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ACOUSTICS BULLETIN

Institute of Acoustics
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ACOUSTICS BULLETIN

Acoustics Bulletin Volume 49 No 6 November/December 2023

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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.

Institute of Acoustics
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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

I trust this letter finds you in good health as we approach the end of 2023. This past month has afforded me the opportunity to reflect on the remarkable work being undertaken by both emerging talents embarking on their careers in acoustics and those individuals who have already made significant contributions to the field, as well as to our Institute.

I had the privilege of spending an enriching day at Sheffield University for the UK Acoustics Network (UKAN) annual conference 2023. The conference's theme, 'Maximising Acoustics Funding,' provided a platform for insightful presentations and workshops geared towards nurturing innovative ideas that will shape the future of acoustics research. It also provided me with the opportunity to reaffirm the IOA's steadfast support for the commendable work of these young researchers, and emphasise the pivotal role it plays in contributing to the UK and global economies, and protecting health and wellbeing.

Speaking of research, I invite you to keep an eye out for the second part of Mike Lotinga's piece on onshore wind turbines, featured on page 26. You will note his significant emphasis on the imperative for further research and understanding of human response impacts in this area.

IOA Renewable Energy Working Group

In my previous correspondence, I mentioned Council's decision to reconvene the Wind Farm Noise Working Group. As an update, I am pleased to inform you that the group's scope has been expanded to encompass other renewable energy sources, including solar, heat pumps, wave energy, and more. Council has appointed Richard Perkins as the Chair of this newly formed Renewable Energy Working Group. He is extending an invitation to all interested parties wishing to contribute to the group's endeavours, to reach out to him or our office. It is our intention that this group will be comprised of dedicated acoustics professionals, with diverse backgrounds in policy, regulation, industry, consultancy, and research expertise.

A few days after my inspiring experience with young researchers in Sheffield, I had the pleasure of celebrating the 50th anniversary of the ANC (the Association of Noise Consultants) at their annual conference in Birmingham. The conference featured a diverse range of topics, all delivered with a commendable level of enthusiasum, particularly in the presentations strictly limited to just four minutes! I wish to extend my heartfelt gratitude to Russell Richardson

and Graham Parry for their warm hospitality at this event. Looking ahead, we will be celebrating our own 50th anniversary next year, and I look forward to reciprocating the favour.

50 years of the IOA

Our Immediate Past President, Stephen Turner, has very kindly accepted the role of Chair for the 50th Anniversary Planning Group and I would like to encourage members to support their efforts. This can probably best be done by actively engaging with your local branch committees and coming up with ideas for celebratory activities throughout the year. Our anniversary year will also be marked by the release of specially branded editions of the Acoustics Bulletin. Each will feature extracts from past decades, so look out for those!

As we take time to reflect on our history and the enduring support of our Institute, I would like to personally pay tribute to the exceptional service and exemplary leadership of Geoff Kerry, with whom I had the honour of serving on Council for many years. You can find a heartfelt tribute to his life and service on page 6.

Warm regards,

Alistair Somerville, IOA President

Geoff Kerry

It is with profound sadness that we announce the passing of our much-loved colleague and friend, Geoff Kerry, on 23 August 2023 at the age of 79. A world-renowned expert in acoustics, Geoff's significant contributions to the field throughout his long and distinguished career are ingrained in the legacy he leaves behind at Salford and the IOA.

By David Waddington, IOA President Elect

Left: Geoff at the first anechoic chamber at the University of Salford, which he helped to design and build

Famous for his meticulous attention to detail and uncompromising execution, Geoff's philosophy is felt through the generations of acousticians who he mentored and inspired over the years. Geoff was always the most enthusiastic, energetic person in the room.

He had time for everyone – from the new undergraduate to the professor, from the technicians to the researchers; passing on his vast knowledge of all things acoustics (and a talent for recalling that thing hidden in a cupboard which was exactly the thing to solve the problem of the moment).

Geoff was perhaps the person most responsible for documenting and communicating the history of not only the IOA but acoustics itself. The development of acoustics in the UK has run hand-in-hand with Geoff's career; and as everyone who ever spoke to him knows, he was an impressive advocate.

The early days

Born in Manchester, England in 1944, Geoff's journey in acoustics began with his studies in applied physics at the University of Salford. After graduating and a short period at Hawker Siddeley Aviation, he joined the newly formed Department of Applied Acoustics at the university, a relationship that would span more than 58 years. Even after his official retirement in 2005, Geoff remained an integral part of acoustics at Salford, continuing to support the commercial laboratories he first established with Peter Lord with his invaluable insight and auditing skills until his second retirement in 2021.

Geoff's research interests were broad, but he was particularly interested in outdoor sound propagation and the management of hearing impacts from blast noise. He led teams from the University

Below: The late Peter Lord with Geoff

of Salford that carried out a series of field trials for the Ministry of Defence, the Royal Air Force, and the Defence Research Agency. His work has had a major impact on the way that noise is managed in the military and in other industries.

IOA founding member

Geoff was also a passionate advocate for the profession of acoustics. He was a founding member of the Institute of Acoustics (IOA), and served in many roles within the organization, including President from 2002 to 2004. He was also a Fellow of the IOA and a Chartered Engineer.

Geoff made significant contributions to the development of the IOA. He was a founder member of the Institute's North-West Branch and of the Industrial Noise Group (now the Noise and Vibration Engineering Group). He served on the Membership Committee for 18 years from 1998 to September 2016. His experience of being on Council and then President meant he could bring to the table the why and how on many of the Institute's decisions over the years. His contribution to the Membership Committee will be remembered for many years. Geoff also served as the IOA's Honorary Treasurer and as Vice President Groups and Branches.

Geoff was a highly respected authority on acoustics, characteristically generous and always keen to share his knowledge and experience with others. He was a mentor to many young acousticians, and a great friend to many people. He will be truly missed by all who knew him.

Geoff's funeral took place on September 13 2023 at Macclesfield Crematorium. David Waddington, the President Elect of the IOA, represented the Institute at the funeral.

Top: Geoff and a colleague at St Michael's Mount, Cornwall, measuring sonic booms from Concorde in around 1978

Above: Geoff with David Warrington, being filmed by a BBC's 'Tomorrow's World' crew at Shoeburyness

Inspirational

As we remember Geoff, we celebrate his life, his friendship, and his contributions to the field of acoustics. His legacy will continue to inspire and guide us in our work. In the words of Geoff himself, "Gosh – I feel I must write down the history now."

Rest in peace, Geoff. Your memory will continue to resonate in the halls of the University of Salford, in the meetings of the IOA Executive, and in the hearts of all those who had the privilege of knowing you.

Thank you, Geoff, for everything.

Above: Geoff at third and current anechoic chamber at the University of Salford, which he helped to design and build

Geoff's family has requested that any donations be made to the Greater Manchester Asbestos Victims Support Group (**https://gmavsg.org/**)

We carried an article about Geoff in the September/October 2021 issue of Acoustics Bulletin as he was getting ready to retire for the second time. You can read it again at **https://www.ioa.org.uk/catalogue/publication/acoustics-bulletin-september-october-2021**

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

We interviewed three candidates in October and we continue to train interviewers by having them initially sit in as observers. Our list of interviewers is therefore growing but we would still like to hear from anyone else who would like to be part of the team. I hope to get an article from one of the new interviewers for a future issue of Acoustics Bulletin.

I can't emphasise enough how important it is to look at UK SPEC 4 when drafting reports. The example reports we send seem to have helped but there is no substitute for mapping your own work experience to the requirements in the standard. As there are no accredited graduate programmes in the field of acoustics, all candidates also need to supply an IPD report. The steps you need to take are clearly indicated in the guidance document we send. Please take the time to 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, together with the new additional support report examples. We are always ready to comment on the content of your professional review report prior to submitting the final draft. 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.

The initial stages of your application will be processed by Emma Lilliman, who does a great job making sure all the fundamentals are in place. You can check the copy of UK SPEC 4, if you are unsure, on the Engineering Council website.
The link is in this report here **https://www.engc.org.uk/ukspec**

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). The IOA Diploma is a way of demonstrating that you have attained the master's level (M level) learning if you do not have the academic qualifications to M level

Below:
We are now interviewing using the Engineering Council UK SPEC version 4

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and you graduated after 1999. It is a requirement that you have three merits one of which must be General Principles of Acoustics to be able to meet the M level requirements. There are other routes such as experiential learning in the workplace, but we will deal with those on a case-by-case basis.

Interviews

We hold several interview events through the year, depending on the number of candidates we have coming forward for registration. If you are interested in taking the next step to becoming a professionally registered engineer, email us at **acousticsengineering@ioa.org.uk** sending a copy of your CV and copies of certificates and transcripts of your qualifications. It is important that we have all your further and higher education certificates (not A-Levels) and not just your highest attainment, training courses are not relevant at this point.

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 below).

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

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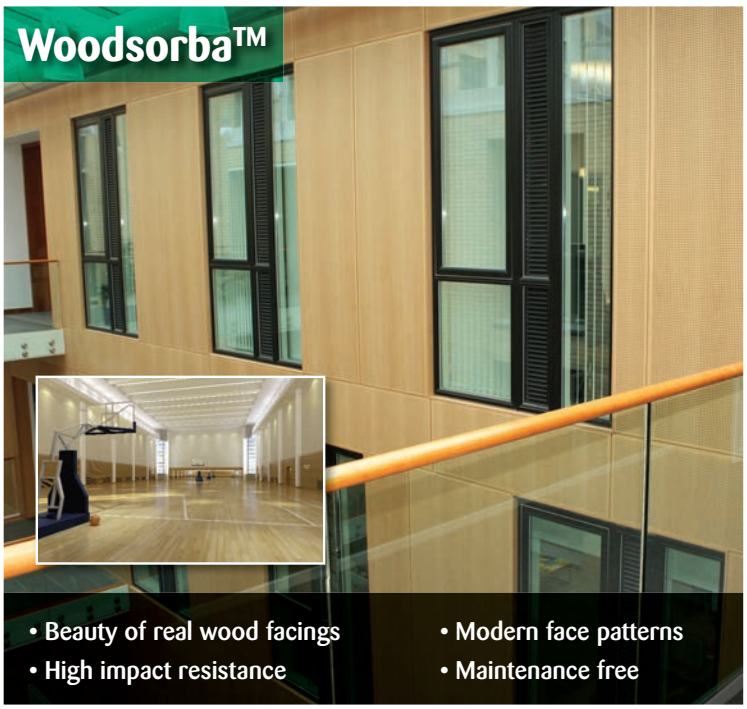

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IOA Events for 2023/24

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14-16 November 2023
The Bristol Hotel, Bristol

Organised by the Underwater Acoustics Group
ICUA2024
International Conference on Underwater Acoustics
17-20 June 2024
University of Bath Organised by the Underwater Acoustics Group

ACOUSTICS 2024 - 50th Anniversary Conference
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Financial support for IOA events

Have you ever seen a really interesting event, that would be great for your CPD, but the cost prohibits you from attending?

By Angela Lamacraft, Chair of the IOA EDI Working Group

The IOA has two funding mechanisms that may help: the Bursary Fund and the Carer's Fund.

Bursary Fund

The Bursary Fund is available to improve IOA members' access to acoustics-related training and activities and assist them in carrying out acoustics-related STEM activities, where funding from other sources may be limited or unavailable. There are three categories for funding:

1) Full or part-time course related to the field of acoustics (if you are currently in employment, the course needs to be unrelated to your or your employer's business or business development).

Example: A member who has recently been made redundant wanting to retrain into a different area of acoustics to help increase their re-employment opportunities, or a postgraduate student researching a building acoustics topic wishing to achieve the Certificate of Competence in Building Acoustics Measurement.

2) Acoustics-related short-term course, meeting, lecture, or conference, and/or reasonable travel and subsistence costs to participate either as an attendee or presenter (if you are currently in employment, the topic needs to be unrelated to your or your employer's business or business development).

Example: An undergraduate attending an IOA one-day meeting on a subject they are interested in.

3) Undertake activities to promote acoustics and the IOA in public forums, including STEM activities in schools.

Carer's Fund

The newly created Carer's Fund aims to support members with caring responsibilities with the additional costs of paying for carers when attending an IOA event, meeting, or conference. This is a great opportunity for members who have been unable to attend events due to the cost of additional care to attend events, liaise with colleagues in the IOA or share knowledge through presentations.

	Bursary Fund	Carer's Fund
Purpose:	To improve IOA members' access to acoustics-related training and activities and assist them in carrying-out acoustics-related STEM activities. Examples are: Full or part-time course; A short term-course, meeting, lecture, conference; Activities to promote acoustics, including STEM activities.	To help IOA members attend IOA events or conferences that they might not otherwise be able to attend because of the cost of arranging additional care. Examples of how the grant might be used include: • Extended hours for a child-minder or care worker. • Babysitter costs. • Travel expenses for friends or relatives to care for your dependants. • After school activities, clubs, or play-schemes. • Medical, nursing or respite care.
Who can apply:	Any IOA member; Priority will be given to Early Career Members, those that are unemployed and student members.	• Any IOA member. • Use the grant towards the costs of additional care; and • Attend an IOA conference, meeting, or event.
Process:	Application forms are available at **https://www.ioa.org.uk/can-we-help/bursary-fund-application-form** Complete the form with a statement demonstrating: How the IOA and the wider acoustics community will benefit from the activity. How the funding will enable this outcome to be achieved. Applications open three or four times a year. A decision is made within four weeks once the funding round closes.	Application forms can be downloaded from **https://www.ioa.org.uk/catalogue/publication/carers-fund-guidelines-form** Applications must be submitted at least four weeks prior to the event. A decision will normally be made within two weeks of receipt of your application. Retrospective applications will not normally be accepted.
Maximum value per application:	£1,000	£250
Maximum value per person per year:	£1,000	£250, although exceptional circumstances will be considered
Follow-up required:	Once the application is approved, submit proof of enrolment in the activity or course. When this is completed, as a condition of receiving the bursary, a short article about the course/research or a presentation may need to be prepared to share the experience with the wider IOA membership.	Complete and return a brief feedback form after the event: • Confirming attendance. • Any benefit obtained from attendance. • The effectiveness of the fund in contributing to your additional costs. • Feedback on the process.
Contact:	**ioa@ioa.org.uk**	**ioa@ioa.org.uk**

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Tomorrow's Engineers Week

If you have opened and read your Acoustics Bulletin as soon as it was available/landed on your doorstep, you are in luck...this week is Tomorrow's Engineers Week (**https://www.teweek.org.uk/**).

by Vicky Wills and Matt Muirhead

The annual campaign, TEWeek, is run by Engineering UK, to shine a spotlight on engineering, engineering careers and engineering professionals.

This year, the focus of the campaign is around local challenges and turning a passion into a career, and this certainly sounds like something that acoustics professionals can get on board with.

If you are a regular user of social media, you will hopefully have seen some of the things that we have been able share recently. Below is a summary of these initiatives and campaigns:

Virtual work experience

For the past two years, the IOA has commissioned a Virtual Work Experience (VWEX) through an online platform hosted by Springpod. This is 10 hours of free, interesting, fun, and interactive content on acoustics for anyone that is 13+ and may be interested in acoustics. The new and improved on-demand content has just gone live. Please share the link with young people, or the influential people in their lives at **https://tinyurl.com/IOASpringpod**

2023 IOA Schools Competition winners

The winners of the IOA School Competitions for 2023 have recently been announced (full details will be given in the next issue of Acoustics Bulletin). This year, to ensure that schools have as long as possible to enter, the 2024 competitions have already launched — find out more at **https://tinyurl.com/IOAschools2024**

Careers Hive

IOA STEM volunteers were at the Careers Hive, an educational event organised by Edinburgh Science, with the IOA as one of the sponsoring organisations. It provides 11–14 year-olds an immersive introduction to the future of work and highlights the breadth of opportunities available if they continue to engage with STEM subjects (science, technology, engineering and maths) throughout their education. Careers Hive 2023 took place in the National Museum of Scotland, Edinburgh from 6–11 November. Throughout the week 3,000 students were guided through three-hour sessions featuring an interactive exhibition, hands-on workshops, and inspirational talks.

Lottie working on a construction site with NDY in New Zealand

Lottie working with CDM Stravitec in Brighton

The Women's Engineering Society Lottie Tour

The Women's Engineering Society (WES) run an annual campaign, the WES Lottie Tour (**https://www.weslottietour.org.uk/**), where volunteers take a 'Lottie' doll to many different locations to show Lottie carrying out the work that they do in engineering and related careers.

This year, IOA STEM committee members have joined in with the Lottie Tour, providing a number of dolls for the members to use, along with accessories like hard hats, yellow hi-vis vests and hearing protection. We were particularly lucky to start the tour when we did, as ANV Measurement Systems were able to provide each doll with a mini sound level meter.

We didn't know if there would be much interest in the tour, but at least 25 different organisations have joined the tour since mid-September and Lottie has been to conferences, tried her hand at underwater acoustics, been on noise surveys, tried noise modelling, designed speakers, carried out acoustic tests and we have even seen dolls on tour in Canada, Australia, and New Zealand.

Follow Lottie

See all the brilliant things that Lottie has been up to and support the tour by following **#WESLottieTour** and our tag **#AcousticianonaMission** on social media. This is an annual campaign and hopefully something that we will continue to support. If you have any questions about our tour, please contact **STEM@ioa.org.uk**

Above left: Lottie taking road side measurements with AtkinsRéalis in Bristol

Above right: Lottie and Finn learning about loudspeakers with Tymphany in Bridgend

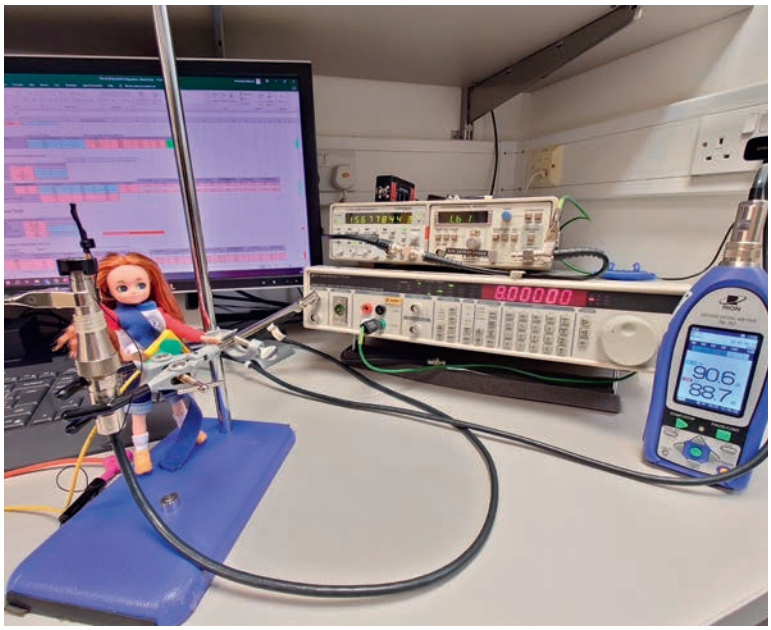
Below left: Lottie at SRL

Below right: Lottie at ANV Measurement Systems in Milton Keynes

STEM Ambassadors

Finally, if you are a STEM Ambassador, please look out for a forthcoming email about a new STEM community page on acoustics which is open to all with careers or an interest in acoustics. Through this collaboration site we will be able to share the latest materials, canvas thoughts on new initiatives and support those going to events.

Please join us in supporting all of these initiatives by doing the usual sharing, liking, and commenting on our social media posts.



Ecoacoustics, bioacoustics, and everything to do with the sounds of nature – In conversation with Dr Carlos Abrahams

Richard Grove (RG) and Dr Carlos Abrahams (CA) had an online conversation recently to delve into the emerging world of ecoacoustic monitoring, biodiversity net gain (BNG), and what these might mean to the acoustics industry as we seek to address issues of biodiversity.

By Richard Grove, Chair of IOA Sustainable Design Task Force (SDTF)

Above: Ecoacoustic measurement

With 10% BNG becoming enshrined in law, the conversation below is a timely reminder that we may need to consider acoustic impacts beyond our traditional scopes, and collaborate with more diverse disciplines.

Dr Carlos Abrahams has been a consultant ecologist for over 20 years. He is Technical Director and Director of Ecoacoustics at Baker Consultants, a Fellow of the Chartered Institute of Ecology and Environmental Management, and a lecturer on the BSc Environmental Biology course at Nottingham Trent University. His background was originally in countryside management and nature conservation although, inspired by Jacques Cousteau, decided to become a marine biologist, which evolved into becoming a freshwater ecologist. He has worked with a wide variety of habitats and species, with much of that work being on bats, birds, and badgers using a variety of different survey and monitoring approaches. The study of bats is one of the few areas which has some history in acoustic recording and his work now focuses on the meeting of ecology and acoustics, hence ecoacoustics.

[RG] How did you arrive at introducing acoustics into ecology?

