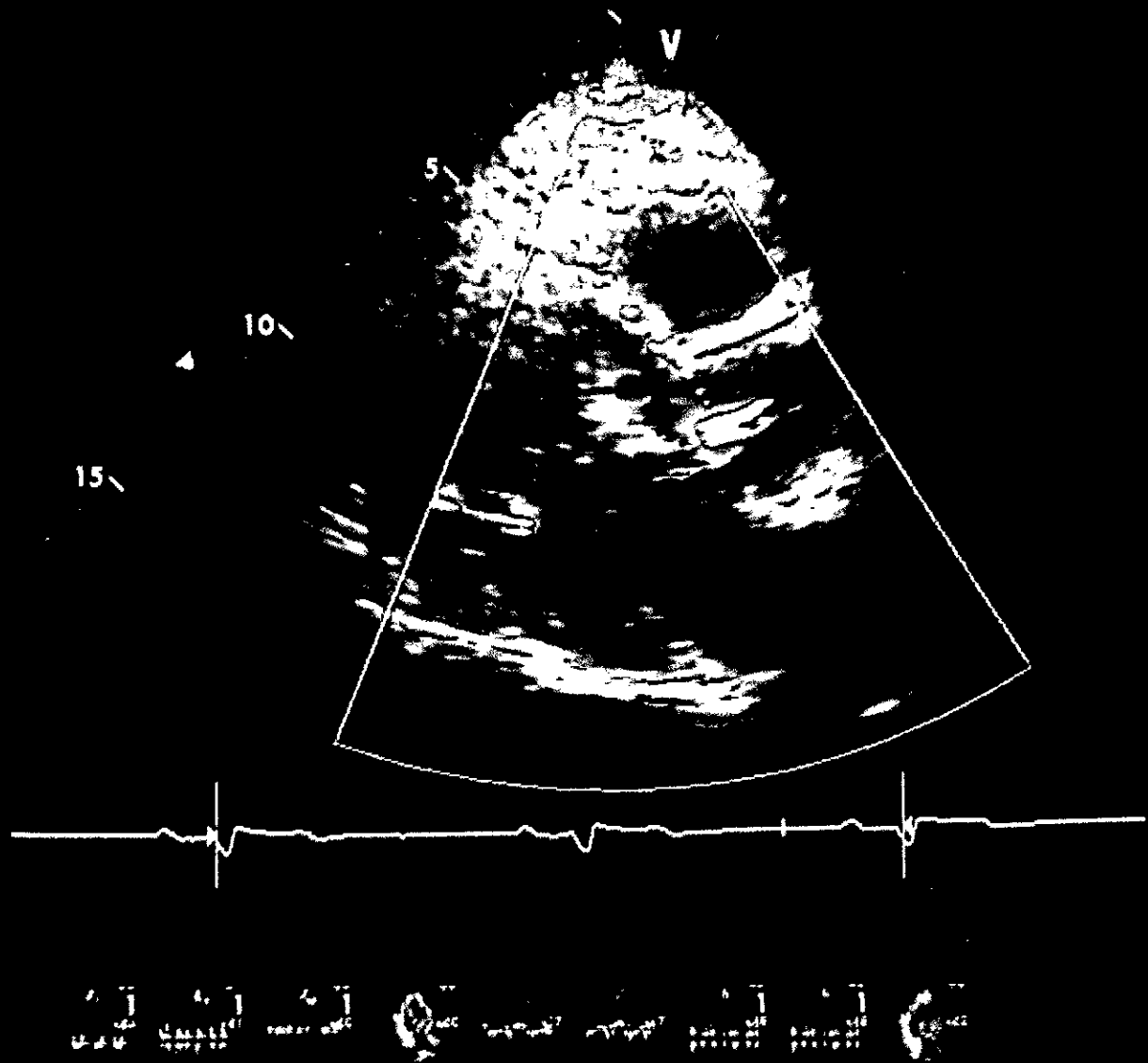


ACOUSTICS

BULLETIN



in this issue... 32nd Annual Council Report

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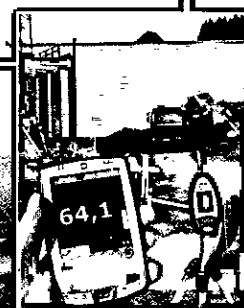
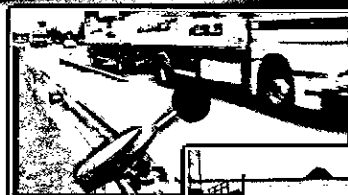
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ACOUSTICS

BULLETIN

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The Institute of Acoustics was formed in 1974 through the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society and is the premier organisation in the United Kingdom concerned with acoustics. The present membership is in excess of two thousand and since 1977 it has been a fully professional institute. The Institute has representation in many major research, educational, planning and industrial establishments covering all aspects of acoustics, including aerodynamic noise, environmental, industrial and architectural acoustics, audiology, building acoustics, hearing, electroacoustics, infrasonics, ultrasonics, noise, physical acoustics, speech, transportation noise, underwater acoustics, and vibration. The Institute is a Registered Charity no.267026

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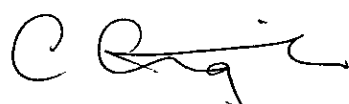
K M Macan-Lind

Dear Members

Following the success of the Spring Conference, the Building Acoustics Group's sixth International Conference on Auditorium Acoustics was equally successful. The conference has now become a firm fixture in the Institute's calendar and this year was the first time that we have held a conference overseas. The event lived up to its 'international' title, attracting papers from no fewer than eighteen countries and over 150 delegates. A full report on the conference will appear in the Bulletin. The choice of Copenhagen as the venue provided delegates with the chance to tour its spectacular new opera house. Direct experience of a performance venue is invaluable to designers and I am sure that the success of this conference will allow us to stage future events overseas. The smooth running of a large conference involves a tremendous amount of organisation and I thank all those involved on the organising committee and at head office for their hard work in ensuring the success of the event.

Staying with the international theme, Council has decided that it is time for us to host another major international conference. Holding such a conference is important not just for our standing in the international acoustics community, but because it also gives our own members, particularly younger members, the chance to participate in the interchange of ideas and information at the highest level. In May we formally submitted our initial proposal to stage EuroNoise 2009 to the General Assembly of the European Acoustics Association held in Finland. This was very well received and we are now developing a detailed bid to hold the conference in Edinburgh.

In my last letter I referred to the work that has been undertaken on the strategic development of our Institute. We are constantly looking for new services that will make the Institute even more relevant and valuable to its members. I am pleased to announce that we have now introduced a Professional Indemnity insurance scheme that is specifically designed to meet the needs of those members who undertake relatively small amounts of consultancy work, and this should be of particular interest to academics and local authority workers who undertake a small number of consultancy contracts. We have worked closely with Lampier Professions Ltd to develop this PI cover that will only be available to individual corporate members of the Institute. Lampier Professions Ltd will be well known to many of you as it has specialised in providing PI cover for many acoustic consultancies and therefore understands the risks of the profession and is well placed to offer a competitive and reliable service. I hope that those of you who undertake part-time consultancy will find this initiative of value. Full details of the scheme were inserted in the last edition of the Bulletin and shortly we will have application forms available on the web site.



Colin English

PRESIDENT



Meeting Report

Colin Grimwood and John Hinton. Developments in Noise Research

This one-day meeting was held on 23 May 2006 at the Arden Hotel, Birmingham. It was jointly organised by the Environmental Noise Group and Midlands Branch and was held during Noise Action Week 2006 and supported by Defra. The intention was that the event would cover a wide range of recently completed and ongoing environmental and neighbourhood noise research projects. Around 80 delegates attended and the feedback received from attendees was very encouraging. One important suggestion was that the meeting should be made an annual event.

The morning session was chaired by Colin Grimwood (Bureau Veritas Acoustics & Vibration, IOA Environmental Noise Group). Colin began the day by introducing Kevin Macan-Lind to delegates, and it was good to see our new Chief Executive making his presence felt at a wide range of meetings.

The first presentation was made by **Richard Perkins** on behalf of Defra who described the department's noise and nuisance research programme, and encouraged delegates to seek out the large quantity of useful and interesting material now on the Defra noise research website. See the web site at <http://www.defra.gov.uk/environment/noise/research/index.htm> for more information.

Richard asked delegates to come up with ideas for future research projects and received suggestions ranging from investigating the noise from domestic wind turbines, to improving the soundscape, and supporting action plans in accordance with the Environmental Noise Directive.

Ginette Unsworth, senior marketing and operations manager with ENCAMS, the environmental campaigning organisation, was the next speaker. Ginette described the lessons that have been learned from the application of market research techniques to the neighbour noise issue and concluded by announcing that there will be a media campaign, including radio advertising, held during July 2006 aimed at noise sufferers. The campaign would be directed at the market segment described as "don't want a drama", referring to those people who have done little to communicate with their neighbours about noise problems. A questioner at the end of her presentation suggested that some delegates would welcome an even more extensive campaign and so the results of this initiative will undoubtedly be closely monitored to see whether the campaigning should be extended.

Jim Griffiths, Vanguardia Consulting, presented a summary of the results from a research project undertaken by Capita Symonds and BRE which will be used by Defra

to inform the development of the new night noise offence from licensed premises. This extensive project included both laboratory and field research and concluded that the majority of the public are able to tolerate a modest degree of intrusive audible entertainment noise in their home late at night from infrequent events. The noise metric found to give the best overall prediction of subjective ratings by the public of all the different types of entertainment noise tested (which included rock music, dance music, karaoke and sports noise) was absolute A-weighted Leq. The full research report is already available on the Defra research website and makes very interesting reading.

The next speaker was **Stuart Dryden**, Rupert Taylor Associates, who described the outcome of his research into the use of noise abatement notices by local authorities, including a number of suggestions to improve the current situation. Stuart intends that this research will be used by Defra as part of the development of the national noise strategy.

The last speaker of the morning session was **Rick Jones**, AEA Technology, who described research contributing to the improved prediction of environmental noise from railways. The research will allow rail head roughness to be accounted for in the Calculation of Railway Noise (CRN) through a post-CRN roughness correction based on the concept of acoustic track quality (ATQ). However, Rick was keen to stress the value of trying to get local information on ATQ which could improve the accuracy of noise predictions by up to 20dB. An interesting question was posed before the lunch break, in connection with the use of CRN to predict noise levels 15 years hence: how quickly does new rail become acoustically rough? The answer, in short, was 'it depends'. If you want to know more you really should come along and participate in meetings like this.

The afternoon session, chaired by John Hinton (Birmingham City Council, IOA Midlands Branch), commenced with a presentation from **Paul Shields** from Scott-Wilson on the use of noise mapping for assessing the noise impact of proposed industrial developments. He described and demonstrated how commercially available noise mapping software can be used for optimising designs to reduce noise, for demonstrating compliance with noise related planning conditions and as a tool to inform the public on the likely impact of planned developments.

This was followed by a talk from **Chris Skinner** of the Building Research Establishment on his research into the effectiveness of noise mitigation measures at traffic noise hot spots and at locations where roads have been resurfaced with quieter

materials. Chris described how 'before and after' noise level measurements and a questionnaire survey had been conducted at selected locations with particular emphasis on hot spots in the Midlands area. He then went on to explain the results in some detail.

A presentation by **Dominic Stokes** of the Environmental Protection Section at Sheffield City Council was given before the tea break. Dominic's presentation concerned noise and summer cooling in city centre housing. In particular, he had looked at the results of a questionnaire survey recently carried out in Sheffield, targeted on the residents of new residential accommodation fitted with special sound insulating windows and associated special ventilation. The results of this survey indicated that a high percentage of those who responded were bothered by external noise even with their special windows closed and many had to open their windows in summer for added ventilation. Even so, 70% were either satisfied or very satisfied with their living environment!

The final part of the meeting was kicked-off with a presentation from Prof **Stephen Stansfeld** of the University of London on possible interventions to combat the effects of aircraft noise on children's cognition. Stephen reviewed recent studies, including the RANCH Project. He concluded that there was evidence to suggest that reducing noise levels in the classroom improved school performance, that both external noise exposure and internal classroom acoustics should be addressed, and that there was still a need for further research including the psychological and educative aspects of classroom noise exposure.

A thoroughly enjoyable and informative day was rounded off in fine style by **Mike Swanwick** of Rolls-Royce, Derby who gave a presentation on perceived environmental noise from aircraft and how to halve it! Mike described how aircraft noise, and in particular engine noise, had been reduced in recent years and how it could be reduced even further in the future. He played recordings to demonstrate the level of improvement that could be achieved by innovative design. He concluded that many promising concepts for reducing aircraft noise are being developed, but that further work is required to prove and develop ideas for application in the very demanding aero-engine environment. On this positive, but cautionary, note the meeting was closed ... until we meet again next year!

Meeting Report

Colin Batchelor. Eastern Branch

On Wednesday 22 March 2006 Rob Dolling of Capita Symonds gave an interesting presentation entitled 'The Control of Concert Noise: The show must go on!' The venue was Ipswich Town Football Club's ground in Portman Road, where Capita Symonds had in the past undertaken noise assessment and instigated control measures for concerts such as REM and Elton John. Although the venue capacity was of the order of 24,000, the speaker on this occasion attracted sufficient interest to fill to capacity the meeting room overlooking the pitch.

Rob was able to provide first-hand evidence of the experiences of assessing concert noise, the likely sources of complaint and means of mitigation. The presentation also included an assessment of a site with previous recordings, the prediction of sound levels at the site and how these would change based on the positioning of stage and speakers, the use of barriers, and the selection of appropriate speaker systems.

The audience included a selection of Environmental Health Officers from various parts of the eastern region who have experience of dealing with complaints and taking enforcement action. The views from potentially opposing factions ensured a lively debate on the contrasting requirements of concert noise control and contributed to a very informative evening.

Meeting Report

Stan Simpson. South West Branch

'Noise Mapping of Bristol' was the topic of an evening meeting of the South West Branch on 26 April at the University of the West of England, Bristol. The meeting was attended by 30 members.

The evening was introduced by Richard Perkins, Contract Research Manager, Defra who outlined the department's role in the implementation of Directive 2002/49/EC on the assessment and management of

environmental noise.

The main presentation was given by Graham Parry, Divisional Director of the Temple Group, who produced the noise map of Bristol. Graham covered the requirements of the noise mapping contract, and shed light on the technical challenges that had to be overcome in the production of the maps. This was followed by a long and lively discussion on the noise mapping exercise.

Meeting Report

London Branch

The latest London Branch evening meeting was held on 17 May 2006. Dr Matthew Muirhead of QinetiQ was the guest speaker, whose subject was the prediction of helicopter noise contours for land use planning.

Matthew gave an enlightening presentation on the latest development of the QinetiQ software (HELIACT) to predict helicopter noise. The presentation included some interesting video clips showing the method used to record the source noise levels of

various helicopter types. Source measurements are made using two large vertical arrays employing some 43 microphones suspended from large cranes. The integration of the measured data together with the prediction techniques was explained, and the application of the software for the prediction of noise contours was demonstrated. Although the software was primarily developed for helicopters, its application can be used for other aerial noise sources.

Young Person's Award

Wonderful, wonderful Copenhagen!

Andrew Hurrell, winner of the 2005 Young Person's Award for Innovation in Acoustical Engineering, has returned from his prize trip to Denmark. Andrew, of Precision Acoustics Ltd, was awarded the inaugural Young Person's Award for Innovation in Acoustical Engineering at the IOA Autumn Conference last October. In addition to being awarded the silver trophy, Andrew received £500 and a luxury weekend for two in Copenhagen. The biennial award is sponsored by IAC Ltd, who also donated the trophies and prizes.

Knowing that Copenhagen can be 20 degrees below in the winter months, Andrew and his wife Donna wisely delayed taking the trip until the end of March.

"The whole weekend was delightful and we really enjoyed every minute. All the arrangements went without a hitch. We stayed at the superb Admiral Hotel on the harbour waterfront, an eighteenth-century warehouse tastefully converted into a luxury hotel. It has ten-inch oak beams everywhere. Very impressive! The food was lovely and in

spite of the cold weather we enjoyed plenty of retail therapy!

"On the Saturday evening the award sponsors, IAC, had treated us to the best tickets to see the ballet 'Requiem'. At first we thought from the tickets that it was on at a theatre across town. Once there, though, it was pointed out to us that it was taking place at the new National Opera House right back where we'd come from! We blitzed it back in a taxi and approached the Opera House right behind the limo which, it turned out, was carrying a member of the Royal Family, also going to the ballet – a Royal Command Performance! The ballet was stunning and the acoustics in the building were superb – Arups have done a good job. It was good to 'hear' them in action, so to speak. We returned to our hotel that night in the Hotel's own water taxi, a suitably romantic ending to a great evening."

Entries for the next Award, 2007, will be invited from 1 October 2006, with the Entry Form available as a download from www.ioa.org.uk and www.iac1.co.uk.



Donna and Andrew Hurrell – and Hans Christian Andersen – next to Copenhagen City Hall

Meeting Report

Nicola Stedman. Central and London Branch Evening Meeting

On Wednesday 25 April 2006 the Central and London Branches held a joint evening meeting at the BRE Airbus facility in Garston, Watford. John Seller began the presentation by describing the facility, why and how it was built, and this was followed by a tour of the facility and a short demonstration 'flight'.

Why?

BRE is currently involved in a number of international research programmes. Two of the main fields of study are 'Health Effects in Aircraft Cabin Environment' (HEACE) and 'Friendly Aircraft Cabin Environment' (FACE). The latter is a project funded under the Technology Platform in the European Community (EC) 5th Framework Programme.

HEACE aims to achieve a better understanding of the health and comfort impacts within the working environment of an aircraft on the crew. FACE, a project jointly funded by the EC and the consortium of partners, aims to improve

environmental comfort in aircraft cabins and cockpits. It addresses the environmental comfort parameters that depend on noise, vibration and air quality, and includes effects on, and from, multimedia use.

How?

The ex-South African Airlines A300 Airbus arrived at the BRE facility with some difficulty in September 2002 on the back of a lorry, and was carefully placed on a specially designed frame. By May 2003, and after 4km of cabling had been laid, the aircraft was finally completed and commissioned. The 'aircraft simulator', which is placed on a permanent frame isolated from vibration, consists of a 17m long passenger cabin which can accommodate up to 40 passengers, the flight deck and two galleys.

The aim of the facility is to make the 'passengers' and 'crew' believe they are in a real aircraft environment, during a real flight. To ensure that the research is representative of an actual aircraft

during flight various environmental factors can be artificially controlled by the BRE team. These include temperature, humidity, noise, vibration, and air distribution and recirculation. In addition, clouds are projected on to the internal walls of the facility to create the sense of an aircraft cruising at altitude.

Noise and vibration measurements were undertaken on a number of real flights in order to recreate similar conditions within the 'aircraft simulator', a flight on which incorporates a short take-off, cruising at altitude and a short landing.

The 'Flight'

A real test flight, which involves passengers, cabin crew and a flight crew, will last approximately three and a half hours. However, owing to the limited time available to us, attendees experienced only a short demonstration 'flight'. The inquisitive nature of the members led them to take full advantage of the opportunity to tour the aircraft during the flight, and an active discussion forum followed. The flight itself was very impressive, but unfortunately on leaving the facility we were still in Watford - and it was still raining!

The Central and London Branch Committees would like to extend their thanks to John Seller, Chris Skinner and the rest of their team, for a very interesting presentation and tour of the facility.

Meeting Report

Irish Branch

An afternoon visit to the Sonic Arts and Research Centre (SARC) at the Queen's University Belfast was held on 23 March 2006.

The meeting was started by Raf Orlowski of Arup Acoustics giving a presentation on the acoustic design of the Sonic Arts Centre, Queens University, Belfast. Raf began by outlining similar centres around Europe. These vary from the forerunner to the SARC, which is the Institut de Recherche et Co-ordination Acoustique et Musique Espace de Projection in Paris, which has variable acoustics provided by 'toblerones' with acoustically reflective, absorptive and diffusive surfaces giving a wide range of room characteristics as well as a variable height ceiling (in three sections and capable of moving from 15 metres to 1 metre), through to the University of York Music Research Centre which is a fixed acoustically 'dead' space with room characteristics provided electronically.

The vision for the SARC was to include one main large room (the Sonic Laboratory) for research in experimental music, sound creation and public performance, and a number of other 'critical' spaces including a control room, a surround sound room, sound studios and a multi-media suite. This was all to be provided within a relatively tight budget.

The Sonic Laboratory was to be flexible both acoustically and spatially forming a 'specialist research environment conducive to both creative and scientific activities. The room was to be inherently reverberant, but with variable acoustics so that reverberation times can be selected to range between 2.5 and 0.5 seconds, and to be

independent from all other rooms so as to be both quiet and to limit sound transmission to other areas of the building.

The variable room acoustics are provided by three layers of panel absorbers that can be wound down from high level, mineral wool bats that can be laid on the sub-floor (some 3.5 metres below the listening level floor grid), and absorptive pads that can be laid on the variable height 'lighting' grids. The lighting grids can also have reflective panels attached in order to provide early reflections for performers and listeners.

Whilst the primary use for the Sonic Laboratory is for electroacoustic performances, with loudspeakers located around the room at each of three distinct levels so as to allow for the movement of the reproduced sound to appear to emanate from any area of the room, there was also the requirement for the option to be able to have acoustic performances with up to a 20-piece chamber ensemble.

As well as the main Sonic Laboratory and its associated control room, there are a number of workstation rooms where the principles of electroacoustics are taught, a number of listening rooms, and a well equipped surround-sound room. The listening rooms and the surround sound room are nominally quite acoustically dead, and by the mix of absorbers have a relatively flat reverberation time across all frequencies.

The design of the mechanical ventilation system which enters at low level and, by natural



IOA member tour the Sonic Arts Centre, Queens University Belfast

displacement, exits at high level was specified as needing to be less than PNC15.

Following Raf's presentation, those present were then given a tour by Chris Corrigan of the SARC starting with the lesser rooms where there is housed an impressive array of loudspeakers and electronic equipment, and culminating in the Sonic Laboratory where a display of electroacoustic music written for this type of space was certainly impressive to listen to. Whilst the music was impressive the quietness was also obvious and considering that it was not evident that there was any ventilation noise in any of the critical rooms, the criterion of PNC15 appears to have been achieved.

Thanks were given to Raf Orlowski and Chris Corrigan before the Branch Members retired to attend their Annual General Meeting. This was the first Branch meeting since the passing of the founding chairman of the Branch Dr Gerry McCullough, and a few words were spoken by his long-time friend and colleague Oliver Hetherington. The annual reports were read and Martin Lester was elected to Chair the Branch for the next year, along with the able assistance of Garry Duffy in the position of Vice-Chair. A number of the members then retired to a nearby restaurant for a pleasant social event.

Meeting Report

Richard Tyler. Harmful? - Judge For Yourself!

The Measurement and Instrumentation Group organised a one-day meeting entitled 'Harmful? - Judge for yourself!' and subtitled 'Making the vibration regulations work safely' on 17 May 2006. It took place in the spacious lecture theatre of the Society of Chemical Industries in Belgrave Square, London.

Martin Armstrong, Alcor S&V, the meeting organiser, opened the proceedings with an introduction relating the introduction of the new vibration regulations and the Measurement and Instrumentation Group's role in bringing them to the attention of the Institute's members. The 28 delegates then enjoyed seven presentations outlining different perspectives of this topic.

Dr **Neil Mansfield** of Loughborough University commenced his presentation entitled 'Filling the gap between manufacturer's declared values and hand-arm vibration emission under real working conditions' with brief overviews of the Physical Agents (Vibration) Directive, the Machinery Safety Directive and the HSE's Control of Vibration at Work Regulations, which served as the basis of the rest of the day's topics. He then went on to explain that the test codes derived for measuring vibration emissions of many power tools do not give the levels experienced by operators in real life, and that other data sources were needed to calculate the exposure of workers. References were made to EN/TR 15350 giving guidelines to estimate exposure from manufacturer's declared emission values, and to a database being established under the Off-Highway Plant and Equipment Research Centre (OPERC) in conjunction with Loughborough University and others, which aims to supply more realistic exposure data on the web for hundreds of different tools. This commenced in early 2006 and will be extended in due course, but applies to hand-arm vibration exposures only at present.

The emphasis then switched to 'Whole-body vibration - Exposing the risk with little data' co-authored by **Richard Stayner** (RMS Vibration Test Laboratory) and **Andy Scarlett** (Scarlett Research), presented by Richard. He discussed the difference between using rms or vibration dose values (VDV) data, and made the comment that exposures measured by the two metrics were not directly related. He noted that unlike hand-arm vibration for which several data sources are appearing, there was very little information available from anyone listing whole-body exposures from machinery of any type, and that this was a problem in arriving at an exposure assessment. There are also very few test codes in existence for performing these assessments. He then went on to describe measurement work he had undertaken,

showing that with the exception of a few small building tools, most driven machines exposed the operators to levels exceeding the action value, but not exceeding the limit value, during a normal working day. He showed that correct adjustment and maintenance of the seats on these vehicles was vital to maintaining the lowest exposures, but operator training in how to minimise vibration was also required.

The viewpoint of tool manufacturer Atlas-Copco Tools AB of Sweden was presented by **Lars Skogsberg**. He pointed out that vibration is not the only risk manufacturers and users have to evaluate in using power tools, but that hand-arm vibration syndrome (HAVS) was largely irreversible once contracted and that no real protection against it existed. He explained that ISO 20643 has new test codes that require declared values from manufacturers (a) to represent the upper quartile of in-use vibration, and (b) to be repeatable and reproducible, two requirements which Lars and others find incompatible. He agreed that current methods often under-estimate exposures, and suggested that multiplying the declared emission value by a factor between 1.5 and 2 was a better guide to real exposure. However, he added that if the declared value was less than the exposure action value of 2.5ms^{-2} , then the value used should be 2.5ms^{-2} and this still needed to be multiplied by 1.5 when working out exposures!

A complete change of emphasis closed the morning session. Dr **Mark Hall** from Norwich Union Occupational Health presented 'Health surveillance for hand-arm vibration syndrome in a large distributed workforce', giving an overview of monitoring for potential HAVS problems. He described how he and his team had built up a series of questionnaires that managed to screen out people who were not affected by HAVS without the need for medical testing, but recommended that it was used annually. He thought that most people who suffered from vibration white finger were aware of it occurring, and that the responses to the questionnaires allowed medical intervention when required. He explained the value of education to power tool workers about the correct use of the tools they used, and restated that once blood vessel or nerve damage had occurred, the only real course of action was to limit the worker's time and frequency of tool use.

Following lunch, the Measurement and Instrumentation Group held its AGM, and then **Steve Wray** from the Industrial Noise and Vibration Centre (INVC) asked 'Hand-arm vibration measurements - why bother?' a provocative question for the organisers! He described several practical ways of assessing

hand-arm vibration, maintaining that supervisors were often far more accurate in assessing exposure durations than the workers themselves. He acknowledged that there was a lack of real data for hand tools, although INVC was also amassing a database from its own measuring experiences. Where no data existed, measuring may be the only answer, but he showed that following the HSE Guidelines could result in a situation where measurement showed a risk to be present, but the predictions showed no risk. What should be done then? Risk must be assumed to be present, but he said it was better to take steps to reduce risks than to try to get a definitive measurement of the actual exposure.

