Vol 33 No 2 MARCH/APRIL 2008

ACOUSTICS BULLETIN

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plus... **The Institute Diploma Examination 2007**

Pioneers of acoustics: Henry Engelhard Steinway (1797-1871)

Consulting in occupational health and safety - Getting it right

The rise of reverberation

Institute of Acoustics

ACOUSTICS BULLETIN

Vol 33 No 2 March/April 2008

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Designed and printed by:
Point One (UK) Ltd., Stonehills House, Stonehills, Welwyn Garden City, Herts, AL8 6NH
e-mail: talk2us@point-one.co.uk
web site: www.point-one.co.uk

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Annual subscription (6 issues) £126.00
Single copy £20.00

Contents

Front cover photograph: For the evening of Friday 30 November at RS23, the organising committee arranged for a talk entitled *A new approach to sound system design for small-scale touring bands* by Kenneth Jacob (Bose), which was interspersed with, and enhanced by, live musical entertainment from the Dutch Jazz Band.

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Brüel & Kjær

Dear Members

This year has already seen two of our groups hold important one day meetings. The first of these was organised by the Speech and Hearing Group and took as its theme ***Speech and Hearing in Learning Environments.*** *I am delighted to see that this group has become active again after being dormant for many years. Speech and hearing are at the very heart of so much of our work and I am grateful to all of those who have worked so hard to revive the group. Delegates enjoyed an unplanned practical demonstration of the art of listening when the venue's projector broke during one presentation and many felt that this actually added value to the meeting – perhaps we should occasionally learn to do without the ever-present PowerPoint.*

Last year's Spring Conference tackled the increasingly crucial issue of sustainability in the built environment. As designers we are used to working in a multi-disciplinary environment, but it was obvious that for sustainable development to become a reality, even closer co-operation is needed. We resolved to develop relations with other institutes working in this area and the joint meeting between the Building Acoustics Group and RIBA held in February was the first fruit of the hard work put in by Richard Cowell and the BAG committee. The meeting brought together acousticians and architects to explore the ways in which a good soundscape can positively contribute to creating better buildings.

The steady growth in the membership of the Institute over many years has continued to allow us to widen the range and quality of meetings; however, we have recently discovered that it may bring an unexpected problem. We expect to pass the 3000 barrier later this year, but those who set up the Institute wrote into the Articles of Association that membership should be limited to this number. It is unclear why this clause is included, but perhaps it seemed an unattainable level of membership when the Institute started with a few hundred members. To pre-empt the problem I shall be asking the AGM to remove this limit on numbers.

Colin English

PRESIDENT

Sound engineering advice

...helps students box clever

Introducing young people to the world of acoustical engineering is the aim of engineers from the Institute of Acoustics (IOA) who believe that not enough is known about this exciting career prospect.

With this in mind, on 16 January 2008 as part of an engineering day, Acoustics Ambassadors from local companies joined forces with Setpoint Hertfordshire in engaging Year 9 students at Knights Templar School in Baldock. The aim of the session was to raise awareness of the nature of engineering, and in particular acoustics, by investigating aspects of sound transmission and insulation through a fun project.

Pupils were asked to find the best materials to soundproof a model room. Students were grouped in fours and told they were members of a fictitious band who would be allowed to practice in a bedroom as long as the noise did not disturb the neighbours or the parents! A metal box represented the bedroom and the materials provided included panels of wood, metal and foam. The 'model band' included a fan on a plate masquerading as a drum kit and an MP3 player representing a bass guitar.

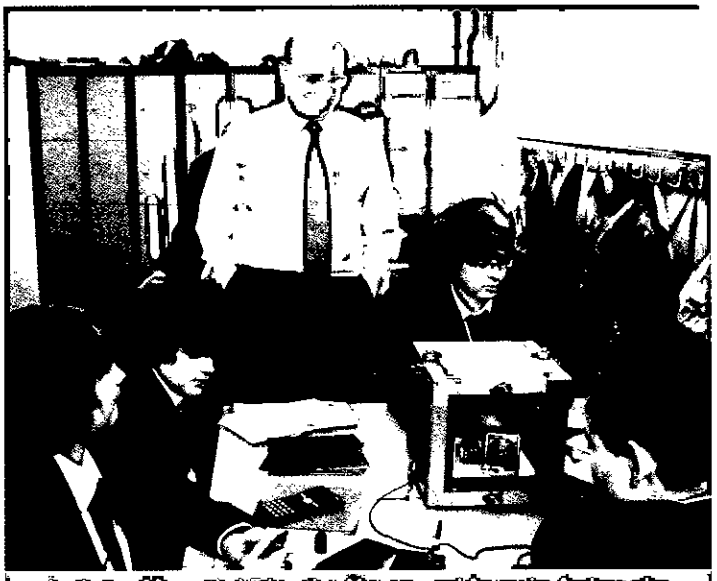
With a fictitious grant from the IOA up for grabs, students competed enthusiastically to find the best way to reduce the sound emitting from their test rigs. The results were then tested using a sound level meter to determine the levels of sound coming from the box and to decide on a winner.

Form Teacher Glenn Christodoulou, present throughout the activity, said that it was a new experience for the students as it gave them a chance to explore an area - acoustics - that they wouldn't normally get the chance to know about. By doing the activity they had a better grasp of sound insulation and understood why they were doing the exercise. It was also a good exercise in developing problem solving, team building and communication skills.

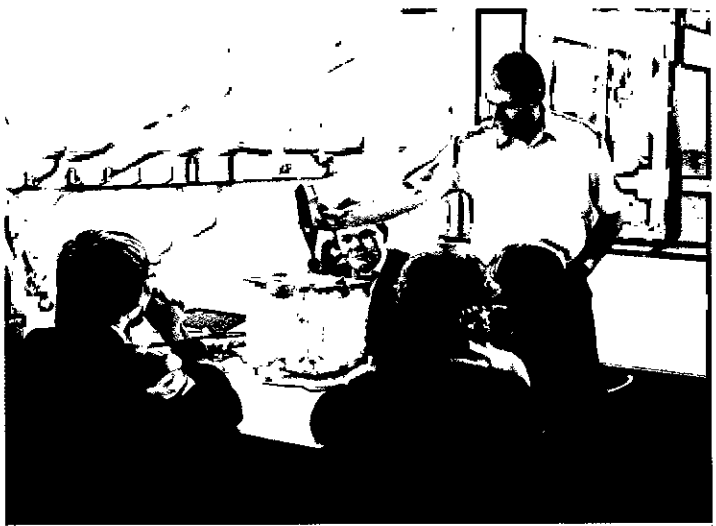
Richard Collman from Acoustical Control Engineers, who was instrumental in designing the project said that science, engineering and specifically acoustics could be fun as well as being a good career option. This project introduced several important acoustic concepts such as insulation, absorption and vibration as well as more general ideas such as testing a prototype, evaluating it and refining the design. These get the students involved in a science-based activity which is fun.

One of the main aims of the IOA is to promote acoustics to young people and raise awareness of this important sector of industry. There is a great demand for acoustical engineers at the moment and we are grateful to Setpoint Hertfordshire which has helped to create Acoustics Ambassadors to spread this message under the science, engineering and technology ambassador scheme. Acoustics Ambassadors present were Richard Collman (Acoustical Control Engineers), Paul Goring (NHBC Acoustic Services), Ric George (AIRO Ltd), and Keith Attenborough, Education Manager for the Institute of Acoustics.

The Ambassadors (l to r) Paul Goring, Richard Collman, Ric George, Keith Attenborough, Kevin Matcham-Lind



Institute of Acoustics' Education Manager and Acoustics Ambassador Prof Keith Attenborough helps out



Richard Collman tests the efficacy of one group's efforts

Electronic newsletter

Several members are still not receiving the bimonthly electronic newsletter, which is prepared with considerable care and dedication by Judy Edrich to fit 'in between' issues of Acoustics Bulletin. We know there is a problem because the newsletter 'bounces back' from some email addresses. The latest e-newsletter was mailed out on 19 February. If you did not receive it, please contact Judy Edrich at judy.edrich@ioa.org.uk so that a copy can be sent to a working email address.

Meeting Report: London Branch

0_2 Arena and acoustic design

The London Branch raised its curtains this year with a very interesting subject, the acoustic design of the 0_2 Arena. The meeting was particularly well attended.

The topic was presented by Mark Murphy of Vanguardia Consulting. Mark is an acoustic engineer with several years of experience in the design of acoustics and electroacoustics for sport arenas. A project of that scale requires a great knowledge of acoustics in all areas such as sound insulation and PA/VA systems design. It is such knowledge that Mark has in abundance and thus in a relatively short period of time he was able to illustrate and describe all the major acoustic considerations that were involved in this project.

The Millennium Dome initially opened back in 1999 and was later redeveloped and renamed as the 0_2 Arena. It has since become the most popular venue in the world today, according to Pollstar, with a maximum capacity of 23000. The first band to play at the reopened O2 Arena was Bon Jovi, on 24 June 2007. Since then many more musical acts have followed suit ensuring numerous plaudits for the arena's design.

The main concept was to accommodate all types of bands and be able to operate normally by providing reasonable sound perception throughout the venue. During the design process extended meetings and discussions took place with the client and the architects. The American client, AEG, with its experience in sport venue architecture, was keen to accept all design decisions that would contribute to improving the arena's overall acoustic aspect.

Conducting extensive research of various arenas and opera houses was of paramount importance prior to the design stage. The Staples Centre in Los Angeles and the Nashville Arena in Tennessee were two venues which were studied in great detail. However, these studies prompted a variety of questions and sometimes meant that methodologies were considered that superseded Beranek's ideas.

Some questions arising from these studies were: should the use of classic theories and principles be adapted in order to design the arena? What shape should the arena be in order to give the best outcome? Should the arena be oval or circular? Will Sabine's theory be effective on such a large-scale space? Other theories, from Cremer and Muller, and Eyring, along with Sabine, were compared. After extensive examination it was decided that Eyring's theory produced the most favourable results in regards to the design of the arena.

The design target for the reverberation time within the arena with amplified music was 1.9 seconds. This was similar to that of the Amsterdam Concertgebouw concert hall. It was important to understand how a specific type of source would affect the overall distribution of sound energy within the arena. Sabine's diffuse field theory tends to indicate against loudspeakers of the liner ray type because of the way they disperse sound into the space.

Mark then proceeded to explain the importance of creating computer aided acoustic models. Software packages used included CATT acoustics for the internal acoustic of the arena, EASE for the electroacoustic design, and RAYNOISE for all noise level break-out calculations. During the modelling process, especially that of the arena's internal acoustics, questions were raised as to whether a single figure descriptor was adequate to describe the acoustic quality of the space. It was also questionable whether the field was adequate in relation to diffusion.

During the modelling stage, individual areas were divided into smaller elements, and these were investigated in order to determine where absorption should be applied. Architects needed to know exactly why the majority of the spaces had to be covered with absorptive materials: absorption was also applied to the undersides and backs of the seats. The interaction of musicians on stage was also considered, and this led to the introduction of local absorbers around the stage area.

Because of its location near a densely populated area, the sound insulation of the arena was of great importance. A roof on main beams expanding up to 142 metres was expected to contribute greatly to the containment of the sound. This resulted in a composite roof with an Rw value of 52dB, pushing the weight of the roof up to 62kgm^{-2}. The roof also contributed greatly to the overall sound absorption within the arena, as its underside was a perforated liner tray.

The use of pre-cast stepping can greatly compromise any sound insulation if it is not designed carefully. In the 0_2 Arena sealant was used to block 25mm gaps between the steps. As a result the overall sound insulation performance of the pre-cast stepping was increased from 18dB to 54dB, following tests conducted by SRL.

Acoustic testing was required upon the arena's completion to establish and test all the predictions made during the design stage. Sound power levels of 116dB had to be produced in a field as diffuse as possible, meaning that a conventional dodecahedron loudspeaker array was unsuitable. A V-dosc sound system was therefore hired and installed in-house for the test measurements. In order to gain a good spatial idea of the sound within the arena, about 100 individual measurements were taken. The sound insulation of the arena was also tested, by taking measurements at various locations outside and around the arena, witnessed by the local authority. A concern which arose during the tests was whether or not BS.3382 was the most appropriate test methodology for the efficient testing of spaces of this scale.

Electroacoustic design was also of equal importance when it came to the acoustic design of the O_2 Arena. For example a great deal of consideration was given in the beginning as to what type of sound source should be used, whether a point source, a liner array or distribution system. A liner array was finally selected, with a central cluster for the middle tiers and sub-bass units at roof level. At a later stage delay circuits were installed for the upper tiers, and a digital distribution system was also provided for efficient control of the network.

Mark concluded by commenting on the envelope's design and its sound insulation, which was proved adequate by the test programme. He mentioned that the test results were very similar to, but generally slightly better than, the predictions. The average mid-frequency reverberation time varies between 2 and 2.5 seconds throughout the arena.

The presentation ended with a two-minute video clip of the 0_2 Arena's opening day, followed by an interesting question-and-answer session.

Meeting Report: London Branch

Nicola Stedman.

This year the London Branch annual dinner was held on Wednesday 21 November 2007 at the Bleeding Heart, which has been described as 'arguably the finest French restaurant in London'. A private function room had been booked for the sole use of the IOA, where guests were able to enjoy good food, good wine and good company. The dinner was very well attended with the London Branch being privileged to have Joe O'Herlihy as the after-dinner speaker. Joe is one of the world's leading sound engineers having been the sound director of the band U2 for over 20 years. He has also worked for other leading bands and artists such as REM, Counting Crows and Rory Gallagher. Joe gave guests an insight of life as a sound engineer, describing how he came to join U2, with a few stories of his early years with the band and his travels all over the world.

The London Branch would like to extent their thanks to Joe for taking time from his busy schedule to join us for the evening.

Meeting Report: London Branch

Roll over RaSTI – Santa has some new toys

Peter Mapp delivered a fascinating introduction to speech intelligibility at the December meeting of the London Branch. In this, he discussed the particular challenges encountered when trying to design systems to achieve adequate speech intelligibility for all occupants in a space.

The presentation, which was attended by over 30 people, began with a summary of the principles of speech intelligibility and how the individual properties of speech modulation were historically measured, such as the use of gas flames and phonograph membrane traces. It soon became evident, however, that the properties varied considerably between orators, whether male or female, young or old, regional dialect or RP, and depended on the individual words themselves, which in turn affected the perceived level of speech intelligibility.

The intelligibility achieved throughout a space was then shown to be further affected by a number of factors, such as the directivity of electronic speakers, their distribution, the bandwidth and frequency response, and the reflection paths and reverberation time in the space itself. The point was made that whilst there was a fair correlation between the speech intelligibility and the reverberation time in a space, there were also some more specific parameters that needed considering when designing loudspeaker systems.

A factor identified as being particularly critical to achieving a good level of speech intelligibility was the ratio between the direct field (direct and early decay) and reverberant field (late and reverberant reflections). A very useful demonstration was conducted which showed how the intelligibility of a signal deteriorated once the primary reflections returned 60ms or more after the initial signal, and that a delay of 250ms was perceived as a distinct echo, detracting from the direct sound.

The discussion then progressed onto the problems associated with the other side of the system, the differences between listeners. Hearing loss, for example, could be an important factor. A query was raised as to how the correlation could be determined between the measured frequency response of a system and what was actually heard.

After further discussion, the presentation closed with a look at the current Speech Transmission Index range, which ranges from zero (unintelligible) to 1 (perfectly intelligible), with various subjective descriptor bands between. A suggestion was made as to how this could be improved by adopting narrower bands and by adopting a quality rating system (similar to that for showing the efficiency of household items) for the particular application in question. Unfortunately it was at this point that time ran out, but Peter has kindly offered to come back and expand further on his talk - so watch this space!

Citation

Awarded to James Dunn for Distinguished Services to the Institute

James, or Jay as he prefers to be called, graduated from Birmingham University's Department of Electrical Engineering in 1956. He first joined STC radio division as a graduate apprentice working on coaxial line filters and high power VHF broadcast transmitters. He was recruited to return to Birmingham as the development engineer for a 30 channel, 500 kHz within-pulse, sector-scanning sonar system. This was used extensively over many years within Scottish lochs and at sea for fish-finding purposes. At Birmingham he completed his MSc by research in the Underwater Department under the direction of Gordon Tucker before becoming a permanent member of staff in the department.

As a senior research fellow he was responsible for developing broadband constant-beamwidth transducers and interferometer-based bottom searching sonars. He was considered the transducer expert within the team at Birmingham and built many transducers both in one-offs and small production volumes for industry. Some of these devices are still used regularly in research environments by fellow acousticians.

In his early career he was part of the Underwater group of the British Acoustical Society and attended the inaugural meeting at which the IOA was born. He has served on the Underwater Acoustics group committee of the IOA for over two decades, including terms as secretary and chair of the committee. He helped organise a very successful series of conferences at the University of Birmingham on sonar transducers. These started in the 1970s, with a meeting being held about every five years, and have continued up to the present day. Jay was also responsible for the sale of the UAG proceedings which were much sought after owing to the popularity of these conferences and meetings. It was noticeably always Jay who would ask for time to speak to the non-members at these meetings and publicise the IOA.

Jay joined the Membership Committee of the Institute in October 1994. He took over as chairman in April 1998 and held the post for almost eight years until February 2006. He remained on the committee until November 2007 when he was forced to stand down by ill health, after 13 years of service on the committee.

During his period in office he saw the Chief Executive change twice, was instrumental in the introduction of two new grades of membership (Institutional Subscriber and Technician Member) with the consequent changes to the By-laws, incorporated the CPD Committee into Membership, dealt with two rounds of changes to the Terms of Reference for the Committee and oversaw a major overhaul of all the membership application forms. All this, of course, was in addition to guiding the most important function of the Committee, the processing of literally thousands of applications for membership.

His period of chairmanship will be well remembered (particularly by Jay) for the large rise in the number of code of conduct cases which started to occur at that time.

He was recently awarded the prestigious Fellowship of the Royal Institute of Navigation, one of only 20 given each year, for his 'contribution to the Institute over many years'. His family originally came from Devon where Jay sailed and has a boat, although his father, a GP, moved to Solihull where Jay grew up. Outside University, he was an active member of the Ocean Youth Trust (formerly OYC) and regularly took a hands-on part during their training voyages.

We are delighted to recognise Jay's contribution to the Institute with the Distinguished Service Award. The certificate and tuning fork trophy were presented to Jay in hospital by John Hinton, president elect, on 24 January 2008.

