and experts are some of the considerations at the design stage. Another approach to be sustainable is to build schools to PassivHaus Standard (according to PassivHaus website³ there are currently 28 educational buildings constructed for this standard, with an additional 15 in the pipeline).

The main findings from post-occupancy survey in one of the PassivHaus schools shows⁴, as well as in article⁵, that pupils' concentration levels benefit from



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superior indoor air quality and thermal comfort. In PassiveHaus buildings controlled and maintained CO₂ levels help children to stay alert and attentive throughout the day. Running and maintenance costs of the building itself are also considerably reduced.

Design stages and decision-making

In Scotland, councils take a leading role in the teams, which deliver new school buildings for the public. The project teams, or the hubs, led by council teams, include the design and construction teams, all necessary experts, and, in some cases (i.e. when a new school is replacing an existing one), the teachers association representatives.

At the concept design stage, the key decisions of the school location, topographical orientation, allocation of spaces for external teaching, playgrounds and sports pitches (if applicable) are taken. At this stage the main input from the acoustic designer is to investigate the current noise

environment at the location and to confirm the general plans for the ventilation of the school building, i.e. open window or mechanical ventilation, the suitability of the chosen locations for outdoor learning spaces, and estimate the increase of the noise associated with school activities and its effect on the nearest noise sensitive locations (residential properties). At this stage there is a design flexibility to relocate the building and the facilities, propose fences and barriers to reflect the discoveries from the acoustic environment survey.

At the technical design stage, the internal acoustics is considered in greater detail. The internal school layout is proposed, and the types of constructions for the entire project are assessed and selected. The design features, such as teaching spaces allocations, open plan or enclosed types of classrooms, large spaces dimensions and locations (sports hall, dining, atrium, assembly, library, etc) are determined. As well as the teaching and learning spaces,

the administration and ancillary places are also allocated in the best possible way to complement the acoustic design. At this stage the internal design can still be changed to create the best possible school environment for teaching and learning. This means that the acoustic consultant should work closely with the decision-making team and oversee the entire school design, and have the proposals checked and verified before the design is approved.

Once the construction types and main design features are agreed with the team and the design is approved, only minimal changes will be accepted, and the acoustic design must be conducted only within the given framework.

Design guidance on school acoustics

The main guidance document for the acoustic design of educational buildings is Building Bulletin: BB93, updated in February 2015⁶ with additional information provided in *Acoustics of Schools – a design guide* November 2015 written by ANC⁷. P54

These two documents cover all main aspects of the acoustic design required for any type of educational buildings, from the nursery or early years centre to universities, and provide advice for various room types and layouts.

The standard acoustical design approach for a new or refurbished building is to review and provide advice on the key aspects related to the sound and noise within and around the building:

- control of external sound break-in to the school building;
- control of the noise breaking out from the school (including plant noise to the nearest residential properties);
- control of noise from building services and plant sound and vibrations, both airborne and duct-borne;
- sound insulation between teaching spaces and non-teaching areas; and
- control of reverberation time in all key areas.

The first two aspects are associated with the school as a whole, and therefore covered by the initial design team at stage two. All others are considered later in the technical design.

BB93 is set to specify the ambient noise levels in the teaching and non-teaching areas, noise activity and noise tolerance indicators, sound insulation requirements for various room types, maximum recommended reverberation times, and permitted ventilation noise levels.

The cut-outs from the Tables 1 and 6 (BB93) are shown below.

The ventilation noise levels are given in BB93 with relation to the ambient indoor noise levels, and not to noise rating curves. It also should be noted that the ventilation rates, thermal comfort and indoor air quality are covered by a separate document BB101⁸.

Examples of effect design aspects on acoustics

From extensive personal experience of participation in school design projects, it can be noted that the chosen room layout and the allocation of teaching and non-teaching spaces within the school building can have a positive or negative effect on an individual room's acoustics. Some examples are discussed below.

Table 1: Noise activity and sensitivity levels and upper limits for indoor ambient noise level

Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving room)	New build	Refurbishment
Nursery school rooms <i>Primary school:</i> classroom, class base, general teaching area, small group room <i>Secondary school:</i> classroom, general teaching area, seminar room, tutorial room, language laboratory	Average	Medium	35	40
<i>Open plan:</i> (See also section 1.8) Teaching area Resource/breakout area	Average	Medium	40	45
Primary music room	High	Medium	35	40

Table 6: Performance standards for reverberation time

Type of room	T_{mf} seconds	
	New build	Refurbishment
Nursery school rooms <i>Primary school:</i> classroom, class base, general teaching area, small group room SEN calming room	≤ 0.6	≤ 0.8
<i>Secondary school:</i> classroom, general teaching area, seminar room, tutorial room, language laboratory Study room (individual study, withdrawal, remedial work, teacher preparation) Science laboratory Design and technology: Resistant materials, CAD/CAM area, Electronics/control, textiles, food, graphics, design/resource area, ICT room, art	≤ 0.8	≤ 1.0
<i>Open plan:</i> Teaching area	≤ 0.5 [see section 1.8]	≤ 0.5 [see section 1.8]

Privacy issues

The level of activity noise and expected tolerance of noise are outlined in BB93 for all spaces, and are used to make a decision on the sound insulation of the partitions. However, privacy issues are only discussed in terms of speech intelligibility and are considered only as part of the teaching processes, when sufficient speech privacy between teaching groups is requested (i.e. in open-plan classrooms) in order to avoid distraction (i.e. in footnote 7).

The privacy for interview and consulting rooms, quiet rooms

and rooms for teaching pupils with special needs is not discussed in any guidance documents. Even more, the walls between the store rooms adjacent to the noise sensitive rooms can be classified as non-acoustic (e.g. using the store rooms as buffer zones between the rooms). This can be considered as a good design practice in the areas where noise sensitive rooms are not associated with personal information spoken out (such as music rooms or design and technology laboratories or workshops), but should not be considered acceptable in privacy-sensitive locations. **P56**

The connection between acoustics and ecology

Prizes to be won!

