

Vol 37 No 3 May/June 2012

ACOUSTICS

BULLETIN



in this issue... The Speech Transmission Index after four decades of development

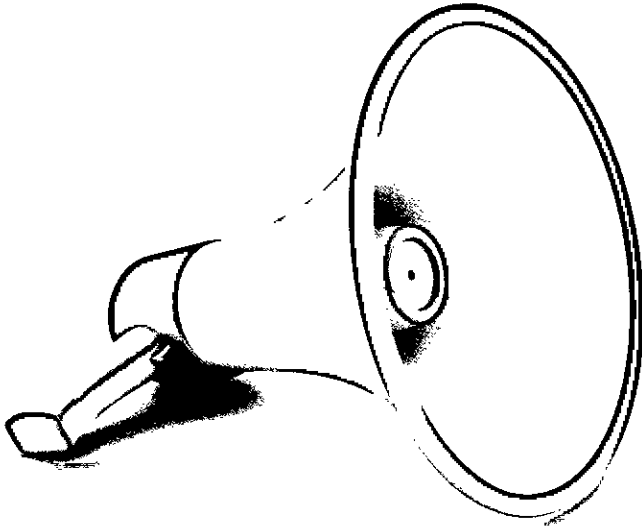
plus... 38th annual report of the Council for 2011

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ACOUSTICS

BULLETIN

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Front cover photograph: The Speech Transmission Index enters its fifth decade in 2012.

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

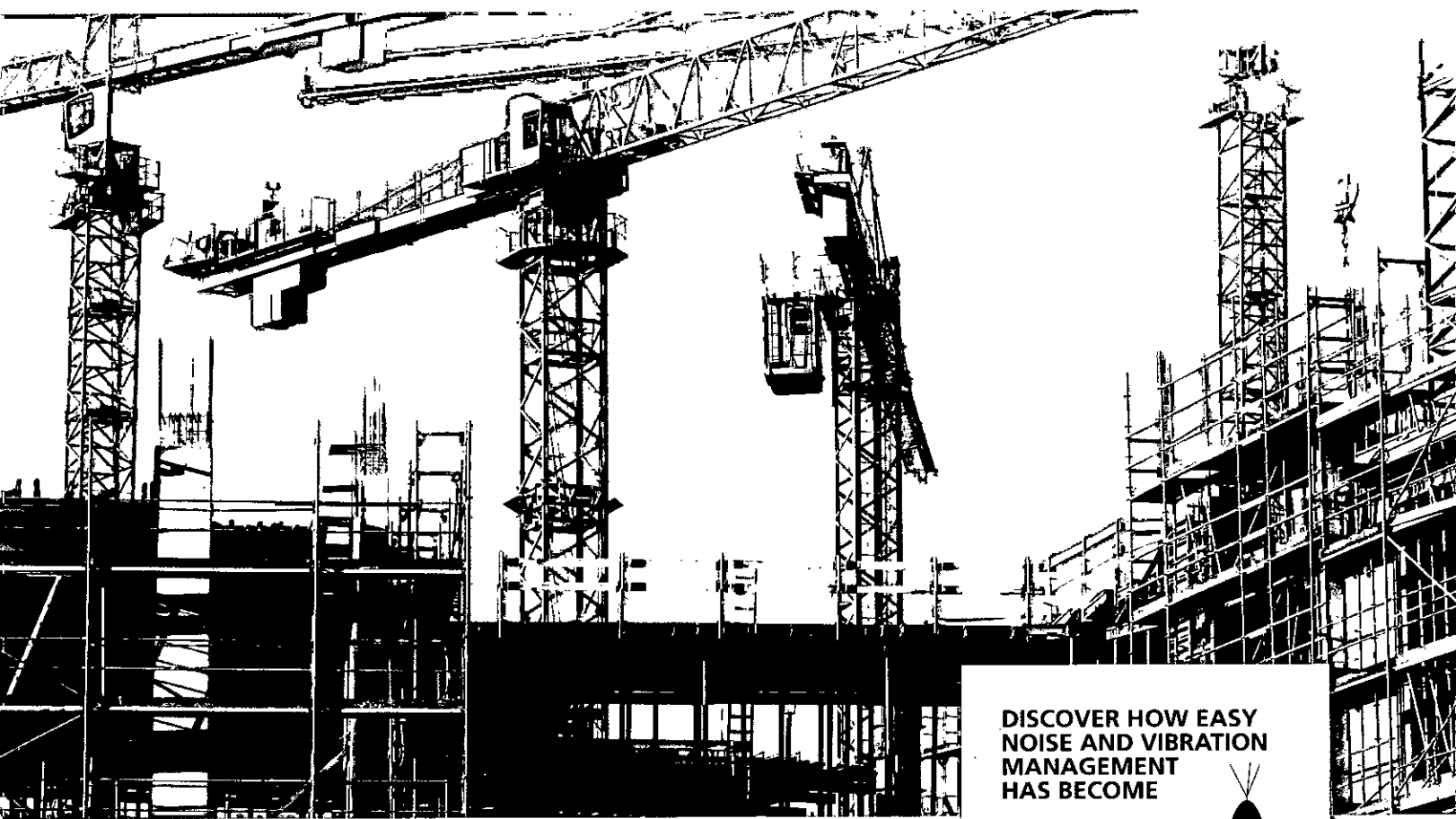
The Institute has over 3000 members working in a diverse range of research, educational, governmental and industrial organisations. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of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



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Dear Members

There is a tradition that outgoing government ministers leave a note for their successors. And as this is my last letter, I thought I could start a similar tradition by writing a note to our next President, Bridget Shield. Hopefully I can leave a more upbeat message than Tory Reginald Maudling did in 1964. "Good luck, old cock ... Sorry to leave it in such a mess." was the message to his Labour successor James Callaghan.

A note to Bridget about politics would be appropriate, including the Institute's role in influencing government policy and drawing up guidance. During my presidency there has been an increasing involvement in such matters by the Institute, continuing the work started by John Hinton my predecessor. Looking back at my presidency, I think the work around BB93 and the School Premises Regulations, in which I had a minor role, is possibly the most significant achievement. However, such matters are never easy. And one bit of advice I might offer to future Presidents is that there will inevitably be dissenting voices whose views need to be carefully listened to and considered. I don't believe that the Institute should stop getting involved. In my opinion it is better for the Institute to engage and pragmatically improve what is proposed. Perhaps my note should simply quote Otto von Bismarck: "Politics is the art of the possible".

I contemplated leaving a more practical and down-to-earth message: "Don't panic about what to wear for award presentations". At my first conference I was praised by some for not turning up in a suit and being a bit more modern, while others criticised me for not wearing a tie. I came to the conclusion that I couldn't win! Of all the jobs the President does, handing out awards was always the most pleasurable for me. I got to meet lots of members at conferences and to know some great acousticians. I only wish I had followed Sophia Loren's lead when she acted alongside the vertically-challenged actor Alan Ladd. She used to stand and walk around in a ditch to make Alan appear taller – I wish I had taken a similar approach for some of the award photos published in the Bulletin.

Given the loss that the Institute made last year, I contemplated echoing Labour's last chief



secretary to the Treasury:

"Dear Bridget, I'm afraid to tell you there's no money left". But I wouldn't want to trivialise the importance of the Institute's finances. And besides I'm hopeful that the recent improvement in budgeting, with monthly forecasts and closer scrutiny of every significant budget line, will lead to the state of the Institute's finances improving during Bridget's presidency.

The least exciting, but probably the most important thing a President does is chairing committees (Executive, Council and Medals & Awards). My simple advice would be: "Don't let these committees get into protracted, rambling discussions about subjects they have no control over". There is a fine balance to be struck between allowing people to have their say on issues and not allowing Parkinson's Law to rule ("work expands so as to fill the time available for its completion", *The Economist* 19/11/1955). Apologies to anyone on these committees whom I have cut-off mid-sentence.

Finally, writing this letter every couple of months has been a lot of fun, which leads to my final bit of advice "Dear Bridget, don't disappear to rural France ignorant of a looming deadline for the President's letter". ■

Trevor

Trevor Cox, President

38th annual report of the Council of the Institute of Acoustics for 2011

Ambitious programme of conferences to continue in 2012

The Institute has continued to serve the interests of its members through its established programmes in the areas of education, professional development, meetings and publications, and by providing representation in areas such as the Engineering Council, Standardisation and International affairs.

The Trustees confirm that in the exercise of their powers as charity trustees, they have had due regard to the published guidance from the Charities Commission on the operation of the public benefit requirements and the aims of the charity are carried out for the public benefit.

During the year:

- Two new team members joined the staff at head office during the year – Hazel Traynor joined the team as Administrative Assistant, and Louise McHugh joined as Accounts Administrator.
- An ambitious programme of well attended conferences and technical meetings was undertaken at international, national and regional level.
- Six formal applications for Chartered Engineer registration and one for Incorporated Engineer were submitted in 2011 and Professional Review Interviews were held in May and December. Three were "Standard Route" candidates, holding accredited degrees, and four were "Non-standard Route". All were successful.
- By September 2011 the "new" Diploma in Acoustics and Noise Control, now in its third year, recruited 112 new candidates, of whom 37 chose to study by the Distance Learning Scheme. As a result of grades obtained in 2010/11, the Diploma has been awarded to 86 students.
- Planning has been ongoing throughout 2011 for ECUA 2012 which will take place 2-6 July 2012 at Heriot-Watt University in Edinburgh, to be held in the UK for the first time in the conference's history.
- Planning had also taken place this year for the Acoustics 2012 conference being organised jointly with the French Acoustical Society – SFA. This will take place in Nantes, 23-27 April 2012.
- The Institute's *Acoustics Bulletin* had a change of editor during the year. After 11 years in the hot seat, Ian Bennett decided to relinquish his responsibility of editing the journal. The Institute's own Publicity Officer – Charles Ellis – agreed to take over and this will complement the monthly e-newsletter which he currently compiles. We all thank Ian for his hard work over the years.
- During the year an election was held to establish new members on the Institute's Council. This was the first time the process had been undertaken since 2003.
- The Institute is represented internationally through the following members: Colin English (Vice President, EAA), Barry Gibbs (Director, IIAV), Prof Y W Lam (ICA Board), and Rupert Thornely-Taylor (Director, IIAV).
- The Institute once again sponsored one of the Noise Abatement Society's John Connell Awards.
- The Institute also sponsored the schools leaflet for Noise Action Week.
- The Institute has pro-actively engaged with a number of government departments (DfE, CLG, Defra and DECC) to influence future policies affecting acoustics.

Standing committees

The operation of the Institute is guided by Council through standing committees concerned with Education, Medals and Awards, Meetings, Membership, Publications, and Research Co-ordination. There is also a committee of the Engineering Division.

Education Committee

The Diploma and Certificate courses have continued to recruit and to provide education and training for both members and non-members of the IOA. The education programmes and courses introduce many working in acoustics and associated professions to the Institute and help in the recruitment of new members.

In September 2011 the "new" Diploma in Acoustics and Noise Control, now in its third year, recruited 112 new candidates of whom 37 chose to study by the Distance Learning Scheme. As a result of grades obtained in 2010/11, the Diploma was awarded to 86 students.

For the 2011/12 presentation of the Diploma the distance learning notes for the Building Acoustics and Environmental Noise Modules have been revised, edited and distributed.

In 2010/11, the Certificate of Competence Courses recruited as follows; Management of Hand-Arm Vibration 14 students (nine passes), Environmental Noise Measurement 164 students (147 passes), and Workplace Noise Risk Assessment 59 students (48 passes). The Certificate of Proficiency programme in Anti-Social Behaviour (Noise) is run in Scotland by Bel Education and Strathclyde University and recruited 27 students (21 passes).

A new Certificate Course, Certificate of Competence in Building Acoustics Measurements, is being launched at eight centres in 2012.

For the purpose of answering student and other queries, the credit transfer rating of the Diploma has been agreed as 90 credits. This valuation is in the light of the advanced standing for Diploma holders awarded by Derby University and NESCOT (Surrey University) for their relevant MSc courses. In 2011, Diploma members interested for CPD or other reasons have been able to register for additional specialist modules but only one has taken advantage of this opportunity.

During the year the Committee has accredited a new Diploma Centre at Southampton Solent University (also accredited for CCBAM and CCENM) and re-accredited centres at Colchester (CCENM and CCWPNRA) and Leeds Metropolitan (Diploma, CCENM, CCWPNRA and CCMOEHAV).

During 2011, Mike Fillery has taken over as chair of CCENM Management Committee, and there is a new Chair, Stephen Williamson, for the ASBA Certificate Committee in Scotland.

The Education Committee continues to be indebted to the support of its members, course tutors and examiners, the work of the Education Manager and for the assistance provided by the Education Administrator and other members of office staff.

Engineering Division Committee

2011 has seen an increase in demand for Engineering Council registration from Institute members, in both Chartered Engineer and Incorporated Engineer categories. The Committee met twice during the year. One internal audit was carried out, with no non-compliances identified. The number of initial enquiries for registration from Institute members grew to 97 and the increase in numbers of candidates wishing to present themselves for interview continued.

Six formal applications for Chartered Engineer registration and one formal application for Incorporated Engineer registration were submitted in 2011 and Professional Review Interviews were held in March, May and November. Three were "standard route" candidates, holding accredited degrees, and four were "individual route" candidates with diverse backgrounds. All candidates were successful.

Presentations on Engineering Council registration were given to consultancies and to members. Interest in IEng registration at a relatively early career stage has increased considerably following a publicity campaign during the summer. ■

Following the grant of a further five-year licence by the Engineering Council in January 2010, a formal risk register, covering the full range of the Institute's activities, has been developed on behalf of Council and put into place in early 2011.

Medals and Awards Committee

Professor John Bradley was awarded the 2011 Rayleigh Medal at the Auditorium Acoustics Conference in Dublin for his outstanding work, especially in the field of architectural acoustics. The IOA Young Persons' Award for Innovation in Acoustical Engineering (sponsored by IAC) was awarded to Georgia Zepidou at the same event.

At Acoustics 2011 in Glasgow, Professor Bridget Shield was awarded the R W B Stephens Medal for her outstanding teaching and research, including her recent work on school acoustics. Three other awards were made at the conference including an Honorary Fellowship awarded to Professor Keith Attenborough for his long and distinguished work in both acoustics research and education. The other two awards were for Distinguished Services to the Institute, one to Tim Clarke partly for his work on ENG, and the other to Andrew Jellyman for his contributions to CPD and also the Midlands Branch.

Elsewhere, Dr Kyle Becker received the 2011 A B Wood Medal. Unusually, there were joint winners of the Professor D W Robinson Prize: Paula Firth and Debra Lumb.

Three prizes were awarded for our Diploma students. The best student prize for 2010 went to Sarah Large and for 2011 Luke Rendell (to be presented in 2012). The ANC Prize for the best Diploma Project for 2011 was awarded at Reproduced Sound to Andy Thompson.

At the same conference, Bob Walker, who previously worked for the BBC, was given the Peter Barnett Memorial Award, and Steve Dorney from University of Southampton was given the Award for Promoting Acoustics to the Public for his work with ISVR developing public engagement and outreach activities.

Meetings Committee

The committee met four times in 2011. The year finally saw some stability within the membership of the committee, with no changes from last year's report. The committee constitutes a chair (Jeremy Newton), secretary (Hilary Notley), young member (Christopher Turner) and two other members – Ken Dibble and Paul Lepper.

The committee presided over the organisation of 11 meetings covering a wide variety of topics. The feedback from the meetings' questionnaires continues to be very favourable. Given the global recession, the financial performance of meetings has been under some scrutiny and we continue to review performances and learn from our experiences so that deficits may be minimised in the future and meetings continue to generate a moderate surplus.

In particular, the financial performance of conferences has been looked at extremely closely and the lessons learnt are being implemented into the planning processes for future events.

Membership Committee

The committee met four times in 2011. One new member joined the committee which now has its full complement of 12 members.

278 applications for membership were considered and 248 accepted. The majority of these were for new associate members and for associate members transferring to corporate member grade when they had accumulated sufficient experience.

Work on the CPD scheme continues. From May CPD became a requirement for all candidates applying for or transferring to corporate grades. The CPD team continued to work on a means of encouraging CPD for the whole membership that will not be burdensome for the members to submit or for the Institute to check.

The committee considered nine Code of Conduct cases. Two were resolved informally and one resulted in the expulsion of the member after a conviction for fraud. The other cases were more complicated with large amounts of evidence submitted. This continues to be a substantial part of the committee's work.

2011	FIOA	MIOA	AMIOA	Tech	Affil	Student	Sponsor	Total
Applicants	3	135	99	15	3	20	3	278
Elected	3	118	85	15	4	20	3	248
New Members	0	26	80	10	5	18	3	142
Resigned	8	58	64	11	13	11	8	173
Deceased	1	4			1			6

Publications Committee

Through 2011 the committee met three times, although the website sub-committee met much more frequently working on the new IOA website. At the start of the year there was a consultation period for stakeholders where requirements for the new website were documented. The sub-committee has now taken these requirements forward, developing the new website and providing the main committee with updates along the way. The new website should be launched early in 2012.

Bi-monthly issues of *Acoustics Bulletin* continue to be produced, providing a high standard of technical content and reporting details of the Institute's meetings and affairs. Towards the end of 2011 Ian Bennett stepped down after 11 years as editor of *Acoustics Bulletin*, and Charles Ellis (IOA Publicity Officer) took over. The committee would like to thank Ian for all his hard work as editor over the years. An editorial board is being formed to assist Charles with the technical contributions. Charles also produces the monthly *Acoustics Update*, developing the e-newsletter to a high standard.

The IOA group on the social networking site LinkedIn continues to attract a steady stream of interested people, now with over 2,000 members. Do drop by when you're in the area and join in the discussions.

There have been two changes in committee membership over the year with one person leaving the committee and another joining. Thanks go to all members of the committee for volunteering their time over the year, especially members of the website sub-committee who have given many hours taking the website project forward.

Research Co-ordination Committee

The committee met twice in 2011, in May and October. Professor Kirill V. Horoshenkov took over the role of chair from Professor Keith Attenborough. The discussions focused on the committee membership structure, organisation of the Acoustics 2012 conference in Nantes (France) and better links between the IOA and EPSRC/Defra/TSB. It has been agreed to introduce a two-tier membership structure of the RCC. There will be a core group (tier one) of committee members. These members regularly attend the committee meetings and contribute systematically to the operation of the RCC. Tier two members are those members of the Institute who play a role in this committee and can be invited to attend some meetings of this committee to assist with various matters which require additional acoustics and acoustics-related expertise. Tier two membership can be more appropriate for younger members, those members who are not based in the UK and other IOA members who cannot regularly attend the RCC meetings. It has been noted that better communication with government funding organisations and the IOA is needed. Actions have been assigned to some committee members to deal with this issue. Two new members have joined the committee, Professor Abigail L. Bristow and Dr Ray Kirby.

Specialist groups

The Institute reflects the broad spectrum of the science and application of acoustics and several specialist groups exist to foster contacts between members of the various specialisms.

Building Acoustics Group

Another busy year has just passed with the group delivering high quality educational meetings, providing thorough and coherent consultations for new documents and standards, and **■ P8 ■**

P7 promoting the IOA to a wider audience.

We were involved with organising the following meetings:

- The IOA autumn conference in Glasgow in September 2011 – this successful two-day meeting was organised in collaboration with the Environmental, Measurement and Vibration Groups
 - 8th International Conference on Auditorium Acoustics in Dublin – May 2011
 - International Symposium on Temporal Design in Sheffield – July 2011
 - Acoustic Challenges in Green Buildings – February 2011
 - Young and Senior Members' Groups meetings.
- Consultations were made on:
- BS8233
 - CIBSE Guide
 - AIS Office Acoustics Guide
 - Schools Acoustics
 - ISO 140
 - BREEAM.

A real effort has been made to communicate acoustics as a profession to schools and universities and our Young Members' Group is growing and becoming more vibrant. The Chairman of the Building Acoustics Group was also the guest speaker at a high level conference on acoustics in Saudi Arabia. Promoting acoustics is an important part of building design.

2012 looks like being another exciting year with the joint meeting with the French Acoustical Society in Nantes and the promise of another high-quality IOA autumn meeting.

Thanks go to all the people who have given their time so generously. We really couldn't do it without you.

Electro-acoustics Group

During 2011, the group committee organised and put on Reproduced Sound 2011, the annual two-day conference that has run every year since 1984. This was held at the Thistle Hotel, Brighton, and was once again well attended with both regulars and new faces. Feedback (questionnaire forms) was sought from attendees and these have been scrutinised to inform future events, especially from the new influx of student attendees. It was announced at RS2011 that RS2012 would return to the Thistle on 14-16 November. Themes will include the use of audio systems to develop and communicate acoustic designs in the inter-disciplinary environment, commonly referred to as auralisation. As ever, abstracts on the wider range of subjects affecting electro-acoustics will be welcomed.

Opinion was also sought at the 2011 AGM as to the venue for RS 2013. The idea of Manchester/Salford, with links to the BBC MediaCityUK development, was enthusiastically received, and investigations into venues and links with the BBC are already being explored.

Environmental Noise Group

In May 2011 the group held a well-attended workshop on Emerging Government Planning Policy: What Does it Mean for Practising Acousticians? The delegates brought together discussions on a number of planning policy changes that may influence ENG member activities in the coming years.

The committee considered several public consultations and prepared a response to the Draft National Planning Policy Framework consultation in October.

In September 2011 ENG members supported the Acoustics 2011 conference in Glasgow. A new decade – a new reality. Rethinking acoustic practices for the austerity decade. The annual meeting was held on 14 September, at which the ENG committee was re-elected with two changes. The chairman thanked the committee for their enthusiasm and diligence in preparing numerous consultation responses in the previous two years. Thankfully the demand for these responses has now slowed.

Measurement & Instrumentation Group

During 2011 the group has played a significant role in the planning and programme of the conference Acoustics 2011, A new decade – a new reality, Rethinking acoustic practices for the austerity decade,

held in Glasgow on 14-15 September. The joint effort of four of the IOA's groups made for a wider coverage of topics, and the visits to nearby sites of acoustic interest, especially the one organised by the M&I Group to the Hamilton Mausoleum, with its magnificent reverberation time, provided some diversification from the fare of papers and presentations at the Crowne Plaza Hotel, and was enjoyed by all who were able to join in.

Over the past year, committee members have continued contributing to the regular Instrumentation Corner article in *Acoustics Bulletin*, which has produced some interesting discussion and articles, and this is scheduled to continue for the forthcoming year.

A one-day meeting in London entitled You want to put a microphone where! – Measuring and assessing noise sources close to the ear was planned for 6 April, but had to be postponed due to difficulties in getting the intended presenters to be available on that date.

A programme of three one-day meetings has been planned for 2012, with the first of these covering environmental noise propagation was planned at the Royal Society, London on 21 March.

Thanks go to all members of the committee for the active roles they take in all aspects of the group's activities and to Martin Armstrong for his secretarial skills on behalf of the group.

Musical Acoustics Group

The Musical Acoustics Group is in the process of being revitalised by Mike Wright and there is a core of people very keen to move forward.

An ad hoc committee has been reformed comprising Paul Malpas, Richard Keeble, Jonathan Kemp, Serafina Dirosario and David Sharp. It is hoped that the group will be co-ordinating its work with the Musical Acoustics Network, a network originally funded by an EPSRC grant but now self funding. A one day meeting, The King of Musical Instruments – Acoustic Challenges, is expected to be held at the National Museum, Cardiff on 21 May 2012. Group members should make their interests known to Michael Wright so that further events can be planned.

Noise and Vibration Engineering Group

Two main committee meetings were held during the year, supplemented by smaller subgroup meetings to develop specific events. The main focus of committee meetings was developing plans for events of interest to the NVEG membership.

A workshop on Sound Power Measurement – Problems and Practice was held at ISVR in early June. This was a repeat of a similar event in 2010 and was very successful, generating good feedback from delegates and interesting technical results.

Several members of the committee assisted in the Acoustics 2011 conference, notably Andrew Watson, who was one of the main organisers. The group contribution to the conference was a session on NVH issues in cars, chaired by Stephen Walsh. An annual meeting was also held at the conference.

Plans for 2012 include assisting in the organisation of Acoustics 2012 in Nantes (Malcolm Smith is on the scientific committee and is chairing various sessions). Plans for other meetings later in the year are being formulated, for example, on low noise design of machinery and possibly another vehicle NVH event.

Joint IOA/IOP Physical Acoustics Group

The Anglo-French Physical Acoustics Conference (AFPAC) was held in Fréjus, France, from 19-21 January. This was a joint meeting with the GAPSUS group of the Société Française d'Acoustique, and brought together acousticians from both countries. There were 60 attendees with 40 papers being presented. The conference was widely acclaimed as being very enjoyable.