[CA] A series of events and a healthy dose of circumstance can often help create new approaches, and there are two major things which happened to lead me into ecoacoustics. Firstly, for a while, Baker Consultants became heavily engaged with underwater acoustics because of burgeoning off-shore wind farm development, monitoring the potential for disturbance to marine life as a result of the piling operations needed to construct the wind turbines. I was on the fringes of this work, but still learned lots about marine bioacoustics, adding to my existing bat survey experience. Secondly, we sponsored two separate PhD and MSc students who were carrying out research on nightjars (a nocturnal bird species) using acoustic methods. This approach correlated and complemented more traditional ecological approaches, and detected far more birds than we might see or hear when on site, so we developed it further into new national standard guidance[1] and consultancy projects.

1 **https://www.researchgate.net/publication/368683386_Good_practice_guidelines_for_long-term_ecoacoustic_monitoring_in_the_UK**

[RG] Ecology and acoustics seem to have shared a similar trajectory in terms of public awareness and perception. Have you noticed a change of perception when it comes to ecology?

[CA] In terms of the jobs that are available and the number of people that are doing ecology work now, it has completely transformed over the past couple of decades. As a consultancy discipline, the ecology sector has grown, increasingly becoming part of regular business in the development industry. It's no surprise to any developer now that they need to do bat surveys and newt surveys and put mitigation measures in place as part of the EIA process. The incorporation of biodiversity into policy both within businesses and government, is on an upward trajectory, even though unfortunately a lot of wildlife is still on a slide. The more the link between the significant climate change impacts we're already starting to see and biodiversity becomes understood, the more we will expect to see ecological work growing, and, in conjunction, increasing financial investment from institutions, developers, and governments.

[RG] Have the approaches and methodologies improved, or do more traditional methods still yield as good if not better results?

[CA] Recording techniques have developed significantly over the past 20 to 25 years. We've been recording whales and dolphins since the 1970s, and bats over that time too, using a range of developing technologies. These were slow hand-held analogue systems originally, without the ability to record sound files, and had limited frequency ranges that could only record some species. Now, we can use bat detectors recording at 384 kHz, and download and analyse it in real-time. These techniques are all now broadly based in audio recording approaches, quite different from traditional acoustic level measurement techniques.

[RG] There seems to be a favouring of audio recording and analysis over level measurements. The data sets must be quite large?

[CA] Since the advent of digital technologies, along with the ability to record large quantities of data both locally and in the cloud, we have been able to record audio for post-analysis utilising spectrographs. So, we have essentially gone from listening to sounds live in the field, to being able to automatically record and then analyse increasingly large data sets after the event. This combination of traditional survey methods with more discrete long-term automated monitoring can develop a full picture of the biodiversity in an area without disturbing or affecting the animals present.

[RG] Are acoustic cameras being adopted in ecoacoustics?

[CA] There have been attempts to introduce sound localisation within ecoacoustics research, fusing arrays of microphones and post-processing to get some indication of the sort of density and numbers of bird species, for example, but this is not generally used in practice yet. Acoustic camera technology has potential to combine passive audio and visual techniques and given the datasets we are generating, AI and machine learning approaches are rapidly developing for analysing recordings, improving our understanding of biodiversity which we may have once missed.

[RG] You've recently published good practice guidelines for long-term ecoacoustic monitoring in the UK. Did you find established approaches to acoustic standards and guidance useful or relevant?

[CA] This is one area where there's a bit of a gulf between acoustics practiced by acousticians, and acoustics practiced by ecologists. I'm aware there's importance placed on performance, calibration, and sensitivity etc within the marine environment, who also have more of a handle on the physics of sound and signal processing than land-based ecologists and ecoacousticians. This is, however, related to the ocean where, in general terms, sound travels equally well in all directions, lending itself to analytical methods for establishing exposure levels and distance to source calculations. So, naturally in the marine world, equipment standardisation is of great importance to the results generated. Currently, this is not the same for ecoacoustic analysis on land, primarily because we are seeking different answers, and that ecoacoustics on land has developed from fairly 'home-made' origins as a back-up to visual methods, seeking some fairly straightforward answers – for example what species of bats are present in this site? So it's a different background and we start from a different place. At Baker Consultants, we are one of the few companies I believe who carry out regular calibration of our microphones for bird and bat surveys. So in general, the traditional 'noise' measurement methods and standards have not really been considered within ecoacoustics work, primarily because most of the practitioners are coming from an ecology background, rather than a sound/physics context. Hopefully though, the world of soundscapes might provide a natural home, and connection point, for ecoacoustics and more traditional acoustics.

[RG] Do you believe the introduction of 10% BNG will, or should, expand the scope of what we consider to be impacted?

[CA] The introduction of BNG into law will require ecological enhancements to be monitored and proven. BNG, rewilding, and similar habitat restoration schemes, are long-term projects, and will require long-term monitoring approaches. Ecoacoustic methods provide a permanent raw data record that can be archived and compared over many years of data collection, but currently it seems likely that more traditional habitat mapping methods will normally be employed. The BNG process is very similar to that of acoustic surveying for EIA, essentially providing a baseline before the development and recommendations for mitigation, with the main difference being the need to monitor for a significantly longer time – 30 years! But whatever we think about this new legislation, the results will almost inevitably be better than the outcomes we have now.

[RG] BNG will predominantly be of interest to property developers and could potentially present an opportunity for the acoustics and ecology industry to further develop their work in this field. How did the projects you have carried out to monitor soil health and the underground world of bugs and invertebrates come about? P20

[CA] The soil work is brand new. An ex-colleague, Jake Robinson, who is now in academia studying environmental microbiomes, spotted work done by Marcus Maeder, a Swiss composer who had started to do some artistic and scientific projects in Switzerland listening to the soil. So Jake and I carried out a piece of research on forest soil restoration and published our findings, this then led to interest from wine producers in France, and a Defra-funded farming innovation project in conjunction with Warwick University Crop Centre.

[RG] How do you approach this work?

[CA] The approach centres on assessing sound character and relating that to an acoustic index to establish biodiversity in soil – basically, more animals making different noises creates a varied soil soundscape that you can measure and track through the course of a day or a season.

[RG] What proportion of global biodiversity lives in the soil?

[CA] Underground biodiversity makes up around two-thirds of the overall global biodiversity, so is arguably more important than other forms of biodiversity and is incredibly important if humans want to grow and eat food. This doesn't include other valuable 'ecosystem services' such as the carbon sequestration ability, and contribution to reducing the impacts of climate change, which means it should be of paramount importance to people to ensure we are maintaining healthy soils. The prevalence of chemicals in our soils, and its adverse effect on soil ecology, has made contemporary agricultural land nothing more than hydroponic systems to hold plants roots together.

[RG] Can the soils recover?

[CA] Yes! The microorganisms, nematodes, and larger animals like worms and beetles can come back and start recovering, given the chance. So regenerative agriculture, and working with nature a bit more than we have done for the past few decades seems to be on the up — often for commercial reasons of sustainability, as much as environmental ones.

Above: Further ecoacoustic measurement

[RG] Is there scope to extend a similar approach to soil health monitoring to underwater habitats?

[CA] We've been doing acoustics work in the oceans for 50 years and we have well established methods, tools, equipment, and practices for doing that. However, the first ever paper published on pond acoustics was in 2015 showing that the amount of work covered freshwater acoustics is minimal, but there is so much more to understand about our underwater life in ponds, lakes, and rivers.

[RG] What cacophony is going on down there?

[CA] Many species of freshwater fauna make sound intentionally, stridulating like underwater crickets. For example, if you look at water boatmen under the microscope — they have a row of pegs along each of their legs and the shape and size and arrangement of these pegs identifies the species. They drag these pegs across their head, like running a stick down iron railings or a music box, and because they are all arranged in different patterns, they all produce a species-specific sound. This has been known about since the 1970s, but later research on this has been sparce until recently, when another species of water boatman only 2mm long was found to use its genitals to produce a signal at 99 dB!

[RG] It seems that acousticians and ecologists are doing the same things in slightly different ways, and for slightly different outcomes, but for fundamentally the same reasons – specifically to mitigate against human impacts for future generations. We can't, and perhaps shouldn't, necessarily prevent development altogether, and there doesn't appear to be a good reason why we cannot bring together our traditional human-centric approaches with ecology through the medium of sound. Do you have any views on how we can bring these worlds closer together?

[CA] Acousticians are becoming more aware of soundscapes beyond the dB levels, and seem to be moving away from considering just the impacts on humans.
I think there's also an increasing awareness within the conservation ecology world of the impacts of sound on wildlife, and the tools are becoming available for us to look at soundscapes more holistically. Green space provision, BNG, and issues of noise and soundscapes are tied together and perhaps there is something that could be done to really integrate better. Acousticians probably don't do the biology very well. And as biologists, ecologists don't look at noise impacts very well. There must be a way where people, and flora and fauna could be integrated better, and maybe there's some guidance that that could be produced to bring those two worlds together a bit more. For instance, the Institute of Lighting Professional has come together with the Bat Conservation Trust to develop guidance on lighting to protect bat species, so there is some precedent for similar guidance that could be developed between traditional acousticians and acoustically-minded ecologists, bringing together the best of our knowledge from both arenas.

Germany is the only country to apply absolute limits to underwater noise emissions from human activity.

10% BNG will be required by law for most developments in England from January 2024

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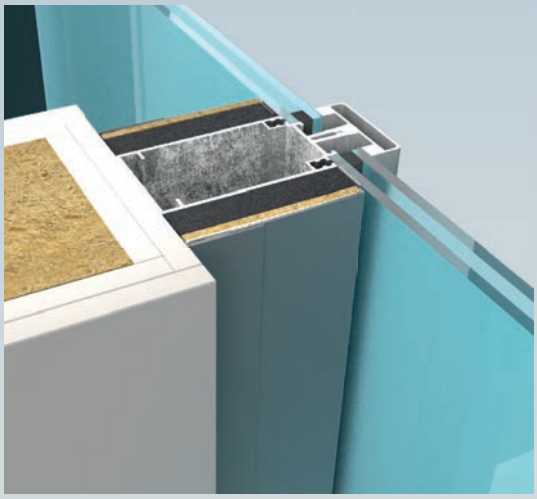

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IOA Early Careers Group news

The Early Careers Group (ECG) aims to bring together a diverse network of acoustic professionals in the early stages of their career.

By Josie Nixon, Chair of the IOA Early Careers Group

The ECG promotes and shares peer knowledge and support, and provides a link to the knowledge of established acousticians and a platform for the continuing development of new and existing skills.

As well as being a good introduction to the IOA, the ECG organises a variety of activities, such as social networking events, presentations, and webinars, so if you are under 35 or in the first five years of your career, become a member and gain access to all of our events.

Students and apprentices are welcome to join the group too and don't forget to look up the student representative group.

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**

Recent activity

Over the summer period members of the webinar group (a subsection of the ECG committee) took a break from their usual activity, but have returned this autumn to bring more webinars to the ECG members and wider IOA community. The webinars are primarily aimed at ECG members, but anyone is welcome to join these meetings.

Recently, we have had webinars on:

- the effects of construction noise and vibration on seahorses;
- noise impact assessments for quarries and mines;
- acoustics and sustainability; and
- the importance of CPD.

We have an upcoming webinar on 27 November 2023 at 13:00 on the *impact of sound from balconies within* buildings, we hope to see you all there.

If you would like to present a topic or suggest a webinar topic, please don't hesitate to get in touch with the team at **earlycareers@ioa.org.uk**

ECG representatives

We have been introducing you to our reps over the past few issues of Acoustics Bulletin and in this issue would like you to welcome **Justyna Lubas — Environmental Sound Group ECG representative**.

Justyna started working in acoustics in 2022 and at the same time joined the ESG as an ECG representative. Justyna started her most recent role as an acoustic consultant at Noise Solutions this year (2023).

Justyna studied an MSc Applied Acoustics at Solent University from 2019 to 2020 with a special interest in soundscaping and psychoacoustics.

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

She believes that joining the ESG will help her to further enhance her understanding of acoustics and provide her with the opportunity to contribute to the environmental aspect of the IOA.

ECG vacancies

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.

We also have some ECG representative positions available, if you would like to join the committee. Currently there are vacancies at:

- Continued Professional Development Group;
- Physical Acoustics Group;
- North-Western Branch; and
- Sound, Noise and Health Group;

If you'd like to join the committee, please get in touch directly with the chair of the Group/Branch, or contact us and we can put you in touch at **earlycareers@ioa.org.uk**

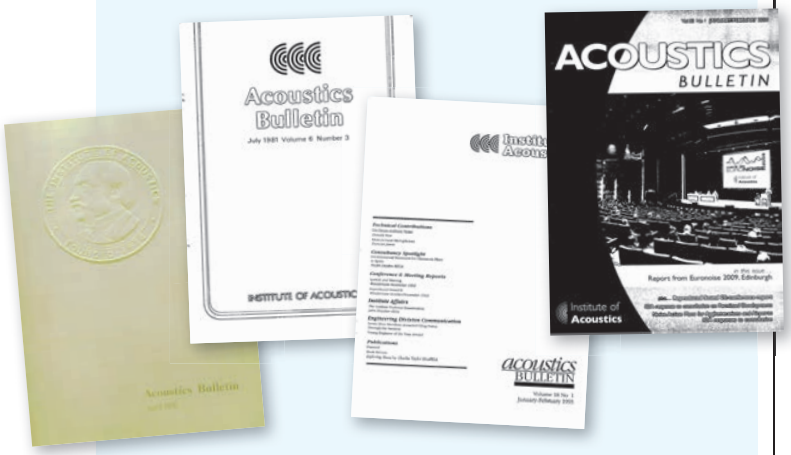
Below: Students and apprentices are welcome to join the ECG (*Image courtesy of Luis Gomez-Agustina, LSBU*)

Celebrating 50 years of the IOA

Next year, we celebrate the 50th anniversary of the Institute of Acoustics. So in each issue of Acoustics Bulletin during 2024, we will travel back in time to see where we started and how we progressed over the decades to become the highly topical, balanced, impartial, and respected institution we are proud to be part of today.

In the first issue of our 50th anniversary year, we will re-visit the 1970s, where it all began, by reproducing excerpts from IOA archives, including archived issues of Acoustics Bulletin and contributions from IOA Specialist Groups and Branches.

For some members it will bring back memories, for others it will be a history lesson almost, but for all of us, it will start to show how the disciplines of acoustics, noise, sound and vibration increasingly influence other industries such as construction, medicine, research, entertainment, and environmental sustainability etc and, we hope, will continue to do so for at least the next 50 years.



If you have any IOA memories or photos you'd like to share in future 2024 issues, contact the editor, Nicky Rogers at nickyr@warnersgroup.co.uk

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.

In recent weeks IOA PLG members have responded to consultations on extending permitted development to support housing in England, and the roll out of smaller renewables in Scotland, continuing to advocate for the consideration of noise impacts early in the planning process. Demonstrating that working to promote acoustic concerns is being heard – the Welsh Government have accepted a number of IOA recommendations on soundscapes.

England: Permitted development to promote housing

The Department for Levelling up and Communities consulted on extending a range of changes to permitted development rights to allow for the change of use of a range of premises types to homes in England. Measures proposed include doubling the amount of floorspace of high street premises like shops, restaurants and offices permitted to change to flats or houses, subject to prior approval planning conditions including noise, and expanding the right to convert high street businesses to dwellings in protected areas.

The IOA has stated for many years that any permitted development that can affect or be affected by the sound environment is not a good idea, as it can lead to poor or ineffective noise management. In responding to the consultation, the Institute stated that while we recognise the need for more dwellings, we cannot support the proposed permitted development policies unless the potential noise impact from all sources is covered by the prior approval process.

Allowing the conversion of existing spaces like betting shops, amusement arcades, hotels etc to dwellings can lead to the exposure of residents of those new homes to noise. We added that noise complaints can lead to costly investigation and remediation, which could be prevented by assessment of the potential noise impacts prior to changing use.

The maintenance of the prior approval process relating to noise from commercial premises as part of the permitted development rights for new dwellings is welcomed. However, non-commercial sources such as transport noise continue to be overlooked. High streets and tourist thoroughfares can be busy with vehicles and people – all generating noise. Permitted development without proper consideration of these sources could result in poor quality homes

and adversely affect the health and quality of life of new residents.

See the consultation and response: **https://www.ioa.org.uk/publications/response-consultations**

England: Reforming major infrastructure planning

The Nationally Significant Infrastructure Projects Action Plan (NSIP), published in February 2023, committed the government to reforms to ensure the existing planning system can support our future infrastructure needs. They say proposed changes will make the NSIP process 'better, faster, greener, fairer and more resilient by 2025'. To date, projects coming under this system include:

- Hinkley Point C nuclear power station;
- the Thames Tideway Tunnel (upgrading London's sewer system); and
- 18 offshore windfarms.

Changes proposed in a consultation over the summer are intended to 'make the system work more effectively for applicants, local authorities and communities'. The proposals include: strengthening the role of pre-application; establishing a fast-track route to consent; streamlining the process for post consent changes to a development consent order; and ensuring the system is adequately resourced, strengthening performance of government's expert bodies, improving engagement with local authorities and communities, building the skills needed to support infrastructure delivery and updating national infrastructure planning guidance. See the consultation here: **https://tinyurl.com/nsip2023**

Scotland: Permitted development for renewables

The IOA Scottish Branch commented on the Scottish Government Review of Permitted Development Rights (PDR) – Phase 3, covering renewable energy technologies. For air source heat pumps, the Branch strongly recommended that the Scottish Government does not pursue minimum set back distances from other dwellings or physical size restrictions as a means of mitigating noise impact, as significant adverse impacts cannot be avoided through these limitations alone. The Branch also disagreed with the proposal for PDR for free-standing domestic wind turbines, as proposed amendments on height and standoff distance are based on aesthetics, not potential noise impact on neighbouring properties. PDR for domestic wind turbines attached to a dwelling could also lead to noise issues. The Branch also objected to a proposal for PDR for solar on some non-domestic buildings, as ancillary infrastructure, such as inverters and transformers can cause noise issues if design and layout are not properly considered.

See the consultation and response: **https://www.ioa.org.uk/publications/response-consultations**

Wales: new noise maps

New road traffic and railway noise maps for Wales have been published. For the first time the maps cover all roads and railways and indicate average sound levels over day/evening and night time. The mapping was undertaken in 2022. It is not comparable to any noise maps generated previously, as it uses new noise mapping methods introduced and transposed into UK law prior to leaving the European Union.

View the Wales noise maps: **https://tinyurl.com/ENMWales**

Wales accept IOA advice on soundscapes

In responding to the soundscape recommendations of the Environment (Air Quality and Soundscapes) (Wales) Bill, the Welsh Government accepted a number of recommendations in evidence given by the IOA to the Climate Change, Environment and Infrastructure Committee. These included:

- confirming the Welsh Government can commit to actively involving key stakeholders in the preparation and review of the National Soundscapes Strategy;
- agreeing that expert advice on soundscapes should be sought; and that
- a definition of soundscape is required, and should be in the Explanatory Memorandum rather than on the face of the Bill to allow flexibility.

See the full report: **https://tinyurl.com/IOA-CCEIC** (soundscape recommendations at 32-35)

Report recommends low noise hand dryers

Research commissioned to support a government technical consultation on toilet provision in England, found that noise from automatic hand dryers was reported to be distressing to the neurodiverse and those with learning disabilities, and potentially distressing to children. Given hand dryers can be accidentally set off, especially where a carer is assisting in a cubicle, the preference was for button operated hand dryers to avoid them being set off accidentally. The report recommends that where new hand dryers are installed, the noise level is low.

See the consultation and report: **https://tinyurl.com/toiletdesign**

Noise cameras included in plan for drivers

The Government plan launched in September to support drivers includes backing the roll out of noise cameras. The plan acknowledges that noise from traffic is a health risk, saying: '*The World Health Organization recognises environmental noise as one of the top environmental health risks in Europe.*' It states that government will '*Issue guidance to local authorities setting out minimum requirements and best practice for the use of noise cameras, sharing the findings of recent trials of this equipment.*' In answer to a parliamentary question in late September, Transport Secretary Richard Holden said: "The Department is awaiting a final report of the trial outcomes before considering next steps.", and at time of writing we await the outcome of the trial.

See the plan for drivers: **https://tinyurl.com/planfordrivers**

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

Onshore wind turbine noise:

A review of the current guidance framework for the UK Government

(Part 2: Conclusions and recommendations)

This article is based on content from the project report *A review of noise guidance for onshore wind turbines*, which presented the results of a research study commissioned by the UK Government Department for Business, Energy & Industrial Strategy (BEIS[1]) and published in February 2023 (**https://www.wsp.com/en-gb/insights/wind-turbine-noise-report**).

By Mike Lotinga, Toby Lewis and Jim Powlson, all WSP, and Bernard Berry, UK-based independent expert

An introductory overview of the project can be found in Part 1 of this series that was published in the September/ October 2023 issue of Acoustics Bulletin. In this part a summary is provided of the project conclusions and recommendations[2].

In 2011, a government-commissioned report was published that analysed the noise assessment reports supporting 46 UK wind energy development applications[3]. The outcome of the analysis was a set of recommendations aimed at improving the consistency and quality of assessments undertaken using the ETSU-R-97 methodology. Many of these recommendations were subsequently addressed in the IOA Good Practice Guide (GPG[4]).