Having heard a variety of views, the 'HSE's expectations for hand-arm vibration risk assessment' from **Chris Nelson** and **Paul Brereton** of the HSE was presented by Chris in order to give the definitive viewpoint. The HSE Guide L140 was covered, as well as the approach of reducing and eliminating risk, rather than simply knowing what the current exposures are. Risk assessments to establish what needed to be done, and the possible use of the HSE points system to estimate exposures were outlined, and health surveillance was recommended wherever there was a risk of exceeding the Action Value. The approach is largely qualitative, with emphasis on adequate information and plans to reduce risks. During 2006/07 it was expected that inspectors would target the construction, foundry, shipbuilding and heavy foundry industries to examine compliance with the exposure levels.

The day concluded with a presentation from **Philip Bladon** of QBE Insurance (Europe) asking 'HAVS claims - are you ready to rumble?' He described some of the approaches used by insurers in assessing both current risks and liabilities in the area of vibration exposure, noting that in a civil court the balance of probabilities was sufficient to secure an award for damages. Settlements ranging from £5000 to £200,000 had been made. He stated that old claims were difficult to defend as documentation of exposure and risk was usually minimal, but the new risk assessments being carried out did form the basis of improvement for the future. Evidence of correct training was also useful in showing a duty of care to an employee, and records of actual measured values in the workplace recommended. He also sounded a cautionary note following a recent case that suggests industries with ongoing significant vibration exposures may face higher premiums.

All in all it was an interesting and varied day where much practical advice was on offer. It was rather disappointing that there were not more people to hear it.

Certificate of Competence in Workplace Noise Assessment

7 April 2006

The following candidates met the required standard and have therefore passed.

University of the West of England

Miss L A Aston
Mrs T E Barratt
Mr S G T Brown
Mr A Dorr
Lord S J Edward
Mr M J Fullalove
Mr M B Griffiths
Mr A Jenkins
Mr E King
Mr K D Millward
Mr D F J Osborn
Mr T J Roberts

Colchester Institute

Mrs D Colquhoun
Mr R V Groborz
Mr W A McCallum
Mr J C McRoberts
Mr M A Pereir
Mr M E Ranson
Mr M E Thornewill

University of Derby

Mr I Boyle
Mr P A Brown
Mr D C Grainger
Mr C Jenkinson
Mr G I Powell
Mr M J Squires

EEF Sheffield

Mr W A Clarkson
Mr S J Granger
Mr J Hewitt
Mr M J Jordan
Mr A R Payling
Mr R Pearson
Mr G T Peel
Ms D J Rose
Mr J Ross
Mr P Slater
Mr P Smith
Mr R A Smith

EEF East Midlands & Mid Anglia

Mr J H Alderson
Mr C E Armstrong
Mr P Crudeinerton
Mr M Cutts
Mr G R Hanmore
Mr D Penny

Institute of Occupational Medicine

Mr L J Appleby
Mr C Chisholm
Mr D McAra
Mr M McGhie
Mr G Millen
Mr R H Monk-Steel
Mr E S M Saunders
Mr B Warner
Mr A Wylie

Leeds Metropolitan University

Ms M H Aitchison
Mr A J Bergus
Mr I Boland
Mr T J Coyne
Miss E Keon
Mr M Leatherbarrow
Mr A D Olney
Mrs L J Pearson
Mr W Taylor
Mr P Thompson

NESCOT

Mr J S Dhesi

Rapid Results College

Mr R G Thompson

Editor's Notes



Ian F Bennett CEng MIOA.

As I write this I am recovering from the sudden realisation that the England football squad can actually play (a bit). Having just beaten Trinidad and Tobago, at least we can relax in the knowledge that the team has qualified for the next phase. However, it also

means that the collective lunacy of noisy celebration is likely to continue for at least another two weeks. In a work context, we are all going to have to be somewhat circumspect in deciding when to carry out environmental noise surveys: a five o'clock match has a profound effect on the ambient noise levels, as was demonstrated when I measured a 5-minute L_{A90} of 37dB outside my office today, compared with the usual peak-hour 50dB. Matters changed somewhat after England scored...

The reason for this topical (or just-out-of-date) introduction is to illustrate the importance of seemingly irrelevant detail in any environmental noise report. The first question that occurs might be 'what day of the week was it?' and I'm sure that very few professional acousticians would consider taking ambient noise measurements on 5 November. A movable feast like a major sporting event, however, might not be obvious - especially a year or two later. Perhaps the Salford University's 'uncertainty budget' check lists should include, alongside weather, wind speed and

direction, distance to reflecting surface and so on, some kind of reference to the day of the week (yes, I know it says 'timing of measurement'), but what about a passing glance at Radio Times to see what was on the 'tube' during the survey?

By the time you read this, the football World Cup will be done and dusted, and we can all return to something like a normal acoustical environment. Although I'm a loyal supporter, I can't see that Colchester United's matches in the Championship next season will precipitate quite as much excitement (not in Stockport, anyway).

Copy date for the September/October issue is 11 August. Thanks are offered to all previous contributors, but if you have an idea for a technical contribution or a less ambitious piece of writing, please don't be modest - give me a phone or e-mail (or even a txt msg).

Ian Bennett

Commendations

The following student authors were commended for the quality of their presentations at the Institute Spring Conference.

Author	Subject of presentation
Yohko Aoki	A parametric study to investigate the properties of active control with piezoelectric patches
Fouad Bechwati	Measurements of surface impedance on activated carbon samples
Christopher Brooks	Axially segmented acoustic liners for turbofan engine access ducts
Kevin Chetty	Modelling the nonlinear microbubble response to coded, multipulse sequences.
Fabrice Castres	An inverse technique for the determination of modes from a turbofan inlet.
Jamie Condliffe	A technique to assess particle distribution following needle-free injections.
Eugene Deane	Turbulent wake predictions for broadband noise calculations
Emmet English	Plane wave aeroacoustic characteristics of an exhaust pipe
Tomos Evans	Audio output of the measured and simulated noise from small centrifugal fans for use in virtual acoustic prototypes
Jochen Eisenblaetter	The air pumping effect at the tyre/road interface
Daniel Finfer	Sound and noise levels from marine mammals and sonar in shallow bubbly coastal waters
Christobal Gonzalez Diaz	Feedback control laws for inertial actuators
Christopher Ham	Deviation of acoustic modal densities of two-dimensional annular spaces
Hanne-Maria Hirsimaki	Electrochemical measurements of optically induced cavitation
Jian Jiang	Acoustic source strength and impedance associated with engine firing
Vincent Jurdic	Turbulence cascade interaction noise
Amir Khan	New types of sound absorbing materials from recycled components
Christos Karatsovis	Cepstral analysis of piano notes
Christopher Lewis	Measurement of broadband sound in aero engine ducts
Robert MacDonald	Non-linear losses at woodwind tone holes
James McLaughlan	Passive cavitation detection system for the monitoring of acoustic emissions to be used in the optimisation of focused ultrasound surgery treatments
Paul Morris	Developments of a 50mhz Fabry-Perot type fibre optic hydrophone
Michael Newton	Physiology of the vocal folds
Mun-Hum Park	Auditory process model for the evaluation of virtual acoustic imaging systems
Robert Pyrzycki	Two models for fluid-structural waves in the organ of corti
Azma Putra	Radiation efficiency of unbaffled plates using computer simulations
Emma Tate-Harte	Acoustics in open plan classrooms
Guen-Tae Yim	Real-time on-line monitoring of ceramic slip in pottery pipelines
Ziyan Xing	Cross-cultural study of acoustic comfort in residential areas

Thirty-second Annual Council Report

For the Year Ended 31 December 2005

Achievements

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. Strategic development of the Institute continued to be a priority and various actions were implemented.

During the year

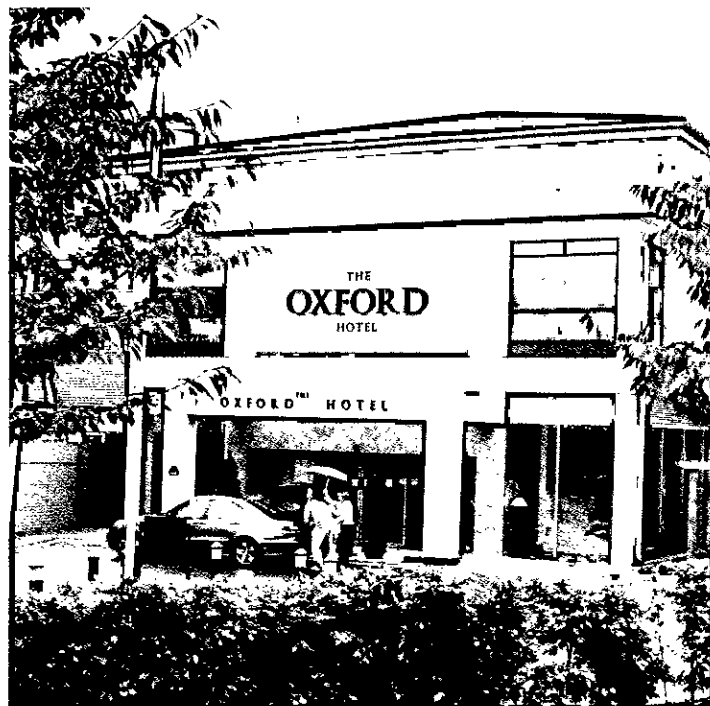
- A Publicity and Information Manager was appointed from 1 January, resulting in greater awareness of the Institute's activities;
- Membership increased by almost 4%;
- An ambitious programme of well-attended conferences and technical meetings was undertaken at both national and regional level, and included the 21st Reproduced Sound Conference;
- A well attended series of new Certificate of Proficiency courses on 'Anti-social Behaviour etc (Scotland) Act 2004 Noise Measurements' was held in Scotland;
- The Institute's prestigious medals and awards programme was enhanced by the introduction of two new awards. The Young Persons Award for Innovation in Acoustical Engineering (sponsored by Industrial Acoustics Company Ltd) was presented at the Autumn Conference, and the Award for Promoting Acoustics to the Public was presented at Reproduced Sound 21;
- The period of office of Ordinary Members of Council was reduced to encourage wider participation of the membership at the highest level;
- Council approved the formation of a new Branch to be known as the Central Branch, to serve members in the northern home counties better;
- Changes were made to the Institute's national, regional and specialist committee structures to improve representation of young members;
- Advertising revenue was increased;
- Demand continued to grow for the Institute's Diploma in Acoustics and Noise Control and for its range of short courses;
- Further development of the Institute's web site took place;
- The Acoustics Archive is now housed at the Southampton University library;
- The Institute has been actively participating in the consultation process for Government initiatives, as well as the formulation of British and International Standards;
- The search for a new Chief Executive was commenced;
- The contract for the production of the Acoustics Bulletin was reviewed and awarded to PointOne as from January 2006;
- A members' survey questionnaire was designed, to be actioned early in 2006.

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 Education Committee has continued to develop its portfolio of



The Oxford Hotel, venue for the 2005 Spring and Autumn Conferences

programmes and courses to meet a record demand for professional training in acoustics and noise control. Many of the successful students then go on to join the Institute.

Under the chairmanship of David Saunders, the management of the Diploma in Acoustics and Noise Control has continued to progress. A major revision of the modular structure of the Diploma is underway for implementation in the near future. The aim of the revision is to produce a modular content that reflects the contemporary needs of acoustics professionals as a post-graduate Diploma award, in the context of the Higher Education qualifications framework. The number of students recruited to the Diploma in September 2004 was 150, including 30 in the Distance Learning Scheme. Following the success of one Distance Learning student from New Zealand in 2003, plans for a franchising arrangement with Auckland University are progressing and discussions are also taking place with members of the Australian Acoustical Society.

Demand for the Certificate of Competence courses in Environmental Noise Measurement continues to grow and the Institute's courses in Workplace Noise Assessment and the Management of Hand-arm Vibration have been reviewed and developed to reflect the requirements of new UK legislation in these areas. Two sets of examined short courses to support the introduction of anti-social behaviour legislation in Scotland were given.

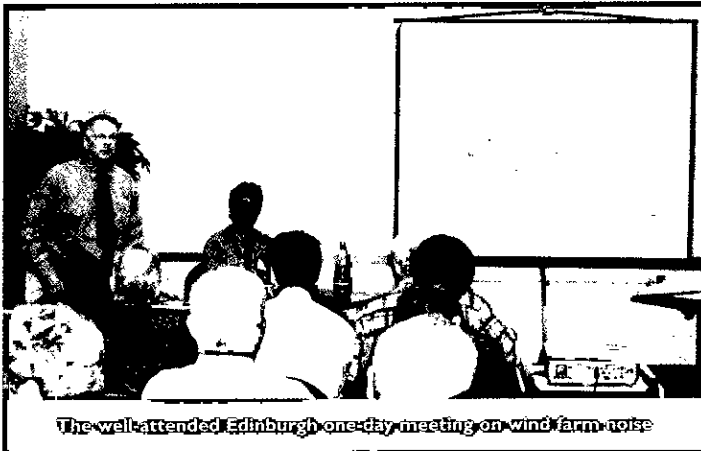
Members of the Education Committee and its associated sub-committees and working groups, and the several Institute members who act as examiners for our courses, continue to give their time and expertise to this vital part of the Institute's work.

Engineering Division Committee

Following the Institute's five-yearly Engineering Council licence renewal audit in 2004, the Policy and Procedures Manual, which is effectively the quality manual for the Division, has been fully revised. The Committee met three times during the year and six candidates were interviewed for Chartered Engineer registration. Two internal audits were carried



Andrew Hurrell receives the inaugural Young Person's Award



The well-attended Edinburgh one-day meeting on wind farm noise



Environmental noise, a major area of interest



PPS24 review meeting at the Society of Chemical Industry, London

out and no non-compliances were identified. Following the 'Get Chartered' promotion in the Bulletin, the number of enquiries for CEng/Eng registration has grown but some candidates still defer or fail to complete their applications. This initiative has also generated offers of help from Institute members willing to act either as mentors or committee members. Surprisingly, the level of interest in Chartered Scientist and Chartered Environmentalist registration was not as high as anticipated.

Medals and Awards Committee

The opening event of the Underwater Acoustics Group's conference held at the National Physical Laboratory in March was the presentation of the 2004 A B Wood Medal to Dr Eric Pouliquen, following which he gave his medal lecture *Recent progress in high frequency sea floor acoustics*.

At the Spring Conference held at The Oxford Hotel, Prof Heinrich Kuttruff was presented with the Rayleigh Medal for 2005 and gave his medal lecture *Retrospective room acoustics*. At the same conference the R W B Stephens Medal for 2005 was presented to Prof Michael Vorländer whose medal lecture was entitled *Buildings - How they sound*. The Spring Conference also provided the occasion to present the inaugural Engineering Medal (for 2004) to Rob Harris who spoke about *The acoustic design of the new Copenhagen Opera House*, and to confer Honorary Fellowship on Dr Geoff Leventhall.

The Autumn Conference also held at The Oxford Hotel witnessed the presentation of the inaugural Young Persons' Award for Innovation in Acoustical Engineering to Dr Andrew Hurrell for his work in developing miniature high frequency hydrophones used in medical imaging. John Sargent and Dr Peter Dobbins received their Awards for Distinguished Service to the Institute, and the Institute's Best Diploma Student Award for 2005 was presented to Simon Faircloth.

At Reproduced Sound 21, also at The Oxford Hotel, the 2005 Peter Barnett Memorial Award was presented to Dr Per Brüel who addressed the theme of the development of instrumentation with *From sound level meters to RaSTI*. Prof James Angus gave his lecture for the 2004 Award, *Spherical chickens and sound reinforcement: How Fourier rules the roost*. New in 2005, the first Award for Promoting Acoustics to the Public was presented at Reproduced Sound 21 to Bronwen Bird, for developing innovative acoustical exhibits and educational programmes.

Other highlights of 2005 included the announcement of Dr Aaron Thode as the winner of the 2005 A B Wood Medal (to be presented at a suitable future conference), the presentation of the joint IOA/ISVR Professor D W Robinson Prize for 2005 to Hooi Yin Loo, John Hinton's award of an OBE for services to noise assessment, Robert Evans being named as the winner of the ANC's Best Diploma Project Award (to be presented at the Spring Conference 2006), and learning that Prof Tim Leighton had been announced as the winner of the Institute of Physics' Paterson Medal for 2006.

Meetings Committee

The Meetings Committee met four times in 2005. The year has seen some change in the Committee Membership: in July, Stephen Turner retired from duty as Chairman and his place was taken by Jeremy Newton. Hilary Notley and Sarah Radcliffe were elected onto the Committee, the former assuming the role of Secretary, replacing Jeremy Newton.

The committee presided over the organisation of fifteen meetings covering a wide variety of topics. The main 'strategic' topics of discussion for the Committee were 'Fees', including guidance for students and speakers and 'Guidelines on organising events' which resulted in a document being prepared for use by meeting organisers explaining the roles and requirements of those involved.

Membership Committee

The usual four meetings were held during the year, and a total of 320

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Annual Council Report - continued from page 13

individual applications (all grades) were considered, including potential new members and transfers between grades. There was a net increase of 94 over the previous year. There was an encouraging increase in the applications for Technician membership, 18 compared with only three in the previous year.

Four complaints under the Code of Conduct arose during the year, all of which are still under consideration. Professional Development matters are now shown as a separate section of the Institute's website. A series of downloadable forms, with examples, is included enabling members to maintain their own informal records. There are no proposals at present to introduce formal requirements but records of training etc. may be taken into account when applications for membership or upgrading are considered.

During the year Brian Tunbridge and Gary Timmins were appointed to the committee. At the end of the year with the approval of Council, James Dunn, having served as Chairman for seven years, handed over the chairmanship to Brian Tunbridge.

Publications Committee

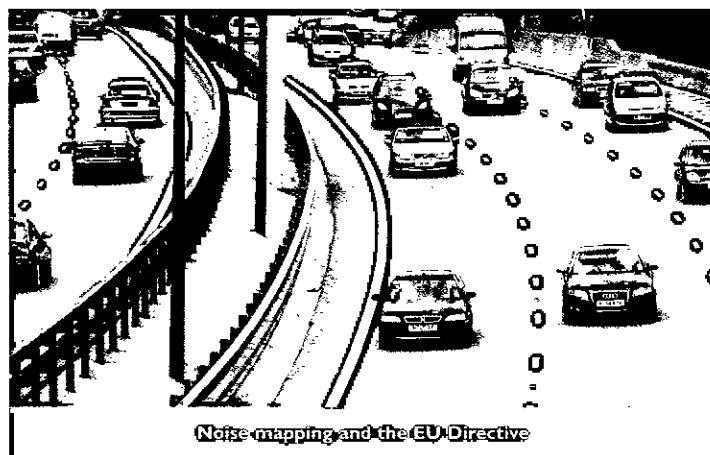
It has been another successful year for the Publications Committee. We have seen the website increasing in its role as an essential communications channel, with an increased number of 'hits'. Especially popular have been the job vacancies that are posted! More developments are planned for 2006/2007 including on-line payment and greater access to Abstracts from meetings and conferences. At the same time advertising revenue has increased, with 2005 looking like a bumper year - much needed as the Institute tries to minimise costs to members yet at the same time we need to offer better services such as the website that cost more.

January 2006 sees the launch of the Bulletin using our new contractors, Point One. This has given us the opportunity for a much needed refresh of style and content, with the promise of more to come. Initial responses from members have been very favourable.

Membership of the committee over the year has seen some changes, with the following retirements; John Sargent, John Tyler and Bridget Shield. All of these have made a huge contribution to the work over the years, and that is much appreciated. We have also welcomed a number of new members; including Peter Bird, Bob Walker, Gary Timmins and Victor Humphrey. Their contributions are already benefiting the work of the committee. Over the next year we would welcome more members, including someone to act as secretary and someone to assume the chair once Matthew Ling steps down in the summer of 2006 after a number of years in the role.

Research Co-ordination Committee

The main activities of the Research Co-ordination Committee in 2005 have continued efforts on three fronts (a) liaison with Research Councils (b) liaison with Government Departments sponsoring acoustically-related research and (c) development of a Foresight proposal. Our contact with EPSRC continues to be fruitful. Dr Angharad Thomas has taken over from Dr Neil Bateman as the EPSRC representative on the committee. We continue to discuss the extent and quantity of their support for mainline acoustics research. In addition we have encouraged the continuing support for mathematics training for postgraduate researchers in acoustics. A second successful Support Mathematics for Acoustics Research Training (SMART 2) was held at Southampton in July. The liaison with Defra continues to be useful especially in respect of noise-related activities. Richard Perkins has taken over from Dr Jo Bray as their representative on the committee. However, the relationship with DTI may suffer as a result of the retirement of Norman Bolton. Much of the committee's activity during the year has been concerned with drafting a proposal for a Foresight project *Understanding, Monitoring and Controlling Environments Using Acoustic Waves*. This was submitted to Karl Cunio in the Foresight office in November and we are waiting for feedback.



Specialist Groups

The Institute reflects the broad spectrum of the science and application of acoustics and several Specialist Groups have been formed to foster contacts between members of the various specialisms.

Building Acoustics Group

The key event of 2005 for the Building Acoustics Group was the very successful Spring Conference held in Oxford in April. The meeting was oversubscribed with capacity attendance of 140 delegates.

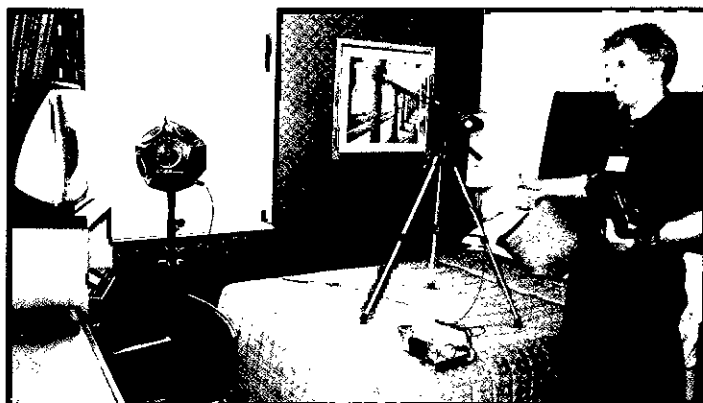
There were a number of specialist sessions on Room Acoustics, Sustainability, School Acoustics and Sound Insulation. In addition there was a workshop on measuring sound insulation throughout the first day with a formal presentation of the results on the second day. The meeting was significantly enhanced by three medal presentations and lectures. Prof Heinrich Kuttruff received the Rayleigh Medal, Prof Michael Vorländer received the R W B Stephens Medal and Rob Harris received the IOA Engineering Medal.

The Building Acoustics Group is preparing for a meeting on Auditorium acoustics for 2006 and is preparing a series of two-day meetings over the next few years.

Electroacoustics Group

Following the long and successful tradition that is Reproduced Sound, the Electroacoustics Group set out to make RS21 something special. The committee was made up from experienced members of the Professional Audio and Acoustician community. The task was clear: To create something that was worthy of the RS title, was informative, educational, inspiring, and, of course, interesting and entertaining.

The committee's choice, under Mark Bailey as chairman, was a title that looked forward as well as back. 'Feedback to the Future' was coined and universally agreed as an apposite title for the 21st conference. Over the preceding months, the conference was honed into a set of



The workshop on sound insulation testing 'embedded' in the Spring Conference



2005 AGM

internationally provided papers, and some entertaining evening sessions - somewhat different from those seen in the past. Whilst all the papers submitted would be worthy of description here, the conference report by Bob Walker contained in the January/February issue of 'Acoustics Bulletin' covers this very well.

Some particular items deserve a special mention. We were honoured by the presence of Per Bruel who gave the Peter Barnett Memorial Lecture which was not only informative, but also entertaining to watch. James Angus' lecture was, in his inimitable style, a delight to attend and most fitting that this Fellow should present at the 21st conference.

Other key 'events' included:-

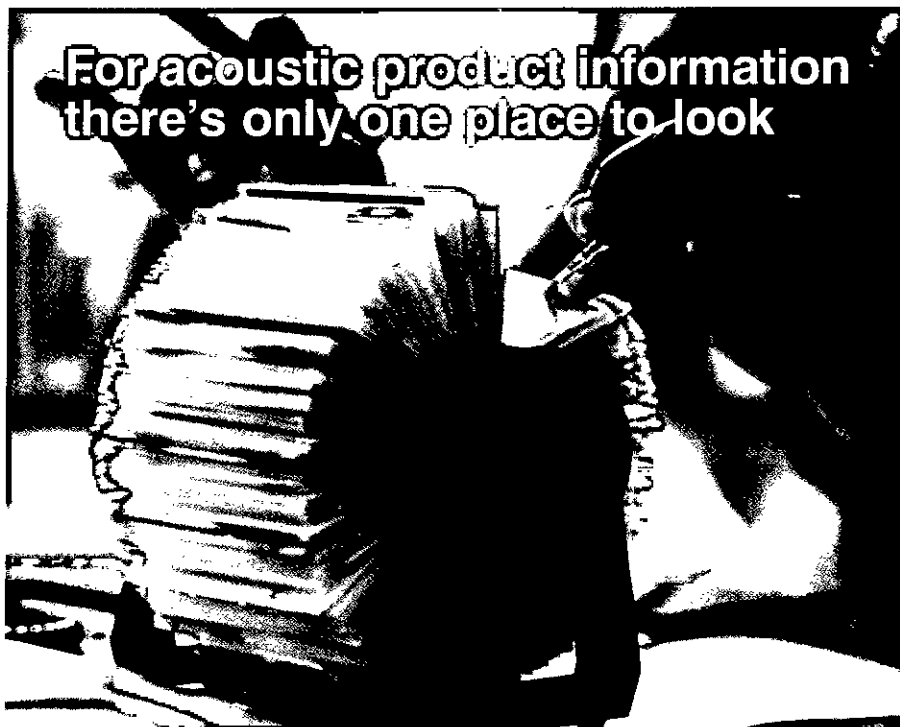
- An 'Antiques Roadshow' (Robin Cross, Mark Bailey, History of PA museum, superbly compered by John Watkinson)
- A University Challenge (written and hosted by Peter Mapp, co-hosted by Mark Bailey)
- Entertainment - Got any 'ose? (a short performance of the famous 'Two Ronnies' sketch - Speech intelligibility indeed! Paul Malpas, aided by Mark Bailey)
- Demonstrations: 'Surround sound in-cars' in a loaned top-specification Range Rover (kindly supplied by Harman Becker).