A successful tutorial day on physical acoustics was held at the Institute of Physics in London on 22 September. Three external speakers presented tutorials that were accessible to non-specialists in their field. This year's theme was Son et lumière or Light and sound and the three tutorials were on: Photo-acoustics (Emmanuel Bossy, Institut Langevin, Paris, France), Acousto-optics (Steve Morgan, University of Nottingham), and Sono-Luminescence (Robert Metin, University of Gottingen, Germany). **P10**

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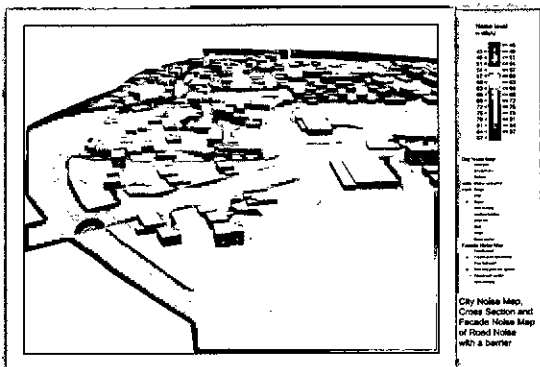
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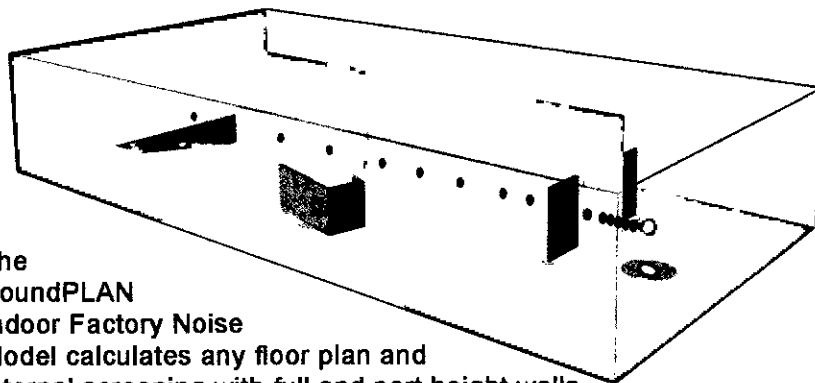


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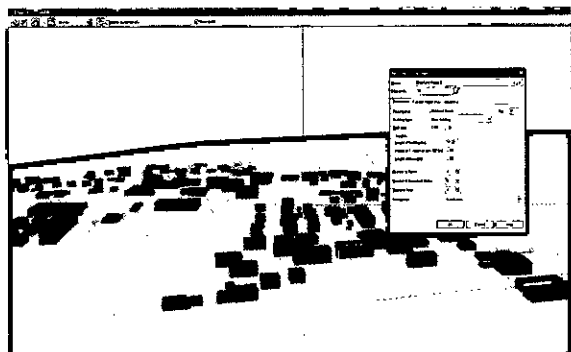
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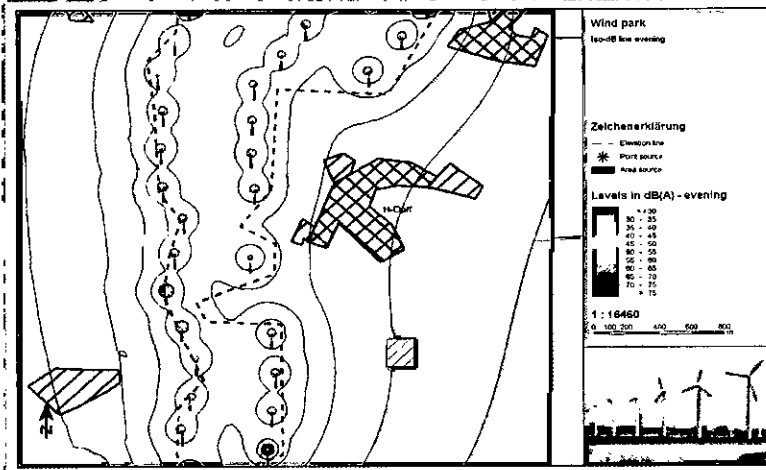
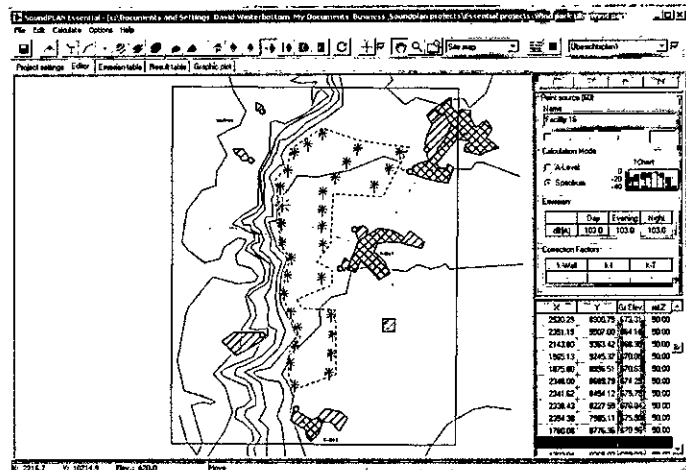


Object	Name	Type	Material	Height	Width	Depth	Volume	Area	Perimeter	Surface Area	Volume	Area	Perimeter	Surface Area	Volume	Area	Perimeter	Surface Area
1	Building 1	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
2	Building 2	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
3	Building 3	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
4	Building 4	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
5	Building 5	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
6	Building 6	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
7	Building 7	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
8	Building 8	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
9	Building 9	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
10	Building 10	Building	Concrete	3.0	10.0	10.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

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Senior Members' Group

The Chairman wishes to record his appreciation for the support and efforts of the committee.

The group was set up in January 2011. There has only been one meeting – the inaugural meeting at which Bridget Shield gave an interesting talk about her experiences in acoustics. We also had a stimulating presentation about the environmental research at London South Bank University in whose building the meeting was hosted.

The Chairman records his appreciation for the efforts made by the presenters at this meeting.

The main objective of the group is to co-ordinate the skills and experience of members for the benefit of the Institute. The following have been our principal activities:

- offering assistance to implement CPD
- assisting in checking out the new website
- assisting the Young Members' Group
- offering to review articles for *Acoustics Bulletin*
- contributing to both *Acoustics Bulletin* and *Acoustics Update*.

The History Project has been progressing under the guidance of Geoff Kerry with assistance from group members.

Speech and Hearing Group

The group committee met four times in 2011. The only event of note held over the year was a fascinating talk on Tinnitus and Hidden Hearing Loss, given by Professor David MacAlpine of the Ear Institute at UCL, immediately before the group's AGM in February.

However, group members have continued collaborating with the Institute's Building Acoustics Group, the British Society of Audiology, the Voice Care Network and the British Voice Association, over issues of common interest. Members of the committee have been involved in the planning of the speech and hearing sessions to be held at Acoustics 2012 in Nantes, France in April 2012 (organised jointly by the IOA and its French counterpart, the SFA). Further activities are planned for 2012, including a visit to the National Sound Archives at the British Library.

Underwater Acoustics Group

In 2011 the group continued to concentrate on the dissemination of knowledge via its conferences. A bio-acoustics contribution to ICBEN's 10th International Congress on Noise as Public Health Problem was made by Paul Lepper and Peter Dobbins. The main event of the year, however, was the joint IOA/USF conference on ambient noise held at the National Oceanography Centre, Southampton, in October. This event was organised by a committee led by Stephen Robinson, and was a great success. There were 83 attendees, 34 speakers and five keynote speakers. There were a lot of positive comments and no complaints. The conference dinner held on board the Princess Caroline was very popular. Following this success, the group is dedicating its main efforts to organising the European Conference on Underwater Acoustics (ECUA 2012) to be held in Edinburgh in July 2012. To date, this conference has attracted more than 400 contributions, and we thank Chris Capus for his efforts in organising this event.

Young Members' Group

The group committee meets quarterly and has a representative on

most of the specialist groups and regional branches.

Activities:

- The Young Members' Group sent out a questionnaire to better understand the needs and expectations of the young members.
- Postcards have been printed for the group for distribution at branch meetings and events.
- Two public inquiry theory and practice seminars have been arranged for London and Manchester (in February). Delegate places at the London seminar have been fully booked.
- We have gained sponsorship for future social events and other seminars/workshops are planned for the coming years.

Regional branches

The regional branches of the Institute exist to further the technical and social activities of the Institute at local level.

Central Branch

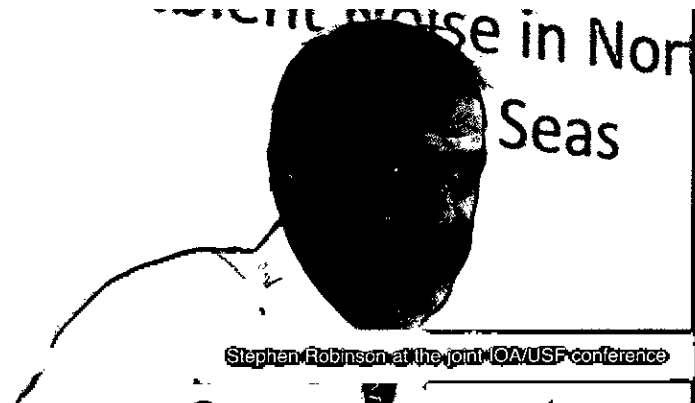
The branch held six evening meetings during 2011 with an average attendance of around 18. The first meeting in February was A Current Review of Acoustic Design for Speech Privacy between Offices in New Developments and Fit-outs presented by Alex Krasnic, which provided a useful round-up of the issues and criteria relating to office acoustics. In May, Professor Dame Ann Dowling gave an interesting talk on Towards a Silent Aircraft, followed in June by a well attended presentation on Structure-borne Noise and Vibration from Building Mounted Wind Turbines by Professor Andrew Moorhouse. Colin English led a discussion headed Review of BS 8233 – An Opportunity to Comment, feeding into the consultation process for updating the standard. In October, Lisa Lavia took us through the Noise Abatement Society's Quiet Deliveries Scheme. In December, Professor Colin Waters introduced A Discussion on the Relative Merits of Different Noise Metrics in the Assessment of Transportation Noise following the annual meeting which included Richard Collman being elected as chair, Mike Breslin as secretary and the retirement of David Watts, Ralph Weston and William Egan, all of whom had served a full six years on the committee from the inception of the branch and to whom a debt of gratitude is due. Thanks are also extended to all the speakers and the venues for hosting the meetings.

Eastern Branch

The branch maintained healthy membership interest via a wide range of presentations in 2011. The topics as usual have been diverse and aimed at both business interests and some social interests. We were fortunate to attract Dr Phil Morgan from the Transport Research Laboratory (TRL) and Dani Fiumicelli from AECOM early in the year and had a really interesting trip to Gemini Recording studios in April. Branch members will know noise from kitchen extract systems is an issue close to Clive Pink's heart and we were really pleased that Peter Hunnaball from Flakt Woods tackled this topic in July. We have had two hugely enjoyable but very different music presentations this year, one on hi-fi equipment and one on voice training, both by true experts in their field. Between those two, we had our eyes opened to new technology for internet-enabled noise monitoring which is certain to take off in a big way in the next few years. Eastern Branch covers a massive area so **P12**



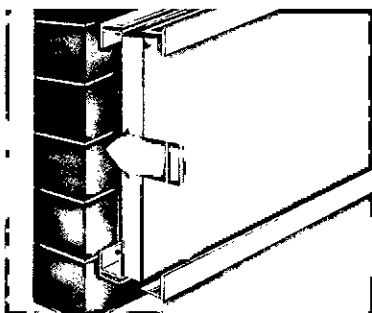
Senior Members' Group members at their inaugural meeting



Stephen Robinson at the joint IOA/USF conference

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Soundsorba manufacture and supply a wide range of acoustic panels for reducing sound in buildings.



WALLSORBA acoustic panels are used as wall linings to absorb sound. They are simple and easy to install even to unfinished wall surfaces. They are available pre-decorated in a wide range of colours. Three different versions are available. They can also very easily be cut to size on site. Noise Reduction Coefficient 0.92 (i.e. 92%).



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IP10 members will appreciate our meetings move around the county more than other branches but attendance generally remains good so we will strive to continue along these lines. Branch meetings 2011 (with attendance figures)

- 24 February – Quiet Deliveries Demonstration Scheme – Dr Phil Morgan – Ipswich – [37]
- 24 March – Noise Impact from Small Wind Turbines – Dani Fiumicelli – Braintree – [32]
- 28 April – Gemini Recording Studios Visit – Pat Gruebe – Ipswich – [14]
- 26 July – Noise Impact from Kitchen Extract Ventilation Systems – Peter Hunnaball – Colchester – [25]
- 29 September – Hi-Fi Myths Busted – Mike Swanwick – Peterborough – [24]
- 18 October – New Technology for Internet Enabled Noise - Monitoring & Group Discussion of Revision of BS 8233:1999 – Dan Saunders and Clive Pink – Woodbridge – [13]
- 22 November – Estill Voice Training System – Ben Mann – Colchester – [22]

Irish Branch

This year has seen three events organised by the Irish Branch, as well as responding to the *Higher Education Strategy Consultation* issued by the Department for Employment and Learning for Northern Ireland.

At the end of June we held our annual meeting at AWN Consulting in Dublin which progressed and closed smoothly, with Robert McCullagh standing for re-election and being duly re-elected. Damian Brosnan was co-opted in order to add "fresh blood". Following the AGM we had two speakers on the subject of Outdoor Music Events in European Cities – Noise Control and Monitoring. Michelle McNally of Dublin City Council gave a presentation on recent research into the Acoustic Control at Outdoor Events in Europe which involved contacting relevant bodies in the major cities in Europe with a questionnaire on standards applied and monitoring techniques used, for which 13 cities responded. Whilst there was some variation, it appears that the general consensus was for a "daytime" noise limit of 75dB L_{Aeq,15min} at neighbouring dwellings being appropriate in city and urban locations, and a limit of 65dB L_{Aeq,15min} for rural locations. Michelle's talk was followed by Gary Duffy of Enfonc giving a presentation on Efficient Noise Monitoring at Outdoor Events in which he gave an example of how modern instrumentation and communication technologies have been employed at a large annual outdoor multi-stage event outside Dublin. This enabled simultaneous real-time noise monitoring at six remote locations with the sound levels being available at a central control location as well as at each of the major stages. This was an interesting and well received meeting.

In September there was a very well attended meeting in Dublin given by Rupert Thornely-Taylor on his involvement in a local Dublin case where residents complained about noise from a recently completed light rail (tram) scheme: Smyth -v- Railway Procurement Agency and Veolia Transport Dublin Light Rail Limited – A Noise Nuisance Judgement. The talk, which was most illumi-

nating, was ended by an extended period of questioning from the floor.

In October we held the sixth annual Gerry McCullagh Memorial Lecture at which Professor Peter Wheeler gave a résumé of his experiences in acoustics throughout his varied involvements in the world of acoustics. It was entitled Taking Tea with Wotan – Tales of an itinerant acoustician, and covered his time at Imperial College, the BBC, ISVR, Rascal Acoustics and Salford.

London Branch

The London evening meetings have been successfully held for a second year at WSP's offices. Attendance has been sustained in line with the previous year's meetings, with a record head count of 78 members reported at our January evening meeting. Typically most other events attracted more than 40 attendees.

It has been another very busy year which has included nine events, comprising seven evening meetings, a half-day visit, a "sound walk and talk" and the annual dinner.

As usual, the topics for the evening meetings have been very varied in nature, covering subjects such as construction noise, soundscapes, a review of BS 8233, and wind farm noise.

The year began with Steve Summers' enlightening talk on construction noise, which had one of the highest attendance records for any London evening meeting. The next evening meeting was held in April and was hosted by Stephen Turner, the Head of the Technical Team at Defra. Stephen presented an update on the latest research, strategy and policy information from the Noise and Nuisance Department at Defra. This was followed by a presentation by Dani Fiumicelli at the next meeting in May, who provided a detailed review of the current assessment methodologies for evaluating wind farm noise. Following our normal two month break for the summer, Dr Bob Peters and Colin Cobbing gave a joint presentation in September on measurement/assessment uncertainty as part of the EIA process. This was followed by an interesting presentation by Simon Kahn on the review of BS 8233. There were a range of views expressed from the floor and a lively debate ensued. Alex Krasnic gave the final talk of the year on the subject of Acoustic Ambassadors.

In February, Stuarts Monks' earlier 2010 talk on the noise strategy for the London Olympics was complemented by an exciting half-day visit to the London Olympic Park in Stratford. As would be expected, this visit was over-subscribed. The visit comprised a guided tour of the park by David Demolder, Head of Licensing. David gave an initial overview of the history of the project and then took our group on a bus to see all the venues. Some of the iconic structures of note were the Olympic Stadium, the Basketball Arena and the Aquatics Centre designed by the international architect Zaha Hadid. After the tour, we walked to the nearby Formans fish restaurant which overlooks the park, where we were treated to a splendid lunch. The visit culminated in a talk by Mark Murphy, who described the sound and acoustic design work that had been completed and was ongoing for a number of the venues.

In June Claire Shepherd and Max Dixon organised a "sound walk" **D**



and talk", which took a slightly different format to our normal evening meetings. The evening began with short introductions by Claire and Max into the concepts behind 'soundscapes' and some suggestions of how participants could get the most out of the sound-walks. The meeting then split into two groups which were led by Claire and Max around planned routes, to demonstrate the wide variety of sounds that can be experienced even in a busy city like London.

In November we held our annual dinner in our usual location, the Bleeding Heart restaurant, which is renowned for its excellent French cuisine and friendly ambiance. Our previous visits have been good and it has always proved popular. This year's after dinner speaker was IOA President-Elect, Professor Bridget Shield. A few days before the annual dinner, Bridget was honoured at the Noise Abatement Society's annual John Connell Awards ceremony held at the Houses of Parliament, at which she was praised for "working tirelessly" to effect solutions for the public benefit. Bridget gave a wonderful talk about her life in acoustics with the aid of some old photographs showing some not so old acousticians – well not old at that time that is! Her work has been markedly varied, dealing with many subjects such as her recent research into noise and poor acoustics in schools; the prediction of industrial noise; community response to railway noise; concert hall acoustics; and annoyance caused by low frequency noise. The talk was well received and the discussion went on into the late evening.

Midlands Branch

2011 has been a very successful year again for the Midlands Branch. We held 10 well attended meetings from a planned 12, with a wide and interesting range of subjects. It is our intention to continue planning one meeting a month for the forthcoming year. CPD certificates are handed out at all meetings and we try to provide a range of topics and use venues across the region to appeal to as wide range of the membership as possible.

Branch meetings 2011

- 18 January – BS5228: Spreadsheet or Mapping; You Decide – Andy Nash, Robert Colder & Peter Hepworth – University of Derby
- 30 March – Hi-Fi Myths, Busted! – Mike Swanwick – Arup. Solihull
- 13 April – Introduction to PA and Speech Intelligibility – Jorge D'Avillez – Atkins, Birmingham
- 18 March – Micro Wind Farms – Dani Fiumicelli – URS Nottingham
- 22 June – NAS- Quiet Deliveries – Lisa Lavia – URS Nottingham
- 21 July – Recent Developments in Soundscape and Case studies of Sheffield Gold Route – Jian Kang – University of Sheffield
- 17 August – Review of BS8233 – Alex Ahern – Saint-Gobain, East Leake
- 20 September – IOA Diploma Student Projects
The Noise Impact of Night-time Deliveries to Supermarkets – Caroline Pope
Evaluation of Prediction and Measurement Methods for Small Studio Design – Ken Liston
Real Ear Attenuation at Threshold (REAT) Using Audiology **P14**



ANC

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The ANC has represented Acoustics Consultancies since 1973. We now have over one hundred member companies, including several international members, representing over seven hundred individual consultants.

Members of the ANC can also apply to become registered testers in the ANC's verification scheme, recognised by CLG as being equivalent to UKAS accreditation for sound insulation testing.

We are regularly consulted on draft legislation, standards, guidelines and codes of practice; and represented on BSI & ISO committees.

We have Bi-monthly meetings that provide a forum for discussion and debate, both within the meetings and in a more informal social context.

Potential clients can search our website which lists all members, sorted by services offered and location.

Membership of the Association is open to all acoustics consultancy practices able to demonstrate the necessary professional and technical competence is available, that a satisfactory standard of continuity of service and staff is maintained and that there is no significant interest in acoustical products.

To find out more about becoming a member of the ANC please visit our website (www.theanc.co.uk) or call 020 8253 4518

- **CP13 Testing Facilities** – Lesley Peplow – University of Derby
- 23 November – Towards a Silent Aircraft – Dame Ann Dowling – Loughborough University
- 13 December – Sounding Places: Past, Present and Future – Trevor Cox – University of Derby

The branch committee would like to thank all the speakers for their technical contributions, and the support from the various sponsoring venues who include: Atkins Birmingham, Arup Solihull, Saint-Gobain, University of Derby, University of Sheffield, Loughborough University and URS, who all provide the vital facilities and refreshments.

Several committee changes were proposed and agreed at the annual meeting namely:

- Mike Swanwick stepped down as secretary, and was thanked for his contributions over the last four years. Kevin Howell was duly elected as the new secretary. Mike agreed to stay on the committee as an ordinary member.
- John Hinton was elected as an honorary committee member to reflect his service to the branch.
- Mike Breslin and Grant Swankie were both elected and welcomed to the committee.

Finally a vote of thanks to the stalwart members behind the scenes, including: Kevin Howell for his *Acoustics Bulletin* reports, and Andrew Jellyman for creating the CPD certificates.

The branch committee also held its traditional planning meeting, where we have planned an equally full programme of monthly meetings for 2012.

The chairman would like to add a very strong vote of thanks for the excellent service from Mike Swanwick in his role as secretary and thanked him for remaining on the committee as an ordinary member.

North West Branch

The generally aged and almost retired branch committee organised five meetings during 2011 starting in February at BDP with a presentation by Keith Vickers of Brüel & Kjaer. He provided a commentary on the surprisingly short history of the sound level meter from the analogue variety up to the current digital models, even giving younger members the opportunity of playing with a type of 2203 model and “is that a needle?” Of course, all the types on display were familiar to the majority of the committee members!

In May, at Arup, Professor Andy Moorhouse of the University of Salford presented the findings of a recent research project funded by the Department for Communities and Local Government, the Department of Energy and Climate Change and the Department for Environment Food and Rural Affairs into structure-borne noise and vibration from micro-turbines mounted on buildings. Andy provided the results of the investigation, which included long term monitoring of two small wind turbines in the field, a measurement survey of transfer functions for masonry buildings, laboratory measurements of mast properties and a field survey of micro wind turbine installations.

Roger Tompsett of Noise Map visited BDP in June where he provided a presentation of Solving Practical Difficulties in the Assessment of Construction Noise. Roger suggested many construction noise assessments are inadequate and need to be more detailed to respond to the requirements of a typical modern code of construction practice, including appropriate mitigation measures. The application of the advice in BS5228 *Noise and vibration control on construction and open sites* was considered and the prediction of noise from a real life situation using a computer model was demonstrated. Useful information on the practical difficulties in assessing construction noise was provided, including the risks of over prediction due to inadequate details of the construction operations particularly “on-time”.

As part of a “round the regions” discussion opportunity to comment on the proposed revision to BS8233 ‘*Sound insulation and noise reduction for buildings – Code of practice*’, Phil Dunbavin of PDA led a meeting at Arup in August. Phil is a representative of the BSI Committee and orchestrated responses from members on the aspects of BS8233 that need to be improved.



Finally in November at BDP, after the annual meeting, David Waddington ably assisted by Eulalia Peris, Gennaro Sica and James Woodcock of the University of Salford presented a summary of the approach to a research project on Human Response to Vibration in Residential Environments funded by the Department for Environment, Food and Rural Affairs (Defra) UK. The project work included face-to-face interviews and internal vibration and noise exposures determined by measurement and calculation. Exposure-response relationships were presented for different vibration sources and the combined effects of vibration and noise exposure were also considered. Comparisons with published guidance, in particular BS 6472-1:2008, the ANC guidelines and BS 5228-2:2009, were briefly presented. The in-depth results of the project are awaited with interest.

The committee needs to be energised and is still hoping for some “new blood” to help organise meetings. Thanks go to Arup and BDP for hosting the meetings and all those who provide the backup at the venues.

Scottish Branch

The Scottish Branch started 2011 with our annual general meeting on 25 January at Heriot-Watt University. This was preceded by an interesting meeting on domestic noise and the new Scottish sound insulation standards. This included a discussion on the proposed IOA accreditation scheme for sound insulation testers. Robert Osborne, Chief Executive of the ANC, attended the meeting and provided an overview of the ANC scheme.

The IOA accreditation scheme was approved by Council in June and Professor Robert Craik was appointed as the Chair of the IOA Sound Insulation Test Accreditation Board. The approved IOA scheme differs from the ANC scheme in that it is exclusively an accreditation of the individual tester rather than being linked to an organisation.

2011 has been a year of significant change in terms of Scottish planning and noise guidance, with PAN 1/ 2011 and TAN-Noise replacing PAN 56. The new standard prompted much discussion amongst members during a meeting at Edinburgh Napier University on 1 June. Feedback was provided to Scottish Government in relation to concerns which may be addressed as part of a future revision. Thanks to Richard McKenzie for hosting the meeting.

The branch's activities for the year concluded with a meeting on the revision of BS 8233 at Edinburgh Napier University on 25 November. Thanks to Colin English for leading us through the issues being considered in the revision process.

The chair, secretary, treasurer and Young Persons' Representative of the Scottish Branch remain unchanged. Many thanks go to Andy Watson for continuing to look after Scottish Branch financial matters, to Nicola Robertson for her continued commitment as Young Persons' representative and to committee members for their support during 2011.

Southern Branch

The branch enjoyed a discussion chaired by Colin English of TECP on the forthcoming revision of BS 8233. The discussion was well attended by consultants and included a lively debate regarding



Hazel Traynor

Louise McHugh

■ strengths and weaknesses of the document.

A series of evening meetings are being planned for 2012 – members willing to discuss a relevant topic are asked to contact either Steve Gosling or Nigel Cogger in the first instance.

South West Branch

The branch held four meetings during 2011, beginning with a very interesting talk organised by Mike Wright, Chair of the IOA Musical Acoustics Group. A talk, Organ Builder – An Intuitive Acoustician?, was given by Lance Foy in Truro, Cornwall. Lance was appointed to rebuild the Truro Methodist Church organ in 1981. Lance introduced the organ and discussed the changes made over the years. This was followed by a recital by Philip Davey, organist, accompanist, composer and teacher, Director of Music Truro Methodist Church. The branch also visited Truro Cathedral where they could experience all three organs, the most famous of these, the “Father Willis” organ, is widely regarded as one of the finest instruments in the country. A fabulous start to the branch’s trips!