This latest 2023-published review represents the first government-sponsored study of the guidance framework itself, since its original publication.

The study covered three workstreams, comprising an evidence review, stakeholder engagement, and a field measurement exercise. The methodology applied in each of these workstreams was outlined in Part 1 of this series. In Part 2, the study findings, conclusions and recommendations are summarised. Extensive referencing of the research evidence supporting the study findings is provided in the project report.

This article is written with the assumption that the reader has a good familiarity with the current UK guidance framework for wind turbine noise assessment. P28

1 In February 2023, BEIS was split into three government departments **https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about**

2 The views expressed in this article do not necessarily represent the views of the UK Government, or the national governments of any of the UK devolved administrations.

3 Hayes McKenzie Partnership, 2011. Analysis of how noise impacts are considered in the determination of wind farm planning applications. HM:2293/R1. Department of Energy & Climate Change. [URL] (Link to: **https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48116/2033-how-noise-impacts-are-considered.pdf**)

4 IOA, 2013. A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise. Institute of Acoustics. [URL] (Link to **https://www.ioa.org.uk/publications/wind-turbine-noise**)

IOA Publications Committee seeks new members

This very active and important committee meets quarterly (online) to oversee every publication produced by the IOA, including:

- Acoustics Bulletin
- Proceedings
- IOA website
- Newsletters
- Blogs
- Social media activity
- Special supplements

We are looking for new volunteer members who would like to find out more about how these IOA publications are produced, and it is an exciting opportunity help steer the content of communications as the IOA enters its sixth decade.

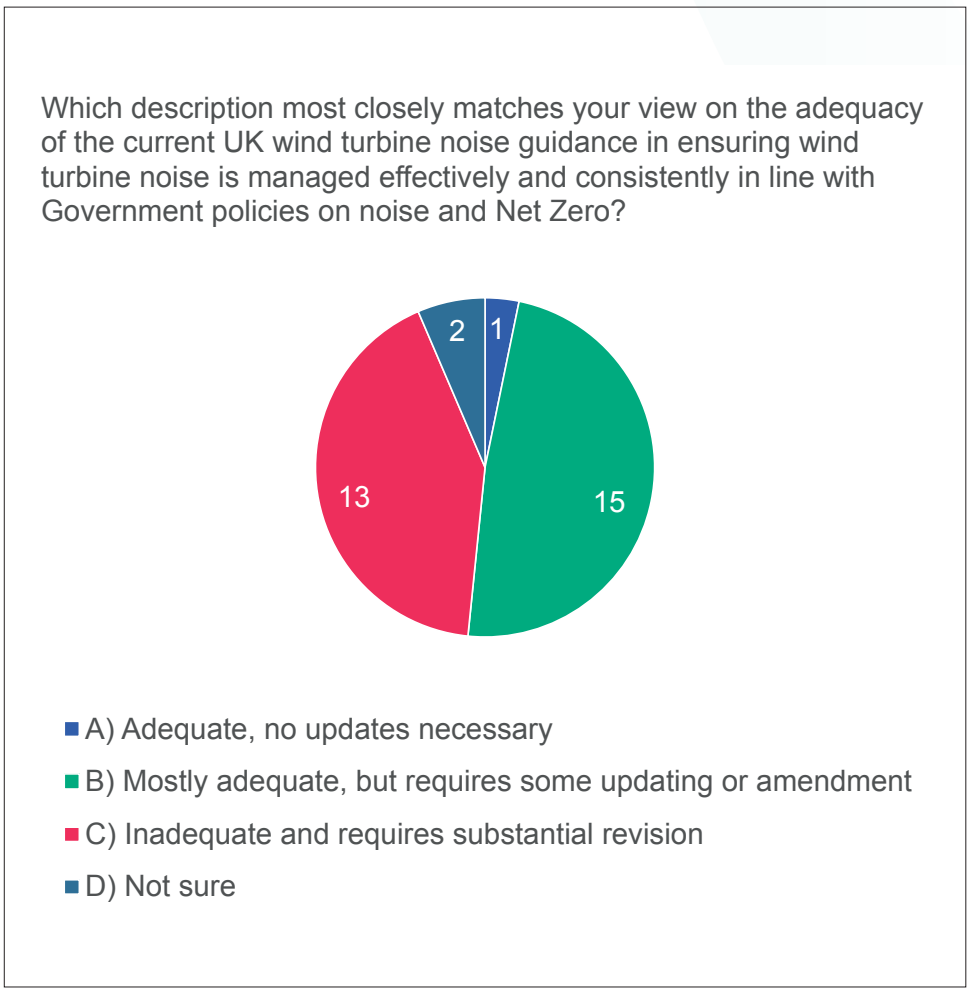
If you'd like to join this friendly and welcoming committee, contact Daniel Goodhand, IOA Publications Committee Chair at daniel@goodhandacoustics.co.uk

Summary of conclusions

The research evidence reviewed in the study, combined with the response analysis from the stakeholder engagement, both indicate that the guidance would benefit from further review and updating. Views from stakeholders on the extent of the updates required varied, with roughly half whose view was that the guidance requires some updating or amendment, and almost the same proportion whose view was that it requires substantial revision (Figure 1). Between these two viewpoints, there was consistency on the aspects of the guidance that the engagement respondents felt should be updated. Those aspects were also consistent with the findings of the evidence review, which identified a substantial body of evidence published since both ETSU-R-97 and the IOA GPG that could inform updates of the areas in question.

The study has identified two primary areas that the evidence review and stakeholder engagement highlighted for further review and updates, outlined in turn below.

Below:
Figure 1: Stakeholder views on need for updates to current guidance



Noise limits

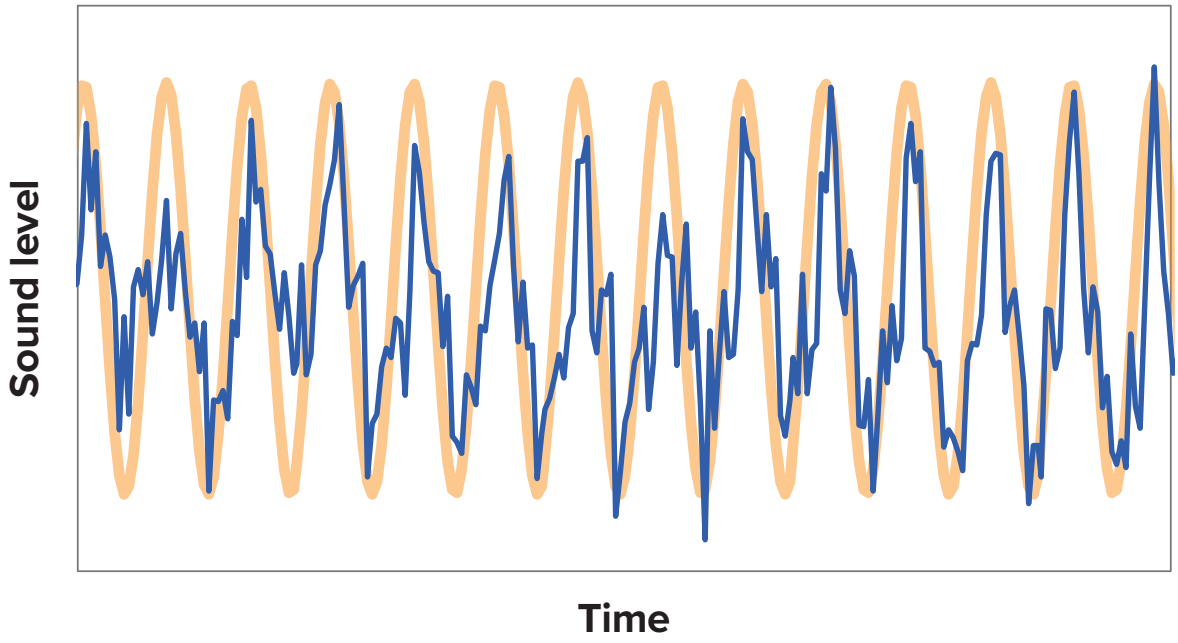
The research indicated that the underlying basis for the ETSU-R-97 limiting values has become outdated. Alongside developments in relevant guidance, there is now a volume of scientific research evidence on the effects of exposure to wind turbine sound, which was unavailable at the time of ETSU-R-97. Much of the recent research was not available when the WHO undertook systematic reviews to support the development of the 2018 Environmental Noise Guidelines for the European Region (ENGER). The conditional recommendation made therein is therefore not considered to be useful as a benchmark. The latest research should be subject to a new systematic review and meta-analysis, addressing evidence on noise annoyance and sleep disturbance, which could then be used to support the development of an up-to-date framework of evidence-based effects thresholds. However, the research has also identified a lack of evidence covering UK rural communities exposed to wind turbine sound. Studies show that local differences are expected to influence responses to environmental noise, and therefore it is recommended that new evidence be obtained from observational research undertaken in the UK that includes rural communities.

The study also indicates that the common application of the ETSU-R-97 noise limits as a binary test of acceptability (i.e., a 'pass/fail' outcome, which is presented in the IOA GPG as a 'loop' in the assessment flow diagram, with a 'fail' indicating further mitigation is needed) is potentially inconsistent with the wider policy frameworks in England and Northern Ireland. In both these devolved administrations, the corresponding national 'noise policy statements' require noise impacts to be addressed in a more nuanced way, with reference to expected effects and thresholds. The policies also require the application of 'guiding principles on sustainable development' in taking decisions, indicating that impacts need to be balanced and weighed within a holistic view of development sustainability. These considerations would now also include the UK Government commitment to achieving Net Zero[5] by 2050.

The research also identified that the use of the '90% exceeded'[6] sound level index (L_{AF90}) for controlling wind turbine sound immissions has been questioned, and was highlighted as a concern in the stakeholder engagement. The motivation for use of L_{AF90} in ETSU-R-97 controls is prompted by the challenges of measuring wind turbine sound using the time-average sound level *(LAeq)*. This is due to the typically low wind turbine sound levels involved, and the consequent influence of fluctuations in the residual sound environment, to which the L_{Aeq} is much more sensitive than the L_{AF90}. An assumption is adopted

5 The UK Government has committed to reduce greenhouse gas emissions to a legally binding target of 'net zero' by 2050. (**https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law**)

6 That is, the 10th percentile of the cumulative distribution of the sound pressure levels within a given period.



Left:
Figure 2: Example of amplitude modulation (AM) in wind turbine sound (blue line), highlighted by underlying sinusoidal function (yellow)

in ETSU-R-97 (based on field measurements) of an approximately constant relationship of ~2 dB between L_{Aeq} and L_{AF90}, for the purpose of defining noise limits over 10-minute periods. In ETSU-R-97, this assumption supports an implicit 'proxy metric' approach, in which the values for limits in terms of L_{AF90} are developed from considerations of evidence based on L_{Aeq}. Arguments against the ETSU-R-97 assumption identified in the study include:

- (i) in the presence of AM, this relationship could be expected to vary by more than the assumed constant value; and
- (ii) there is little or no epidemiological evidence to support the setting of limits using L_{AF90}.

The study considered relevant evidence and views, and recommended that future guidance should explicitly adopt the L_{Aeq} index for the setting of controlling values for wind turbine sound. In conjunction, it was also recommended that a further study be undertaken to identify the most effective proxy index that could be used to estimate L_{Aeq} from measurements, while addressing the issues identified. This type of explicit proxy approach has been adopted in overseas territories, notably including Japan[7], whose government funded a wide-ranging primary research study into wind turbine sound in the period 2010-13 (with publications emerging 2013-18).

Control of amplitude modulation

The research suggests that the current guidance does not fully address the potential impact of amplitude modulation (AM) in wind turbine sound. The evidence identified in the study indicates that the assumptions about AM adopted in ETSU-R-97 do not fully represent the nature of AM as experienced and measured (see Figure 2). The presence of AM in wind turbine sound, when noticeable, can increase negative responses, and some studies indicate this is the most annoying acoustic feature of wind turbine noise. Furthermore, the evidence demonstrating that AM tends to increase during the evening and night-time hours (which had been highlighted in the 2016 AM review) is now stronger. This effect is due to the changes in complex atmospheric conditions, as well as typically quieter ambient sound environments.

The study identified research evidence that could be used to develop guidance on controlling AM impacts, and stakeholder views indicated that official guidance on this issue would be welcomed. It is recommended that a further study be undertaken to confirm the most appropriate approach, and to develop practical guidance on application.

Responses to research questions

The overarching policy objective of the study was augmented by several specific research questions posed by BEIS.

A few highlights from the key findings of the study in response to each of these research questions are summarised below (more expansive responses are found in the project report).

Do current acoustic measurement methods differ from ETSU-R-97?

The research shows that several methods have been developed to detect and quantify the magnitude of AM in wind turbine sound. Of those identified in the study, the IOA Reference Method is believed to offer the best balance between robustness and practicality for use in the field.

It was highlighted during the stakeholder engagement that there are now several standardised methodologies available for evaluating tonality characteristics in sound immissions, which indicates that a review of these methods in comparison with the ETSU-R-97 approach should be undertaken. P30

7 Shimada, A & Nameki, M, 2017. Evaluation of wind turbine noise in Japan. ICBEN 2017, 18-22 June, Zurich. International Commission on Biological Effects of Noise. [URL] (Link to: **http://www.icben.org/2017/ICBEN%202017%20Papers/SubjectArea10_Shimada_1006_3584.pdf**)

Do modern onshore wind turbines emit different sound characteristics that ETSU-R-97 does not currently account for?

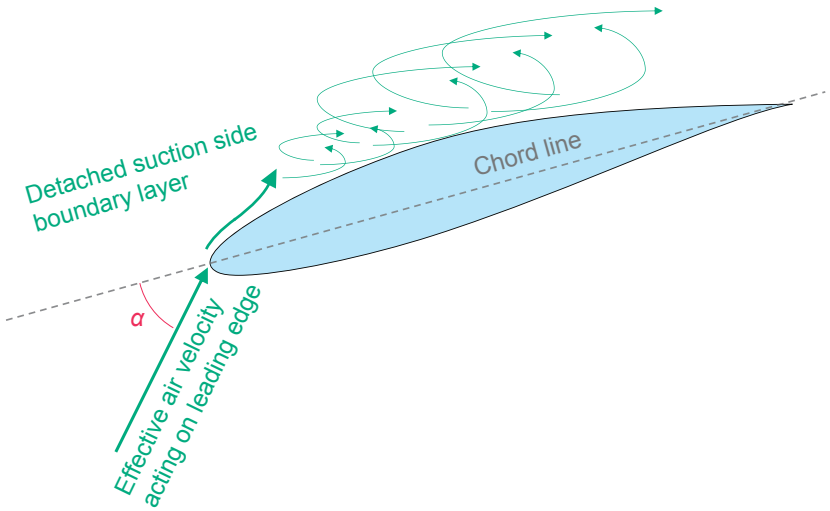
It was suggested in the stakeholder engagement that developments in turbine operational systems have influenced the sound immission profile of modern turbines. Sound power levels of fixed/dual-speed, stall regulated turbines (more common at the time of ETSU-R-97) tend to increase steadily with wind speed, and continue to rise at rated power. This is because blade stall (which increases sound immissions) is used to regulate the turbine lift force at high wind speeds, to prevent damage. By contrast, the variable speed, pitch regulated turbines now ubiquitous in onshore wind developments 'cut-in' with a relatively low sound level, which rises rapidly with wind speed, and then 'plateaus' around rated power for the turbine.

Stakeholders also noted the increasing size of onshore turbines compared with those that were common when ETSU-R-97 was published. There has been a popular notion that larger turbines inherently emit sound with a lower frequency character. However, research evidence on this appears to be conflicting. A study undertaken for the Danish government produced opposing conclusions from two of the project partners, based on analysis of the same measurement dataset. One found[8] that increasing turbine size and power ratings was associated with a systematic increase in the proportion of low frequency sound immissions; the other reached the opposite conclusion[9]. Further analysis was later undertaken on an expanded set of the data, which did not find evidence to support the suggestion that larger modern turbines emit increased lower frequency sound[10,11].

Larger turbine rotors have potential implications for AM characteristics at receptors, although a systematic investigation of the influence of turbine size on these issues was not identified (and so conclusive findings on this aspect cannot be reached):

- variation in the wind speed profile across the rotor span could be increased, and this variation may contribute to momentary blade 'stall', a mechanism that has been associated with increased AM occurrences, and
- another physical phenomenon influenced by rotor size that may contribute to AM is 'partial refractive shading'. This is due to the differences in the sound propagation path conditions for different sectors of the rotor span, which could lead to 'hot' (acoustic illumination) and 'cool' (shadowing) spots occurring during the passage of a blade rotation.

Below:
Figure 3: Turbine blade stall mechanism diagram (blade in cross-section, angle of attack indicated as α)



Do changes in the way modern turbines are sited result in different cumulative impacts?

Responses to the stakeholder engagement suggested that the increased density of wind energy developments may result in more prolonged impacts at properties, in situations where wind turbine sound could be incident from several directions.

Theoretical research evidence has suggested that wind turbine wakes, especially in stable atmospheric conditions, could enhance wind turbine sound propagation and the potential for AM. This indicates that turbine layouts may have some influence on sound immissions and character that may not yet be fully understood.

Do modern onshore wind turbines produce 'excessive' AM, to what extent, and to what effect?

The AM characteristic of wind turbine sound known as 'blade swish' is primarily connected with the directivity of the turbine blade trailing edge, combined with the intrinsic convective amplification associated with a moving sound source. This form of AM is referred to in the study as 'TEDCAR-AM' (trailing edge directivity and convective amplification-related AM). TEDCAR-AM is fairly well understood, and is most prominent at close ranges crosswind of turbines. TEDCAR-AM is described in ETSU-R-97, which states that the noise limits derived include for any additional impact due to 'blade swish'.

Another form of AM is also associated with wind turbine sound, which is not primarily caused by the effects of trailing edge directivity and convective amplification. This form of 'non-TEDCAR-AM' has a lower frequency sound character, and can be present at longer ranges and over different directions from turbines compared with 'blade swish'. Non-TEDCAR-AM has also been linked with reported noise disturbances, and is sometimes described as 'whoomphing'. Mechanisms and factors that may contribute to non-TEDCAR-AM are varying and complex, but the research indicates these include: P32

8 Møller, H & Pedersen, CS, 2011. Low-frequency noise from large wind turbines. Journal of the Acoustical Society of America, 129 (6), 3727-3744. [URL] (Link to: **https://doi.org/10.1121/1.3543957**

9 Madsen, KD & Pedersen, TH, 2010. EFP-06 project: Low frequency noise from large wind turbines. Final report. AV 1272/10. Danish Energy Authority.

10 Søndergaard, B, 2014. Noise and low frequency noise from wind turbines. Inter-noise 2014, 16-19 November, Melbourne. I-INCE [URL] (Link to: **https://www.ingentaconnect.com/content/ince/incecp/2014/00000249/00000001/art00078**)

11 Søndergaard, B, 2015. Low frequency noise from wind turbines: do the Danish regulations have any impact? An analysis of noise measurements. International Journal of Aeroacoustics, 14 (5-6), 909-915. [URL] (Link to: **https://doi.org/10.1260/1475-472X.14.5-6.909**)

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- transient blade stall generating additional turbulence during the blade rotation, which is linked with the blade angle of attack (see Figure 3) and may be affected by flow variation across the rotor span, which is linked with wind shear, wind veer, or 'low level jets' associated with atmospheric conditions, and with topography;
- inflow turbulence variation;
- (as noted above) complex turbine wake effects; and
- (also noted above) 'partial refractive shading' of the rotor disc.

Research indicates that the occurrence of non-TEDCAR-AM is likely to be more prevalent at night than during the day, which is thought to be due to the respective atmospheric conditions prevailing at these times, as well as typical ambient sound diurnal cycles.

The field measurement exercise undertaken as part of the study showed detectable AM at distances and in wind directions that would not be considered as consistent with the more predictable TEDCAR-AM. This tentatively indicates that detectable non-TEDCAR-AM is probably not an unusual occurrence at the measurement sites, although a larger dataset would be needed to draw generalised conclusions about prevalence. Comparison of the project field data with a much larger dataset obtained during the Japan research study[12] indicated a similar pattern of AM depth magnitudes, exhibiting a low-skewed distribution peaking at around 3 dB $\Delta L'_{Aeq,100ms(BPmax)}$ (for metric notation explanation, see Lotinga et al, 2021[13]), as shown in Figure 4.

Evidence from the research identified during the study indicates that audible AM increases the distinctiveness of wind turbine sound and can aggravate noise annoyance responses. The potential impact of AM is influenced by the modulation depth, as well as by its modulation frequency, although the research indicates that the effects are secondary compared with the overall (time-averaged) sound level.

The need for official guidance on the control of AM in wind turbine sound was the single most commonly raised theme in the engagement responses to the question asking stakeholders to suggest what updates to the current guidance may be required.