This activity is designed to help you explore the connection between ecology and acoustics. Soundscapes are the sounds of the things we hear around us. They can be formed from natural sounds (such as a rushing stream or wildlife), sounds made by us (such as talking, playing music or driving cars) or a combination of the two. Your local area will have its own different soundscapes, but have you ever considered how they influence the wildlife around you.

The Competition

This competition is for a small team of up to 3 students between 11 and 16 years of age. Students can be from different year groups and classes; however, they need to be from the same educational establishment.



BirdNET

Activity: Use the BirdNET app to identify the birds present in three acoustically different areas.

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Task 1: Familiarisation of measurement hardware and software

Task 2: Select three different soundscapes

Task 3: Comment on the bird species that are present

The Deadline

The deadline for entries is 31st July 2023. Entries will be judged by a panel of experts. The decision of the judging panel will be final.



Open plan classrooms

Open plan classrooms are especially popular in design of nurseries and primary schools. The flexibility between the spaces and ability to increase the inclusivity for all groups of pupils are key in selecting this type of room design. There are three main types of open plan classrooms (i.e. as shown in footnote 7):

- fully open;
- semi-open; and
- flexible open classrooms.

The fully open classroom design provides a large degree of flexibility of the space use with divisions provided only by means

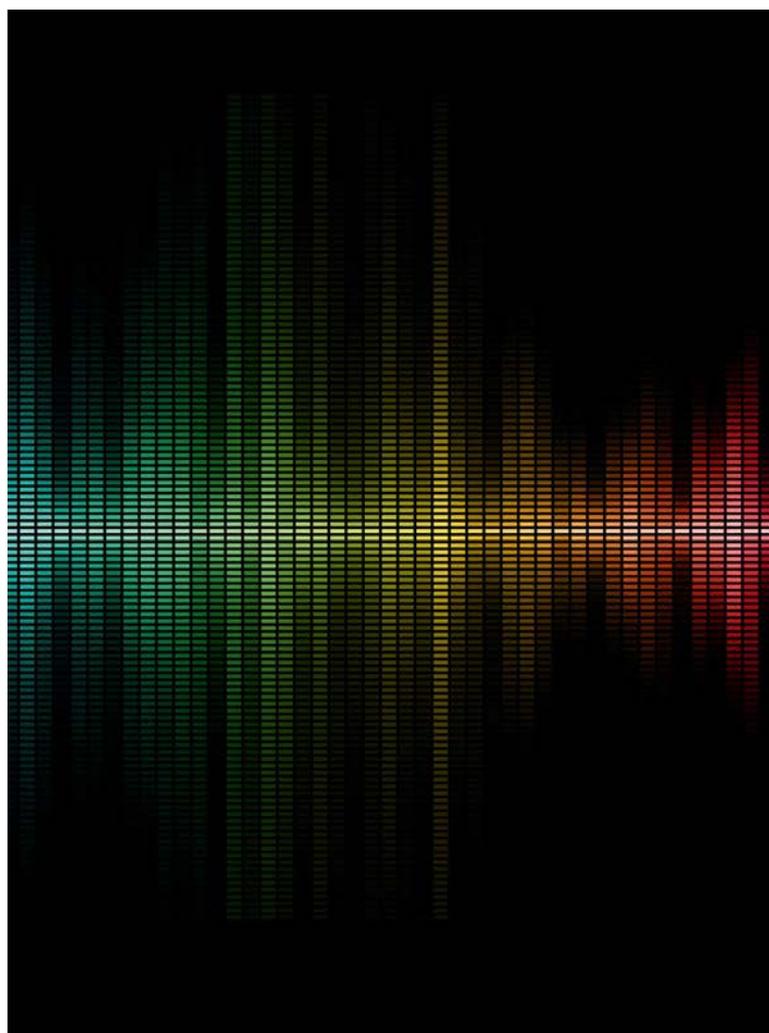
of loose fixtures (moveable screens, bookshelves, coat hangers, etc). Semi-open classrooms are defined by the walls with openings in them (i.e. to the circulation spaces). The flexible classrooms have fitted moveable partitions which allow to change the room configuration from fully enclosed to fully open.

It has been noted from project experience that often these types of classrooms can create disruption to the teaching processes (i.e. lack of privacy in conversations, noisy activities next to quiet studies, etc) and may not be suitable for all school pupils and teachers. Individuals with special health and

behavioural needs (both teachers and pupils) find these classrooms extremely difficult to work in, and raise concerns and complaints about their suitability. Studies^{9, 10} have been conducted on the impact of high levels of reverberation and background noise on autistic or hearing impaired people.

The table below shows the measurements of the ambient noise and reverberation time in two primary school classrooms with semi-open layout and then after remediation works conducted to enclose the room and the comparison with BB93 requirements.

Location	Measured RT, T _{mf} , sec	RT, T _{mf} as per BB93	Measured ambient noise level, L _{Aeq} , dB	Ambient noise level, as per BB93
Semi-open plan classroom	1.29 1.05	≤0.5 (open plan classroom) ≤0.8 (classroom with door) ≤0.4 (ASN classroom)	40 38	≤40 (open plan classroom) ≤35 (classroom with door) ≤30 (ASN classroom)
Enclosed classroom	0.79 (with extra panels added) 0.92 (without extra panels added)	≤0.5 (open plan classroom) ≤0.8 (classroom with door) ≤0.4 (ASN classroom)	34 25	≤40 (open plan classroom) ≤35 (classroom with door) ≤30 (ASN classroom)



The results suggest that by creating a physical separation between the corridor and the classroom affected the ambient noise levels and the reverberation time, although it is showing that further improvements may be required to be able to use this classroom as an additional support needs (ASN) teaching space. [P58](#)