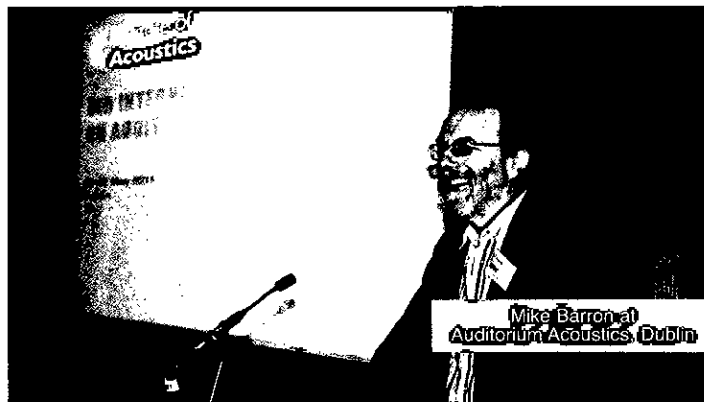
This was followed by a trip to Rockfon in Bridgend, Wales, where the branch was given a tour of their factory and demo room, and a talk based around Rockfon’s regulatory and industry knowledge.

The branch was then given an opportunity to recalibrate their ears during a “Soundwalk” around Bristol city centre, where those attending were able to assess how the changing environment affects the local soundscape. The walk enabled the group to consider how the soundscape of a location has a specific emotional or psychological impact, and further, to consider soundscape enhancement. The annual social meeting followed.

At the final meeting the branch discussed the revision to the BS8233 standard, with the branch making their comments on the revision to the BSI. Colleagues from RIBA and the CIEH were invited to this discussion.

Welsh Branch

2011 was a quiet year for the Welsh Branch. The branch organised a conference in January that explored statutory nuisance and planning. The event boasted high profile speakers including the



head of the Planning Inspectorate in Wales and was held in the Millennium Stadium, Cardiff. The event was well attended and was considered a success by those who attended.

Yorkshire and North East Branch

The branch held two meetings in 2011.

At the University of Bradford Dr Joe Venor gave a talk on vibro-acoustic simulation methodologies. He outlined the use of various vibro-acoustic prediction techniques for the prediction of noise and vibration levels in various diverse situations.

Professor Kirill Horoshenkov resigned as Secretary. The Chairman thanked him for the immense amount of work he has put into the branch.

A meeting was held on Tyneside at Armstrong World Industries, where a presentation on acoustic ceiling tiles was followed by a factory tour. **P16▶**

Grade	MEMBERSHIP	
	2010	2011
Hon Fellow	33	34
Fellow	186	179
Member	1655	1698
Associate Member	811	742
Affiliate	82	67
Technician Member	77	78
Student	74	79
Totals	2977	2931
Key Sponsor	3	3
Sponsor	56	51

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◀ P15

GROUP MEMBERSHIP

Group	2010	2011
Building Acoustics	1171	1206
Electro acoustics	296	311
Environmental Noise	1474	1500
Measurement & Instrumentation	427	455
Musical Acoustics	259	286
Noise and Vibration Engineering	940	968
Physical Acoustics	164	183
Senior Members		81
Speech & Hearing	190	193
Underwater Acoustics	137	156
Young Members		116

BRANCH MEMBERSHIP

Branch	2010	2011
Central	135	148
Eastern	259	262
Irish	142	131
London	728	732
Midlands	402	395
North West	392	378
Overseas	321	315
Scottish	169	163
South West	291	265
Southern	485	456
Welsh	45	67
Yorkshire & North East	215	213

DETAILS OF EMPLOYMENT

Employment Category	2010	2011
Architectural Practice	31	42
Consultancy	1388	1397
Education	209	244
Industry/Commerce	345	369
Public Authority	433	390
Research & Development	185	219
Retired	134	146
Other	86	88

MEETINGS ATTENDANCE IN 2011

Topic	Date	Venue	Attendance
Planning and Statutory Nuisance	26 January	Cardiff	43
Tour of Olympic Site	7 February	London	30
Acoustic Challenges in Green Buildings	16 February	Watford	27
The Art of being a Consultant	12 April	London	48
Auditorium Acoustics 2011	20-22 May	Dublin	101
Government Planning Policy	24 May	Salford	46
Sound Power Measurement	1 July	Southampton	21
ICBEN 2011	24-28 July	London	264
Acoustics 2011	14-15 September	Glasgow	106
Ambient Noise in North European Seas	3-5 October	Southampton	83
RS2011	17-18 November	Brighton	90

INSTITUTE PERSONNEL AT 31 DECEMBER 2011

COUNCIL	Officers	Ordinary Members
President	Prof T J Cox MIOA	Ms L D Beamish MIOA
President Elect	Prof B M Shield HonFIOA	Mrs A L Budd MIOA
Immediate Past President	Mr J F Hinton OBE FIOA	Mr K Dibble FIOA
Honorary Secretary	Dr N D Cogger FIOA	Dr E E Greenland MIOA
Honorary Treasurer	Dr M R Lester FIOA	Prof J Kang FIOA
Vice President: Engineering	Mr R A Perkins MIOA	Mr R Mackenzie MIOA
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Chief Executive:

Mr K M Macan-Lind

Countdown begins for ECUA 2012

International conference will a UK first

Registration is now open and preparations are well under way for the 11th European Conference on Underwater Acoustics (ECUA 2012), which will be held at the Edinburgh Conference Centre at Heriot-Watt University from 2-6 July.

This is the first time this prestigious biennial conference has visited the UK. Originating in 1992 as an international forum for presentation of the latest research and developments in hydroacoustical science and engineering with the support of the European Commission in co-operation with three European Acoustical Societies (IOA; DEGA; SFA), ECUA has become an established and renowned conference series. This year it is being run under the auspices of the IOA and is co-sponsored by the Acoustical Society of America (ASA).

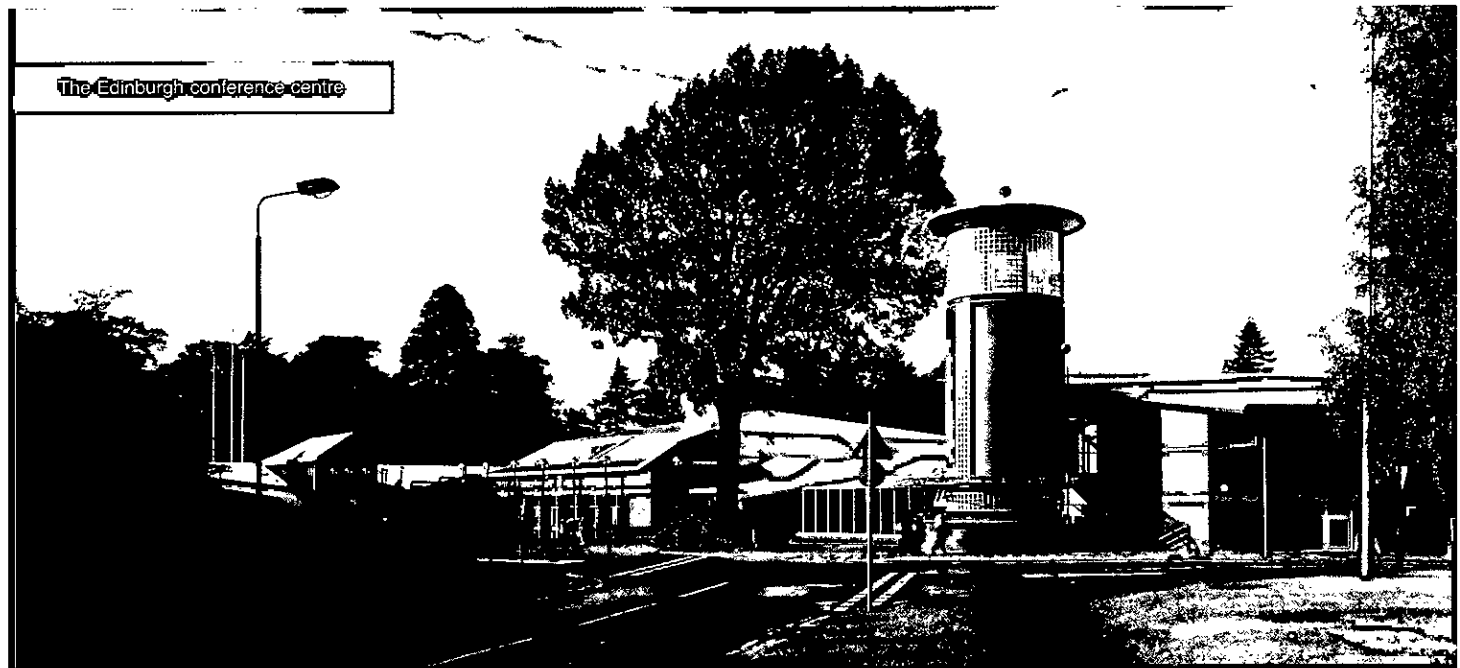
The conference is organised around 40 structured sessions covering major themes in ambient and radiated noise, bioacoustics, oceanography and mapping, ocean renewables, underwater signal processing, scattering, propagation, targets and

detection and communications. Current hot topics include metamaterials and vector acoustics.

ECUA 2012 will host a special session on fluctuations and scattering, celebrating the work and dedicated to the memory of Barry Uscinski, with a keynote speech by Terry Ewart. There are two further keynote presentations from Michel André and Peter Tyack on underwater noise and bioacoustics. A fourth plenary session at the conference will include the AB Wood medal ceremony followed by a presentation by the winner Kyle Becker.

The social programme includes a welcome reception on the first evening, the conference banquet and an evening concert by the Edinburgh Renaissance Band.

Further information, including registration details and the full technical programme, together with details of excellent sponsorship and exhibition opportunities, can be found on the conference website at: <http://www.ecua2012.com> ■



IOA honour for ad manager Dennis

Dennis Baylis has for the past 10 years been the Institute's Advertising Manager on the *Acoustics Bulletin*, the annual *Register of Members*, web advertising, and the on-line version of the Buyer's Guide.

Dennis' background, having worked with a number of instrument manufacturers over the years, has also made him the ideal person to co-ordinate the IOA's exhibitions when they are run in association with the conferences. His empathy with the industry has always been popular with the exhibiting companies' personnel.

A Corporate member of the Institute since 1980, Dennis continues to carry out his duties in difficult economic times with tenacity and in good humour.

For his excellent contribution to the life of the Institute over the past decade, the Institute of Acoustics is pleased to have presented



him with the Award for Distinguished Services to the Institute.

Recently, the Chief Executive, Kevin Macan-Lind, and his wife, Linda, had the pleasure of staying again with Dennis and his wife, Simone, at their farmhouse in the south of France and the perfect opportunity presented itself for the presentation. ■

Full house for Wind Turbine Noise 7

More than 80 delegates 'bowled over' by Cardiff event

Report by Gwyn Mapp MIOA, Senior Consultant, Bureau Veritas

The IOA's Wind Turbine Noise Conference continued its tour of the UK by returning to Cardiff after a gap of two years. The event was hosted by the Welsh Branch and was held at the SWALEC Stadium, home of Glamorgan County Cricket Club. The weather on the day was changeable at best with bright sunshine interspersed with heavy showers. A day's cricket would have been very problematic.

As appears to be the norm for conferences relating to wind turbine noise, the event was oversubscribed, with a healthy attendance of 83.

The majority of the morning session was devoted to the topical Renewables UK research into the subject of Amplitude Modulation (AM). Opening batsman, Dick Bowdler, provided a background to AM that included noise clips and a description of how AM can be heard at distances of 1000m and be measured at distances of up to 2000m.

Next into bat was Jeremy Bass, of RES, who discussed why the AM project was needed and introduced the goals of the project, which were:

1. To improve the understanding of AM – including fundamental research and possible solutions and/or mitigation;
2. To develop a suitable methodology for the assessment of AM – including the development of an objective method for quantifying AM and to develop a well-defined dose-response relationship; and
3. To disseminate widely.

Next at the crease was Matthew Cand, of Hoare Lea, who discussed how the AM project was implemented. In addition to discussing the different work packages involved in the research project, what was being carried out and by whom, Matthew introduced the concept of "Other" AM and discussed how it was different to "Normal" AM. Matthew also discussed briefly the potential causal mechanisms that were suspected of causing "Other" AM.

The fourth batsman of the morning was Malcolm Smith, of ISVR. Malcolm discussed the mechanisms involved in producing AM in Wind Turbines. Malcolm introduced the sources of aerodynamic noise on WT blades, the origins of "Normal" and "Other" AM and discussed how wind shear, stall effects, inflow turbulence and propagation effects can all play a part in increasing the level of AM, but possibly may not be the same in all receptor locations.

Next in was Paul White, also of ISVR, who discussed the devel-

opment of a metric to measure the strength of modulation. By way of introduction, Paul mentioned the difference between AM from WTs and AM as seen on a dial of a radio. Paul continued by discussing the rationale behind the development of several algorithms that were to be tested and presented results of those tests and their suitability in estimating the depth of modulation for the purposes of the research.

The AM topic was brought to a close with the speakers fielding questions from the delegates. The subsequent debate turned out to be lively.

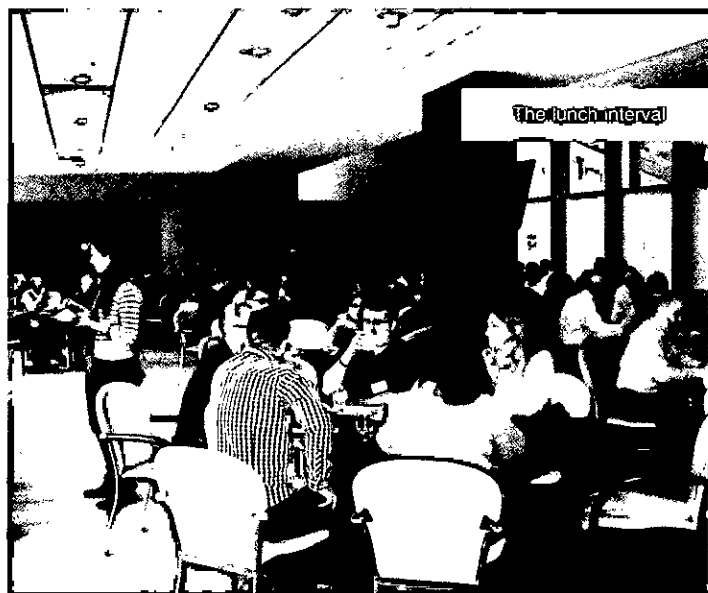
The morning session was continued by Chris Selby and Mike George, both of Cornwall Council, who discussed the formation of a wind turbine assessment panel within the local authority. It was revealed that the assessment panel was considered necessary as Cornwall Council was recently formed by the amalgamation of seven local authorities. Harmonisation of approach in dealing with WT cases was required particularly as it was revealed that Cornwall Council has seen more than a 300% increase in planning applications and screening opinions for single turbines between 2010 and 2011.

Seeing out the morning session was Simon Stephenson of Xodus Group who provided an overview of offshore wind turbine noise assessments. Simon discussed the potential impact of high underwater noise levels upon fish and especially marine mammals. The determination of source strength, prediction of propagation paths and assessment of levels of significance were all discussed, including any errors that may currently exist in the methodology.

As was befitting a cricketing venue, the lunch interval provided an opportunity not only to sample local Welsh fare, but to also network and to catch up on recent events.

The afternoon session was given the loose theme of "Updates and Developments" and was opened by Andy McKenzie, of Hayes McKenzie Partnership (HMP). Andy discussed the project carried out by HMP on behalf of the Department of Energy and Climate Change (DECC) that looked to review Wind Farm Impact Assessments conducted with a view to establishing current good practice in assessing and rating WT noise. The report resulted in a list of recommendations for further clarity and guidance.

Next in to bat was Richard Perkins, of Parsons Brinkerhoff, Chairman of the IOA Working Group which is developing the "Good Practice Guide to Wind Turbine Noise Assessment." Richard



explained that the working group was founded as a direct result of the need for the recommendations of the HMP research to be taken forward. Richard also explained that DECC had approached the IOA to write good practice guidance that would work in conjunction with ETSU – R – 97, not replace it. Terms of reference, composition of the working group, timetables and expected outcomes were all discussed. A formal six- week consultation on the draft good practice guide is expected to commence in April/May 2012.

The final batsman of the day was Dave McLaughlin, of Sgurr Energy. Dave discussed the background and current situation

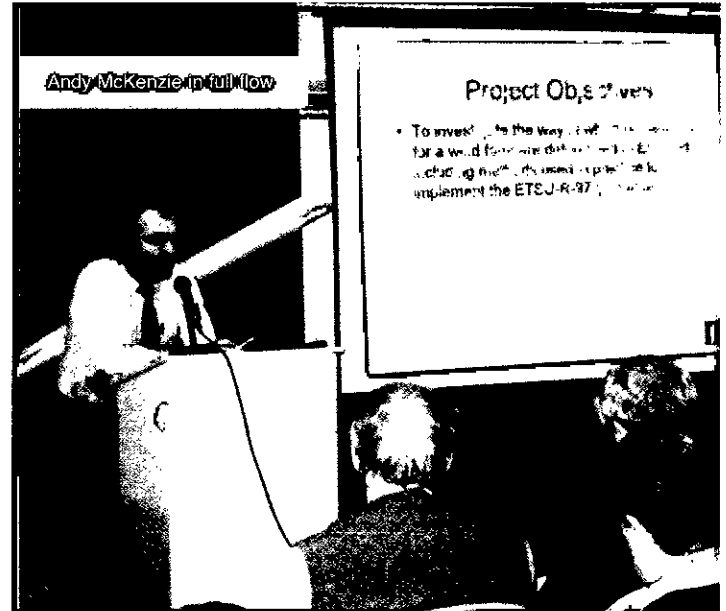
surrounding the issue of wind shear including the potential pitfalls of calculating wind shear from the “reference” height of 10m and the potential solution by measuring wind speed at two heights.

The feedback received by the organisers revealed that the day was a success with both the topics and the venue receiving very positive comments.

The Welsh Branch would like to thank speakers for their informed words of wisdom and for taking the time to contribute to what was a very successful and informative day. ■



The lunch interval...continued



Andy McKenzie in full flow

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NoiseMap

IOA welcomes dozens of new members

More than 100 applications for IOA membership were accepted by the Council in March as the result of recommendations made by the Membership Committee.

Of the 20 successful applications for corporate membership (MIOA), 13 were from existing members, the remainder were from people new to the IOA.

And of the 58 people who successfully applied for associate membership (AMIOA), 45 had not previously been members of the Institute.

The Council approved eight applications for technician grade membership and 19 for student membership. It also approved one application for sponsor membership.

In another change affecting membership, Brian Tunbridge has stepped down as Chairman of the Membership Committee after six years and has been replaced by Paul Freeborn. He remains a member of the committee. ■

Member

Andrews R G
Baker R G
Billin H L
Bray A J
Chapman D
Fazi F M
Hampton R J
Hirst S E
Hogg R S
Jarvie I
Martin D
Millard N J
Miller R
Monks A M
Mottershead A J
Neale W R
Park T O
Payne L

Torjussen M
Valeron V R

Associate

Abu-Khiran E
Barr A D
Bell J H
Bennett R E
Bennett S
Berrill J
Bignell S C
Bolton D J
Bowden L
Boyle M
Brown M P M
Clayson C
Coleman M T
Davidson R D
Davis B

Davis G
Dickson J P R
Edge S E
Finch A L
Fox R B
Fry N J
Goff C J
Green R H
Hainsworth P I
Hancock A R
Iafrati R
Jones J
Kavaney L J
Lemieux F M
Losada-Amor A
Lynch M J
McClaurin A J
McClung J G
Mitchell D L M

Morbelli C
Morris L
Morris R S
Mosley B J
Nash P M
Parker S
Potter V L
Povall J S
Price J
Queenan A E
Rowan N J
Shears R P
Simmons S
Smith N
Smith S A
Stevenson P R
Stickland I E
Symons P J
Thompson P

Todd A S
Tofts J G W
Tonner M P
Unwin A
Williams J G

Technician

Attwood T P
Barnford A S
Bennett M
Bligh J W
Da Silva T
Edwards S R
Knight A C
Rickards J G

Student

Amine-Eddine J
Ashcroft M

Barker C J
Barker P R
Bashir I
Cherian N A
Deane R
Garne S R
Lewis J R
Meggitt J
Mulvaney J
Orita M
Seddon J J W
Shaw G
Somikava N
Wang H
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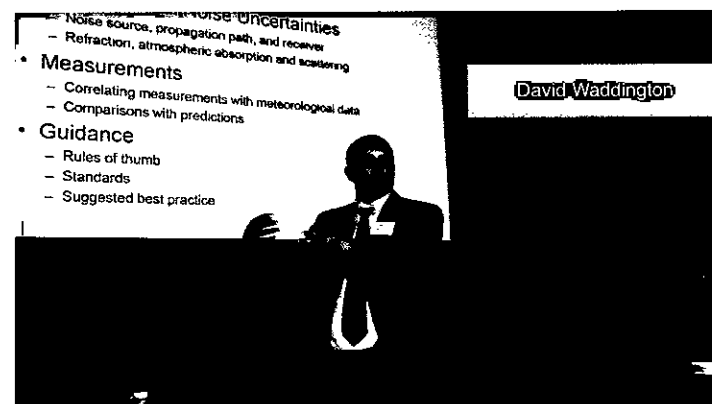
A way of looking at Environmental Noise Propagation

Report by Ian Campbell HonFIOA

Feedback from recent Institute meetings – yes, someone actually looks at and listens to the comments made by delegates – has shown there is a need to change the format of some of our technical meetings. The first thing is, of course, they are technical meetings. It is OK for there to be a commercial element by way of sponsor members mounting technical displays as part of the socialising element, but the main focus should be the technical and academic element. Imparting technical knowledge is not necessarily about new information; there is an important element of revision and updating, and, with this in mind, the idea of starting with a tutorial session to reinforce delegates' background knowledge about the main theme of the meeting was conceived. This has important ramifications for those undertaking CPD or extending their knowledge from one specialist area of acoustics to another. To enable a complete understanding of a new development, presenters will need long enough to expand in detail, as well as to allow the delegates time to participate and test the ideas in the light of their own experiences. Finally, we must not forget that young members and non-members are our future, so meetings have to accommodate them. To help in this area, the Senior Members' Group is providing mentors to be available at meetings to help both non-members as well as those from the Young Members' Group with any aspects of the IOA or careers in acoustics in general.

So much for the theory: the first trial of these suggestions was

the recent Measurement and Instrumentation meeting, Environmental Noise Propagation, at the Royal Society for the Advancement of Science on the 21 March. It started with a tutorial on the effects of weather on sound propagation by David Waddington, of the University of Salford, who delivered it in his usual enthusiastic style and set the scene for the following presentations. The first of these was presented by Keith Attenborough who reported on the extensive studies undertaken into the refinement of the understanding of ground effect on noise propagation. This shows that the accepted excess attenuation used to





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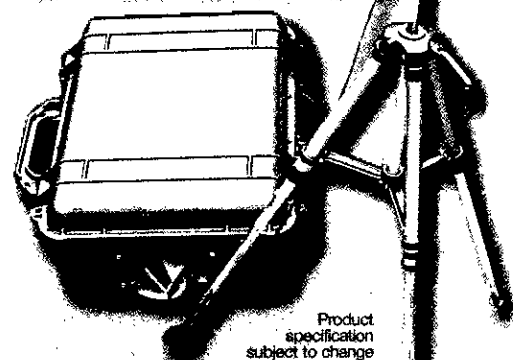
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◀P20▶ date can be augmented by exploiting the effective finite impedance associated with roughness in otherwise acoustic hard ground. Further work also showed potential usefulness of vegetative ground cover for noise control.

Moving from the academic to the applied, Dani Fiumicelli outlined how the balance between preserving the acoustic environment with the need to deploy more and more renewable energy sources if we are to meet our national carbon reduction targets. Wind power is leading in this sector and the technical aspects of noise generation along with the engineering and administrative procedures that can be deployed to balance the competing needs of the consumers of electricity and those impacted by the large scale development of on shore wind farms. The fact that we all work in a "regulations-driven environment" cannot be denied, and with this in mind Tony Clayton from the Environment Agency outlined the way in which the legal framework was being developed under the Environmental Permitting Regulations. These are designed to allow noise limits to be set taking account of Best Available Techniques and Appropriate Measures that can be deployed to control noise impact.

Moving back to the theoretical plane, the next contribution, by Shahram Taherzadeh, explored the principles of and possible application of sonic crystals in environmental noise control. The fact that regular arrays of cylindrical elements produce angle dependent sound attenuation in narrow frequency bands and enhancement in others can be deployed to shape the acoustic environment as well as visual amenity. This effect has been studied in conjunction with the ground plane characteristic which can be shown to be either constructive or destructive depending upon the configuration and hence could be a useful feature in engineering the acoustic environment. The most commonly used tool for the prediction of environmental noise propagation is the BS EN ISO 9613 and the way in which this treats reflections and diffraction make some general assumptions in order not to over complicate ensuing calculations. A paper from Panos Economou showed the impact of some of these short cuts and suggested alternative algorithms that will improve the accuracy of the predictions made.

The particular problems associated with flue stacks were the subject of the next presentation, with particular attention being paid to the way that the resulting environmental noise burden is



affected by the weather conditions. Key among the many interactions investigated by Simon Stephenson was the way in which diffraction due to weather conditions affects the effective incidence angle, resulting in much higher noise levels than traditional theory would suggest. Vegetation on building facades in typical city streets and squares was reported by Yulia Smyrnova, who, along with a team at Sheffield University, has investigated the improvements that can be made to the absorption coefficient by this kind of treatment. In addition to the treatment of facades, the introduction of vegetative low profile barriers can add a few more dB to the improvements noted. The final contribution related to the work at the University of Bradford on the specific acoustic performance of various species of plants. Kirill Horoshenkov showed how the different planting methods will affect the results with the soft loose types of fibrous soils combined with the leaf structure of the plant all interact to determine the insertion loss obtained. Those of us with green fingers can now relate specific plants acoustic properties to the obvious visual impact of the English gardens that should ideally border our streets.