James Dunn

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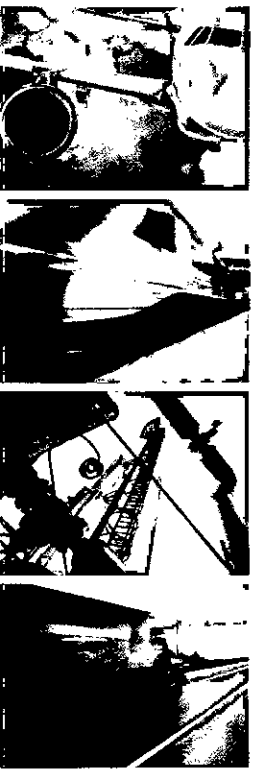

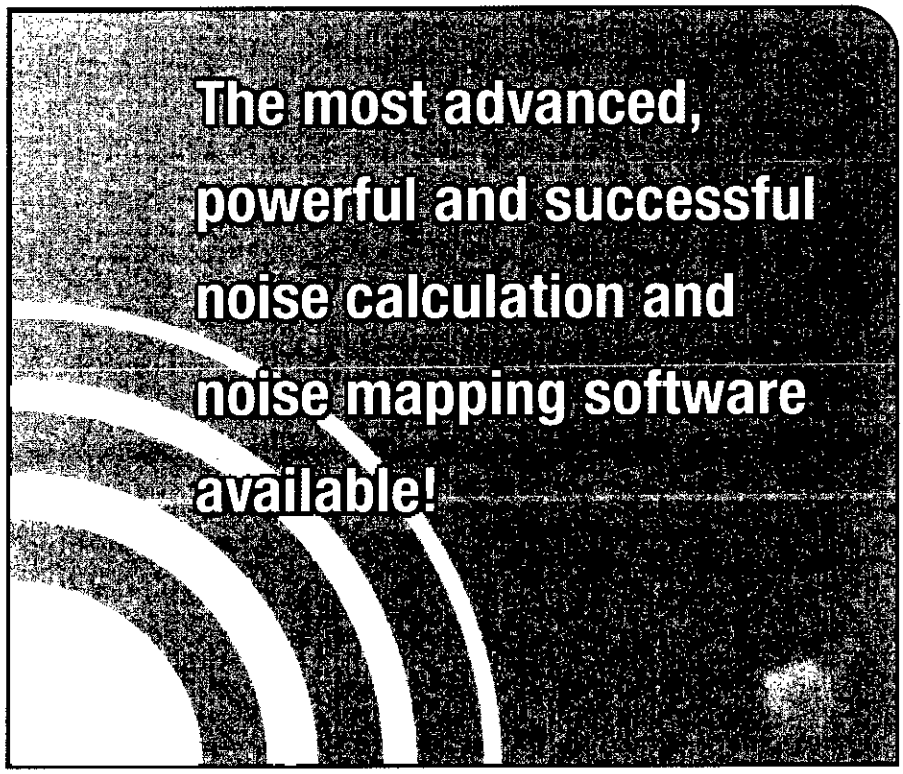

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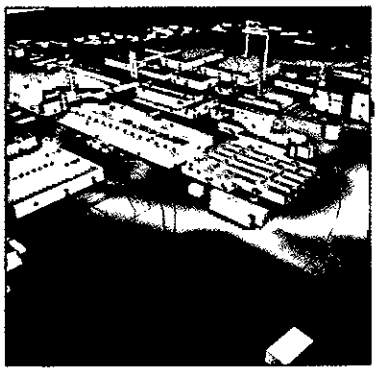
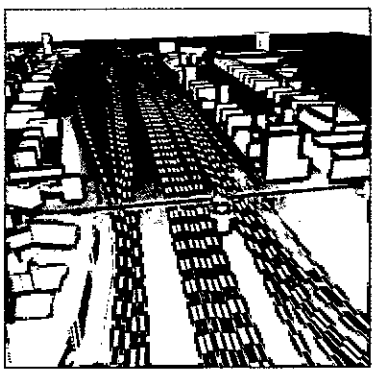


Prediction and detailed analysis of noise at industrial facilities



Optimization of building layout near roads and railway lines

Calculation of noise maps for cities of any size

Soundscapes and Aural Architecture - Better use of positive sound?

Peter Rogers. A review for the Building Acoustics group of the Institute of Acoustics

The IOA is pleased to report an important step taken towards understanding what makes better aural architecture, through a collaboration with RIBA, at the RIBA HQ on 20 February 2008.

This event marked an encouraging start to the IOA's efforts to seek active collaboration with other institutes, in order to stimulate debate on an integrated approach to design both inside and outside the built environment. The IOA teamed up with RIBA to consider where we currently were, and what the next step should be for aural architecture.

The full day conference began with RIBA President **Sunand Prasad** giving an opening introduction to a session chaired by Adrian Popplewell representing the Building Acoustics group of the IOA. The programme was intended for acousticians, architects and associated disciplines alike, and it provided a good foundation for debate, and food for thought, for the diverse mixture of the 56 strong audience who included artists and urban landscape designers.


Sunand Prasad

Eight presenters considered how well we understood what constituted 'positive sound' and how important that was within architecture, with a fertile workshop discussion pulling together the main conclusions that would, it was hoped, be an inspiration for the next step with aural architecture.

Sunand launched the meeting by expressing hope for the future, that our tribal identification should map onto our intellectual identity. Acoustics as a field provided us not only with the tangible ways to do this, but also the softer subjective ways that could allow us to experience the functionality of our surroundings and delight in them.

He shared his early experiences in the architecture of acoustics, giving examples of the issues associated with the design of a nursing home, which suggested to him that acoustics needed to become a consideration to get the everyday right in order to safeguard people's wellbeing. He acknowledged that the presumption of architecture to focus on light and the visual sense had taken priority over aural sense, and this needed to be challenged. Urban design provided an opportunity to consider the spaces between buildings and enhance our architecture aurally into the future.


Prof Trevor Cox

Prof Trevor Cox of Salford University is an academic acoustician who is renowned for his engaging style. As the opening speaker he began with an overview of what he felt needed to be considered when discussing 'positive sound' both inside and outside buildings.

He proposed, perhaps uncontroversially, that the acoustic needs are decided by the occupants, which should be addressed by acoustic design, and that we are all familiar with poor acoustics (such as noisy mechanical plant or computer fans). He wondered why this was so: did we not know any better? Had we poor guidelines or regulations, or was it simply that we needed to think more positively about good aural design? He postulated that an aural environment sits mainly at the functional end of a scale that stretched between functionality and aesthetics. The objective benchmarks available appeared to keep us fairly clearly in the metaphorical toilet of functionality, but acoustic statements should not be restricted to that but should aspire to escape the reductionist numbers game (using only dB) and aim towards getting the aesthetic expressed in architectural design.

The language we use is the first thing we need to consider in order to gain a tangible understanding of the concept of positive sound and aural architecture. He suggested adjectives such as harmonious, dramatic, or rhythmical, in a search of language to modify our understanding of sound in relation to beauty, in order to stimulate thought on how we might use a palate to describe aural beauty of a soundscape. A consensus on others is needed. He cited the example of an atrium as a common and interesting example of a space where hard surfaces and a large volume often lead to a harsh acoustic environment, and posed the question of whether this was acceptable. Does a quieter equate to being more harmonious? He pointed to examples where acoustic design can easily reduce the reverberation without significantly affecting the visual aesthetic, but wondered whether it is the aural contrast between these types of spaces and the intended destination for the listener that is even more useful in striving for an improved aural aesthetic.

He considered how advertisers and automotive designers already used this technique with product marketing, to emphasise quality and other aspirational attributes. The idea that sound might introduce drama, for example, to a given space is an idea that would push aural architecture from purely functional to the aesthetic.

Applying this idea could obviously be a tool to create a sense of wellbeing for the occupant, whilst it could also be used in the opposite way: for example, areas like toilets in schools could be made less desirable for loitering, in order to discourage bullying. A reference to the device known as the 'Mosquito' was made under questions to illustrate negative sound, but the definition of positive sound was perhaps more difficult and needed further work.

Trevor pointed to ongoing work by the Positive Soundscapes project, funded by the EPSRC since 2006. He encouraged professionals to join in on sound walks in London, by contacting w.davies@salford.ac.uk.

He also listed the some examples of favourite sounds currently being explored by the team as possible benchmarks:

- Atmosphere of being part of a crowd
- Sports halls, gyms, indoor public spaces
- London Underground: buskers, trains
- Pub atmosphere: babble
- Post falling through the letter box.

What makes a 'nice' sound appears to be good associations, natural content, positive human activity, things we have control over, complex but able to be ignored, such as water features, spoken babble or bird song. Whilst there was the possibility to make use of electronic systems already installed in many buildings he was not convinced that

'muzak' was the way forward. Trevor explained that the topic of positive sound had challenged his thinking, and it was an area in which acousticians and architects would need to work together to unravel. He felt there was scope for the conscious use of the aural architecture of a building to create a sense of drama, where that was appropriate.

In conclusion he did not believe we should leave soundscapes to chance, but we needed to develop the language to describe what we are doing, and understand that we are not only to exclude the noise, but better define what positive sounds are and how best to use them in architecture.

Stefanie Fischer of Burrell Foley Fischer Architects and Urban Designers began by expressing that simply the fact that this meeting was going on should give clients cheer, and supported the view that a focus on social benefit from better 'aural architecture' is overdue.

Stefanie Fischer

Stefanie drew on her experience with cinemas to illustrate how acoustics could be an important driver in shaping the aural architecture of a building, but raised common criticism over the aural 'reading' for contemporary bars and restaurants, which are perceived to have insufficient regard for acoustics in their design to make them pleasant places to be. Her case studies set out how playing with the variable acoustics of the space could aid functional flexibility, and illustrated their successes in acoustically designing cinemas intuitively. She recalled experiences with physical modelling, and later computer modelling, techniques and the need to seek a little acoustic assistance when tuning one of the cinema spaces at Broadway Nottingham.

Patrick Dillon of Howarth Tomkins Architects considered designs that should be heard. He focused on the case study of the Snape Maltings development on the Suffolk coast as an example where a there is a rich and varied ecological soundscape that ranges from the arable farming in the west to the wind in the reeds, birdsong and draining water of the marshes to the east. He explained that a careful listener could hear the area's history, and that to redevelop the area required sensitivity to the external aural environment and consistency with the existing aural architecture of the much-loved warm acoustic of the concert hall, designed by Derek Sugdon (who was present in the audience). The design of the new concert and rehearsal hall in Studio 1 replicates the original as far as possible, but adds an improvement to the original space where the flexibility of the acoustic and minimising the escape of sound in or out of the hall is concerned. The need for the later was driven by the need to control the impact of sound on the proposed residential development. He explained that the soundscape outside was used as the interrelationship not only of vision, but also of sound. Touch and smell were also considered in the selection of the materials and the resulting visitor experience. The footfall noise on

continued on page 12

Soundscapes and Aural Architecture... - *continued from page 11*

different surfaces introduces to the visitor to a changing aural experience (from the squelch of the mud of the marshes, to the crunch of gravel then the thud on wood of the board walk, and eventually the quiet of the carpet of the venue itself. The aim is to make the experience as personal as possible.

Paul Gilleron of 3D AudioScape changed the focus back towards what can be possible with his talk on 3D sound fields, using electronic systems. He explained the principles of the ambisonics system and the use of a sound field microphone to create B-format coded sound that is effectively 3D. The system can be used as a tool for creating soundscapes, allowing a sound to not only be heard in 3D, but also to be moved spatially and then used as a composition tool. So far it has been mainly used for music and sound art, but he saw a very broad range of applications which could be used to enhance both internal and external spaces by introducing pre-recorded 3D sound. He invited architects to consider using such a tool when dealing with soundscapes, but also listed aural architectural walk-throughs, reproducing archeologically aural environments, teleconferencing, and spaces specialised for hearing-impaired learning as but a few examples. He considered that there could be a time when fractals might drive 3D sound fields. He admitted that this was a long way from being a solution for correcting poor room acoustics, but saw it as a means to introduce complex realistic sound environments into architecture. He listed eight years of project history using this technique, and three projects were under way year.


Tim Brenden

Tim Brenden of Toposonic provided the landscape architect's point of view in a presentation that was perhaps more of a performance piece. He combined background sound as he quoted various passages. He wondered why sound was so poorly considered in architecture, and suggested that we should be striving toward 'harmonic urbanism'. Social bias currently fails to address the aural environment adequately. He urged that architects should all consider themselves to be instrument makers, who then needed to decide what sound to tune the instrument to. He lamented the little white leads of mp3 players, which symbolised how many people simply chose to opt out of the soundscapes they passed through. This removes their connection with the world around them and perhaps suggests that not enough attention has been paid to give people reason to remain engaged.

He wondered if a 'soundscape character assessment' might help to at least try to quantify this quality along similar lines to landscape character analysis (LCA). He introduced the idea of the cultural sound (vernacular sound) and the way our mechanical world is being replaced and eroded by digital synthesised sound. He referred to the Santhal communities of west Bengal who continued to have a very important relationship with sound in their lives, living in 'tuned' villages. Their language has developed a complex definition for each type of sound, separating it into that created by striking something, the calls of animals, and human sounds (subdivided into speech or song).

He suggests the UK has not yet ventured to value sound in the same way, and that perhaps sound categorisation is a way forward, being the cultural meaning of a source plus the intrinsic perceptual property. He noted that the US National Park Service had embraced the idea of soundscapes, recognising that understanding the relationships between individual sounds and their interactions with the environment was vital to protecting soundscapes for current and future generations. He proposed we should not be distinguishing sound as noise, but treating it all as audio wave energy, and aim to improve the quality, so that whether inside or outside the whole experience should be one where the aural experience was as memorable as the visual one.


Neill Woodger

Neill Woodger of Arup Acoustics USA focused on the removal of the communication barriers with clients in his talk about composing soundscapes. He explained how the SoundLab had been developed to allow the designers and clients to be directly involved with the acoustic design process. The use of an auralised ambisonic sound field prediction is then referenced to known benchmark spaces and known and loved examples. He reported that the response had been very positive, and that often clients emerged with smiles on their faces. He showed a picture of US judges smiling during their SoundLab experience, and looked forward to the process becoming more extensive and interactive. He illustrated the possibilities for soundscape design inside and outside buildings referring to the Walt Disney Family Museum and the New York East River scheme.


Ian Taylor

Ian Taylor and **Elvin Chatergon** of Feilden Clegg Bradley Studios Architects used a rather crude voice recording on the move through a space, and challenged the audience to visualise the building based on the information that they go from the recording alone. The talk entitled The sound of mental maps introduced the principal that sound is a key component of storing mental maps of spaces, especially for the visually impaired. Elvin consulted visually-impaired users of the Richard Attenborough Centre to find how important sound was to them to navigate. The results suggested that the extent and value of the aural information around them was crucial to helping them mind map the spaces in and around buildings.

Paul Malpas of COMS facilitated the workshop discussion, and the key points that were drawn from the lively integrated debate that followed served to consolidate the day.

- Architectural design appeared preoccupied with visual aesthetic, but recognises the need to improve consideration of aural aesthetic rather than simply aural functionality. There is the need to move toward a more holistic approach for the senses.
- Aural architecture needs to develop the vocabulary to communicate the requirements, which is holding us back, but this must not get in the way of the design process. Benchmarks for recognised good examples could the way forward.
- We need not only to decide how to define the brief, but what the requirements should be to deliver improvements in soundscape quality and occupant satisfaction both inside and outside buildings.
- We have the opportunity to get aural architecture right or very

The workshop in progress

wrong, so we must better understand what constitutes positive sound and what we would like to hear in and around our urban environments.

- In considering the other senses perhaps smell should also be considered in pursuit of a truly integrated approach.
- Sound may well be architecturally more complex than light because of its temporal nature and the inability to tune out in the way one might look away. We are lagging behind implementing into aural architectural design.
- The cultural relevance of aural architecture must not be ignored.
- In delivering sustainability the aural environment is clearly very important for the social aspects of individual and community wellbeing, and good aural design will help towards an integrated design approach to achieve this goal.
- Pulling planners into the process would seem to be an important next step to make sure the master plans of the future include for positive aural architecture in urban design, which our sense of place is strong and encourages people to live there.
- Active, rather than passive, listening is perhaps a way architects can begin to engage more effectively with the aural aspects of architecture, and where drama or beauty might be added through the use of sound.
- It was suggested that acousticians should get hold of field microphones and more liberally take sound shots for future use, equating visually to a photograph.

The Institute of Acoustics would like to thank RIBA for supporting the event, and seeks to continue active collaborations to achieve cross fertilisation of knowledge to aid the integrated design approaches of the future.

Reproduced Sound 23

R Walker. Conference report

The 23rd Reproduced Sound conference was held on Thursday 29 and Friday 30 November 2007. This year, the Sage Music and Arts Centre in Gateshead provided a new location and a substantial departure from the usual type of venue in a hotel conference facility. This change was primarily to make the conference venue more relevant to the majority of RS delegates and to attract a wider range of participants. It was a rare opportunity for the presenters and the delegates to experience the type of venue that is often the subject of RS presentations. Against that should be set the fact that there was no integral hotel accommodation. Some of the social aspects of previous conferences had been lost because of the distance to the main hotel, and no convenient late-night venue was available for the customary 'out of hours' music and discussion sessions. This was a difficult judgement for the committee and not every delegate could be fully satisfied. Nevertheless, most delegates seemed to regard the new venue as a success.

Thanks and appreciation go to Sam Wise for masterminding the use of the centre through his contacts with the project and to Allen Mornington-West for the substantial assistance given to Sam in organising the event and with the electronic voting system. Thanks also go to the Sage staff, especially the events manager, Anne Stacy, and head of technical services, Chris Durant, who were all extremely helpful and fully co-operative, adding greatly to the smooth running of the conference. Nothing was too much trouble, even when it had not been pre-booked. Chris also gave an impromptu tour of the larger Hall 1, designed for both orchestral and popular music genres. That was much appreciated by the large party of delegates who took advantage of the opportunity to discover how the 'end users' feel about their facilities. This was a chance not often available to the majority of RS delegates and added to the overall success of the event.