ACOUSTIC STUDY FOR GYM MACHINERY

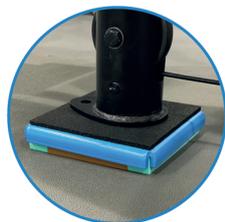
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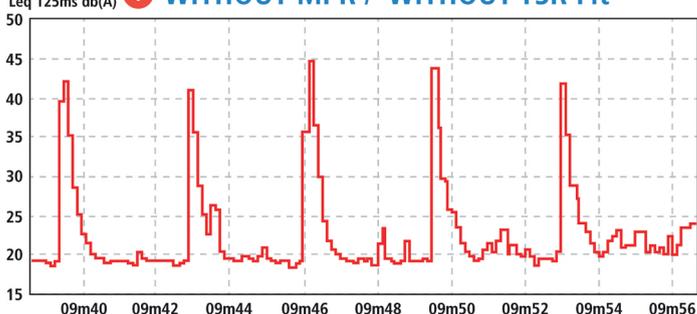
		dB/Octave (Hz)	63	125	250	500	1000	2000	4000	dB(A)	
Guided weight machine	1	Without MPR Without TSR Fit	+23	+20	+33	+25	+14	+7	0	+25	NC
	2	With MPR Without TSR Fit	+13	+14	+15	+15	+8	+2	+1	+10	NC
	3	Without MPR With TSR Fit	+14	+13	+6	+2	+4	+2	+1	+6	NC
	4	With MPR With TSR Fit	+5	+4	+2	+3	+4	+4	+1	+2	C
Regulation limit			-	+7	+7	+5	+5	+5	+5	+5	-

- The values above correspond to the difference between the activity noise level (noise measured in the gym during the activity) and the background noise level (noise measured in the gym without activity).

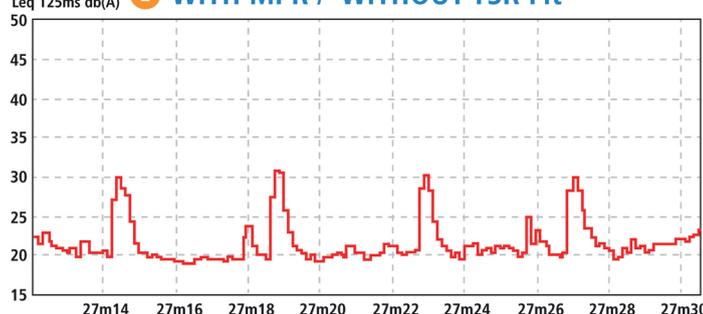
- **GREEN or C:** Complies with regulations.

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Leq 125ms db(A) 1 WITHOUT MPR / WITHOUT TSR Fit



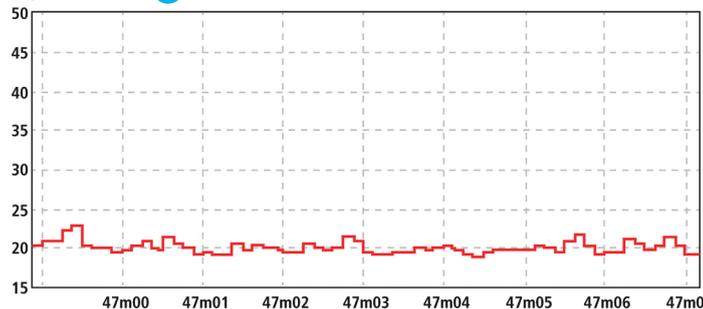
Leq 125ms db(A) 2 WITH MPR / WITHOUT TSR Fit



Leq 125ms db(A) 3 WITHOUT MPR / WITH TSR Fit



Leq 125ms db(A) 4 WITH MPR / WITH TSR Fit



Large halls reverberance

The large halls, such as gymnasiums, assembly halls, sports halls, dining areas and large atria typically have large reverberation times recorded, and therefore low speech intelligibility, flutter echoes, standing waves and general discomfort for staff and pupils when used. These areas are likely to have hard floor covering (for health and safety reasons), double height and hard wall surfaces, with absorption only provided by the roof and some panelling fitted in the available spaces. The acoustic treatments which are recommended may include Class A / B absorptive panels, or Class C perforated plasterboard of respective area. The main challenges which arise at this stage, are to find the best combination of the absorption parameters, aesthetics and the cost of the treatment to satisfy both the requirements of the BB93 and the project budget. Various options can be regarded, but the choice of the treatment may take longer due to inability to trial them all on the walls to decide. Only a simple calculation exercise or software modelling are available at the design stage to support the choice.

Similar issues also affect the ordinary classrooms, when due to the aesthetics concept only hard surfaces are selected for walls, floors and ceiling (i.e. cross laminated timber (CLT) constructions, exposed concrete ceilings, etc). Addition of acoustic panelling is required to meet the reverberation target.

Support tools in decision-making process

As the above examples suggest, some of the decisions on the acoustic design have to be made before the technical design stage,

although they would affect the entire approach to the acoustic design. The decision-making team might not include acousticians at the earlier stage, and therefore they cannot raise the awareness of these issues. Additional to this, in many projects the budget does not expect to include any computer modelling to simulate all the teaching spaces and trial the variety of options before decision-making.

To help future design teams to make decisions on their project and to reduce the potential acoustic issues during the design, construction and utilisation stages, it is proposed that continuous personal development (CPD) presentations should be prepared and delivered to all interested parties to demonstrate the effects of each of the key decisions on the overall school acoustics.

The demos should include samples of various teaching and learning spaces with and without proposed treatments and construction elements:

- * simple software calculations of typical areas;
- * real life recordings of the sounds in different environments; and
- * possibility to listen through various options applied to the particular design and room size, i.e. in auralisation suite.

These CPDs should be delivered to the councils, architectural practices and teaching committees involved in the school design, the

main construction companies and anyone else who may be interested.

If the acoustics issues are not addressed at the design stage with help of the acoustician, the end users complaints may be raised, and then the investigation and the remedial works in the school could be of the high price.

Acknowledgements

I would like to thank my colleagues at Robin Mackenzie Partnership for providing the site testing data and invaluable advice for this work. ©

About the author:

Dr Elena Prokofieva MIOA, is an acoustic consultant/research fellow and lecturer at Robin Mackenzie Partnership/Edinburgh Napier University.

This technical article should remind you that:

- Acousticians should be involved early in the planning stages of a project.
- Open plan classrooms can create disruption to the teaching processes and may not be suitable for individuals with special health and behavioural needs.
- CPD presentations should be prepared and delivered to all interested parties to demonstrate the effects of each of the key decisions on the overall school acoustics.