The meeting programme obviously met the requirements of delegates as we had a full house and unfortunately had to turn some people away, so many thanks to the researchers and practitioners who put so much effort into making the meeting a success and to the M&I Group for sponsoring the meeting. The full papers are available on CD from the IOA. ■

IOA to sponsor 'Noise Oscar' again

The IOA is again sponsoring a major award at this year's John Connell Awards organised by the Noise Abatement Society (NAS) and for which entries are now being sought.

The John Connell Technology Award, established in 2010, recognises and encourages the development of new or enhanced products demonstrating significant technological advancement, and organisations demonstrating a history of sustained innovation across product lines to resolve noise pollution problems.

Submissions for the award should describe:

- the degree of innovation, technological advancement and sustained commitment to reducing noise pollution through product development
- evidence of overall solutions and impact, including target and desired goals and outcomes; measurement against agreed standards; and effectiveness in the mitigation of noise pollution
- placement of the product(s) in the business context: how it helps to achieve sustainability targets (lowering noise pollution)
- any additional environmental benefits achieved.

Dubbed the "Noise Oscars", the awards are named in honour of NAS founder John Connell OBE, who successfully lobbied the Noise Abatement Act through Parliament in 1960 when noise became a

statutory nuisance in the UK for the first time.

Trevor Cox, IOA President, said: "We live in a noisy world. And while technology is the cause of much noise, it also offers the opportunity to improve the soundscape through engineered noise control and innovative low noise products. The IOA is delighted to once again sponsor the John Connell Technology Award."

Gloria Elliott, NAS Chief Executive, said: "We are thrilled to welcome the Institute as generous sponsors for the third year of this award. By working together in this way with industry, trade associations, government, local government and public bodies we can help to further the uptake of quiet alternatives to traditionally noisy solutions, thereby protecting the public and reducing noise pollution."

Closing date for entries is 5.00pm on Monday 15th October 2012. All submissions should be sent to johnconnellawards@noise-abatement.com with 'Technology Award' noted in the subject line.

The technology award will be judged by John Hinton OBE, Panel Chairman and past President of IOA (2008-2010); Gloria Elliott; Max Dixon, town planner and urbanist specialising in noise and soundscape management, formerly of the Greater London Council; Stephen Crosher, consultant and technology expert, Fleet Renewables; and Alan Blissett, environmental health practitioner, Southwark Council

The awards ceremony will take place at the Palace of Westminster, on 6 November 2012 and will be hosted by Mike Weatherly, MP for Hove and Portslade, on behalf of the Noise Abatement Society (NAS) Trustees. ■

Institute shows the flag at ISCEx2012

IOA stand attracts strong interest from visitors

The IOA was again represented at the Institute of Sound and Communications Engineers' annual exhibition and seminars, ISCEx2012, which was held for the first time at Jurys Inn Hotel, Milton Keynes.

A stand manned by Chief Executive Kevin Macan-Lind drew many visitors, generating at least three applications for membership as well as strong interest in Reproduced Sound 2012.

Kevin said: "We've been attending this event for a number of years because we feel it's very worthwhile, both in terms of raising the Institute's profile and publicising events such as RS.

"We enjoy a close relationship with ISCE because of the crossover in some of our activities, so our presence helps further strengthen these bonds. We're already looking forward to attending next year."

The event, which featured 21 exhibitors, attracted some 150 visitors. Three companies used it to launch new products: ADS Worldwide with its T-series multi-zone/multi source matrix range, A K Barns with its Octo Sound Store and Baldwin Boxall with its latest Care-2 product, a new radial wired emergency voice communication system.

The seminars, which ran alongside the exhibition, covered a wide range of topics. Tony Barns, of AK Barns, questioned whether modern technologies were always appropriate. Robin Whittaker (Out Board) considered the science and art behind audio localisation, while Eric Bevilard (Ateis Europe) spoke about Audio over IP and Martin Daley and Stuart McKay (Allen & Heath) demonstrated the future of live sound and controlling the mix "the new way".

ISCE President Terry Baldwin said: "ISCEx2012 has been our best exhibition yet, and we are excited to announce the date of

ISCEx2013 on Tuesday, 5 March 2013, which will be the tenth anniversary of our exhibition."

For further details on ISCE, ring 0118 9542175 or email info.@isce.org.uk



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ACOUSTICS

STEM Acoustics Ambassadors: past, present and future

London Branch meeting

Report by Alex Krasnic

The presentation, by Alex Krasnic, started with a review of the beginnings of IOA Acoustics Ambassadors and a mention of the principal IOA members who had started to forge early relationships with SETPOINT, administrators of the STEM scheme. Moving on to the present status of STEM Ambassadors, it was noted that Acoustics Ambassadors currently made up only a tiny percentage of the number of STEM Ambassadors UK-wide. However, whilst the current numbers were deemed to be small, much progress had been made in recent years nonetheless.

To demonstrate some examples of recent events in which IOA Acoustics Ambassadors had participated in, Alex listed a few events in the last three years where acoustics activities had been a prominent feature at numerous school, engineering and careers events around the UK, most notably in south east England. Examples of these activities included Richard Collman's hugely successful "You're Banned" demonstration which has been presented at many STEM events over the years. Alex then concluded with some outline proposals on ways of promoting Acoustics Ambassadors within the SETPOINT network and

increasing the numbers of IOA members taking part in UK-wide events. The notion of a "STEM Delivery Team" was then put forward, envisaged to promote a range of acoustics activities to be used by any Acoustic Ambassador, depending on the age range of pupils and specific teacher/STEM activity requirements for future events.

While this was generally regarded as a good idea by the audience, a thought-provoking discussion ensued at the end of the presentation. Notably Mike Breslin of ANV Measurement Systems raised the point that to encourage more STEM Acoustics Ambassadors on board, perhaps each regional branch could look into promoting one of their members from within, to act as their official IOA STEM representative. Lastly, Helen Nichols of Effective Learning Environments (ELE) put forward a discussion proposal that; to bridge the gap between the expectations of both STEM as a UK-wide scheme and the delivery of acoustics-based presentations, Acoustics Ambassadors could benefit from engaging educationalist input. This could potentially act as an effective interface with STEM. ■

Noise Management for the Olympics

London Branch meeting

Report by Olly Creedy

Jim Griffiths and Olly Creedy from Vanguardia Consulting gave a joint presentation at WSP in January on The London Olympic Park – Noise Management for the Olympics, which proved to be a very popular topic, attracting a large audience.

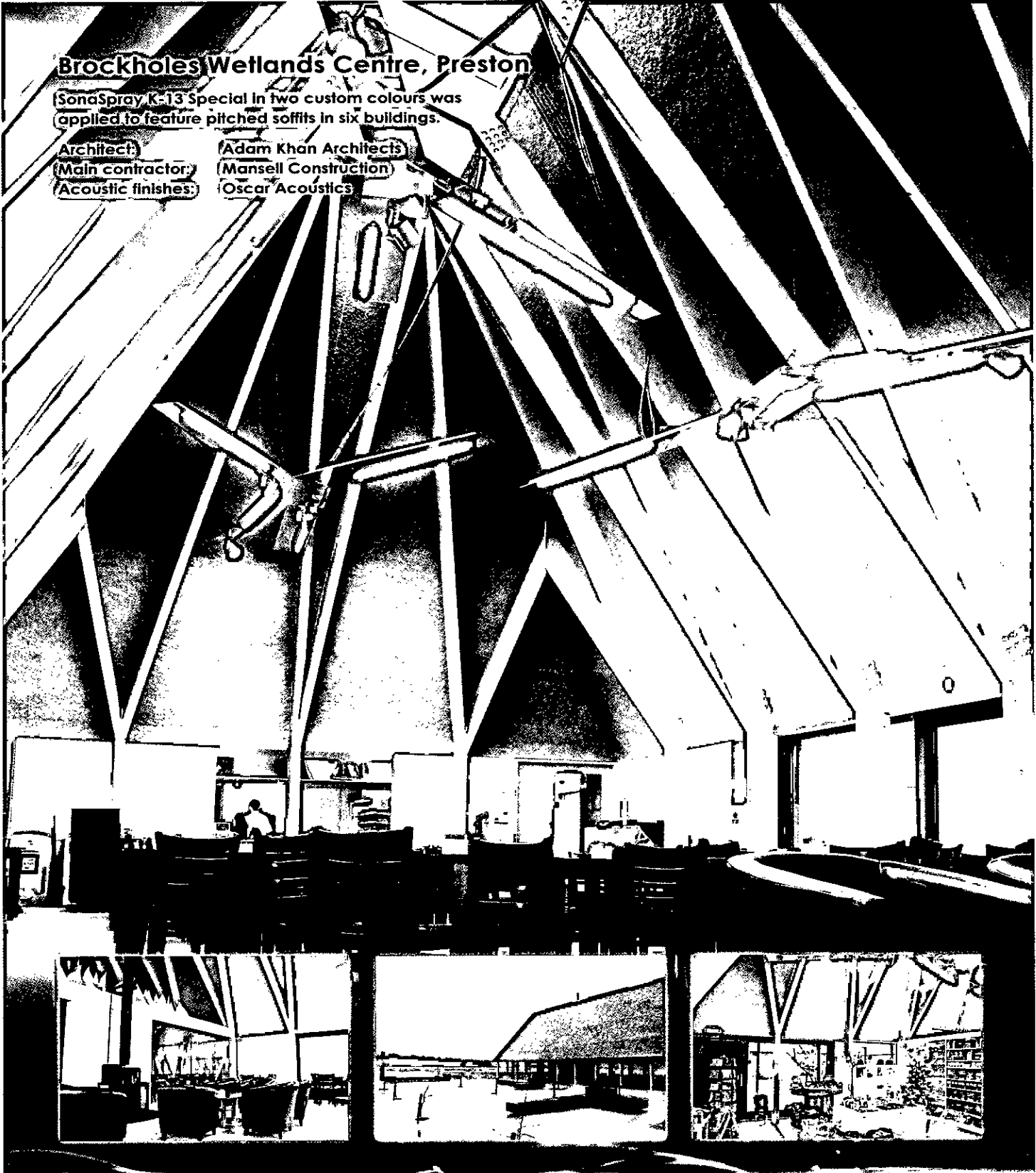
Jim introduced the presentation discussing the noise management plans of the Olympic site, including a brief overview of each venue outlining the huge scale of the project. Target off-site noise

levels were presented with site and venue management discussed as ways to minimise noise from the games. The different phases of the works were addressed, including pre-Olympic activities, Olympic and Paralympic activities, transformation period and Legacy period.

Following Jim's presentation, Olly talked briefly about the noise mapping of the Olympic site for all PA systems and temporary plant noise. An overview of the unique modelling procedure was reviewed and a summary of results presented to the audience. The presentation ended with an outline of inter-site noise between venues, in particular during the Paralympics.

Topics and speakers for the evening meetings are generally organised by the London Branch Committee, but they always welcome new ideas and suggestions for future presentations. If you have any ideas or suggestions, or may even like to give a presentation yourself, please contact Nicola Stedman-Jones on stedmann@rpsgroup.com ■





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Varied and informative programme for Midlands Branch members

Reports by Kevin Howell

Towards a silent aircraft

A large audience were treated at Loughborough University to an excellent presentation by Professor Ann Dowling on the Silent Aircraft Initiative.

This project is a collaboration between about 40 researchers from the University of Cambridge, MIT and a Knowledge Integration Community including industry, government and academia.

The aim is to develop a conceptual aircraft design that would result in noise being almost imperceptible outside an urban airport perimeter. The target is not "silence" but noise levels similar to those in urban areas in the daytime.

The industry has set a target of about 62/63dB(A). This would be about 25dB(A) quieter than current aircraft, which in turn are already 25dB(A) quieter than when turbo fan engines were first introduced. This requires a radical rethink of the configuration of the aircraft, necessitating a closer integration of the airframe and engines than is current practice.

Professor Dowling went into great detail on the design changes likely to be required and the progress to date. These included:

- the need to take advantage of shielding of engine noise by the airframe, and results so far suggest 15dB screening is possible.
- utilisation of low-noise engines with large low speed jets.
- a significant increase in the performance of absorptive liners in the engine ducts; 20 dB reduction appears possible but requires the complicated optimisation of multi-segment liners.
- the introduction of low-noise operations, including the lower approach speed of 60ms⁻¹ and staying higher for longer approaching the airport. Low-noise landing gear could achieve a 7dB high frequency reduction using improved detailing and enclosure of components.

It is, of course, vital that the design should not have a detrimental effect on other operational parameters such as aircraft control and fuel burn. The current emerging design, the SAX40, is predicted to achieve a radical reduction in external noise while using 25 per cent less fuel per passenger mile than the best of current aircraft. Internal noise has not been modelled in this project but it is felt intuitively that noise levels would be higher.

It may be just a few problematic modes that could be actively controlled. Thank you to Professor Dowling for her comprehensive and interesting presentation and to the University of Loughborough for hosting the meeting. The presentation was preceded by the branch annual meeting.

Sounding places: past, present and future

IOA President Trevor Cox gave his inimitable take on the acoustics of spaces to a large audience at Derby University.

His initial research interest in concert hall design has now expanded to embrace all sorts of places with interesting acoustics and his talk was illustrated with numerous examples from around the world. Trevor's first example saw him in a London sewer recording the echo of his hand clap reflecting from a staircase one kilometre away.

Then onto Glasgow and the Hamilton Mausoleum with a mid-frequency RT of 11 seconds, and to an unused underground reservoir in Dundee where the RT measured from a balloon burst was about 17 seconds. Trevor also cited a large reservoir in the USA which has a reputed mid frequency RT of 27 seconds.

His next topic was the acoustics of curved surfaces with many examples including the strange effects experienced when putting your head into the 2m sphere of a Camera Obscura, when walking inside the huge spherical glass Maparium in Boston, and the effect of the large domed ceiling of St Paul's Cathedral, London

The 17th century German Jesuit scholar Athanasius Kircher had an interest in acoustics and understood the effects of curved ceilings, but also had many off-beat ideas, including a rather disturbing "cat piano". In the early 20th century the Finnish architect Alvar Aalto was obsessed with the use of curved ceilings and used a complex design to improve communication in the auditorium of the Viipuri Municipal Library in Vyborg. Dionysius of Syracuse designed the roof of his prison in an ear-trumpet shape leading to a listening room where he could listen to his captors' conversations.

However, Trevor has modelled this design and produced recordings that suggest it would not have worked very well! Trevor completed his talk with a discussion of "whispering spaces" (spaces where people can whisper to one another while some distance apart) including the 17th century Gol Gumbaz mausoleum in India, the gallery of St Paul's Cathedral, the arches in Grand Central Station, New York and at the Guggenheim, Bilbao. The presentation prompted a very enthusiastic question session.

Noise and statutory nuisance

A very practical presentation by David Horrocks at the University of Derby on the issues associated with noise nuisance investigation attracted our largest audience for some time.

David began by showing numerous press cuttings of noise nuisance cases and noted that, despite the plethora of regulations emanating from Europe, the concept of statutory nuisance went back to the 1875 Public Health Act.

He stated that understanding the concept of nuisance was hindered by a lack of precision and identified a number of examples from relevant case law. He noted that even the Government had got it wrong in its guidance for the 2003 Licensing Act. Some noise sources were excluded from nuisance action such as aircraft, railways (but only activities to do directly with the operation of the railway) and National Strategic Infrastructure Projects (although judges had the power to remove this latter exemption).

David reported that many local authorities (LAs) considered that there was no requirement to investigate cases in which commercial premises are the victims of nuisance. He believes this was an "urban myth" and that such investigations were required under the general LA duty to inspect their district.

Staff undertaking noise nuisance work must be competent, have the relevant experience and be appropriately authorised. He was concerned that in the current funding cut-backs many experienced EHPs were being lost to the authorities and also that the number of LAs providing out-of-hours noise services had reduced from 245 to 156 between 2001 and 2011.

He outlined the essential requirements for a meaningful investigation and subsequent action. Most importantly there was a need to remain independent and objective (it was easy to be led by the complainant) and to ensure timely communication with all parties, with face-to-face contact essential.

Judges expected evidence to be well prepared; they did not generally have experts to help them, and might consider that subjective evidence provided by an EHP no more valid than that expressed by a member of the public. It was therefore important to consider carefully what role noise measurements might play in the evidence. David illustrated many of these issues by discussing the details of a number of difficult cases. ■

Name that tone

Report by Paul Hopwood AMIOA

Many acoustic investigations require the measurement of tones, which can vary from simple noise assessments such as BS EN 4142 that require adjustments added to noise rating levels if tones are present through to much more detailed analysis required in electroacoustic measurements such as BS EN 60268 or investigation of sources of noise in machinery.

The simplest form of assessments for tones requires an analyser with the ability to select a frequency range for analysis, the degree of frequency selectivity required in the instrument depends upon the task being undertaken, originally it was common to find octave bank filters in tools but these days 1/3rd octave or even 1/12th octave bank filters are not uncommon in standard instruments. These days it is unlikely that the filters in instruments will be analog but rather digital with the performance of the filter banks specified in BS EN 61260 ensuring that measurements made on separate instruments are comparable.

When it comes to identifying whether a noise source is tonal the best instrument for performing this task is the human ear, however the ear is not suitable for measuring tones and whilst ISO 1996 identifies the need for subjective assessment it also specifies in detail in its annexes two separate methods for performing measurements on tones.

To perform a tonal analysis it is likely that either 1/n octave analysis will be used or narrowband FFT analysis, there are issues with both of these methods, FFTs are complex to correctly setup and are constant bandwidth whereas 1/n octave filters are constant percentage bandwidth filters.

Tones are often identified in filter banks by a peak in one band with lower levels in adjacent bands, but with 1/n octave analysis the frequency resolution decreases as the frequency of interest increases, a 1/3rd octave filter at 63Hz has a bandwidth of 14.5 Hz whilst at 16 KHz the bandwidth has grown to 3.6 KHz. Similarly if the tone falls between two of the octave filters the energy will be shared between the two filters and the indicated level will be inaccurate and is unlikely to be noticed as a tone.

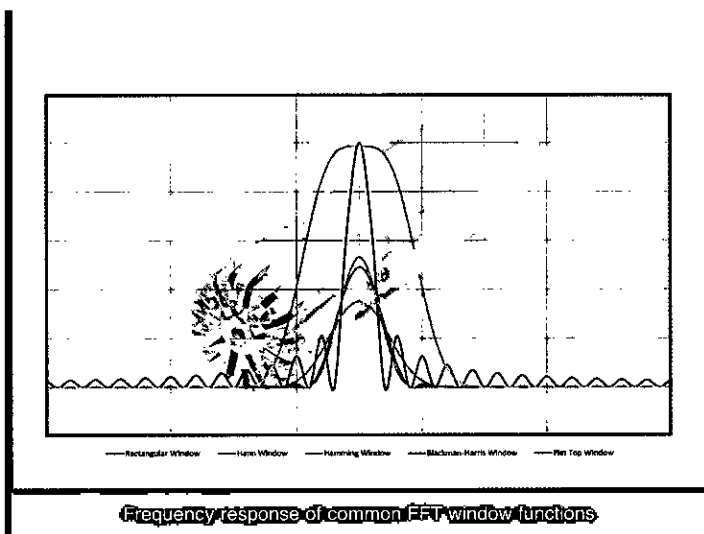
Using an FFT analysis involves a series of trade offs and potential pitfalls, to get the optimum settings for analysis prior knowledge of the noise source is normally needed which is why it is often preferable to have a recording for analysis. Fundamentally FFT analysis takes a window of time and transfers this to the frequency domain, this results in the major trade off, a high frequency resolution results in a low time resolution and vice versa, the sampling frequency of a FFT is normally fixed in hardware so control over the trade off between time & frequency resolution is governed by increasing or decreasing the FFT block length, often called the number of lines or bins.

The mathematics behind FFTs assume a periodic time signal is being analysed, in the real world most signals analysed are not periodic in the sample time windows and the discontinuities lead to spectral leakage, frequencies being created which are not present in the input signal.

The solution to spectral leakage is to use a window on the input data, multiplying or convolving the signal with a function which is zero at the end of the time window and large in the centre of the window, essentially concentrating the FFT on the data at the centre of the time window.

When a window is used the input signal is being modified, essentially it is being amplitude modulated and perfectly accurate results cannot be expected. Once again selecting the correct window is a trade off and requires knowledge of the signal that is to be analysed.

Using a hanning window gives good frequency resolution and is best for noise and periodic signals longer than the time



windows but gives an inaccurate reading with transient signals which are already zero at the start and end of the time signal, for these signals a uniform rectangular window should be used. If a signal's amplitude is needed to be known accurately, such as during calibration a flat-top window is used to combat the temporal variation in amplitude of the hanning window, the flat-top is accurate to within 0.1dB compared to the hanning which is accurate to within 1.5dB.

There are many other window functions available for special applications such as the Blackman-Harris used for resolving closely spaced frequencies with differing levels or the force window used for impact testing. Often settings are available in the FFT to overlap windows. Overlap means that instead of waiting for a new sample period we use some new data & some old data to create a measurement. This data increases the display rate, indicating the direction and the change in spectrum but it is not correct until the new sample period is reached, but the increased display rate is useful for situations where making adjustments or for RMS averaging.

Typically there are also settings for scaling the data and averaging the data, scaling allows the measurement to be treated as a RMS signal or as a peak signal, the latter multiplies the calculated FFT by $\sqrt{2}$ and should therefore be used carefully. There are two main types of averaging, although they are called by numerous names, both types of averaging may also be weighted in time with linear or exponential weights. Power averaging reduces signal fluctuations giving a RMS figure for the signal plus noise and with a sufficient number of averages allows an estimate of the noise floor. Vector averaging works on the complex FFT spectrum and requires a trigger signal to make sense, with a trigger the signal is phase coherent but the noise isn't allowing an improvement in the signal to noise ratio.

There is a promising technology which has been written about in papers on acoustics that may bridge the gap between 1/n octave analysis and FFT analysis. Wavelets are widely used in other engineering fields; the images in this issue of Acoustics Bulletin have probably been stored & compressed using wavelets and have attractive properties for acoustic measurements. Wavelets use constant percentage bandwidth like 1/n octave analysis but the time & frequency tradeoff isn't consistent, at low frequencies wavelets have a higher frequency resolution with low time resolution but as the frequency is increased the frequency resolution worsens whilst the time resolution improves, more closely matching the performance of the human ear. ■

Defra gives updates on key noise issues

Briefing for stakeholder organisations

Defra held the first of a series of six-monthly meetings in March to inform stakeholder organisations of recent, current and future research, activities and consultations related to environmental and neighbourhood noise.

As well as the IOA there were representatives of other bodies concerned with noise such as the ANC, Noise Abatement Society, Aviation Environment Federation, CIEH, CPRE, UKNA plus other government agencies and departments.

Short presentations on various aspects of noise research and policy were given by Defra staff. Topics covered included:

- current preparations for the 2012 National Noise Attitude Survey. A new questionnaire is being developed to be consistent with that used in the last survey carried out by BRE in 2000 (<http://www.bre.co.uk/pdf/NAS.pdf>)
- an update on EU policy on environmental noise and the first round of noise mapping. Last year the European Commission published a report on the implementation of the Environmental Noise Directive (<http://ec.europa.eu/environment/noise/home.htm>). The results of the first round of noise mapping are available on the Defra website. In compliance with Environmental Noise (England) Regulations 2006, maps were produced for major roads, railways and airports, and for population centres with more than 250,000 inhabitants. Preparations are now under way for the second round of mapping, and Defra will be holding a consultation in the near future. In addition to the areas covered in the first round, roads and railways with fewer movements than previously will be included, and all agglomerations with a population of over 100,000 are required to be mapped.
- the current consultation on the Code of Practice on Noise from Ice Cream Van Chimes which seeks to establish whether the Code should remain as it is or be revoked, or whether its recom-

mendations should be changed. The consultation is a result of the government's Red Tape Challenge which seeks to reduce 'unnecessary burdensome regulation on businesses'.

- (<http://www.defra.gov.uk/consult/2012/03/08/ice-cream-van-noise-1203/>). See page 31 for more details.
- the government's commitment to identifying and protecting urban quiet areas, as specified in the Natural Environment White Paper, published in June 2011 (<http://www.defra.gov.uk/environment/natural/whitepaper/>). In 2011 Defra commissioned a study into the economic value of quiet areas; the final report was published in March 2011 and is available on the Defra website.
- the work of the Interdepartmental Group on Costs and Benefits which carries out economic evaluations of the noise impacts of government policy. The group has published two reports in the past few months: *Quantifying the Links between Environmental Noise Related Hypertension and Health Effects* which uses Quality Adjusted Life Years (QALYs) to evaluate the costs of health effects caused by environmental noise; and *Estimating the Productivity Impacts of Noise* which aims to identify the potential mechanisms through which noise affects productivity (both reports are available on the Defra website).

Since the stakeholder meeting the government has published the full results of the Red Tape Challenge. Caroline Spelman, the Environment Secretary, announced that "environmental regulations will be made simpler and more effective while remaining as strong as ever". Defra has published a report on the environment themes arising from the Red Tape Challenge (<http://www.defra.gov.uk/news/2012/03/19/red-tape-challenge/>). The Noise and Nuisance Team will be developing an agreed implementation plan with the Cabinet Office over the next few months, to prioritise required actions. ■



Strong call in Welsh Assembly for robust school acoustics standards

Welsh Assembly member Aled Roberts has called for more robust and mandatory testing processes to ensure schools meet higher acoustic standards

Opening a short debate in the Senedd, he outlined the difficulties that school children with a hearing loss faced when trying to follow their teacher in a classroom with poor acoustics.

"Good acoustics in schools are essential for all children – and

their teachers – but for children who have a hearing loss they are absolutely essential," he said.