The venue facilities fitted the conference requirements admirably. The technical presentations took place in the main auditorium of Hall 2, which had seating for a total of 350. However, only the floor level area was used for the conference so the resulting atmosphere retained the intimate and social character of RS conferences. The Barbour Room, on the floor above the hall, provided a generous exhibition space for the exhibitors and was also used for refreshment breaks and meals, including the Conference Dinner.

A substantial amount of audio equipment had been brought into the auditorium by or on behalf of the various presenters. The overall effect was very impressive, with loudspeakers of many different sizes in different directions, including some stacks of large bass drivers. Advantage had been taken of the unused balcony space to install more sets of loudspeakers at different heights to provide more realistic 3D synthesised ambience. Thanks for all this installation and setting up are owed to very many people. Amongst them were Mark Bailey of JBL, John Taylor of d&b audiotecknik (who also operated it all on behalf of the presenters), db audio for the five point surround system as well as the house PA loudspeakers, Pete Harris of Warehouse Sound for actually delivering the db system to the site and to our own RS regulars, Ken and Robin Dibble, who provided the continuous PA for the presenters throughout the conference.

Many opportunities were available for delegates to meet and talk in the main auditorium, in the lobby and in the exhibition space. The contributions of the exhibitors to the success of the conference are gratefully acknowledged. Thanks also go to AMS Acoustics for sponsoring the welcome reception on Wednesday evening and to Alcons Audio BV for sponsoring the reception and conference dinner on Friday evening.

The conference theme continued from previous years, with its main focus on developments in electroacoustics, room acoustics and intelligibility. In addition to two invited papers and an award lecture, 18 other technical papers were scheduled to be presented in seven sessions by nationally and internationally respected authors. Unfortunately, two of the presenters had to withdraw at the last minute. Substitutes from the Sage management and a local theatre filled the two vacant slots admirably, with impromptu but very informative and interesting talks. The programme was intensive. A number of the papers involved audience participation in the form of a live electronic 'voting system'. Those presenters who took advantage of that had clearly given much consideration to how the system might be used to the best to get meaningful data from an audience of specialists much larger than can normally be assembled for acoustic tests. It is hoped that the detailed results of these tests will be made available when the analysis is complete. Unfortunately, it had not proved possible to do that before the end of the conference.

The conference was well attended, with 113 registered delegates, 17 of whom were students, and nine exhibitors. As a result of much promotion, the EAG committee was gratified to see that a larger proportion of the delegates than usual were students. The Electro-Acoustics Group committee was pleased with the response to the programme and is now planning the 24th in the series, to be held in November 2008 at a venue yet to be decided.

The conference in detail

Conference registration was open from 6pm on Wednesday 28 November in the Sage Centre, with a welcome reception and plenty of opportunity for new arrivals to find friends and colleagues and to look at the venue. The reception was kindly hosted by AMS Acoustics.

The conference proper was opened at 9.15am on Thursday by the chairman, Bob Walker, who welcomed the delegates. That was followed immediately by two invited papers, the first by Dr Michael Barron, well known internationally as a designer of concert halls and other large-scale public venues, and the second by John Taylor, well known for his accessible tutorial introductions to sound reinforcement principles and technologies.

The technical sessions continued, with breaks for refreshments and meals, until 5.30pm. Afterwards, a sherry reception was held in the lobby, followed by dinner at 6.30pm. After dinner, Graham Bank presented his Peter Barnett Memorial Award lecture. The second day of the conference started at 9.10am with more technical sessions. They continued until the last paper of the conference at 6.30pm. The Electro-acoustics Group AGM was held after the last technical session of the day. A sherry reception was followed by the Conference Dinner at 7.00pm, both kindly hosted by Alcons Audio BV.

After dinner, the President of the Institute, Colin English, presented the Peter Barnett Memorial Award to Graham Bank (as reported in Acoustics Bulletin vol.36 no.1). The committee chairman, Bob Walker, then thanked the EAG committee for their work, Ken and Robin Dibble for the technical support, the Institute staff for their organisation of the conference, the venue staff for providing their substantial help and, finally but most important, the delegates for their support. Sam Wise and Ken Dibble added their special thanks to those many people that had made their substantial contributions to the conference. After dinner, the evening was spent in a combined talk and demonstration by Ken Jacob of BOSE in the auditorium, with the admirable assistance and support of the Dutch Jazz Band.

Overall, the organisation of the conference went well, with a very full programme and activity taking place all of the time. The delegates certainly appeared to have had an enjoyable and worthwhile conference, with many already looking forward to RS24 in 2008.

Technical sessions, Thursday 29 November

The technical programme began with an invited lecture *Auditorium Acoustics – a room acoustician's perspective* by **Dr Michael Barron** (University of Bath), giving an acoustician's view of some aspects of sound

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Peter Mapp presents...

Allen Mornington-West gives his paper

Graham Bank receives the Peter Barnett Memorial Award from the President, Colin English

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system design for auditoria. In a wide-ranging talk, he discussed aspects of intelligibility, sound levels and acoustic measurements. He described how sound levels decrease with increasing distance in a large enclosed space and how that can differ substantially from the simple theoretical model. A new law had been devised to include the effective attenuation as a function of time as well as distance. He also described a substantial body of evidence that the subjective sound level was more or less constant in any given hall, in contrast to the objective behaviour. That conflict sometimes led to anomalous results in setting up sound reinforcement systems. The various ISO382 measurement parameters were discussed briefly. Parameters such as RT, EDT, C_{50}, C_{80}, lateral fraction, strength, *etc* were defined and were frequently valuable guides, but did not present the whole story. Accurate calibration was essential and the form of presentation was important. Mike finished his talk with a review of the development of the different forms of concert hall layout since 1850, which he showed had occurred in a more or less time-sequential pattern of contemporary fashion.

The programme continued with another invited lecture *Testing, testing ... One, Two... Can you hear me?* by **John Taylor** (d&b audiotecknik). He said that his talk was a tutorial in which the objective was to demystify audio and that the main objectives of sound reinforcement were to provide good quality, intelligible and faithful sound to every seat in an auditorium. In the presentation, John used many demonstrations to illustrate some common problems and their solutions, as well as some of the common misconceptions held by practitioners with inadequate technical knowledge.

These two invited papers were followed by a coffee break in the exhibition area. There, delegates could take a break, get some refreshment and discuss matters of interest as well as talking to the representatives of the organisations exhibiting at the conference.

After the break, **Peter Mapp** (Peter Mapp Associates) asked *How accurate are acoustic models and measurements with regard to speech intelligibility?* He began with a general review of speech intelligibility and continued by reviewing criteria and the STI concept and the accuracy of different techniques for intelligibility measurements. He showed how signal processing and a wide range of sound system defects could have a significant effect on measured results. A proposed new STI scale was presented which was designed to avoid subjective interpretations and thereby overcome some of the misinterpretations of the existing scale. Peter then continued with a brief revue of computer modelling techniques. The paper concluded with a number of case histories and examples, comparing predictions from computer modelling with measurements made on the completed systems.

The session continued with Allan Mornington-West giving an introduction and teach-in on the IML electronic voting system. This was to be used by several of the presenters to obtain live feedback and, it was hoped, meaningful data from the large audience of specialists, something that was normally difficult and expensive to organise. Allen's introduction was followed by *Can you catch the rap or follow the lieder? Explorations into a simple-to-use subjective intelligibility test for song lyrics* by **Sam Wise** (Arup Venue Consulting) and **Allen Mornington-West** (broadcast consultant). He described the way in which all parts of sound systems had improved over the years but poor sound quality was still encountered and noted that it was common experience that quality was lost with amplification and that undervaluing of the venue staff and maintenance allowances also contributed to it. He suggested that STI measures might not be appropriate for music, especially as measures of lyric intelligibility, and introduced the concept of a 'LID (Lyric Intelligibility Test)'. The remainder of the paper was occupied with subjective tests, using the electronic voting to carry out such a test. Allen and Sam had clearly put a great deal of effort into the design of the tests and into the recording of the musical excerpts, using a professional singer to sing nonsense sentences with the test words embedded. Allen pointed out that the addition of music to a standard word-scoring test greatly increased the number of degrees of freedom available.

After a buffet lunch, again held in the exhibition space, the head of technical services at the Sage Centre, Chris Durant, conducted a short tour of the main auditorium, Hall 1. The tour was very well attended, with

A few choice words from Sam Wise

[l to r] Kevin Macan-Lind, Colin English, Peter Mapp

The voting system, operated by Dave Palmer, interactive producer, IML Ltd

what appeared to be well over half the conference delegates taking part and providing a lively question-and-answer session, which had to be cut short to keep the conference (nearly) on schedule.

After the lunchtime tour, the main technical sessions continued with *Lossy in the sky with demons* by **Helen Goddard** and **Tim Gully** (AMS Acoustics). The paper was given by Helen. Using the electronic voting system, Helen presented a number of compressed musical excerpts at different bit rates. The results generally showed that, under those listening conditions, differences in compression rates were not readily audible. One result that was fairly clear showed that a variable bit rate was not preferred over a comparable fixed bit rate, perhaps illustrating that the complexities and cost of variable sample rates are not justified, at least for large venues and audiences.

The next paper was *Doof and intelligibility: does bass do it for you?* By **Glenn Leembruggen** (Acoustic Directions) and **Tony Stacy** (AMS Acoustics). The paper was presented by Glenn. He said that the primary aim was to investigate the masking effects of excessive low and mid frequency energy on speech intelligibility. Male speech passages with vastly different tonal balances were presented at two different sound pressure levels and assessed for intelligibility by the audience, using the real-time voting system. He suggested that the standard STI measures do not account very well for poor tonal balance, masking or absolute sound level.

After the tea break, **Paul Malpas** (COMS) presented a paper entitled *A method for subjective judgement of speech quality and intelligibility in the presence of simulated noise and reverberation.* The paper focussed on the differences between the results of objective measurements using test signals or pre-recorded announcements and the actual practice, with live announcers. Paul acknowledged that measurement-based specifications, such as Speech Transmission Index (STI), had led to real improvements in audio systems and acoustic finishes. However, they did not take account of the variability introduced by live talkers. The paper proposed a workshop method for exploring that proposition, using an auditioning method to include reverberation and noise effects, replayed through a realistic loudspeaker system in room of appropriate acoustic volume. The presentation continued with a demonstration and live test of the methodology using the electronic voting system and the audience to carry out Mean Opinion Score tests with several different conditions.

The final paper of the day was *The life of a theatre sound designer* and was presented by **Rob Brown** (Head of Sound, Northern Stage). This was one of the papers arranged at the last minute to replace one of the ones withdrawn. What followed was a fascinating presentation, part life history and part revue of what sort of things can happen in real jobs. Rob had clearly been committed to his interest in audio for many years and had found a nice niche with the Northern Stage. His was a most refreshing view on an aspect of reproduced sound that few of the delegates got to make contact with.

That concluded the main technical sessions for the first day of the conference.

Technical sessions, Friday 30 November

The second day of the conference began promptly at 9.10am with *Conception, design, development and application of the Turbosound polyhorn* by **Laurence Dickie** and **Dominic Harter** (Turbosound). The presentation began with a description of basic horn principles and acoustic impedance matching requirements. The difficulties caused for designing arrays of multiple, convention horns by the disparity between acoustic and physical centres were described. The new design of the polyhorn showed how a multicellular array of arbitrary directivity could be achieved by control of the differential paths lengths. The final product appeared to be a very complex 3D shape. A number of different manufacturing methods were described. The paper was concluded with demonstrations of the uniform directionality of the new design, which led to many questions from the audience and a lively discussion.

The second paper of the day was *The subjective and objective differences*

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Reproduced Sound 23 - *continued from page 17*

between subwoofer topologies in differing applications by **Mark Bailey** (JBL Professional). In his paper Mark described the various options for reproducing the lowest frequency band - direct radiators, horn-loaded drivers, cardioid arrays and forward steered arrays. The choice was dictated by many factors, including the space available in the venue, the space available in the truck, how loud it needed to be and the chosen crossover frequency. Mark then used the electronic voting system to discover whether the audience could distinguish between examples of the four bass loudspeaker arrangements by asking the audience to choose which was playing for a range of material types. Overall, the audience was unable to make conclusive identifications.

The next paper, and the final one before the coffee break, was *A new approach to loudspeaker data presentation in EASE 4.2* by **Wolfgand Anhert** and **Stefan Fiestal** (Anhert Feisal Media Group). The paper was presented by Wolfgang, who began by outlining the limitations of the older style of the GLL loudspeaker data tables. These consisted of relatively low resolution, magnitude-only data for hypothetical point sources. For arrays, the data was measured for a single driver and the results combined. Now it was possible to use complex data which resulted in more accurate data for combinations of drivers. Wolfgang then demonstrated a new processor that was able to carry out real time de-convolution and thus derive a continuous display using real signals. He showed how it was possible to present real-time displays of impulse response, STI, RT, etc in a stadium with 70,000 people present, using the existing PA signals.

After the break, **Ned Crowe** presented the paper *Developments in design: the Alsion Konsertsal, Sondeborg, Denmark and Hall 1, The Sage, Gateshead* by himself and **Dr Raf Orlowski** (Arup Acoustics). In the presentation Ned presented many comparisons and contrasts between these two recent developments in performance spaces. Both were intended as multi-use spaces, with no compromises made for amplified music. The Alsion hall was on a university campus whereas the Sage Centre was a public facility. In both halls, extensive provisions had been made for noise reduction, sound insulation and internal diffusion. Both halls also had provisions for varying the reverberation times. Testing, with live orchestras, had also been carried out in both halls at early stages of the construction.

In his paper *Face mounted microphone performance*, **Alex Queenan** (ISVR, University of Southampton) presented a brief review of his PhD work, which was an extensive study of the use of miniature microphones, mounted at various places around the performer's face and head. His motivations for the work had been that the position of the microphone significantly affects the quality and character of the signal and that few other studies of this had been carried out. His investigation had consisted of four parts - talking to the industry, the physical processes, objective experimentation and subjective experimentation. This was clearly a very extensive and thorough body of work that should prove useful to practitioners.

The final paper before the lunch break was *Providing audio design for public art works - collaboration with artists and the changing public perceptions of the aural environment* **Paul Malpas** (COMS) and **Alban Bassuet** (Arup Acoustics), presented by Paul. The theme was that public art is no longer restricted to classical statuary and paintings and that both the artist and the 'consumer' may be interested in other modes of communication, in particular that the aural channel. Paul went on to describe four different works that were primarily based on sound. The first was an installation in the Broadgate Arena, using an exterior Ambisonics system and a library of exterior soundscapes to provide 'an escape from the noisy, urban environment'. The second was in the Tate Modern, using recordings of the structural vibrations of the Millenium Bridge. The third was an attempt to humanise a particularly bad underpass used by road traffic and pedestrians. By installing a great deal of acoustic absorption and then replaying a modern composition, constructed partly from road traffic noise, the aural environment had been transformed. The fourth installation was in the 'Earth to Earth' exhibition in New York and was a statement about species extinction, using an existing multichannel loudspeaker system to reproduce a composition by Alban, based on sounds representing extinct or nearly extinct species.

After the lunch break, **Bruno Fazenda** (University of Huddersfield) presented *Localisation of sound sources using coincident microphone techniques*. This was an investigation of whether the direction of a sound source could be derived from signals recorded by different arrangements of microphones. The microphone arrangements tested included MS, Blumlein pair and Soundfield microphone. The venues investigated included a recording studio and a concert hall. Experimental measurements had been made using six loudspeakers at 15° intervals over 90° from front to right. The first results showed that a resolution of 20° was achievable in both venues.

In *Sound field reconstruction using functional analysis approach* (**Fillipo Fazi** and **Philip Nelson** (ISVR, University of Southampton) Fillipo presented parallels between problems in acoustics and analogous ones in quantum mechanics. The original motivation had been that the quantum mechanical solutions were already well known. Although functional analysis had been successfully applied in other branches of physics, such as quantum mechanics, it had not been widely used in acoustics, even though the other branches of physics shared many similar analytical approaches. Some of the concepts from functional analysis were applied to the problem of analysing and reconstructing sound fields. That enabled an analogous analysis to that provided by matrix formulations, but in terms of continuous spatial functions and provided some valuable insights into sound field reconstruction problems, for example radiation patterns and acoustic holography. Though this description makes the presentation sound highly academic, actually Fillipo's presentation made a difficult and challenging topic very interesting.

The next paper, *The perception of dialogue loudness levels within complex soundtracks at similar overall sound pressure levels in rooms of different sizes and decay times*, by **Philip Newell** (Consultant), **Keith Holland** (ISVR, University of Southampton), **Branko Neskov** (P&B, Lisbon), **Sergio Castro** (Reflexion Arts), **Antonio Pena** (University of Vigo), **Marisol Torres** (University of Vigo) and **Eliana Valdigem** (freelance technician) was presented by Phil. The difficulties encountered in using smaller mixing theatres for cinema sound were described. These included perceived sound levels, the relative level of dialogue versus effects and the spectral balance. Historically, large and expensive rooms had been used to minimise the number of variables involved in transferring a mix from the studios to public cinemas. However, recent requirements for compatibility with smaller theatres and homes had highlighted the problems of compatibility of playback in rooms of different sizes. A new multi-disciplinary study group has been set up to carry out a detailed study of the problems and potential solutions.

After the tea break, **Stanislas Boivin-Champeaux** (Sound Directions Ltd) presented *A study of how loudspeaker high frequency directivity affects speech intelligibility*. Stanislas described how the trends to larger buildings containing more people and the increasing stringent specifications for public address system quality were causing system designers substantial problems. He suggested that high frequencies could provide the listener with audio clarity, limit masking effects from public generated background noise and trigger psychoacoustics reflexes that limited speech masking by reverberation. He also suggested that an even and wide distribution of high frequencies was desirable to achieve good speech intelligibility in noisy and reverberant spaces and that one of the significant problems in the industry was the restricted high frequency directivity of typical PA loudspeakers. He demonstrated comparisons between two different loudspeakers at angles of 0°, 30°, 45°, and 60° off-axis, showing how an improved design could achieve more uniform directivity.