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Sonata acoustic absorbers offer Salvation

Sound Reduction Systems Ltd (SRS) were contacted by leaders of the Southport Corps of the Salvation Army to talk about a noise problem they were experiencing in their large, modern church hall. SRS Director, Alex Docherty said: “The Salvation Army had an impressive and modern new facility to conduct their activities in but, unfortunately, the excess reverberation and echo in the main hall was causing many issues for the congregation in terms of speech intelligibility and they were finding it difficult to understand what was being said. This was down to the sheer size of the space, combined with the fact that there were virtually no soft furnishings or finishes in the room.”

After the visit, SRS used their in-house software to create an acoustic model of the room to see how it was currently performing. Using the information gathered, including room dimensions and surface finishes, they were able to add the right amount of their Sonata absorbers to the model to cure the problem and send the client a full report detailing the ‘before and after’ performance, a quotation, and a layout proposal of how the panels would be arranged in the hall.

The fitting of the panels took place over one weekend and following the installation one Salvation Army member said: “The service this last Sunday was wonderful. For the first time in over 10 years, I was able to hear every word without a constant battle with my hearing aids settings.”

The XL3 Acoustic Analyzer – always connected

Practitioners can connect directly to the XL3 Acoustic Analyzer anytime, anywhere through the NTi Connect website, offering efficient working and convenience in daily measurement tasks. Using a web browser to operate your XL3 from wherever you are, measurement data, audio recordings, screenshots and more can be transfer to your computer.

The XL3 Acoustic Analyzer further allows integration into existing measurement systems by controlling the XL3 from your existing software with NTi’s Command API. This makes it easy to automate measurements and measurement sequences.

On a local network, you can access the XL3 via the IP Address. If this is restricted outside your own network, the NTi Connect web service offers a simple and convenient solution. The XL3 Acoustic Analyzer can be connected from anywhere using a unique key and configurable password.

A USB-C interface is available for a local connection to the computer and to connect the XL3 to a network, you can choose between WLAN, LAN (with USB adapter), and mobile data (with external modem).



Farrat’s specialist acoustic isolation and structural thermal break pads contribute to Claridge’s development



Farrat Hybrid Bearings used to isolate the steelwork to the new rooftop extension

A seven-year development project at Claridge’s in Mayfair, London, included a new four storey rooftop extension and five storey basement, with 72 new suites, a spa and pool area all without having to close its doors to guests who are used to the highest level of customer experience.

Farrat supported quantity surveyor, Rainey & Best and appointed structural engineers WSP with specialist technical advice resulting in the design and supply of a series of steelwork isolation pads and acoustic vibration solutions specifically developed to prevent construction noise travelling through the structure and disturbing hotel guests. In addition, their structural thermal break product TBK was used within the construction of the swimming pool area to thermally separate structural connections preventing heat loss in the building envelope. The project was featured in a BBC documentary *The Mayfair Hotel Megabuild* aired in January this year (now available on BBC iPlayer).

Farrat were initially tasked with the isolation of the new steel structure constructed for the rooftop extension using their Hybrid Bearing Technology. CEO Oliver Farrell said: “We worked with WSP to develop a robust system that met both the acoustic requirements and was easily adapted for a range of spatial constraints and loadings.” He added. “Manufactured at our Altrincham site acoustic bearings, washers and bushes were cut and delivered within days of design completion.”

Farrat also worked on the new ballroom (pictured), supplying the specialist high-performance acoustic floating floor which can be adapted for numerous applications including cinemas, concert halls, entertainment venues, and auditoriums.

Neil Wilson Senior Project Delivery Manager at Farrat commented: “Delivering a project of this scale whilst remaining open was always going to be a challenge for



everyone involved, from hotel staff to the developers, architects, structural engineers and builders and we were delighted with the results from the work put in by our team.”

The Farrat specialist floating floor system being installed in Claridge’s Art Deco ballroom

Acoustics expert appointed to leadership role at trade association

Russell Richardson has been elected as Chairman of the Association of Noise Consultants (ANC).

Bringing decades of consultancy and academic experience to the leadership role, Russell has been appointed to serve for the next two years.

A graduate in electroacoustics at the University of Salford, Russell's career began in acoustics consultancy followed by further work in academia researching the subjective response of audiences in concert halls at London South Bank University (LSBU).

He then went on to co-found RBA Acoustics, now one of the largest independent consultancies in the UK.

Throughout his career, Russell has played an extensive role in the wider acoustics sector. This has included several years as Hon. Secretary of the IOA, as well as a visiting lecturer on the Environmental and Architectural Acoustics MSc course at London South Bank University.

He is also a member of industrial advisory boards at both LSBU and Birmingham City University and a student mentor at the University of Salford.

Russell first joined the ANC Board in 2006, with previous roles including Hon. Secretary and Hon. Treasurer.

He is a member of ANC's Certification Committee and is the Senior Examiner for the Association's ADVANCE Registration Scheme for sound insulation testing, where he's played a pivotal role in driving high standards of governance and professionalism.

Russell was elected at the ANC's recent AGM and takes over from previous Chair, Paul Shields.

Graham Parry, President of the ANC, said: "We're delighted to welcome Russell to the role of Chair of the ANC.

"He brings a wealth of experience to the role and we look forward to working together closely throughout his term of office.

"The Board would also like to thank Paul Shields for his hard work in the role of Chair and commitment to the ANC."



Russell Richardson, Chairman of the Association of Noise Consultants

Updated Norsonic 850 Building Acoustic Software

Whether practitioners are making simple single channel or multi-channel laboratory measurements, the Norsonic 850 software enables users to make and process them with ease.

The software suite covers UK and International standards for field and laboratory measurements, so users report to any standard they are ever going to need. With the new 'collection feature' users can handle multiple tests simultaneously with time saving admin tools to produce reports efficiently.

For laboratory measurements where PCs can be run in parallel with sound level meters the complete measurement can be run from software to control the tests. In field measurements where it is not convenient to run a PC, the software can be used to upload details of the day's testing to the Norsonic instrument, helping to manage the testing in an efficient way.