Environmental Noise Group

The Environmental Noise Group continued to be very active throughout the year. The group organised two one-day meetings, in London and Birmingham (jointly with the London and Midlands Branches), on the Defra Consultation on the transposition and implementation of the Environmental Noise Directive (2002/49/EC). Following these meetings, and based on the consensus opinion of the participants, the Environmental Noise Group committee formulated the Institute's response to Defra.

continued on page 16

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Annual Council Report - continued from page 15

The group also organised a half-day workshop on the emerging PPS24 and this, together with its report in the Acoustics Bulletin, was largely responsible for the Institute being asked to provide a representative on the Defra PPS24 Technical Working Group (the Environmental Noise Group committee provides the representative). The group was also responsible for the one-day meeting on Developments in Noise Research held in Birmingham.

In addition, the group's committee assisted the Institute's Council with a number of consultation responses to external documents from Defra and other organisations, and it continues to liaise with internal and external groups to ensure that the Institute keeps up to date with the latest issues in environmental noise.

Measurement & Instrumentation Group

The Group's Committee has thrived during the year, and has been responsible for three one-day meetings and the Autumn Conference.

On 15 February, 'From DAT to DISK' was held at the Royal Society in London, organised by Simon Bull from Castle Group, attracting 53 delegates. There were presentations on aspects of noise and vibration recording and analysing in the morning, and the afternoon was devoted to workshops on various relevant techniques, with individual equipment consultations offered by Group members.

On 13 July, the Health and Safety Laboratory in Buxton was the venue for 'Let's get Physical' organised by Liz Brueck of the HSL. 65 delegates packed in to hear about the latest implications of the Physical Agents Directives on vibration and noise as seen by HSE, Insurance Companies, Trades Unions, businesses and consultants. As the meeting was over-subscribed, it was requested that it be re-run, and this occurred on 1 December at the same venue and with an almost identical line-up of speakers, who on this occasion addressed 38 delegates.

The AGM of the group was held at the first HSL meeting. Four committee members were required to stand down, but were all duly re-elected unopposed as no other nominations had been received and all were willing to continue on the committee.

The major organisational task of the year was without doubt the Autumn Conference - What noise annoys? A workshop and 22 papers were organised and successfully presented to 110 delegates. Topics ranging from environmental noise legislation and environmental factors in noise assessment through to sound quality and noise mapping were covered, and speakers from six European countries as well as the UK provided a wide-ranging view of the topics.

A full programme is well in hand for both 2006 and 2007, which it is hoped will continue to benefit all members of the Institute.

Musical Acoustics Group

The Musical Acoustics Group remains effectively dormant, although there has been some activity in 2005. Arrangements are being made for a repeat of the performance by the New Violin Octet held in Aust, South Gloucestershire, in 2004. This time the event will be in Edinburgh in 2006 and, again, will include opportunities for members to learn about these new instruments which were developed by Carleen Hutchins over the latter part of the 20th century. It is also on the cards that a meeting of the New Violin Family Association (the American organisation that promotes study, further development and performances of the instruments) can be arranged in Edinburgh to coincide with the performance. Additionally, the EPSRC funded UK Musical Acoustics Research Network under the Culture and Creativity Programme has been established, coordinated by Murray Campbell at Edinburgh University. To date, some organisational meetings have been held, but it is hoped that the network activities will provide an opportunity in 2006 for the long overdue Musical Acoustics AGM.

Noise and Vibration Engineering Group

The main public event organized by the group during the year was a meeting 'Good Practice in Reducing Noise', held in Oxford in October.



Spring Conference 2005



The Royal Society, London, on a stormy winter's day

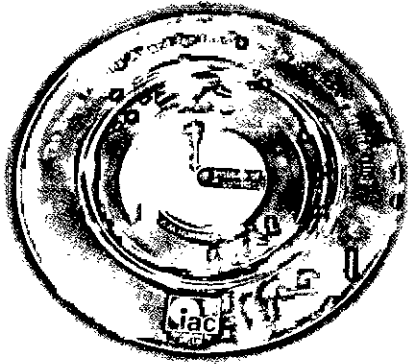


From DAT to DISK

The meeting, which was organized jointly with the Health and Safety Executive (HSE) for the European Week for Safety and Health at Work, was highly rated by the 72 delegates who attended, 28 of whom were not members of the Institute. This meeting was used to advise of the imminent revision of the noise at work regulations and to publicise the release of the HSE's *Good Practice Guide to Noise Control*.

During the course of 2005 there was a gradual evolution in the group's committee with a number of new members being recruited in an attempt to diversify the activities and interests of the Group. Malcolm Smith was elected as Chairman at the AGM held following the meeting in Oxford. Four committee meetings were held during the year, facilitated by a successful teleconferencing system, and two newsletters were sent out with the Bulletin.

Given the success of the event organised with HSE, the committee is actively considering the possibilities for other joint events that would be of interest to its members which could be with external groups (architects, automotive engineers etc) or other Institute Groups.



The Young Person's Award for Innovation in Acoustics

Joint IOA/IOP Physical Acoustics Group

The highlight of the year was the Anglo-French Physical Acoustics Conference (AFPAC '05) which was held in Le Havre in January. This meeting, which is held annually on opposite sides of the Channel, was organised jointly with the Groupe Spécialisé d'Acoustique Physique, Sous-marine et Ultra-Sonore of the Société Française d'Acoustique. In total 78 delegates attended the meeting, with 41 from the UK. Over two days some six invited talks, 39 papers and five posters were presented, covering a very wide range of topics and frequencies from Hz to GHz! A particular feature of the conference is the encouragement given to PhD students to present their work.

In addition a very successful Tutorial Day on Physical Acoustics was held at the Institute of Physics in London on 22 September. This took the form of three extended lectures on very different aspects of physical acoustics and ultrasound. These enabled the presenters to provide comprehensive reviews of their topics.

Speech Group

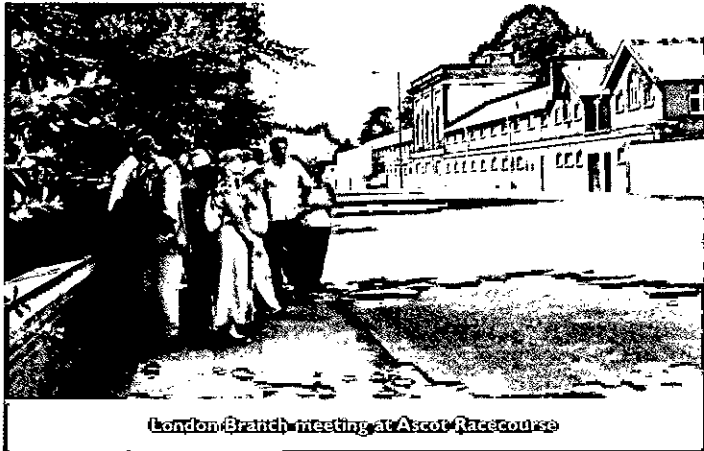
Again there was no activity during the year but attempts continue to find a new Chairman and reactivate the group during 2006. Consideration is being given to changing the name of the group to the Speech and Hearing Group.

Underwater Acoustics Group

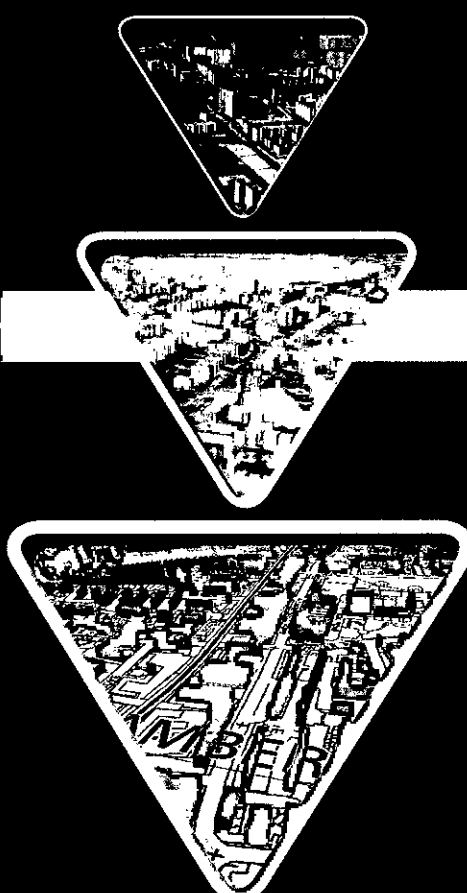
The group held regular committee meetings throughout the year. This year Dr Paul Lepper of Loughborough University joined the committee after his election in the Spring.

The main conference organised by the committee was led by Dr Steve Robinson and Prof Victor Humphrey. The conference on 'Sonar transducers and numerical modelling in underwater acoustics' was hosted

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London Branch meeting at Ascot Racecourse



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We are now accepting advertising for the 2006 - 2007 issue, which is due to be published in late September - the beginning of the budgeting and buying season for many of our member's organisations.

If you would like more information on the advertising opportunities in the *Institute of Acoustics Members Register: 2006 - 2007* please contact either of the following:

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by the National Physical Laboratory (NPL) at Teddington in March. The conference attracted 81 delegates from 12 countries and included the A B Wood Medal presentation lecture for 2004 by Dr Eric Pouliquen. The committee, through the Institute, also co-sponsored the conference 'Boundary influences in high frequency, shallow water acoustics' organised by Prof Nick Pace at the University of Bath in September.

In the pipeline for 2006 is a session at the Institute's Spring Conference and a Signal Processing conference which is to be held in the sunny climes of La Spezia, Italy.

Regional Branches

The Regional Branches of the Institute have been established to further the technical and social activities of the Institute at local level.

Central Branch

In May 2005 members in the Hertfordshire, Buckinghamshire and Bedfordshire regions were invited to express interest in the formation of a new regional branch to cater for members finding travel to London, Eastern or Midlands Branch meetings difficult.

Council duly approved the formation of the Central Branch in October and an ad-hoc seven strong committee was set up. The Central Branch was publicised in the Acoustics Bulletin and will be included on the 2006 Subscription Notices.

Venues in Milton Keynes and Stevenage were identified for evening meetings on the first Tuesday in the months of March, June, September and December in 2006.

The Central Branch indicated a commitment to provide a forum for members in the region and in particular to develop the areas of professional development, the interests of younger members and the promotion of acoustics in schools.

Eastern Branch

Over the year the Eastern Branch Committee organised five technical meetings and one social meeting. These meetings had an average attendance of around 18 members and were organised from four committee meetings.

As always, the committee members have tried to provide a wide cross-section of topics with venues spread across the Eastern Region as much as possible, although the majority have been held at the Colchester Institute. The first meeting of the year was an afternoon meeting in March on ventilation system design by Iain Kinghorn and was combined with a tour around Flakt-Woods at Colchester.

This was followed in April by a meeting at Colchester delivered by Graham Frost on medical applications of acoustics. In May, Adrian James gave an illustrated talk on the 'Design of BBC East TV Studios'. This meeting was held at the Forum in Norwich and included a tour around the building afterwards. After the summer break our branch members returned in October to enjoy our planned social meeting for the year which was a very enjoyable Gourmet Meal at the Balcerne Room Restaurant at Colchester Institute. This was closely followed in late October by a meeting at Colchester on underwater noise from wind farms and its potential for effects on marine animals delivered by Dr Jeremy Nedwell. The final meeting in November was held at Colchester Institute when Philip Harrison delivered a lecture on 'Forensic Acoustics - The Millionaire Coughing Investigation' combined with the AGM.

Irish Branch

This year has had some ups and downs for the branch. The downs include the passing away of our Chairman and founder of the Irish Branch, Dr Gerry McCullagh, during October. His enthusiasm for the education and promotion of acoustics throughout the island of Ireland will be sadly missed. As a branch we failed to have any evening meetings, although the committee did meet twice. The 'up' side is that the Irish and Scottish Branches combined to hold a well attended (106 delegates) one-day meeting in Dublin on the topic of *Sound Insulation in Dwellings*. For those who attended it was an informative meeting and also a time to socialise with others in the acoustics world.

Representation of the branch at the biennial Groups and Branches Meeting in St Albans was informative and allowed a time to meet new faces and talk to old friends. During the year to come it is planned that the Branch will be more active and that new blood will be encouraged on to the committee.

London Branch

As usual, the London Branch of the Institute can report another busy year comprising a successful one day conference, an interesting half day visit, the annual dinner and a programme of evening meetings.

A total of ten events were held throughout the year. These consisted of six evening meetings held at Capita Symonds' offices in Holborn, a half day visit to the Ascot Racecourse, a one day conference and the annual dinner.

Attendance at the meetings and functions has been good and generally on a par with previous years attendance figures, ranging from 15 to 40 members per evening meeting.

The half day visit was attended by 20 Institute members and 6 non-members and was held at the site of the new Ascot Racecourse development. After a tour around the site, a presentation was given consisting of 6 interesting talks, covering all aspects of the new development relating to acoustics. A full write up of the visit was included in the September/October edition of the Acoustics Bulletin.

The one day conference held in December, was on the subject of 'Planning and Noise: PPS24 and related topics' and was very well attended. Papers covered a range of topics including the revision of PPG24, IEMA/IOA noise impact assessment guidelines update, controlling external noise intrusion and the planning process relating to new noise sensitive premises.

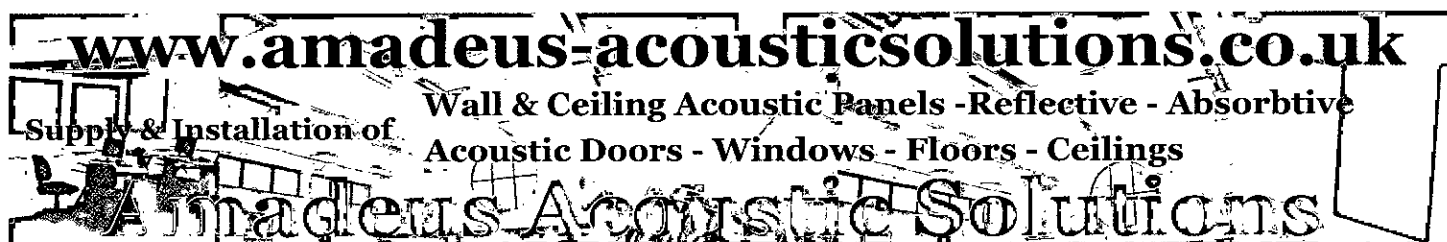
The annual dinner was held on 17 November at the Mar-i-Terra restaurant in Southwark. The after dinner talk was given by Peter Mapp and was thoroughly enjoyed by the 40 attendees.

Evening papers throughout the year were given on the topics of: Calculation of road traffic noise in low speed situations, Being an expert witness, Results of the NPL study into comparative room acoustic measurement techniques, Human response to vibration, The Glastonbury festival and Silencing gas turbines. A full programme is being planned for this forthcoming year and the Branch looks forward to continued support from its members.

Midlands Branch

At the AGM John Sheldon stepped down from the committee. Brian Hemsworth and Adrian Allman agreed to join the committee and as all other committee members had indicated their willingness to continue

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in post the following were re-elected to serve for 2005/2006 John Hinton - Chairman, Ron Hawkes, John Grant, Mike Fillery, Kevin Howell, Mike Swanwick, Paul Shields (Secretary).

Of the five meetings held in 2005, the first was held on 16 March at Coventry City Council House, where Professor Bill Davies of Salford University gave an interesting and lively presentation regarding a Defra funded project on Noise from Pubs and Clubs. Bill's talk covered his review of the evidence available, discussed how assessments of noise from pubs and clubs are currently made and illustrated some of the problems that arise with the various assessment methodologies used. There were some interesting and challenging questions from the floor, which provided further food for thought.

The second meeting, was a half-day event at the Rolls-Royce plc Derby Sinfon site. This involved a presentation by Mike Swanwick, Principal Technologist with Rolls-Royce, followed by a guided tour of the Rolls Royce Heritage Museum. Mike provided an interesting insight into a complicated and under utilised method of identifying where major or protrusive noise sources emanate from a complex noise field composed of multiple sources. Although few of the audience are likely to have access to the 100 plus microphones that Rolls-Royce often use, those present went away with a better understanding of the methods used and potential pitfalls. Following the meeting the group was given a guided tour of the Heritage Trust Museum showing the evolution of Rolls Royce and its aero engine development from the First World War, through the evolution of the Spitfire's famous Merlin engine to the latest Trent engines that are fitted to Jumbo Jets and the new Airbus.

The third meeting entitled 'IPCC - Noise Permitting - Pitfalls and Practice' took place 6 July at W S Atkins, Birmingham. Keith Horton of Environment Acoustics gave an excellent presentation on his work with the Environment Agency. This covered:

- The Agency's approach to noise regulated under IPPC;
- The experience of dealing with consultant's reports;
- The role of strategic permitting groups;
- The working better together protocol; and
- Considerations of the impact on wildlife.

Keith was particularly concerned about the varying quality of BS4142 assessments that he had to review.

The University of Derby was the venue for our fourth meeting and appropriately the topic for the evening was student presentations. This was the third year that the Midlands Branch has hosted this event where the best student projects of the year from the Applied Acoustics Masters courses made three presentation to the meeting. This year Scott Wilson had generously donated a prize for the best presentations on the night. As a final coda to the evening, Mike Fillery on behalf of the branch congratulated the Chairman John Hinton on his recent award of an OBE for services to Noise Assessment.

The fifth meeting of the year and AGM was held on 16 November, again at Coventry City Council House with a presentation from the Health and Safety Executive's (HSE) Tim Ward on the Implementation of Physical Agents Directive – Noise. Tim's talk outlined the content of the new regulations, and gave an insight into how employers, and those who advise employers, should take forward this revised approach to controlling noise at work. This talk upheld the fine standard of all the presentations in this years interesting and varied programme. The formal issues of the AGM were dealt with after the presentation.

The branch committee also held a planning meeting in December to discuss the programme of meetings for 2006.

North West Branch

The North West Branch commenced meetings in February, with a presentation by Peter Mapp of Peter Mapp Associates. Peter gave a relaxed and informative talk on speech intelligibility and his experiences in measurement and its accuracy, current trends in sound system design and the implications of working in acoustically hostile environments.

In April Tim Ward of the Health and Safety Executive (HSE) presented the basic requirements of the new Noise at Work Regulations. Tim expressed that the primary aim was to reduce the risk of excessive noise levels in the work place using practical methods, and not for widespread noise surveys demonstrating compliance with a limit. It is the long term aim of the HSE to reduce noise levels in the workplace, as far as practically possible.

Dr Andy Moorhouse of University of Salford provided us in July with a useful presentation of work undertaken on behalf of Defra in the assessment of low frequency noise complaints. Andy outlined the procedure for assessment, how the procedure was derived, and the results of field trials.

After the 'summer recess', Max Dixon, Principal Advisor to the Greater London Authority, fought his way north in November through bad weather to present his experiences in implementing London's ambient noise strategy. Max completed his talk with some thoughts on the future development of the Soundscape dimension – an opportunity for getting planners to consider noise or sound more seriously?

Our final meeting held at the end of November gave us time to hold our 'long awaited', but effectively short, AGM and plea for younger members to be considered for the branch committee to breath more life into committee meetings and the meetings programme. However, the main reason for the meeting was a useful talk by Phil Dunbavin of Philip Dunbavin Acoustics Ltd on his experiences in preparing new noise control case studies in industry for the HSE.

We are again indebted to Arup and BDP for hosting the meetings and providing great organisation at the venues, and to Bureau Veritas, if we can keep up to date with the name changes, for providing a venue for committee meetings. Paul Freeborn and Paul Michel who keep the kettle boiling and succinct minutes respectively, are keen to be joined on the committee by young enthusiastic members; sorry Jo Webb, you are no longer young!

Scottish Branch

2005 was a fairly eventful year for the Scottish Branch committee and one of significant change.

David MacKenzie, our Chairman for the previous two years, moved onto pastures new having taken up a new teaching post in Inverness. The branch is grateful to David for all the energy and enthusiasm he put into the Scottish Branch during his tenure. David's experience and ideas will not be entirely lost, as currently he remains as a committee member.

At the Scottish Branch AGM which took place in Edinburgh on 20 September, Alistair Somerville was appointed as Chairman. Alistair is well known for his involvement in Institute activities and the committee looks forward to Alistair's input as he takes over this role.

During 2005 Scottish Branch members organised two very successful meetings. The theme of the first meeting, held immediately prior to our AGM, was 'Wind Farm Noise'. The turn out for this meeting was limited only by the size of the venue! Particular thanks go to Dick Bowdler for organising such a popular, topical and interesting meeting.

In November the Scottish and Irish Branches jointly organised a one day meeting on sound insulation. This was hosted by the Irish Branch at the Clontarf Castle Hotel in Dublin. Special thanks are due to the Irish Branch Committee for their hospitality and for transforming the programme into a memorable event. Thanks are also due to Sean Smith for organising many excellent speakers and for his own informative presentation. It goes without saying, that where the Scottish and Irish Branch are involved there is always a social side to their meetings and, true to form, after the close of the final session, attendees retired to the bar for some much needed refreshments. Those who were staying

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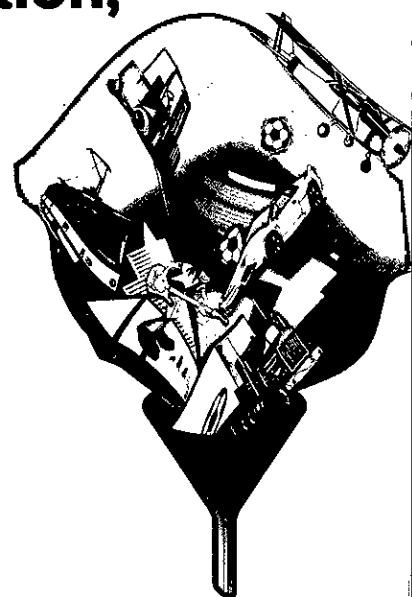
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overnight later ventured into Dublin Centre to sample traditional Irish hospitality.

The Scottish Branch hope to return the favour by inviting the Irish Branch over to Scotland for a reciprocal event during 2006

Southern Branch

The branch held a presentation on Bubble Acoustics in Nature – From Waterfalls in Space to Dolphin Sonar by Professor Tim Leighton at the ISVR Southampton on 3 March. The meeting was attended by thirteen members and four guests.

A second meeting entitled, Being an Expert Witness, addressed by Mike Wright of W S Atkins, was held at the Winchester Guildhall on 12 May and attended by twenty two members and three guests.

South West Branch

The current committee membership is: Tim Clarke (Chair), Stan Simpson (Secretary), Adam Lawrence, David O'Neill, Steve Peliza, Richard Perkins, and Graham Rock. The committee met twice in 2005 and organised one branch meeting.

As often before, the University of the West of England was our host for this meeting entitled 'Being an Expert Witness' which (was presented by Mike Wright, the Principal Acoustics Consultant at W S Atkins Noise and Vibration). This proved to be a very interesting meeting for the 24 people who attended.

It is hoped that the Branch can build on this for 2006 and promote more meetings. To this end, the committee would welcome participation from other members in the region instead of reliance on the 'usual suspects'.

Yorkshire and Humberside Branch

David Daniels was elected Chairman of the Yorkshire and Humberside Branch at their meeting in May 2005. This represents a resurgence of interest in the branch again, as is demonstrated by its recent meetings. In May a meeting was held at Sulzer Pumps in Leeds. Following a branch meeting, Guy Rickard of Brüel and Kjær gave a talk and demonstration on the use of sound intensity methods to measure sound power. This was followed by a tour of the Sulzer Pumps works, viewing their impressive range of pumps, used for example in oil and gas production.

The September meeting was a joint Yorkshire and Humberside Branch and North West Branch meeting held at Holset Engineering in Huddersfield. It was followed by an interesting talk entitled 'Can the sound quality of a product increase sales?', presented by Dr Sophie Maluski of Hoare Lea Acoustics. The company gave a tour of the turbocharger production facilities. More meetings are planned for 2006, in order to continue the regeneration of this important regional branch.