In *Voice alarm systems for exhibition centres: design, prediction and verification*, **Thomas Steinbrecher** (Bose Professional Systems) described the application of PA systems to very large halls, of the sort used for large exhibitions. He described how a variety of IEC 60849-compliant emergency sound systems had been designed for voice alarm purposes in the halls of the newly constructed Hamburg trade fair. In the paper distributed and centralised design approaches utilising both waveguide-based speakers as well as line-arrays were evaluated. Optimised solutions were presented for typical hall geometries. Computer simulations had been used to predict the achievable intelligibility values in a large number of highly detailed room models by

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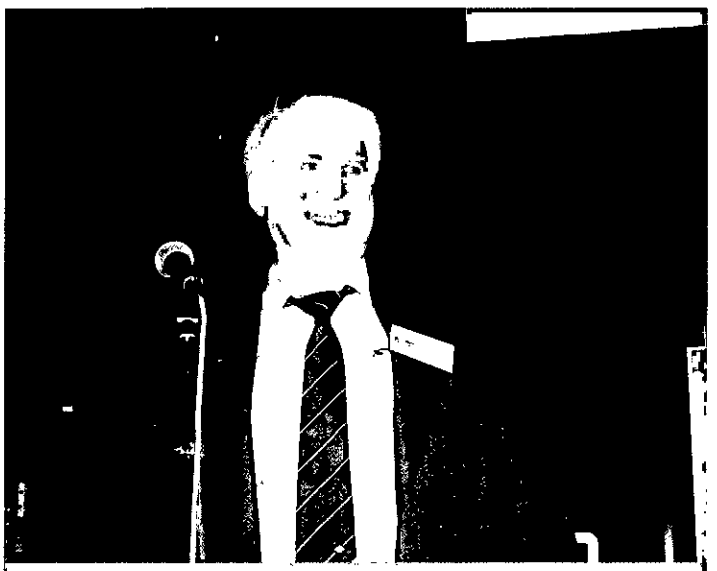
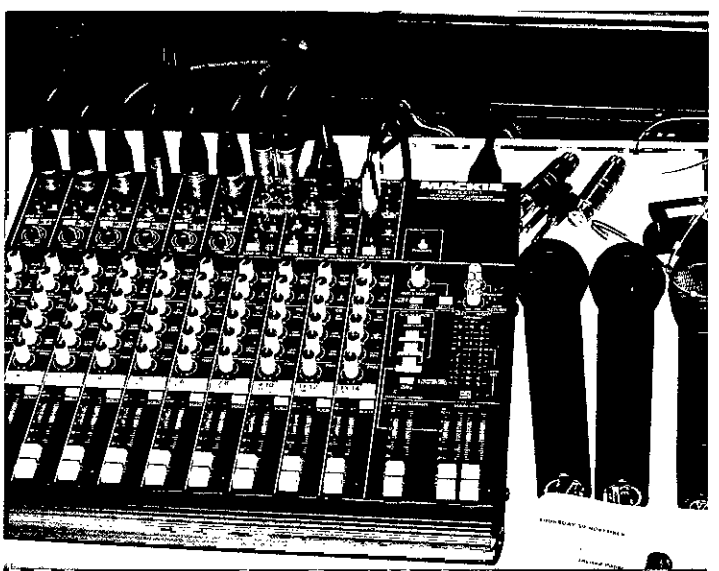
The audience settles for the next session



Bob Walker is happy to introduce...



The microphones and mixing console for the advanced 3D PA system

Reproduced Sound 23 - *continued from page 18*

utilising the Speech Transmission Index (STI). The models had been verified by comparisons with some existing halls. Measurements of the installed systems were used to verify the accuracy of the predictions. The paper also included audio demonstrations of comparisons of the quality of auralisations from the computer model with binaural recordings from the actual installed systems

The final formal paper of the conference was *The Noise at Work Act - a venue perspective* by **Chris Durant** (The Sage Centre). Chris had been persuaded to stand in for one of the absent speakers. The result was a fascinating insight into the impact of the Act on the workers in an industry whose *raison d'etre* was making 'noise'. Chris demonstrated how the statutory action levels were fairly easy to meet for casual or part-time workers and how the exposures could add up to be serious limitations for full-time staff. That applied not only to those working directly with audio but also to other staff, such as hall attendants and ushers. Very careful attention to work patterns and task allocation was needed to ensure both compliance and the aural health of all the staff. The Sage had put in place a comprehensive monitoring and control system.

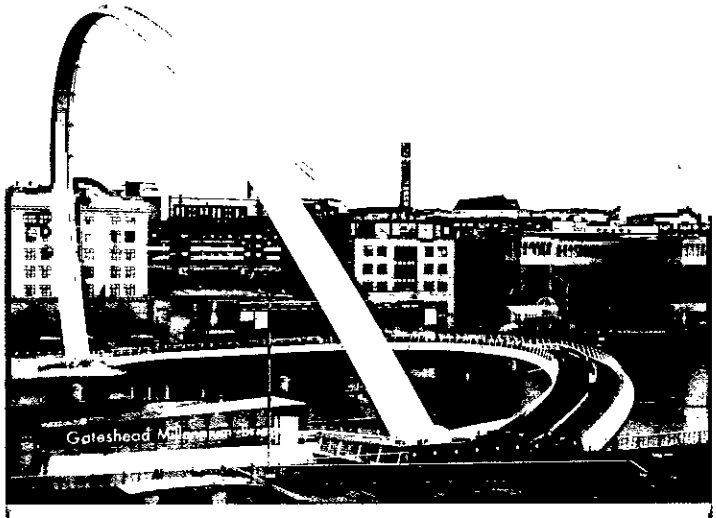
To close the session, Sam Wise presented a brief summary of the data from the electronic voting system. He also thanked the staff of IML, who provided the system, for their work in making the two days run successfully and, in particular, providing the overall analysis before the end of the conference.

Dutch Jazz Band

Evening sessions

Thursday evening, 29 November

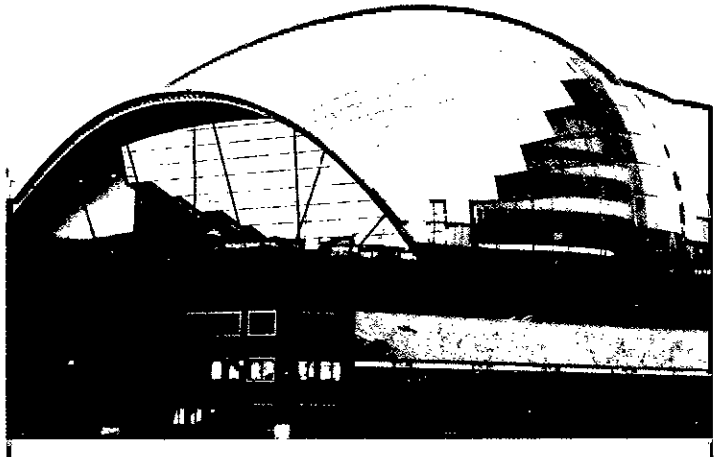
The Peter Barnett Memorial Award Lecture *Resonances in audio - they're bad things - aren't they?* was given by the Award recipient **Graham Bank** (Deben Acoustics Ltd). In his lecture, Graham started with the premise that acousticians were usually taught to avoid, eliminate or damp out resonances in audio devices because 'everyone knows that resonances are bad things'. However, he then pointed out that musicians would definitely not agree because almost every musical instrument used resonance to generate or amplify the sound output. A violin with no body would be essentially useless. Thus, some resonances were necessary whilst others were taboo. He proposed the concept of good and bad resonances. He continued with a brief history of the common moving-coil loudspeaker as first described by Rice and Kellogg in their paper *Notes on the Development of a New Type of Hornless Loud Speaker* in 1925. The main efforts since then have been to control the resonances, or at least their effects, by elimination or frequency limitation. The lecture described a journey of discovery where the goal was to determine what made a good resonance and what turned it bad. During the course of the lecture, Graham recounted his early work at Celestion, where the first scanning laser interferometer in the loudspeaker industry was designed and built. It finished in the present day, by describing the invention of a loudspeaker which used resonances as an integral part of the design - but only the good ones, of course. He finished by demonstrating the sound quality obtained from a small pair of experimental speakers using those principles. The lecture was very well received, with a substantial question-and-answer session following it.



Millennium Bridge, Gateshead: It doesn't wobble, it blinks!

Friday evening, 30 November

After the formal Conference Dinner, **Kenneth Jacob** (Bose Professional Systems Division) presented an evening talk and entertainment entitled *A new approach to sound system design for small-scale touring bands*. This extended session described a new approach to live music amplification employing small, personal line arrays placed behind the performers. Because of the properties of the line arrays, the system simultaneously acted as monitors for the performers and the PA system for audiences of up to several hundred. The research leading to the new approach was described, as well as its strengths and limitations as judged by performers who were using the system and audiences that were listening to it. The whole evening's presentation was interspersed with periods of live music from the Dutch Jazz Band. Many of the conference delegates stayed until the Sage staff closed the venue (and the bar) at 11pm. By the end, all present had had an enjoyable and informative evening.



The Sage, Gateshead

The Institute Diploma Examination 2007

Prof Keith Attenborough.

The numbers of candidates gaining merits (M), passes (P) or fails (F) in each module are shown for each centre in the table of results. This includes the results of appeals. Note that the 'fail' grade numbers include those who were absent from the written examinations. This year 167 candidates entered for the General Principles of Acoustics (GPA) written paper (216 entered in 2006, 135 entered in 2005, 140 entered in 2004, 121 entered in 2003, 154 entered in 2002, 129 entered in 2001, 150 entered in 2000 and 183 entered in 1999), and nine candidates were absent or withdrew. There were 75 candidates for Law & Administration (L&A), 140 for Noise Control Engineering (NCE), 90 for Architectural and Building Acoustics (ABA), 40 for Transportation Noise (TN), five for Vibration Control (VC), six for Sound Reproduction (SR) and 12 for Measurement (M). There were 45 candidates who deferred their projects until November and 24 have still not completed their projects. Candidates who have not submitted their project reports are shown as failures in the table.

The mean marks for the GPA this year were the highest since 2001. In the GPA written examination, Question 4 involving calculations and assessment of noise due to an exhaust pipe outdoors was popular and was answered fairly well. Other popular questions were 2, 7 and 8, concerning sound insulation, definitions of acoustic terms and personal sound exposure respectively. The mean scores obtained by distance learning candidates at Edinburgh for questions 7 and 8 were higher than those obtained at other centres. The mean scores on questions 2 and 4 obtained by the 'full-time' candidates at Bristol were significantly less than those at other centres.

As in the previous three years, a merit threshold of 70% was applied to

IOA Diploma results 2007

Centre name		GPA	project	ABA	M	L&A	NCE	TN	VC	SR
Colchester Institute	merit	2	1	0	0	0	1	0	0	0
	pass	8	10	0	0	8	11	0	3	0
	fail	1	0	0	0	3	1	0	0	0
University of Derby	merit	5	3	0	0	0	2	0	0	0
	pass	15	16	6	0	10	11	15	0	0
	fail	5	4	6	0	2	4	0	0	0
Leeds Metropolitan University	merit	1	2	1	0	0	1	0	0	0
	pass	12	9	2	0	4	5	4	0	0
	fail	3	2	3	0	1	1	0	0	0
Liverpool University	merit	0	0	0	0	0	0	0	0	0
	pass	1	1	1	0	0	0	0	0	0
	fail	0	0	0	0	0	1	0	0	0
NESCOT	merit	4	4	0	0	0	1	0	0	0
	pass	10	8	8	0	8	19	2	0	0
	fail	6	7	0	0	4	4	3	0	0
Salford University	merit	2	3	0	0	0	2	1	0	0
	pass	7	7	8	0	1	7	0	0	0
	fail	2	1	1	0	0	3	0	0	0
University of Ulster	merit	3	2	0	0	2	0	0	0	0
	pass	9	7	6	0	3	15	0	0	0
	fail	0	0	0	0	0	0	0	0	0
University of the West of England	merit	0	0	0	0	3	2	1	0	0
	pass	6	10	0	0	11	16	1	0	0
	fail	2	5	1	0	4	1	0	0	1
DL (Bristol)	merit	4	1	0	0	0	5	0	0	1
	pass	4	8	5	1	3	1	2	0	0
	fail	3	5	5	0	0	2	0	0	2
DL (Edinburgh)	merit	3	3	0	1	0	1	0	0	0
	pass	2	4	4	1	0	4	1	0	0
	fail	0	1	1	0	0	0	0	1	0
DL (St Albans)	merit	6	6	0	2	0	2	0	0	0
	pass	9	10	12	4	1	6	5	1	3
	fail	2	2	2	1	0	2	0	0	0
Totals	**merit**	**30**	**25**	**1**	**3**	**5**	**17**	**2**	**0**	**1**
	pass	**83**	**90**	**52**	**6**	**49**	**95**	**30**	**4**	**3**
	fail	**24**	**27**	**19**	**1**	**14**	**19**	**3**	**1**	**3**

the written paper and the conflated GPA mark. The examination scripts of candidates satisfying the conflated mark threshold but gaining between 67% and 69% on the written paper were examined at moderation, re-marked where appropriate, and judged individually as 'pass' or 'merit'. However, even if these criteria were satisfied, a merit was not awarded if the assignment mark was carried over from a previous year.

The mean coursework marks for ABA, NCE and L&A in 2007 were lower than the corresponding mean written examination marks and were adjusted at moderation. Even after adjustment, 11 of the 25 appeals received this year concerned the ABA coursework. Nevertheless subsequent discussions between tutors and examiners agreed that the coursework was appropriate. The mean NCE written paper marks were significantly higher than last year. Moreover they were significantly higher than the mean written paper marks obtained on any other module. Consequently at the moderation meeting a more stringent than usual criterion was agreed for the award of merits. For a 'merit' grade on the modules other than NCE, candidates were required **either** to have a conflated mark of at least 75% plus a mark of at least 70% in the written exam **or** a mark of at least 70% in the written exam and a mark in the upper quartile in the relevant assignment. No merit was awarded if it depended on a deferred score.

The high number of appeals this year continued the trend from last year, although as remarked earlier, many resulted from the ABA coursework.

The IOA Diploma prize for best overall performance (four merits including project) was awarded to Jacqueline Patel (Salford). Special commendations for achieving three merits (including project) were sent to Mark Payne (DL Bristol), Robert. Hall (DL Bristol), Stephen Arden (DL St Albans), Jonathan Harrison (Derby), and Pamela Christie (Ulster).

The ANC prize for the best Diploma Project was awarded to Mark Payne (DL Bristol).

List of projects 2007

Colchester Institute

Critical review of London noise mapping

Noise at work assessment from use of woodworking machinery

Noise impact assessment of a wind turbine in a school

Reverberation time tests and their compliance with Approved Document E

Noise impact assessment of a domestic micro-wind turbine

Evaluation of sound transmission from outside to inside

Assessment of sound insulation testing variables

Acoustic performance of a roadside noise barrier

Control of noise from a photocopier finisher

Monitoring of environment al noise from a London heliport

A comparison of sound insulation provided by two dwellings

University of Derby

Noise exposure in the foundry industry

Evaluation of methodologies of low frequency noise assessment

Acoustics of school classrooms

Effectiveness of BS.5228

Planning assessment of a car wash

Noise exposure of double glazing window fitters

Noise exposure of refuse loaders (of waste glass collections)

Comparison of predicted and measured reverberation times of a sports hall

Planning assessment of industrial and traffic sources near a residential development

Noise exposure of semi-professional rock musician

The CRTN shortened method for PPG24 assessment

Insertion loss of a thin reflective barrier

Noise exposure from forestry equipment

Noise levels before and after a bypass at Oakham

Assessment of noise exposure risk associated with sound insulation testing

Anomalies in the Birmingham Noise Map

Stereo recording techniques

Effect of gates and openings on performance of a noise barrier

Investigation into the potential for further improvements in airborne sound insulation by increasing the isolation of standard floor and ceiling systems

Critical review of noise and health surveillance at Unilever Burton

The effect of green transport policy on residential noise levels

Evaluation of proposals for permitted development for micro-generation wind turbines

Leeds Metropolitan University

Comparison of noise from concrete and mastic asphalt road surfaces

Sound power levels and noise exposure levels from garden machinery

Control of noise from a horizontal band saw

Evaluation of the NTI Acoustilyzer and comparison with a type 1 sound level meter

Noise from the air extraction system of a public house

Assessment and control of hand arm vibration exposure from a metal pipe factory

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The Institute Diploma Examination 2007 - *continued from page 23*

Noise and vibration impact in the workplace from the installation of two 6kW wind turbines on the roof

Comparison of road/tyre noise from two types of road surface

An analysis of road traffic noise on wet and dry road surfaces and its implication for the choice of acoustic windows in nearby housing

The efficiency of council workers carrying out memorisation and recall tests under pink noise conditions

BS.4142 investigation of noise from MDF door manufacturer

A study of noise from a domestic wind turbine situated within the Metropolitan Borough of Calderdale

Measuring the vibration isolation afforded by a car seat

NESCOT

Sound attenuation provided by an air ventilation plenum

Noise from commercial premises close to residential dwellings

Noise exposure of staff in pre-school nursery classrooms

Effectiveness of a partial noise enclosure fitted around a portable generator

Noise from a garage spray bake booth

Noise impact of early morning flights over a residential property

Acoustic design and requirements of a space fro church worship

A noise metric for noise insulation in schools near Heathrow airport

Noise from domestic wind turbines

Impact assessment of construction and deconstruction noise

Breakout of plant and entertainment noise from a public house

Speech privacy of a local authority interview room

Sound insulation of different types of open windows

Validation and calibration of auralisation equipment

Noise impact from a bus garage

Noise impact assessment of a newly installed air handling unit

The quality of acoustic reports submitted to local authorities

Noise impact assessment for development proposals for Lavant Quarry

Salford University

Noise and annoyance mapping for the Environmental Noise Directive

To investigate the effect of topography on the background noise level from wind farm

Assessment of sound insulation of a newly constructed bedroom.

Computer noise in the small recording studio

School re-modelling and boiler plant replacement at a primary school

Control of Noise at Work Regulations 2005: implications for a modern day nightclub

A comparison of assessment of measured and predicted sound insulation of a party wall separating two rooms on site

Crosstalk via internal natural ventilation paths

Empirical testing of circular ducts to create formulae to assist in sound pressure level prediction

An investigation into the personal noise exposure to guides at Sellafield visitors' centre and assessment of acoustic conditions of the visitors' centre classroom

Performance comparison of two different densities and four different thicknesses of reconstituted foam in 18mm chipboard composite.