Output of reports is simple, and all data can be exported to Excel for uploading to external software or cloud portals for reporting.

With advancements in technical and understanding, conducting building acoustic investigations has never been so easy. Simplified software, portable equipment and user-friendly interfaces combined have made the lives of acousticians more efficient. ☺



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BRANCH NEWS

Central Branch

By Matt Torjussen,
Central Branch Secretary

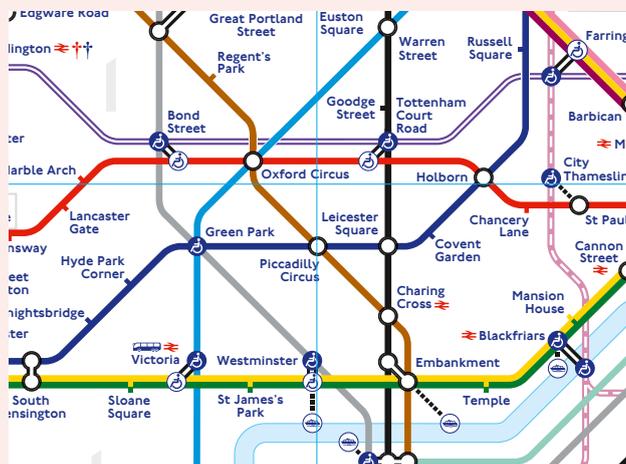
Three valuable presentations

It's been a busy few months for the Central Branch. In November we held a joint meeting with the Midlands Branch in Coventry for a factory visit to Polytec UK. We were treated to a technical presentation from Dennis Berft, who 'Zoomed' in from Germany, and demonstrations of Polytec's laser doppler vibrometers, which included simple point sensors as well as sophisticated scanning systems.

In December, Miguel Garcia Pedroche joined us at IOA headquarters in Milton Keynes to give an introduction to psychoacoustic measurements. Miguel illustrated how the A-weighted decibel is not the best descriptor for sound affecting humans in most situations and that psychoacoustic metrics, such as loudness, tonality, sharpness, roughness and fluctuation strength might give a better indication of human response.

Finally, we were lucky to host Adam Fox from Mason UK in January who presented a case study of an 18th century building, Cambridge House in London, that needed retrospective isolation from ground borne vibration caused by three London Underground lines. Adam described how Mason UK supplied and installed rubber mounts by supporting the entire building on composite beams. The daunting task was brought to life with drawings and photographs of the project, as well as videos of the mount manufacturing process.

The majority of the Central Branch's meetings are filmed and hosted on the IOA's website. Visit the IOA's members videos page to find out more. If you have a case study, piece of research, or general curiosity that you think would make a good presentation, get in touch, we'd love to hear from you.



Above: Cambridge House, in Piccadilly sits on top of three Tube lines

London Branch

By Roslyn Andrews

Increasing our capability to measure infrasound underwater in order to detect natural disasters and nuclear explosions. Ben Ford – National Physical Laboratory

At the IOA London Branch meeting held last November, Ben Ford from the underwater acoustics team at the National Physical Laboratory (NPL) presented on the topic of accurately measuring and calibrating devices to measure infrasound.

Events such as natural disasters (earthquakes, eruptions etc) and nuclear weapons testing are known to emit noise down to low frequencies below 1 Hz. There are numerous monitoring systems worldwide that utilise hydrophones, microphones and accelerometers to monitor noise emitted from these sources. Doing so can provide early warning of tsunamis or triangulate the location of nuclear weapons testing. However, these existing monitoring systems cannot currently be calibrated down to the low frequencies required to totally capture the noise from these sources.

NPL is currently involved in an EMPIR-funded research project along with a number of other European laboratories with the goal of extending our capability to calibrate and therefore accurately measure down to very low frequencies. The project aims to achieve this within the fields of air acoustics, underwater acoustics and vibration. In underwater acoustics the goal is to be able to calibrate a hydrophone to accurately measure down to 0.5 Hz.

Ben presented an overview of the work being undertaken by NPL including new primary calibration standard facilities such as the laser pistonphone and reciprocity coupler, and the development of an in-situ calibration method for hydrophones that are in position and cannot be removed from their signal chain to be sent to a laboratory. Together with existing secondary calibration standard facilities this can create a traceability chain reaching from our labs all the way to in-situ hydrophone monitoring stations and provide a certainty to the operators of those stations that the measurements they are getting down to 0.5 Hz are accurate.

To find out more about the work being undertaken on this project by NPL and the other European partners visit the project website <https://www.ptb.de/empir2020/infra-auv/home/>

Southern Branch

By Sebastian Woodhams

Professor Tim Leighton's talk on airborne ultrasound

On Wednesday 7th December, around 20 IOA Southern Branch members welcomed Tim Leighton of the Institute of Sound and Vibration Research to the Winchester Science Centre, and were treated to a fascinating talk regarding the effects of airborne ultrasound on people.

Tim discussed the truth and fallacy surrounding the impact of airborne ultrasound. He highlighted that there are very few studies of the physiological and psychological effects on humans, and was quoted in the House of Commons during a debate on anti-loitering devices, saying: "whilst there is over fifty years of anecdotal reports of the adverse effects of ultrasound on humans (supplemented by limited laboratory testing), the state of knowledge is insufficient to meet regulatory needs".

Anti-loitering devices were discussed at length, as their marketing suggests that they only affect teenagers, however people ranging from babies to middle aged adults can hear the devices. In 2010, the Council of Europe found that these devices are 'degrading and discriminatory' to youngsters and use should be banned because it 'violates legislation prohibiting torture'. In addition, many of us in the acoustics industry are aware of the impact of noisy environments on the concentration and behaviour of children, and airborne ultrasound plays a major part in this. Airborne ultrasound is also generated by pest control devices, which when located in homes or schools may also have a negative impact on children if they are audible.

The most publicised instance of airborne ultrasound in the media is the

'Havana Syndrome', where multiple US and Canadian diplomats at the US embassy in Cuba complained of symptoms including dizziness, hearing loss, loss of balance and anxiety. An assessment and subsequent report by the National Academies of Sciences, Engineering and Medicine was conducted and found that airborne ultrasound was the likely culprit which caused these health issues. However, Tim has criticised these findings as the methodology used to come to this conclusion was flawed – he has yet to hear back from the US about his concerns.