Measurement and control schemes intended to quantify AM and characterise the additional annoyance expected have been devised. The IOA Reference Method for AM measurement[14] has been shown to be a robust and practical approach to quantifying AM within large field measurement datasets, although other methods have since been devised, and metric development will probably remain an active field of research – in particular, machine learning approaches may offer more reliable detection rates[15]. Recent work on AM response has focused on revisiting existing experimental exposure-response results using the IOA metric to provide a common platform from which to make direct comparisons and to combine different studies[13].

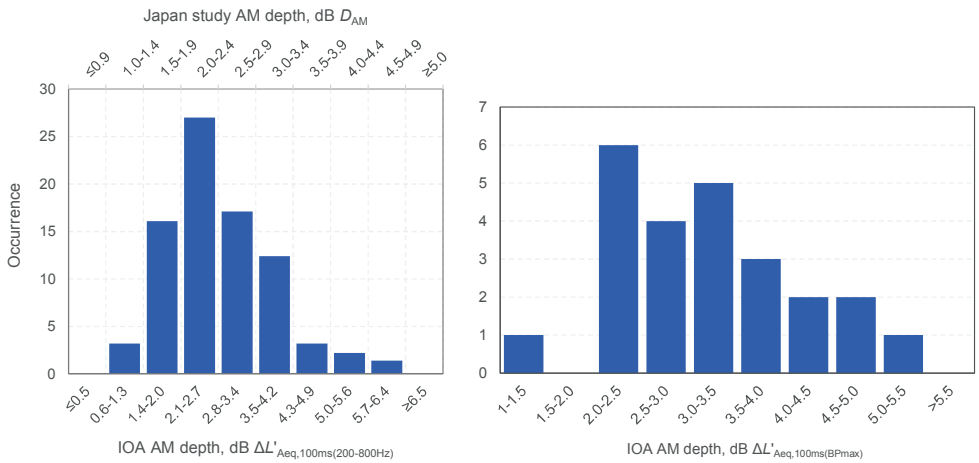
Do international comparisons suggest the ETSU-R-97 guidance is out of date?

The research suggests that the most apparent difference between ETSU-R-97 and overseas national or regional guidance and regulations is that the ETSU-R-97 'night-time minimum noise limit' (the fixed value part of the limit) is less stringent than the daytime. This situation appears to be unique to the UK and Ireland among the territories considered.

The research also suggests that the ETSU-R-97 daytime minimum noise limits appear to be comparable with those imposed in overseas territories.

Comparison of the relative 'margin above background sound level' limits (based on the BS 4142 method) indicates that this part of the ETSU-R-97 approach is also taken in New Zealand, Ireland, and the Australian states of South Australia and Victoria. Japan, and the states of New South Wales and Queensland impose a more stringent relative limit, which appears to be connected with the use of L_{Aeq} to control wind turbine sound immissions instead of L_{AF90}. France and Italy also impose forms of relative limit based on 'sound emergence' (see ISO 1996-1:2016 for definition), which is not directly comparable with the ETSU-R-97 'margin above background sound level' approach. There appears to be very little (if any) scientific evidence supporting either of these forms of relative impact control. Therefore, it was recommended that a study be undertaken to determine the relevance and effectiveness of the BS 4142-style of relative P34

Below:
Figure 4: Comparison of measured AM depth distributions; (a, left) data taken from Japan study taken at 81 locations around 18 wind farm sites in Japan; (b, right) project data taken at seven UK wind farm sites

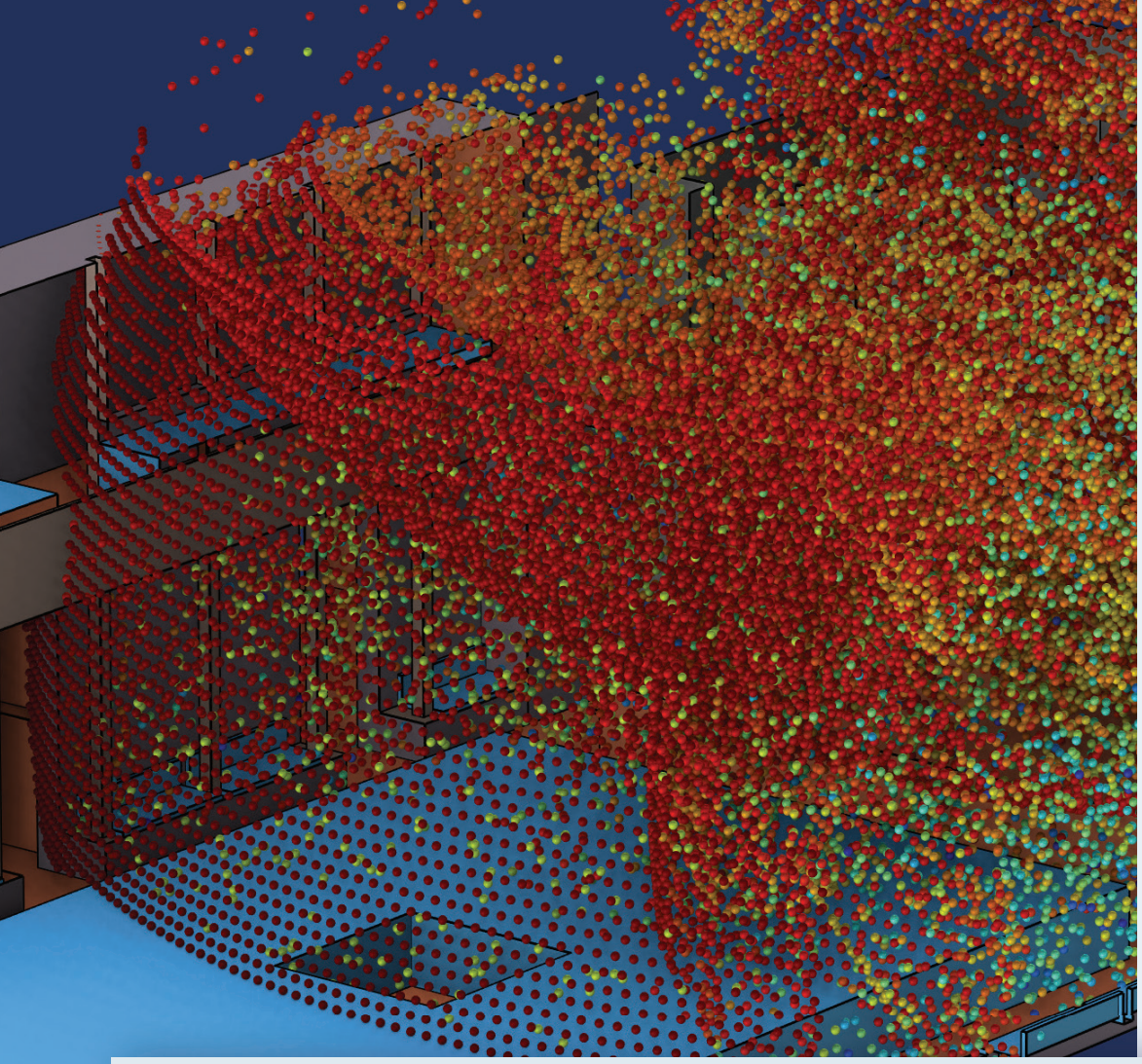


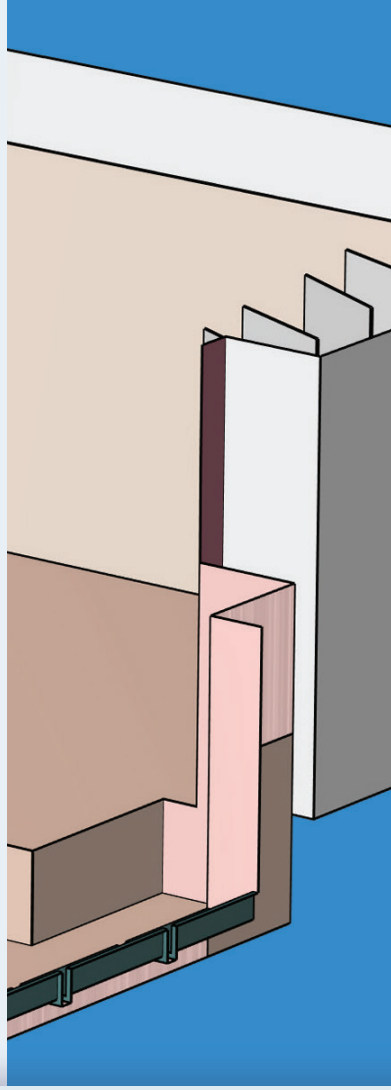
12 Tachibana, H, Yano, H, Fukushima, A & Sueoka, S, 2014. Nationwide field measurements of wind turbine noise in Japan. Noise Control Engineering Journal, 62 (2), 90-101. [URL] (Link to: **https://doi.org/10.3397/1/376209**)

13 Lotinga, M, & Lewis, T, 2021. Subjective responses to wind turbine noise amplitude modulation: Pooled analysis of laboratory listening studies and synthesis of an AM character rating penalty. Wind Turbine Noise 2021, 18-21 May, Remote from Europe. INCE-Europe. [URL] (**Link to: https://www.researchgate.net/publication/351303327**

14 IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group, 2016. Final report: A method for rating amplitude modulation in wind turbine noise. [URL] (Link to: **https://www.ioa.org.uk/sites/default/files/AMWG%20Final%20Report-09-08-2016_0.pdf**)

15 Nguyen, PD, Hansen, KL, Lechat, B, Zajamsek, B, Hansen, C & Catcheside, P, 2022. Beyond traditional wind farm noise characterisation using transfer learning. JASA Express Letters, 2 (5), 052801. [URL] (Link to: **https://doi.org/10.1121/10.0010494**)





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impact control in wind turbine noise assessment.

National and regional guidelines are frequently updated, and a more detailed review could be valuable. However, vigilance should always be exercised in considering guidance and regulations; the underlying scientific evidence and any professional judgements applied should be identified and considered, and, if evidence or judgements are not clear, the information should be treated with caution.

The study also considered the relevance of WHO guidelines (past and present) to the current wind turbine noise limits. It was noted that past guidelines have been based on evidence for sound sources that are dissimilar to wind turbines. It has increasingly been recognised that different sound sources impart varying effects on people, which undermines the application of such evidence to wind turbine sound. The 2018 WHO ENGER directly addressed wind turbine noise effects, but in doing so used an approach that directly compared exposure-response relationships from research employing differing methods, which the study shows could be misleading.

A recent comparison of wind turbine sound exposure-response relationships (ERRs) attempted to synthesise a general curve from data obtained across several countries and regions[16]. To do this it was necessary to 'reverse-engineer' the published data to a common sound level index, which required several assumptions. The present study identified that – similar to the WHO ENGER – the assumptions applied overlooked distinguishing details in the original methodologies, which challenge the approach applied. As shown in Figure 5, the adoption of alternative assumptions, aimed at (as far as feasible) normalising the exposure estimation to an equivalent basis[17], produces estimates that are significantly higher than the original synthesised curve. This exercise further underlines the uncertainties involved in converting sound level indices from studies employing varying assumptions.

A further suggestion made by Davy et al[16] was for a noise limit to be based on the level corresponding with 10% highly annoyed (%HA, according to the ERR). A more nuanced general approach proposed by researchers in Switzerland[18] involves considering the relative 'disability weight' (DW) values assigned to various adverse effects in determining an appropriate 'acceptable risk' – effects with high DWs (such as heart disease) being assigned smaller acceptable risks than effects with low DWs (such as annoyance). In the analysis of Brink et al[18], the maximum acceptable %HA risk was assigned 25%, based on the WHO DW of 0.02, (by comparison, the acceptable risk for %highly sleep disturbed was assigned 15% for a DW of 0.07). Considering the relevant Swiss legislation (as outlined in the original paper[18]), this approach could be considered as broadly analogous with determining a Significant Observed Adverse Effect Level (SOAEL, as defined in the England and Northern Ireland Noise Policy Statements).

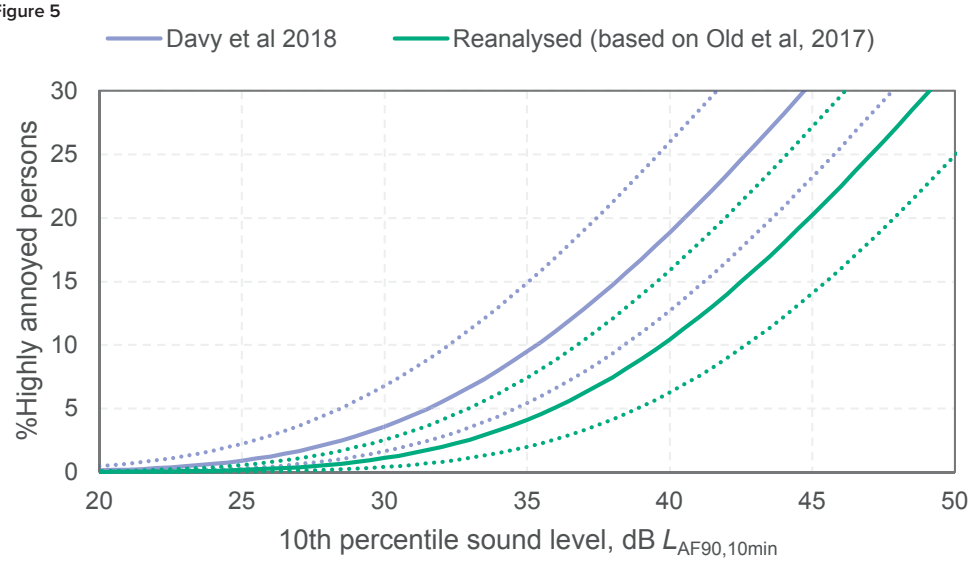
Defining a LOAEL for noise can also be a challenge. Considering the lowest level of wind turbine sound exposure that currently implies assessment action (though not necessarily mitigation) in the UK guidance framework, 35 dB $L_{AF90,10min}$, the reanalysis in Figure 5 suggests this may correspond with a response typically expected to be in the range of ~2-7 %HA. As discussed in the review report, there are differing perspectives on the representation required for an effect to be considered an 'observed effect', and the subjectiveness of noise annoyance means responses are often widely dispersed – even at very low exposure levels, some proportion of a population will remain 'annoyed' (or even 'highly annoyed'). As such, investigating the importance of personal and contextual factors in influencing overall responses is an increasingly active research area – the project report outlines which of these factors have so far been highlighted in research as influential.

Infrasound

Wind turbine infrasound has arguably become one of the most controversial topics in environmental acoustics in recent times[19]. One view, supported by anecdotal reports from some wind farm neighbours, is that wind turbine infrasound exposure, even while imperceptible, causes adverse physiological and psychological effects in humans. The opposing P36

Below: Figure 5: Community Tolerance Level model-based exposure-response curves combined from various studies, as proposed by Davy et al (2018)[16], and as reanalysed by using assumptions based on normalising exposure estimations (using reference data from Old et al, 2017)[17]; solid lines: mean CTL curves; dotted lines: mean CTL curves +/-1 standard deviation

Figure 5



16 Davy, JL, Burgemeister, K & Hillman, D, 2018. Wind turbine sound limits: current status and recommendations based on mitigating noise annoyance. Applied Acoustics, 140 (2018), 288-295. [URL] (Link to: **https://doi.org/10.1016/j.apacoust.2018.06.009**)

17 Old, I & Kaliski, K, 2017. Wind turbine noise dose response – comparison of recent studies. Wind Turbine Noise 2017, 2-5 May, Rotterdam. INCE-Europe.

18 Brink, M, Boegli, H, Walker, U, Artho, J, Wunderli, J-M, Röösli, M & Thomann, G, 2020. Revision of Swiss noise exposure limits in the wake of the WHO environmental noise guidelines: Methodology matters. Inter-noise 2020, 23-26 August, Seoul. I-INCE [URL] (Link to: **https://www.ingentaconnect.com/content/ince/incecp/2020/00000261/00000004/art00071**)

19 Bowdler, D, 2018. Health effects of wind turbine noise – more divided than ever? Acoustics Australia, 46 (1), 17-20. [URL] (Link to **https://doi.org/10.1007/s40857-018-0132-0**)

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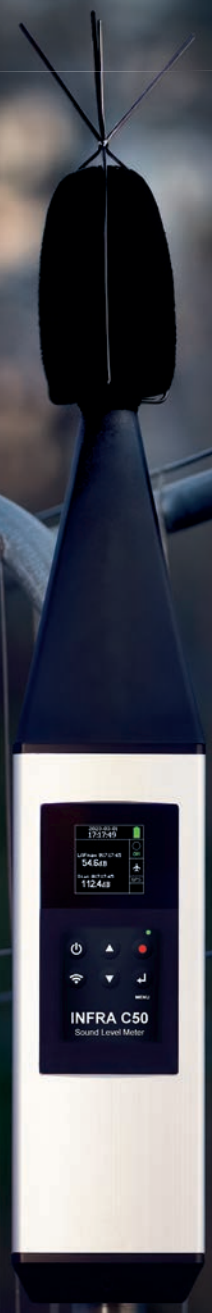

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view is that wind turbine infrasound is at levels well below perception thresholds at normal receptor range and (similar with other common sources of environmental infrasound) is unlikely to cause any adverse effects.

The WHO 2018 ENGER considered wind turbine infrasound, noting that few studies of the potential effects were then available. The systematic reviews on which the ENGER were based considered evidence only up to 2015; a considerable amount of further evidence has since been published.

In 2017, ANSES (the French Government Agency for Food, Environmental and Occupational Health & Safety) published (see Part 1 of this article series) results from its research study into wind turbine infrasound, which included infrasound measurements at three wind farms. It concluded that there was no evidence to support a connection between wind turbine infrasound and health effects, although it also noted a relatively small number of available studies, and recommended further research be undertaken[20].

As part of the evidence review for the present study, the latest available research was considered, including on the topic of infrasound. The evidence review strategy (described in Part 1 of this article series) meant that the eligible evidence was primarily gained from studies published in reputable, peer-reviewed journals.

While some experimental studies have linked infrasonic signals with activation of physiological sensory processing[21,22], these have tended to be based on signals that are not representative of wind turbine infrasound. Any observed sensory activation has not been reliably linked with any physiological or psychological effects on individuals, and has typically been observed during exposures higher than expected for wind turbine infrasound incident at dwellings. On the other hand, it has been demonstrated in controlled experiments[23,24,25,26] including the involvement of participants self-reporting to be sensitive to wind turbine infrasound, that exposure to infrasound at levels representative of wind turbine immissions at dwellings is not associated with physiological or psychological health effects. While biologically plausible pathways for infrasound activation of the auditory or vestibular systems cannot yet be definitively ruled out, the infrasound immissions from wind turbines at ranges relevant to neighbouring dwellings are typically too low to expect any adverse effects, even for people with heightened sensitivity due to medical conditions[27]. Moreover, the expectation of adverse effects from being exposed to wind turbine infrasound, and positive or negative messages influencing that expectation, has been shown to have a significant effect on health symptom reporting[23,28], irrespective of actual exposure to infrasound. These results support the nocebo hypothesis, which is (perhaps understandably) deeply unpopular among wind turbine objector groups, or residents complaining of adverse effects. Yet it is nonetheless a recognised phenomenon in medicine,[29] predisposition to which may be linked with personality traits or emotional states, such as worry or anxiety.[30] The nocebo hypothesis suggests that (real) health symptoms could appear due to anxiety or stress associated with the expectation that an individual may have about the risk to their health from exposure to wind turbine infrasound, which in turn could be elevated by attention paid to confirmational media and information. In considering this hypothesis, it is important to recognise that the symptoms themselves are not imagined or fabricated, but may actually manifest psysiologically, in relation to an individual's expectations and psychological outlook. A further risk that may arise if this hypothesis is correct, is that treatment for the symptoms may not be sought or effective, while the cause is believed by the sufferer to be ongoing exposure to imperceptible wind turbine infrasound.

In the stakeholder engagement, it was suggested that a clear guiding statement on the relevance of infrasound to wind turbine noise assessments could be helpful for assessors and decision takers to understand the appropriate P38

20 ANSES, 2017. Opinion of the French Agency for Food, Environmental and Occupational Health & Safety regarding the expert appraisal on the "Assessment of the health effects of low-frequency sounds and infrasounds from wind farms". Request No 2013-SA-0115 on Wind turbines [URL] (Link to: **https://www.anses.fr/en/system/files/AP2013SA0115EN.pdf**)

21 Salt, AN & Hullar, TE, 2010. Responses of the ear to low frequency sounds, infrasound and wind turbines. Hearing Research, 268 (1-2), 12-21. [URL] (Link to: **https://doi.org/10.1016/j.heares.2010.06.007**)

22 Weichenberger, M, Bauer, M, Kühler, R, Hensel, J, Forlim, CG, Ihlenfeld, A, Ittermann, B, Gallinat, J, Koch, C & Kühn, S, 2017. Altered cortical and subcortical connectivity due to infrasound administered near the hearing threshold- Evidence from fMRI. PLoS ONE, 12, e0174420. [URL] (Link to: **https://doi.org/10.1371/journal.pone.0174420**)

23 Tonin, R, Brett, J & Colagiuri, B, 2016. The effect of infrasound and negative expectations to adverse pathological symptoms from wind farms. Journal of Low Frequency Noise, Vibration and Active Control, 35 (1), 77-90. [URL] (Link to: **https://doi.org/10.1177/0263092316628257**)

24 Nelson, P, Bryne, A, Waggenspack, M, Lueker, M, Feist, C, Herb, B & Marr, J, 2019. Testing the human response to wind turbine emissions. Wind Turbine Noise 2019, 12-14 June, Lisbon. INCE-Europe.