"Currently, all new builds under the 21st century schools programme will need to reach a minimum acoustic standard, but there is no obligation to undertake what is called a 'pre-completion compliance test'. This means that by the time they are finished, many buildings will not have been subject to a mandatory technical check to make sure that the minimum standard has been reached.

"In addition, nurseries and colleges currently fall outside the regulations and this is something I would like to see changed.

"The National Deaf Children's Society has done a wonderful job in highlighting these problems and it was encouraging to see excellent cross-party support at their recent event in the Assembly marking their campaign, *Let's Make a New Year's Resolution that Sounds Good!*

"The Welsh Government gained the power to change Building Regulations on 31 December 2011. We now need the Government to use these new powers in a positive way to extend the commitment it has already shown to good acoustics.

"Placing a compulsory requirement on building authorities to demonstrate compliance with acoustic standards is the only way that we can ensure *all* new school buildings in the future will sound good."

Mr Roberts, who is the Lib Dem spokesman on education, won support from Conservative AM Mark Isherwood who spoke of his own personal experiences and also called for the government to address the deficiencies. ■



Aled Roberts
Welsh Assembly member



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ANC launches new groundborne noise and vibration handbook

Report by Robert Osborne

The Association of Noise Consultants (ANC) has published the second edition of the *Measurement & Assessment of Groundborne Noise & Vibration*. This book, previously produced in 2001, has been revised and updated by the ANC to encompass changes associated with the 2008 version of BS 6472, the availability of improved monitoring and analysis systems and the growth of the number of projects requiring vibration assessments, particularly railway projects.

The ANC formed a working group in 1997 to develop the original guidelines on the measurement and assessment of groundborne noise and vibration. The need then arose following difficulties with the use of some of British Standards, such as the 1992 version of BS 6472 for vibration assessment, the lack of suitable equipment for measuring vibration dose values, the widely different measurement data obtained by various organisations, the different criteria adopted by consultants and local authorities and the current involvement in major projects requiring groundborne noise and vibration assessments.

Following the preparation of the first edition of the guidelines in 2001, BS 6472 has been revised, more dedicated monitoring and analysis systems have come to market, and good practice has improved. Also since the first edition of the guidelines further research has been undertaken, other standards relevant to the field have been updated or issued for the first time and there has been growth in the number of projects requiring vibration assessment, particularly railway projects.

The ANC working group decided not only to revise the guidelines in light of all the changes described above, but also to change the focus of the guidelines. This second edition, therefore, provides a wider best practice guidance in the field of vibration assessment and measurement, rather than guidance specifically in the context of BS 6472.

The book will be launched at a conference in London on 16 May where attendees will be able to purchase a copy of the new book at a reduced price of £35 a copy. To find out if places are still available, please contact the ANC on 020 253 4518 or email

info@theanc.co.uk The book will be available to purchase after the conference at £70 (or £50 for ANC members) plus £4 postage and packing. Details of how to order are available on the publications page of the ANC website www.theanc.co.uk

Pre-Completion Testing for Building Regulations

In the last few weeks the number of tests registered through the ANC scheme passed 250,000. Tests continue at a steady rate and the total for 2011 was up on the previous year. A separate version of the scheme was developed to cover testing under Scottish Building Regulations and those companies testing in Scotland are able to extend their registration to cover this by a simple and relatively quick process which involves a review of their report template.

A workshop open to all ANC registered testers takes place on 27 June in Birmingham. The programme will include an update on the non-compliance issues seen by examiners and look at common problems encountered on site as well as a number of other issues. This is the first time since the 2008 conference that ANC has run an event specifically looking at PCT and a good attendance is expected as there are now over 300 individual testers working for the 85 companies in the scheme.

The ANC scheme is part way through an independent third party review of its systems and procedures. The scheme handbook has already been revised and reissued to take account of some of the points identified by the auditor and the final requirement for a witnessed test to be observed by the auditor should have taken place by the time this article appears.

ANC guidelines – noise measurement in buildings

Updated versions of the two guideline documents covering Noise from Building Services and Noise from External Sources (Parts 1 and 2 respectively) have been produced. These are available only in electronic format and can be downloaded from the publications page of the ANC website. ■

Stansted flies high in Acoustics Cup

Report by Jo May

Eight teams from the acoustics industry got together in Essex in March to play a five-a-side football tournament organised by Campbell Associates in aid of Sports Relief. The event raised £813.

Group A was dominated by Bickerdike Allen who saw off AIRO, Allaway Acoustics and Campbell Associates to reach the final. In doing so they scored an impressive 11 goals without conceding any.

Group B, involving Cole Jarman, Sharps Redmore, SRL and Stansted Environmental, was a much tighter affair and came down to the final game between Cole Jarman and Stansted, with Stansted winning 2-1.

The final between the two group winners produced an excellent spectacle. Although Bickerdike Allen dominated much of the play, Stansted came from behind to equalise from a corner in the dying seconds to send the game to a penalty shoot-out which they won 4-2.

Jo May, of Campbell Associates, said: "It was a great evening and we're delighted to have raised so much money. Because of the success we are hoping that it will become an annual event." ■



New law 'will hinder noise nuisance investigations', warns environmental health chief

Proposed new laws on surveillance will prevent environmental health officers from effectively carrying out noise nuisance investigations, the Chartered Institute of Environmental Health (CIEH) has warned.

Monitoring sound levels without the consent of the householder concerned as part of a noise nuisance investigation could amount to "surveillance" under the Regulation of Investigatory Powers Act (RIPA).

The Protections of Freedoms Bill, currently making its way through the House of Lords, requires surveillance operations to be approved by a magistrate. This could lead to noise investigations becoming more time-consuming for cash-strapped local authorities.

An amendment to the Bill put forward by Baroness Hamwee, who is also a CIEH vice-president, would have exempted RIPA investigations undertaken under Part 3 of the Environmental Protection Act 1990 or the Noise Act 1996.

But Baroness Stowell, the government spokesperson in the

House of Lords, said the amendment was unnecessary.

She said: "Surveillance conducted and governed under RIPA relates to private information only. It requires that when public authorities obtain private information covertly, they do so only when it is necessary and proportionate, in line with our right to privacy."

"However, the privacy implications of someone making a loud noise will usually be such that RIPA is not engaged."

CIEH principal policy officer Howard Price said: "Her comments are a mixture of sophistry and misunderstanding. Noise investigations certainly do engage RIPA and her officials admit it. Our main disagreement is just about how often."

Baroness Hamwee's amendment was withdrawn, but the Home Office has indicated it will meet with the CIEH to discuss possible revisions of the RIPA code of practice.

No date for the meeting has been set, but it is expected to take place after the Bill becomes law. ■

Views sought on ice cream van chimes

Defra to consider code changes

Defra has launched a consultation seeking views on the future of the Code of Practice on Noise from Ice-Cream Van Chimes Etc. 1982.

The code gives guidance on methods of minimising annoyance caused by the operation of loudspeakers fixed to ice-cream vans and similar vehicles used to sell perishable goods to the public. This includes the volume, playing time, frequency, and use of chimes in sensitive areas. Views are sought on whether to alter the

restrictions recommended in the code, whether to revoke the code, or to leave it unchanged.

The consultation is an outcome of the Red Tape Challenge, a campaign to reduce unnecessary burdensome regulation on businesses. It will be of particular interest to those in the ice-cream and other mobile vendor industries, local authority environmental health departments, members of the public with an interest in chimes, and other interested stakeholders with views on noise issues.

The deadline for comment is 2pm Thursday 31 May 2012. Responses should be sent in writing or email to Code of Practice on Noise from Ice-Cream Van Chimes Consultation, Noise and Nuisance Team, Department for Environment, Food and Rural Affairs, Area 5A Ergon House, Nobel House, 17 Smith Square, London SW1P 3JR Email: noise@defra.gsi.gov.uk ■



I ETSU-R-97: an alternative view

Report by Dick Bowdler FIOA

ETSU-R-97 – *The Assessment and Rating of Noise from Wind Farms* was published in 1996 and is the UK government's preferred method of assessing wind farm noise for planning purposes. It was the work of a Noise Working Group set up about two years earlier by the then Department of Trade and Industry (DTI) whose renewables role is now performed by the Department of Energy and Climate Change (DECC). DECC's role in the control of noise from wind farms is unusual. In almost all other types of noise control it would be DEFRA, in England, and equivalent government departments in Scotland, Wales and Northern Ireland or, in practice, individual environmental health departments in Local Authorities. Other renewables are simply controlled locally. For example biomass plants may have to meet levels of 25dBA at night in quiet countryside whilst wind turbines can operate at over 40dBA when background noise may be well below 30dBA.

ETSU-R-97 compares the turbine noise with a level 5dB above background noise but, when background noise levels are low, it sets a lower limit. The day time lower limit can be anywhere between 35 and 40dB and the night time lower limit is 43dB. All these noise levels are quoted as LA90 and so are about 2dBA less than the LAeq. The most bizarre result is that night time noise can be up to 8dBA more than the day time noise. No other standard anywhere in the world has a night time limit higher than a day time limit. After more than a decade of insisting that ETSU-R-97 is fit for purpose DECC has asked the IOA carry out a review of the document. However, this review is not a proper independent review by the IOA as it does not include the limits which, we are told, "are government policy". If ETSU-R-97 is government policy then the whole document is government policy, not just the noise limits. In any case there is nothing to stop the IOA setting up an independent working group to look at any aspect of government policy it feels needs looking at. So the review is not able to tackle the real problems of the assessment of wind farm noise. Indeed, it will not be truly independent because, as we heard from the chair of the group at the Wind Farm meeting in January, the work of the group "would be in vain if government did not feel they could endorse it at the end of the day".

ETSU-R-97 clearly needs a complete re-think not a patch up. This article presents an alternative assessment methodology which is transparent, fair and complies with the law.

Environmental Impact Regulations

If a scheme meets ETSU-R-97 then it passes the planning noise test, if it does not meet it, it fails the test. It is prescriptive. But the purpose of the planning system is to allow development to take place whilst still protecting the environment and the amenity of people. It has to achieve

a balance in the public interest between the case made for a development and the predicted impact(s) on neighbours and the general environment. It is supposed to be a transparent and fair process in which the impact is clearly set out in a way that will allow the decision maker to make an informed decision and the public – particularly those directly affected – to understand how the decision was made.

The impact on the environment and people is determined, in larger projects, by an environmental assessment but the principle behind the regulations applies to all planning assessments including the smallest noise assessment. In this way there can be complete clarity throughout the process and people on both sides of the debate can understand each others' points of view. The requirement to describe the impact of a development in this way is set out in EU Environmental Assessment Directive 99/337/EEC [CD] and incorporated into law in the UK by means of Regulations. Article 3 of the directive says "The environmental impact assessment shall identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11, the direct and indirect effects of a project on . . . human beings. Annexe IV requires that an estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed project is made". It also requires "A description of the likely significant effects of the proposed project on the environment resulting from . . . - the emission of pollutants". What is required is that the assessment clearly describes the impact the development will have.

ETSU-R-97 does not fulfil the requirement of a "description of the likely significant effects" in the EU Directive. For example at night the lower ETSU-R-97 limit is 43dB. At a wind speed of around 6m/s when turbines might have reached more or less their maximum noise output they could be running at this limit of 43dB. At one site, perhaps near a main road, the background noise level could be 38dB and so the margin of turbine noise over background noise is 5dB. At another site out in a quiet rural area the background noise might be 28dB and the margin 15dB. Clearly the significance of the impact is more in the second case than in the first but ETSU-R-97 is blind to this. Consequently it does not provide residents with a description of the significant effects of the development and so they do not know whether the impact is small or great – merely that it meets a target noise level set, in part, in such a way as to avoid placing unreasonable restrictions on wind farm development.

The problem with the prescriptive nature of ETSU-R-97 limits is that it results in inappropriate noise limits being set. Fig 1 shows how the noise levels permitted at two small agricultural developments are significantly higher than those permitted for the 250 turbine 500 Megawatt wind farm ■



at Whitelee south of Glasgow. Since the purpose of planning is to balance the need and scale of the development with the impact on residents, larger renewable developments would expect to get higher noise limits than small ones rather than the other way round as is the case with these examples.

So the use of ETSU-R97 does not comply with EU law or with UK regulations on environmental impact assessment. What is more it is not fair.

The Alternative

The alternative to ETSU-R-97 and one that complies with EU law and UK regulations is one that sets out the impact of noise from the development on people and the environment. BS 4142 *Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas* is a British Standard that has been in existence for over 40 years. Indeed the Noise Working Group that wrote ETSU-R-97 used BS4142 as the basis for their rating method. It is widely used throughout the UK as an assessment tool for planning purposes. It is so widely used that hardly any local authority in the country does not use it for some types of assessment and most require it for assessments of developments where a new non-transportation noise is introduced into an area – even such noise sources as football pitches. It compares the new noise level with the existing background noise level. A simple system of assessment comparing calculated turbine noise with pre-existing background noise is a good starting point to providing the impact of a scheme, particularly if the turbine noise level is adjusted for any significant factors other than simple noise level. Of course it will be more complicated than usual because all the noise levels vary with wind speed.

Background Noise

The background noise measurement process as carried out for ETSU-R-97 assessments, together with a few modifications is fundamentally sound provided that the factors leading to inaccuracy or unrepresentative levels are carefully controlled. Since we are comparing a turbine noise level calculated from the sound power level with the background noise measured at noise sensitive receptors, both the calculated turbine noise and the measured background noise have to be related to the wind speed measured at the same location. It is becoming common practice for this location to be hub height of the turbine. At present this speed at hub height is reduced to 10m height by a standardised method though this is likely to change to hub height when the new turbine noise measurement standard is published. The relation of background noise levels to hub height wind speeds is important because wind speeds at NSRs are usually much less than those at hub height. So if the measured background noise levels were plotted against the wind speed near the NSR instead of at the hub they, and the resulting curve, would be shifted to the left. This means that the background noise curve would be too high when the turbine noise curve (calculated relative to hub height) is compared with it and so the impact would appear to be reduced. Fig 2 shows how the curves vary significantly with measurement height.

The difference between hub height and near ground wind speed is due to two effects. The first is wind shear and the second is shelter provided mostly by topography but also sometimes by trees. High wind shear occurs mostly in flat areas of the country and particularly flat areas in a large bowl surrounded by hills. In more hilly areas wind shear is not generally as high as in flat areas but houses in hilly areas are often built in sheltered valleys whereas the turbines are more likely to be on the hill. So the effect of shelter from valleys in hilly land is the same in principle to the effect of wind shear in flat land. All this results in background noise levels being very variable when related to hub height wind speed. They also vary according to the distribution of wind speed during the measurement period, the time of year, micro-siting of the noise measurement

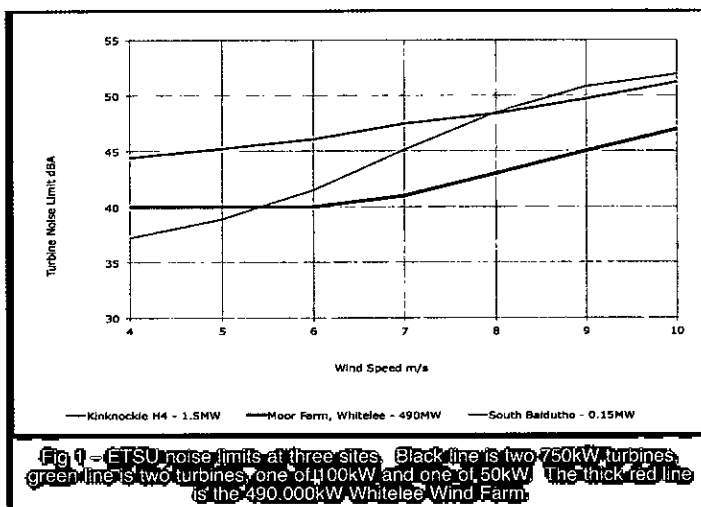


Fig 1 – ETSU noise limits at three sites. Black line is two 750kW turbines, green line is two turbines, one of 100kW and one of 50kW. The thick red line is the 490,000kW Whitelee Wind Farm.

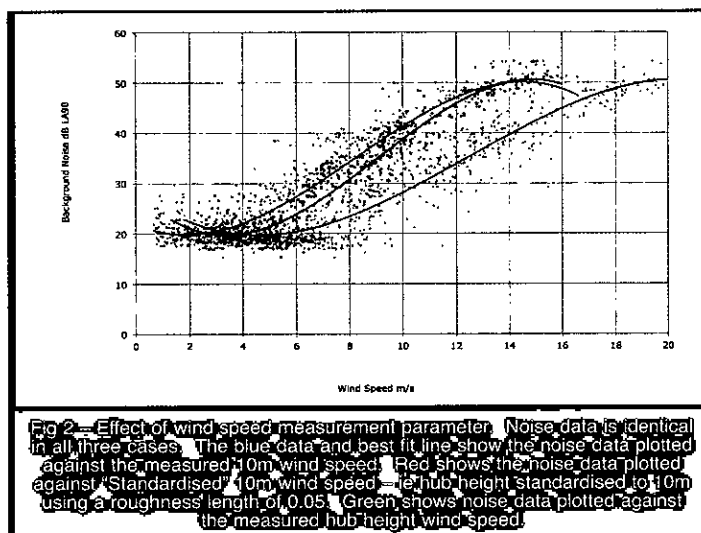


Fig 2 – Effect of wind speed measurement parameter. Noise data is identical in all three cases. The blue data and best fit line show the noise data plotted against the measured 10m wind speed. Red shows the noise data plotted against standardised 10m wind speed – ie hub height standardised to 10m using a roughness length of 0.05. Green shows noise data plotted against the measured hub height wind speed.

equipment and other factors many of which are still not entirely clear. It is not uncommon for two developers to carry out background noise levels at the same property and produce significantly different results. Fig 3 shows four sets of background noise measurements related to wind speed made at the same property and Fig 4 shows two measurements made at the same property at another location.

So the background noise measurements, if they are to be representative need to be very carefully controlled. At least two measurement periods would be needed at different seasons of the year. The equipment would need to be specified carefully and, in particular, the wind shield. Each measurement period would have to cover the full range of conditions of wind speed and wind direction appropriate for the location and a structure for ensuring this would need to be drafted. Furthermore people's perception of intruding noise is based on what they hear in the quiet times not what they hear on average. The background noise curve should not be based on the best fit or average line but on, say, the average less one standard deviation. This is similar to the principle of taking the quietest part of the night when the dominant noise is road traffic rather than the average over the whole night period. P34▶



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CP33 Calculated Turbine Noise

A common methodology is needed for the calculation of turbine noise. This is an easier problem to deal with and was reasonably well established in the *Prediction and Assessment of Wind Turbine Noise* published in the March/April 2009 edition of the Bulletin though this has no formal status. Some minor adjustments are needed to this methodology – particularly the precise definition of what sound power level should be used and variations in propagation across different topography such as concave and convex topography and water. A methodology for this would be easy to structure.

Assessment

BS4142 says that “A difference of around 10dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance”. However, turbine noise is measured by a different parameter (LA90) from all other industrial noise (LAeq). The difference between the two parameters in the case of wind turbines is 2dB so this needs to be subtracted from the margin above background noise in order to rate the noise under BS 4142. Thus, in wind turbine noise measurement parameters BS4142 says that a difference of around 8dB or more is likely to cause complaint and a difference of around 3dB is marginal. We could postulate that if the turbine noise level was predicted to be likely to give rise to complaints then this would constitute a major loss of amenity. Bearing in mind that this would mean turbine noise was twice as loud as the background LA90 this seems a reasonable interpretation. At a point that BS4142 describes as marginal that could be considered a marginal loss of amenity. Interpolating between these we can construct the following table to describe the basic measure of objective significance. All noise levels are LA90.

- A difference of 1dB or less – insignificant
- A difference of 2 to 4dB – marginal loss of amenity
- A difference of 5 to 7dB – significant loss of amenity
- A difference of 8dB or more – major loss of amenity

BS4142 also includes a penalty to reflect the nature of the noise. If it is tonal, has clicks and bang or is otherwise likely to attract attention then a penalty is applied of 5dB. ETSU-R-97 includes a penalty for tonal noise on a sliding scale which is probably more acceptable than a choice of 5dB or nothing. There is no penalty for amplitude modulation in ETSU-R-97 but it is possible that a robust one could be devised in the near future when the results of the RenewableUK research project are known.

The final question in the objective assessment whether we should take account of non-acoustic factors in assessing impact? That there are often significant non-acoustic factors in people's perception of noise has been well documented for over 20 years. In an international study of wind farm noise at in 1993 [1] it was found that the “amount of annoyance was hardly related to the objective sound level”. Pedersen et al established that wind turbine noise annoys more than most other noise with similar loudness [2]. Dani Fiumicelli discussed some of these issues in the Nov/Dec 2011 Issue of the Bulletin.

It is likely that, in the UK and some other countries, wind turbine noise is perceived to be worse than other noise of a similar level because of the way wind farms are procured. People quite simply see the process as unfair and this perception has increased over the years by the actions of developers and government. Though there are some exceptions, developers in the UK have not involved communities and have been secretive and unco-operative. They may consult but only after the design and siting has been more or less established. Government has been dismissive of wind farm objectors and has put out and still does put out inaccurate and misleading information. In contrast, in parts of Germany, where there is a much greater take up of wind energy than the UK and less complaints [3] communities are often involved before the site is chosen or the wind farm designed.

The fact that people complain even at relatively low noise levels because they don't see the process as fair and open does not mean that such objections are not valid. Wolsink et al concluded in their 1993 paper [1] that, whilst sound level had hardly any effect on annoyance, “This conclusion must not be misunderstood. The fact that sound level is not predicting annoyance does not mean that people are ‘not really annoyed’ when they are reporting it”. It is the responsibility of the noise maker and more particularly government, to ensure that noise is managed properly. That is as important as ensuring that the noise levels themselves are low

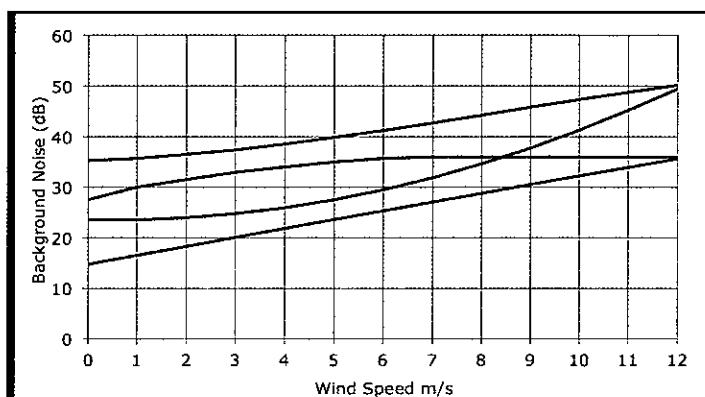


Fig 3 – Best fit curves for background noise measured at the same notional location. Three of the measurement locations are within a few metres of each other.

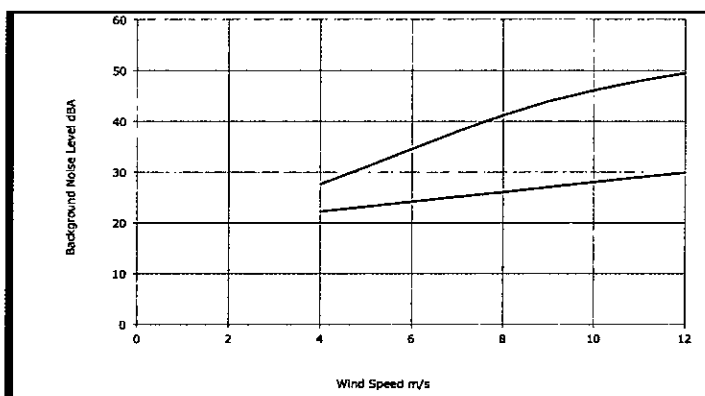


Fig 4 – Best fit curves for another site. Measurements made within a few metres of each other.

enough. Schomer [4] takes the view that “adjustment for ‘public relations,’ ... can range from a 5dB penalty to a 5dB bonus depending on the quality of the relations between the noisemaker and the community”. So, in the same way as residents with a financial involvement in a wind farm can have 5dB more than the standard, perhaps there should be a 5dB penalty on wind farm noise for those not involved until those affected feel they are being treated fairly.

The Decision

We now have the calculated turbine noise levels modified as necessary for other factors and the “worst case” background noise levels. We can compare the two and use the objective descriptions set out above at each noise sensitive receptor at each wind speed. This all needs to be accompanied by a narrative to describe the likely subjective impact that the noise will have on each sensitive receptor. That narrative will include those factors that are not taken into account by the objective test – for example for how long do particular levels of impact last, is the noise likely to be masked by the background noise or are the frequency characteristics quite different, does the intruding noise have significant levels of low frequency. This is all set out in such a way that everyone understands the position and then a proper planning decision can be made.

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A low-cost post-earthquake cardboard concert hall in L'Aquila, Italy

Report by Daniel Commins FIOA, of commins acoustics workshop, Paris

Introduction

A powerful earthquake of magnitude 6.3 struck the Italian town of L'Aquila on 6 April 2009. Hundreds of lives were lost. Ten-thousand buildings were destroyed or seriously damaged and 58,000 people were left homeless.

Assistance was provided and a tent city was erected. Today, businesses are still closed and most residents are unable to return to their homes.

Very early after the disaster, since L'Aquila is known as a "City of Music" and since the National Conservatory of Music had suffered serious damage from the earthquake, it was deemed important to provide music facilities.

The speedy construction of an easy-to-build and durable concert hall would provide momentum for the renewal of musical activities and provide some support to the victims of the disaster. It is significant to note that the Japanese Government led this initiative.

For the concert hall construction project, the Government of Japan has provided funds and has mandated Shigeru Ban, a Japanese architect specialized in "emergency architecture", and commins acoustics workshop to design the facility. The design work was performed on a voluntary basis by architects, engineers and construction companies, since the total budget was only around half a million euros.