If you would like to know more about this topic then the full recording of the event is available on the IOA website, and Tim has published many works available online. 📄



Profound Automated Changes of Reverb Time in Concert Halls and Audio Labs



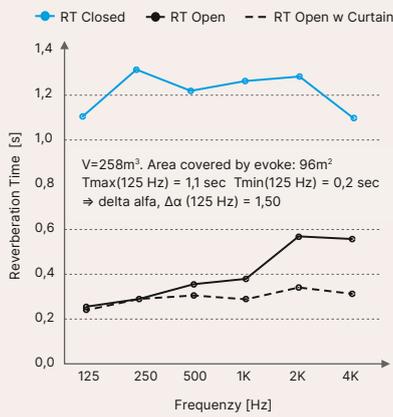
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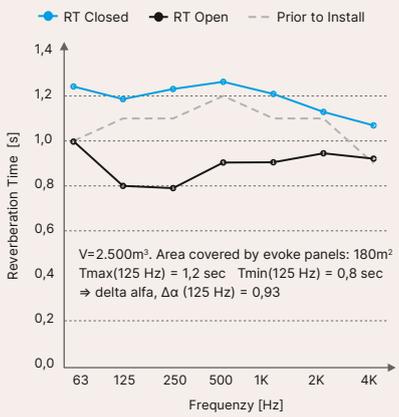
Watch Product Video





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NEWS

IOA Diploma

David Thomson is to be congratulated on his completion of the Diploma through the tutored distance learning scheme via the DL Edinburgh Centre.

Stolen equipment

A sound level meter and environmental case was stolen between 1 and 6 February 2023 from a site in Birkenhead:

- RION NL-52 sound level meter, serial number 654033
- RION UC-59 microphone, serial number 08287
- RION NH-25 pre-amplifier, serial number 54078

If anyone comes across the equipment, please contact Paul Taylor on +44 161 871 0065 or Paul.Taylor2@Stantec.com

KP Acoustics Research Labs offers IOA accredited report writing course

KP Acoustics Research Labs (part of the KP Acoustics Group) has secured accreditation from the IOA for its training course on technical report writing. The course, which provides guidance on elements of good practice relating to acoustic report writing and communication, is the first of its kind to be accredited, putting the company at the forefront in delivering the latest acoustic training.

The IOA Certificate of Proficiency in Technical Report Writing and Preparation (CPTRW) is aimed at early career acousticians, as well as those who require a refresher in report-writing skills. The course covers the principles of technical report writing focused on acoustics applications, such as what needs to be included in a technical report, expressing technical information clearly in a suitable format for the audience, ensuring clear statements of method and presentation of results and conclusions.

Keep up to date with all the latest news, opinion focused content and case studies from KP Acoustics at <https://www.kpacoustics.com/>



Tinnitus UK award Marie and Jack Shapiro Prize for research into the genetics of tinnitus

Tinnitus UK (formerly the British Tinnitus Association) has awarded the Marie and Jack Shapiro Prize to a study that looked at a possible genetic component to tinnitus.

The paper *Genome-wide association study suggests that variation at the RCOR1 locus is associated with tinnitus in UK Biobank* conducted by teams based at King's College London and the Ear Institute, University College London using data from the UK Biobank found a number of interesting candidate genes which may be linked to tinnitus, notably the RCOR1 locus.

The prize was judged by Tinnitus UK's Professional Advisers' Committee, who commented: "The authors of this study have used the records of over 170,000 participants in UK Biobank to identify a gene they newly link to the risk of developing tinnitus. Importantly, the gene was not linked to hearing loss, but seems to have an independent link to tinnitus. Future research on this gene might help to identify mechanisms of tinnitus or develop new treatments."

Deanne Thomas, Chief Executive of Tinnitus UK, said: "We're delighted to award the Marie and Jack Shapiro Prize to this useful study. This project's findings were very interesting and indicate that there are possible genetic risk factors for developing tinnitus.

The study shows the potential benefits that a dedicated Tinnitus Biobank could bring, allowing us to understand the condition much better and answer many other questions that, thanks to chronic underinvestment, so far remain unanswered." 🎯

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For further details please email linda.canty@ioa.org.uk or visit the official website <https://auditorium2023.org/>

We look forward to seeing you there.



XL3

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SPECIALIST GROUPS

Noise and Vibration Engineering Group

By Malcolm Smith (Past NVEG Chair, retired from ISVR Consulting) and Naomi Tansey (NVEG Chair, Senior Engineer, Dyson)

Quarterly online seminar series

During the Covid lockdown the Noise and Vibration Engineering Group (NVEG) committee initiated a quarterly series of lunch-time seminars on topics of interest to noise and vibration engineers. The list (below) shows the diverse range of themes covered:

- development of commercial products for improved subjective acoustic characteristics;
- the potential adverse health impact of noise and vibration on people; and
- basic mechanisms and physics of electromagnetic or aerodynamic noise sources.

Sue Hewitt presented most recently and on page 67 of this issue, we have a write up of her well received talk.

NVEG seminars between January 2021 and November 2022

- **Nathan Thomas:** Acoustics of the Dyson Airwrap
- **Malcolm Smith:** Aerodynamic noise from planes, trains and buildings
- **Karine Degrendele:** Noise due to electromagnetic forces in automotive applications
- **Simon Roberts:** Active noise control for transportation systems
- **Antonio Torija Martinez:** Drone noise: the next public health challenge
- **Gurmail Padden:** Acoustics and Vibration Section at the Institute of Naval Medicine
- **Daniel Elford:** Low frequency attenuation with natural ventilation: noise control solutions based on acoustic metamaterials
- **Sue Hewitt:** Differences between manufacturers' declared vibration emission data and in-use measurements

<https://www.ioa.org.uk/video-category/branch-and-group>

The 35-40 minute duration of each talk gives our expert speakers scope to cover their specialist topics in some depth, followed by 15 minutes of questions from the audience directed by a member of the NVEG committee. The series has been very successful, attracting audiences of at least 90, and up to 160 attendees for some events. These numbers far exceed attendance at one-day events organised by the committee in previous years, and so it seems this method of communication has nicely hit the mark of being both interesting and accessible.