25 Maijala, PP, Kurki, I, Vainio, L, Pakarinen, S, Kuuramo, C, Lukander, K, Virkkala, J, Tiippana, K, Stickler, EA & Sainio, M, 2021. Annoyance, perception, and physiological effects of wind turbine infrasound. Journal of the Acoustical Society of America, 149 (4), 2238-2248. [URL] (Link to: **https://doi.org/10.1121/10.0003509**)

26 Krahé, D, Alaimo Di Loro, A, Müller, U, Elmenhorst, E, De Gioannis, R, Schmitt, S, Belke, C, Benz, S, Großarth, S, Schreckenberg, D, Eulitz, C, Wiercinski, B & Möhler, U 2020. Lärmwirkungen von Infraschallimmissionen (Noise Effects from Infrasound Immissions, in German, with abstract in English). [URL] (Link to: **https://www.umweltbundesamt.de/publikationen/laermwirkungen-von-infraschallimmissionen**)

27 Harrison, RV, 2014. On the biological plausibility of Wind Turbine Syndrome. International Journal of Environmental Health Research, 25 (5), 463-468. [URL] (Link to: **https://doi.org/10.1080/09603123.2014.963034**)

28 Crichton, F, Dodd, G, Schmid, G, Gamble, G & Petrie, KJ, 2014. Can expectations produce symptoms from infrasound associated with wind turbines? Health Psychology, 33 (4), 360-364. [URL] (Link to: **https://doi.org/10.1037/a0031760**)

29 Benedetti, F, Lanotte, M, Lopiano, L & Colloca, L, 2007. When words are painful: Unraveling the mechanisms of the nocebo effect. Neuroscience, 147 (2), 260-271. [URL] (Link to: **https://doi.org/10.1016/j.neuroscience.2007.02.020**)

30 Kern, A, Kramm, C, Witt, CM & Barth, J, 2020. The influence of personality traits on the placebo/nocebo response: A systematic review. Journal of Psychosomatic Research, 128 (2020), 109866. [URL] (Link to: https://doi.org/10.1016/j.jpsychores.2019.109866)

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scope of noise assessments. Based on the evidence reviewed, it appears that such a statement could be robustly justified, until such time that the position is reviewed against any newly emerging evidence. In particular, at the time of preparing the project report, it was expected that further evidence would be published from the Australian National Health & Medical Research Council (NHMRC) funded studies led by researchers from the University of Sydney and Flinders University. Further evidence has subsequently been released, in the form of two peer-reviewed journal articles published in 2023.

The first of these articles presents what is probably the most comprehensive and carefully controlled experimental study of wind turbine infrasound exposure-effects on health to date, and concluded there was no evidence found to support any connection with a wide range of physiological and psychological symptoms[31].

The second study investigated detectability of wind turbine infrasound, and concluded that the participants, which included a sub sample of people self-reporting to be suffering from sleep disturbance due to wind turbine noise, were unable to detect the presence or absence of wind turbine infrasound above chance, when exposed at typical levels[32].

These results continue to add to the body of scientific evidence indicating that claims of wind turbine infrasound affecting health have not been substantiated by robust investigations.

Conclusions

In view of the results of the study, it was concluded that the identified aspects of the current guidance should be reviewed and updated. Current research evidence could be used to support any updates, alongside the relevant experience of stakeholders. However, the study also highlighted gaps in the state of knowledge, which it is recommended should be addressed by further research to support guidance updates.

Research gaps

Current evidence gaps identified in the study report include the following:

- An up-to-date systematic review and meta-analysis of wind turbine sound exposure effects, focused on noise annoyance and sleep disturbance. Meta-analysis methodologies should ensure study heterogeneity is rigorously addressed. Such a review could support a robust framework of effects thresholds to inform controls for wind turbine sound.
- A UK-based observational exposure-response field study including rural areas. Such a study could be used to investigate specific issues of particular importance, including AM impact, and influences of personal and contextual factors.
- There appears to be very little (if any) scientific evidence supporting the background sound-based 'relative impact' approach taken in ETSU-R-97 (and in BS 4142). Studies investigating the relevance and robustness of this approach, by examining the influence of ambient soundscapes on audibility, sound masking, partial loudness and noticeability, would be valuable.
- A comprehensive primary evidence review of overseas guidelines on wind turbine noise assessment could assist in providing context for informed decisions on balancing the benefits and disbenefits offered by onshore wind energy developments. The methodology for such a review would need to be diligent in ensuring that scientific evidence or professional judgements supporting overseas approaches are identified, and weighed accordingly.

Outlook

This review study represents only an initial step in any process of updating the existing guidance that may be decided on in the future; the report itself does not provide new guidance or supersede any parts of the current policy or guidance frameworks in place in any of the devolved administrations.

Several other recommendations were made in the report findings for further elements to be considered in developing new guidance, and for how new guidance development could potentially be managed in the future.

The findings of the study should be considered within the context of its strengths and limitations, (some of which were outlined in Part 1 of this article series), which are discussed in detail in the project report.

About the authors:

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The birds and the bins – sound power and the rural soundscape

Have you noticed that there is a sound power label on your wheelie bin and wondered why? Mark Dowie, Physical Test Applications Specialist at HBK has the answer.

By Mark Dowie, Physical Test Applications Specialist at HBK

Left: Figure 1: Sound power label on recycling bin

Below: Wheelie bins at dawn

Sound power measurements are more commonly used for power tools and heavy machinery, and not for items that spend most of their working life producing no noise.

After a brief internet search, I learned that the sound power label on a recycling bin requirement comes from the European Outdoor Noise Directive 2000/14/EC (OND); the objective of which is to improve the control of emission in the environment by equipment for use outdoors.

Additionally, the directive seeks to ensure the smooth functioning of the European Economic Community while protecting human health and wellbeing. This all seems very sensible but, as I'd never felt disturbed by my neighbours putting out their bins, I was interested P42

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to understand what was being measured and why. Without extensive research I noted that there are two main sources of noise from a wheelie bin:

- the lid being dropped; and
- the bin being dragged along a bumpy pavement.

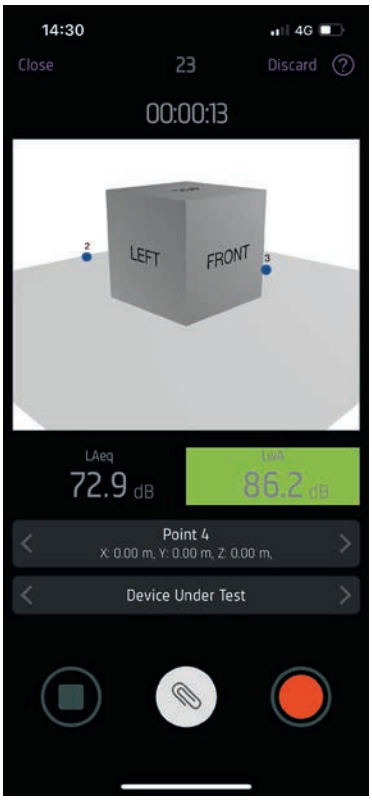
To understand which noise is loudest I set up a simple sound power measurement. The wheelie bin was empty as the rubbish bags have a damping effect. The measurement was performed with a sound level meter and a 1m stick to make four measurements around the bin. For the bin lid, I did three drops per 10 second measurement. This gave a result of approximately 86 dB LWA. For the rolling noise I vigorously dragged the bin past the meter three times within a 10 second period and dropped it back on its base. Despite my best efforts to be loud, this measured 74 dB LWA. Both results were below the 89 dB stamped on the bin but, at least the investigation shows that the bin lid being dropped produces the higher level.

Widening the research

This led me to wonder whether any of my neighbours had ever been irritated by the bins being put out.

I live in a rural area and during the pandemic residents of the local villages started using WhatsApp to support each other; these groups are still going and are a popular way for the communities to stay in touch and discuss village issues. I posed a question via these local WhatsApp groups, *'What sounds do you enjoy and what sounds to you dislike when you are outside your house, in your garden or going for a walk?'* I also met with people at the local sports centre and asked the same question. I also asked more freely what sounds they noticed and how they felt about them.

The people I asked live within a five mile radius of a town with a population of about 20,000. The surrounding area is mostly farmland with a few small villages. For me, with my acoustic hat on, there are a number of obvious noise sources including an active MoD base, dog kennels and some industrial sites. There are also two fairly busy single carriageway A-roads that intersect in the town. There is a busy motorway about three miles north of this five mile radius, which



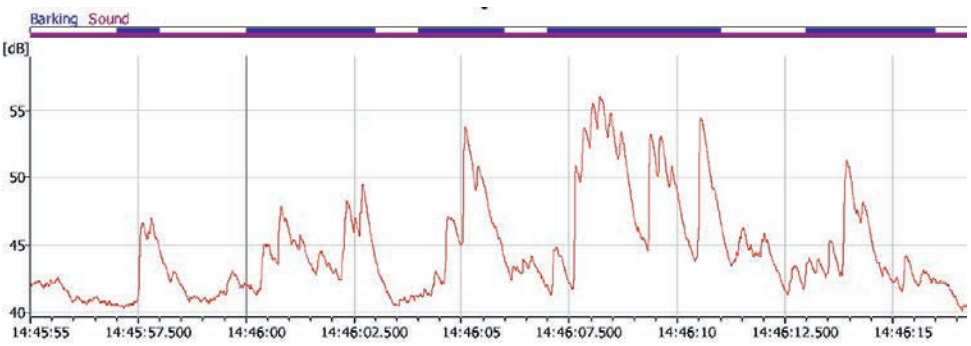
Above & above right: Figure 2: Bin lid drop test

Above & above right: Figure 3: Rolling bin test

is audible in the villages to the north of this area if the wind is blowing from the north.

The area is also on a flight path for flights coming from Heathrow, Gatwick and further afield and these flights were noticeably absent during the first Covid lockdown. The wider area is home to RAF and Army training facilities; low level fly-pasts of Hercules aircraft and Chinook helicopters are common, and occasionally you can hear very low frequency booms from Salisbury Plain 25 miles away. There can be some motorsport noise from off-roading events as well as the nearby MoD base

Left: Some people were very specific about the birdsong they liked, such as blackbirds



Above: **Figure 4**: Barking from dogs in kennels is highly impulsive

being used to film motoring shows infrequently. Despite all of these sound sources, it can be noticeably quiet with night time LA90 levels dropping below 30dB.

What my neighbours think about their local soundscape

I've tried to give an overview and some specific examples, so let's start with the negatives:-

- neighbours shouting;
- neighbours' music;
- cars, motorbikes, and quad bikes – horns, alarms and unnecessary revving and screeching;
- Low-flying aircraft;
- garden machinery such as chainsaws and leaf blowers; and
- dogs barking, either from next door, passing by or from the local kennels.

'Next door's Smart speaker being shouted at and then being played too loud'

'Next door's boiler turning on'

'Slamming of metal footpath gates'

'Lawn-mowing at silly times of day'

'Foxes at night'

As a side note, I did some measurements in a resident's garden about 250m from the local dog kennels. If it was assessed as an industrial premises to BS 4142:2014 then it would have an impulsivity penalty of 9 dB based on the 10ms data. Individual barks can be seen on Figure 4 on the left. P44

The positive and most liked sounds by neighbours included:

- birdsong;
- church bells;
- tractors;
- nearby stream/running water;
- grazing sheep and cows; and
- lawn mowers.

'Nice children playing'

'Willow on leather (cricket)'

'Horse hooves on tarmac'

'Autumn leaves in the wind'

'Silence near the lake'

'Bees buzzing around the flowers'

'Falling of ripe apples'

'A good thunderstorm'

'The soft clucks of chickens'

'Rain on the conservatory roof'

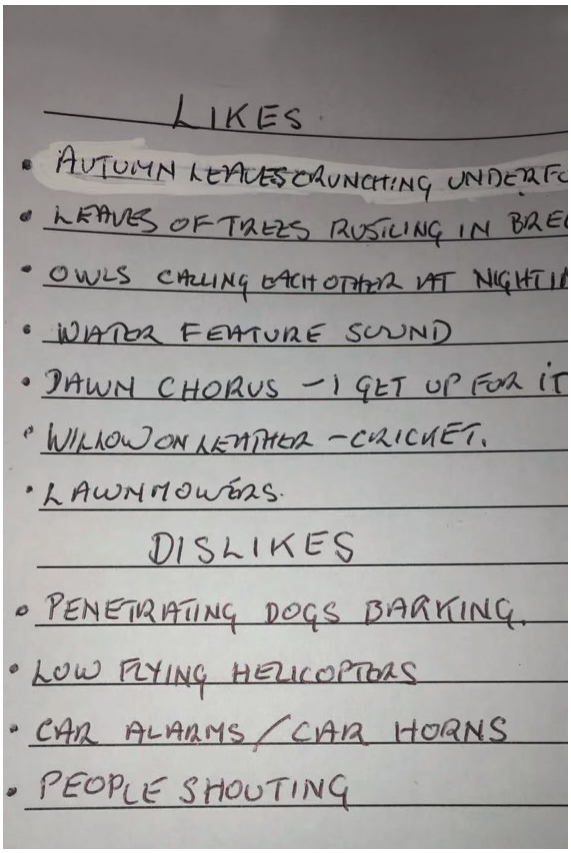
There was one thing that everybody, without fail, said that they liked — birds. Some people were very specific with different people highlighting skylarks, blackbirds, woodpeckers, and owls but, everyone I asked said they enjoying hearing birdsong. Pigeons, however, are a little like Marmite and are not universally popular.

Notably, out of the 30 or so people that responded, no-one had an issue with wheelie bins. It could certainly be argued that in this case outdoor noise directive has achieved its goal. However, as a rubbish bag being thrown into a bin is only an occasional and brief noise, it was never going to be a major contributor to noise pollution within the rural soundscape.

Protecting the fragile rural soundscape

On a more serious note, birdsong (with the exception of the dawn chorus) is a low level sound and, as these local residents have alluded to, great pleasure can often come from a single blackbird, owl, or lark. These delicate sounds are easily drowned out (or possibly stopped) by the less natural sounds that have been slowly encroaching on the rural soundscape. Even distant dog barking can be more dominant than a bird three metres away.

Most of the 'negative' noises listed by local residents are regulated in some way individually. The Defra statutory guidance for dog kennels requires them to have a noise management plan but there doesn't appear to be any level limit to protect the nearest residents. Motor sport has vehicle noise limits for track racing, however, it's unclear if these restrictions apply to ad-hoc events on airfields and farmer's fields. Noisy neighbours can be reported to the local authority for investigation and, as previously mentioned, garden tools will be subject to sound power tests and noise limits. However, there is not a way to universally manage the cumulative effect of all these sources. As noise monitoring options reduce in price and software learns to identify source types maybe instrumentation could provide a simple method for protecting the fragile rural soundscape that is so highly valued by local residents.



Above: Figure 5: An individual response

Below: Delicate sounds are easily drowned out by the less natural sounds that have been slowly encroaching on the rural soundscape

From this article, you should note that:

- The sound power label on a recycling bin requirement comes from the European Outdoor Noise Directive 2000/14/EC
- The Defra statutory guidance for dog kennels requires them to have a noise management plan but there doesn't appear to be any level limit to protect the nearest residents
- Instrumentation could provide a simple method for protecting the fragile rural soundscape

Acoustic sensing from the sky

Drone audition is revolutionising sound acquisition and processing, with novel applications including search and rescue, human-drone interaction, and bioacoustics monitoring.

By Lin Wang and Andrea Cavallaro, Queen Mary University of London

Multirotor drones can hover above an area as a sensing platform equipped with a variety of sensors, such as cameras, microphones, laser scanners, or ultrasonic radars. For this reason, multirotor drones are increasingly used in a wide range of applications such as search and rescue operations, personal and professional video capturing, and wildlife monitoring.

While visual sensing is a mature technology in this space, sound-enabled applications have been relatively overlooked due to several technical barriers. The main barrier to effective drone-based acoustic sensing is the strong motor and propeller noise, which masks the sound from target sources (e.g. voice) and makes the sound recording from a flying drone unusable.

Since the onboard microphone is much closer to the motors and propellers than the target sound sources, the signal-to-noise ratio (SNR) at the microphones can be lower than -20 dB, which makes sound processing a very challenging task. We have been conducting pioneering research in drone audition, addressing the challenging ego-noise problem, and promoting novel applications such as human-drone interaction and bioacoustics monitoring.

Separating the target sound

We developed a range of microphone-array algorithms that enable a drone to localise sound sources in the environment, and separate the target sound from the strong ego-noise. Since the target sound source from the rotors and propellers originate from different spatial locations, a key idea is to mount a microphone array on the drone and exploit the spatial discrimination ability of the array.

Left:
Figure 1:
An auditory drone with a microphone array

In addition to algorithm design in extremely low-SNR scenarios, a challenge also arises from the limited payload of the drone, so optimisation of the size and weight of the microphone array system to be carried by a flying drone is required (see Figure 1). Other applications include search and rescue and aerial filming. For instance, when deploying drones in search and rescue operations, microphones would be important to locate sound-emitting targets (e.g. a person in distress), especially at night, in low visibility, or in the presence of visual obstacles and occlusions (e.g. a victim under debris).

Solutions to wildlife monitoring

With the capability of flying over hard-to-reach terrains, drones also promise solutions to wildlife monitoring in the context of global biodiversity loss for monitoring acoustically active species, such as birds and bats. We developed a hardware prototype consisting of a quadcopter and a shotgun microphone suspended with a rope (Figure 2). The shotgun microphone pointing downwards can collect the target sound from the ground and reject the ego-noise effectively. We also developed noise-robust machine learning algorithms to recognise the wildlife species from the noisy drone recording. An initial experiment demonstrated that the prototype system works robustly at a monitoring altitude of up to 30 meters, which is suitable for deployment in the wild. We are now deploying the system in situ to investigate its performance and its impact on wildlife experimentally.

Below:
Figure 2:
An auditory drone with a microphone suspended underneath the drone for bioacoustics monitoring

Museum soundscapes

British museums of the late Victorian era were created and designed to house vast collections of artefacts; characterised by expressive volumes and hard reflecting surfaces which result in a cold soundscape. More recently, museums have undergone significant changes in their mission: aiming to become inclusive places for learning and self-development where the emphasis is on the visitor experience.

By Rebecca Romeo Pitone and Jack Harvie-Clark

This article explores how, in conjunction with curatorial practice, acoustic design could reinforce this important shift.

When designing a new type of museum soundscape it is particularly important to consider visitors with hearing and visual impairments, sensory issues, and non-native speakers, as well as those that feel museums are 'not for them'.

We carried out a consultation on behalf of an architectural firm, tasked with the refurbishment of a public war museum in the North East of England.

The museum and its renovation

The Museum was built in the 1960s and its collection includes hundreds of thousands of artefacts, including documents, weapons, uniforms, medals and other war memorabilia.

In 2016, the local authority closed the museum because of low visitor numbers. However, following a campaign led by the local community, this decision was overturned and after a consultation led by the architect, the local authority agreed to restore the venue. The renovation includes an upgrade of the existing building, a purpose-built extension to hold the museum collection, and the redesign of the outdoor area to be turned into a reflective garden. Plans featuring ambitious exhibitions, state-of-the-art educational facilities and a new section dedicated to restaurants are representative of a bigger repositioning plan for the museum within the regional and national cultural landscape.

Due to the grandeur of their architectural design, museums have acquired a distinctive soundscape — we can all picture the imposing ambience of the museum foyer, which warns us about the imminent enforcement of silence. The acoustics in this type of building is reminiscent of that of a place of worship and reinforces the idea of the museum as a 'temple'.

Dr David Fleming, Director at National Museums Liverpool[1], describes how the museum architecture itself functions: *"Many museums were designed to overwhelm visitors. The classical columns and pediments, the banks of steps, the ornate iron gates — these are devices that convey numerous messages, all quite conscious, about what an entry to this grand edifice will lead to. Museum architecture has always been, and still is, an area where pomposity and vainglory can run riot. [...] It is the cavernous interior that often reduces people to hushed whispers and an impression that, somehow, they oughtn't to be there."*

New museums ought to explicitly counteract the impression that their spaces and collections are exclusive to a certain group of people. Questions of accessibility and diversity are at the heart of the new museum, not just as drivers for attendance, but as key values for an institution that needs to reflect change in society. In the new museum, the emphasis must be on the visitor experience and the services required to satisfy their expectations[2]. And, for the visitors who can hear, the museum is not a visual place, but an audiovisual environment[3], therefore their experience needs to be addressed from an aural perspective too.

Our initial task during the consultation was to characterise the desired visitor experience from an acoustic perspective.