The purpose of the present paper is to inform the acoustical community of the existence of this unusual concert hall and to invite acousticians to visit it and to evaluate the result.

An unusual architecture

Shigeru Ban is known for his excellent projects experimenting with the use of cheap and recyclable materials such as cardboard or bamboo in response to emergencies arising from natural disasters. Through these cost-effective projects, Ban has been able to build dozens of buildings around the world in very poor areas affected by catastrophic events. He often collaborated with a network of volunteers.

Shigeru Ban has used paper components for emergency construction after disasters in Kobe, Turkey, Rwanda and Haiti and also for the Pompidou Center auditorium in Metz, France.

First site: real estate difficulties

A site was chosen: an old bus depot with a large roof on columns. The first sketches included the use of paper tube walls.

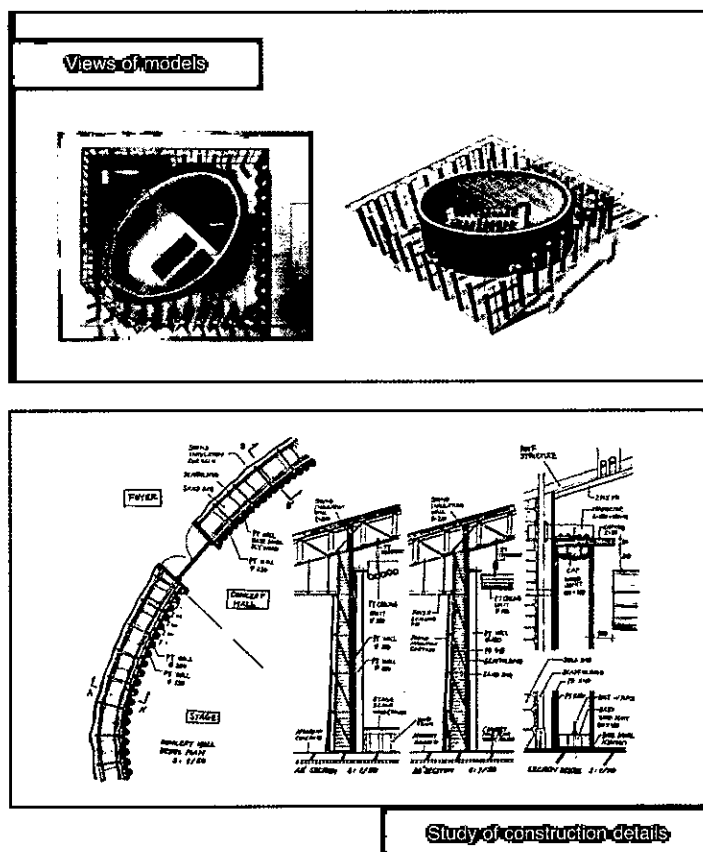
It then happened that the facility was the property of a very powerful Italian organization and that negotiations were complicated; several years would be necessary to clear this up.

Second site: the final design

A safer site was picked and the same design principles were kept.

As can happen, in spite of the arguments of the acoustician, the architect designed a quasi-elliptical hall inserted in a square 25-m x 25-m building covered by a lowered pyramid; the main hall houses theoretically 230-seats. The walls of the auditorium are made of heavy cardboard drums, recovered from print paper rolls. A combination of diameters, 150-mm and 280-mm, were used to create a diffusive wall that would be operational over the widest possible frequency range. The thickness of the drums contributes to the acoustical insulation but the tubes are also filled with sand; they are backed-up by thick sandbag walls that provide additional sound insulation.

Paper tube columns are also used as structural components. The other materials are more common: a wooden floor on



sleepers and a triple-layered plasterboard ceiling.

The final design is a simplified version of earlier plans because of lack of funds. The elliptical shape was kept after studies showed that focusing effects would be moderated by diffusion from the walls and ceiling.

Low-cost construction

During design and construction, the main goal was to keep costs at a minimum: most of the work was performed by volunteers and most materials were donated.

Of course, the building must meet all the regulations and safety requirements. This resulted in a lot of modifications which were not always compatible with good acoustics.

In December 2010, there appeared an acoustical study by *Presidenza del Consiglio dei Ministri: Dipartimento della Protezione Civile* which tried to demonstrate that large volumes are not necessary for concert halls since the "Decreto Ministeriale 18 dicembre 1975" which deals with school acoustical specifications proposes small volumes. It also concluded that a single plasterboard layer was sufficient for the ceiling and that a wooden floor on sleepers was not adequate.

It is not simple to reverse such decisions but, after long discussions and with assistance from the Japanese Ambassador in Rome and from the architects, the ceiling went back to its original position and thickness and the wooden floor was restored.

The following pictures illustrate construction phases and the final result. **P36▶**

IP35 Results

Some measurements have been performed in the empty hall. Typical results are given below.

Conclusion

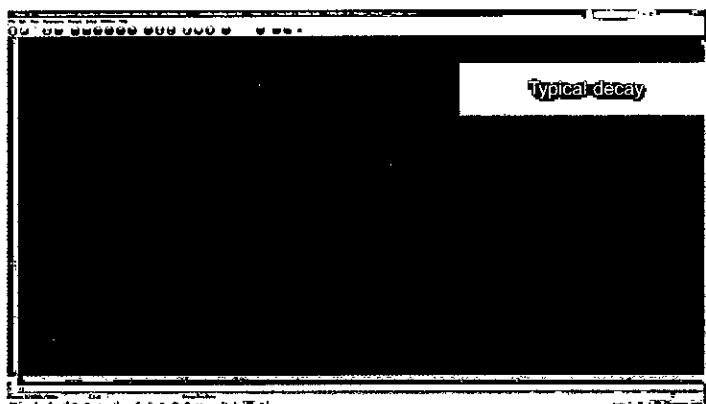
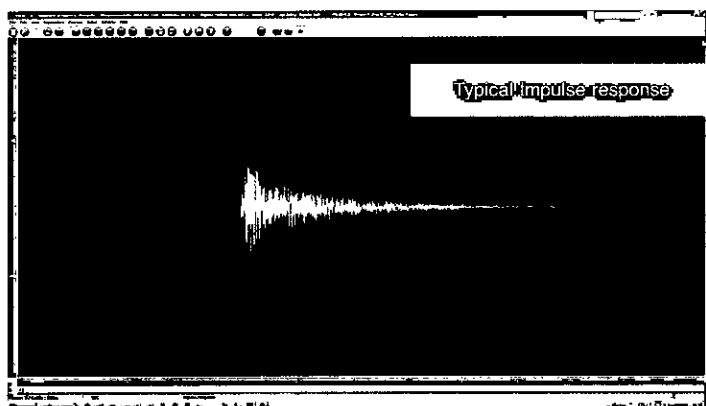
The project was a challenge for the design team because of the unusual technical, economic and political context. Furthermore, the shape of the preliminary project of the hall and the wish to use unusual materials complicated the acoustical design.

Non-classical solutions had to be devised to provide, at the lowest possible cost, good acoustics for music and a reasonable acoustic insulation.

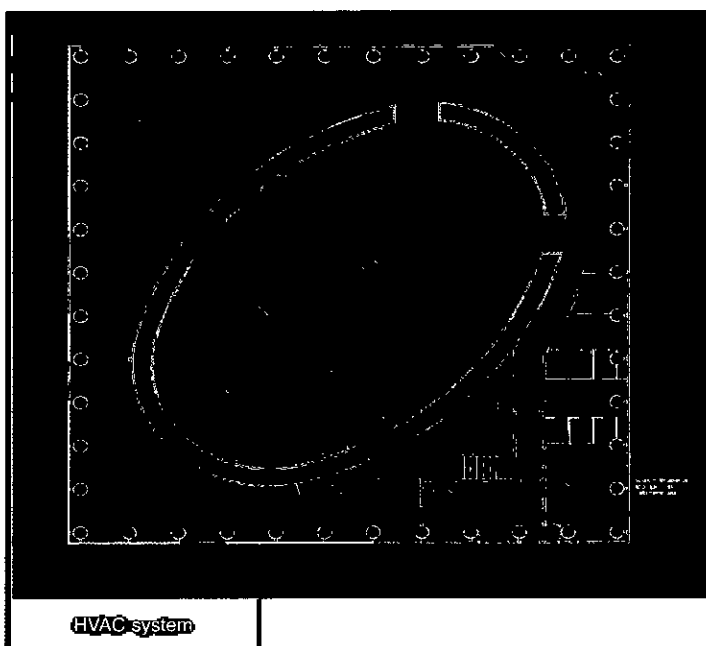
It turned out that some of the cheapest materials, the strongly diffusive heavy cardboard cylinders and the high insulation sandbags, were actually assets.

The concert hall has been well-received by the artists, the public and the professors and students of the Conservatorio Di Musica "A Castella", for its original aesthetics and for its acoustics.

This example may pave the way for low-cost concert halls of the future. ■



Measurement results in the last rows							
Octave band Hz	125	250	500	1000	2000	4000	8000
EDT [s]	2,08	1,99	2,62	2,13	1,62	1,11	0,73
T20 [s]	1,48	1,94	2,38	2,22	1,63	1,23	0,96
T30 [s]	1,73	2,05	2,47	2,18	1,65	1,26	0,97
Ts [ms]	137	177	202	156	96	77	57
C80 [dB]	0,43	-3,49	-3,07	-0,87	2,15	3,51	5,49
D50	0,32	0,15	0,21	0,25	0,50	0,53	0,01



The Speech Transmission Index after four decades of development

Report by Sander van Wijngaarden, Jan Verhave and Herman Steeneken

This year, the Speech Transmission Index celebrates its 40th birthday. It has been four decades since Steeneken and Houtgast first published their objective method for predicting speech intelligibility in *Acustica*. Since then, the STI has evolved into a versatile and mature method, used in a diversity of applications. It is now more popular than ever, with record numbers of STI users as well as manufacturers of STI measuring solutions. We mark the occasion by looking back at the development of the Speech Transmission Index throughout the decades, while also presenting an overview of current developments and challenges.

Origins of the Speech Transmission Index

What inspired Houtgast and Steeneken to develop the STI was their desire to save time and to eliminate the dull work associated with subjective intelligibility tests. Or, in the words of Houtgast: their "laziness". Their work back then, at TNO in the Netherlands, consisted largely of carrying out lengthy evaluations of speech intelligibility, mainly of military communication systems, using large numbers of human test subjects. The need was there for a faster, and

more diagnostic, alternative to subjective listening tests. The primary design objective was that it should be a physical measuring method (i.e., based purely on physical principles without humans in the measuring loop), which could produce results fast. Moreover, a measuring method was required that could use a test signal in order to obtain direct and immediate results. This sets the Speech Transmission Index apart from the Articulation Index, which was already around at the time. The STI owes several of its key characteristics to the work done by French and Steinberg on which the AI is also based. However, the AI (and later on its successor SII) is basically calculated from measured sound pressure levels, theoretical data or measured impulse responses. Among other things, this means that the AI and SII are inherently "blind" to non-linear effects, whereas the STI incorporates these effects.

The Speech Transmission Index concept also incorporated insights crossed over from research in the visual domain in the early 1970s. Optical system engineers back then already used the concept of the Optical Transfer Function (more generally named the Modulation Transfer Function) to quantify the transmission quality of optical

P38



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IP37 systems. Houtgast and Steeneken realized that similar principles in the time domain should apply to transmission of speech signals.

Key concept

Houtgast and Steeneken designed their STI test signals based on modulated, speech-shaped noise. The basic principle underlying the STI is that preservation of speech intelligibility during transmission is achieved by preservation of the natural intensity fluctuations in speech spectra. The design of test signals was such that they mimicked these natural modulations, but in such a way that measurements could be carried out quickly, precisely and within the constraints of calculation (computer) power of the time. After four decades of evolution, the basic principles remain unchanged – although the computer power is now available in handheld devices, whereas the necessary equipment originally required several people to lift.

Initial use of the STI method

In the 1970s, the STI was very much a niche method. The inventors themselves used the STI in various real-life applications, but use by others was limited to a few studies done out of scientific interest only. The publication of Steeneken and Houtgast's JASA paper in 1980 marked the beginning of more widespread use of the method. The growing group of STI users forked into two separate (but overlapping) communities almost from the very beginning.

On the one hand, there is a scientific community, attracted to the way the STI predicts speech intelligibility based on a near-universally applicable model with only few design parameters. On the other hand, there is the engineering community, interested mostly in the practical advantages that the STI was designed for: fast, objective and accurate predictions of speech intelligibility.

To the engineering community, standardization of the STI method by successive IEC-committees (in successive editions of IEC 60268-16) turned out to be of key importance. The version of the STI described in Steeneken and Houtgast's 1980 JASA paper was standardized as the original, first edition of IEC 60268-16. TNO already had a variety of test signals available, but the RASTI test signal (Room Acoustical STI), designed specifically for application of the STI in room acoustics) saw the most widespread use. This was largely due to the availability of RASTI measuring hardware from B&K, based on TNO's earlier RASTI device.

Over the years, a lot of criticism towards the STI came from users having experiences with RASTI outside its intended scope of use. RASTI measurements are accurate measurements of the STI, if applied to pure room acoustics; i.e., transmission chains featuring electro-acoustic components should never be measured using RASTI. Words to this effect in the RASTI manual have not stopped people from attempting to do so anyway – and even publishing criticizing accounts of how RASTI failed to yield accurate predictions.

IEC 60268-16 second edition (1998)

There was also a certain amount of justified criticism towards the "original" STI, which triggered a significant amount of research at TNO in the 1980s and 1990s to improve on the method. Several major improvements were standardized in the second edition of IEC 60268-16, which was released in 1998.

The original STI did not account for the fact that speech perception is aided by synergistic effects between adjacent frequency bands. Among several other improvements, additional model parameters were added to take these between-band interactions into account. The 2nd edition of the STI was named STIr ('r' for revised), but the subscript was dropped later on. It is now customary to simply refer to any version as "STI," indicating which revision of the IEC standard applies in accompanying text (if relevant).

The STIDAS IID device produced by TNO was capable of measuring the STI according to first and second editions, using a host of different test signals, including full STI modulated noise test signals and STITEL (specifically for telecommunication measurements). This device was sold worldwide, but its specific hybrid analog-digital design made it too expensive for many users. Some of these units remain in service to date, mostly at military research facilities.

A trend in the 1990s was that many acousticians started to use estimations of the STI based on measured impulse responses. Affordable PC-based software for impulse response measurements was becoming commonplace. If certain conditions are met (among which linearity, no background noise or band-pass limiting), then the STI may be precisely derived from the impulse response. This is what many users were doing (or rather, what their software was doing for them). Unfortunately, the conditions for this approach to work do not generally apply. In fact, much like RASTI, impulse response-based STI estimates can only be relied upon in evaluations concerned purely with room acoustics. A need was widely felt for a test signal (and a version of the STI method) that was applicable to electro-acoustics transmission chains, and could be measured quickly and directly. This led to the development of STIPA.

IEC 60268-16 third edition (2003)

The third edition introduced two major changes. Most importantly, it introduced the STIPA test signal (sometimes referred to as STI-PA), which is a test signal optimized for PA systems. Compared to RASTI, STIPA has the advantage that all octave bands are covered (125 Hz – 8 kHz), although only two modulations frequencies are tested per octave band. This means that STIPA can be used reliably in nearly all cases involving electro-acoustics as well as room acoustics. STIPA can be used in any condition that RASTI was previously intended for, with the possible exception of rooms featuring pronounced, individual echoes. Since RASTI is inherently unsuitable for any condition involving electro-acoustics, the introduction of STIPA made RASTI completely obsolete.

The third edition also introduced the concept of level-dependent masking. Earlier versions of the STI ignored the fact that auditory masking curves flatten out at higher sound levels, effectively reducing intelligibility. The resulting mismatch sometimes observed between the STI and subjective intelligibility at high sound levels no longer exists from the third edition onwards. The price for this added accuracy is that measurements need to be calibrated in terms of the (A-weighted) sound pressure level. This was already common practice, but not specifically required before. If acoustic calibration is not feasible (e.g., when evaluation intelligibility of purely electronic devices that may be used at arbitrary speech levels), level dependent masking may be disabled. The resulting STI is then only valid for comfortable listening levels.

The design and release of STIPA had the intended effect. Measuring devices by several manufacturers reached the market, and the last users that had been holding on to their now-obsolete RASTI equipment made the transition. Although STIPA is just one of several standardized test signals in the 3rd edition, it turned out to be virtually the only one used in practice. Many users still using indirect (impulse-response based) measurements also decided to obtain STIPA-capable devices. Some (local) regulations specifically requiring STIPA helped to speed up this process. In practice, situations for which the STIPA test signal is insufficient, and "full STI" measurements are required, are rare; this is the case mainly when strong discrete, single echoes occur.

IEC 60268-16 fourth edition (2011)

Even if the STI method itself had some room left for future improvement in its third edition, it was mostly the text of the IEC standard itself that now became criticized. With more equipment manufacturers implementing STIPA, it became apparent that it was not easy to build a STIPA-capable device when using the standard as a single source of information. The standard was therefore completely overhauled and much information was added.

The standard outlines not only how to design direct STI measurement (using modulated test signals such as STIPA) but also how to implement indirect (impulse response-based) measurements. Limitations of different approaches and test signals are now clearly indicated in the standard. In other words, for different types of application, the standard now prescribes which methods may, and which ones may not be used safely.

The fourth edition features only a single (minor) change to the STI algorithms itself: the calculation of level-dependent masking was

changed from a discrete lookup-table to a smooth continuous function. Also added is information on interpretation of the STI relative to true speech intelligibility. Whereas the STI quantifies the impact of the transmission channel on intelligibility, there is also an influence of talkers and listeners. There are fixed and well-known relations between STI and intelligibility for "normal" populations. The 4th edition of the standard also assists in interpreting the STI for populations of non-native talkers and listeners, as well as certain categories of listeners with hearing loss.

The major current challenge: validation and certification

Every successive update of the STI method was validated at TNO, using a reference system called COMCHA. This reference system simulated a wide variety of representative test channels (78 channels based on band-pass limiting and 68 channels for communication channels). TNO also maintained reference versions of successive generations of measuring devices. Besides validation of new additions to the STI framework, these tools were also used to provide third-party validation and certification services, for instance for STIPA measuring devices from various manufacturers.

Today, validation services based on these assets are no longer being offered by TNO. In practice, there is no other institute or company capable and willing to take over this service that has the same level of confidence, expertise and (especially) independence. This is perhaps the major current challenge for the future of the STI: making sure that all STI devices measure consistently and correctly according to the standard and produce identical results. Likewise, all STIPA signals (and also other STI test signals), should be interchangeable and compatible with each IEC-compliant measuring device.

For the moment, the best solution appears to be to create an open-source validation database. TNO and Embedded are collaborating in creating such a reference database of degraded STIPA test signals using the original COMCHA conditions, verified with "golden

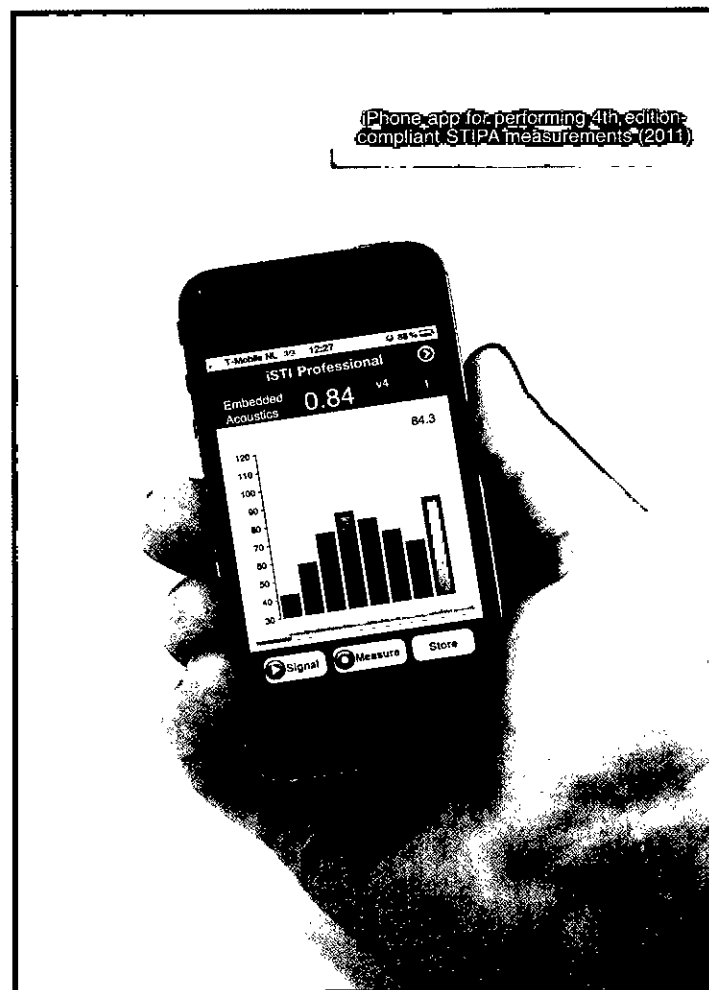
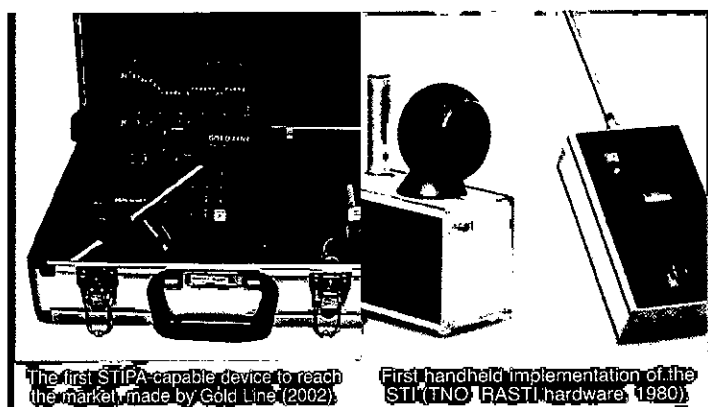
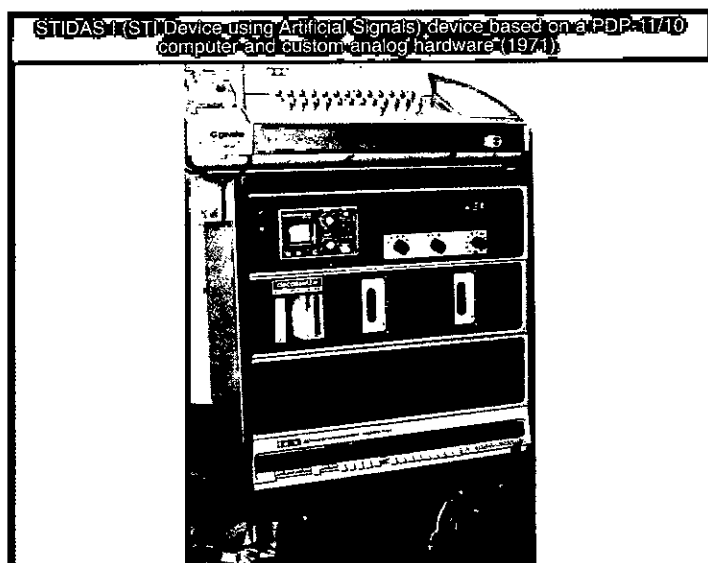
standard" software from TNO. This set of signals will represent the various types of conditions for which STIPA is sensitive, such as noise, reverberation, peak clipping, etc. This database will be made available through the internet under an open licensing regime, such as (for instance) GPL.

Not only will developers be able to test and validate their devices using these signals; their users (and competitors) will be able to check compliance using the very same database. In our view, this provides for a system of checks and balances that eliminates the need for an impartial certifying authority.

Current and future research

The STI has been a tool in many scientific studies, but it is also itself the subject of scientific investigation. In the past, the focus was often to improve the method, in terms of solving known inaccuracies and issues with the method. Nearly all of these issues have been thoroughly investigated and are now closed chapters; examples are the interaction with gender, non-linear auditory masking and variations in the modulation spectrum. Right now, the focus of research is more on *extending* the scope of the method rather than just generally improving it.

One very interesting field of research is measuring the STI using real, recorded, speech instead of artificial test signals. This was actually considered from the very beginning; in the early years however, there was simply a lack of processing power for this to be practically feasible. First accounts of speech-based STI measurements were published in the 1980s. A difficulty with speech-based STI measurements is that useful, natural modulations are present (such as in the artificial test signals), but detrimental components, such as nonlinear distortion components, tend to have similar modulation spectra. Alternative approaches were proposed, among others, by Drullman and Payton, but their approaches were only partially successful in separating between useful and detrimental modulations. The concept of weighing modulations frequencies within an **P40**



◀P39 MTF based on the question whether or not phase shifts occur was explored by Van Gils and Van Wijngaarden, and proven promising. Speech-based STI measurements were, among other applications, shown useful to evaluate digital voice coders. An open question at the moment is to decide on optimal phase weighting functions. Also, further validation in a wider range of realistic conditions is needed.

Another field of research is the study of binaural STI measuring methods. The STI has always been a monaural model. This means that the STI cannot be used to distinguish between conditions in which binaural listening benefits are significant. Specific model additions have been proposed by Van Wijngaarden and Drullman to incorporate binaural listening. Similar work has been done by Beutelmann et al. in the context of the Speech Intelligibility Index (the successor to the Articulation Index). This work needs to be consolidated into a robust addition to the STI model, that may optionally be used to refine STI-based studies in which binaural listening plays a predominant role. Such an addition also needs to be validated.