In a quest to refine and broaden the impact and interest of the seminars we analysed data available from feedback forms (completed by individuals requesting a CPD certificate, about 50% of participants), data from the Eventbrite booking system,

and attendance data from the Zoom meeting itself. A detailed report will be provided in a future Acoustics Bulletin article; however a basic overview is outlined below:

- the number of people registering for a ticket is approximately double the number actually attending, indicating that people book the event in their diary and attend when they can;
- for the most recent talks, approximately two thirds of attendees were IOA members. While our main remit is to provide events of interest to members, attracting a significant audience from outside the Institute also has benefits;
- approximately half of attendees are involved in consultancy activities, with the other half coming from other backgrounds such as industry and manufacturing, councils and the civil service, or research and academic organisations. As a result, we plan to improve our communication for particular market segments, such as the education community; and
- attendees hear about the talks from a wide variety of sources, particularly IOA emails, but also publicity posted on LinkedIn and other media, as well as word of mouth.

Changes to the committee and future plans

Given the success of the format, the committee intends to continue the series for the indefinite future. If you wish to receive notifications of future seminars, please ensure that you are registered to receive notifications of NVEG events via the IOA website (Home – My Details – View Contact Dashboard – Your Groups). 2023's calendar of talks is already filling up, however, we are always pleased to receive suggestions for suitable topics and expert speakers. NVEG intends to host a hybrid evening seminar this year, in order to give members the opportunity to get together in person. Topics of future seminars will be released in due course.

After becoming chair of NVEG in 2005, Malcolm has decided to step down to provide more free time in his retirement. The committee thanks him for his years of dedication and commitment to developing the committee and NVEG community. The committee has elected Naomi Tansey as the new Chair and she is looking forward to building on the success of the group.

The committee is currently looking for a new member to join. We are particularly interested in acquiring someone with an industrial noise background, as the committee strives to have members from a diverse array of engineering remits.

Finally, NVEG will be hosting a session at Acoustics 2023 in Winchester, we welcome and encourage any abstract submissions by Monday 27 March 2023. We hope to see you there, if not before.

Difference between manufacturers' declared vibration emission data and in-use measurements

By Chris Steel NVEG committee member

In her NVEG presentation, Sue Hewitt, HSE Noise and Vibration Specialist Inspector told us why HSE inspectors can't just say yes or no when we ask, "can you use manufacturers' tool data for hand-arm vibration assessments."

Early vibration test codes were developed to provide repeatable and reproducible data and not necessarily data for risk assessments, so HSE set out to find which test codes produce data representative of power tools in use. Over the course of Sue's career, she, and other HSE scientists, tested many power tools across Britain and at the HSE laboratories in Buxton.

Test codes from before 2001 were found to produce emission data that was typically below the in-use magnitudes. Most often this was due to the difference in the methods needed for a repeatable and reproducible test under laboratory conditions. After 2001 test codes began to be modified to be more reflective of in use data. This is an on-going process.

Sue then showed examples of grinders, sanders, lawnmowers, breakers, nail guns and impact wrenches to help explain some of the problems with site and laboratory measurement practice.

Some of the findings about emission standards (laboratory) were:

- angle grinders with auto-balancers that do not work properly can increase vibration exposure rather than reduce it;
- the standard emission test for an impact wrench tends to over predict vibration magnitudes;
- the standard emission test for sanders tends to underpredict vibration magnitudes; and
- the standard emission test for fastening devices (nail guns) tends to give good correlation with in-use vibration magnitudes. However, the number of shots fired with nail guns is key to understanding exposure.

Some of the factors that affect in-use measurements (site) are:

Power tool	Factor affecting measurements
Angle grinders	Uneven wear, damage to the abrasive, use of different abrasives
Breakers	Incorrect use of suspension handles, back hammering (pulling the tool out while it is running), scoring (of the road surface) or jamming the bit
Mowers	Terrain and performance of isolation handles when idling
Sanders	Varying operation forces, speed and attachments (e.g. use of interface pads increase vibration over basic paper discs)
Pneumatic tools	Use at operating air pressure other than manufacturers' recommended pressure
All tools	Influence of the measurement mounting position (accelerometer)

Sue concluded that:

- standard test codes for vibration emissions must be repeatable and reproducible to be worthwhile but controlling and reducing the sources of variability affect the outcome of the tests; and
- HSE found that, of the test codes published since 2009, some produce vibration emission data that over-predicts vibration risk, some under-predicts, and a small proportion of the emission data represents workplace vibration risk.

Because it is not possible to provide generic guidance on the use of vibration data in a vibration risk assessment HSE publishes data in their guidance document and on their website <https://www.hse.gov.uk/vibration/hav/source-vibration-magnitude-app3.pdf>

The noise and vibration research produced by HSE over 20 years can be found in the HSE RR Reports; a valuable resource for acousticians, at <https://www.hse.gov.uk/research/rrhtm/index.htm>

Senior Members Group

By Michael Sugiura, Senior Members Group Chair

The Senior Members Group (SMG) Committee has issued an invitation to all retired members to join. The aim is to widen the demographics of our members and increase our influence in the UK and internationally. It is important to note that

SMG meetings are open to everyone and provide the opportunity for experienced members to get together from time to time to discuss issues arising from the IOA and to listen to speakers covering all aspects of acoustic science. One of the aims of the

group is to communicate particularly with members of the IOA who have retired and are living overseas.

To join or find out more, email:
Michael.sugiura@sugi.co.uk

P68

Measurement & Instrumentation Group

Founder member steps down after 27 years

By John Shelton, M&I Group Chair

The M&I Group AGM in December saw the retirement of Martin Armstrong from the committee. Martin was one of the original members when the committee was founded in 1995, and since then he has authored several papers in the Instrumentation Corner series, as well as providing invaluable input to the group's activities. His past employment with the likes of Ling Dynamics and Bruel & Kjaer made him the go-to person for all matters vibration, and he kept members up to date on standardisation matters in human and ground vibration measurement, at a time when BS6472, ISO8041, ISO16063 and other standards went through sometimes major revision.