A comparison of classroom acoustic measurements in a secondary school to BB93 performance standards

Protecting musicians' hearing – a review

An investigation to assess reverberation time and ambient noise levels in a primary school and its subsequent compliance with BB93

Investigation into the acoustic performance of a new-to-the-market insulation material

University of Ulster

Performance and installation of diesel engine exhaust silencers

Noise nuisance arising from guard dog kennels

Airborne sound insulation of plasterboard and concrete partition walls

Occupational and environmental assessment of noise from pig units

Occupational noise exposure assessment of leisure centre workers

Noise exposure assessments of ground maintenance staff

Use of a domestic garage as a drum practice studio

Improving the sound insulation performance within an existing timber frame compartment

Noise impact assessment of a micro-wind turbine

University of the West of England

Sound levels from MP3 players and hearing risk assessment

Variability of hearing thresholds at low frequencies

Repeatability and precision of environmental noise measurements

Attenuation of noise breakout from ductwork

Variation of LAeq over time with respect to PPG24 assessment

The consistency of identification of acoustic features in the assessment of environmental noise

Insertion loss of a silencer for a four-cylinder internal combustion engine

Assessment of gunfire noise

Investigation into the acoustic treatment of a small goods vehicle

Effect of drop heights and damping on noise produced by material falling into a metal container

Variation of noise levels (LAeq,T) over time with respect to PPG24

The directionality of clay target shooting noise and the effect of wind velocity gradients

Distance Learning (Bristol)

Optimising loudspeaker and listening positions in a room for accurate low frequency response

Measuring the underlying noise level in the presence of continuous amplified music

The directionality of sound from a shotgun

Design and implementation of room acoustic improvements for a multipurpose school hall

Measurement of sound power levels of a compound mitre saw in semi-reverberant and free field environments

Comparison of measured and predicted outdoor sound propagation

Effectiveness of prediction of external and internal noise levels from road traffic

Variation of measured and predicted noise levels with distance from a petrol lawnmower in a free field environment over various surfaces

An investigation of the effectiveness of a bale barrier attenuating sound from a mini-motorcycle

Distance Learning (Edinburgh)

Investigation of acoustical problems at a kindergarten

Study of noise control measures which will reduce risk to 'as low as reasonably practicable' in connection with the Control of Noise at Work Regulations 2005

Abbey Road in a semi-d

Façade reflections

Sound propagation over water

Attenuation of noise over artificial grass surfaces

Investigation into noise levels from a personal computer

Directivity of radiated underwater noise from a moving surface vessel

Distance Learning (St Albans)

Noise impact of a motorway road widening scheme

Measured STI and RASTI against subjective intelligibility

Repeatability and performance of reverberation time measurements using interrupted random noise, single impulse and sine sweep

Maximising noise reduction for acoustic panels in low frequency applications

Sound insulation in a workshop

Sound transmission within a domestic dwelling

Assessment of noise from a household waste and recycling site

Sound transmission through holes in structures

Investigation of noise arising from an industrial estate in a rural area

Comparison of measured and predicted road traffic noise levels

Comparison of fixed position and swept microphone methods for airborne sound insulation measurements

Assessment of BS.8233 calculation method for prediction of internal noise levels from external sources

Comparison of different methods of measuring sound insulation (effect of operator in the room)

The role of BS.4144 in the assessment in the assessment of noise nuisance

Exploration of some issues relating to the measurement of sound insulation in buildings (source height, source spectrum, and energy/arithmetic averaging)

The acoustics and psychoacoustics of localisable sound for auditory warning systems

Maximising noise reduction for acoustic panels in low frequency applications

A new approach for environmental acoustics

Comparison of mathematical and scale modelling techniques for the evaluation of top edge modifications to noise barriers

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The Institute Diploma Examination 2007
- *continued from page 25*

Successful Diploma candidates 2007

Colchester Institute
Bass D J
Bennett R C
Browne S D
Finch A L
Hammond S G
Hawes A M
La Vigars N
Lane M J
Livesey H A
Masterson A J
Parkin L
Summerland S C
Watts C F D
Whitman M P

University of Derby
Ashraf S
Colder R
Coulthard A
Drakeley R F
Gell D K
Goodwin P
Green A M
Green W A
Grove I P
Hales M
Harrison J P
Hedges R
Howat C H
Massey N P
McKeever S
Mendis J J M
Morris C
Pell K R
Rowlands C L
Symons B D
Williams E M

Leeds Metropolitan University
Anderson J
Corfield J
Delorenzo C
Devlin R O
Ehlert M N
Haynes S L
Hooper L B
Hutton D N
Landles S L
Parris A
Sheikh S
Swift G
Weatherall I

NESCOT
Akhurst P J M
Akil H
Ballard S N
Carrick M J
Cobain S J
Elias A I
Garcia I M
Hastings T B
Hinxman G
Jones S
Lane H F
Legon M
Magbadelo P A
Ngoka O C
Richards G M
Rose G
Ryan D M
Schwarz P
Yates D
Zafar M

Salford University
Archer N P
Awbery S
Castro Llach C A
Clare D
Clark P
Creedy O
Dunbar D
Hebson H M
Holmes D W
Patel J A
Walsh R A

University of Ulster
Acheson S
Allen J N
Breslin C P
Christie P H M
Cooper C E
Dunne K D
Flanagan N
Henry N E
Hutchinson B
McCloy K A
McEldowney S
McElroy K R
O'Brien L
Rankin R A
Reynolds J M
Sloan M H

University of the West of England
Ball S
Brunt K C
Jay A M
Keen J M
March S
Rossiter P R
Sharp G
Smith R
White A S

Distance Learning (Bristol)
Gibson A C
Kelly P A
Liley G R
Morgan A W
Olver T R
Payne M J
Rees A J
Reeve S R
Shaddick R S
Snaith S R
Walsh P J J
Williams R D

Distance Learning (Edinburgh)
Brzezinski G
FitzGerald D
Giudice R M
Hall R B
Riddoch N A
Sanderson P J
Spence A C

Distance Learning (St Albans)
Arden S C
Babington X
Barker J L
Blacklock J D
Boehm A J
Boyd J M
Dodd A J
Gully T P
Harcombe S J
Haseler S P
Heath A T
Hutchinson K
McNeillie C R
Miretti F
Murgia S
Petrasso S
Robson L V
Templeman B J
Villa S
Wright C M

Pioneers of acoustics: Henry Engelhard Steinway (1797-1871)

John Tyler.

This may be stretching the 'acoustic pioneers' definition a little, but Henry did produce the ultimate in applied musical acoustics as far as pianos are concerned, and his story makes interesting reading.

Early life

There is some disagreement among the several sources about Henry's early life but what follows is a conflation of the information from the several sources. In particular there are conflicts about the names of certain family members. However it is hoped that these discrepancies will not spoil the story.

He was born Heinrich Engelhard Steinweg in Wolfshagen im Harz, Germany on 15 February 1797 (this fact is common to all the accounts). He had a hard and impoverished childhood, losing most of his family when he was young; several of his brothers were killed during the Napoleonic wars and his father, mother and remaining brother died from disease when he was 15 years old. Henry himself was drafted into the Prussian army and allegedly fought at the battle of Waterloo.

A fascinating alternative story about the early days comes from an authoritative source; a book by Richard K Leiberman, Professor of American History at La Guardia Community College published in 1997 and sourced from the Wagner Archives which houses the Steinway historical papers.

' One summer Heinrich, his father and his half brothers, were out in the woods far, from home, when a storm suddenly arose, accompanied by ferocious winds and lightning –typical Harz mountain weather. They sought shelter in an abandoned hut, huddling together for warmth and comfort. But lightning struck the hut, setting it on fire. Heinrich was knocked out by the blast and when he came to, he found the dead bodies of his father and two brothers lying strewn around the shack. Aged barely 15, Heinrich was both an orphan and penniless. He sought refuge in the army. Two years later he was fighting against Napoleon at the Battle of Waterloo. '

This story does not appear in other sources - I cannot imagine why - it would have made a wonderful operatic episode, probably with music by Weber!

On his return from the army at 21 Heinrich began work as a carpenter and was apprenticed to an organ builder in Goslar, about ten miles from Harz: although he had no musical training he progressed rapidly and eventually learned to play the organ and, in 1818, became a church organist. His introduction to piano construction was in 1820 through his Jewish friend Karl Brand, a cantor's son: he copied Brand's piano design, probably an early square piano.

In 1825 he married Juliane Thiemer, the daughter of a property owner and established glove maker. As a cabinet maker without property, Heinrich was 'marrying up'. The couple moved to Seesen, a town in Lower Saxony a few miles from his birthplace. He built the first piano of his own design and gave it to his bride as a wedding gift. In 1836 he built his first grand piano in his kitchen. This piano survives and is known as the 'kitchen piano' and is on display at the New York Metropolitan Museum of Art together with a Steinweg square piano of 1836.

continued on page 30

Figure 01

A detailed view of an original balustrade and door of one of the Steinway Workers' Homes.

Figure 02

Between 1877 and 1879, Steinway constructed a group of handsome row houses on Winthrop Avenue (today's 20th Avenue) and on Albert and Theodore (41st and 42nd) Streets. Even the street names bore witness to the Steinway family, since Albert and Theodore were sons of Henry Steinway. The Steinways rented these homes to their workers.

Figure 03

Henry Z. Steinway Limited Edition

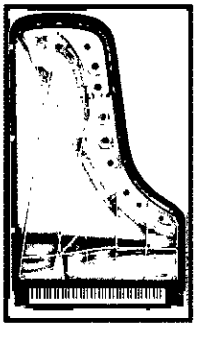

Figure 04

Concert Grand an art poster published in 1984

Figure 05

Heinrich Englehard Steinweg Picture taken about the time of his journey to America

Pioneers of acoustics:... - *continued from page 28*

Heinrich and Juliane had seven children, all of whom, together with their offspring, eventually became involved in the Steinway company. They were Theodore, Dorette, Charles, Henry, Wilhemina (Minna), William and Albert.

In Seesen Heinrich came up against the guild system's regulations, which stipulated that members could start a business only in their place of birth. The very year he moved to Seesen the town was virtually destroyed by an extensive fire. As a consequence the chief justice of the town decreed that master builders like Steinweg be permitted to establish businesses there and so rebuild the town. Accepted as a burgher (citizen), a year later Heinrich established an organ building business and by 1829 had made enough money to purchase a two-storey house with a workshop. By 1835 he had started producing pianos and attached his nameplate 'H Steinweg, Instrumenten-macher, Seesen' to every instrument. In 1839 Heinrich Steinweg received first prize for his pianos at a fair in Brunswick, Germany and by 1848 he had produced over 400 pianos.

However at this time the failure of revolution of 1848 caused many Germans, who had hoped for its success, to be unwilling to return to a life under the restored authoritarian regimes and chose emigration - mostly to the United States.

Heinrich was one of these and as his business began to suffer he sent his son Charles to America in 1849 to survey the field. Charles had supported the failed revolution and this probably determined Heinrich's choice of son to do the reconnaissance!

Charles sent back a very favourable report on the working conditions and chances of success in America and this persuaded Heinrich to up sticks in 1850 and take his family to America. Theodore remained in Germany to look after the Steinway factory, but he too came to the USA in 1865 to help manage the business.

They sailed in June 1850 on the ship Helene Sloman from Hamberg, Germany to New York City. The journey took almost five weeks and when they arrived they all managed to get jobs working in various piano factories in the city.

In America

After working for three years for other piano makers Heinrich Steinweg (as he then was known) and his family established the partnership of Steinway and Sons in 1853, anglicising the name for business purposes because at that time English-made pianos were considered the best in the world. He changed the family name to Steinway legally in the mid 1860s. They built their pianos in a rented loft on Varick Street in Manhattan; the first one they produced can be seen in the Metropolitan Museum of Art.

In view of the increasing wealth of the American middle class during the first half of the nineteenth century and the developing desire for the latest amenities, which included pianos, it was clear that Henry Steinway had entered the market at a very opportune time.

While the company had the skill to produce a quality product, they realised that in order to succeed they needed to have a efficient marketing policy. This is where William and Henry Junior came into their own.

The techniques of advertising were only just being developed and the main way of becoming known was to exhibit at trade fairs and exhibitions. In 1854 Henry Steinway Jr entered the Steinway piano in the Metropolitan Mechanics Institute Fair in Washington DC, where it won first prize, and at the American Institute Exhibition in 1855 in the Crystal Palace in New York City where it won the company's first gold medal. It gained much praise and attention from the press, for example a reporter wrote 'Their square pianos are characterised by great power of tone, a depth and richness in the bass, a full mellowness in the middle register and brilliant purity in the treble, making a scale perfectly equal and singularly melodious throughout its entire range, In touch, they all that could be desired.' By this time the Steinway square grand had a seven-octave keyboard range and a full iron frame with over-stringing.

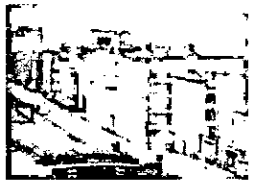

Figure 06

Steinway factory at Park Avenue New York, around 1890

Figure 07

Cartoon, originally published in August 1867, after Steinway's success at the Paris Exposition.

Figure 08

Early Steinway grand piano, 1850s.

Figure 09

The Steinway home in Seesen

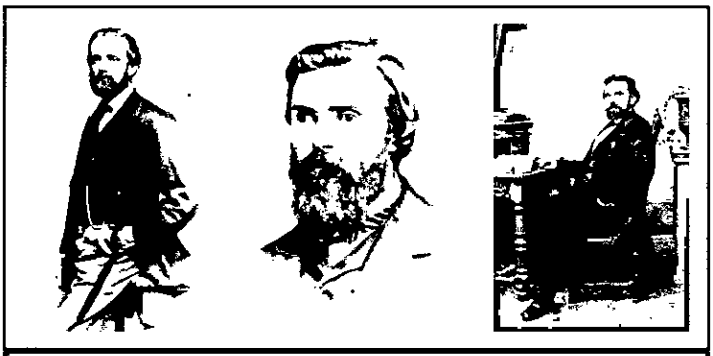

Figure 10

Charles Steinway *Henry Steinway Jr* *Theodore Steinway*

Figure 11

Steinway Hall 14th Street

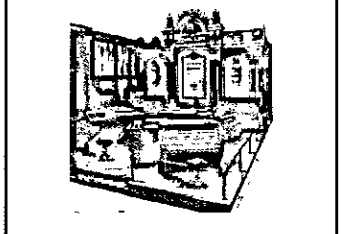

Figure 12

Steinway and Sons' exhibition at the Centennial Exposition 1876

By the end of the following year the effect of these efforts was to triple sales compared with 1854. This success and the financial gain, which it provided, enabled the company, in 1858, to purchase and move into their own 175,000ft² factory at Park and Lexington. With steam engines powering elevators and much of the woodworking equipment, it was the most mechanised factory in the city at the time. Production increased to 30 square pianos and five grand pianos a week.

Henry Jr was also the design engineer of the company and he was continually developing the way in which pianos were made: some of his innovations revolutionised the instrument. A major problem at the time was that with the wood and metal construction of the time the piano had to be constantly retuned owing to the movement of the materials. The use of cast iron, although stabilising the tuning, produced a tinny sound. By 1859 Henry had changed the shape of the cast iron plate, over-strung the sound board and altered the hammers. He filed 19 patents from 1850 to 1874. The result was a piano with more keys, a richer sound capable of more variation in volume. He had produced the modern piano that remains, with comparatively minor changes, the same today.

It has to be admitted that the English piano maker Broadwood was pursuing the same lines of development but Steinway led the field in America in spite of strong competition from another American manufacturer, Chickering. In 1859 Henry Steinway Jr followed the lead given by Chickering by soliciting testimonials from renowned pianists of the world. Henry also wined and dined influential music critics, newspaper editors and sheet music publishers. By 1860 Steinway employed 300 workers and produced more than 1000 pianos annually.

Henry Jr however was not satisfied with national recognition; he wanted to be known all over Europe, the recognised music capital of the western world. So, in 1862, in pursuit of this goal, he entered Steinway pianos at the London Exhibition. The professional and amateur musicians were enthusiastic about the Steinway instruments but the jurors did not fully appreciate the benefits of the Steinway system and awarded the grand prize for pianos to the English piano maker, Broadwood who had previously set the industry standard. However, Steinway was judged the best American piano.

There is no doubt that the outstanding achievement of Henry Steinway and the family company was their success in the 1867 World's Fair held in Paris. Over 400 piano manufacturers exhibited at the competition and Steinway showed four models. Steinway won a gold medal in May and in July won the prestigious Grand Gold Medal of Honour for excellence in manufacturing and engineering, and also honorary membership of France's distinguished Societe des Beaux Arts. The Steinway company had become the first American firm to win top prize in the piano category. Their main competitor, Chickering, also won a gold medal and a special 'Legion of Honour' award, and both companies had their instruments endorsed by Franz Liszt.

Both American companies launched an intense marketing war via newspapers, saturating their pages with advertisements highlighting their Paris awards. The Chickering company erected a large replica of their Legion medal on top of their 57th Street factory in New York! Steinway surpassed Chickering's endorsements by using complimentary statements from European royalty, including one from Queen Victoria.

The Paris World's Fair established Steinway and Sons as the leading choice for pianos in Europe and soon after the exhibition the company was selling twice as many instruments as its nearest competitor.

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Figure 13

Albert Steinway

Figure 14

Steinway factory in Astoria

Figure 14

Steinway village houses, Astoria

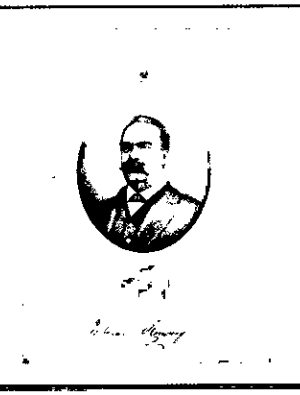

Figure 15

William Steinway

Pioneers of acoustics:... - *continued from page 31*

American Civil War

From 1861 to 1865 the American Civil War was in progress, and it did not leave the Steinway family untouched. In 1861 Charles Steinway, the first of the family to come to America, joined New York's 5th Regiment. This was made up largely of Germans and Charles became paymaster for the Civil War. He took part in the occupation of Arlington Heights, Virginia. In 1863 Albert Steinway, who was only nine years old when he came to America, joined the Civil War effort in Pennsylvania, serving as a first lieutenant with the 5th Regiment at Harrisburg, Marysville, Carlisle and Chambersburg. He stayed in the army until 1871 when he resigned with the rank of Brigadier General. The year 1865 turned out to be a sad one for the Steinway family: Henry Jr died of tuberculosis and Charles, the first Steinweg to come to America, died of typhoid fever. In 1871 Henry Englehard Steinway, the founder of the company, died on 7 February at his home in East 53rd Street, after a long illness.