Measuring the “full” STI with modulated noise carriers

Another relevant current research topic is concerned with improving and extending the current array of test signals. At the moment, the STIPA test signal is used nearly exclusively. This means that only 2 modulation frequencies per octave band are tested. A “full” STI measurement involves modulation frequencies sampled in 1/3 octave bands from 0.63 Hz to 12.5 Hz. In practice, a sparsely sampled MTF matrix (such as the one offered by STIPA) suffices for most applications – but not all. As mentioned above, care should be taken when using STIPA in rooms with discrete echoes. All current commercially available methods for measuring the full MTF matrix make use of inverse calculation of the MTF based on impulse response measurements. This is not permitted if nonlinear distortion components may

occur. Only the TNO reference system currently features a fully IEC-compliant measurement mode for full STI measurements. The drawback of the TNO system is that it is based on obsolete hardware, takes up to 10 minutes for a single measurement point, and requires the test signal generator and the STI analyzer to be synchronized.

Embedded Acoustics has initiated a research project that is intended to result in an advanced full STI measuring scheme, based on modulated noise carriers, that does not need to be synchronized. In practice, a measurement will appear to be similar to a STIPA measurement, except for the measurement time (which will probably need to be 1 to 2 minutes).

On to the next four decades...

When the fourth edition of IEC-60268-16 was published last year, hard- and software vendors proved quick to update their products. This is encouraging; it shows that the market is quick to respond to changes. Several companies will launch new STI products in 2012, from STIPA modules for existing hardware to completely new devices and mobile apps.

Also, the STI is finding its way into new standards and regulations every year, replacing now-obsolete subjective intelligibility tests and less advanced metrics. This ranges from the national NEN-2575 standard for certification of Voice Evacuation systems in the Netherlands, to the NFPA-1981 standard in the US for testing speech intelligibility of face masks.

In conclusion, there is a community willing and able to support the STI, and the number of users is also consistently growing. Keeping the method up to date for another forty years will be an effort that requires this community of individuals and companies to actively cooperate. We predict that in the next few years we will see this community pulling together, and starting to prepare work for the fifth update of the IEC standard, somewhere around 2016. ■

People News

I New recruits come aboard consultancies

Vanguardia has announced the arrival of two new staff, Ian Bromilow and Paulie Roche. Ian, who joins as principal consultant, has 20 years professional experience with a preferred focus on architectural acoustics. After graduating from the University of Salford, he worked in the acoustic test laboratory, before starting consultancy with Atkins and then Sandy Brown. He went on to form and lead the acoustics group in BDP London for 10 years before turning freelance. He joins Vanguardia to assist with its expansion due to an ever increasing workload on high profile projects.

Paulie Roche has graduated in professional sound and video technology at the University of Salford and will be assisting in a variety of audio visual, animation and acoustics projects.

In another move, Adam Mottershead, acoustic consultant, has recently joined Acoustic Dimensions in Coventry, where the team includes Nicholas Edwards, Neil Bachelor and Janet Burman.

The consultancy provides a range of services in acoustics, concert hall and theatre design as well as audio, video and lighting technology. In the UK it has worked on a number of prestigious projects, including the Royal Shakespeare Company's new theatre in Stratford-upon-Avon and Birmingham University's Bramall Music Building.

Capita Symonds has appointed Claire Drewery as associate director, acoustics – Scotland.

She joins from Hodgson & Hodgson where she was principal

consultant/business leader responsible for providing a range of services to various clients, such as Morgan Sindall, Berkeley Homes, Lovell, St James and Barratts.

Claire has worked on numerous large scale multi-use developments, including Gunwharf Quay, Portsmouth; Caspian Wharf, London; and Bromyard Avenue, Acton, as well as smaller, more specialised projects such as recording studios and theatres. ■



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Anti-tamper data verification with the new AuditStore.
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Advanced triggering of audio recording and alerts using any combination of threshold, rate of change and tonal noise criteria. Use up to 20 independent rules across 5 templates to detect, record and identify noise sources.

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Store audio recordings at 96kHz/32bit for further analysis or store at 16bit/16kHz for listening and source identification.

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Tonal noise detection using ISO 1996-2:2007 Simplified Method or the new Cirrus improved method (extended frequency range, user defined thresholds, A & Z weightings & detection of tones between bands).

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Over 3 years*1 data storage with the 32GB memory option.

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3G/GPRS data download & GPS location data with the new CK:680 outdoor measurement kit. SMS, Email & Twitter alerts when an Acoustic Fingerprint template is triggered.

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View NR & NC values & curves on screen using 1:1 octave band data.

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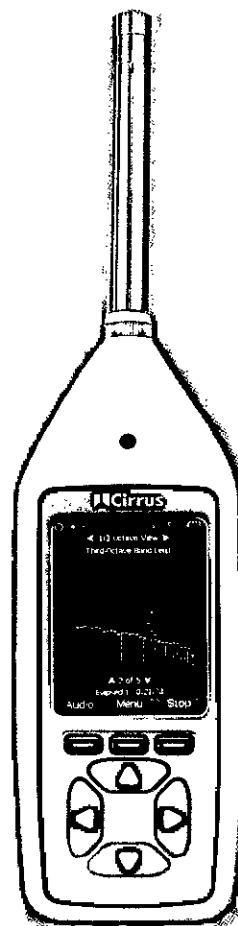
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*1 dependent upon audio recording and time history data rates.

*2 features subject to instrument specifications.

AuditStore & Acoustic Fingerprint trademarks pending. Optimus® is a registered trademark of Cirrus Research plc.

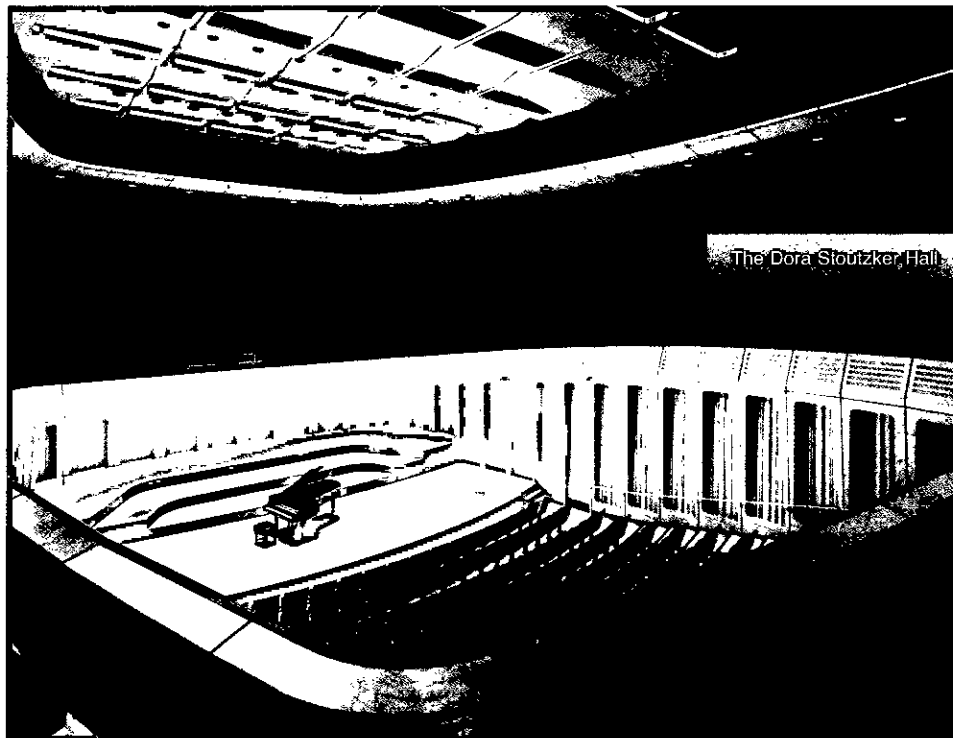
New music venue hits just the right note for BBC Young Musicians of the Year

The BBC Young Musician 2012 Category Finals and Semi Final were recorded for broadcast from a new Cardiff-based world-class music venue with acoustics designed by engineering consultancy Arup.

Ian Knowles, Acoustic Consultant and Associate Director at Arup, said: "We have been privileged to deliver the acoustic design of some of the UK's most exciting new performing arts buildings. The new Royal Welsh College of Music and Drama's Dora Stoutzker Hall is a facility where future generations of talented young musicians in Wales will have the opportunity to train and perform."

Described by concert pianist Noriko Ogawa as "one of the very best I have ever seen in the world", the 450-capacity hall adds a world-class rehearsal and performance facility to the college and is the first purpose-built chamber recital hall in Wales. The hall is equipped with a variable acoustic system that allows changes in the room response to facilitate performance and rehearsal of a wide variety of musical styles from chamber music and choral work through to jazz and amplified music.

For more details to www.arup.com ■



SRS solves sports hall acoustics problem

Panels reduce noise

Poor room acoustics in the sports hall of a special school in London are a thing of the past – thanks to measures implemented by Sound Reduction Systems (SRS).

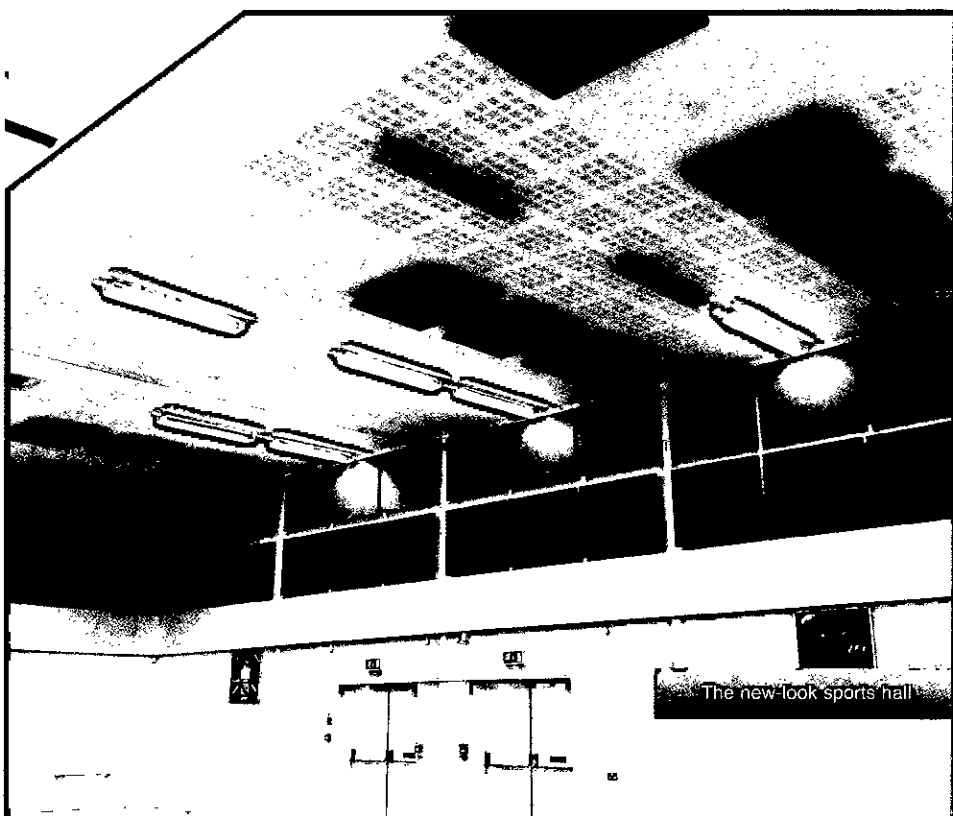
Data collected by SRS from Charlton School was fed into its reverberation modelling software, and by adjusting the level of absorption within the equation, it was able to specify, to the exact panel, the area of absorption required to address complaints from pupils and staff.

SRS proposed the use of 126m² Sonata, its acoustic absorber range. Sonata Vario panels were suspended across the ceiling and also fixed at high level on the walls to ensure good, even absorption across all frequencies.

Following installation by Floorscan Acoustics, Deputy Head Deborah Reid commented: "The reduced noise delivery in the hall was noted by parents and governors when we recently held a whole school assembly with 250 people present."

"The physical education department has also noted the difference in student behaviour, particularly with students who have autism as the noise level has been greatly reduced and this allows the sessions to be calmer and with less background feed."

For more details ring 01204 380074, email info@soundreduction.co.uk or visit www.soundreduction.co.uk ■



'Arresting' acoustics at the Old Police Station

Echo problems solved

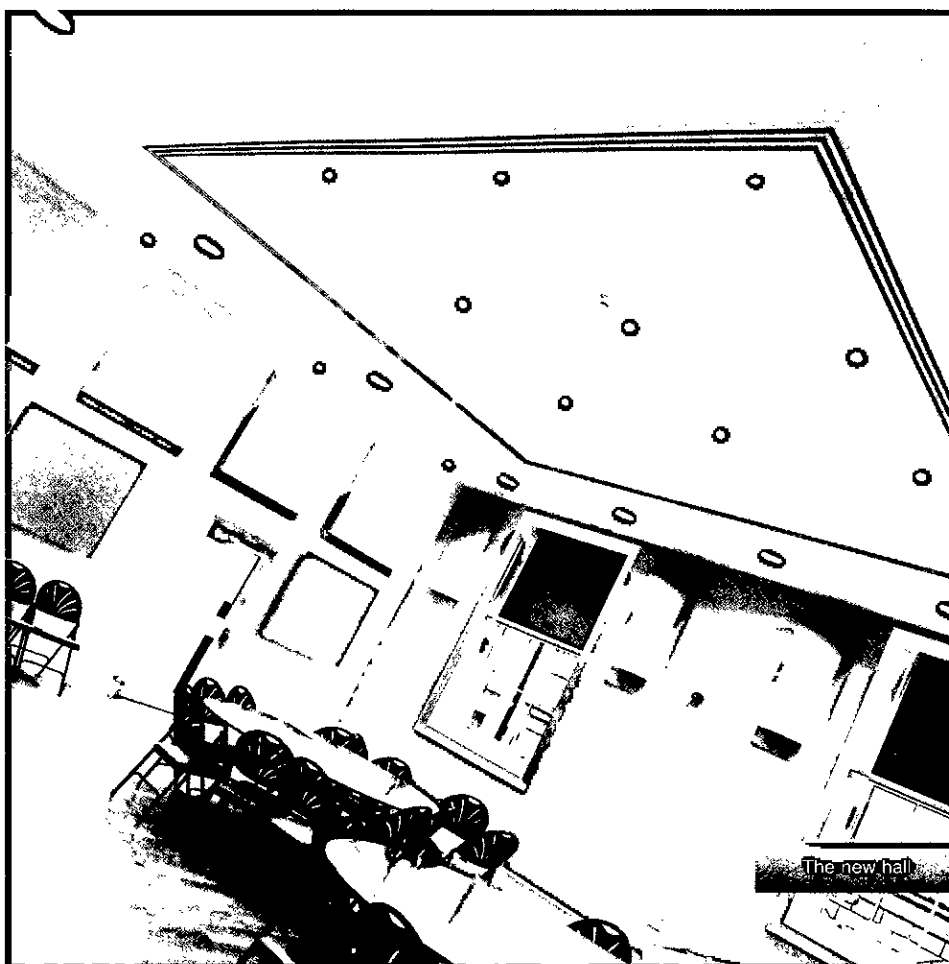
Sound Reduction System's Sonata panels are being used to control the acoustics in a new hall which had a particularly bad echo and reverberation problem due to the number of hard, acoustically reflective surfaces.

Keighley Council requested their installation at the Old Police Station, Keighley following a full-scale refurbishment of the former police building which resulted in the creation of an events hall on the first floor.

A combination of white and blue Sonata Vario absorbers was installed by Floorspan Acoustics on the walls to fit in with the existing décor.

Afterwards Alan Parry, council special projects co-ordinator, commented: "The outcome of the absorption panels is amazing."

For more information contact Sound Reduction Systems at 01204 380074 or www.soundreduction.co.uk



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Based in the centre of Brighton, Anderson Acoustics Ltd has developed a reputation for client focused, high quality acoustics consultancy. We provide services within the construction, transport, airport, residential development, industrial and commercial, school design, planning, and building acoustics sectors & UKAS accredited sound insulation testing.

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You will be educated to at least degree level in acoustics (or a related subject) and, depending on experience, will hold at least AMIOA status – though MIOA preferred.

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Selectaglaze hits the right note at music department

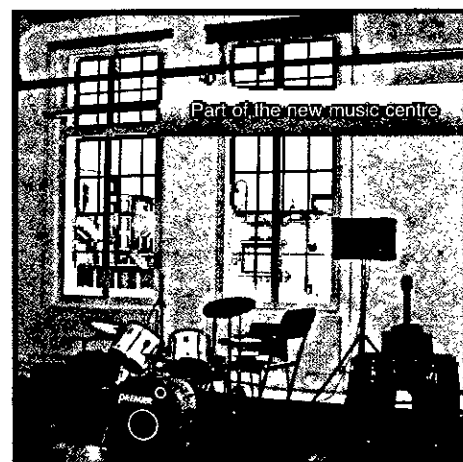
Selectaglaze has played an important role in the creation of a new music department for the University of Reading through the installation of secondary glazing.

Because of the need to retain many of the Victorian building's original features, including a mixture of curved and sash windows, all of which were single-glazed, windows were treated with hinged casements incorporating twin memory compression seals, multipoint locking and a 6.4mm laminated glass to ensure the best acoustic

performance. Flush hinges and flush locks fitted with escutcheon plates provide clean lines and minimal dust ledges.

The installation in the two-storey building has also markedly reduced draughts and general heat loss through the windows, ensuring comfortable conditions for practising musicians.

For more details, ring 01727 837271, email enquiries@selectaglaze.co.uk or go to www.selectaglaze.co.uk



Church congregation sings praises of ceiling

Acoustic tiles cut reverberation time

The congregation of a new church in Belfast is reaping the rewards of an acoustic ceiling solution from Saint-Gobain Ecophon.

The Christ the Redeemer Church in Lagmore was completed in August 2011. Ecophon, part of international materials company Saint-Gobain, worked closely with Gerry Loughrey Architects, to ensure that a space characterised by lots of hard surfaces, would perform well acoustically.

Traditionally, church buildings suffer from

high reverberation and lots of echo, so it was important to find an acoustic solution that would limit these factors.

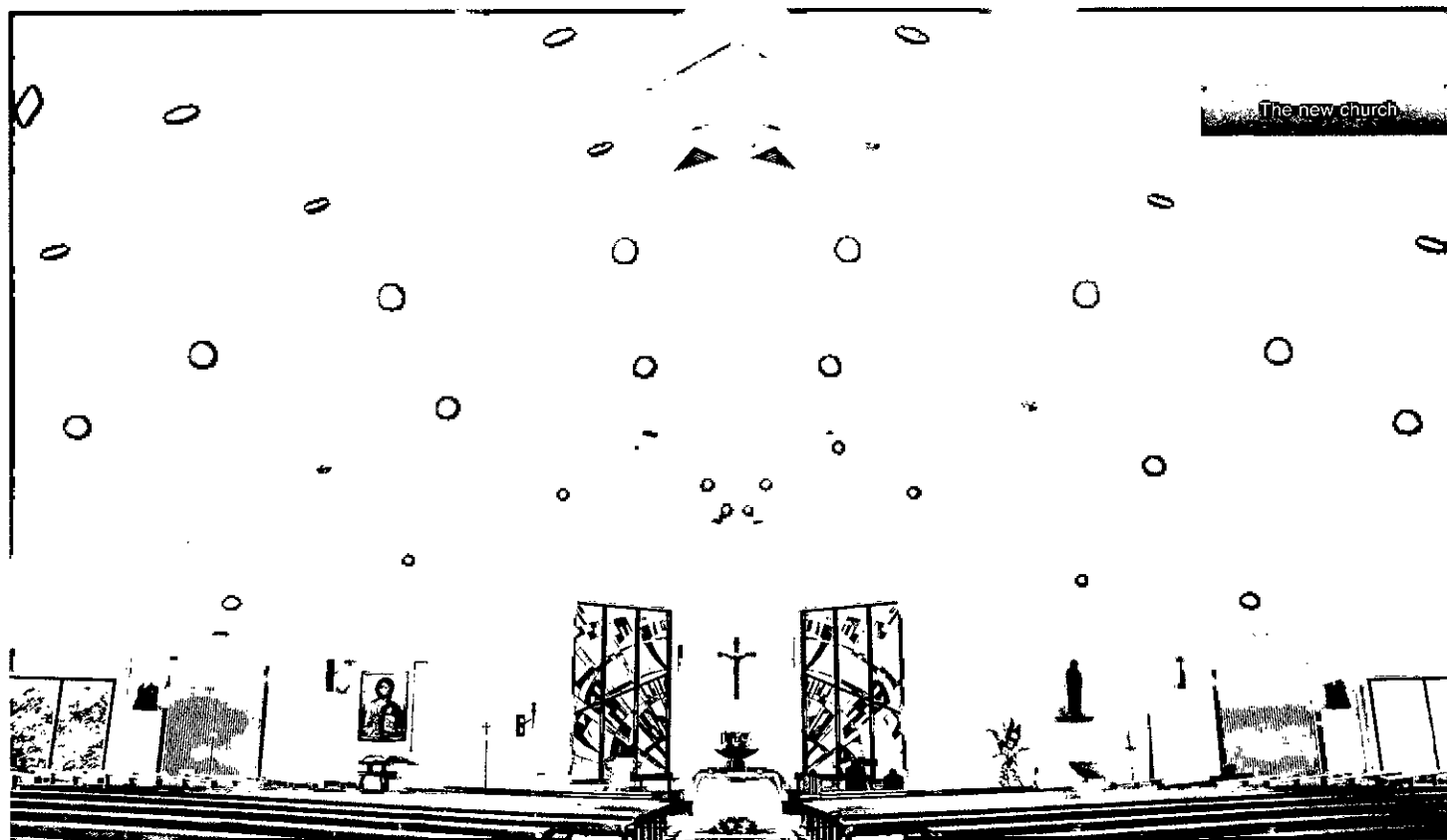
Ecophon's Focus Ds acoustic ceiling tiles and Texona wall panels were installed in the church to provide Class A sound absorption to help reduce the reverberation time. The Focus Ds tiles were used in the pyramid-shaped roof which peaks at more than seven metres high, while the wall panels were installed at a lower height.

Alan Crampton, Ecophon's regional

manager for Ireland, said: "The pyramid shape of the roof meant that the installation was challenging for Contract Ceilings and required the tiles to be fitted into a pentagonal shape at an angle. The ceiling height was also a factor as well as the bulkheads which are at regular intervals all the way up."

Gerry White, architect from Gerry Loughrey Architects, said: "We worked very closely with Alan and the technical team at Ecophon to ensure the ceiling was fit for purpose. It took six weeks for the tiles to be installed and the finished result is not only very striking aesthetically but importantly, creates a great sound environment for the congregation to enjoy."

For more details, phone 01256 850989 or email marketing@ecophon.co.uk, www.ecophon.co.uk



Wind Turbine Noise: How it is produced, propagated, measured and received

editors Geoff Leventhall and Dick Bowdler

Review by Andy McKenzie FIOA, Hayes McKenzie Partnership

It is now 15 years since the publication of *Wind Turbine Noise* by Wagner, Bareiss and Guidatii and, as a result of the developments which have occurred over the 15 years, Multi-Science Publishing have now published *Wind Turbine Noise*, rather curiously using the same name as the earlier work, edited by Dick Bowdler and Geoff Leventhall, as a kind of update. The book originates from an idea by Geoff who has been active in this field since he became aware of the extent to which his work in respect of low frequency noise and infrasound was being mis-quoted in connection with wind turbine noise.

The result is a densely packed tome with chapters covering basic acoustics, noise sources, noise propagation; noise at the receiver; amplitude modulation; effects on people; measurement and analysis; and criteria. Perhaps inevitably, there is a degree of overlap between some of the chapters with, in some cases, conflicting remarks between authors! The opening chapter by Geoff presents a concise yet comprehensive and well-rounded introduction to the basic science and concepts of acoustics.

This is followed by a detailed exposition, by Stefan Oerlemans from the Netherlands, of the various sources and significance of aerodynamic noise sources on a wind turbine blade. It inevitably involves some maths and categorically demonstrates trailing edge noise as the most significant and important source. It also gives theoretical insights into the generation of amplitude modulated noise and introduces design concepts giving significant reductions in overall noise output including the use of trailing edge brushes and serrated blades together with explanations as to why these work.

The chapter on sound propagation by Andrew Bullmore and Andrew Peplow (the join does show!) from Hoare Lea provides an extremely helpful and well-structured explanation of propagation effects and the way these are included by different approaches to modelling. It usefully puts the requirements for accuracy into context and provides a helpful summary of the pros and cons of

different approaches together with a discussion of model validation under various conditions. Although this chapter would be equally at home in a general text on environmental acoustics, it is nevertheless welcome here as it adds context to some of the later chapters and gives a useful bridge between noise generation and noise receivers.

Bo Søndergaard from Denmark then illustrates how reflection factors around the receiver location can be modelled and put into context before moving on to internal effects, particularly in respect of low frequency noise and its significance. Audibility and masking is discussed including a discussion of critical bands which determine what the ear can and cannot hear in the presence of competing noise. This is followed by a very brief discussion of impulsivity and amplitude modulation.

There then follows a chapter on amplitude modulation by Frits van den Berg, the reluctant Dutch champion of "wind shear" effects, and Dick Bowdler. This rather overlaps the amplitude modulation section in Frits's following chapter on the effects of sound on people, which is the only criticism of the structure of the book, but it nevertheless provides a helpful review of the work of others in this area including a synopsis of the preliminary findings of the research commissioned by Renewable UK on this issue.

Frits's chapter then provides a useful review of some of the work which has been carried out in Sweden and in the Netherlands on subjective response to turbine noise (surely it is time something similar was done in the UK?) including the factors which lead to annoyance. The influence of acoustic factors, including low frequency noise, infrasound and amplitude modulation are contrasted with non-acoustical factors and the links between annoyance, stress, sleep disturbance, health and distress are very eloquently described. Finally there is a brief discussion of the two phenomena named as Visceral Vibration Vestibular Disease and Vibroacoustic Disease and their relevance to the effects of wind turbine noise.