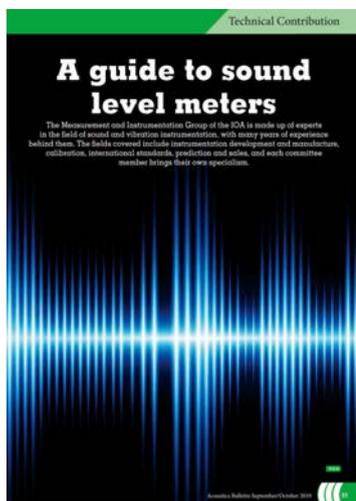
Martin would refer to this as his second retirement, as he officially retired from B&K many years ago, and has been an active member of the IOA Retired Members Group.

To commemorate his retirement, he was presented at the AGM with a mounted B&K 2635 charge amplifier and plaque, and he certainly would have sold many of these fine amplifiers during his career.

We wish him enjoyment in his retirement, probably somewhere in the south of France, but we will surely stay in touch.



Above: (L-R) John Shelton with Martin Armstrong, who has retired from the M&I Group committee after 27 years



Above: M&I Group sharing the benefits of good measurement practices

Instrumentation Corner articles now available on the website

Since 2009, the M&I Group committee has been collectively writing a series of articles for Acoustics Bulletin, under the Instrumentation Corner banner.

These have covered such topics as ground vibration, calibration, statistics in 1/3 octaves, Leq time intervals, smart cities and many more related instrumentation issues.

This series of some 82 articles has been available on the members' pages of the IOA website, but now we're pleased to have them available on the public-facing part of the site, so the benefits of good measurement practices are available to all.

One key document is the Guide to Sound Level Meters, co-authored by some of the leading UK authorities in sound level meter design and standardisation, and is a handbook for those who need to be sure their meter is up to snuff.

If you haven't yet had a browse, you can find them at <https://tinyurl.com/bdedkm55> and we will continue to update as new subjects and technologies arise.

If there is a topic you would like covered, please get in touch via the website. ☺

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bit.ly/ArtofConsultant

The Art of Being an Acoustician

Friday 21 April 2023 – The Little Ship Club, London EC4R 3TB
bit.ly/ArtofAcoustician

Organised by the IOA's Early Careers Group (ECG), these events are aimed at young consultants, those new to the profession, and students who are considering a career in acoustics. Presentations by practicing industry leading consultants cover a wide range of issues.



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The screenshot shows the 'Edit an existing material' dialog box. It includes a table for material layers, a 'Perforated Plate Properties' section with input fields for hole diameter and perforation ratio, and a 'Random Absorption Coefficient' graph. The graph plots the absorption coefficient (alpha) against frequency (Hz) from 63 to 8000 Hz, showing a peak around 500 Hz.

Num.	Name	Type	Thickness <mm>
0	Backing	Rigid backing	
1	Fluid Layer	Fluid Layer	50
2	Porous Layer	Porous Layer	50
3	Perforated Plate	Perforated Plate	5

Total Thickness: 105.00 mm

Perforated Plate Properties

Hole diameter (mm): 1.0

Perforation ratio: 0.100

Graph: Absorption coefficient (Random incidence) vs Frequency [Hz]. The curve shows a peak absorption coefficient of approximately 1.0 at 500 Hz.



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Committee meetings 2023

DAY	DATE	TIME	MEETING
Wednesday	15 March	10.30	Council
Tuesday	21 March	11.00	CPD Committee
Tuesday	28 March	10.30	Engineering
Wednesday	29 March	10.30	Engineering
Tuesday	4 April	10.30	CCWPNA Examiners
Tuesday	4 April	13.30	CCWPNA Committee
Thursday	20 April	10.30	Membership
Thursday	27 April	10.30	Meetings
Thursday	4 May	11.00	Publications
Thursday	11 May	10.30	CCHAV Examiners
Thursday	11 May	13.30	CCHAV Committee
Tuesday	23 May	10.30	Research Co-ordination (London)
Thursday	25 May	10.30	Executive
Wednesday	7 June	10.30	Council

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The New Rion NL-53

Class 1 Sound Level Meter - Pattern Evaluated to IEC 61672-1:2013

3.5-inch
Colour LCD with touch panel

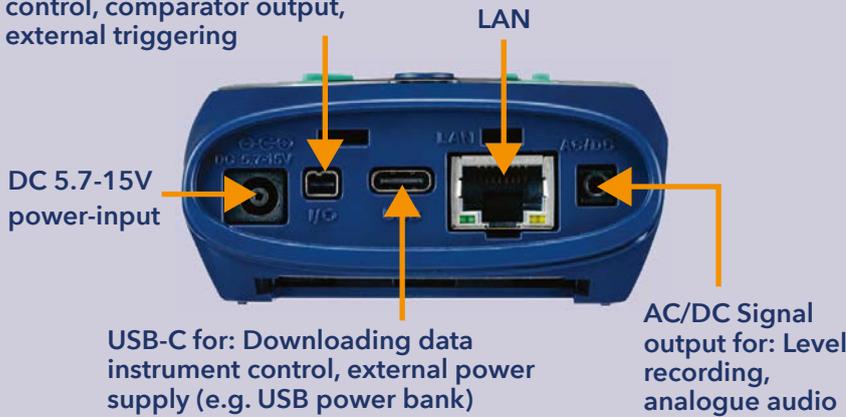


3 hardware keys
Physically operated keys for reliable measurement execution



Get Connected

RS232-C for: Instrument control, comparator output, external triggering



USB-C for: Downloading data instrument control, external power supply (e.g. USB power bank)

AC/DC Signal output for: Level recording, analogue audio

Need live-to-web data and real-time alerts? Connect the NL-53 to:



Connect via WAN (router with internet connection required) to check the status of the unit, view and acquire data, and listen to real-time sound.



Compatible with existing hardware

Options for:

- Wave Recording
- Octave/1/3 Octaves
- FFT Analysis