TABLE 2: GROUP MEMBERSHIP

Group	2004	2005
Building Acoustics	719	777
Electroacoustics	202	214
Environmental Noise	1075	1119
Measurement & Instrumentation	273	288
Musical Acoustics	135	149
Noise and Vibration Engineering	673	705
Physical Acoustics	98	107
Speech	96	104
Underwater Acoustics	131	129

TABLE 3: BRANCH MEMBERSHIP

Branch	2004	2005
Eastern	236	238
Irish	112	107
London	558	584
Midlands	360	357
North West	297	301
Scottish	124	125
South West	205	221
Southern	437	442
Yorkshire & Humberside	171	184

TABLE 4: DETAILS OF EMPLOYMENT

Employment Category	2004	2005
Architectural Practice	18	22
Consultancy	875	946
Education	190	185
Industry/Commerce	329	316
Public Authority	515	498
Research & Development	195	185
Other	74	76

TABLE 5: MEETINGS ATTENDANCE IN 2005

Topic, Date (Venue)	Attendance
From DAT to DISK 15 February (London)	53
Sonar Transducers & Numerical Modelling 21-22 March (NPL)	80
Does the END justify the means 14 April (London)	20
Spring Conference 2005: The Heart of Building Acoustics – what makes it tick? 19-20 April (Oxford)	150
Does the END justify the means 28 April (Birmingham)	30
Developments in Noise Research 24 May (Birmingham)	67
PPS24 Planning and Noise 1 July (London)	57
Lets get Physical 13 July (Buxton)	65
Wind Farm Noise Workshop 20 September (Edinburgh)	70
Autumn Conference 2005: what noise annoys 18-19 October (Oxford)	110
Good Practice in Reducing Noise 26 October (Oxford)	72
Reproduced Sound 21: Feedback to the future 4-5 November (Oxford)	89
Sound Insulation in Dwellings 25 November (Dublin)	106
Lets Get Physical 2 1 December (Buxton)	38
Planning and Noise 7 December (London)	94

TABLE 6: MEMBERSHIP

Grade	2004	2005
Hon Fellow	21	22
Fellow	196	194
Member	1371	1402
Associate Member	714	751
Affiliate	96	92
Technician Member	10	26
Student	49	53
Totals	2457	2540
Key Sponsor	3	3
Sponsor	28	39
Institutional Subscriber	15	15

INSTITUTE PERSONNEL AT 31 DECEMBER 2005

COUNCIL

	Officers	Ordinary Members
President	Dr A J Jones FIOA	Mr N Antonio MIOA
President Elect	Mr C E English FIOA	Prof T J Cox MIOA
Immediate Past President	Mr G Kerry FIOA	Prof R J M Craik FIOA
Honorary Secretary	Dr R J Orłowski FIOA	Prof B M Gibbs FIOA
Honorary Treasurer	Mr K A Broughton MIOA	Mr C J Grimwood FIOA
Vice President: Engineering	Dr B McKell MIOA	Mr G J Heald FIOA
Vice President: Groups & Branches	Mr S W Turner FIOA	Prof T G Leighton FIOA
Vice President: International	Mr B F Berry FIOA	Mr A W M Somerville MIOA

COMMITTEES & SUB COMMITTEES

	Chairman
Education	Dr D J Saunders FIOA
- Diploma in Acoustics and Noise Control, Board of Examiners	Prof K Attenborough FIOA
- Certificate of Competence in Environmental Noise Measurement	Mr D Trevor-Jones FIOA
- Certificate of Competence in Workplace Noise Assessment	Mr T Ward MIOA
- Certificate in Measurement of Sound Transmission in Buildings	Prof R J M Craik FIOA
- Certificate in the Management of Occupational Exposure to Hand Arm Vibration	Mr T M South MIOA
Engineering Division	Dr B McKell MIOA
Medals & Awards	Dr A J Jones FIOA
Meetings	Mr J P Newton MIOA
Membership	Mr B J Tunbridge MIOA
Publications	Dr M K Ling MIOA
Research Co-ordination	Prof K Attenborough FIOA

SPECIALIST GROUPS

	Chairman	Secretary
Building Acoustics	Prof R J M Craik FIOA	Mr P J Rogers MIOA
Electroacoustics	Mr R Walker FIOA	Mr P R Malpas MIOA
Environmental Noise	Mr K M Collins MIOA	Ms N D Porter MIOA
Noise and Vibration Engineering	Dr M G Smith MIOA	Mr J Richards MIOA
Measurement & Instrumentation	Mr R G Tyler FIOA	Mr M J Armstrong MIOA
Musical Acoustics	Dr P F Dobbins FIOA	Vacant
Physical Acoustics (Joint with the Institute of Physics)	Mr D Cartwright	Dr N Saffari
Speech	Vacant	Vacant
Underwater Acoustics	Dr G J Heald FIOA	Dr P D Thorne FIOA

REGIONAL BRANCHES

	Chairman	Secretary
Eastern	Mr M P Alston MIOA	Mr C L Batchelor AMIOA
Irish	Dr M R Lester MIOA	Mr S Bell MIOA
London	Mr J E T Griffiths FIOA	Miss A L Carey MIOA
Midlands	Mr J F Hinton MIOA	Mr P J Shields MIOA
North West	Mr P E Sacre MIOA	Mr P J Michel MIOA
Scottish	Mr A W M Somerville MIOA	Ms L Lauder MIOA
Southern	Dr N D Cogger FIOA	Dr H Sagoo MIOA
South West	Mr T Clarke MIOA	Mr S Simpson MIOA
Yorkshire and Humberside	Mr D Daniels	Dr K V Horoshenkov FIOA

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- The bi-monthly ANC meetings provide an opportunity to discuss areas of interest with like-minded colleagues or to just bounce ideas around
- Before each ANC meeting there are regular technical presentations on the hot subjects of the day

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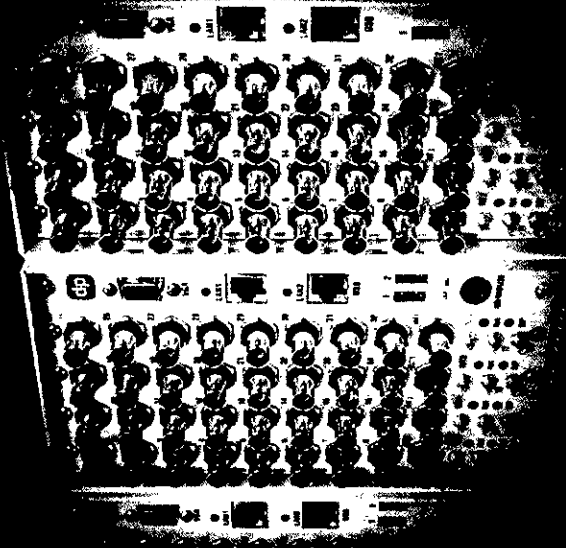
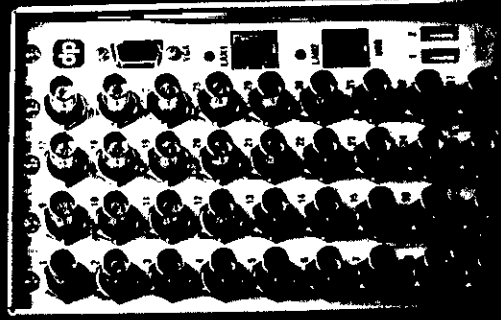
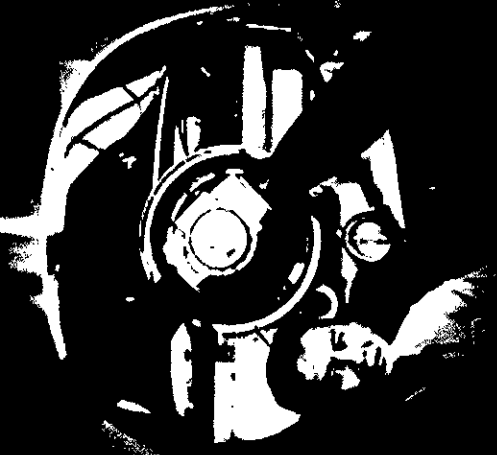
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Virtual Acoustic Prototypes

Andy Moorhouse MIOA. Listening to machines that do not exist

Introduction

One of the most difficult and interesting aspects of acoustics is that it spans two realms, the physical and the psychological. In acoustics, unlike most other technical disciplines, we deal with 'causes' that are physical, but 'effects' that occur literally between the ears of the listener, and are primarily psychological. Whereas the field variables in the physical domain are precisely measurable quantities, the 'field variables' describing human reaction are of a quite different nature, and they are not necessarily related to the physical variables in a straightforward way. For example, most indicators for environmental noise now use the A weighted Leq, effectively quantifying the average energy of the sound after filtering by the ear, but it is well known that the LAeq is not a reliable method of compare sounds with different characters. Thus, in the automotive sector and, increasingly, in domestic product manufacture, designers are coming to the conclusion that the only reliable way to judge the effect of a particular sound is to listen to it.

The designer of say domestic or outdoor equipment wants the sound to evoke positive feelings in customers and other listeners. The design targets are therefore in the psychological domain (essentially they are 'feelings'), whereas the parameters under the control of the designer are physical quantities of quite a different nature (thickness of plates, type of material etc). How then do we assess the effect of a design change (physical) on the target quantity (psychological)?

Architects and visual designers face a similar problem: the feelings evoked by a particular shape can best be judged by looking at the shape, and a wide range of visualisation tools has been developed ranging from drawings and physical scale models to virtual prototypes and environments. These tools aim to convey an accurate impression of the looks of the product to an appropriate level of accuracy and detail depending on the stage to which the design has progressed. The level of detail needed may mean that less than a minute is taken to prepare a sketch, or weeks or months to assemble a prototype.

The tools of a similar nature available for acoustic design are currently very few. In concert hall design auralisation techniques have been available for some time whereby the reverberation in a computer-modelled hall can be added to music recorded under anechoic conditions. In the automotive sector, simulations of the sound and vibration of vehicles are nowadays produced before prototypes become available, to give an impression of what the driving experience will be like. The level of technology required to achieve the acoustic equivalent of an architect's model is clearly quite sophisticated. This is surely a reason why acoustic design tools are years behind those used for visual design.

It can be argued that if acoustic design is to succeed in shaping sounds then designers need design techniques to convey an accurate impression of the sound of a product whilst it is still on the drawing board. Furthermore, an array of tools is needed to cater for different stages in the design process, ranging from simple methods to more 'high level' techniques. In this article the use of 'virtual acoustic prototype' techniques will be explored, mainly in the domestic and outdoor products sector. The examples of VAPs given were developed during the recent Nabucco project, funded by the EU.

What is a Virtual Acoustic Prototype?

A Virtual Acoustic Prototype (VAP) can be considered as a computer representation of a machine (washing machine, refrigerator, lawnmower etc) such that its sound can be heard without it necessarily having to exist as a physical machine. Like a real machine, a VAP is constructed from 'components', although the VAP components do not necessarily correspond to the physical components of the real machine. Each constituent part of a VAP is a representation of some vibro-acoustic mechanism taking place within the machine. The example of concert hall auralisation, which is more familiar than VAPs, may help explain what is meant.

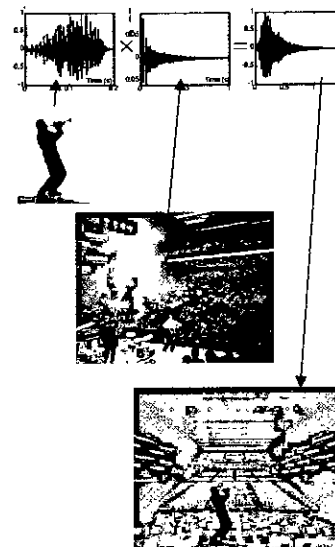


Figure 1

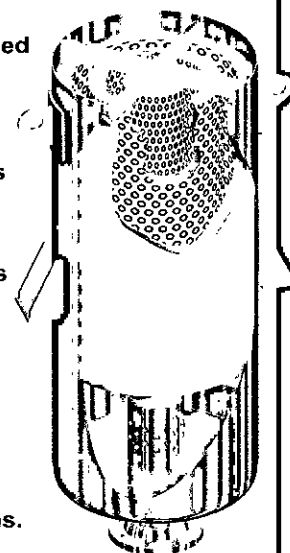
Auralisation techniques are now widely used for concert halls: music is recorded in anechoic conditions; the impulse response of the hall is measured or calculated (centre photo shows the Royal Festival Hall, London being tested with a pistol shot); the music and room response are combined in the computer (courtesy Prof Trevor Cox).

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Substructuring into active and passive parts

Figure 1 shows a schematic of how acoustic designers can listen to a concert hall while still on the drawing board. The main steps in this process are:

- A recording is made of a musician playing in an anechoic chamber
- The impulse response function of the hall is measured, or calculated by numerical methods such as ray tracing
- The anechoically recorded music and the impulse response function are combined in the computer by convolution and the result is auralised, for example by playing over headphones.

Thus, the original music and the reverberance of the room are both heard on the auralisation.

One of the features of this technique, which is relevant for VAPs, is that the data representing the source (the music) and the room are independent of one another. Source and response data can readily be interchanged so that for example a musician can be heard 'playing' in a hall he has never visited.

Constructing a VAP is similar: the first step is to separate the sources from the remaining passive parts of the machine. The components in a VAP, as in the concert hall example, are therefore of two types: active and passive. Active components are associated with physical components that initially generate the excitation, eg fans, pumps, compressors, electric motors etc. All remaining parts of the machine are categorised as passive and are collectively termed the 'frame'. The frame does not generate excitation, but modifies that from the active components on its way to the receiver (listener) position. The frame can be thought of as a filter, attenuating or amplifying certain frequencies by the action of resonances or diffraction. Like the concert hall, it plays an important role in what is heard by the listener without generating any initial disturbance itself.

An important requirement for the VAP is that the data chosen to represent the source must be independent of the frame and vice versa. If this requirement is met then each source can be combined with any frame and vice versa. In the concert hall analogy this allows musicians to 'play' in any hall, existing or not. In the case of the VAP, it allows a source, say a fan, to be installed (virtually) into any frame and the sound of the assembly to be heard.

A Simple Example

A fairly simple example of a VAP is shown in Figures 2 and 3. The machine to be represented is the cabinet of a telecommunications base station with two identical cooling fans in its door. This is analogous to the concert hall: the fan (the source) corresponds to the musical instrument, and the ductwork and cavities to the hall. The only major difference was that the calculations were carried out in the frequency domain. To model the base station, a fan was removed and mounted in an acoustically transparent box, using the methodology of ISO 10302 (1996) so that the sound power could be measured in the absence of the frame (Figure 4). From the measured sound power, the 'source strength' was back-calculated. The source strength was taken to be the net fluctuating force acting on the air by the impeller, which was assumed equivalent to the force exerted by a single dipole acting at the centre of the impeller along the axis of the fan (as illustrated in Figure 5). The frame was then represented by the transfer function from this excitation point to the external receiver position. This transfer function included the combined effects of cavity/duct resonances, transmission from the end of the duct etc. and was measured using a reciprocal technique (Moorhouse et al 2003, see also Pavic et al 2003).

The spectrum of sound pressure at the receiver location, calculated by combining the source strength and transfer function, is shown in Figure 6 and agrees well with the directly measured sound pressure spectrum. Furthermore, the auralised sound at this position was similar to the real sound.

Practical Limitations on VAPs

The 'holy grail' for designers is to carry out all their design in the virtual domain, working purely from electronic data and avoiding physical prototypes completely until the design is finalised. The advantages in terms of cost and time-to-market of this approach can be huge. However, in the above example the two sets of data were obtained by measurement. Clearly, this implies that the machine, or at least the parts of it, must already exist. What then are the advantages of the approach, and furthermore, how can it be claimed that the model is a virtual prototype at all?

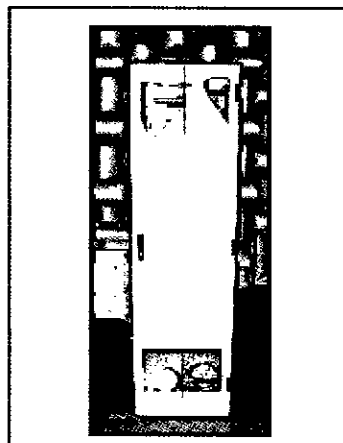


Figure 2

A telecommunications base station with cooling fans in the door (from Moorhouse et al. 2003)



Figure 3

Inside the base station door, showing two fans (from Moorhouse et al. 2003)

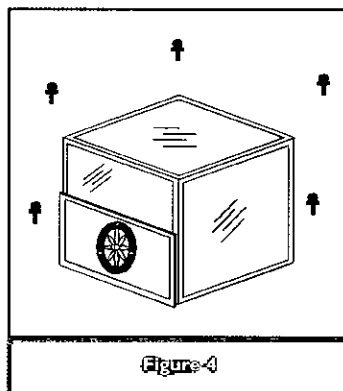


Figure 4

The fan is removed from the frame and tested in an acoustically transparent box according to ISO 10302 (1996)

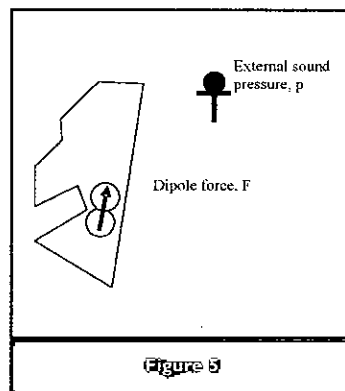


Figure 5

Schematic of the base station with the fan represented by an equivalent acoustic dipole at the fan centre. The source strength is the dipole force and the transfer function the external sound pressure per unit dipole force.

Advantages of VAPs

There are few advantages of a VAP if measurements are still needed, and there is only a single component and a single frame: one might as well assemble them and listen to the real machine. However, with a database of several active components and several frames the possibilities start to become interesting. A washing machine is typical of many products where complete redesign from scratch is rarely needed, because each new design is a gradual evolution from a similar existing design. Many of the components in the new design already exist and their vibro-acoustic properties can be measured.

Consider the apparently simple choice of how to select the optimum washing machine motor from the many possibilities on the market to suit a particular frame. The potential advantages of a virtual approach in terms of cost and time are clear. It is less obvious that the virtual approach could actually be more reliable than real prototypes. This is because to make a comparison one needs to keep everything constant except the variable of interest: in this case one should change the motor and keep the frame constant. This is easier said than done: there is no guarantee that the frame will be identical before and after disassembly. There is growing evidence that small structural changes can bring about significant differences in vibro-acoustic behaviour. On the other hand, using a virtual approach the frame is guaranteed identical by using the same transfer function data. Then different motors can be listened to in the same frame. Naturally, the sound of the VAP cannot be a better likeness than the real thing in an absolute sense, but the interest is in differences before and after modifications - relative effects - and the VAP has some advantages over a conventional approach.

Perhaps the biggest advantage is the insight that comes from breaking down

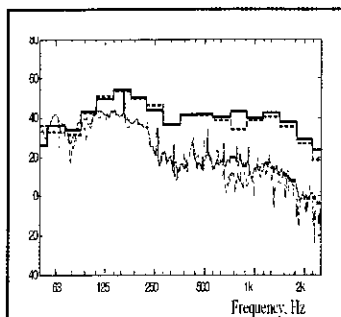


Figure 6

Figure 6 Sound pressure level measured on the real prototype (solid lines) compared with that predicted from the VAP (dotted lines). Narrow band in dBlin, third octave band values in dB(A).

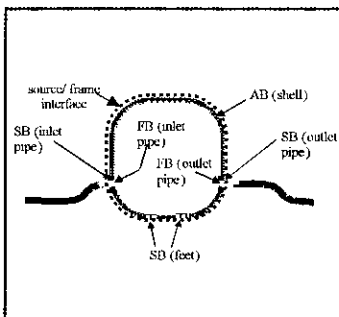


Figure 7

Source/ frame interface around the compressor showing structure-borne (SB), airborne (AB) and fluid-borne (FB) excitation of the frame

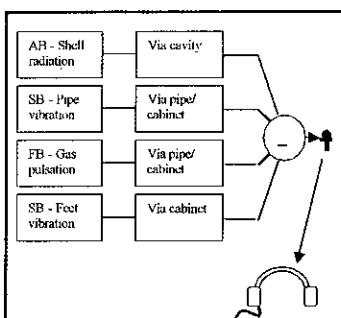


Figure 8

Vibro-acoustic scheme for refrigerator

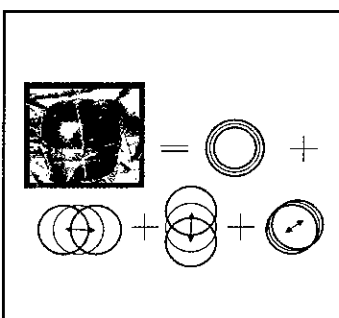


Figure 9

The real compressor shell is idealised as a combination of a monopole (breathing sphere) and three perpendicular dipoles (oscillating sphere) for AB sound.

the machine in a systematic way. For industrial participants in the Nabucco project this was considered the most useful aspect of the approach.

An Example VAP: A Domestic Refrigerator

A refrigerator is considerably more complicated than the base station considered above, since the excitation from the compressor is a combination of airborne, fluid-borne and structure-borne.

General scheme for the refrigerator

These excitation types can be seen when the complete machine is subdivided into source and frame. To define the substructures, a boundary is drawn around the source (Figure 7) so that all sound generating mechanisms are inside and what is outside is purely passive. The excitation of the passive frame is then considered to be purely through excitation over the interface. Where the interface cuts through solid structures, the excitation is considered to be structure-borne (SB) in origin, where it intersects fluid in a pipe it is fluid-borne (FB), and where there is air on the frame side of the interface, it is considered airborne (AB). Applying this logic the excitation of the frame is a combination of:

- direct sound radiation from the hermetic shell (AB)
- vibration in discharge and suction pipes (SB)
- gas pulsation in discharge and suction pipes (FB)
- vibration of the compressor feet (SB).

The scheme for the VAP is then as laid out in Figure 8. Although in the physical prototype there is only a single active component, in the VAP there are four sources corresponding to the above excitations which must be treated separately.

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Note that energy can be converted between different forms on its way to the receiver location. For example the FB excitation of the fluid in the pipe must be converted to pipe wall vibration and then into sound waves in the surrounding air in order to be heard at the listener location. All these effects are grouped together as FB sound because that is the nature of the initial excitation. Similarly, SB sound starts as vibration, but must be radiated into the surrounding air to be heard. In the next subsections we will consider how each of the excitation types is dealt with in constructing the VAP.

Airborne Sound

In order to construct the VAP we need to find a way to represent the excitation and transmission mechanisms. In this subsection we consider how to find the data to fill the top line of boxes in Figure 8. For AB sound the real compressor shell is idealised as a vibrating and breathing sphere. In other words the true shell is represented by a combination of a monopole and three perpendicular dipoles as shown in Figure 9.

The strengths of these elementary sources are obtained from vibration measurements. It turns out that the above four types of motions can be extracted from the readings from six accelerometers positioned on the poles of the principal axes as shown in Figure 10. The strength of the monopole is given by the average in-phase outward acceleration:

$$Q_{monopole} = 4\pi r^2 (A_1 + A_2 + A_3 + A_4 + A_5 + A_6) / 6j\omega \quad (1)$$

where $Q_{monopole}$ is the source strength of the monopole, A_1, A_2 etc are the accelerations (Figure 10), r is the radius of the sphere and ω the radian frequency. The strength of the x direction dipole is proportional to the rigid body acceleration in the x direction:

$$D_x \propto (A_1 - A_2) \quad (2)$$

Where D_x is the strength of the x direction dipole (similarly for y and z). There are four frequency spectra representing the strength of the monopole and the three dipoles.

The AB source strength is characterised without the need to perform any acoustic measurements. This indirect measurement has several advantages over a conventional sound power measurement, not least that the measurements are almost completely immune to background noise. The use of four equivalent elementary sources is also more accurate than using the compressor sound power, because the sound power is not an invariant quantity when there are reflecting surfaces and cavity modes in the near field of the source. For example anti-symmetric modes couple well with a dipole with the same alignment, thereby amplifying their contribution, an effect which is not accounted for using a sound power approach.

Next the transmission from the compressor shell to the external receiver location is considered. This is represented by transfer functions, one for each of the four equivalent sources of Figure 9. The external sound pressure (from AB excitation) is then given by:

$$p_{AB} = Q_{monopole} H_{monopole} + D_x H_x + D_y H_y + D_z H_z \quad (3)$$

where $H_{monopole}$ is the transfer function for the monopole, etc for the dipoles. This equation is shown diagrammatically in Figure 11.

The transfer function $H_{monopole}$ corresponds to breathing of the compressor shell. It quantifies the external sound pressure per unit volume velocity of the shell, (the volume velocity is the volume of air displaced by the breathing per cycle, given in $m^3 s^{-1}$). To measure this transfer function conventionally the compressor shell would be replaced with an idealised sphere of the same size, pulsating with a known volume velocity, and the sound pressure at the external receiver positions would be measured. The arrangement is shown schematically in Figure 12 (left). However, it is difficult or impossible to perform tests in this way because of limited space within the cavity where the compressor is housed. There is also the difficulty of obtaining a suitable source. Instead, the principle of acoustic reciprocity (Fahy 1995) is used, whereby the source and receiver positions are interchanged. Therefore, a monopole is placed at the external receiver position and the average, in-phase sound pressure measured over the surface of the shell. This is done by placing microphones close to the surface at the same positions as were used for the accelerometers in Figure

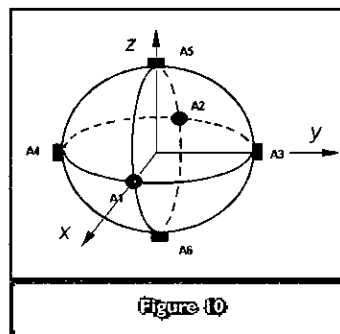


Figure 10
Six accelerometer arrangement used to measure AB and SB source strength of the compressor shell

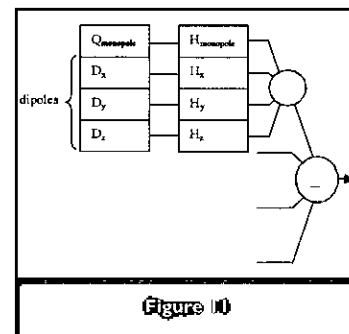


Figure 11
Development of Figure 8 showing contributions to the AB sound from the compressor shell

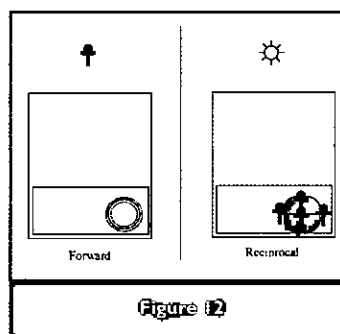


Figure 12
Forward measurement of the transfer function (left) and reciprocal measurement (right)

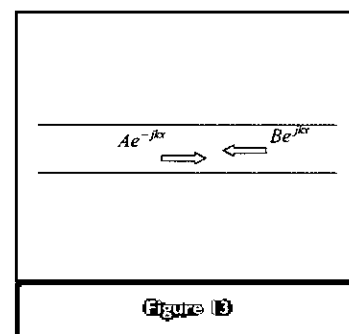


Figure 13
The sound pressure in the discharge pipe is a superposition of outward and reflected waves.

10. The measurement setup is illustrated in Figure 12 (right).

The same microphone arrangement can be used to extract the x, y and z dipole transfer functions, but rather than the in-phase pressure the difference in pressure of the microphones on the x axis is used in a similar way to equation (2), and similarly for y and z .

Fluid-borne Sound

The refrigerator was one of two products studied in the Nabucco project where fluidborne noise needed to be taken into account, the other being a washing machine with a pump. For pumps, it is usual to characterise the source by 'source strength' and 'source impedance' as defined in ISO 10767 (1996). However, this same arrangement cannot be easily adapted to the refrigerator compressor. One of the reasons is that the refrigerant fluid undergoes changes from liquid to gas phases as it passes around the pipe circuit. Consequently its properties, wave speed in particular, at any point in the circuit are unknown. The measurement of source impedance is also problematic, even for specially equipped laboratories, and even more so for industries with limited time and resources.

Fortunately, a simplification was possible in that the suction pipe contribution was found to be negligible. The question of how to characterise the compressor as a source independently of the frame still needed careful consideration. Since the pipe is narrow compared with a wavelength, plane wave propagation only can be assumed in the pipe. The pressure pulsations in the discharge pipe are then made up of the superposition of an outgoing and a reflected wave (Figure 13). The terms 'pressure pulsation' or 'pressure ripple' are usually used by refrigeration engineers where acousticians would use the term 'sound pressure'.

The strength and phase of the reflected wave are determined by downstream discontinuities and are therefore affected by the frame. On the other hand, it is reasonable to assume that the outgoing wave is determined only by the source and is independent of the frame. The independence criterion needed for the VAP can then be met if the amplitude of the outgoing wave can be found.

The reflected wave cannot be physically removed. However, it is possible to remove it using appropriate signal processing techniques. It is well known that using two pressure transducers in a waveguide the amplitudes of the outgoing and reflected waves can be obtained, provided that the wave speed is known.

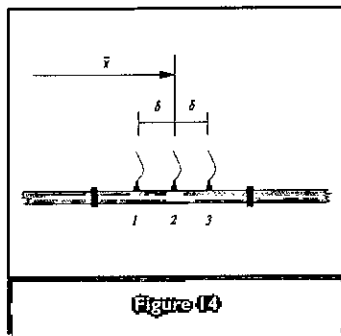


Figure 14

Rig for measurement of outgoing wave amplitude and wave speed in the refrigerant fluid.

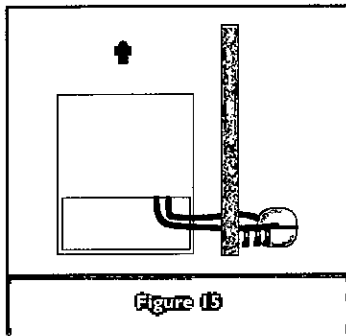


Figure 15

Test setup for the FB transfer functions. The sound pressure at the receiver position is measured and is normalised according to the measured FB source strength.