After the war

After hostilities ended the Steinway business grew steadily and needed more space to expand their factory buildings. In 1870, William Steinway bought 400 acres of farmland in northern Astoria, in Queens, Long Island for their new factory, which still dominates the area. Between 1870 and 1873, in addition to the factory, a small town was built to provide housing, a library, a church, a kindergarten and a public trolley (tram) line (horse-drawn in the beginning). The figures illustrate the factory, the workers homes and the recreational facilities provided nearby at North Beach (now La Guardia Airport).

This site was ideal for the business as it was near water, which facilitated the transport of the heavy timber and iron ore used for the manufacture of pianos. The 53rd street factory was retained for some time, assembling pianos from the components made in Astoria.

Ferry boats were used to ship the parts from Astoria to Manhattan and also to transport workers living in Manhattan to and from work. The Astoria factory communicated with the 53rd Street factory by telegraph until telephones were installed in 1884.

The philanthropic Steinways

To be fair to the Steinway family they did not have profit as their only motivation. They were very caring about their employees, providing rented houses for the workers near the factories, and also constructing facilities for the general public in New York. For example in 1866 William Steinway carried out the planning and construction of the Steinway Hall on East 14th Street, near Union Square. This was done with the full cooperation and support of city of New York. This ornate, white marble building opened in 1866 as the second largest concert hall in the city. It provided excellent acoustics, seating for 2000 people with a concert stage for a full 100-piece symphony orchestra, music rooms and studios. Its four floors had enough space to fit in a showroom for more than 100 pianos. The New York Philharmonic Orchestra performed in the Steinway Hall until the larger Carnegie Hall opened in 1891.

William recognised that it would be good for piano sales if famous pianists had a place to play on Steinways and also took an example on a concert tour. In 1872 Steinway and Sons organised an extensive concert tour of 215 performances in 239 days for the Russian virtuoso Anton Rubenstein.

There are now many Steinway Halls all over the world including the one in London, which opened in 1875 and became the first Steinway Hall in Europe.

Figure 16

Steinway Family Playing Croquet

Figure 17

Steinway Family

Figure 18

Craftsmens' tools at the Steinway factory, where pianos are still made in the basic processes designed by Henry Steinway.

Figure 19

The Steinway factory still operates in the same location today as it did in the 1800s.

Figure 20

North Beach, the beachside amusement park set up by Steinway for his workers.

Figure 21

The Steinway mansion is still a private house on 41st Street.

Figure 22

Workers outside the Steinway factory.

Steinway and Daimler-Benz

(A little known bit of Steinway history)

In 1886 the first cars, powered by a fast running internal combustion engine, left the workshops of Gottlieb Daimler and Karl Benz and ran on the streets of Mannheim in Germany. On October 6 1888, a contract was signed between William Steinway, of Steinway and Sons in New York, and Gottlieb Daimler. The two men had met through Wilhelm Maybach who, during the World's Fair in Philadelphia, visited his brother, an employee of Steinway. The result of the contract was the production of Daimler engines and products in America and the establishment of the Daimler Motor Company in New York.

The site of the Steinway piano factory in Long Island, New York, provided enough space for the production facilities, especially for the installation of Hartford-made engines into boats: William Steinway had concluded a contract with the National Machine

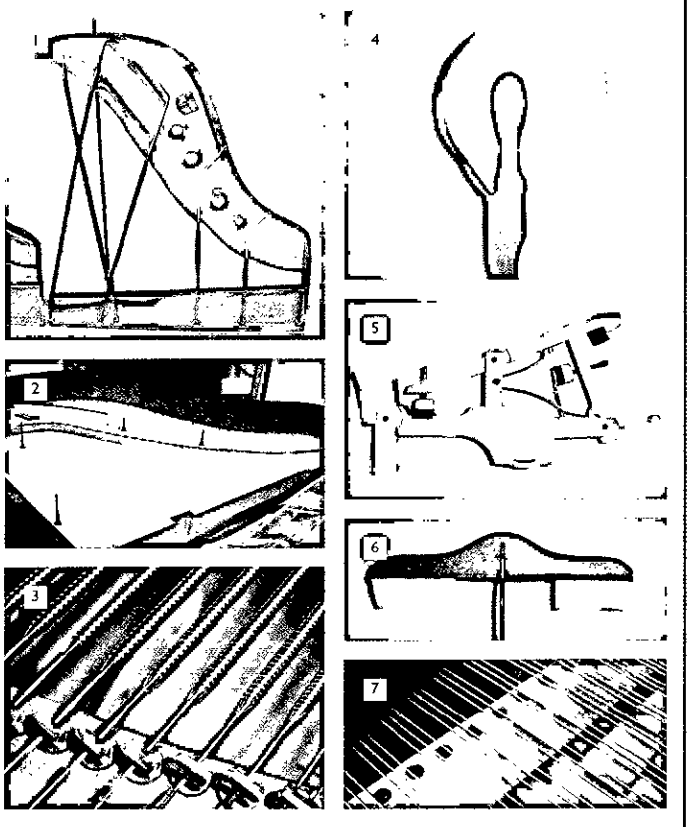

Figure 23

Some critical parts of a modern piano (there are over 12000 parts in a Steinway)
(with acknowledgements to Jeffrey Shackell, (concert piano technician, Witney, Oxfordshire),

(1) Cast steel plate. (2) Sound board and bridges. (3) Coned ends to bass strings. (4) Hamburg hammer head with magenta core and mahogany moulding. (5) Action repetition lever with jack adjusting screw. (6) Damper head with wire (7) Damper sockets.

Figure 24

Steinway Hall, 14th Street, New York

Figure 25

Henry Ziegler Steinway, great grandson of the founder, at the opening ceremony of the Steinway Gallery in Carlsbad, Germany

Company of Hartford, Connecticut for the purpose of manufacturing Daimler engines.

Final notes

(with acknowledgements to Shannon Wingard, North County Times)

In 1942 the young Henry Steinway, a graduate of Harvard became a factory manager at his family's company. After a brief service in World War II he rejoined the family business and eventually became president of Steinway and Sons in 1955. He served in that role for more than 20 years.

In December 2007 Henry Steinway, now 91, great-grandson of Henry the founder of the company, was honoured at the dedication of the new Steinway Gallery in Carlsbad, Germany. Over 200 piano dealers, instrument makers, and piano enthusiasts were present to acknowledge the latest Henry for his contributions to the music industry.

John Tyler FIOA is Associate Editor of Acoustics Bulletin

Consulting in occupational health and safety - Getting it right

Tim Ward and Andrew Thompson.

Introduction

The social and economic benefits that would arise from reducing, or eliminating, the problems of occupational noise-induced hearing loss (NIHL) and hand-arm vibration syndrome (HAVS) are indisputable. For employers to discharge their legal and moral responsibilities in these areas requires that they are in possession of knowledge, means and a willingness to take action; and where knowledge is lacking, employers often turn to consultants.

With new or revised legal requirements on noise and vibration introduced in recent years as a result of European Directives, with more employees and industry sectors coming in to scope due to a lowering of acceptable risk thresholds, and programmes of targeted activity on the part of the Health and Safety Executive (HSE), consultants in these fields may well have seen demand for their services increase.

But if you are a consultant, or 'competent source' of advice and information, as the guidance' to *Control of Noise at Work Regulations 2005*[2] puts it, how can you make sure that the advice you give is what the client needs, that is, advice that helps the client to control the risks? Common failings on the part of employers include: having measurements of noise or vibration made, but not doing anything with the results; putting excess effort in to attempting a very precise quantification of the exposure when the risk to employees is in fact quite evident; failing to properly consider known good practice solutions to the noise or vibration problems; or in the case of noise, relying solely on personal hearing protection where other control measures are reasonably practicable. All of these are areas where the employer would benefit from good quality advice.

This article outlines a pragmatic approach to the management of occupational risks from noise and vibration, and shows how a consultant can assist in helping the employer to achieve the goal - management of risks and a reduction in incidence and severity of ill-health.

A framework for compliance

Ill-health caused by work-related exposure to noise and/or vibration is invariably permanent and incurable. Following the published guidance[1,3] to achieve compliance with the regulations[2,4] will result in risks being under control and should, over time, lead to eradication of new cases of disabling ill-health. The following is a summary of the guidance given by HSE to employers on managing noise and vibration risks:

- assess the risks to workers, including by estimating the likely noise or vibration exposure and comparing to the exposure threshold values;
- take immediate action to reduce workers' exposure to below the legal limits (subject to transitional arrangements for hand-arm vibration);
- introduce a programme of controls to eliminate risk or reduce exposure to a level as low as reasonably practicable;
- provide information and training on health risks and the actions being taken to control risk;
- introduce a programme of health surveillance;
- maintain a record of the risk assessment and controls;
- keep health records for employees under health surveillance; and
- review and update the risk assessment as required

Health and safety advice

Where a company seeks external assistance on noise or vibration issues, the reasons are likely to be varied but may include:

- inability to determine whether its workers are at risk;
- lack of knowledge or expertise on the likely technical or managerial solutions;
- confusion as to just what is required of it by the regulations.

There may also be an external motivating factor – for example, a recent visit by a health and safety inspector from HSE or the local authority might have brought the need for action in to sharp focus!

Some employers coming to consultants for advice will know exactly what they want. They may have accessed the information on the HSE website on 'Looking after your business', be aware of how to seek competent advice and have looked at the publication INDG420 'Getting specialist help with health and safety'[5]. Others however will not have any particular knowledge, and may need help and advice at a very basic level. But whether the client appears knowledgeable or not, it will always be worth exploring whether what it wants is the same as what it needs.

Whilst many consultants undoubtedly produce high quality work that results in the companies that commissioned them receiving excellent advice and guidance, HSE's inspectors regularly encounter situations where businesses have not been well served by their external help providers. Inspectors report that they see examples of bad advice (ie just plain wrong, or given by someone with inadequate knowledge/experience) and poor advice (not fit for purpose, *eg* dealing with trivial risks; excessive paperwork; not tailored to provide practical advice on managing risk in that particular workplace). If nothing else this reflects a missed opportunity to provide the client with sound advice on how to reduce noise and vibration risks in its workplace.

As a final point on this subject, consultants will no doubt wish to be aware of section 36 of the Health and Safety at Work *etc* Act 1974. This sets out that where an offence is committed under the Act or any of the subordinate regulations, and it can be shown that this was due to the act or default of some other person, that other person will be guilty of the offence and may be charged. This may apply where, for example, a consultant's advice has lead to an employer not being in possession of a suitable risk assessment, or failing properly to manage a risk. Providers of external advice would be advised to be familiar with the 'HSE statement to the external providers of health and safety assistance'[6].

Assessing the risks

A risk assessment is the starting point in managing a health or safety risk. Risk assessment means examining what, in the work, could cause harm to people. It means weighing up if enough precautions have been taken, or if more should be done to prevent harm. In practical terms, a noise or vibration risk assessment can range from the very simple ("workers are clearly exposed to risk here, it's caused by that process, let's do something about it") to the more detailed, such as for a complex work pattern or new process. Arguably, external consultants should only be necessary at the more complex end of assessment.

Since in the regulations on noise and vibration, daily personal exposure to these agents is used as a surrogate for risk, there is a need to assess this exposure. But the regulations do not require a very precise estimate of exposure to be made; they do not even *require* measurements to be carried out (although these might be necessary if the situation is complex or there is a lack of reliable information on exposure).

If a potential client comes to a consultant asking, for example, for a 'noise assessment' or a 'vibration survey', it may be that what they really are asking is 'help me understand the risks in my workplace'. A consultant in this position would be advised to consider whether this client would be best served by being helped to come to a rapid understanding of the risk. Is this situation as described one where it is clear that the defined exposure thresholds for noise or vibration are likely to be exceeded? Is there published information, perhaps on the HSE website, that gives sufficient information for it to be assumed that there is a risk to be managed? Is there clear good practice in control and management of risks for this situation which is not being followed? In these cases it would be in the interests of the client for it to move directly to thinking about control of noise or vibration risks. Simplified exposure assessments, for example using typical noise levels and assumptions of exposure duration and the HSE noise ready-reckoner[7] (shown in Figure 1) could be sufficient. Certainly, a consultant would be

continued on page 36

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Consulting in occupational health and safety - *continued from page 34*

expected to let the potential client know that simply taking measurements is not compliance and more importantly will not protect the workers.

There will of course be circumstances where measurements of noise or vibration in the workplace are necessary. Perhaps the work or the work patterns are unusual or complex and reliable information on daily exposure is not available from other sources. Here it is essential that the measurements are carried out by someone who has the necessary competence (this might be particularly important where measurements of hand-arm vibration exposure are concerned), such as a noise or vibration consultant.

Even so, the time and effort that has to be put in when making measurements should be considered. In fact, given the uncertainties attached to any live working situation involving human beings, the more measurements are taken, the more confusing a situation may become! What is required from any measurements is an estimate of likely exposure, sufficient to establish whether the action or limit values are likely to be exceeded. Knowing when to stop taking measurements is a competence the consultant would be expected to have.

It is important to remember that it is the noise or vibration exposure of the people that is important. The well-known 'noise map' is only really helpful if it can be combined with information on where people work, for how long, and what they are actually doing (which presumably is not simply standing at the measurement location!) So observing the work and working patterns is very important. For hand-arm vibration it is 'finger-on-trigger' time which is important. In Figure 2 a video-camera is being used to establish the usage time of a rail cutter by a track worker. A video camera is not essential; other methods such as direct observation, talking to workers and supervisors and analysis of work-time and production records can provide reliable estimates for the purposes of a risk assessment.

At the end of the risk assessment process, whether at the very simple or the detailed end of the spectrum, the employer should be in possession of an action plan setting out what is intended to be done about the risks identified - how the workers are going to be protected. In fact, a risk assessment does not meet the requirement of being 'suitable and sufficient' if it does not identify what measures are necessary to eliminate risks and exposures, or reduce them to as low as reasonably practicable.

Protecting the workers - Planning and acting to reduce exposure

Reducing risks, reducing exposure and protecting the health of workers - this is where the employer should be concentrating its efforts. Developing an action plan is the first stage, and putting it into practice the second.

Not every consultant will be competent to advise on appropriate measures to control noise or vibration (similarly, not every consultant will be competent to advise on noise or vibration risk assessment or carry out assessments of exposure). So long as the client understands the limits of the advice it has been given, all should be well. Some consultants include 'generic' noise or vibration control information in their advice: while this may be helpful in a general sense to the client, it is unlikely to be sufficient to form the basis of a control action plan, and clients should be made aware of this. Advising the customer what else is required and where it can be obtained is a valuable service. Importantly, making sure the client is in no doubt if more action is required by them and that it does not end with the exposure assessment.

An employer with noise or vibration risks to manage would be expected to put in place an action plan with immediate, medium-term and long-term components. Issues falling in to the 'immediate' category include any situations where noise or vibration exposure limit values are being exceeded: employers need to know about these as soon as practicable, and they should receive due prominence in any report provided.

Developing an action plan to tackle noise or vibration risks begins with identifying what is possible in a given circumstance, and how much reduction in exposure could be achieved. This allows a decision to be made on whether the control measures identified are 'reasonably practicable'. This term is at the heart of health and safety legislation. Whilst the concept of weighing costs against benefits is well understood, it is not so widely known among employers that for a particular measure *not* to be reasonably practicable there must be a gross disproportion between the cost (time, money, effort) involved and the benefit that would be gained. Consultants advising clients on

Noise exposure ready-reckoner (Daily exposure)

Sound pressure level L_{eq} (dB)	Duration of exposure (hours)								Total exposure points	Noise exposure L_{eq} (dB)
	½	¼	1	2	4	8	10	12		
105	320	625	1250							
104	250	500	1000							
103	200	400	800							
102	160	320	630	1250						
101	125	250	500	1000						
100	100	200	400	800					3200	100
99	80	160	320	630	1250				2500	99
98	65	125	250	500	1000				2000	98
97	50	100	200	400	800				1600	97
96	40	80	160	320	630	1250			1250	96
95	32	65	125	250	500	1000			1000	95
94	25	50	100	200	400	800			800	94

Figure 01

HSE noise exposure ready-reckoner

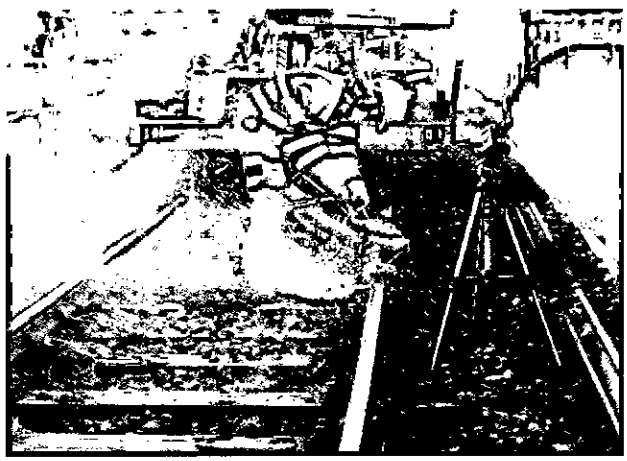

Figure 02

A track worker engaged in rail maintenance

practical noise or vibration control measures, and wanting to act in their best interests, would do well to develop some persuasive arguments around the meaning of 'reasonably practicable'. Employers can be inclined to persuade themselves that a less stringent test of cost versus benefit can be applied. It must be recognised however that the Court is the final arbiter of what is or is not reasonably practicable.

As mentioned earlier, established good practice and case studies can provide a valuable insight in to what is possible in noise or vibration control, and employers would be expected to be researching these areas. The HSE websites for noise for hand-arm vibration will be a useful starting point here, as may contact with trade associations. Consultants working in the field of occupational noise and vibration would benefit from knowing where to obtain this type of information, and having a good understanding of its content. But the aspect of this where clients may need the most help is in understanding how the general principles which a case study might illustrate can be adapted and applied to the particular situation confronting them. Here the consultant with specialist knowledge in noise or vibration control or engineering principles can play a valuable role in bridging that gap in the client's understanding.