The context of museums' soundscapes

ISO 12913-1 defines context as a complex system of *'interrelationships between person and activity and place, in space and time*[4]. It is context that transforms an acoustic environment into a soundscape. Since museums are cultural venues,

Footnotes

1. D. Fleming, 'Creative space', in Reshaping Museum Space - Architecture, Design, Exhibitions, Ed. London: Routledge, 2005, pp-53-61.
2. P.C. Marani, R. Pavoni, Musei — Trasformazioni di un'istituzione dall'età moderna al contemporaneo. Venezia: Marsilio Editore, 2006, p. 59.
3. S. Voegelin, 'Soundwalking the Museum — A Sonic Journey through the Visual Display', in The Multisensory Museum - Cross-Disciplinary Perspectives on Touch, Sound, Smell, Memory and Space, Ed. Plymouth: Rowman & Littlefield, 2014, pp. 119-130.
4. BS ISO 12913-1:2014 — Acoustics — Soundscape Part 1: Definition and Conceptual Framework, London: ISO, 2014.

Above: Figure 1. Binaural video of main exhibition room **https://vimeo.com/825782544/e82d07de74**

context needs to be framed from a cultural perspective. In the full version of this article, we explore the origins of the soundscape of the museum-temple, tracing its connection with colonialism.

To understand the concept of the museum-temple, we need to look at at the history of museums as a Western institution. Directly evolved from the Cabinet of Curiosity, early museums served various functions within the Western Imperial project. The dual hierarchy of Coloniser/ Colonised was reproduced both through the collections of colonial artefacts and the museum building as their container. Within a philhellenistic framework, it was the architectural language of Ancient Greece, with its expressive volumes and the quest for symmetry, to be chosen as a tool to convey ideas of White supremacy.

When we talk about White supremacy, we must remember that "being white is historically contingent with being intelligent, civilised and able"[5]. By designing inclusive museum soundscapes, we are challenging ideas of normalcy and functionality that are associated with colonial systems; we are trying to, at least tangentially, "counter the impact of a culture built upon whiteness and ability"[5]. Museums were for so long the emblem of this culture and this is what makes them an appropriate starting point for reconsidering how we design acoustics for inclusion and what this means from a cultural perspective.

If the museum-temple that was designed to overwhelm and intimidate its visitors is a huge, extremely reverberant space where every footstep, whisper and cough is amplified and where the build-up of sounds gets uncomfortable, especially for people with sensory issues, then, these acoustic qualities will carry connotations of exclusion, even when transferred to the new museum.

Acoustics in museums is not a widely researched topic. As mentioned previously, we know that museum-temples were designed to contain vast collections of artefacts; current literature has not yet discussed whether any consideration was given to their acoustic performance.
At this stage of the research, we must assume that the acoustic qualities of the museum-temple are a by-product of its geometry and the materials employed — marble, granite, alabaster etc all contribute to the 'echo chamber' effect[6].

Carvalho et al[7] studied the difference between the acoustics of 'modern' and 'old' museums. What they define as 'modern' is the museum built later than the mid-twentieth century, whose design is based on reinforced concrete. According to the authors, the modern museum often presents acoustic issues due to reflective coatings, hard floors, high ceilings and very expressive volumes; whereas the 'old' museum is the museum installed in 'historic' buildings; which, based on their definition of 'modern' could be anything before the mid-twentieth century. Carvalho et al. state that older museums tend to behave better acoustically, compared to modern museums.

A big acoustic challenge when it comes to museums is to create an environment that allows quiet contemplation without preventing the visitors from talking with other visitors or museum staff.

In the preliminary investigation we contrasted two types of museum soundscapes: the first, linked to the museum-temple, is characterised by more reverberant conditions (based on our perception, not measurements in-situ). It is quite common to refer to this environment as 'cold'[8]; since every little sound is magnified against an overall silent background, the attention can suddenly be drawn to us; the experience in these rooms can be quite alienating, especially for people who are not regular museum-goers.

An example of this environment can be heard in this binaural video (at Figure 1) recorded in the P48

Footnotes

5. D. Goodley, ' Dis/ability Studies - Theorising disablism and ableism, Abingdon: Routledge, 2014, p.44
6. Asi Architectural, 'Acoustics In Museums: The Science Of Sound, 2020. [Online]. Available: **https://www.asiarchitectural.com/acoustics-in-museums/**. [Accessed: 24-Apr-2023].
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main exhibition room of an art gallery in the North East.

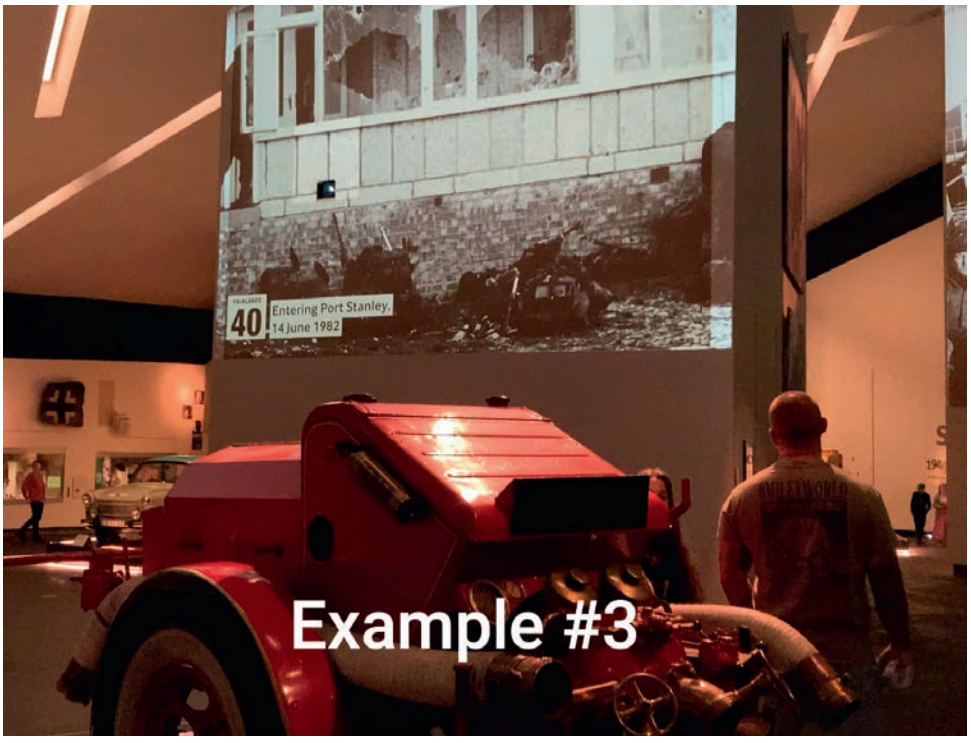
We can immediately notice that the acoustics are not appropriate for the activity being carried out and the overall soundscape is rather cold.

On the other end of the spectrum, this binaural video (at Figure 2) shows an example of a museum space that was designed to host multimedia installations, as well as traditional exhibitions. Here, despite the expressive volumes and the darker colour palettes, the space feels 'warm'.

Inclusive museum soundscapes

To obtain a space like this, which is almost conceived as a walk-in cinema, acoustics needs to be carefully designed. The understanding of accessibility is rapidly changing and the role that the built environment plays in the exclusion of people is getting more widely recognised[9]. Our consultation for the museum drew from recent scholarship and government guidance, (PAS6463)[10] aimed at designing inclusive buildings. One of the main aspects that is considered in this literature is reverberation control. Reverberation typically affects acoustic comfort negatively; it causes background noise to rise and reduces speech intelligibility. Longer reverberation times make listening very tiring for people with a hearing impairment and non-native speakers; while also making orientation difficult for people with a visual impairment. People with neurodegenerative conditions, such as dementia, and neurodivergent conditions (autism, ADHD, dyspraxia) and people with hearing differences, such as hyperacusis and misophonia, are often extremely sensitive to noise. For individuals with high and hypersensitivity, higher background noise can increase stress levels, cause anxiety and ultimately sensory overload[11].

PAS6463 goes into detail about the practical solutions for inclusive design.



Above: Figure 2. Binaural video of contemporary museum. **https://vimeo.com/825785665/de674f5977?share=copy**

Links

This article is an adaptation of a research paper titled *Decolonising Museum Soundscapes* (by Rebecca Romeo Pitone and Jack Harvie-Clark), submitted to the Forum Acusticum 2023 Torino, Session A14-01 Indoor Soundscaping.

These include:

- isolating the quietest areas from the noisiest areas, allowing a gradual transition to and fro;
- background noise level control;
- avoiding hard reflective surfaces, favouring soft furnishings, and providing the correct amount of absorption;
- creating smaller semi-enclosed spaces within a big area; and
- enabling the building users to change their acoustic environment, e.g. switching fans on or off, closing and opening windows, moving from space to space, accessing quiet rooms, choosing the level of noise of an appliance.

This level of control may be difficult to obtain in a museum, where the visitor experience is always mediated (by security and other museum staff); however, emphasis can be placed on the ability to access quiet areas when needed. It is therefore important to make a variety of spaces available and easily accessible to visitors.

Another aspect that may be difficult to implement from a curatorial perspective, is the creation of smaller spaces within an open area; different artefacts from the same collection are usually shown in the same room for narrative purposes.

Conclusion

A warm and inviting soundscape puts the emphasis on the visitor's experience and it can help reduce the museum's threshold fear, i.e. *'the physical [and programmatic] barriers that make it difficult for the uninitiated to experience the museum'*. It reinforces the shift from the museum-temple, to the new, welcoming and inclusionary museum.

There could be a correlation between a warm soundscape and an improved visitor experience. From a commercial perspective, this would imply that acoustic design may have a role to play when it comes to repositioning museums during their refurbishment; changing them from obsolete museum-temples to welcoming, multilayered and inclusive cultural attractions.

Footnotes

9. A. Heylighen, G. Vermeir, M. Rychtáriková, 'The Sound of Inclusion: a case study on acoustic comfort for all', in Designing Inclusive Features, ed. London: Springer, 2008, pp. 75-84.

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The connection between acoustics and ecology competition 2024

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The Competition

This competition is for a small team of up to three 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.

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 31 July, 2024. Entries will be judged by a panel of experts. The decisions of the judging panel will be final.

Visit **ioa.org.uk** for further details

Assessing industrial sound inside dwellings

In the UK, impacts at residential properties arising from industrial sound are appraised using the assessment methodology provided in BS 4142[1]. This Standard considers the prevailing acoustic background, character of the industrial sound and contextual factors to assess impacts at outdoor receiver locations.

By Louise Morris CEng MIOA, Associate, AtkinsRéalis and Adam Lawrence CEng FIOA, Associate, AtkinsRéalis

Above: Industrial exhaust fans

As BS 8233[2] is not specifically intended for advising on acceptable sound intrusion levels from industrial sound, there are no equivalent alternative methodologies that could achieve this aim.

This means that the lived experience inside properties relies on external assessments when verifying sound emissions, for environmental permitting or when investigating complaints.

To determine whether this is an issue, Defra commissioned a scoping study to explore methods for assessing industrial sound inside dwellings using an evidence-based approach. An outline methodology based on BS 4142 was identified that can be developed further in future pilot phases.

Scope

The scope of the study was limited to new or existing fixed equipment and processes at industrial sites, including heating,

- ventilation;
- air-conditioning plant (HVAC); and
- refrigeration plant.

Low frequency sound was considered but it is expected that NANR45[3] would be used in parallel with the outline methodology for a full assessment where low frequency sound is prevalent.

The scope of the project **excluded**:

- planning applications for housing developments near industrial sites;
- domestic heat pumps covered by the Microgeneration Certification Scheme;
- commercial sound sources;
- mobile plant;
- sound from loading/unloading activities;

P52

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3 Moorhouse, A.T., Waddington, D.C., and Adams, M. (2011). Procedure for the assessment of low frequency noise complaints, NANR45, Revision 1. Manchester: University of Salford.

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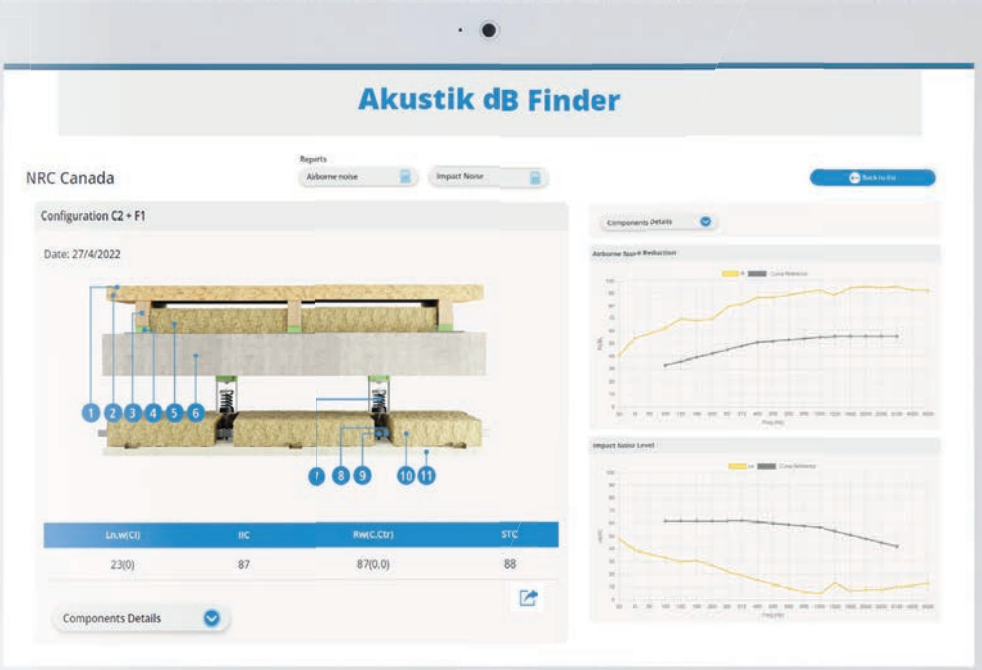

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- groundborne sound; and
- vibration-generated sounds.

These items may be added to the scope of the methodology in due course — if and when it becomes more developed.

Benefits of extending BS 4142

A BS 4142-based approach benefits from decades of development to focus on impacts from industrial sound, where updates reflect current evidence and feedback from practitioners. Impacts are considered in the context of relative change, which allows industrial sound to be assessed in a common way in rural, suburban, and urban settings. A BS 4142-based method would ensure that a consistent approach is used for assessing industrial sound inside and outside of dwellings, and avoids integrity and ethical risks from practitioners who may select an alternative method to achieve a more favourable outcome.

Additionally, BS 4142 allows the consideration of several important contextual factors within its assessment methodology and is based on the perceptibility of sound leading to annoyance of individuals. This means that it is set up to fully consider local acoustic and non-acoustic factors as part of an impact assessment to ensure that the outcome is appropriate to the assessment location.

The acoustic feature corrections reflect the negative valence and arousal response to sounds with distinct characters and can be applied to an indoor context using the subjective method. Extending BS 4142 to internal dwelling areas offers an opportunity to consider indoor soundscaping qualities such as comfort, content, and familiarity[4] as contextual factors influencing significance. BS 4142 provides some guidance on the effects of masking and on annoyance and sleep disturbance from indoor sound levels, which can be further developed.

Outline approach

Key features

The outline methodology retains the assessment style of BS 4142 and introduces the following features:

- a partially open window is assumed for a reasonable worst-case assessment and acoustic feature corrections are applied using the BS 4142 subjective method. Closed windows may also be assessed if this reflects the situation at the dwelling;
- assessment of direct and reverberant sound at an indoor reference position located 1.5m horizontally from the partially open window. Additional points may be required depending on room use, size and multiple windows;
- on-time corrections are not applied to better account for arousal and valence responses. For the same reason, specific sound sources that are best represented using short-term indicators (such as L_{Amax}) can also be considered;
- there is a requirement to use an outdoor-to-indoor transfer function and octave band frequencies (63 Hz to 8 kHz) to account for spectral change to the specific sound level from the partially open window; P54

Below: Extending BS 4142 to the indoor environment introduces additional uncertainties that require consideration, for example, the characteristics of the partially open window and the level of sound attenuation it provides

References

4 Borresin, S., Albatici, R., Aletta, F., Babich, F., Oberman, T., Siboni, S., and Kang, J. (2020). Indoor soundscape assessment: A principal components model of acoustic perception in residential buildings. Building and Environment, vol 182 p107152.

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- a new character correction for low frequency sound is proposed to account for increased disturbance;
- the margin of exceedance is based on the residual L_{Aeq} sound level instead of background LA90 sound level; and
- additional contextual factors are identified, including masking and indoor soundscaping qualities.

Above: BS 4142 considers the prevailing acoustic background, character of the industrial sound and contextual factors to assess impacts at outdoor receiver locations

Methodology steps

The outline assessment methodology would broadly operate as follows:

1. Dwelling selection

BS 4142 assessments often focus on the nearest sensitive receptor(s) to the industrial sound source(s) but dwellings further away may need to be assessed depending on contextual factors. These factors include the behaviour and directivity of the sound source, façade insulation and internal acoustic absorption, which all affect the received sound inside the dwelling.

2. Data collection for outdoor and indoor environments through measurement or prediction

a) Obtain the outdoor specific, residual and background sound levels using the current BS 4142 methodology.

b) Obtain the indoor specific, residual and background sound levels in the room(s) of interest with a partially open window using measurements or predictions.

Indoor sound measurements can be performed using the ISO 1996[5] methodology at the reference location, with the practitioner noting relevant indoor contextual factors. Measurements should be overt and care must be taken to avoid collateral intrusion and measuring self-generated sound[6].

Predictions can be undertaken using a suitable outdoor to indoor transfer function that considers both the direct and reverberant sound at the reference location. The reverberant sound can be predicted using BS 12354-3[7], which enables the sound attenuation of different frequencies through the partially open window to be considered.

3. Initial impact assessment

Calculate the indoor rating level ($L_{ArT,indoor}$) using the subjective method set out in BS 4142. The subsequent impact calculation is performed by subtracting the indoor residual sound level ($L_{Aeq,indoor}$) from the indoor rating level ($L_{ArT,indoor} - L_{Aeq,indoor}$). A minimum internal sound level 'noise floor' of 20dB L_{Aeq} may be used to represent the indoor residual sound level where outdoor background sound levels are low.

4. Contextual factors and uncertainty

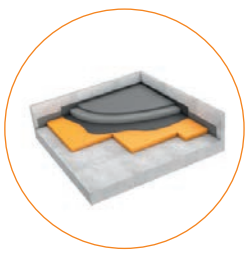
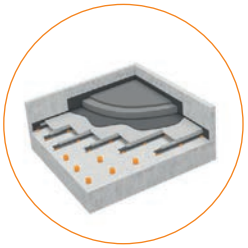
The initial impact may need to be adjusted to take into account outdoor and indoor contextual factors and their relative influence on impact significance. The following may apply to an indoor environment: P56

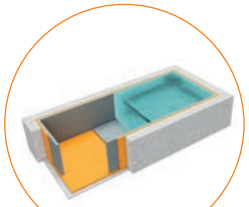
References

5 International Organization for Standardization. (2017). ISO 1996-2:2017 Acoustics – Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure level. Geneva: ISO.

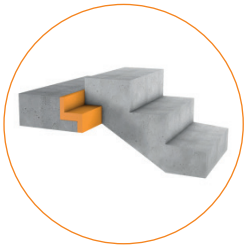
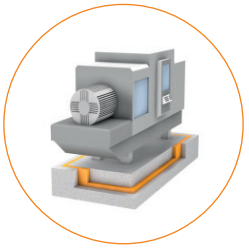
6 Association of Noise Consultants. (2020). Technical Note on BS 4142, Version 1.0. Northallerton: ANC.

7 British Standards Institution. (2017). BS 12354-3:2017 Building acoustics – Estimation of acoustic performance of buildings from the performance of elements. London: BSI.



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- Visibility;
- positioning and orientation of the specific sound source from the partially open window;
- masking provided by internal sound sources;
- attitudinal factors;
- ventilation options;
- acceptability at different times of day; and
- presence of exterior reflecting surfaces near the window that may increase or decrease incoming sound.

Extending BS 4142 to the indoor environment introduces additional uncertainties that require consideration, for example, the characteristics of the partially open window and the level of sound attenuation it provides, spectral content of the specific sound source, and acoustic conditions inside the dwelling.

5. Final impact significance

Bring together the initial impact assessment, contextual factors and uncertainty risks to determine the final outcome.

Knowledge gaps and limitations

The ability to further develop the assessment methodology is currently limited by knowledge gaps in the evidence base. The measurement pathway inherently carries less risk and uncertainty than the prediction pathway, as access inside the dwelling enables a better understanding of the indoor acoustic environment and the opportunity to identify standing waves. The prediction pathway has more limitations to overcome and will need to incorporate practical advice on how to proceed when limited information is available. The highest priority for further development is a common definition of a partially open window that can be repeated and reproduced by practitioners for different window types, sizes, and opening styles. Data from NANR116[8] and Locher et al[9] are a useful starting point on the sound attenuation from different windows but further test data collected from real-world conditions is required, including situations where the external sound field is not diffuse. The relationship between the background and residual sound levels in both the indoor and outdoor environment when there is a partially open window requires further exploration to support the use of an L_{Aeq} metric to represent the indoor environment when the specific sound source is inactive. Further work is also required to develop the impact significance criteria, taking into account human response to industrial sound levels and character in outdoor and indoor residential contexts.