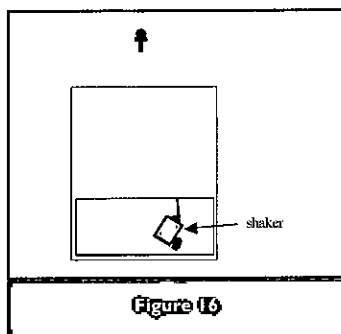


Figure 16

Test setup for measurement of SB transfer functions: a known force is applied to the end of the pipe from a shaker and the sound pressure is measured.

Similar algorithms are used in two-microphone impedance tube measurements to obtain reflection coefficient. It turns out that if a third transducer is added then the wave speed (not known for the refrigerant fluid in this case) can also be deduced. The measurement rig adopted consisted of three equally spaced pressure transducers in the discharge pipe (Figure 14). The source strength of the compressor was then characterised by the amplitude of the outgoing wave.

In order to measure the transfer function, the sound pressure due to FB excitation was measured directly.

In order to do this it was necessary to

eliminate the contributions of AB and SB sound. This was achieved by running the fridge from a compressor in an adjacent room (to eliminate AB contributions), connected via long pipes with flexible sections (to remove SB contributions). The test setup is illustrated in Figure 15. It was also necessary to measure simultaneously the source strength. This is because the transfer function is defined as the output (external pressure) per unit input (FB source strength in this case), so the strength of excitation must be known. The source strength was measured using the three pressure transducers described earlier.

Structure-borne Sound

To consider the effect of SB sound from the pipe, the source strength parameter was defined as the sum of squared vibration amplitudes in three orthogonal directions. The feet were treated in a similar way. These source strengths could be obtained by a transformation of the six velocity measurements used to characterise the AB sound source strength (Figure 10). Thus, no additional measurements were needed to obtain source strength data.

Transfer functions were measured using a forward technique in which a force was applied to the end of the pipes from a shaker through a force transducer. The resulting sound pressure was measured and then divided by the force input to obtain the sound pressure per unit force. The force was applied in several different directions and an average calculated.

It should be noted that the representation of the SB excitation and transmission mechanisms was significantly simpler than for some other cases because there was a large impedance mismatch between the pipe and the shell. It was possible to assume that the vibration of the pipe was the same as that of the shell, i.e. that the compressor was a velocity source with respect to the pipe. In general it is necessary to include an impedance or mobility matching step to calculate the contact forces (see for example Moorhouse 2003).

What the Customer Hears: Combining AB, SB and FB Contributions

Having obtained source strength and transfer function data for AB, SB and FB excitation types, the sound pressure spectrum due to each could be calculated

and summed to predict the overall external sound at the receiver position according to the scheme of Figure 8. The sound pressure spectrum for each case is shown in Figure 17. The SB contribution through the feet was relatively small and is not shown.

In Figure 17, for each excitation type a harmonic series is evident, with strong peaks at multiples of the compressor speed. However, the spectrum shapes are significantly different. The AB component, which is dominant in terms of dB(A), contains a wide range of frequencies. The SB component is predominantly low frequency, consisting of a rapidly falling set of harmonics. The FB component contains strong peaks up to about 600Hz, and the envelope of the peaks has a pronounced bell shape between the second and sixth harmonics. This shape would be caused by a resonance, probably somewhere in the pipe circuit, and is significant in terms of sound quality.

The breakdown given in Figure 17 allows the designer to perform a conventional rank ordering by comparing for example the dB(A) levels associated with each excitation type. The contributions in order of importance to the dB(A) level in this case were AB, FB, SB (pipe) and SB (feet). As all noise control engineers know, a rank ordering is the first essential step to designing effective noise control, so the ability to carry out rank ordering is an important function of a design tool.

The value of the above spectra can be extended considerably by auralising the results. The designer is then able to listen, not just to the combined effect as with the real prototype, but also to individual contributions, perhaps to identify the source of an unpleasant feature of the sound.

Auralisation : Listening to the Virtual Machine

So far, all the calculations shown have been in the frequency domain, in the form of narrow band spectra. This differs from the concert hall analogy, where the calculations were done in the time domain, the time history of the source being convolved with the impulse response function of the hall to obtain the modified sound.

In order to perform the auralisation starting from frequency domain data, any spectrum could be transformed to the time domain using Fourier analysis, but there are two problems which must first be overcome:

- phase data is missing;
- the number of data points is sufficient only for a very short time sample.

Sound pressure signals recorded in the real world are real functions. However, when transformed to the frequency domain a complex Fourier spectrum results, and the spectrum associated with a given time history has both magnitude and phase. If both magnitude and phase are known then the time history can be reconstructed exactly by inverse Fourier transformation. However, the phase will be lost if any kind of averaging is carried out on the spectral data. In the example of the refrigerator the most effective source strength for the SB component of excitation proved to be sum of the squares of the vibration levels in three orthogonal directions. During the summing operation, effectively a sum of the energy of the vibration in each direction, all phase information is lost. The resulting spectrum for SB sound includes only magnitude information. In some cases it would be possible to retain phase data, for example the AB source parameters and transfer functions for the fridge could in theory all be measured as complex spectra. However, in practice retaining the phase information creates measurement and data handling difficulties, particularly for medium-technology industries, the intended users of such techniques.

Therefore, the lack of explicit phase data for the auralisation must be accepted. Fortunately this is not a major drawback for steady state sounds. Such sounds can be auralised by assuming the phase spectrum to be random. The phase spectrum is therefore generated as a sequence of random numbers with magnitudes in the range 0 to 2π , (except for the zero frequency and maximum frequency values which are set to zero). The resulting phase spectrum is then added to the measured or calculated magnitude spectrum before inverse Fourier transformation and playback of the time history.

The question of the length of the time record obtained now arises. Narrow band spectra do not usually contain more than 3200 frequency lines, and sometimes fewer. When transformed to the time domain the sampling rate is

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determined by the bandwidth of the spectrum. For the refrigerator, the calculated spectrum extended to 6kHz (only the bottom 3kHz is shown in Figure 17). Because of aliasing, the sample rate must be at least twice the maximum frequency - at least 12kHz. The 3200 samples will thus produce less than a quarter of a second of audible sound, which is insufficient for auralisation. A short sample produced in this way could be lengthened by looping, but this usually creates an audible 'looping' artefact that gives a misleading impression of the sound.

The solution is to increase the number of data points without increasing the frequency range, which by interpolating the magnitude spectrum as illustrated in Figure 18.

A final problem to overcome is that the spectrum should be double-sided for inverse transformation, whereas so far there is only a single-side spectrum. One more step is required: add an alias spectrum, or a reflection of the spectrum with reversed phase, to the single-sided spectrum.

Procedure for Auralisation

Combining the above operations we arrive at a procedure for auralisation of steady state sounds, as summarised in Figure 18. The sequence is as follows:

1. The magnitude spectrum is interpolated to give as many data points as required.
2. For each spectral line of the magnitude spectrum a phase angle is generated. For the zero and maximum frequencies this phase is set to zero, otherwise it is set to a random value between 0 and 2π .
3. The spectrum is reflected about the maximum frequency (the Nyquist frequency) to give a double-sided spectrum, so if there are n samples in the single sided spectrum then the magnitude spectrum is extended to $2^{(n-1)}$ samples with magnitude M given by:

$$M(n+p) = M(n-p), \quad p = 1, 2, \dots, n-2$$
4. The phase spectrum, ϕ , is reflected in a similar way except that the values above the Nyquist frequency are negative so as to form an antisymmetric spectrum:

$$\Phi(n+p) = -\Phi(n-p), \quad p = 1, 2, \dots, n-2$$
5. The double-sided antisymmetric spectrum is then transformed to the time domain.

For the refrigerator example, a double-sided spectrum with 36k data lines gives a three second audio clip at 12kHz sampling frequency, so 18k samples are required in the interpolated single-sided spectrum. In practice 16385 points would be chosen for the single-sided spectrum so that the double-sided spectrum contained 32768 lines, which is a power of 2 and can be transformed more efficiently.

Interpretation of auralised data

The results of auralisation are quite revealing. The AB component sounds as one would expect a refrigerator compressor to sound. The SB component sounds like a 'low hum', although the higher harmonics are also audible giving slight 'rattle'. The FB component gives a pronounced 'boxy' tone to the sound, which, on its own, sounds fairly unnatural. This feature is not particularly noticeable in the combined sound, being masked by the more dominant AB component. However, were the AB component to be reduced then the 'boxiness' would become audible. This can be simulated fairly easily once the data are available by simply adjusting the levels before combining the different components. This tells the designer to be wary: a design modification that reduces the relative contribution of the AB component would make the 'boxiness' more pronounced, which may be undesirable. A reduction in dB(A) could even result in a sound that is subjectively louder.

Some Applications of VAPS

One of the main uses of VAPs is for comparison of different active components in the same frame.

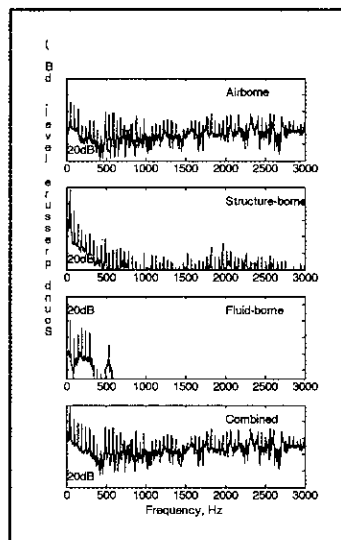


Figure 17

Contributions to the external sound pressure from AB, SB and FB excitation for the fridge. (y axis references are suppressed for confidentiality reasons)

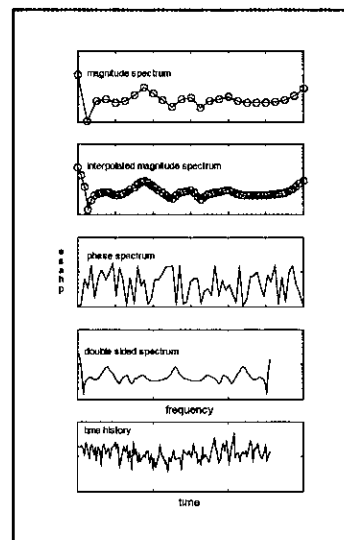


Figure 18

The sequence of operations for auralisation from a magnitude spectrum. The spectrum is interpolated, reflected, random phase is added and the complex spectrum is transformed to a time signal

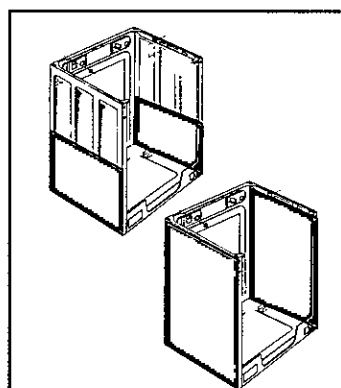


Figure 19

Washing machine cabinet before and after removal of some absorbent lining (courtesy Electrolux)

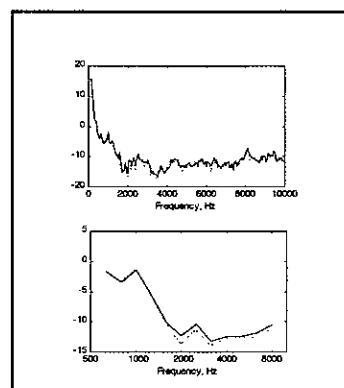


Figure 20

Insertion loss of the washing machine cabinet measured before and after modification. Upper plot: narrow band; lower plot: third octave bands.

Modifications to the frame

Another example from a washing machine is shown in Figure 19. Here, rather than replacing the motor, the frame was modified by removing a small amount of the acoustically absorptive lining from the cabinet. The conventional method to quantify the change would be to run the machine before and after modifications and to compare the measured sound power or pressure. However, even with a sophisticated motor control system it is impossible to guarantee identical operation of the motor for both tests. This introduces an uncertainty into the results such that differences of the order of 1 or 2 dB could not be attributed with certainty to the frame modifications, but could result from variations in the motor. On the other hand, using the VAP approach the frame performance is quantified using transfer functions measured using a controlled sound source, and the reproducibility is extremely good. Figure 20 shows the insertion loss of the washing machine cabinet obtained from the measured transfer functions before and after modification. Differences of up to 2dB were observed at some frequencies. Importantly, a check on the reproducibility of the results produced two curves that could not be distinguished, even on a narrow band plot. This means that the 2dB differences can clearly be attributed to the frame modifications. The VAP techniques therefore prove to be rather a 'sharp instrument' capable of reliably measuring small differences in performance. As designs become more refined, differences

of one or two dB are becoming more significant, so the ability to measure small changes is becoming more and more important.

Concluding Remarks

Considerable sophistication is required to auralise the sound of even a fairly simple machine. For the time being at least, a VAP cannot be purely 'virtual', but will necessarily include some measured data. However, the advantages of the virtual approach are many. Obvious advantages include reducing the cost and time associated with constructing physical prototypes. Less obvious advantages include the observation that the components of a VAP can be exactly reproduced so that more precise comparisons can be made of the effect of varying one element, such as a motor. Some situations can be constructed in a VAP which cannot be realised physically.

There are two main advantages to the designer. Firstly, the process of constructing a VAP provides a systematic framework for understanding how and why the machine makes the sound that it does. Secondly, auralisation is a powerful tool for communicating ideas about acoustics. In the Nabucco project it became evident just how much difference it made to non-specialists like managers and accountants to be able to hear the sound of the machine, as opposed to having it described to them. This observation makes clear that there is a strong potential to improve understanding of acoustics issues through auralisation techniques, but at the same time it also illustrates how big is the divide between specialists and non-specialists at current state of the art.

Acousticians in various sectors - buildings, automotive, transport, consultancy etc - are increasingly becoming aware of the potential for virtual techniques and auralisation in acoustics, and VAPs can be thought of as just one part of an increasingly wide movement. In the future, design drawings might be accompanied by sounds, and consultants' reports might routinely include computer auralisations.

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Acknowledgements

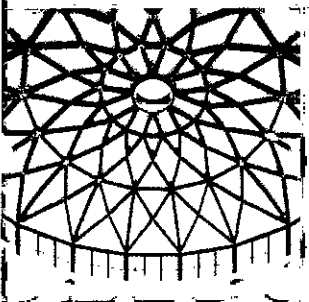
Much of the work presented here was carried out the in EU funded project 'Nabucco' no GRD1-1999-10785, support for which is gratefully acknowledged. The contribution of Goran Pavic, the mastermind behind much of this project, is especially acknowledged. The refrigerator example was largely the work of Leon Gavric, Michel Darpas and Jean Tourret at CETIM, France. The base station example was the work of Per-Olof Berglund, Mats Abom, Anders Nilsson and Leping Feng, at KTH Stockholm, Sweden. The auralisation procedures were obtained from Roland Sottek and Holger Kaempfer at HEAD Acoustics, Germany. Several other people also contributed to the material presented, notably Timo Avikainen, Krystof Krynski, Marco Clara, Georg Eimer, Walter Angelis, Barry Gibbs, Gary Seiffert, Richard Cookson.

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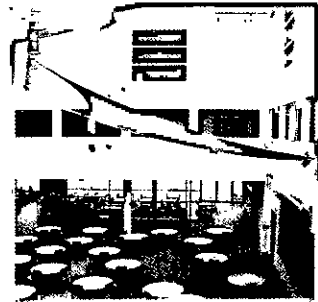
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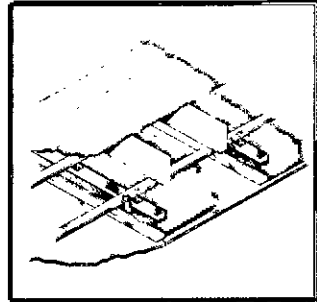
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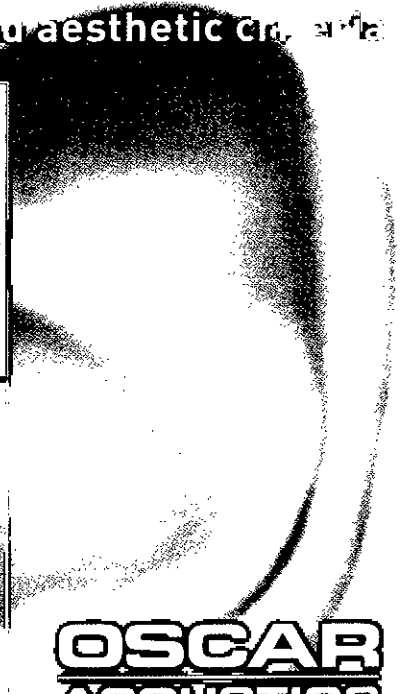
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Predicting Acoustic Pressure Fields in Transducers for Foetal Heart Monitoring

Pierre Gelat

The magnitude of research and development costs are of concern to many UK companies, especially acoustic transducer manufacturers who make medical devices which need to adhere accurately to regulatory, safety and quality standards. NPL's Finite Element (FE) Modelling Facility helps manufacturers to reduce costs and get new products to market faster. The facility offers an economic advantage by streamlining design, prototyping, production, quality assurance and product reworking.

Assessment of the foetal condition by Doppler ultrasonography was introduced in the 1960s and has become an established part of obstetric care. A transducer placed on the maternal abdomen repeatedly transmits short bursts of low-power ultrasound (typically of time duration of 50ls to 100ls; centre frequency of 1 to 2 MHz and total acoustic power of 50mW). Echoes received by the transducer from internal organs are Doppler shifted according to the velocity of the reflecting surface.

Traditionally, optimisation of transducer performance has had to be largely empirical, because the equations describing real-world transducers have been either too difficult to solve or make too many simplifying assumptions to predict the outcome of design changes accurately. Recently, the availability of increased computing power has enabled these problems to be tackled numerically.

The purpose of this work was to predict the acoustic pressure field produced by a seven-element foetal heart monitoring transducer for a given sinusoidal voltage input. As each element is nominally identical, an axisymmetric model of the PZT-5A single-element transducer was first produced. The orthotropic and piezoelectric properties of the crystal were accounted for. The fluid loading is modelled using fluid FEs together with a boundary element (BE). The latter enables the modelling of a semi-infinite region of fluid by solving the surface Helmholtz integral equation.

When undertaking an exercise of this type, it is a good idea to add complexity to the model gradually. Hence, the first task consisted of modelling a PZT-5A disc in vacuo and comparing its electrical impedance with measurement. In the axisymmetric case, for an orthotropic material, the following elastic compliances, piezoelectric constants and dielectric constants are sufficient to define a piezoelectric element (see table).

Elastic compliance/ Piezoelectric constant/ Dielectric constants	PZT-5A value
$S_{11}^E \text{ (m}^2 \text{ N}^{-1}) \times 10^{-12}$	16.4
$S_{12}^E \text{ (m}^2 \text{ N}^{-1}) \times 10^{-12}$	-5.74
$S_{13}^E \text{ (m}^2 \text{ N}^{-1}) \times 10^{-12}$	-7.22
$S_{33}^E \text{ (m}^2 \text{ N}^{-1}) \times 10^{-12}$	18.8
$S_{44}^E \text{ (m}^2 \text{ N}^{-1}) \times 10^{-12}$	47.3
$S_{66}^E \text{ (m}^2 \text{ N}^{-1}) \times 10^{-12}$	44.3
$d_{15} \text{ (C N}^{-1}) \times 10^{-12}$	584
$d_{31} \text{ (C N}^{-1}) \times 10^{-12}$	-171
$d_{33} \text{ (C N}^{-1}) \times 10^{-12}$	374
$\epsilon_{11}^S \text{ (F m}^{-1}) \times 10^9$	15.3
$\epsilon_{33}^S \text{ (F m}^{-1}) \times 10^9$	15.0

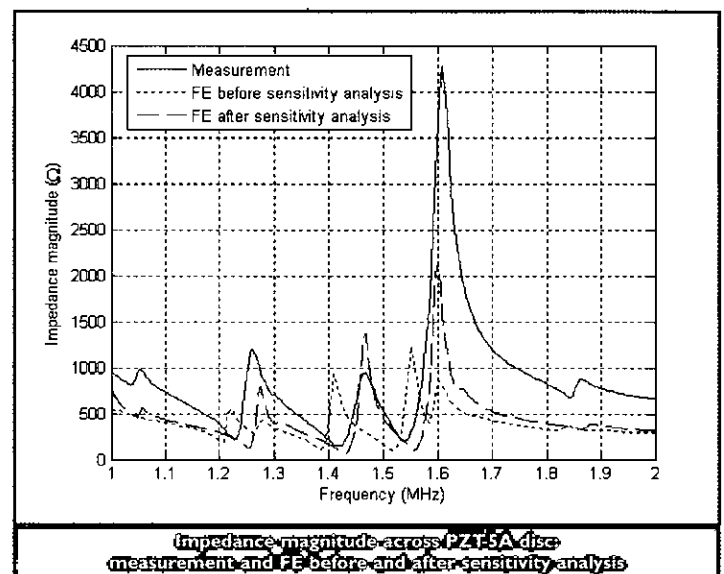
Elastic compliances, piezoelectric constants and dielectric constants used to define a PZT-5A axisymmetric element.

- S_{ij}^E represents the elastic compliances at constant electric field where i is the direction of the strain and j is the direction of the stress
- d_{ij} represents the piezoelectric constants (strain per electric field at constant stress)
- ϵ_{ij}^S are the clamped dielectric constants.
- The subscript 1, 2 or 3 respectively represents direction x , y or z of the crystal, where the z -axis coincides with the direction of positive polarisation. The subscript 4, 5 or 6 respectively represents shear about the x , y or z axis.

The density of PZT-5A is taken as 7750 kg m^{-3} [1].

The surface of the disc which is to be bonded to the face plate is assigned a zero potential. A sinusoidal voltage is applied to the other surface and the electrical impedance across the PZT-5A disc is computed between 1 MHz and 2 MHz. Model results are compared with experimental data over the same frequency band, as measured by an Anritsu MS520A Network Analyser while the element is held lightly in a rig. The measured data is adjusted to allow for stray impedances of the rig, which are determined by measuring a known network of similar resistance and reactance to the element under test.

Given that the tolerances of the constants in the table are $\pm 20\%$ [1], some discrepancies between the FE calculations and the experimental results are to be expected. To improve the model, a sensitivity analysis was carried out in which the parameters in the table were varied within specified ranges to obtain a better fit to experimental data. The graph shows a comparison of the impedance magnitude.



When solving the surface Helmholtz integral equation, a problem of non-uniqueness occurs at an infinite number of values of the wave number k relating to the corresponding interior Helmholtz integral equation [2], [3]. To overcome this mathematical problem, the Combined Helmholtz Integral Equation Formulation (CHIEF) was devised by Schenck [4]. This method introduces an additional number of equations N_C to the standard number of equations generated by the surface Helmholtz integral equation, for N_C 'collocation' points within the region interior to the BE. In this case, six collocation points were used.

The acoustic field within the BE, may then be predicted. Based on the assumption that the mechanical vibration of one element does not affect that of the other, the complete acoustic field generated by the seven elements is obtained by superposition. Measurements show that

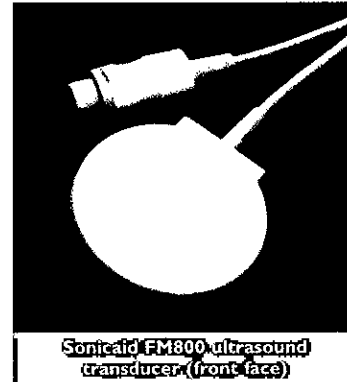
the characteristics of the pressure field generated by this type of transducer are successfully predicted using the FE/BE approach.

The FE/BE method allows the complex electrical, mechanical and acoustic interactions between a medical ultrasonic transducer and its surrounding medium to be modelled. The model accurately simulates the behaviour of prototypes, enabling designers to modify key design parameters to improve prototype performance without the need to construct several prototypes.

Sonicaid, a manufacturer of non-invasive medical devices now owned by Huntleigh-Healthcare Ltd, used NPL's FE modelling facility to develop a new foetal heart monitoring transducer design. This design resulted in the FM800 ADAPT transducer being produced for their flagship foetal heart monitor. As shown in the above diagram, the FE modelling was successful in predicting the acoustic pressure field produced by a seven-element foetal heart monitoring transducer for a

given sinusoidal voltage input. Most importantly for today's global market, prototypes are calibrated against NPL standards that have been validated by international comparisons, providing manufacturers with confidence in their data and ease of access to foreign markets.

More information can be found at
www.npl.co.uk/acoustics/fe_modelling_facility
pierre.gelat@npl.co.uk



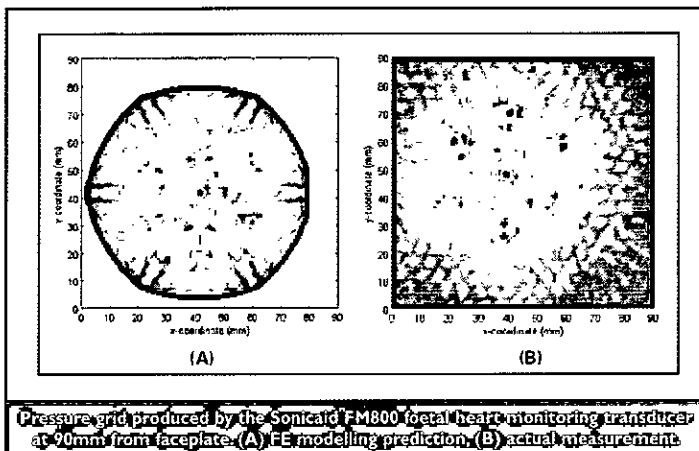
Sonicaid FM800 ultrasound transducer (front face)



Sonicaid FM800 ultrasound transducer (rear)

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The Association of Noise Consultants Registration Scheme for Pre-Completion Testing

Sue Bird MIOA.

Introduction

When the Building Regulations provision for 'reasonable resistance to the passage of sound' was updated in 2003, new and converted dwellings were required (except in certain circumstances) to be tested for sound insulation. Approved Document E (ADE) said that "Test bodies conducting testing should preferably have UKAS accreditation (or a European equivalent) for field measurements". At the time, few organisations were UKAS accredited for these tests, and the Association of Noise Consultants (ANC), with encouragement from the Office of the Deputy Prime Minister (ODPM) set about forming its own Scheme which would be acceptable to all concerned. This was achieved, and in July 2003, ODPM put out a circular letter which confirmed that approved members of the ANC Registration Scheme were suitably qualified to carry out pre-completion testing.

This article describes how the Scheme was set up, how it now operates, and what we have learned and have still not agreed upon within the Scheme. I chaired the committee which put the Scheme into operation, and am now the Chief Examiner for the Scheme.