The penultimate chapter by David Hessler from the USA essentially describes the problematic nature of measurements of wind turbine noise and potential solutions, although I'm not sure that using eight sets of measurement equipment to evaluate compliance at one property is entirely necessary, nor about the use of Type 2 (in IEC 651 speak) measurement equipment. I'm also not sure just how "comical" the issue of wind shields being removed by livestock is, having dealt with the kinds of issues he describes for the past 20 years! I feel I should also put right the suggestion that wind turbine noise at source is quantified by reference to measured 10 metre height wind speed according to IEC61400-11. In practice the reference is to hub height wind speed converted to 10 metres using a "reference" ground roughness condition which is quite different.

The final chapter, by Mark Bastasch, also from the USA, describes different types of noise limits and how they are implemented both internationally and within the USA, which has no applicable federal noise regulation standards. This shows the quite wide discrepancy between standards which are applied across the globe for planning purposes. Again I feel I should put right the suggestion that the ETSU-R-97 day-time noise limit only applies to "quiet waking hours" whereas in practice it applies to whole of the day-time period although it is based on the "quiet waking hours" background.

Finally, I have to say that cramming the amount of material which has been included into this size of book means that the print size is incredibly small and also that it could have done with better proof reading in parts. This latter issue is not usually catastrophic but mildly annoying in places. Overall, however, the book is a very interesting and informative, if intense read and there is something for everyone in here, and not just those who are interested and concerned with wind turbine noise.

Wind Turbine Noise How: it is produced, propagated, measured and received is published by Multi- Science Publishing. Price £58.50



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Wind farms and the control of Excess Amplitude Modulation (EAM)

In 2009 MAS Environmental developed a decibel control to enable the identification and prevention of excess Amplitude Modulation (EAM) from wind farms. In the November/December 2011 issue of *Acoustics Bulletin* Dr Jeremy Bass of RES, the Den Brook wind farm developer, has attempted to criticise the condition as unworkable.

As the author of the Den Brook condition, I can advise Dr Bass has established nothing which either undermines the condition, or is new. We have had the opportunity of analysing Dr Bass's data and have identified a number of misconceptions which fundamentally relate to a lack of understanding of when EAM occurs and what to measure.

At a recent seminar Dr Bass accepted the Den Brook condition parameters successfully identifies EAM when present

and so in this respect it works. This has also been demonstrated by a study by the Renewable Energy Foundation.

There are a number of errors in Dr Bass' article which other experts have also identified, such as failure to consider whether the observed modulation was plausibly at turbine blade-passing frequency. Some of the other main ones are listed below:

1. EAM is primarily a problem which occurs after sunset. If measurements are restricted to one hour after dark to one hour before sunrise then false indicators are virtually eliminated. We found two exceptions in Dr Bass's data, a car alarm and wind interacting with his microphone assembly. Despite a number of significant problems with Dr Bass's data it was virtually free of false triggering at night.
2. Failure to focus analysis on periods of

high wind shear arising due to meteorological effects. The main periods of concern will arise under a limited range of meteorological conditions enabling the filtering of data based on atmospheric stability, wind speed and directions. Dr Bass did not filter his data in this way.

3. Failure to ensure appropriate data recorded suitable to test the parameters. Instead of recording 125ms LAeq values as the condition requires, Dr Bass recorded low quality audio which he converted to 'A' weighted data.

To avoid Dr Bass's mistakes and readily identify EAM a number of simple steps are recommended which will shortly be published on our website (www.masenv.co.uk).

Mike Stigwood MIOA

The author of the article in question has replied to Mike Stigwood as follows:

My objective remains to work with other acousticians in this field to formulate an objective measure of AM from wind turbines. The Den Brook Condition 20 methodology, as presently written, simply does not provide this: when applied to data from a rural site with no turbines the methodology indicates that "greater than expected AM" from wind turbines is present, which it clearly cannot be.

My analysis has assumed that the methodology set out in Den Brook Condition 20 should be followed as written. If there are necessary additional criteria that must be followed, as suggested by Mr Stigwood, then these need to be explicit in the methodology, so it can work effectively at any time of day and in any atmospheric conditions. I look forward to, and welcome, Mr Stigwood's simple steps "to readily identify EAM" as promised in his letter.

Ultimately time domain analysis, which is what the Den Brook Condition 20 methodology comprises, does not work because it only looks at broadband changes in amplitude rather than changes in amplitude at a particular frequency. This debate itself shows that the methodology is doomed in terms of practical application and our collective efforts should instead turn to refining a frequency domain method that can be applied consistently and reliably to detect problematic AM.

RES have repeatedly offered to engage Mr Stigwood's professional services over the last five months to independently analyse the condition using data he himself records, but so far he has not been willing to undertake this work. Despite this, RES's door remains firmly open and we hope we

can positively engage with him in future.

In response to Mr Stigwood's specific points:

- he says that I have established nothing which "undermines the condition, or is new". In terms of the former, I would regard a false positive rate of ~80 % as catastrophic for any test, whether for AM or anything else. In terms of the latter, if this is the case then I would be grateful if Mr Stigwood could indicate where interested readers can find this previous analysis? I am not aware of any such work and would certainly have referenced it had I been so.
- Mr Stigwood has had the opportunity of analysing "my" data because I sent it to him in October 2011. I did this because I was keen to continue the debate regarding this methodology and believed the best way forward was to apply the methodology to real data.
- in quoting me, from my presentation at the Institute of Acoustics' Wind Turbine Noise conference in January 2012 (partially based on my *Acoustics Bulletin* article), Mr Stigwood points out that I acknowledged that the work of Dr Moroney, of the Renewable Energy Foundation, appears to show that the methodology has a low rate of false negatives, i.e. it rarely fails to identify the condition as being satisfied when we "know" it should be. He omits to mention that I also said that the methodology suffered a high rate of false positives, i.e. it identifies the condition as being satisfied even when we 'know' it should not – the main thesis of my article.
- regarding Mr Stigwood's first point, I have broken down my analysis by time of day and, whilst it is true to say that these less false positives occur at night than

during the day, this argument is essentially irrelevant. It doesn't matter when or why greater than expected AM occurs – what matters is that you detect it when it's there, and not when it isn't. The Den Brook Condition 20 methodology demonstrably fails to do this.

- regarding Mr Stigwood's second point, there was no need to focus on these periods because I had continuous audio for two sites for one week each, and was able to apply the Den Brook Condition 20 methodology to all of it. The methodology says nothing about filtering, in the way suggested, and the key take away from this analysis is that "greater than expected AM" was discovered in the absence of turbines. Even if, as Mr Stigwood says, high shear is a cause of greater than expected AM, as there were no turbines in the vicinity I'm not sure how this is relevant?
- regarding Mr Stigwood's third point, I recorded audio as 16-bit, mono WAV files at 12 or 16 kHz (depending on the meter used) – hardly "low quality" – and used proprietary software from 01dB – dBFA – to generate the required 125 msec LAeq data from this. An independent assessment of this methodology by Temple Group concluded that "both of these comparisons found that the waveform processed noise data closely matched those derived from the supplied LAeq,125ms noise level data".

I would like to take this opportunity to publicly applaud Mr Stigwood for his personal contribution to this area: were it not for his efforts to pursue his interests in AM, it is unlikely that our collective understanding of amplitude modulation would have reached the level of sophistication that it currently does.

Jeremy Bass, MIOA RES

New Cirrus Research range provides outdoor protection for noise monitoring kits

Cirrus Research has developed a range of outdoor noise measurement kits for environmental and community noise monitoring which offer the ability to measure noise over long periods at such places as construction sites, airports, traffic and wind farms.

The CK:670 provides protection for an Optimus Green sound level meter and microphone capsule against all weather conditions that could potentially affect its performance.

The case can fit the standard instrument accessories, including the outdoor microphone, an extension cable, an acoustic calibrator and documentation. It can be locked while the noise measurements are being carried out and can also be used to safely transport all the equipment needed.

The kit comes with a battery that provides power for up to seven days, as well as an additional seven-day battery pack. Each pack contains an intelligent charging system that can maximise the performance of the battery and maintain the operating life for a longer period. A power cable is also provided, allowing users to connect the kit to an external power source for longer operation.

The CK:680 outdoor kit adds a 3G/GPRS Modem and a GPS location system which allows measurements to be downloaded from remote location directly into the NoiseTools software. Noise measurements can be displayed on a map using the GPS data, allowing the exact location where the measurements took place to be recorded and identified.

For more information, contact Cirrus Research on 0845 230 2434 or visit: www.cirrusresearch.co.uk □



The new CK outdoor kit

New app aids music enjoyment

SoundBest Player from SK Planet

SK Planet has launched a personalised audio enhancement app, SoundBest Player, available for Windows PC, iPhone and Android smartphone music libraries.

The app targets people's hearing ability with a quick and simple sound test that extracts and saves their personal hearing curve. By uncovering the frequencies where they have difficulty hearing and adjusting audio output levels accordingly, SoundBest Player provides them with a better quality of sound when listening to their music library.

Every person experiences different levels of hearing that are based on high and low sound frequencies. The SoundBest Player app utilises Auto Fitting, or AF, Mode to test and isolate people's personal hearing curve.

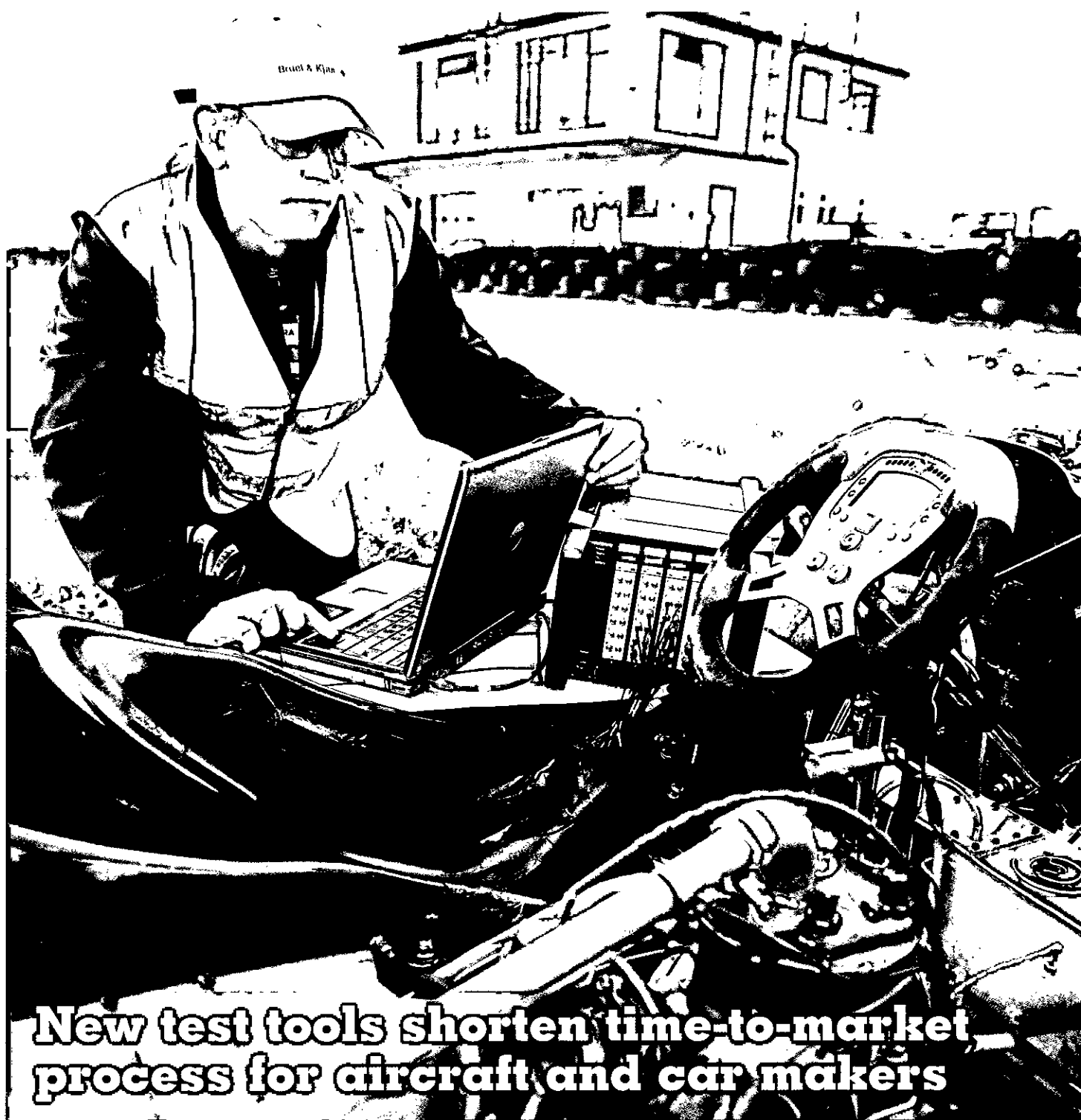
The hearing curves are then converted into optimal equalizer settings that, when

employed, create an entirely custom and personalized audio experience. These settings enable people to listen to music

more comfortably when the app is applied.

For more details, go to <http://www.SoundBest.me> □





New test tools shorten time-to-market process for aircraft and car makers

Brüel & Kjær's advanced test-FEA integration tools allow aircraft and vehicle manufacturers to speed up their time-to-market process by optimising strategies for testing physical models and improving the development of FE models.

As part of its latest data analysis platform - PULSE 16.1 - the PULSE Reflex Correlation Analysis software has been enhanced with FE interfaces for importing FE models from various leading FEA programs, such as NASTRAN® and ANSYS® or as UFF files.

The Finite Element Analysis (FEA) results are useful for test planning, as the modes can be animated to indicate frequency range of interest, mode density and critical modes for the modal test. These animations also help users choose optimal excitation and response locations for the modal test.

A new PULSE Reflex Correlation Analysis package for test and FE model correlation is also available. The software allows users to perform a complete visual and numerical correlation analysis of two

modal models, in terms of natural frequencies and mode shapes (MAC and Orthogonality), thus validating the theoretical model.

Accurate correlation is quickly obtained by following an intuitive, yet flexible workflow process that guides the user efficiently through geometry alignment, DOF mapping, vector comparison, mode pairing and reporting.

For more information go to <http://www.bksv.com/Products/PULSEAnalyzerPlatform/LatestPULSEVersion.aspx> 

I New Sky studios are state-of-the-art

Broadcast audio equipment supplier HHB Communications was chosen by Sky to provide audio equipment for the broadcaster's multi-million pound new production facility, Sky Studios, based in Isleworth, west London.

In addition to staging critical listening evaluations and ultimately supplying 370 Genelec monitors, HHB brought its experience in broadcast audio production to bear on the production chain, working alongside the Sky engineering team and systems integrators to help supply the "audio glue" necessary to ensure efficient workflow throughout the facility.

Integrated multi-format 3G/HD-SDI video monitoring and audio de-embedding alongside loudness metering, Dolby and SMPTE2020 metadata analysis comes courtesy of 98 Wohler AMP2-16V-3G rack-mounting devices, part of a total complement of more than 200 Wohler boxes employed within the building.

Consistent with BSkyB's commitment to HD and 3D pictures coupled with surround sound and stereo compatible audio, the sound control rooms are equipped with 5.1 Dynaudio loudspeaker systems and include digital audio processing tools from Cedar, Dolby, Soundfield and TC Electronic.

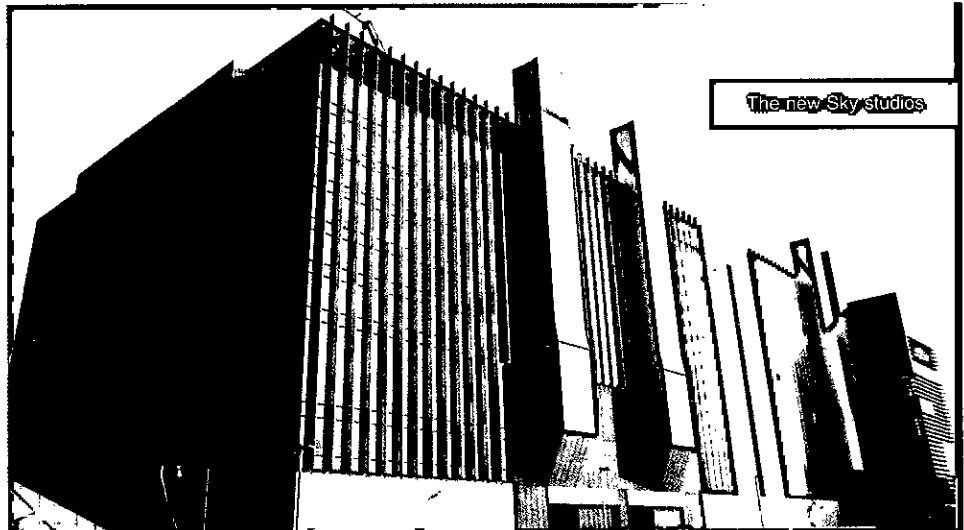
HHB has supplied BSkyB with audio

equipment throughout the broadcaster's 20-year history.

HHB Director of Sales Martin O'Donnell said: "Sky Studios is one of the most advanced TV production facilities in the world, and it's also one of the most sustainable, with energy conservation at the heart of its design. We're delighted to have played a role in such an ambitious and rewarding project."

Sky Studios incorporates eight studios along with post-production and transmission facilities for Sky's broadcast and sports news departments. Natural ventilation of the studios combines with innovative natural resource capture on site to create the most sustainable broadcast centre anywhere in the world.

For more details, go to www.hhb.co.uk ■



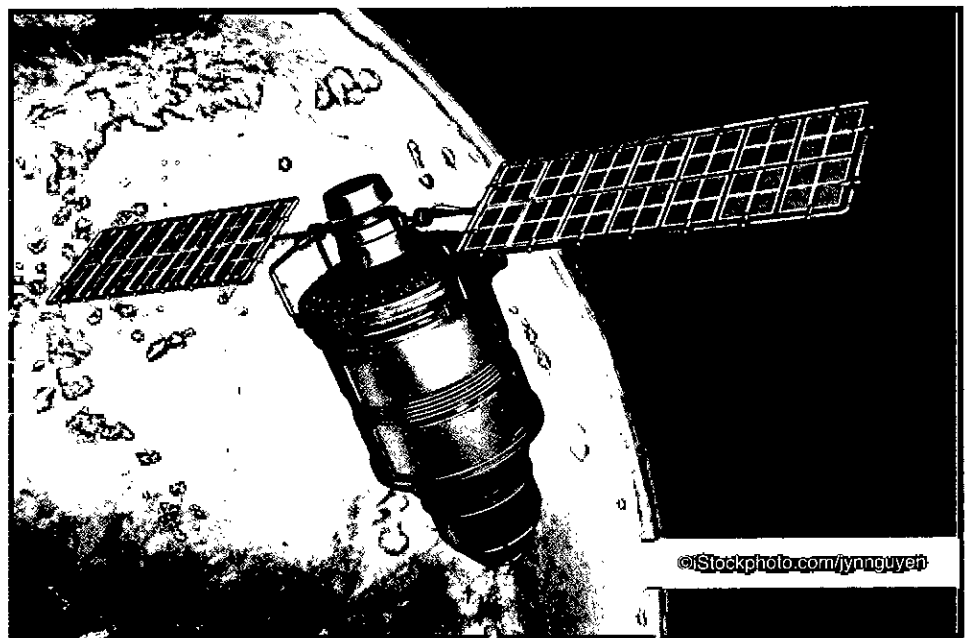
Sky's the limit as LDS V994 vibration shaker is used for satellite testing

Brüel & Kjær is to provide ASTRUM, the leading space technology company, with an LDS vibration shaker system for mechanical vibration and shock testing of satellites.

Built within the scope of Republic of Kazakhstan SBIK satellite project, the system is for the new satellite assembly, integration and test complex (AITC).

Brüel & Kjær will provide a Head Expander and LDS V994 Shaker, which will be equipped with a large auxiliary slip table - and a special, extra bearing positioning.

As part of the mechanical testing facili-



ties, a shaker capable of operating in 3 axes was required.

ASTRUM, an EADS company, has been selected as prime contractor from KGS (the JSC National Company "Kazakhstan Gharysh Sapary" reporting to the national space agency of Republic of Kazakhstan) for the SBIK satellite system.

The agreement covers the supply of Earth observation satellites equipped with

a high-resolution optical sensor, an Assembly, Integration and Test Centre - and the entire ground segment of the system, which will carry out in-orbit operation, data acquisition and processing. ASTRUM will also provide all satellite launch and test services.

For more information visit www.bksv.com ■

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Committee meetings 2012

DAY	DATE	TIME	MEETING
Thursday	3 May	10.30	Membership
Thursday	17 May	11.00	Publications
Tuesday	22 May	10.30	CMOHAV Examiners
Tuesday	22 May	1.30	CMOHAV Committee
Thursday	29 May	10.30	Engineering Division
Wednesday	20 June	10.30	CCBAM Examiners
Wednesday	20 June	1.30	CCBAM Committee
Wednesday	20 June	10.30	CCENM Examiners
Wednesday	20 June	1.30	CCENM Committee
Thursday	21 June	10.30	Diploma Tutors and Examiners
Thursday	21 June	1.30	Education
Thursday	28 June	11.00	Executive
Thursday	12 July	11.00	Council
Thursday	26 July	11.30	Meetings
Tuesday	7 August	10.30	Diploma Moderators Meeting
Wednesday	12 September	10.30	Membership
Thursday	13 September	11.00	Executive
Thursday	27 September	11.00	Council
Monday	1 October	11.00	Research Co-ordination
Thursday	4 October	10.30	Diploma Tutors and Examiners
Thursday	4 October	1.30	Education
Thursday	11 October	10.30	Engineering Division
Thursday	18 October	11.00	Publications
Thursday	1 November	10.30	Membership
Tuesday	6 November	10.30	ASBA Examiners
Tuesday	6 November	1.30	ASBA Committee
Thursday	8 November	11.30	Meetings
Thursday	15 November	11.00	Executive
Wednesday	21 November	10.30	CCENM Examiners
Wednesday	21 November	1.30	CCENM Committee
Tuesday	4 December	10.30	CCWPNRA Examiners
Tuesday	4 December	1.30	CCWPNRA Committee
Thursday	6 December	11.00	Council

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

Conference programme 2012

21 May 2012
Organised by the Musical Acoustics Group
The king of musical instruments – acoustic challenges
Cardiff

12 June 2012
Organised by the London Branch
Music to your ears – outdoor entertainment and environmental noise
London

2-6 July 2012
Organised by the Underwater Acoustics Group & ECUA
Committee ECUA 2012
Heriot-Watt University, Edinburgh

27 September 2012
Organised by the Building Acoustics Group
Acoustic challenges in green buildings 2012
Watford

6 November 2012 (date TBC)
Organised by the Measurement and Instrumentation and Young Members' Groups
Basic measurement techniques
London

14-16 November 2012
Organised by the Electro-acoustics Group
Reproduced Sound 2012
Brighton

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

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Anderson Acoustics	43	Odeon	15
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Building Test Centre	45	SoundPLAN UK&I	9
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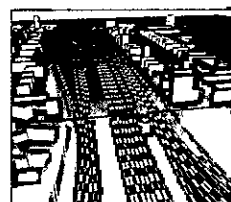
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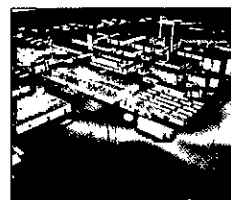
- Calculation of industrial, road, railway and aircraft noise with about 30 standards and guidelines
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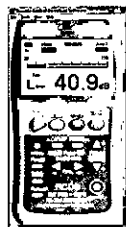
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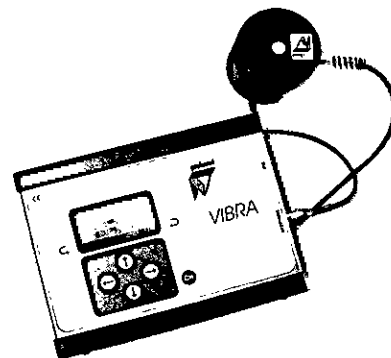


- Downloads & controls noise monitors using the GSM network
- Cost effective and reliable
- User configurable alarm levels
- SMS text alarms to multiple numbers
- Downloaded data in csv format easily imports into online systems
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- Hundreds of systems already supplied & principally deployed on construction sites
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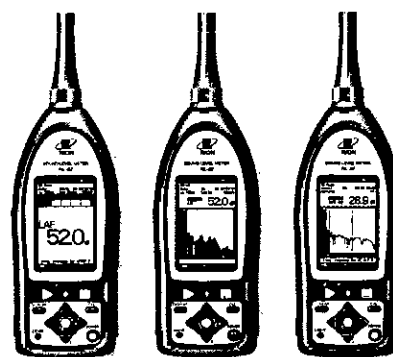
Vibra+ Designed for Demolition and Construction Monitoring

- Logs PPV and dominant frequency (essential for BS 7385: 2 evaluation)
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- Accuracy complies with DIN 45669 Class 1
- Integral GPRS modem sends out daily data & alarm e-mails
- User friendly software displays data and exports to csv file
- Real time clock and dominant frequency given for each measurement
- Very easy and intuitive to use



RION NI-52 A Complete Solution for Environmental Noise Measurement

- L_{Aeq} , L_{Amax} , L_{Amin} , SEL & 5 Statistical Indices
- 100 msec data logged simultaneously with processed values
- Uncompressed audio recording NX-42WR (option)
 - Continuous
 - Manual start /stop
 - Triggered by up to 4 user selected levels (different triggers for different times)
 - Periodic samples (including 2 minutes – perfect for windfarm compliance)
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 - Full logging functionality maintained but in octaves or third octaves
- Narrow band FFT analysis NX-42FT (option)
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- Up to 1 minute pre-trigger
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