Acknowledgements

The authors are grateful for feedback provided by Defra and Richard Collman received during the project. Defra intends to publish the scoping study report soon and welcomes feedback from the acoustics community.

Below:
The relationship between the background and residual sound levels in both the indoor and outdoor environment when there is a partially open window requires further exploration

References

8 Waters-Fuller, T., Lurcock, D., Mackenzie, R., and Mackenzie, R. (2007). NANR116 Open/closed window research: sound insulation through ventilated domestic windows. Defra and Napier University.

9 Locher, B., Piquerez, A., Habermacher, M., Ragettli, M., Röösli, M., Brink, M., Cajochen, C., Vienneau, D., Foraster, M., Müller, U., and Wunderli, J-M. (2018). Differences between Outdoor and Indoor Sound Levels for Open, Tilted, and Closed Windows. International Journal of Environmental Research and Public Health, 15(1) p149.

Launch of online refreshers

A series of short online refreshers based on extracts from videos created for the IOA Diploma in Acoustics and Noise Control are available now in the videos section of the IOA website.

By Keith Attenborough, IOA Education Manager

These refreshers could be useful to members wishing to revise their knowledge of fundamental concepts and methods or those wanting to update their knowledge in various areas of acoustics and vibration. These online refreshers do not involve any assessment (self or otherwise).

Human Response to Noise

This refresher has four videos:

- the ear and the hearing mechanism;
- health surveillance and hearing protection;
- loudness, calculation of loudness, speech intelligibility, noise rating and noise criteria; and
- speech interference level, speech transmission index, vocal effort, and privacy.

Human Response to Vibration

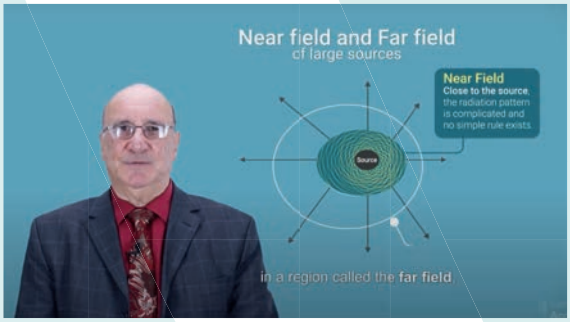
This refresher comprises three videos:

- effects and assessment of vibration introducing the various vibration indices;
- vibrations from transport, industrial, construction and quarrying sources, and building vibrations; and
- vibration effects continued and aspects of measuring and controlling vibrations.

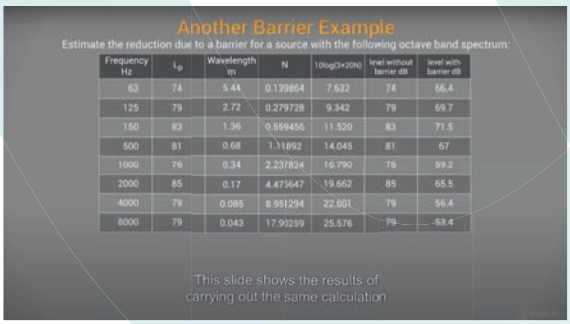
Vibration

This refresher has two videos relating to:

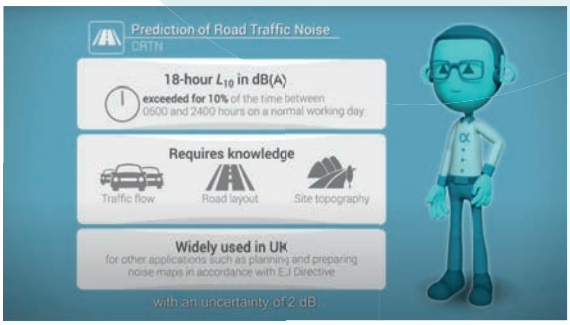
- vibration fundamentals; and
- building vibrations.



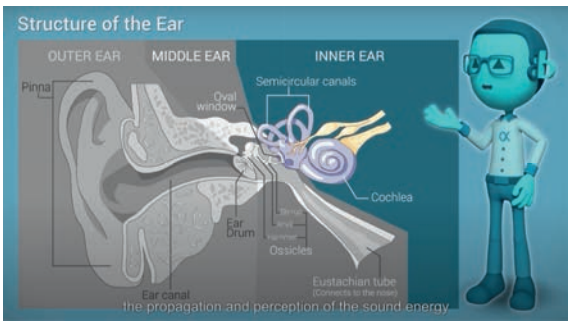
Above: Explaining radiation from finite sources



Above: Working an example barrier calculation



Above: Explaining CRTN



Above: Describing the ear and hearing

Room acoustics

There are four videos for this refresher:

- sound absorption;
- sound absorbers and sound absorption measurement;
- standing waves and room modes; and
- room acoustics calculations and aspects of design for good room acoustics including auditorium acoustics.

Sound Insulation

There are seven videos for this refresher:

- principles of sound transmission
- factors that influence sound insulation and ways of improving sound insulation
- airborne and impact sound insulation measurement
- sound insulation rating
- sound insulation in practice covers topics such as robust details, and guidance on relevant considerations in schools and hospitals
- control of building vibrations; and
- noise from building services.

Sound propagation outdoors

This refresher looks at:

- wavefront spreading;
- radiation from finite planar sources and building façades;
- reflections from vertical surfaces and the ground;
- atmospheric refraction and turbulence;
- transmission around barriers and through vegetation; and
- prediction schemes.

Transport Noise

This refresher offers:

- two videos on road traffic noise;
- one video on railway noise; and
- one on aircraft noise.

Flying High:

IOA, University of Salford, and industry collaborate to prepare students for aviation noise careers

The IOA, the University of Salford, and industry partners AcSoft and Noise Consultants Limited (NCL), are working together to prepare students for careers in airport noise.

By David Waddington, Professor in Environmental Acoustics in the Acoustics Research Centre at the University of Salford

Through a combination of classroom instruction, hands-on training, and real-world experience, the programme is helping students develop the skills and knowledge they need to succeed in this exciting field.

The Environmental Noise Measurement and Modelling module (led by the author of this article) is delivered to final year and masters level acoustics students, with the new addition this year of masters students in sustainable aviation.

Above:
Svantek Class 1 sound level meters loaned to students

Left:
University staff and student at Manchester's Runway Visitor Centre for he field measurements

Industry collaboration

In a recent class, students had the opportunity to learn from NCL experts James Trow, George Gibbs, and Chris Youdale on the topics of aviation noise and environmental noise measurement and assessment. AcSoft also

loaned the students 10 SV 971A Class 1 sound level meters.

In a separate session, Aidan Hubbard, Aaron Priestley, Jo Hare, and Sibo Ngcobo of Svantek UK visited the university to provide hands-on training on the brand new Assistant Pro App and SVANPC++ software for accessing and analysing data.

Following the training sessions, students completed a practical test before visiting Manchester International Airport to make noise measurements for a scenario where the café at the visitor centre is to be demolished and replaced with apartments. Students worked in groups to produce a consultancy report based on the application of Professional Practice Guidance on Planning and Noise (ProPG) to advise the hypothetical client.

The importance of acoustical expertise among aviation specialists

Many of the students on this course are already employed in aviation or have secured employment in the acoustics industry. Some students work for or have secured employment with aviation companies based abroad. Others are in their final year of studying acoustics, after completing a year out working in acoustic consultancy.

This programme is a shining example of how academia and industry can successfully collaborate to prepare students for careers in airport noise. Through this partnership, students are gaining the essential skills and experience they need to thrive in this growing field. Additionally, the programme is raising awareness of the importance of acoustical expertise among aviation specialists, which is vital to the industry's survival.

The IOA is proud to support this important initiative and is committed to helping students develop the skills and knowledge they need to succeed in the acoustics industry. The IOA's support for this programme is also helping to foster a culture of collaboration between academia and industry, which can lead to new research and innovation.

The next generation of aviation noise consultants is ready to take flight!

Right: AcSoft's Aidan Hubbard providing students with hands-on training

Right: Masterclass by George Gibbs of NCL

Right: Salford's David Waddington and AcSoft's Sibo Ngcobo with students in class

BRANCH NEWS

Eastern Branch

By Martin Jones, Eastern Branch Chair

The last IOA Eastern Branch meeting was held at the offices of Create Consulting Engineers Ltd, following some debacles at our usual venue and we had a really great turnout from local acousticians.

In September, we were treated to a talk by Giles Parker of Sound Barrier Solutions. He gave an insightful presentation into what constitutes a good quality acoustic barrier, which will stand the test of time. Other areas were also covered in his presentation, including the basics of acoustic design for barriers.

There was a lot of research presented which suggests that the 10-12 kg/m^2 rule that is so commonly used by acousticians when specifying acoustic barriers is not the be-all and end-all for the design criteria, likewise, neither is it about the positioning or the height of the barriers. We all took a step back to the basics and looked at several other options available, given the rapid degradation of timber barriers.

Giles has a lot of experience in this field and this became evident once the questions started flowing from our Eastern Branch audience. Overall, it was a very good evening and it was great to have so many people at our face-to-face meeting.

Above: IOA Eastern Branch members at their September meeting

Irish Branch

by Siobhan Maher, Redkite Environmental Ltd

Gerry McCullagh Memorial Lecture 2023 — Noise mapping past, present and future

It was an honour to welcome Simon Shilton, CEng, FIOA and Director of Acustica Ltd to a well-attended evening meeting of the Irish Branch in September 2023 to give his talk on *Noise Mapping, Past, Present and Future*.

The meeting was timely as Round 4 maps published in Ireland in 2023 represent a step change in approach with the introduction of the common European method (CNOSSOS-EU) and the assessment of health impacts.

The talk was presented in Trinity College Dublin (TCD) — a fitting location as acoustic research has a long history of over 340 years at TCD! The first use of the word "microphone" was by the Reverend Marsh, Provost of TCD in 1683 as published in the Doctrine of Sounds in the same year.

Things have moved on a bit since then (thankfully). Simon's talk was jam-packed and full of information outlining how mapping was completed in the past with less powerful computers than we have today and how laborious it was to build a noise model. He also noted how software packages differ and crucially, how the pathfinder in software is most important. For example, CNOSSOS is 10 times slower than CRTN as there are more paths and more sophisticated diffraction paths. All this represented a calculation burden for Round 4 transportation noise mapping with the Irish Guidance being completely rewritten and due to be published by the end of 2023.

Simon also looked to the future and outlined the latest developments in the UK with cloud-based real-time mapping and the use of digital twins to inform decision-making. Mapping may be extended in the future to cover, for example, ecosystems.

After the talk, members convened to The Lincoln's Inn, close to TCD where a great time was had by all catching up with old acquaintances and meeting new ones in the Irish Branch.

The Irish Branch would like to thank Simon Shilton for his time and effort in presenting the talk and thanks also to Dr John Kennedy, Assistant Professor at TCD for generously providing the venue.

Thanks also to Linda Canty and committee members, James Mangan, Diarmuid Keaney and Gary Duffy for organising the talk and refreshments.

Best Diploma presentations

Congratulations to Luke Coffey of iAcoustics and Smart Studio and Sean Rocks of Wave Dynamic Acoustic Consultants, who both received a presentation for Best Diploma for Irish Students for the years 2021/2022 and 2022/2023 respectively.

Below: Luke Coffey, Best Diploma Ireland 2021-22

Below: Sean Rocks, Best Diploma Ireland 2022-23

Southern Branch

By Chris Barlow

On Monday 31 July, a small but select group of 20 IOA Southern Branch members visited the QinetiQ National Maritime Systems Centre at Portsdown Technology Park near Portsmouth for an in-person talk by Seb Woodhams on the acoustic measurements of naval platforms including surface vessels and submarines. Due to security restrictions only a limited number of people were able to attend, and the talk proved so popular that it was sold out within 24 hours!

Seb leads the acoustics capability within the Maritime Ranges Engineering Support group, ensuring that QinetiQ's ranging capability is fully operational while developing improved acoustic technologies to benefit their customers.

Seb first introduced the history and principles of maritime acoustic ranging, starting with the UK's first maritime acoustic range developed at Loch Goil during the Second World War. As acoustic detection systems such as passive sonar have been in operation since as early as the First World War and are a key means of detecting vessels, it is essential for naval platforms to be as quiet as possible, so good acoustic design is a critical part of a successful platform.

Vessels are tested on these ranges to characterise their acoustic signatures in order to optimise their design and operation. This may be for commissioning new platforms or those which have undergone a re-fit, and for regular checks of in service platforms.

QinetiQ utilise a number of maritime acoustic ranges in the UK and overseas which can be used for static and underway acoustic testing of naval platforms, and Seb discussed the various ranges and their different capabilities, as well as outlining some of the technology used on them, and the way in which the acoustic signatures are analysed and characterised. A key project is the upgrading of test systems to an entirely digital workflow, including redesigning and commissioning new digital hydrophones which are both more effective and speed up workflow.

Seb also discussed some of the challenges facing naval platforms – for instance in the event of refit or replacement of equipment, their acoustic signature can change, requiring them to attend a range for assessment and potential remedial work to optimise performance.

Yorkshire and North East Branch

On Thursday 28th September the Yorkshire and North East Branched visited the Gateshead factories of Zentia, a UK manufacturer of mineral ceiling tiles, baffles, and patented grid technology.

Yorkshire and North East Branch members were invited by Zentia for a tour of their factories to see the manufacturing process, and to view their current range of products. The visit began with an introduction to Zentia and how they evolved from Armstrong Ceiling Solutions, followed by a tour of the first factory where the ceiling tiles are created from waste paper, recycled fibreglass, and virgin Rockwool in different combinations for different products. Every part of the manufacturing process is carried out in the Gateshead factory, including mixing of their own paint to coat the tiles, making Zentia one of the largest UK paint manufacturers, providing the finished tiles in 35 different colours.

The tour continued to the second factory, where tiles are painted and dried within only a few minutes. This factory also manufactures the grid for the installation of tiles, as well as proprietary grids for rafts and baffles. The tour finished with a presentation on the range of tiles available and their acoustic properties. Zentia are currently undertaking testing in different configurations at both SRL and University of Salford, building their database on acoustic performance of tiles and baffles. We're very grateful for the team at Zentia for letting us get some insight of just what goes into their products.

Above: Zentia plays host to IOA Yorkshire and North East Branch members

Environmental Sound Group update, November 2023

By Steve Mitchell, Mitchell Environmental Ltd, Chair of the IOA Environmental Sound Group

Welcome to the first Environmental Sound Group (ESG) update that will now feature in every other issue of Acoustics Bulletin. Your ESG committee will bring you two or more short pieces written by ESG members on current issues and trends that we hope will interest you and help keep you informed on some wider aspects of managing environmental sound.

We start with two pieces looking at different aspect of managing noise though planning and permitting. The first is a local authority officer's observations on a possible trend in public expectations on environmental noise in rural areas. The second is from the Environment Agency (EA) who have issued further guidance on the use of a BS we all know, to help ensure the quality of the permit applications that receive.

The Environmental Sound Group is holding a winter meeting on Wednesday, 13 December 2023 to further discuss the Environment Agency guidance, see more details on page 63 of this issue.

Noise nuisance and loss of amenity in planning new commercial developments in rural area

By Chris Christofis, Wokingham Borough Council

A growing trend for farmers seeking to diversify the use of their land can introduce new noise sources into quiet rural areas

In my district there is a growing trend for farmers in rural areas seeking to diversify the use of their land, often to storage/distribution, or sometimes commercial unit rentals. These introduce new noise sources into quiet rural areas. When completing environmental noise assessments for such planning applications we are guided by various guidelines on noise (e.g. BS4142, BS8233). Our intention is to achieve acceptable levels of noise for the existing neighbours after a new development is in place.

In the case shown in this image, the landowner would like to operate a storage/distribution facility near existing houses, and is seeking planning permission. Background noise levels are low, and clearly as shown, significant noise impacts are likely so there is a need to consider mitigation if planning permission is to be granted. This may involve restricting operations and likely a substantial noise barrier. Such a barrier could have a considerable impact on views from the neighbouring houses that previously enjoyed views over the countryside.

If we adhere to the adverse effect levels in our guidelines, we hope this is sufficient to mitigate any noise nuisance. I am finding for rural areas with a quiet background there may still be a perceived nuisance where there is a notable change. This is particularly noticeable where former agricultural or greenfield sites are developed for commercial purposes.

The question arises in considering a loss of amenity in such circumstances, should we consider the change to a rural acoustic environment, or soundscape, and how that is perceived by existing property owners in addition to the accepted decibel level guidelines in our planning policies? And also, if a large noise barrier is required to achieve this, how do we weigh into this judgement the loss of amenity it may create?

Publication of Environment Agency Method Implementation Document for BS 4142

By Tony Clayton, Environment Agency

New noise guidance was published by the Environment Agency on GOV.UK in spring 2023. The Method Implementation Document (MID) for BS 4142 is intended to supplement BS 4142:2014+A1:2019 Method for rating and assessing industrial and commercial sound.

The guidance was developed by the four UK regional industry regulators, the Environment Agency, National Resources Wales, Scottish Environmental Protection Agency, and the Northern Ireland Environment Agency.

Above: MIDs explain how to use the standards when applying for a permit or complying with permit conditions for a regulated activity

MIDs are sometimes published by the regulators to support national and international standards. They explain how to use the standards when applying for a permit or complying with permit conditions for a regulated activity. They should be used alongside the standard, in this case BS 4142, as their structure follows the clause numbers and section titles. They do not repeat text from the standard or re-state all its provisions. They just provide extra guidance where needed.

You **must** follow the requirements in the MID for BS 4142 if you are applying for a new environmental permit, applying to vary an existing permit or, if you are sending the regulator sound monitoring and impact assessments. You **must** also follow the requirements of BS 4142 and the guidance *Noise and vibration management: environmental permits*. This also applies to acoustics consultants carrying out this work on behalf of clients.

The MID for BS 4142 is intended to improve the quality of BS 4142 reports received by the UK regulators. To date, a large proportion of noise impact assessments received by the regulators are inadequate. The aim of the MID is to clarify any common misinterpretations of BS 4142 and to stipulate what the regulators require. The MID follows the structure of BS 4142 itself and Section 2 updates the normative references to include recent soundscape guidance.

The MID makes clear how to deal with existing site sounds for background (and residual) measurements when assessing the impact of proposed, modified or any additional sources. This includes when assessing the impact of extended hours of operation or when introducing an additional item of plant. If necessary, a proxy measurement location should be used.

BS 4142 requires the uncertainties of the measured and calculated values to be reported and the MID gives some detailed guidance on this. It stresses that the uncertainty caused by sound level meters is actually the lowest of all the possible sources of uncertainty. It also warns about the high risk of inaccuracy when measuring sound power in the near field.

Context is a crucial aspect of BS 4142 assessments more than ever and the MID addresses this. It also points to the guidance *Noise and vibration management: environmental permits*, which should be consulted for a list of what can be considered as context.

The four UK regulators report that unsatisfactory BS 4142 assessments, submitted as part of permit applications and variations, is a major issue for them. It's hoped that the MID for BS 4142 will clarify any misinterpretations of the standard and improve the quality of BS 4142 reports submitted by operators and their consultants.

You can view the MID for BS 4142 at **https://tinyurl.com/MIDBS**

Sound Advice:

IOA Environmental Sound Group winter meeting to explore BS 4142 and the Environment Agency

Join us for a lively and informative discussion on the latest developments when assessing sound for an environmental permit.

New noise guidance was published by the Environment Agency on GOV.UK in spring 2023. The Method Implementation Document (MID) for BS 4142 is intended to supplement BS 4142:2014+A1:2019 Method for rating and assessing industrial and commercial sound.

The guidance was developed by the four UK regional industry regulators, the Environment Agency, National Resources Wales, Scottish Environmental Protection Agency, and the Northern Ireland Environment Agency.

This meeting will be held on Wednesday 13 December 2023. There is no need to register so just use this Teams link to join **https://www.ioa.org.uk/civicrm/event/info?reset=1&id=845**

P.S. Don't forget to bring your sense of humour. The ESG is known for its friendly and welcoming atmosphere, and there's always plenty of laughter at our meetings.

Barrisol Acoustics®: combining innovation, acoustics, and environmental commitment

The Barrisol Acoustics® solution helps provide acoustic comfort in living and working spaces while combining aesthetics, acoustic performance and durability.

Barrisol improves the acoustics of spaces (aw up to 1.0) and demonstrates its commitment to the environment with its product ranges made from up to 60% recycled materials and which are 100% recyclable at end of life. Its Biowood® range of sheets are made with up to 92% natural ingredients.