ANC

Firstly, it is important that the structure and aims of the ANC are understood. The ANC the only professional association for independent acoustic consultants, and its objectives are

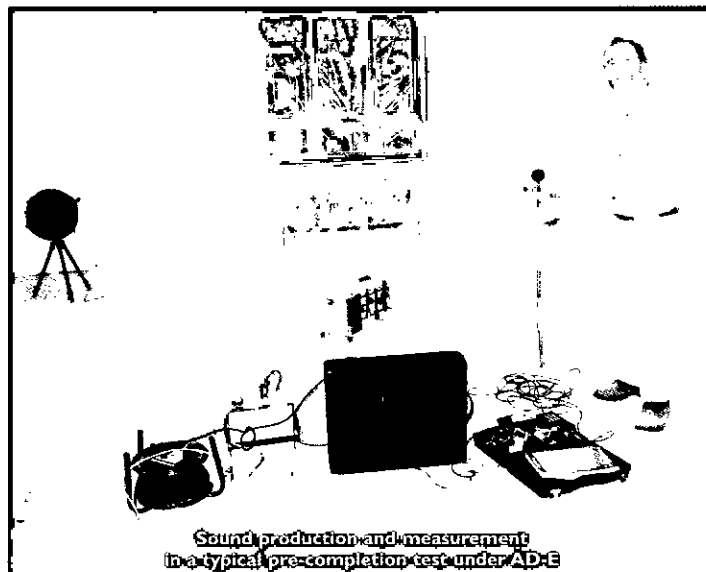
- To maintain and, where possible, improve the standards of conduct and competence of consultants concerned with noise, acoustics and vibration;
- To represent and make known the views of its membership upon matters relating to or affecting their interests;
- To promote further education and knowledge in noise control, acoustics, vibration and related matters;
- To inform the public of the existence of consultants concerned with noise, acoustics and vibration and the services they provide;
- To provide its membership with a forum for discussion and exchange of information on matters of common interest; and
- To co-operate with other organisations on matters of mutual interest.

The minimum membership requirements are as follows:

- Members should not subcontract more than 25% of their turnover.
- 50% or more of the permanent consulting staff should have graduate or equivalent status and hold membership of a recognised learned society in acoustics (in practice this almost always means corporate membership of the IOA).
- The principal, head or manager of a Member organisation should be able to commit the Member technically or financially, and should be a competent practicing acoustician. The Member organisation should be able to demonstrate substantial independence of service.
- No more than 25% of the Member's consulting activity should lie in specific areas covered by hardware interests of the Member organisation or of companies or groups with which the Member is financially linked.
- Members are required to carry a relevant amount of professional indemnity insurance
- If a Member is partly or wholly owned by any organisation concerned with the manufacture or sale of acoustic products, then this interest is to be declared to prospective clients whenever there is any possibility of a conflict of interests.
- Members are required to charge for their services at rates appropriate to a self-sustaining organisation.

Two grades of membership are available, Member and Associate Member.

In order to join the ANC, not only do members have to fulfil the conditions above and pay membership fees, but they also have to be technically



Sound production and measurement in a typical pre-completion test under AD-E

competent, and before they are admitted they have to submit a number of reports which are examined by the executive committee, and they are subsequently interviewed. Not all people who apply are admitted.

Background to Registration Scheme

The Registration Scheme for pre completion testing was started specifically for ANC members. The ANC knew that many of its members would want to do pre-completion testing - of course, it was a new source of income and we didn't want to be excluded - but we also know that many businesses in the ANC are composed of 1 or 2 people, and we felt that it would be extremely difficult for these organisations to become UKAS accredited because of the cost and time factors involved. In fact, we spoke to UKAS about this situation, with the hope that perhaps we could work something out for this specific test, but they were not able to be flexible in the way we had hoped, so we had to think of something else. We therefore started to conceive our own scheme. ODPM were interested and encouraging from the start.

The Scheme was set up as a service to ANC members, rather than as a competitor to UKAS, or as a business venture. A number of volunteers spent a lot of time thrashing out the format of the Scheme before it was officially born. It was felt that being a member of the ANC was a good initial basis for being registered. For an organisation to be admitted to the ANC they need to convince the Association that their operation and technical ability is good.

Technical requirements

We had to look at both ADE and the relevant ISO standards in great detail on how the tests should be carried out. I may have been naive, but before we did this I thought that an ISO was pretty cut and dried. However, I realised through the work we did on the sound insulation standards that they are often written by people who don't do the tests, especially not in the field, that they often have particular (and sometimes national) axes to grind, and that they are not always written in a way which is straightforward to interpret. Clearly we had to insist that the tests were carried out according to the standards. We knew that there were probably (technically) better ways of doing some parts of the test but that if we went down that road we would never agree about anything. Ensuring standardisation was the aim, not making improvements to the test method.

Perhaps the longest running discussion (at times rather heated) we had was about loudspeakers. The ISO stipulates the characteristics required of polyhedral loudspeaker systems, but appears not to actually insist on their use.

Other means of generating a uniform diffuse sound field using cabinet loudspeakers. Argument came mainly from people who had spent a lot of money on dodecahedron speakers because they thought it was required, and those who hadn't, and didn't want to. Members of the ISO committee were consulted, but there didn't seem to be a definitive answer. It is my own feeling that whilst the ISO committee may have meant to say that a dodecahedron speaker was required, they didn't do that, and so we decided that it could not be insisted on for the Scheme.

Other discussion points were the averaging of measurements (ADE says that logarithmic averaging should be used for the microphone positions for one source position, but arithmetic averaging for the 2 source positions). It basically treats the test as two separate experiments, the results of which are averaged statistically, rather than energetically. This is not, unfortunately, explicitly stated in the ISO or achievable using the onboard software on dedicated sound level meters (SLMs). We have to insist, therefore, that people take the data from the SLMs, perform the arithmetic average manually, before arriving at the final figure. There are also problems for the unwary in rounding, it has to be done at a specific point in two stages, and if not, the final figure can be different.

Set up of Registration Scheme

The Scheme registers the organisation. The organisation has to be well set up with good filing practices as well as training, calibration and equipment care. The correct equipment must be used. In addition, there are approved testers in each organisation. We expect a tester to be at least a technician member of the IOA, and to have experience in carrying out these tests, or at least assisting with testing. We have paid examiners who look at each application to test, and each application is seen by 2 examiners. The Scheme asks for specific inclusions in the reports, those which are required by the ISO and by ADE, and although we do not insist that everyone's reports are the same, we need to know that they all contain the same information. We have also asked that the final data is presented in the form indicated in the ISO.

The Registration Scheme only covers sound insulation measurements carried out to the relevant standard. Although many of those registered will have expertise in acoustic design, defect diagnosis and remedial advice, the Scheme itself only applies to the measurement and reporting.

Once an organisation is registered, it can begin to carry out testing under the Scheme. An independent organisation logs the tests, puts the results in a database, and sends out the certificates. This is all done over the web, and the system works very well. The use of centrally issued certificates was devised to control the data feedback and audit system and provide a suitably consistent verification for the approval authority (ie building control).

As yet, no-one who has applied for registration has been refused, although with some organisations we have had to go through some lengthy and detailed 'education' and changes.

Audit

Each organisation registered in the Scheme is contacted every year by the

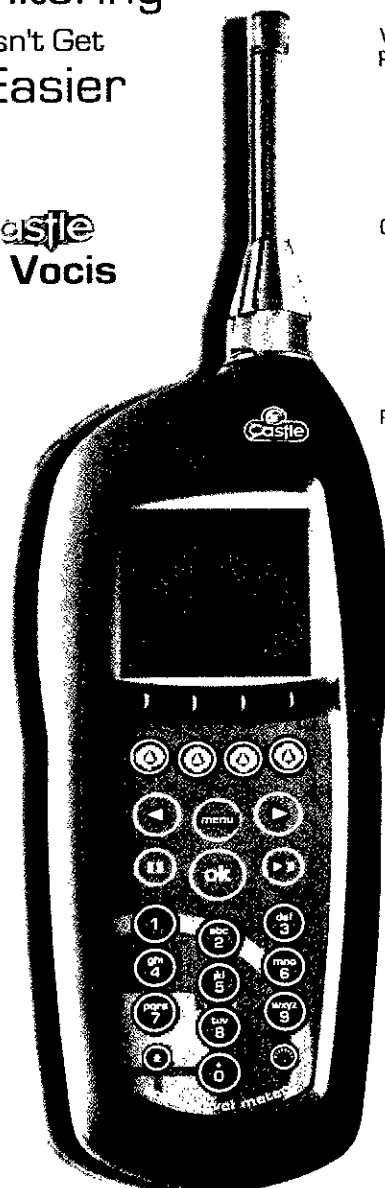
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ANC - continued from page 35

secretariat and asked to provide the raw data and the report for a particular test which was carried out in the previous year, and which is selected randomly from the database. This is checked by an examiner and directions to change the operation or reporting of the tests are made as necessary. Each year one in three organisations will have one of their tests witnessed by an examiner, and once again, comments and instructions can be issued as necessary.

Statistics

At the time of writing, of the 89 ANC member organisations, 53 have registered on the Scheme, and there is a total of 211 individual testers.

At a current throughput of around 2000 tests per month, the situation is sustainable at an average of 10 tests, per tester, per month. There should therefore be capacity for further growth of PCT, if necessary.

Early analysis of tests in postcode regions indicates that testing is probably not being enforced in some parts of the UK.

Benefits

Firstly, it is worth considering the general benefits of pre-completion testing

- Pre-completion testing demonstrates that initial failure rates are now around 10% or less, which compares with 40% to 50% prior to the introduction of ADE (2003). Where fails are detected, remedial work is carried out, further improving overall performance.
- In conjunction with Robust Details, this represents a dramatic improvement in the build quality of new housing stock in the UK.
- Builders are forced to think about acoustic principles and better workmanship to avoid failures, due to the cost of remedial work and retesting.
- Pre-completion testing, preferably with some 'expert' design input at the outset, is the only way in which satisfactory living conditions in converted property can be achieved.

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There have also been benefits from setting up this Registration Scheme.

- Many people discussed this test in great detail - people who actually do the tests in practice, not only those who write the standards. We had to decide exactly what were the standards required as well as what was good practice. Members were very open and honest about how they did the tests, and over time we came to a consensus on how tests should be carried out. The ANC will be publishing a good practice guide in time to help with points which are not covered in the standards.
- Because of the concentration and examination of the standards and test methods, the testing carried out by ANC members is consistent as far as we know.
- The requirement for testers to be accredited or registered has raised the standard of testing. We know from our discussions and applications that not all people were carrying out the tests correctly.
- We have a huge amount of empirical data going to the central database of measurements on various different types of construction. At some point in the future when resources are available, this database can be used for research. We already know from it that some areas of the country do not seem to have had any tests carried out by registered testers.

Current Discussion

Although this Scheme is up and running, there are always issues which need discussion or points of contention, and as the Scheme is used, there are things we may need to change. Several issues are current.

One which is being discussed at the moment is whether impulsive noise sources can be used for the measurement of reverberation time. The ISO is not clear on this, and in the past we have taken the view that impulsive sources can be used. This has been challenged from outside the ANC, and we are both gathering technical information to back this up, and also awaiting a 'judgement' from the ODPM. One possibility is that impulsive noise sources will be acceptable providing they are analysed by the reverse Schroeder method.

There is always a background of complaint from registered organisations about people doing tests who are not accredited or registered, and who can often significantly undercut those who are on price. However, apart from reporting this situation when it occurs, this does not come within the responsibilities or the remit of the ANC.

Practicalities

If you have not done any pre completion testing, you may be interested to hear of the more personal side.

- Testing on building sites, especially large ones, is difficult. We send out a checklist to the developer beforehand, giving details of the conditions we need, but there is nearly always background noise which delays testing.
- Often, the buildings are not complete, in fact, at times they hardly seem to have been started. Access is often difficult (for example having to get a dodecahedron speaker up a ladder) and there may be no mains power.
- Building Inspectors are very variable in their understanding and interpretation of the regulations.
- Some geographic areas require accredited or registered testers; others do



not seem to bother.

- These tests, especially on a full day, can involve significant physical effort. (Sometimes not easy for the more mature tester!)
- Have you checked out the toilets on building sites lately? And if you're female you'll be lucky ever to find any.

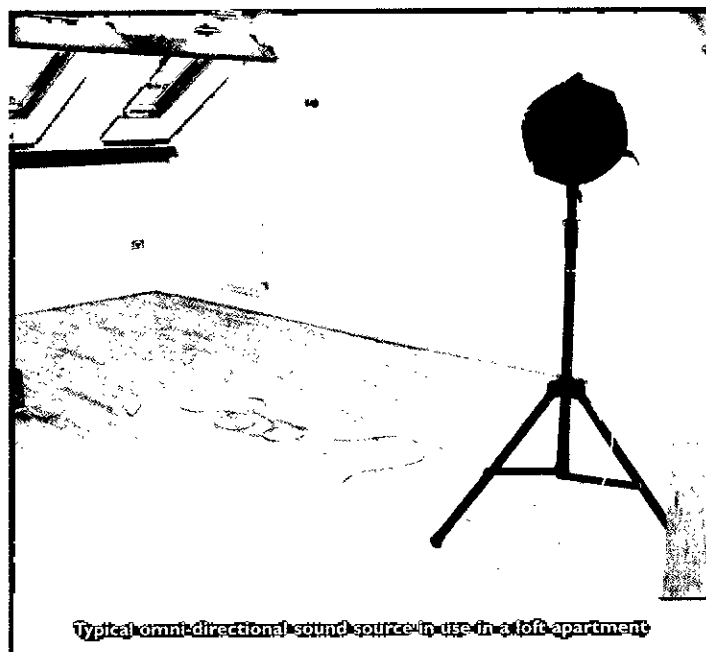
Of course, not only do we have to do the tests, but we have to deal with our clients, and whilst the vast majority of them are fine to work with, we do have our problems, both potential and real.

- Bad payers - some members always ask for payment in advance. It is

sometimes difficult getting money out of a client whose partitions have just failed.

- Many members have been offered inducements when a partition has failed.
- Some members have been threatened with violence when the inducement fails.

These do not make up the majority of pre-completion testing work, but the volume of testing at the moment means that they do happen some times. Incidentally, I have been told that when members stand firm on the rejection of inducements, the threats disappear.



Typical omnidirectional sound source in use in a loft apartment

Conclusions

The ANC Registration Scheme was set up to carry out pre-completion testing to comply with the Building Regulations. The basis of the Scheme is that its members have already demonstrated technical and organisational competence as members of the ANC, and they have to demonstrate specific competence in pre-completion testing.

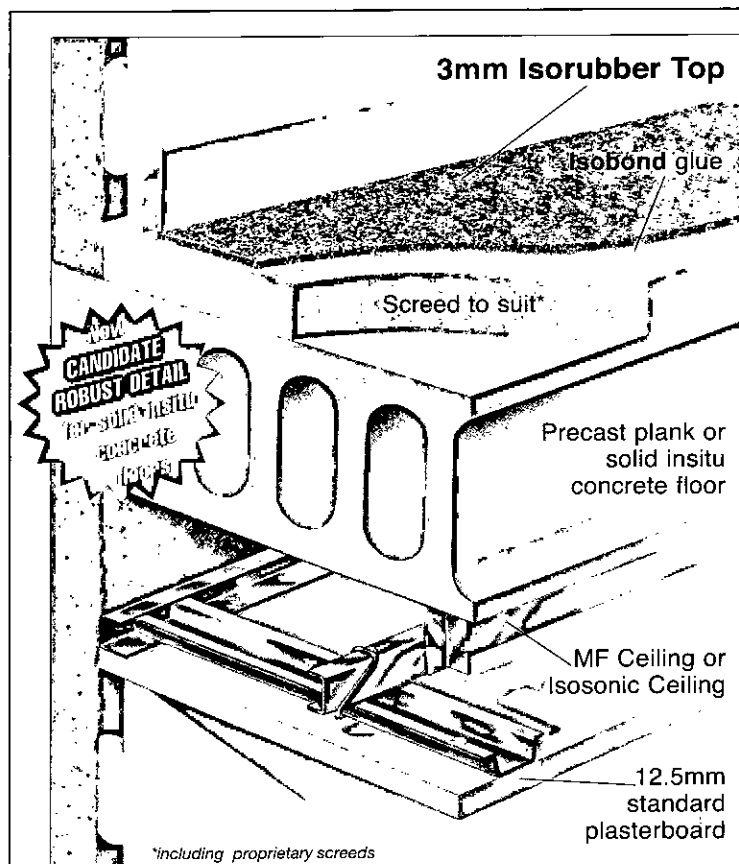
The Scheme was set up with the encouragement of the ODPM, but it is a specific Scheme for its members, and for one test only. Most registered members would probably be able to offer advice on sound insulation in buildings, but this is not a part of the Scheme.

The relevant standards have been examined and the measurements carried out, as far as we are aware, as closely as possible to the requirements of those standards.

Members' technical work and reports are audited annually, and tests are witnessed periodically. Any remedial requirements will be raised at these times.

The results of all ANC registered PCT tests are entered in a central database, providing a unique opportunity for analysis of a large sample of test data for pass rate and trend analysis.

Sue Bird MIOA is with Bird Acoustics, a member of the Association of Noise Consultants.



FIXED RESILIENT SURFACE LAYER SOUND INSULATION SYSTEM FOR CONCRETE FLOORS

SITE TESTED FOR THE NEW 2003 REQUIREMENTS

- ▶ Site testing consistently in excess of new 2003 Approved Document E requirements
- ▶ Typical site test results (average of 8): Airborne 53dB DnTw+Ctr; Impact 49dB LnTw
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- ▶ Widely used in framed construction
- ▶ **Isorubber Top** is a tough material suitable for the direct application of ceramic tiles and most types of hard and soft floor coverings
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- ▶ Tested for 10 yr foot traffic durability by the British Carpet Technical Centre



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Parliamentary Reports

From Hansard

18 Apr 2006: Aircraft Noise

John Penrose: To ask the Secretary of State for Transport what assessment his Department has made of the difference between peak and mean aircraft noise levels near British airports.

Derek Twigg: The Department has not made any specific assessment of the difference between peak and mean aircraft noise levels. This is because the suitability of what measurement is used will depend on the type of noise situation being addressed. The Department uses various measures of aircraft noise levels. The departure noise limits at Heathrow, Gatwick and Stansted relate to peak noise¹ and aircraft noise events at the fixed noise monitors (where the limits apply) are measured accordingly.

Since 1990, the Department has used equivalent continuous noise level - effectively an averaging out of noise energy over a given period - as the measure of average aircraft noise exposure².



Mean peak aircraft noise levels are not assessed on a routine basis but would be considered if appropriate and reported in technical studies carried out by the Environmental Research and Consultancy Department of the Civil Aviation Authority. For example, CS Report 9539 "Review of the Departure Noise Limits at Heathrow, Gatwick and Stansted Airports" includes statistics broken showing the reference mean levels, standard deviations and other statistical information relating to the peak noise of actual flights. A copy of this report was placed in the House Library.

1. Measured in L_{max} dB(A)

2. This entails the calculation of L_{eq} , logarithmic average sound exposure levels (SEL) for each aircraft type

19 April 2006: Mini-motorcycles

Mr Ian Austin: To ask the Secretary of State for Environment, Food and Rural Affairs if she will take steps to tackle noise pollution caused by mini-motorcycles.

Mr Bradshaw: Under Part III of the Environmental Protection Act 1990, local authorities have a statutory duty to inspect

their areas for existing, potential and recurring statutory nuisances from time to time; to take reasonable and practicable steps to investigate complaints of statutory nuisance; and to issue an abatement notice where it is satisfied that a statutory nuisance exists, or may occur or recur. Local authorities may also seize noise-making equipment.

Noise from mini-motorcycles on premises is capable of being a statutory nuisance. Premises can include land and beaches, and, in the case of vehicles, streets. Mini-motorcycles can also be seized as noise-making equipment. A statutory nuisance is one that materially affects someone's reasonable use of their home and/or is prejudicial to their health, as assessed by the local authority on a case-by-case basis. It is not a tool for addressing noise pollution in general.

Mini-motorcycles ridden illegally or in a careless or anti-social manner (that is, causing or likely to cause harassment, alarm or distress) may be seized by the police under section 59 of the Police Reform Act 2002 powers. A new guidance document was published in November 2005 and sent to all Chief Police Officers.

19 April 2006: Roads

Mr Spellar: To ask the Secretary of State for Transport what estimate he has made of the percentage of total capacity on the motorways that is used.

Dr Ladyman: No estimates of the total capacity of the motorway network have been made nor what percentage of this capacity is currently

used. On most motorways, the traffic demand reaches capacity for a relatively small proportion of the day, usually during the morning or evening peak periods, or both.

Stephen Hammond: To ask the Secretary of State for Transport how much has been awarded in compensation to people who have suffered blight from road noise in each year since 1997.

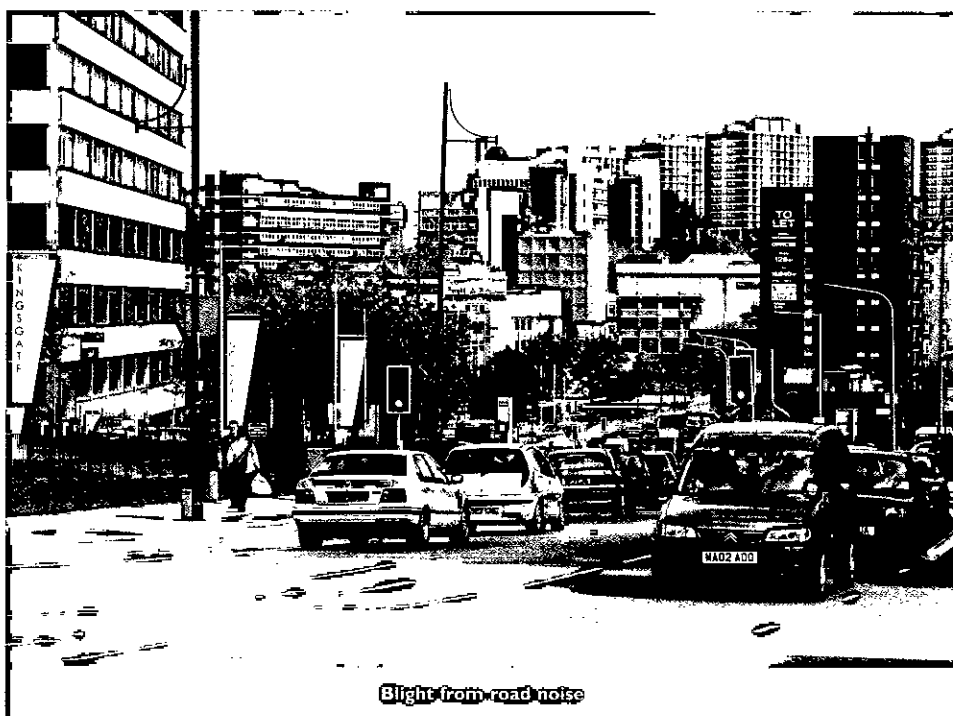
Dr Ladyman: The Highways Agency does not break down financial information on claims for compensation specifically for noise intrusion, resulting from the use of new or improved trunk roads.

The following amounts have been awarded by the Highways Agency under part I of the Land Compensation Act 1973 as compensation for the reduction in value of property caused by physical factors (including noise). These gross figures include interest on the compensation and agents' fees:

	£ million
1997-1998	22.09
1998-1999	15.23
1999-2000	26.54
2000-2001	31.47
2001-2002	29.43
2002-2003	25.59
2003-2004	49.96
2004-2005	29.22
2005-2006	48.57

Local highway authorities follow the same statutory process under part I of the Land Compensation Act 1973 for the payment of noise compensation following the construction or alteration of non-trunk roads. Compensation is funded from local authority revenue and is not reflected in figures given to this question.

continued on page 40



CAREER OPPORTUNITIES **in** **East** **Anglia**

The PDA Group is currently looking for experienced, self-motivated consultants to be based in our expanding office near Bury St. Edmunds.

The PDA group of companies was established in 1988, and has built a well respected reputation for the quality and speed of service to clients in the field of acoustics. We are currently working on a wide and varied range of contracts from architectural design in listed buildings to massive new build residential schemes. PDA also has many projects involving industrial, environmental and legal work.

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Mr. P. R. Dunbavin
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All applications will be treated in the strictest confidence

Parliamentary Reports - continued from page 38

3 May 2006: Noise Limits (Airports)

John Penrose: To ask the Secretary of State for Transport what estimate he has made of the maximum (a) safe and (b) desirable limits on peak aircraft noise expressed as L_{max} dB(A) for airports; and what the existing equivalent continuous noise level (L_{eq}) limits are.

Derek Twigg: The Department for Transport has not made any general estimate of safe or desirable limits on peak aircraft noise for all airports. The departure noise limits at Heathrow, Gatwick and Stansted, set by the Secretary of State, are 94 dB(A) L_{max} between 07:00 and 23:00; 89 dB(A) between 23:00 and 23:30, and 06:00 and 07:00; and 87 dB(A) in the night quota period, 23:30 to 06:00. The noise limits relate to a fixed reference distance 6.5km from start-of-roll. The full reasons for applying these limits are set out in the document 'Noise limits for aircraft departing from Heathrow, Gatwick and Stansted airports: decision of December 2000' which is available in the House Library. At other airports noise management is the responsibility of the airport operator. All civil aircraft operating in the UK must comply with relevant international noise certification requirements.

The Department for Transport has not set limits on equivalent continuous noise level (L_{eq}). However, based on research, the Government use various levels of L_{eq} as indicators of disturbance or of potential annoyance, or as criteria for mitigation measures, including advice for land use planning purposes. For example, the Government use 57 dB(A) L_{eq} as the level of daytime noise marking the approximate onset of significant community annoyance.

Daytime noise contour criteria for mitigation schemes were set out in the 'Future of Air Transport' White Paper. In particular, we expect operators of larger airports (those with over 50,000 air transport movements a year) to offer relocation assistance to households subject to daytime noise of more than 69 dB(A) L_{eq} and to offer acoustic insulation to non-domestic noise-sensitive buildings, such as schools and hospitals, exposed to daytime noise levels of 63 dB(A) L_{eq} or more.

John Penrose: To ask the Secretary of State for Transport whether measurements of, and limits on, peak aircraft noise L_{max} dB(A) are in place for airports other than Heathrow, Gatwick and Stansted.

Derek Twigg: The Department for Transport does not collect comprehensive information about noise control measures at airports other than Heathrow, Gatwick and Stansted. However, existing practice at a number of larger airports is set out as follows:

- Manchester airport sets departure noise limits of 92 dB(A) L_{max} in the day and 85 dB(A) L_{max} at night (23:00 - 06:59).
- Birmingham international airport sets departure noise limits of 92 dB(A) L_{max} in the day and 87 dB(A) L_{max} at night (23:30 - 06:00).

- London Luton airport sets departure noise limits of 94 dB(A) in the day and 87 dB(A) at night (23:30 - 06:00 Monday to Saturday, 23:30 - 07:00 Sunday).

These noise limits apply at the noise monitors and departing aircraft are monitored against the relevant limit. Airports also have noise and track-keeping systems, which are required to assess breaches of departure noise limits, in place.