The 'general principles of prevention' set out in the Management of Health and Safety at Work Regulations 1999 (as amended)[8], and carried through in to the regulations on noise and vibration, should be considered in planning and implementing noise or vibration control measures. The general principles include that risks should be avoided or eliminated, risks should be combated at source, technical progress should be incorporated, the dangerous should

progressively be replaced by the less dangerous, and collective protective measures should be given priority over individual protective measures. Elimination of risk from noise or vibration is most likely to be achieved through changing the work process or the adoption of alternative ways of working, but employers often have difficulty in seeing how this can be achieved, perhaps because they are too close to the work itself. An external consultant with an understanding of what is possible can bring a fresh eye to the situation and allow the range of alternatives to be properly considered. Even if process change or alternative working methods are not reasonably practicable now, it would be expected that keeping these options under review would form part of an employer's ongoing management of risks. So, for example, choosing a 'better' hand tool now to reduce risks from hand-arm vibration could be seen as an interim measure until the more sustainable control measure of an alternative working method which eliminates or greatly reduces hand-tool use becomes viable.

Other areas where employers could benefit from a persuasive external influence in developing an effective action plan include a couple of commonly held misconceptions. Firstly, it is often thought that a control measure that does not reduce employees' exposure to below a particular exposure threshold is not worth doing. Here the employer must be persuaded that any reduction in exposure is likely to have intrinsic value in reducing the risk and, in the case of noise, may mean that less reliance need be placed on personal hearing protection, subject as it is to the frailties of human behaviour and a highly burdensome management requirement for supervision.

Secondly, it may be thought that the exposure limits set in regulation are allowable exposures that can be worked up to. This seems a particular misconception in respect of hand-arm vibration, where it is common to see employers presented with, or generating for themselves, information which could be characterised as 'for how long can I get away with using this tool?'. Leaving aside the point that it is bad practice to plan to work up to exposure limits when the law requires that risks and exposure be minimised, often no thought is given to how the system might work in practice where an employee might use several different hand tools over the course of a typical day. Whilst it may appear attractive to employers to throw the burden of managing the risk from day-to-day on to the employee, with expectations of them totting up 'points' as the working day goes on, the primary duty to manage the risks rests with the employer. The meeting of exposure limits by restriction of exposure duration might be the most appropriate immediate or short-term measure, but it is does not take away the responsibility to be investigating and developing more sustainable means of reducing exposure and risk to a level as low as reasonably practicable.

Having developed an action plan, perhaps in consultation with external advisors with appropriate competence, and based on known good practice and industry standards, the application of general principles of noise or vibration control, and with due regard to the general principles of prevention, the plan needs to be implemented. This becomes a matter for the employer of simple good business practice: timetabling, assignment of responsibilities to individuals, ensuring the work is carried out, and checking the effectiveness of what has been done.

The report

The product of a consultant's work is most a likely a report. There is no right or wrong format or layout for a report. Whether the report refers to a simple assessment of noise or vibration exposure, suggestions for the content of an action plan to reduce risks and exposures, or a proposal for how the work will be done, it must be suitable for the needs of the client. These needs should be established at the beginning of the contract process so that the employer knows what it can expect in the report.

A client has a right to expect that any report received contains the answer to the question asked (or the question that the client was persuaded to ask). Given that the client needs the information in order to manage risks and protect against employees developing disabling ill-health, the importance of ensuring that the information is clearly communicated is obvious. Equally importantly, the limits of any advice given should be clear, and consultants will serve their clients well by identifying, to the extent that their competence allows, what further action the client should be considering in order to manage the risks.

Reports which contain a great deal of background information or raw data, without thought to how this is best presented, can lead to the client becoming confused or bogged down. Presenting raw measurement data, and leaving the client to do further interpretation in order to get the answers needed, is simply unacceptable. It will not be necessary to regurgitate the regulations in a report, unless of course the client has specifically requested this. But even if information on legal duties has been requested, it may be better to describe in outline the essential elements of what the law requires for the protection of workers' health.

Summary

Ill health due to occupational exposure to noise or vibration can be reduced or eliminated if employers understand the level of risk to their employees and, crucially, take action to control the risks as the law requires. Employers need access to good quality advice and information to do this effectively, and external consultants have a valuable role to play in this process.

Consultants that develop a good understanding of how risks from noise or vibration are best managed and controlled, and are thus able to understand both what the client wants and what it needs, are in the best position to contribute to reducing ill-health. Tailoring advice to the specific circumstances, understanding the limits of their own competence and the advice they are giving, and communicating clearly to the client both what has been done and what more needs to be done to manage the risks are all important elements to the provision by consultants of good quality advice on noise and vibration.

Tim Ward and **Andrew Thompson** are with the HSE.

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The rise of reverberation

Paul Absolon.

While contemporary interior design favours the use of hard, reflective surfaces, the consequence is that reverberation times within buildings are on the rise. Ever smaller rooms within buildings compound this, as developers seek to maximise the use of available land space. Where occupants are concerned, reverberation in the very least will be mildly disruptive, and at its most extreme, can cause physical discomfort. This article discusses the drivers behind the rise of the reverberation challenge, and offers some advice on reducing reverberation times in various types of development.

Reverberation, sometimes known in layman's terms as 'echo', is a sound phenomenon created when sound waves are reflected by surfaces within a room, such as floors, walls and ceilings, so that one source of sound seems to become several.

In general, the harder the surface, the stronger the reflection, and the more severe the reverberation. Hard surfaces are prevalent in modern building design because of the absence of soft furnishings and the increased use of tiled and wooden finishes. In buildings such as schools and offices, reverberation can result in disruption, as it inhibits the clear transmission of sound such as speech, which is then heard less clearly by the listener.

The concept of reverberation

Reverberation is measured in units of time, and the reverberation time RT60 is defined as that taken for the sound pressure to fall by 60dB after the source of the sound has ceased abruptly. Reverberation time can be calculated based on the volume of a room using the well-known formula devised by Wallace Clement Sabine. For room volumes less than 1000m³, an approximate reverberation time can be calculated using either of two formulae.

If the average absorption coefficient α_m is less than 0.3, Sabine's formula is used:

$$T = 0.16V/A \quad ...[1]$$

where T is the reverberation time in seconds, V is the volume of the room in m³ and A is the total absorption in metric sabines (the total absorption is defined as the absorption coefficient of each surface multiplied by its surface area in m²).

If α_m is greater than 0.3, the Sabine-Eyring formula is used:

$$T = 0.16V/\{A_{air} - S_T \ln (1 - \alpha_m)\}$$

where S_T is the total surface area in m² and A_{air} is the acoustic absorption of the air volume.

Reverberation times are often described in the six octave bands between 125 and 4000 Hz. The longer the reverberation time and the lower the frequency, the more difficult the sound is to control.

Planning and control

While some level of reverberation is required in a room for sound to be heard effectively, there is a point when it actually becomes disruptive, particularly in educational buildings. To help overcome this, legislative guidance has been introduced in the form of BB93, which sets the standard for reverberation time in newly built schools at 0.8 seconds. However, a good teaching environment will typically have a reverberation time of 0.4 to 0.8 seconds, while a poor reverberation time could be anything between two and 12 seconds.

Where reverberation time is unacceptably long, the usual method of control is to absorb the sound directly. Different types of absorber are available, the selection of which will depend on the level of absorption required.

Natural sound absorbers

Included in this group are upholstered furniture, curtains, carpets and cushions. Thanks to the open cell structure of soft materials, they naturally absorb sound and prevent some of it from reflecting and travelling onwards. This is why the absence of soft furnishings, in line with minimalist styling, has made reverberation a modern acoustical challenge.

Porous absorber / anechoic material

These are made from open cell or fibrous materials that dissipate the sound energy within their structure. The sound is deflected inside the material, the friction from which converts it into low-level heat. In terms of performance, the thicker the material, the higher the absorption capacity, because there will be more cells through which the sound energy can deflect. An absorptive material would not be a practical control method at low frequencies, as the wavelengths are relatively long and the absorption coefficients low. It may therefore be necessary to consider some form of acoustical barrier where the problem is predominantly at low frequency.

Resonant absorber

This dissipates sound energy in a similar way to a porous absorber, in that friction converts the sound energy into low-level heat. However, a resonant absorber does so by allowing vibrations of the air in an enclosed space. The volume of air also helps mute the sound, offering a two-pronged approach to reverberation control. Where very high levels of reverberation are apparent, a porous absorber with a resonant element would be used.

The best practice would be to account for reverberation at the start of a development, by ensuring that the room volume is of a sufficient size - certainly more than 25m³ - and not including too many reflective surfaces. Designing a room with a suspended ceiling will also help as this creates a void that will act as a resonant absorber.

In reality, apart from developments governed by BB93, remedial cases emerge because the acoustics within an environment are not always considered as important as the control of sound between spaces: Part E of the Building Regulations (for residential developments) is one example, although a calculation of the required absorption area in common parts of a residential building is called for. This may change in the future as reverberation in an apartment can raise sound levels to such an extent that it travels between dwellings, a problem not currently dealt with at the site testing stage.

Reverberation amplification results in a higher starting sound level than would be considered normal. For example, a television in a normally furnished apartment emits 70dB into the room. However, the same television in an apartment with no soft furnishings whatsoever could reach as high as 76dB. This increased sound level could result in audible sound in neighbouring dwellings. Problems occur for a number of reasons, including the actual noise levels being higher than anticipated, or the reverberation arising as an issue in non-teaching areas, such as dining rooms.

Focus on solutions

Depending on the environment, there are a number of different acoustic solutions that can be implemented, incorporating either porous or resonant absorbers. Where remedial work is necessary, the constraints and the practicalities of an environment must be considered along with available budget. A reverberation control method appropriate for a school may well be different from the method used in an art gallery or theatre.

Measuring performance

The absorption performance of reverberation control measures is classified against the British Standard ISO 11654: 1997. The

performance is measured as a noise reduction coefficient (α_w) which relates to a percentage reduction in sound: if α_w is unity, 100% of the sound energy is absorbed. The sound absorption classes are summarised in Table 1. The laboratory testing to determine the values according to ISO 11654 is carried out using the random incidence method to BS EN ISO 354 (2003).

Sound absorption class	α_w
A	0.90; 0.95; 1.00
B	0.80; 0.85
C	0.60; 0.65; 0.70; 0.75
D	0.30; 0.35; 0.40; 0.45; 0.50; 0.55
E	0.25; 0.20; 0.15
Not classified	0.10; 0.05; 0.00

Table 01: Sound absorption classes

Acoustic wall coverings

Reverberation is commonly controlled using acoustic wall coverings. These are available in various formats to accommodate flexibility of use and design requirements. For example, tiles or rolls might be used to achieve total wall coverage, and as these are available in a wide range of colours, they can become part of the interior design. Some materials do not fray when cut, which means logos or even a detailed mural can be created on the wall area. If total coverage is not feasible or appropriate, a few tiles can be installed on the wall and used as a pin board.

Acoustic wall coverings are also ideal for areas where there is likely to be impact, such as sports halls and corridors, both being areas where reverberation is a common problem. While acoustic wall coverings are available in a range of absorption classes, they are most frequently used where Class C absorption is required. As they are applied after construction, acoustic wall coverings are suited to both new build and remedial works.

Wall panels

An alternative to complete or partial wall coverage is to install bespoke acoustic panels. These offer superior absorption to the wall coverings owing to their increased thickness, and are generally used where Class A or B absorption is necessary.

As they are manufactured to order on a bespoke basis, they can be colour-matched and sized to meet any particular requirement on site. This means that effective reverberation control can be achieved without changing the existing interior environment. Acoustic panels can be installed in a variety of different ways, but the two most common methods of installation that offer non-visible fixing systems are fixing clips and fabric-covered metal strips. For increased acoustic absorption, the panels can be installed on timber battens to create an air void behind the material. Panels can also be installed as a suspended product, where fixing to the wall is not feasible or will not deliver the required performance.

The performance of the acoustic panel is determined by several variables such as the type of backing, depth of air gap, and method of suspension. This is illustrated in Table 2.

frequency Hz	125	250	500	1000	2000	4000
12mm panel, solid back	0.05	0.10	0.35	0.60	0.75	0.85
25mm panel, solid back	0.05	0.30	0.70	1	1	1
25mm panel, 25mm air gap	0.10	0.40	0.95	1	1	1
25mm panel, 50mm air gap	0.20	0.55	1	1	1	1
50mm panel, solid back	0.30	0.85	1	1	1	1
50mm panel, 50mm air space	0.45	1	1	1	1	0.95
50mm panel, suspended	0.34	0.80	1.01	1.04	0.98	0.98

Table 02: Typical acoustic absorption coefficients for absorptive panels

Reverberation control in action

CMS Acoustics has provided advice on reverberation control for a range of requirements, ranging from schools, police stations and churches to commercial developments. While there are a number of off-the-shelf reverberation treatments that can often resolve the challenges being faced, more innovative approaches are sometimes required, particularly where budgets are limited or particular aesthetic wishes must be catered for.

Autism.westmidlands

Autism.westmidlands school for autism is a residential and day facility for pupils aged from 8 to 19, which provides specialist teaching strategies designed to overcome the barriers to education caused by autism. One of these potential obstacles to learning is background noise, and if left untreated this can cause stress and anxiety for the autistic children.

The dining hall at the autism.westmidlands school was identified as a problem area as its concrete design intensified the reverberation of noise caused by metal knives and forks. Whilst an acoustic treatment in the dining hall was obviously required, it would also need to account for the constraints of a school environment. Because of the special requirements of the pupils, any solution would need to be kept out of the children's reach.

In order to reduce reverberated noise in the school dining hall, CMS Acoustics provided its Melamine acoustic foam with self adhesive backing. This was easily installed on the dining hall ceiling by the school's own maintenance staff. To cover the whole dining hall ceiling area of 44m² the material was supplied in sheets of 2.5m × 1.25m × 30mm thick.

Since the installation of CMS Acoustics' Melamine acoustic foam, background and vocal noise has been significantly reduced in the dining hall and has helped to reduce anxiety amongst the autistic pupils.

The flexible nature of CMS Acoustics' Melamine acoustic foam makes it appropriate for high temperature applications, since it has a thermal conductivity value of around 0.0033$Wm^{-1}K^{-1}$. This meant that the Melamine was compatible with the under-floor heating on the first floor of the school.

continued on page 40

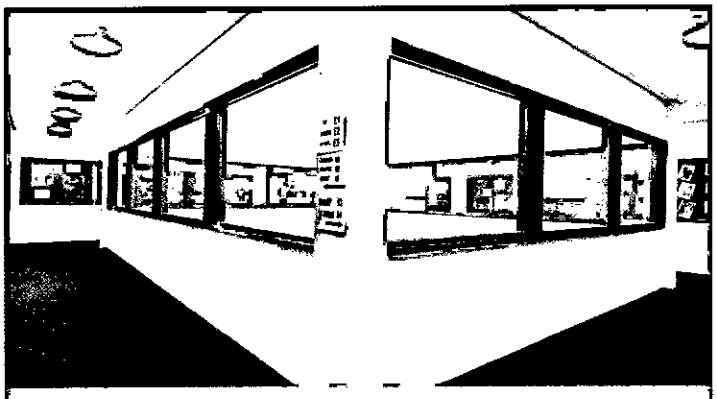

Figure 01

Glazed surfaces are highly sound reflective

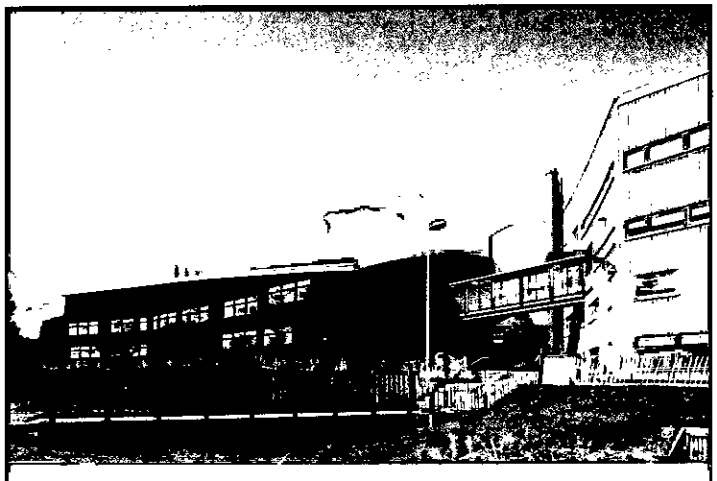

Figure 02

External view of Redland Green School

Figure 03

The Street at Redland Green School: some of the absorptive panels can be seen top right

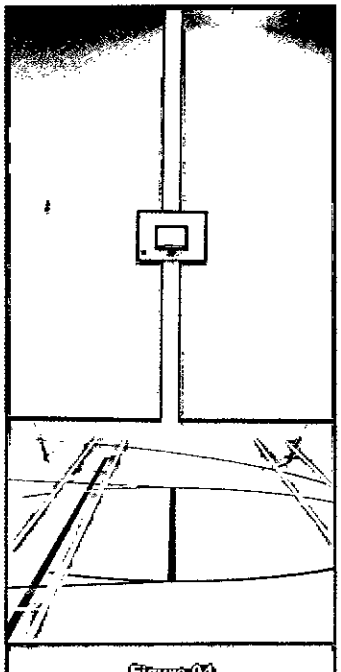

Figure 04

Wall treatments applied to upper wall surfaces in a gymnasium

The rise of reverberation - *continued from page 39*

Redland Green School

As part of a significant investment programme in school buildings, Redland Green School in Bristol benefited from a major new build development, designed to deliver one of the most modern, state of the art learning environments in the south-west. Described as the 'school under the hill', the main teaching spine is situated under the existing hillside beneath a green sloping roof. In line with the sustainability agenda, the natural contours of the hill are carried over the spine to create an inspiring open air learning environment, which overlooks the city of Bristol and its surrounding countryside.

The building design incorporated 'The Street', an architectural vision that aimed to inspire learning but posed a reverberation challenge. The Street was designed to be the main area where pupils would congregate, but it contained lots of hard surfaces. Without taking preventative measures, the noise level would have been unacceptable. However, because the acoustic treatment was to be detailed later on in the development, it was critical that it should integrate well with the interior environment.

Fully bespoke SuperPhon acoustic wall panels were identified as the most effective solution to meet all of the project requirements. These panels reduce noise by absorbing sound at the surface, combining impressive acoustic capabilities with an aesthetically appealing woven textile finish. More than 200 SuperPhon panels were precision installed on the upper half of the walls, throughout the 100m × 5m Street. They were used in 32 different sizes, each one 25mm thick and covered in coloured fabric designed to integrate the panels into the scheme's overall design.