Barrisol products vary in shape, application, and integration, and include acoustic properties thanks to the micro-perforations of their surface materials. These versatile products, some of which can provide air-conditioning solutions, help to correct room acoustics while still providing the right amount of light. Some can be backlit using translucent materials while others can be formed into 3D shapes etc. and all these acoustically treated solutions offer low weight and speedy installation, perfectly uniform quality, and light transmission, and comply with fire safety standards.

Barrisol acoustic stretch ceilings are available in more than 230 colours and 20 finishes (lacquered, satin, matt, mirror, suede, metallic, translucent, Arcolis® acoustic frames, recycled and biosourced and BioWood etc.).

Above: Acoustics design: cabinets d'architecture Lab Architecture et Bates Smart

New HEAD acoustics ArtemiS SUITE

HEAD acoustics has overhauled ArtemiS SUITE, its software platform for sound and vibration, psychoacoustic, and structural dynamics analysis. Release 15 brings improvements in useability, performance, scope of operability, and connectivity.

ArtemiS SUITE 15 offers improved model creation and calculation of the transfer functions for structure-borne and airborne sound according to different methods, such as matrix inversion for indirect determination of forces or volume velocity, blocked forces, effective mount transfer functions, and airborne sound sensitivity. Users can also perform the synthesis of path contributions in the time domain and export ready-to-use models for optional analysis and post-processing to Prognoise, the software for binaural transfer path analysis and synthesis. The Modal Analyses, Shape Comparison, and ODS projects are integrated and work seamlessly with the TPA project.

ArtemiS SUITE Release 15 has an updated interface to the augmented reality solution from HoloMetrix, making a physical measurement grid obsolete and sound power measurements more efficient and reliable, providing users with a powerful means for efficient sound power measurement based on sound pressure and sound intensity measurements.

The psychoacoustic analyses according to the 2nd edition of the standard ECMA 418-Part 2 are now implemented in ArtemiS SUITE 15. The standard describes the psychoacoustic loudness calculation method, significantly improving the loudness prediction of any signal containing narrowband and/or tonal components compared to the Zwicker, Moore and Glasberg methods. The Sottek Hearing Model, developed by the HEAD acoustics research team, forms the basis of the standard's psychoacoustic methods.

New Whisper® sound absorbing foam set to combat swimming pool noise

The ambient noise level of indoor pools can be unpleasant for both pool users and staff and noise levels can also be a health and safety issue. CMS Danskin Acoustics' new sound absorbing polyethylene foam product, Whisper®, addresses the problem.

Developed for use for indoor and outdoor environments, lightweight Whisper® panels absorb sound energy, reduce echo, and eliminate reverberation while being resistant to water and humidity. Whisper® provides acoustic performance of up to Class A and as Whisper® FR has a Reaction to Fire classification according to EN 13501-1 of B-s1,d0 (20-30mm)/B-s2,d0 (40-50mm).

Durable, long-lasting and easy to clean, Whisper® does not lose acoustic performance over time in high humidity environments. It is fibre free, UV resistant and, at less than 1.5 kgs per square metre at 50mm, it is lightweight.

The most economic method of using Whisper® is as vertical hanging baffles in an interior space. Whisper® absorbs sound on both sides, so baffles enable minimum product for maximum absorption. It can also be used as ceiling rafts where height in a building is restricted.

Whisper® UV is available in thicknesses of 25mm, 50mm and 100mm in a standard size of 2400mm x 1200mm (other sizes available on request) in black. A 15-year warranty is provided against acoustic degradation, which applies in indoor pools when installed in accordance with the manufacturer's recommendations as a vertical baffle and protected from UV light, organic acids, physical abrasion, immersion, and solvents.

Whisper® FR is available in thicknesses of 25mm, 40mm, 50mm, 60mm and 100mm in a standard size of 2400mm x 1200mm (other sizes available on request) and in two colours; white or anthracite grey.

Structural isolation for historic buildings

Structural isolation in a pre-existing structure is complicated and therefore rarely attempted. Here, find out how Mason UK helped isolate a Grade I listed building in Mayfair, London.

Built between 1756 and 1761 Cambridge House was bought in 2013 by developers who planned to transform the building into a luxury hotel, but the noise generated from nearby trains, which transmitted into the building via the basement structures, would have been intolerable to guests.

Hoare Lea devised an acoustic specification to provide the necessary levels of isolation and Mason UK helped to deliver it through the provision of bearings but a key unknown was the distribution of loads across the bearings.

Making things work architecturally was also challenging. At the basement level, a network of rooms and walls under the ground were acting as a transmission path for vibration. Mason UK therefore sliced through these walls to remove the rigid connections and replaced them with a series of rubber connections. Approximately 1,500 6Hz isolation bearings were supplied for this purpose and each one was designed bespoke to take a specific load, and had a unique identifier to ensure its intended location was adhered to during the installation phase.

New name for Atkins

SNC-Lavalin Group Inc. (TSX: SNC), a fully integrated professional services and project management company with offices around the world, has re-branded to AtkinsRéalis.

Building on more than a century of accomplishments from brands such as SNC-Lavalin, Atkins, Faithful+Gould, DTS and Atkins Acuity, AtkinsRéalis brings the whole organisation together under one single brand. Headquartered in Montréal, Canada, AtkinsRéalis combines the expertise of its 36,000 employees across markets and regions to deliver end-to-end solutions in the built and natural environments.

The name AtkinsRéalis is a coined term that combines Atkins, a legacy brand that is well-established, and 'Réalis,' inspired by the city of Montréal and the Company's French-Canadian roots. 'Réalis' also resembles the verb 'to realise' or 'to make happen' which emphasises the company's focus on outcomes and project delivery.

P66

Unique acoustic challenge posed by two halls at Whittle Le Woods

Whittle Le Woods Hall in Lancashire was built as a chapel in 1840 before being used for industrial purposes. It is now a thriving community hub providing users with a fantastic resource to stage all manner of events.

A second hall was constructed at the rear of the premises to cope with demand, using modern methods and materials providing a contrast to the traditional look and feel of the old hall.

Whittle Le Woods Hall suffered from poor acoustics resulting in excessive reverberation and echo that affected productions and caused speech intelligibility issues for the groups that used them. So earlier this year Secretary, Peter Higham, contacted Sound Reduction Systems (SRS) for help and advice.

SRS's Alex Docherty said: "Whittle Le Woods Hall provided us with challenges, not least the treatment of two completely different types of building – one modern and one traditional. The modern building had a metal profile ceiling so we knew that a bonded Sonata Aurio solution would work best and meant that we wouldn't have to mechanically fix through the metal profile itself. The traditional hall presented a more testing challenge in that the ceiling had a complex design of exposed timber beams that limited the space available to install the panels without spoiling the aesthetics."

Following completion of the installations, hall secretary, Peter said: "Now that both halls have had the Sonata panels installed, it is so much easier to communicate within the rooms as the echo has been minimised. It has made a tremendous difference to the sound experience."

New noise source for measuring impact sound insulation

The IB01 Impact Ball is a lightweight, easy-to-use, and professional impact source for stimulating ceilings during impact sound insulation measurements in accordance with the DIN EN ISO 16283-2:2020-11 standards for buildings as well as ISO 10140-5:2021 standard for laboratory applications.

This provides building acousticians with a product that has great time-saving potential. The Impact Ball is very well suited to simulate low-frequency sound events, such as those caused by footsteps or children jumping on wooden beam ceilings and the Sound Insulation Reporter software supports the evaluation of the measured values recorded with the Impact Ball.

Wooden buildings are becoming increasingly popular however, wooden beam ceilings are more susceptible to transmitting low-frequency impact noise to lower floors. Measuring impact sound insulation using a simple and effective method is important.

The IB01 Impact Ball is a practical impact sound source, not just in terms of dimensions and weight. The excitation spectrum produced is also lower in frequency and therefore more applicable in many cases. Anyone who has ever had to carry out an impact sound measurement with airborne sound correction will appreciate that the rubber ball only emits minimal airborne sound.

The application is uncomplicated and the results are reproducible — the ball is brought to the standardised height of 1m using the included measuring stick and dropped at the desired location. The sound level LAF is measured in the reception room.

Printed acoustic ceiling baffles from AllSfär

Ceilings are crucial for maintaining acoustic comfort in open-plan spaces, however their potential for creativity is often overlooked. AllSfär aims to revolutionise this by applying innovative design thinking to create a captivating collection of acoustic solutions that not only serve their purpose but also add a visually intriguing touch.

Introducing BreezeSense Printed Acoustic Ceiling Baffles:

- made from 60% recycled PET;
- low VOCs and no formaldehyde binders;
- high-resolution printing provides a realistic wood effect;
- easily retro-fitted and easily removed to access services;
- designed and created in-house delivering fast lead times and bespoke options;
- creative way to add visual interest to ceilings;
- easily specified on the NBS platform using AllSfär's BIM files; and
- Made in Britain accredited.

SuperPhon Art Panels combat lunchtime noise at primary school

Children and staff at Gatley Primary in Cheadle, Cheshire, are enjoying quieter lunch breaks following the installation of a set of CMS Danskin Acoustics' SuperPhon Art Panels.

Cheshire Soundproofing were called in to address noise and reverberation levels in the school dining area, which accommodates 50 to 60 children for lunch. Serving staff and children were struggling to hear each other.

A scheme, which involved SuperPhon Art Panels, was developed by Cheshire Soundproofing using CMS Danskin Acoustics' acoustic calculation system. The brief from the school required an improvement in the acoustics, but also sought to add vibrance to the room and to promote healthy eating.

Six 1200mm x 1200mm Class A noise absorbing SuperPhon panels were installed, each printed with high resolution images depicting colourful, fresh vegetables and fruit selected from a database of images. The addition of the SuperPhon Art Panels, along with acoustic ceiling tiles, has created a more pleasant environment for staff to work in and the children are happier, reports the school.

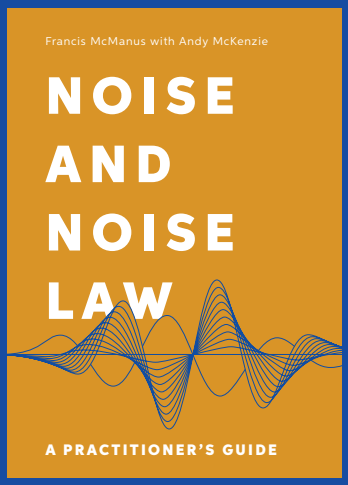
A spokesperson from the school said, "We were delighted to return to school after the holidays to a new, vibrant and bright look to our dining hall. The pupils love the artwork on the panels yet more importantly the acoustic improvement was noticeable immediately to the teaching and catering staff and has created a more acoustically pleasing environment for everyone."

SuperPhon provides up to Class 'A' acoustic performance and has a Noise Reduction Coefficient from 0.80 to 1.15 — an NRC of 0 indicating perfect reflection and an NRC of 1 indicating perfect absorption. The sound absorption coefficient is tested to BS EN ISO 354:2003.

Available in a wide selection of colour finishes and installation options, bespoke designs, such as corporate identity, commercial or decorative designs, murals and images are also an option. SuperPhon can provide complete or partial wall coverage and is available in standard or bespoke sizes and thicknesses.

NEWS

Noise and Noise Law: A Practitioner's Guide



Written by Francis McManus with Andy McKenzie *Noise and Noise Law: A Practitioner's Guide* published by Edinburgh University Press, is intended to provide practitioners and students with an introduction to the scientific background to noise, as well as a comprehensive and detailed account of the substantive law relating to the control of noise. *Noise and Noise Law* includes an account of common law nuisance, statutory nuisance, neighbourhood noise, noise and human rights, transport noise, noise mapping, town and country planning, and noise in the workplace.

https://edinburghuniversitypress.com/book-noise-and-noise-law.html

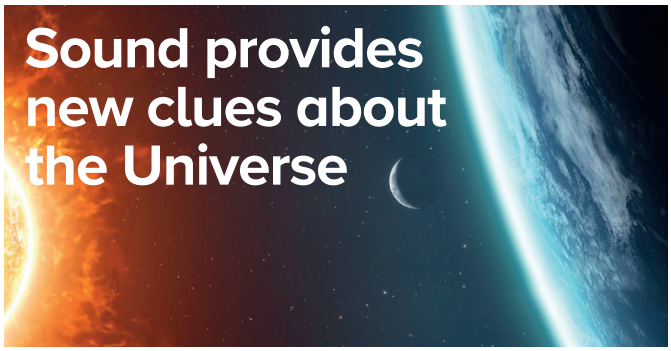
Theme park apologises to neighbours after blaring Halloween sound effects all night

The theme park in Chertsey, Surrey, played wails, screams and spooky music for 12 hours straight after a technical glitch led to noise from its Fright Night event continuing into the early hours.

A spokesperson for Thorpe Park said: "We would like to apologise for the noise disturbance that took place on the night of Sunday 8 October. We care about all our local residents and do our utmost to ensure we are good neighbours.

"Our team worked hard to establish the root cause of the technical issue and worked as swiftly as possible to find a resolution.

"We have since put in place preventative measures to ensure we can stop our sound systems from playing immediately in the event of a system malfunction. We are confident that with this new process and with our ongoing proactive sound checks, disturbance will be kept to a minimum."



A growing number of astronomers are now also analysing the Universe using data sonification' to convert numbers into audible tones, chirps, and hums.

"Some data is very difficult to visualise," says Anita Zanella, an astronomer at Italy's National Institute for Astrophysics. Her research often involves correlating more variables and parameters than a data visualisation can accommodate. "One thing we can do is have an image, and then add sound. You see the shape of a galaxy, and then 'listen' to its brightness or velocity.

"We cannot directly hear the sound, but we can arbitrarily associate sounds to data," Zanella says.

In addition to opening new avenues for research and knowledge creation, data sonification also creates new entry points into professional and amateur astronomy, both for people with visual impairments, and for people who interpret sounds more easily than pictures.

"Asking people to use only one sense is limiting," says Nic Bonne, a visually impaired astronomer at the University of Portsmouth, UK.

"People think of astronomy as a visual science, but that doesn't necessarily make sense," he says. "Most of the Universe is outside the visible spectrum, we're observing X-ray, radio waves, or ultraviolet radiation. For people who are visually impaired or blind, data sonification can give them access. Sometimes it just makes sense to turn things into sound. Sometimes listening for a pattern yields better results than looking for it."

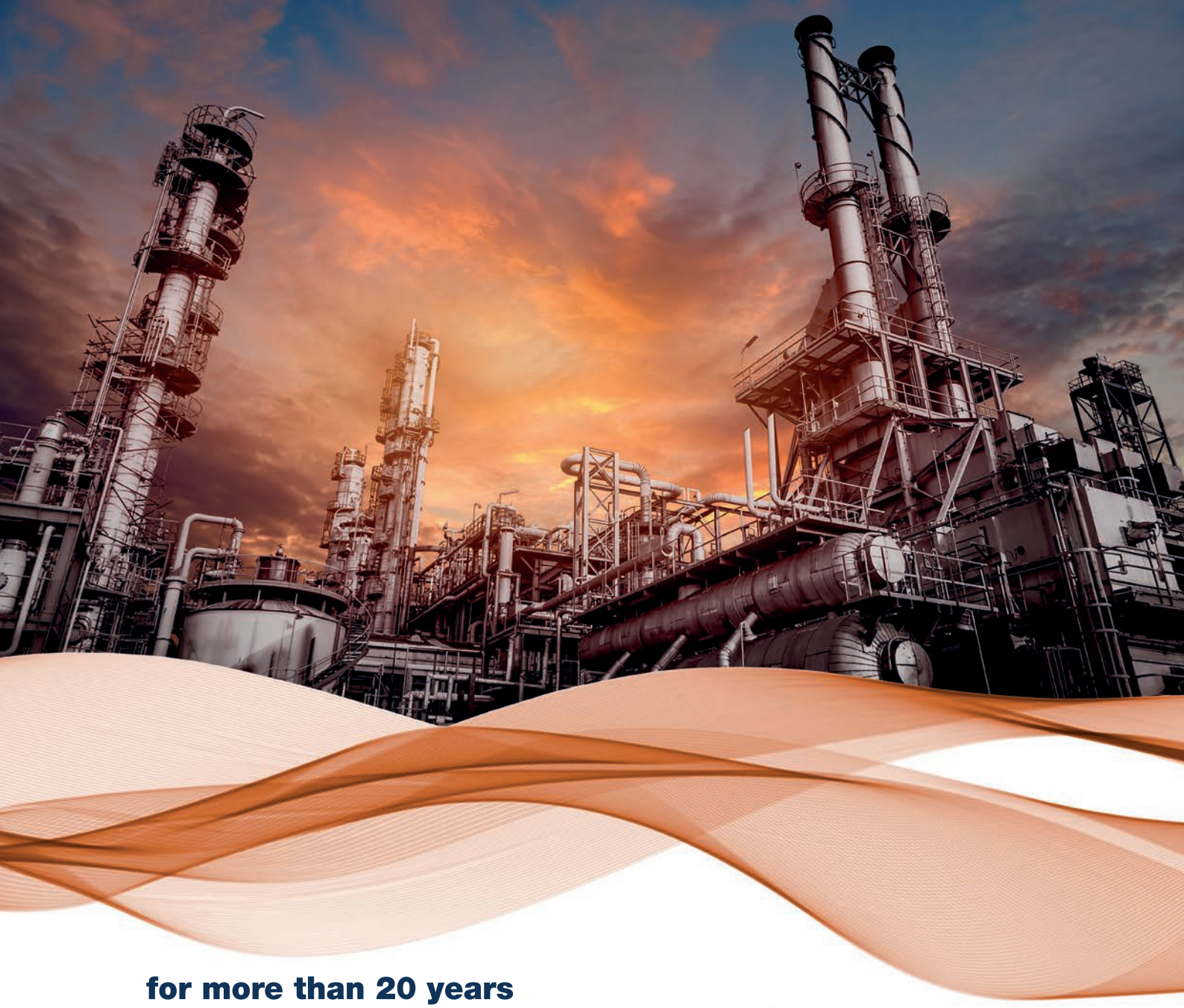
Research links plane noise to heart health hospitalisations

Research published in the summer from Imperial College London and the University of Leicester has investigated the potential impact of living near Heathrow airport on heart health.

The researchers found that the sound of planes flying overhead late at night is linked to a slight increase in hospital admissions for heart-related problems the following day.

Hospital admissions numbers and mortality data were combined with environmental modelling to assess short-term associations between aircraft noise and cardiovascular events the following day. The study covered a population of 6.3 million living near Heathrow Airport between 2014-2018. They found a 10 decibel increase in noise during the previous evening and previous early morning was associated with a small increase in risk for all cardiovascular disease admissions. There was no evidence of an association between aircraft noise and deaths due to cardiovascular disease.

The study author suggests that future research should investigate the efficacy of measures that could be offered to local communities of busy airports, including runway rotation and noise insulation.



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create solutions to the noise and vibration challenges in the

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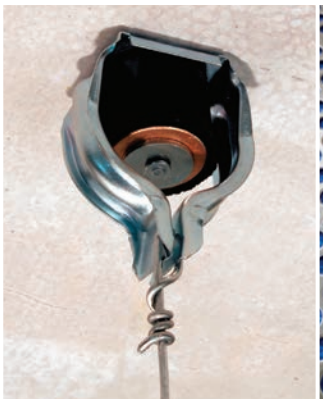
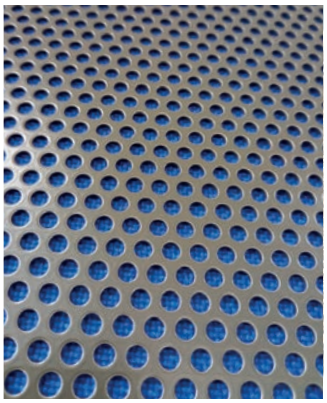


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Committee meetings 2023/2024

DAY	DATE	TIME	MEETING
Tuesday	21 November	10.30	ASBA Examiners (Edinburgh)
Tuesday	21 November	13.30	ASBA Committee (Edinburgh)
Thursday	23 November	10.30	Membership
Thursday	30 November	10.30	Executive
Wednesday	**6 December**	**10.30**	**Council**
Thursday	18 January	10.30	Membership
Thursday	1 February	11.00	Publications
Thursday	8 February	10.30	Meetings
Thursday	15 February	10.30	Diploma Tutors and Examiners
Thursday	15 February	13.30	Education
Wednesday	28 February	9.30	Engineering
Thursday	29 February	9.30	Engineering
Tuesday	5 March	10.30	Diploma Examiners (London)
Thursday	7 March	10.30	Executive
Wednesday	**13 March**	**10.30**	**Council**
Tuesday	19 March	11.00	CPD Committee

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Colour LCD with touch panel

3 hardware keys
Physically operated keys for reliable measurement execution

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

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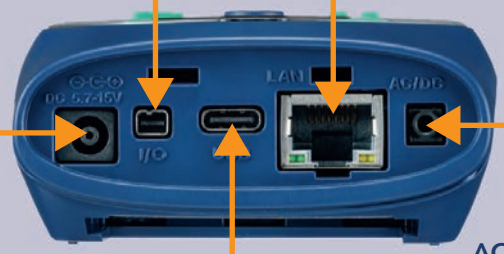

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