John Penrose: To ask the Secretary of State for Transport whether he plans (a) to introduce new and (b) to change existing measurements of, and limits on, peak aircraft noise in terms of L_{max} dB(A) for airports.

Derek Twigg: The Government sets departure noise limits at Heathrow, Gatwick and Stansted airports which are designated for the purposes of section 78 of the Civil Aviation Act 1982. We will consider exercising similar powers at other airports if there is evidence that a major noise problem is not being dealt with adequately through local controls; otherwise, such limits are the responsibility of the airport operator.

The present noise limits at Heathrow, Gatwick and Stansted have applied since early 2001 and have been subject to further review. The results were published in the Civil Aviation Authority's Environmental Research and Consultancy Department (ERCD) Report 0207, 'Departure Noise Limits and Monitoring Arrangements at Heathrow, Gatwick and Stansted Airports', in April 2003. The main findings were summarised in our April 2003 consultation paper on night flying restrictions, together with a broad indication of how we would take them into account. This has been taken forward in the Stage One and Stage Two consultation papers on night flying restrictions published in July 2004 and June 2005 respectively.

In the Stage Two consultation, we proposed possible changes to the departure noise limit applying in the night shoulder periods (23:00 to 23:30 and 06:00 to 07:00). We also proposed that two additional noise monitors should be sited at Heathrow. We will announce our conclusions in due course. Copies of all the consultation papers and of ERCD 0207 were placed in the House Library.

8 May 2006: Aircraft Noise

Adam Afriyie: To ask the Secretary of State for Transport what the Government's definition is of excessive noise from aircraft; and what the World Health Organisation guidelines are on aircraft noise.

Derek Twigg: We have stated in consulting on our proposals for night flying restrictions at Heathrow, Gatwick and Stansted that one of our broad aims is

'to strike a fair balance between the protection of local communities from excessive aircraft noise levels at night and the provision of air services at night where they are of benefit to the national, regional or local economy'.

The expression 'excessive noise' does not apply to a specific level of aircraft noise. Based on research, the Government use various

measurements of aircraft noise as indicators of disturbance or of potential annoyance, or as criteria for mitigation measures, including advice for land use planning purposes.

The World Health Organisation has produced 'Guidelines on Community Noise'. The guideline values have regard to specific environments and effects rather than the source of noise, so there are no specific guidelines on aircraft noise. For each environment and situation, the guideline values take into consideration the identified health effects and are set based on the lowest levels of noise that affect health. Guideline values typically correspond to the lowest effect levels for general populations.

The 'Guidelines on Community Noise' document, which sets out the full range of guideline values, is on the internet at <http://www.who.int/docstore/peh/noise/guidelines2.html>

Adam Afriyie: To ask the Secretary of State for Transport what steps his Department (a) is taking and (b) plans to take in the Civil Aviation Bill to bear down on aircraft noise.

Derek Twigg: The 'Future of Air Transport' White Paper set out the combination of measures by which the Government aim to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise. These include promoting research and development into new low noise engine and airframe technologies. We have incorporated the key elements of the International Civil Aviation Organisation's balanced approach to controlling noise at airports into UK law; EU Directive 2002/49/EC requires periodic noise mapping at many airports from 2007 to identify day and night noise problems and, from 2008, action plans to deal with them.

The Government has powers to regulate noise at airports designated for the purposes of section 78 of the Civil Aviation Act 1982 (Heathrow, Gatwick and Stansted airports are currently so designated). This regulation includes departure noise limits and restrictions on night flying. We will also consider exercising similar powers at other airports if there is evidence that a major noise problem is not being dealt with adequately through local controls.

The Civil Aviation Bill will give airports clear powers to impose penalties on airlines who fail to follow noise preferential routes and other procedures designed to avoid, limit or mitigate the effects of aircraft noise. In the case of airports designated for the purposes of section 78 of the Civil Aviation Act 1982, where the Secretary of State has specified noise controls, he will have the power to direct that a penalty scheme be made, amended or revoked to enforce those controls. It will be for the managers of non-designated airports to decide whether to use these powers in the light of their local circumstances.

CMS Acoustics

Cottam Power Station

CMS Acoustic Solutions has helped Vinci Services to soundproof its Flue Gas Desulphurisation (FGD) project at Cottam power station, by recommending Damping Sheet DS03 and Damping Compound Type DC to insulate critical noise areas.

FGD units were installed at Cottam to

remove sulphur dioxide from flue gases before their release into the atmosphere. Vinci Services consulted CMS Acoustics to identify a solution that would prevent noise from these units affecting surrounding villages.

Damping Compound Type DC was applied to an aluzinc raw gas duct within the FGD unit.

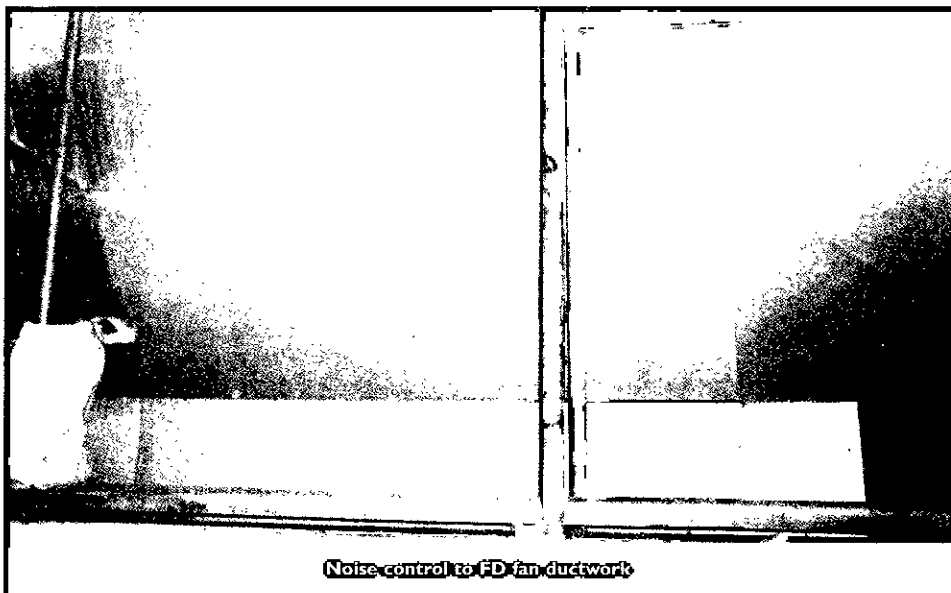
This water-based, polymeric emulsion inhibits the build up of resonant vibrations and efficiently reduces levels of radiated noise.

To soundproof the induced draft (ID) fan, Damping Sheet DS03 was installed. Manufactured from a mixture of bitumen, plasticizers and elastomers, Damping Sheet DS03 is a self-adhesive backed material. Designed to insulate sound in industrial areas, it adheres directly to formed steel and aluminium panels.

Commenting on the project, Joe Hendry, Vinci Services, said that the ID fan was an integral part of the sulphur dioxide removal process but it was particularly loud, so an effective soundproofing solution was needed. Damping Sheet DS03 was easy to install, provided a cost-effective solution and exceeded the specified minimum 2mm sheet thickness.

Damping Sheet DS03 is easy to cut and install. Provided in black, it is available in four standard weights and can be used with metal panels of varying thicknesses.

Applied at a 3mm thickness, the spray grade damping compound is ready for use and is directly put onto metal or plastic. This user-friendly emulsion dries quickly between applications and can be protected by most types of paint.



Noise control to FD fan ductwork

Cetacean Reaction to Sound

University of St Andrews Scientists Propose Experiments

A team of scientists from Scotland is proposing to carry out experiments on killer whales in the wild in order to study their reaction to sound. Biologists from the University of St Andrews in Fife want to work out at what frequencies and volume the orcas show signs of stress. Sound is considered as important to some marine mammals as sight is to humans. Some believe that military sonar could be harming whales and dolphins, and the issues were examined recently in the BBC Radio 4 programme *Costing the Earth*.

A few metres below the waves, sound is the only way to communicate, navigate or hunt. Cetaceans such as whales, dolphins and porpoises now have to swim through what some researchers described as 'acoustic fog' because the oceans are now full of background noise from shipping, drilling and naval exercises.

A report released in February by the Inter-agency Committee on Marine Science and Technology said research into the effect of sound in the oceans on marine mammals should be commissioned by the UK

Government. The report identified 13 cases of strandings by whales and dolphins which appear to have been linked to specific sources of noise, and most of those sources involved naval vessels. Post-mortem evidence gathered after a number of whales beached themselves during military exercises in the Canary Islands four years ago indicated the presence of tiny gas bubbles in the animals' internal organs, particularly the liver, which is believed to be linked to sonar.

A team from the Sea Mammal Research Unit at St Andrews wants to attach transmitters to a pod of orcas off Norway and study their behaviour as they turn up the sonar. When they show signs of stress by swimming away or not feeding, the sound would be stopped. They argue that this is the only way to prove exactly how sound waves affect cetaceans, and as a result the team would be able to advise navies or geologists how to avoid harming marine mammals. Some animal welfare groups are uneasy saying the research only yields results when the animal begins to suffer.

*A physicist,
a mathematician
and a biologist see two
people walk into a house.*

*A few minutes pass, then
they see three people
coming out of the house.*

*The biologist says
"It's reproduction!"*

*The physicist says
"It's experimental
uncertainty!"*

*The mathematician says:
"Now, if one more person
enters the house, it will
be empty again!"*

CMS Vibrations

Keeps Paddington Central on Track with Regupol 6010BA

London based concrete frame specialists LByrne Bros (Formwork) has worked with CMS Vibration Solutions to ensure the new Paddington Central CrossRail deck will remain structurally sound. CMS Vibrations recommended Regupol 6010BA, a heavy duty screed isolation solution, to protect the project's concrete slab foundations from ground-borne vibrations.

CMS Vibration Solutions operates purely in the anti-vibration and structural isolation marketplace. Working with architects, contractors, acoustic consultants, developers and structural engineers, the company supplies innovative acoustic and anti-vibration solutions through exclusive partnerships, including the complete Regupol range from manufacturer BSW, as well as their own manufactured materials. CMS is able to meet the acoustic needs of all types of developments, from refurbishments through new build developments to bespoke architectural projects.

The Paddington development required a heavy duty solution that would isolate the 500mm concrete slabs, to prevent them from being destroyed by the eventual vibrations of high-speed trains.

Jon Hurd, project manager for Byrne Bros, explained that The CrossRail track would eventually run through tunnels cored beneath the deck foundations. Preventative measures were therefore needed to isolate the concrete slabs from the ground and the columns supporting the deck. Regupol 6010BA was chosen to sit beneath these slabs as it was proven to reduce high-impact noise



Regupol 6010BA, heavy duty screed isolation solution

and vibration from very high loads, and stood the test of time.

Paul Lafone, sales director of CMS Vibrations, commented that they had had no doubt that Regupol 6010BA was ideal for this particular project. Even under high loads, the product had minimal creep. It was also quick and simple to install, which was important for projects of this nature where time was of the essence.

The construction of the CrossRail podium deck, which forms the foundations for the second phase of the Paddington Central development, will allow future phases to continue independently of CrossRail works. Standing eight metres above ground level, the deck is the largest structure of its

kind in the UK.

CMS Vibrations supplies an extensive range of anti-vibration products which includes CMS manufactured solutions, as well as the high performance Regupol range.

Through sister company CMS Acoustic Solutions, CMS Vibrations also provides access to the full range of acoustic products for construction and industrial applications.

Products are distributed from the CMS Group's new distribution centre in Warrington, where clients nationwide are already benefiting from the option of immediate dispatch. Plans are underway to open an additional distribution centre at the company's Colchester site later in the year.

Contract Award

Mediation to Reduce Noise Nuisance

To inform the development of the National Noise Strategy, Defra has commissioned Rupert Taylor's practice to review the usage and effectiveness of mediation services used by local authorities and housing associations throughout the UK.

This project complements one that Rupert Taylor has recently completed for Defra on the use of noise abatement notices under the Environmental Protection Act. That study considered alternative methods for reducing noise, one of which was the use of mediation.

Mediation is a process for resolving disagreements in which an impartial third party (the mediator) helps people in a dispute to find a mutually acceptable

resolution. Local authorities and housing associations may either have in-house mediation services or use external mediation services, for resolving such things as noise complaints between neighbours as well as a whole range of other issues.

Mediation is generally believed to be more cost-effective and quicker than going to court, which is often not the case with statutory nuisance complaints. It is also an excellent preventative tool and can be used effectively to stop problems escalating and becoming worse, ie before they become a formal/statutory complaint.

The new study will review the types of mediation services available, who runs

them, whether there are geographic preferences to where these services are used, and the point at which the services are taken up by local authorities and housing associations. It will also examine how effective the services are and the results achieved, and report on areas where it is felt that improvements can be made.

It is envisaged that the study will involve consultation with housing professionals in local authorities and housing associations.

Anyone wishing to contribute their views and experience to the study should please contact Stuart Dryden of Rupert Taylor (smd@ruperttaylor.com or 01993 852347).

Robust Details

1000th RD Sound Test

Robust Details Ltd (RDL), the company established to implement the Robust Detail alternative to mandatory pre-completion sound testing for new homes, is pleased to announce that it has recently conducted its 1000th 'Robust Detail' sound test.

The test, which was carried out at Laing Homes' Upper Reach development at Chertsey Bridge Wharf in Chertsey, Surrey, was a complete success. Charles Bladon, director at RBA Acoustics, was the RDL inspector who conducted the test. He says "These timber-framed apartments are a good example of the high standards achieved through Robust Details. The sound insulation of the floors and walls out-performed Building Regulations requirements and the Robust Details targets, with the walls in particular providing exceptional results."

Upper Reach consists of seven private residential apartment buildings, designed to ensure the best possible views and forming one of the most individual Thames-side developments outside London. The properties for sale have been designed to maximise prime riverside views and bring as much light as possible into all apartments.

Charles Bladon said that in his opinion, Robust Details as a scheme was going very well indeed. He had personally yet to come

across any failures after twelve months of testing, which had impressed him very much. The scheme really was a way forward for house and flat builders, as it gave them a good steer in the right direction with what was potentially quite difficult acoustic detailing. It was invariably poor junction detailing that caused acoustic problems and the Robust Details scheme avoided such pitfalls providing, indeed, some very robust designs.

Lee Merricks, senior design and planning executive at George Wimpey South West Thames, the developer which owns the Upper Reach development, said that there were basically two reasons for using Robust Details. Firstly, they were designed with building and build quality in mind - a builder using them correctly should not go wrong. Secondly they were designed so that when buildings were in use there is no question of sound transference. George Wimpey had definitely found the scheme beneficial as the details really lessened the impact of the Part E changes in the Building Regulations and testing new homes would be a nightmare without them. Nine out of ten of their developments currently in build or in design were now using them as a matter of course.

Dave Baker, Chief Executive of Robust Details Ltd said that the 1000th RDL sound test was



Charles Bladon

a real milestone, and the company was very pleased it was such a success. He looked forward to working with many more developers to secure the 2000th and 3000th successful test in the not-too-distant future.

For more details on Robust Details Ltd visit the website www.robustdetails.com

WSEAS

Working Group on Acoustics and Music

The World Scientific and Engineering Academy and Society is going to organise the 8th WSEAS International Conference on Acoustics and Music: Theory and Applications (AMTA'07) in Vancouver, Canada, on 18-19 June 2007. They have requested partners (as co-organisers), reviewers, etc...

Interested IOA members should in the first instance e-mail working-groups@wseas.org with WSEAS in the subject line.

The web site of the conference is currently under construction.

ASBO

Silences a noisy preacher

A selfish and irritating street preacher who has been shouting his message through a huge amplifier in a crowded shopping street for years on end has, at last, been given an Anti-Social Behaviour Order (ASBO).

Philip Howard, 52, was ordered by a court not to use 'any amplification device' in Oxford Street, London, where he has been grating on the nerves - and possibly even damaging the hearing - of shoppers for years.

Westminster City Council said that it had been forced to bring the action at Horseferry Road Magistrates' Court after receiving many complaints. It had attempted to strike a deal with Howard, whose address was given as a hotel in Paddington, to curtail his activities but the approach had failed. The court was told that Howard used the megaphone to harangue and harass individual members of the public at Oxford Circus, and on a traffic island on Regent Street, as well as preaching at shoppers near Selfridges.

Conference Information

From INCE/Europe

The 12th International Conference on Low Frequency Noise and Vibration and its Control will be held in Bristol, UK between 18 and 20 September 2006. The conference aims to cover all areas of infrasound, low frequency noise and vibration, their perception and effects. It is of interest to scientists and engineers working in these fields and to environmental professionals who deal with problems in the low frequency

region. There is still time to submit an abstract of your conference presentation.

For further details see www.lowfrequency2006.org

The conference is being held in association with INCE/Europe and MultiScience Publishing Co Ltd, publishers of the Journal of Low Frequency Noise, Vibration and Active Control. The conference organisers are Geoff Leventhall and Bill Tempest.

Vanguardia Consulting

Sounds Good

Jim Griffiths and John Staunton have formed Vanguardia Consulting, a new acoustics company based in Oxted, Surrey. Launched on 2 May 2006, Vanguardia provides the full range of consultancy services in sound, noise, acoustics and vibration.

The former Acoustics Director and Technical Director of Capita Symonds (formerly Symonds and Travers Morgan) have track records spanning 25 years and together with their team will be offering the industry the quality of advice and practical solutions for which they have become renowned.

Both Jim and John have built on their roots in environmental noise to gain extensive experience in the acoustic design of venues from both an architectural and sound system perspective as well as being recognised experts in sound control and licensing for the entertainment business. They have been involved in over 600 of the most prestigious concerts in the UK, Ireland and elsewhere in the world "Live Aid to Live8" with venues including Wembley Stadium, Twickenham Stadium, The Point-Dublin, Honk Kong Stadium and the Millennium Dome.



Jim and John at the setup for the Prince's Trust 30th Birthday concert at the Tower of London, 20 May 2006

Jim and John intend Vanguardia to set new benchmarks for acoustic consultancy. Jim explains "We recognised a gap in the market for a consultancy which could offer true depth of technical expertise across a diverse range of acoustic services, combined with applied business acumen and powerful industry contacts. Vanguardia clients will benefit from a dynamic approach to resolving conflict and creating solutions."

John expands "As a business we are highly agile and proactive, anticipating and responding to needs

swiftly with a breadth of thought that the market is finding refreshing. The response has been outstanding. In the first weeks of business we have secured a number of high profile contracts including the Prince's Trust 30th Birthday concert at the Tower of London (20 May 2006).

For further information:

Jim Griffiths, Vanguardia Consulting,

Tel: 01883 718690

E-mail: jim.griffiths@vanguardiaconsulting.co.uk

Temple Group

New Recruits

Temple Group Ltd, a broad-based environment and planning consultancy, is pleased to announce the appointment of a leading figure in the environmental sector, Dr John Henry Looney as Operations Director.

Dr Looney, on the council of the Institute of Environmental Management and Assessment (IEMA), has joined Temple from Millennium Science & Engineering where he held the position of Managing Director. Before this he worked at Parsons Brinkerhoff and Halcrow. Dr Looney brings with him over 27 years of experience in the UK and internationally, working in over 20 countries in sectors such as transportation, power, petrochemical and pharmaceutical; for both private and government clients. These include the Ministry of Defence, Philips, Petroleum Plc, British Nuclear Fuels and the National Power Corporation. His work and findings have been widely published and he lectures at Bristol, Nottingham and Bath Universities. He is also a regular speaker at industry conferences.

Dr Looney comments: "I am delighted to have joined Temple Group at this important time and am keen to play a key part in developing and implementing Temple's growth agenda. My immediate tasks will be to continue to expand Temple's client base in the private sector, to work with the four divisions and to develop the range of services offered."

Mark Southwood, MD, adds: "I am looking forward to working with John Henry and I am confident that his broad technical knowledge and understanding of the

market place, together with his commercial acumen will deliver significant benefits to the Company."

To support the growth agenda Temple's divisions have also been strengthened. Edd Bergin has joined Temple Planning as a consultant. Edd has gained experience in both the private and public sectors, working as a junior consultant for URBED Manchester and as a research analyst for Westminster City Council.

Temple Environment has appointed Andrew Ryan as junior acoustic consultant. Andrew graduated from Salford University in 2005 with a degree in Audio Technology including railways, roads, construction and industry.

Temple Regeneration has appointed Jeremy Head as senior consultant, previously with Entec. Jeremy has more than 7 years experience working on contaminated land projects and related matters. He will be joined by Marina Tzima as a junior consultant. Marina holds a Masters degree in Environmental Pollution and Protection and has an in-depth knowledge of contaminated land, remediation and risk assessment and speaks several languages.

For further information visit Temple's web site, www.templegroup.co.uk or contact Holly Lowe, Marketing Manager,

Tel: 01825 790964

E-mail: holly.lowe@templegroup.co.uk



Dr John Henry Looney



Edd Bergin



Andrew Ryan



Jeremy Head



Marina Tzima

Comment on 'Achieving Great Concert Sound' by Sam Wise (Vol 31 No2)

Over a period of about twenty years I acted as acoustical consultant to architects briefed to design or modify opera houses, theatres and multi-purpose halls. I therefore began to read Sam Wise's article with eager anticipation, particularly because it purported to be focused on the needs of amplified music, of which I have little experience. I regret to say that I was no wiser after carefully reading it three times. I found that the article tended to jump between room acoustics aspects of amplified and unamplified music, and was rather equivocal. I was at a loss to understand what I felt were vague or even incomprehensible phrases and sentences.

I cite a few examples of imprecise and

confusing text: 'In one band's performance, an amplified double bass delivered a stunningly detailed sound full of personality and lots of notes (when needed)...'. 'The necessarily split bass...'. 'Masking seems to worsen with rising amplitude. We know this to be true...'. 'Can we make an abdomen bouncing/trouser flapping transient wave that tracks the kick drum, while eliminating most of the harmonics that would mask the aural experience of timbre?'. Finally: 'we should be trying to achieve direct sound spectra and sound power spectra that are the same, so that reverberation energy spectra match, rather than exceed, those of the direct sound across all frequencies. In other words, we need a truly "constant Q" loudspeaker'.

I do not offer this criticism simply as an academic exercise. I consider that publication of this article does not enhance the reputation of the IOA, and that it gives a poor example to young, inexperienced readers who may be led to believe that 'acousticians were invented' simply to spread confusion and uncertainty.

Emeritus Professor Frank Fahy FIOA

I must admit I thought I understood most of what Sam wrote in his article, which was based on an RS21 paper at my request. I prefer Mozart to Morrissey, presumably as does Prof Fahy, but perhaps a young, not necessarily inexperienced reader would care to comment? Ed.

Product News: SubPrimo

Acoustic Insulation for Timber and Laminate Flooring

SubPrimo is the latest acoustic solution from sound insulation specialists Sound Reduction Systems Ltd. Specifically designed to be installed beneath timber and laminate flooring, SubPrimo targets the widespread problem of sound transmission between flats and apartments where timber floor finishes are installed.

The current trend of replacing carpet and underlay with timber flooring can cause serious problems for downstairs neighbours, and many leases prohibit the installation of such floors without taking acoustic insulation into account. SubPrimo floor has performed particularly well in recent acoustic tests, and is one of the most effective methods of insulating a timber floor against impact and airborne sound transmission.

The biggest problem associated with timber floor finishes is the transmission of impact sound. Many people will replace a carpet with a laminate without realising the effect it will have on the people below. Carpets are a soft floor covering, and will naturally help cushion physical impacts on the floor such as footsteps, moving furniture and dropped objects. A laminate floor, on the other hand, will offer no resilience between the source of the impact and the floor, allowing the vibration to enter the structure, and increasing the impact noise experienced below.

One of the benefits of SubPrimo is the ease and speed with which it can be installed. The material is simply loose laid onto the existing structural floor in a brick pattern. The product can be easily cut and shaped using a standard trimming knife. The timber floor finish is then installed directly onto the SubPrimo, as with

conventional underlays.

Technical Director Julian Donnelly MIOA, said that SubPrimo was a welcome addition to the product range. The increasing amount of timber floors being installed within multi-occupancy dwellings and the volume of related complaints demonstrated the need for a quality product. In SubPrimo he believed that SRS had delivered an economical yet high performance solution for this growing problem.

SubPrimo floor is also part of the 'Total Party Floor Solution', a system designed by Sound Reduction Systems to be fully compliant with the performance requirements of Approved Document E of the 2000 Building Regulations.

The system has been developed taking into consideration clients' preferences for timber floor finishes, and also their privacy requirements, whilst affording specifiers peace of mind and flexibility.

The Total Party Floor Solution consists of a Maxi 60 ceiling system installed below the floor joists and SubPrimo underlay on the floorboards above. The Maxi 60 ceiling system combines high levels of acoustic insulation with a one-hour fire rating. The SubPrimo complements the ceiling by providing additional impact and airborne sound insulation. The system has been tested in the field and gave the following results.



Construction: 8mm laminate floor on 6mm SubPrimo underlay on 18mm chipboard deck, 225mm x 50mm timber joists at 450mm centres, with 100mm mineral wool infill density 45kgm⁻³. Maxi 60 ceiling system consisting of 17mm Maxiboard and 12.5mm Fireline plasterboard fixed to 30mm deep Maxi resilient bars at 300mm centres.

SubPrimo is an effective solution for both the domestic user and the specifier, providing high levels of sound insulation whilst maintaining scope for the use of decorative timber floor finishes.

For more information:

Sound Reduction Systems Ltd

Tel: 01204 380074 Fax: 01204 380957

E-mail: info@soundreduction.co.uk

Web site: www.soundreduction.co.uk

	Airborne sound test		Impact sound test
	$D_{nT,w}$ (dB)	$D_{nT,w} + C_{tr}$ (dB)	$L'_{nT,w}$ (dB)
Total party floor solution	60	54	49

Casella CEL

Creates noise measurement kits for all work occasions

Casella CEL, the UK manufacturer of occupational health, safety and environmental monitoring equipment, has created a combination of easy-to-use noise monitoring kits so that employers can perform comprehensive surveys no matter what the working patterns of employees.

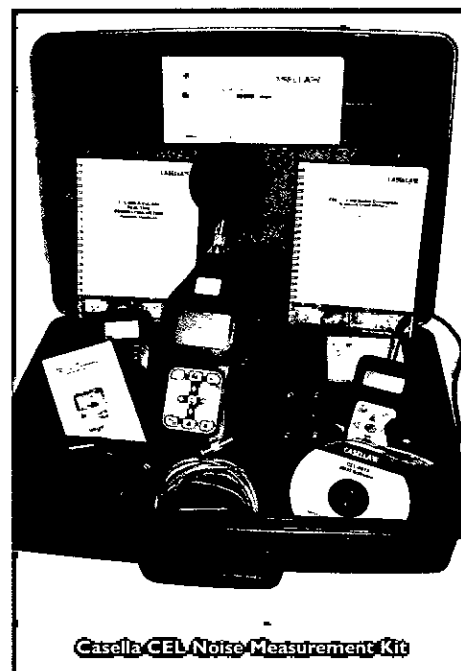
The new kits will further help employers meet the Control of Noise at Work Regulations, which have been in force in EU member states since April 2006.

The noise monitoring kits are designed to meet the needs of the modern workplace. For employees who are highly mobile, such as fork-lift truck drivers, noise dosimeters worn on the body of the employee can be used. For employees who work at fixed locations, sound level meters to take measurements at the ear,

pointing the instrument at the noise source, are most appropriate. Casella CEL noise monitoring kits include both instruments housed in a rugged case. An acoustic calibrator and a comprehensive software package to download data from the instruments via USB are also included.

A range of different kits is available, including intrinsically safe (IS) instruments for noise monitoring in potentially explosive atmospheres. The brand new CEL350 dBadge personal noise dosimeter can now form part of a monitoring kit.

For more information
Casella CEL
Tel: 01234 844100
E-mail: info@casellacel.com
Web site: www.casellacel.com



Marathon Belting Ltd.

ColourMesh

Woven wire meshes or 'metallic fabrics' have been widely used by architects and interior designers for wall coverings and screening for very many years. Fine examples of these intricate designs, almost exclusively in stainless steel, can be seen in many important buildings throughout the world.

Marathon Belting Ltd has significantly widened the concept of metallic weaving by introducing an innovative range of woven, semi-metallic meshes that can be used in internal or external applications.

Their new product, known as ColourMesh, is a radically new architectural material, encompassing the use of stainless steel in the warp (lengthways direction) with distinctive coloured silicone in the weft (crossways direction). The silicone can be positioned in stripes of varying widths using up to four colours per design at a maximum weaving width of 3m. The stainless steel warp can be substituted by brass wire if thought to be more aesthetically appropriate for a particular application.

The product has undergone extensive sound absorption testing and has proven to be acoustically transparent. This, coupled with its BS476: Parts 6 & 7, Class 0 fire rating, presents very interesting possibilities for a tough durable covering for panels of sound absorbing materials.

The natural physical resilience of ColourMesh, in comparison with existing acoustically transparent fabrics, makes it ideally suited for the exposed areas of studios and auditoria.

Availability of the whole spectrum of colour,

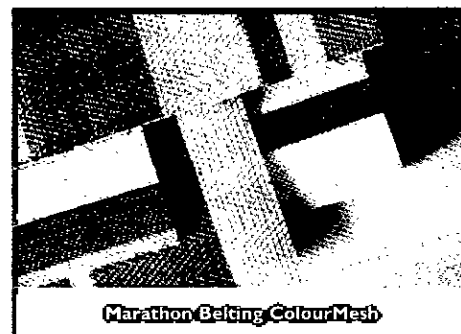
including silver and gold, allows bespoke weaving of specific corporate colours for wall claddings, in-store displays, exhibition stands, tensioned structures, facades, balustrades, canopies, solar screens and many other applications.

Night-time enhancement by up-lighting or down-lighting presents new possibilities for exciting colour/stainless steel combinations to whet the appetites of architects and interior designers. Encapsulation of ColourMesh within glass panels makes a very interesting material for screening or covering of all types of surfaces. The silicone polymer used in the weft is widely used for cable sheathing in areas requiring increased levels of public safety from the point of view of fire resistance and low smoke emissions.

The product is tough, durable, and easy to maintain. Silicone has the following excellent properties for outside use:

- High and low temperature stability
- Low temperature flexibility
- High chemical resistance
- High moisture resistance
- High abrasion resistance
- High UV and weathering resistance
- Oxidation virtually nonexistent
- Ozone resistance excellent
- Mildew and fungus resistance excellent

Short quantity production runs of niche technical textiles are a speciality of our company in all our product areas. ColourMesh is very easy to customise to specific designer requirements, as long as the



standard stainless steel warp is utilised with any combination of weft colours. In addition to our modern rapier weaving looms, we have our own 'in-house' extrusion facility for production of the weft. This assures total versatility, prompt delivery, and competitive tendering.

The following basic specification of ColourMesh provides a guide to what we can offer so that thought can be given to uses of the product in specific projects.

- Standard manufacturing length: 300 metres
- Minimum manufacturing length: 30 metres
- Maximum width: 3.0 metres
- Minimum woven width: 1.5 metres
- Minimum cut width: 0.5metres
- Thickness: typically 2.0 mm
- Weave style: herringbone twill, plain weave, or sateen
- Weight: typically 3kgm²

The product has been tested by AIRO and is acoustically transparent. It also has a class 0 fire rating. The manufacturers expect it to be very useful for covering acoustic walls or panels where abrasion resistance is needed.

Marathon Belting Ltd Tel: 01706 657052

AICO

Issue Free New FAQ Booklet

Fire safety specialist Aico Ltd has just issued a useful Frequently Asked Questions (FAQ) booklet covering their extensive Firecap range of fire and sound protection covers, fire protection sleeves for electrical services and vapour and thermal seals for loft voids.

The free FAQ guide is aimed at general electrical installers, lighting installers and those in a position of responsibility for domestic or commercial safety.

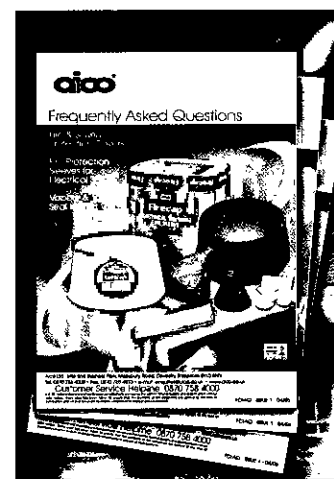
The Aico products featured in the FAQ guide are intended to restore the fire, acoustic and heat loss integrity of ceilings, walls or floors after they have been cut into for the purposes of installing lighting or running cables, conduits, pipes and ducts.

The section on Firecap fire protection covers explains the need to restore a ceiling's fire rating after installing recessed lighting. It looks

in detail at the legislation that requires this to be done, choosing products in compliance with standards and installation methods amongst other issues. There is also separate information on fluorescent module protection and a guide to how Firecap Fire Protection covers can also provide acoustic protection, and reduce heat loss.

There is also detailed information on the use of fire protection sleeves where any hole is made through a fire barrier such as walls, ceilings or floors to run cables, pipes or ventilation ducts. Again, there is a handy guide on to how to comply with the present standards and how to select the right product that complies with the relevant standards, as well as installation information.

Finally, the booklet looks at Aico's Loftcap vapour and thermal seals for loft voids. Primarily intended to prevent a break in the vapour seal and to stop heat loss through gaps in insulation caused by installing recessed lighting in the ceiling, Loftcaps have been recently proven to restore a ceiling's fire integrity. The FAQ explains the regulations involved and how Loftcap can help to



All you need to know about Aico products

meet them.

For a free copy of the new Aico FAQ Guide, telephone 0870 758 4000.

Bay Systems

Radio Link for microphones and accelerometers from 1 to 24 channels

Two or four cables can be tidy but when numbers reach eight or more they invariably become a tangled mess. A radio link between the transducers and the recording system can solve this problem. A radio link will replace a long cable run and eliminate the risk of injury caused by tripping.

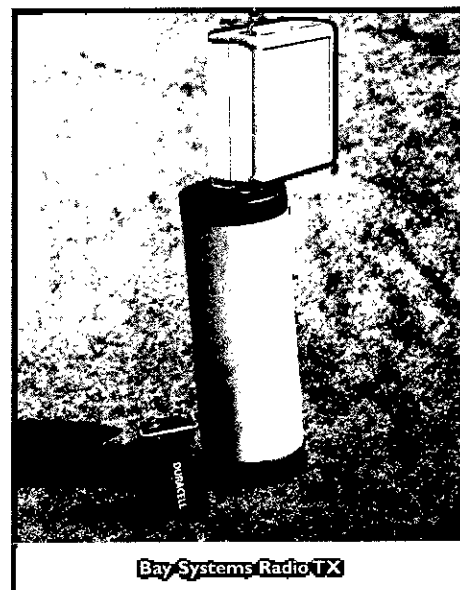
The system is optionally supplied configured as a fully integrated microphone and radio transmitter that can be placed almost anywhere and left to transmit whatever comes within range. Clearly the performance will be slightly compromised by the closeness of the microphone to its enclosure. However as the enclosure is only 65 x 65 x 25 mm in size and weighs 110g it is somewhat less intrusive than a hand, and far less disturbing than the human body that is normally holding the sound level meter!

The integrated microphone can be replaced using a standard microphone and cable; a particularly interesting option when recording a mobile subject such as a driver. The transmitter can be more than 100 metres from the receiver using the standard antenna.

If the high gain receiving antenna is used then the range becomes 600-plus metres. Where small size and lightness are not required then the system is offered in a range of IP65 aluminium enclosures.

A radio transmission licence is not needed for the device in the UK. It transmits by phase modulation and is available with four non-interfering channels, which will be increased to 24 by the end of the year.

Applications where the device might come into its own, says the company, include environmental and concert noise level monitoring, where widely distributed microphones could be placed without miles of cable. In building sound transmission testing, the sound pressure levels could be measured simultaneously on both sides of a wall without running cables through doors or windows. Vehicle pass-by noise tests could be completed by a single operative (the driver): trackside microphones could be linked by radio to the acquisition system in the vehicle itself. Sound power level determinations on large machines such as excavators, where



Bay Systems Radio TX

measurements are made on a 30metre hemisphere, could become more manageable. Tyre noise could be measured actually inside the tyre, and correlated with radiated noise.

For more information:

Alan Bennetts, Bay Systems

Tel: 01458 860393 Mob: 07836 230475

Fax: 01458 860 693

E-mail: sales@baysystems.ltd.uk

notified body : laboratory : site : building acoustics : dedicated pre-completion testing team



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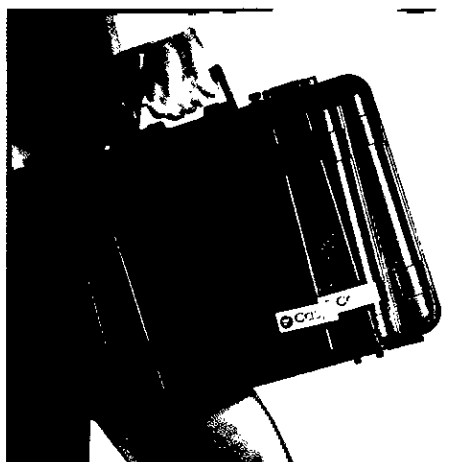


Castle Group

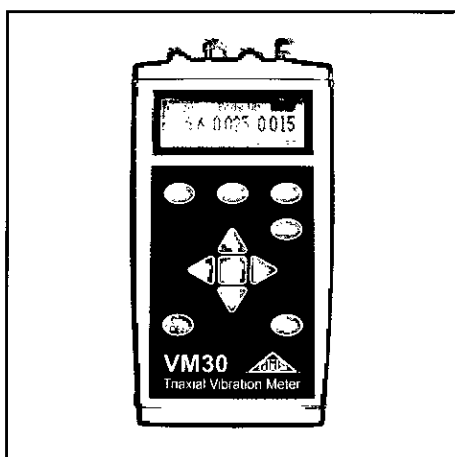
Instrument Rental

A new Instrumentation Rental brochure has been launched by noise and vibration specialists, Castle Group Ltd. The Castle Rent service offers a wide choice of instrumentation, available at a moment's notice to anyone who has a need for monitoring noise or vibration in industry or the environment. Conducting noise or vibration measurements in the workplace or in the environment can mean dealing with a lot of equipment issues such as capital outlay, storage and care, maintenance and calibration and never having just the right features and functions you need for the current job. Castle Rent provides calibrated equipment for short or long term rentals to cover occasional work, immediate requirements, specific contracts or specialist jobs with delivery almost always the next day. Another reason for renting equipment like this can be for tax benefits as rental can be written off entirely against profits as opposed to capital purchases that are subject to depreciation rules. Renting is also a great way to 'try before you buy' and Castle will even give a 50% refund to customers who then go on to purchase the equipment. Rental periods start at three days, and the longer the term, the better the price. Special contract rates are available for rentals of more than a month. Return carriage and accidental damage waiver are also available, taking the onus off the user having to make special arrangements.

For more information: Nicole Allen, Bull Marketing and PR
Tel: 01753 858063 Fax: 01753 857164
E-mail: na@bulluk.com



Instrumentation at a moment's notice



Metra VM30 Triaxial Vibration Meter

Human Vibration Meter

Campbell Associates

Campbell Associates is pleased to announce the launch of the new VM30-H Human Vibration Meter to meet the requirements of the 2005 Control of Vibration at Work Regulations.

Excessive exposure of vibration causes adverse medical conditions to the human body which are well documented. It is therefore essential as part of employers' health and hygiene programmes that 'at risk' personnel are monitored.

The new VM30 HVM provides a simple system for measuring and quantifying the risks. It is supplied as a complete kit with mounting accessories for both hand arm vibration measurements to ISO 5349 and/or whole body vibration to ISO 2631.

The VM30 is simple to operate and provides values for three axes of vibration simultaneously (x, y and z), and displays in real time the weighted single value answers required for assessing exposure. The system is available for sale or hire.

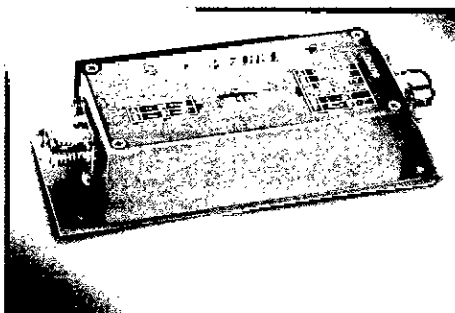
For more information: Campbell Associates,
Tel: 01371 871033 Fax: 0371 879106
E-mail: info@campbell-associates.co.uk
Web site: www.campbell-associates.co.uk

PCB accelerometers and force sensors

PCB® Piezotronics Inc.

The Vibration Division of PCB® Piezotronics Inc. has introduced series 495B10 differential remote charge converters, for use with differential charge output piezoelectric accelerometers. Differential sensors and signal conditioning electronics are widely used in flight test applications owing to their common mode noise rejection, which greatly reduces noise in the measurement signal. These rugged, low noise units not only convert a transducer's differential high impedance charge input signal to a low impedance voltage output and supply the normal acceleration output, but also supply a separate integrated output for velocity.

Series 495B10 charge converters operate from 10v to 32v DC power, over a temperature range of -25°C to 85°C, and are packaged in a lightweight aluminium housing. They are available in charge sensitivities of either 2 mV/pC or 10 mV/pC. The user can specify a low frequency roll off of 10, 15,

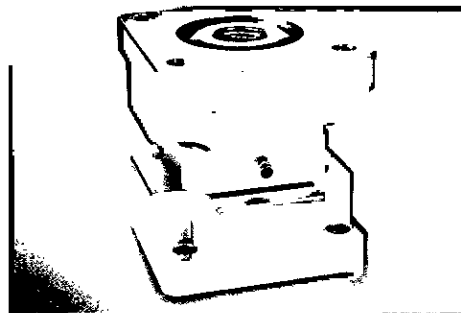


PCB 495B10

20 or 25 Hz.

The 261A series triaxial force link sensors from the Force/Torque Division of PCB Piezotronics simultaneously measure dynamic and quasi-static forces in three orthogonal directions. The sensors are used during vibration testing of aerospace structures to match the mechanical impedance of shaker inputs and may be used to force limit the shaker controller to prevent damage to expensive structures. Other applications include cutting tool monitoring, biomechanics feedback, and automobile chassis dynamics.

Series 261A units come preloaded between two plates, with a four-screw mounting pattern to allow easy installation and feature full-scale measuring ranges from 2.2 to 18 kN) in the x and y directions,



PCB 261A03

and from 4.5 to 45 kN in the z direction. Single axis models are also available.

For additional information, contact the Vibration Division or the Force/Torque Division of PCB Piezotronics (as appropriate) or web site www.pcb.com

Vibration

Tel: +001 716 684 0001
Fax: +001 716 685 3886
E-mail: vibration@pcb.com

Force/Torque

Tel: +001 716 684 0001
Fax: +001 716 684 8877
E-mail: force@pcb.com

ATKINS

Atkins plans, designs and enables the delivery of complex infrastructure and projects for clients in the public and private sectors across the world. It is the largest multi-disciplinary consultancy in Europe; the largest engineering consultancy in the UK; and the fourth largest design firm in the world.

The Acoustics, Noise and Vibration business is part of the Water and Environment Division comprising more than 1300 staff. Following significant growth in the UK and Dubai we are seeking to recruit the following:

Business Manager (Epsom) – to £50k + benefits + bonus (DE1459)

A business manager is required to manage our Acoustics, Noise and Vibration business operating out of the group's corporate headquarters in Epsom. The successful candidate will have P&L responsibility for the Epsom Division and will have proven line management and leadership skills as well as business development experience. They will have corporate membership of the Institute of Acoustics with a strong background in environmental acoustics. This is an excellent opportunity to direct the future growth of this well established business.

Principal/Senior Consultant (Warrington) – to £42k+ benefits (DE1737)

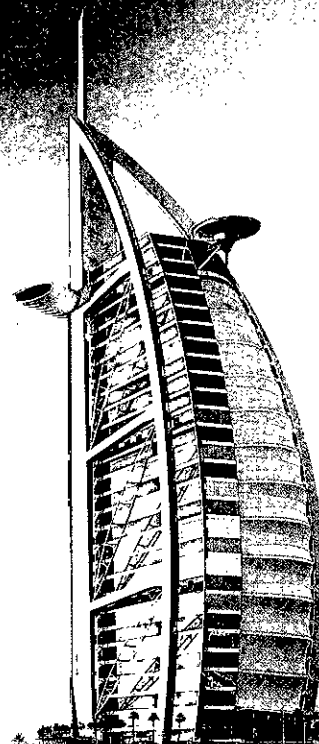
A principal/senior consultant is required to manage a small team of acoustic consultants based in our Warrington office. The successful candidate will be able to demonstrate a proven track record in line management as well the ability to manage and deliver complex projects. They will have corporate membership of the Institute of Acoustics with 8+ years post-graduate experience.

Acoustic/Senior Consultants £22k to £35k+ benefits (DE1738)

As part of our continuing growth we are seeking consultants with experience in building and environmental acoustics for our offices in Birmingham, Epsom and Bristol. Acoustic consultants with 3+ years post-graduate experience are sought and seniors with 8+ years.

If you would like further information about these positions or a confidential chat, please contact Graham Haines on 0121 488 5522

Apply online at www.atkinsglobal.com/careers



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

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Applications for Sponsor Membership of the Institute should be sent to the St Albans office.

Details of the benefits will be provided on request.

Committee Meetings 2006

DAY	DATE	TIME	MEETING
Thursday	6 July	10.30	Engineering Division (St Albans)
Tuesday	11 July	10.30	ASBA Examiners (St Albans)
Tuesday	11 July	1.30	ASBA Committee (St Albans)
Tuesday	8 August	10.30	Diploma Moderators Meeting (St Albans)
Thursday	7 September	10.30	Membership (St Albans)
Thursday	14 September	11.00	Medals & Awards (St Albans)
Thursday	14 September	1.30	Executive (St Albans)
Thursday	28 September	11.30	Council (St Albans)
Thursday	5 October	10.30	Diploma Tutors and Examiners (St Albans)
Thursday	5 October	1.30	Education (St Albans)
Thursday	12 October	10.30	Engineering Division (St Albans)
Thursday	19 October	10.30	Publications (St Albans)
Thursday	2 November	11.00	Research Co-ordination (London)
Tuesday	7 November	10.30	CCENM Examiners (St Albans)
Tuesday	7 November	1.30	CCENM Committee (St Albans)
Thursday	9 November	10.30	Membership (St Albans)
Tuesday	14 November	10.30	ASBA Examiners (St Albans)
Tuesday	14 November	1.30	ASBA Committee (St Albans)
Thursday	16 November	10.30	Meetings
Thursday	23 November	11.00	Executive (St Albans)
Tuesday	5 December	10.30	CMOHAV Examiners (St Albans)
Tuesday	5 December	1.30	CMOHAV Committee (St Albans)
Thursday	7 December	11.30	Council (St Albans)
Tuesday	12 December	10.30	CCWPNA Examiners (St Albans)
Tuesday	12 December	1.30	CCWPNA Committee (St Albans)

Light 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.

Conferences & Meetings

Diary 2006

11-12 September 2006

Underwater Acoustics Group

International Conference on Synthetic Aperture Sonar and Synthetic Aperture Radar - Lerici, Italy

26 September

Electroacoustics and Measurement & Instrumentation Groups

Intelligible Measurements! How accurate are speech intelligibility measurements in practice? - London

16-17 October 2006

Environmental Noise Group

Autumn Conference - Oxford

3-4 November 2006

Electroacoustics Group

Reproduced Sound 22 - Raising the Standard - Oxford

10-12 April 2007

Underwater Acoustics Group

4th International Conference on Bio Acoustics - Loughborough

Further details can be obtained from

Linda Canty at the Institute of Acoustics Tel.: **01727 848195**

or on the IOA website: **www.ioa.org.uk**

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Gracey & Associates Noise and Vibration Instrument Hire



Gracey & Associates specialize in the hire of sound and vibration instruments

The biggest UK supplier of Brüel & Kjær, CEL, DI, GRAS, Norsonic, TEAC, Vibrock and others, many new instruments added this year

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Full details on our web site – www.gracey.com

Gracey & Associates - 01933 624212
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Campbell Associates Ltd

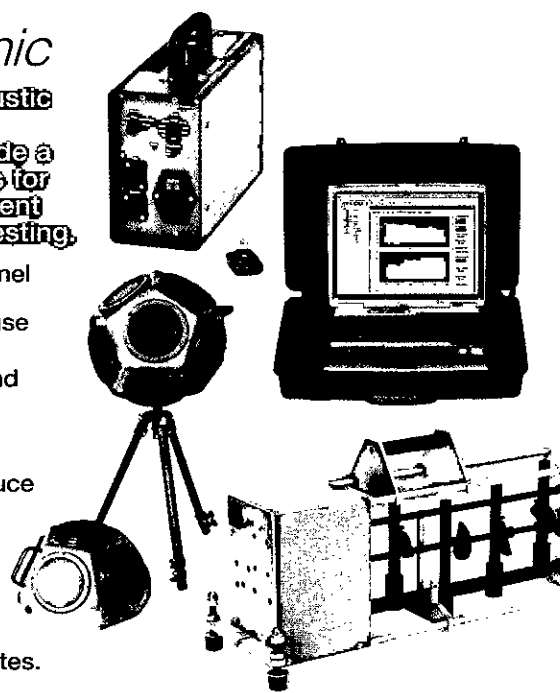
SOUND & VIBRATION SOLUTIONS
FOR SALE AND HIRE

Complete measurement solutions for building acoustics



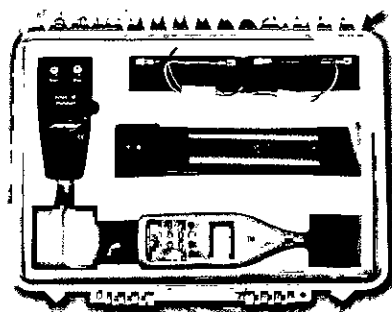
Norsonic
- the Building Acoustic
Instrumentation
Specialists - provide a
choice of solutions for
accurate and efficient
sound insulation testing.

- ⊙ Single and twin channel cable free systems, which are simple to use and robust in design.
- ⊙ New lightweight sound sources with built-in noise generation.
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- ⊙ Drag and drop data to the NorBuild software to instantly produce test certificates.



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A comprehensive range of easy to use instruments for sale and hire



The Nuisance Recorder

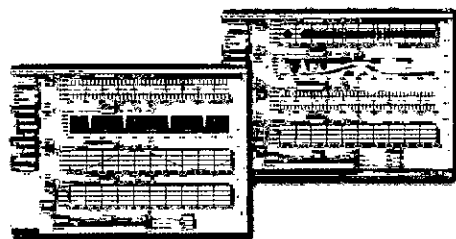
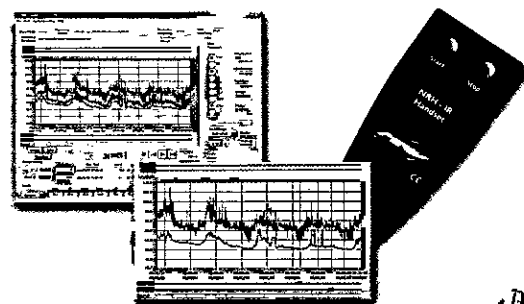
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Software displays synchronised audio and data

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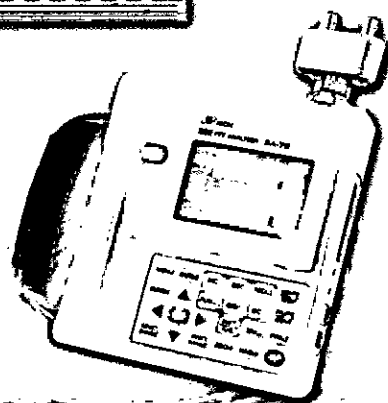


RION SA-78

Dual Channel Sound & Vibration Analyser

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Correlation & Transfer Function Analysis



Downloading
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RION NL Series

Integrating Sound Level Meters

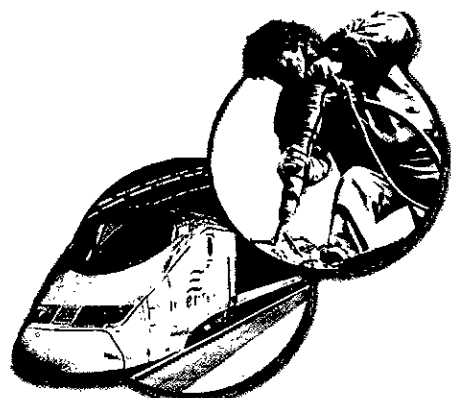
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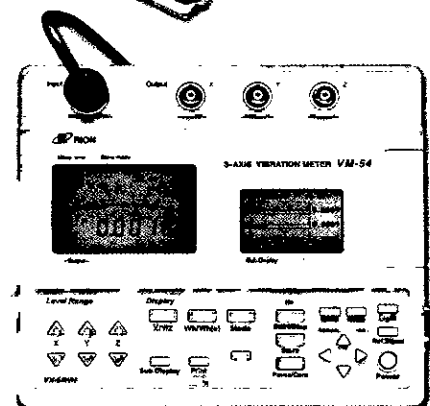
Easy to use Tri-Axial Vibration Meter for Occupational and Environmental Vibration

VX-54 WH Hand-Arm Vibration Program Card

VX-54 WB Whole-Body Vibration Program Card

Complies with Vibration at Work Regulations 2005

Complies with BS 6472 and ISO 2631: Parts 1, 2 & 4



Excellent Quality ■ Exceptional Value ■ Knowledgeable & Friendly Service

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