Having opened its doors to the first wave of students, Redland Green School is now operational, and The Street is proving as popular as it is striking. In spite of being a bustling area, as the architects intended, the reverberation of sound remains controlled.

Ryton Comprehensive School

Gateshead Council faced an unexpected acoustic challenge when a sound absorbing board failed in the new sports hall at Ryton Comprehensive School, Tyne and Wear.

To prevent the potential for damage from the impact of balls used in sports activity, a rendering system was installed on top of the absorbing layer. However, this inadvertently compromised the acoustic performance as it covered the slots in the board, which were designed to allow noise into the plasterboard cavity. To minimise reverberation levels whilst protecting the wall surfaces within the sports hall, Gateshead Council needed to source a durable, high performing remedial treatment that did not appear to be a corrective measure. Following consultation with CMS Acoustic Solutions, the Council selected Vertiface Composition, a retrospectively applied acoustic wall covering system designed to reduce levels of reverberation. Adhering directly onto finished wall surfaces to deliver an aesthetically appealing acoustic treatment, 350m² of Vertiface material was installed onto the upper half of the sports hall walls to control excessive reverberation.

Offered in a collection of 30 colours and three different thicknesses, Gateshead Council chose 12mm thick 'butter' to reflect the colour scheme of the sports hall. Since the installation, teachers and pupils at Ryton Comprehensive have been able to continue sports activity without suffering intolerable levels of reverberation. Furthermore, the material's high recovery properties mean it can control excessive reverberation and withstand the impact of balls, making it a long term solution.

Paul Absolon is Technical Director of CMS Acoustic Solutions Ltd

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British Standard EN ISO 11654 (1997). Acoustics – sound absorbers for use in buildings - ratings of sound absorption.

CMS Acoustics

delivers Eco-nomical sound solution for Victoria Mills

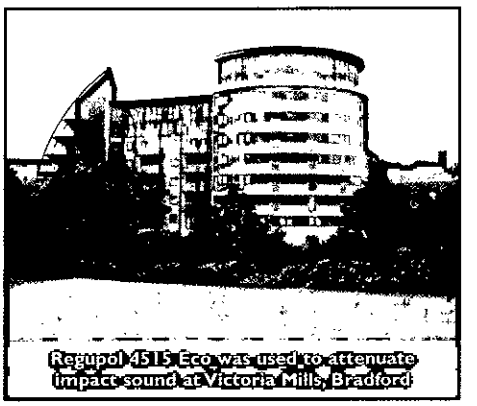
Quarmby Construction has used Regupol 4515 Eco to achieve Part E compliance at the new Victoria Mills development in Shipley Glen, Bradford. Commissioned to design and construct the new-build element of the complex, Quarmby selected Regupol 4515 Eco, a recycled rubber crumb and cork compound acoustic underlay, to control impact sound cost effectively and maintain the required floor-to-ceiling heights without applying a screed or floating floor.

Available exclusively through CMS Acoustics in the UK, the product offers an efficient method of sound control by attenuating noise at source. The material is quick and easy to install, being simply bonded to the subfloor with the final floor finish then laid directly on top. With no floor finish laid, an improvement of 17dB in the impact sound insulation has been found in tests.

To ensure effective acoustic design of the apartments, Quarmby initially conducted on-site testing with no sound treatment in place. This identified that airborne sound was adequately controlled but that impact noise control would be necessary to achieve Part E standards. Regupol 4515 Eco was favoured because it was more environmentally friendly than using a thicker concrete slab, and compared with a floating floor, it would keep the construction height to a minimum.

Colin Gebbie, contracts manager at Quarmby Construction, explained that a cost-effective treatment was sought that would deliver the required level of sound insulation and maintain the required floor-to-ceiling heights without applying a screed or floating floor. Supplied in standard thicknesses of 3mm and 4.5mm, Regupol 4515 Eco is available in rolls of 20m and 12m. The material has been tested over time and been shown to maintain its performance without collapse under high point loads.

The first phase of the Victoria Mills new build apartments is now complete with pre-completion testing confirming that Part E compliance has been achieved throughout. The second phase is currently under way, and the product is again being used to control impact sound. A total of 167 apartments over eight storeys will be created. The Victoria Mills project is due for completion in November 2008 (see **www.victoria-mills.com**).



Regupol 4515 Eco was used to attenuate impact sound at Victoria Mills, Bradford

Regupol 4515 Eco is part of the Regupol 4515 range of acoustic underlays. More details can be found at **www.cmsacoustics.co.uk**.

Industry partnership addressing hand-arm vibration

HAVTEC and EPTA

Key members of the construction industry have come together to provide users of hand-held electric power tools with information which will help control their exposure to hand-arm vibration.

The partnership between contractors, manufacturers and suppliers has resulted in a joint statement of cooperation between the Hand Arm Vibration Test Centre (HAVTEC) and the European Power Tool Association (EPTA) which agrees to the:

- continuation and development of the HAVTEC register as the common and freely available resource for the industry;
- publication of tool test data in compliance with manufacturers' legal obligations under the Supply of Machinery Regulations;
- provision of exposure information which will enable the user to comply fully with health and safety legislation;
- development of a 'traffic light system' for each tool giving exposure detail based on the duration of usage and type of material worked on; and
- production of training materials and best practice guidance.

This will mean an expansion of the HAVTEC register as users of hand-held electrical power tools will have access to additional accurate and detailed real-life exposure data for new tools such as combi-hammers, breakers, saws etc. The data enables them to identify which tools they should use, for how long, and on which material, in order to control exposure to hand-arm vibration.

Members of the Major Contractors Group (MCG) welcome the agreement between HAVTEC and EPTA as it continuous to support their policy (made in January 2007) to use only those hand-held power tools that are listed on the HAVTEC register. All those involved in the supply and use of such tools are urged to access the free information and resources within HAVTEC by visiting the OPERC (Off-highway Plant and Equipment Research Centre) web site at **www.operc.com**.

Mark Owen, head of health and safety at Shepherd Construction, an MCG member, said that their intention was to ensure everyone, without exception, had access to good, freely available hand-arm vibration information in order to make considered judgements on the procurement and use of power tools. The HAVTEC database delivered the information required to make those decisions sensibly, and ultimately gave any employer he opportunity to offer good protection for their workforce. He was delighted that EPTA had given its full support to HAVTEC. Bo Risberg (CEO of Hilti and EPTA president), Gerry McHugh (MD of Hitachi Koki Europe and EPTA vice-president) and Brian Cooke (EPTA director general) agreed that they were very pleased to have reached agreement, as it would assist them greatly in their relationships with their customers in the construction and plant hire industry. They looked forward to working closely with all those involved for the benefit of customers and users alike. Dr David J Edwards of Loughborough University added that they were satisfied the new standard for assessment of HAV relating to operation of hand-held electric power tools provided a useful first approximation of the risk posed to operators from hand-arm vibration. EPTA members were now working with the Major Contractors Group, the Major Hire Companies Group, and the Off-highway Plant and Equipment Research Centre to support the HAVTEC initiative based at Loughborough, ensuring the ongoing success of HAVTEC and providing a greater service to industry.

Mark Turnbull, Speedy Hire's health and safety director, added that he was particularly delighted with the agreement of a common database. This meant that the hire industry was able to provide its customers with reliable data, in a uniform manner, with the minimum of confusion. EPTA had paved the way and he hoped that other manufacturing groups would follow suit.

Buyout secures future for Lorient

acoustic, smoke and fire seals manufacturer

A Newton Abbot based international business has become the subject of a management buyout by three of its Directors.

The majority shareholding in Lorient Holdings Ltd, which specialises in the design and manufacture of acoustic, smoke and fire sealing systems, has been acquired by **Maria Simmonds**, **Tom Kingdon** and **Jason Williams** for an undisclosed sum. Founder Rob Mann retains a stake in the business and provided a significant part of the finance for the deal to complete without the involvement of venture capital. His role remains at the heart of the business; continuing to serve as Technical Director and providing strategic direction on significant international projects.

Lorient was established in 1979 manufacturing fire seals from a base in Surrey, relocating to Devon in the early 80's. The Lorient Group has grown to encompass businesses around the world and has established Lorient operations in Australia, the Middle East, as well as the UK, USA and Hong Kong. Recognised as a leader in its field, it has a strong reputation for innovation, research and development and sophisticated extrusion technology.

The MBO team has plans to develop the business, which employs 100 staff in the UK and a further 30 worldwide. Speaking of the deal Simmonds said that it provided the very best future for Lorient, in that the buyout team was proven and successful with over 30 years' service, taking the company forward for the next generation. The commitment to staff and all those associated with the business is to continue to operate with the same values upon which this business has been built, but with the intention to grow into an even more successful internationally renowned company. Investment in a relatively new 30,000 sq ft factory and office complex underlined the intention to remain and grow on Heathfield, Devon, with the help of a talented and dedicated staff.

For more information:
Maria Simmonds **msimmonds@lorientuk.com**
tel: **01626 834252**

Imbibers less likely to publish

New research (!)

A recent study claims to have shown that researchers who happen to spend a great deal of time in the pub produce a lower number of papers. Ecologist Tomáš Grim has found an apparent correlation between the amount of beer drunk and the quality of scientific research.

Grim study set out to determine to what extent social activities play a part in the quality of publications, pointing out that one of the world's most frequent social activities is drinking alcoholic beverages.

The research was carried out in two areas of the Czech Republic, the country with the highest per capita beer consumption rate in the world, and therefore, arguably, the perfect candidate. Grim found that the researchers who drank more beer during the course of a year published fewer papers, had fewer citations altogether, and fewer citations per paper.

The obvious short-term consequences of a heavy night of cervisial consumption were said to be part of the problem, along with longer-term effects such as depression and lack of co-operation with other researchers. Reduced quality of papers was also linked with the employability of the researcher. It therefore suggested that drinking copious amounts of beer might not only affect the current paper being published, but the researcher's future financial income and social status.

So will this penetrating study put scientists and engineers off their pints? It seems doubtful, somehow.

Parliamentary reports

From Hansard

Commons Written Answers

13 December 2007
Roads: Noise

Mrs Maria Miller: To ask the Secretary of State for Transport how much was (a) allocated to and (b) spent on mitigating the effects of noise generated by major roads and motorways in each year since 2000; how much has been allocated for this purpose in each year until 2011; if she will place in the Library copies of research commissioned by her Department on identifying, mapping and modelling communities affected by such noise; and if she will make a statement.

Mr Tom Harris: Since 2000 the Highways Agency has been allocated £5 million per annum for noise mitigation measures to deal with the most serious and pressing cases, where practical and cost-effective measures can be provided. These measures are applied to the entire strategic road network including both motorways and trunks roads. This annual allocation for noise mitigation is scheduled to continue until the end of the period covered by CSR07.

The Agency's expenditure in this area is not limited to this figure as noise mitigation measures are included in all the Agency's schemes, where warranted, as it is more cost effective to do this work concurrently with other scheme works. The cost of these works are subsumed within the overall cost of the individual schemes making it impossible to extract the exact figure spent on noise mitigation without incurring disproportionate costs.

In 1999, the Agency commissioned research to develop a system which would help to identify and classify residential areas adjacent to the road network on the basis of their noise exposure. A copy of the report from this research will be placed in the House library. More recent research has been undertaken by DEFRA, as a result of the introduction of the Environmental Noise Directive into UK legislation. This has required major sources of noise to be mapped, including the entire strategic road network. These maps are expected to be published by DEFRA in early 2008.

22 January 2008
Noise: Health Hazards

Dan Rogerson: To ask the Secretary of State for Health what research he has (a) commissioned and (b) evaluated on the effects of low level decibel sound on public health; and if he will make a statement.

Dawn Primarolo: A Departmental ad hoc advisory group is currently preparing a report on the effects of environmental noise on health, due to be completed early in 2008, which will examine a number of noise and health related issues, including low intensity and low frequency noise. The results of this work will feed into the Department for Environment, Food and Rural Affairs (DEFRA), 'Noise Strategy for England'.

In addition, Departmental officials work closely with DEFRA on a number of noise and health related matters and a number of research projects have been carried out by DEFRA around noise, including low frequency noise.

23 January 2008
Wind power: Noise

Dan Rogerson: To ask the Secretary of State for

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Parliamentary Reports - *continued from page 43*

Environment, Food and Rural Affairs what steps he is taking to measure the low level sounds produced by wind turbines.

Jonathan Shaw [holding answer 22 January 2008]: In 2004, the then Department for Trade and Industry (DTI) (now the Department for Business, Enterprise and Regulatory Reform - DBERR) commissioned Hayes McKenzie to report on claims that infrasound or low frequency noise emitted by wind turbine generators were causing health effects. Hayes McKenzie reported to the then DTI in May 2006 that there was no evidence of health effects arising from infrasound or low frequency noise generated by wind farms. The report recommended further work on the specific issue of Aerodynamic Modulation (AM).

A Government-funded research study, entitled 'Research into Aerodynamic Modulation (AM) of Wind Turbine Noise', undertaken by Salford University, reported in 2007 that although the incidence of AM could not be fully predicted, the incidence of AM and the number of people affected was probably too small to make a compelling case for further research:

"Considering the need for further research, the incidence of AM and the number of people affected is probably too small at present to make a compelling case for further research funding in preference to other types of noise which affect many more people. On the other hand, since AM cannot be fully predicted at present, and its causes are not fully understood we consider that it might be prudent to carry out further research to improve understanding in this area."

On consideration of the Salford report the Government decided that there was not at present a compelling case for further work into AM, and that it would not carry out further research, but it would continue to keep the issue under review.

Further information is available on the website of the Department for Business, Enterprise and Regulatory Reform.

28 January 2008
Noise

Mr Evennett: To ask the Secretary of State for Environment, Food and Rural Affairs when he expects to publish a national noise strategy.

Jonathan Shaw: The Government plan to publish a combined National Noise Strategy for England, covering ambient and neighbourhood noise, later this year.

29 January 2008
Heathrow Airport: Noise

Mrs Villiers: To ask the Secretary of State for Transport (1) what assessment she has made of which postcode areas would lose their break in the day from aircraft noise as a result of ending runway alternation at Heathrow; (2) which postcode areas will be exposed to increased noise by the ending of the Cranford Agreement on Heathrow airport; (3) which postcode areas would experience increased noise by the ending of the westerly preference at Heathrow airport; (4) which postcode areas would experience less noise as a result of ending the Cranford Agreement in relation to Heathrow airport; (5) which postcode areas will experience less noise as a result of ending the westerly preference at Heathrow airport; (6) which postcode areas would be adversely affected by noise as a result of building a third runway at Heathrow airport; and which postcode areas would be added to the 57dB Leq noise contour for Heathrow as a result of building a third runway; (7) which postcode areas are affected by noise from Heathrow airport at the level of 50dB; (8) which postcode areas will be affected by aircraft noise at a level of 50dB or greater as a result of building a third runway at Heathrow.

Jim Fitzpatrick: The noise effects of the various possible changes at Heathrow are illustrated by a series of noise contours contained in the supporting technical report 'Revised Future Aircraft Noise Exposure Estimates for Heathrow Airport' issued as part of the current consultation 'Adding Capacity at Heathrow Airport'. Contours are shown from 57dB(A), with 54dB(A) contours included for sensitivity purposes. In addition, the Department's website includes a facility allowing individuals to identify the likely change in noise levels, by postcode, under the various proposals. This includes Heathrow options with and without the Cranford agreement, mixed mode and a third runway. The noise levels are from 57dB(A) upwards and are presented with both a westerly preference and an easterly preference. They are indicative and should be used only as a guide.

The search facility includes postcodes in the following local authority areas: Bracknell Forest, Ealing, Hammersmith and Fulham, Hillingdon, Hounslow, Kensington and Chelsea, Kingston-upon-Thames, Richmond upon Thames, Runnymede, Slough, South Bucks, Spelthorne, Wandsworth, Windsor and Maidenhead. Areas outside those boroughs are not expected to experience any change. Further information is on the website at: **www.dft.gov.uk/heathrow consultation** and the postcode facility can be accessed at: **www.dft.gov.uk/consultations/open/heathrowconsultation/furtherinformation/postcodesearch/** .

6 February 2008
Aviation: Noise

Justine Greening: To ask the Secretary of State for Transport when she was informed of the Non-Stated Preference peer review findings in relation to the Attitudes to Noise from Aviation Sources in England report; and if she will make a statement.

Jim Fitzpatrick [holding answer 17 January 2008]: Officials informed the Secretary of State of the findings of the non-stated preference peer review group at a meeting on 30 October, the day of their receipt in the Department. The Secretary of State announced the results of the study on 2 November.

Justine Greening: To ask the Secretary of State for Transport when (a) her Department and (b) the project steering group were informed that the ANCON model would not be used for modelling work undertaken as part of the attitudes to noise from aviation sources in England study (ANASE); which organisations (i) tendered for the ANASE contract, (ii) are represented on the ANASE project board and (iii) peer reviewed the stated preference aspect and other aspects of the study; and if she will make a statement.

Jim Fitzpatrick [holding answer 31 January 2008]: The information is as follows:

(i) The specification for the project did not specify whether the UK Aircraft Noise Contour Model (ANCON) or the U.S FAA's Integrated Noise Model (INM) should be used by the successful contractor, as both models are used in the UK for noise modelling purposes. In July 2002 MVA informed the Department that their preference was to use the INM model because it is publicly available at low cost and meets all the technical requirements of the study. MVA Information Note No. 14 "Project Team Answers to SASIG Questions" dated 15 May 2006 - which was circulated to steering group members on 25 May 2006 - explained that INM had been used for modelling.

(ii) The following organisations bid for the ANASE contract: Civil Aviation Authority, ITS/Eurocontrol, Peter Davidson Consultancy, MVA Consultancy, Rand Europe, and Steer Davies Gleave.

(iii) The following organisations were represented on the ANASE steering group: Department for Transport, Department for Environment Food and Rural Affairs, Aviation Environment Federation, Airport Operators Association, British Air Transport Association, Strategic Aviation Special Interest Group of the Local Government Association, Professor Graham Loomes (School of Economic and Social Studies, University of East Anglia).

(iv) The Stated Preference elements of the study were peer reviewed by Professor Ian Bateman (School of Environmental Science, University of East Anglia), Dr Brett Day (University of East Anglia) and Professor Mark Wardman (Institute for Transport Studies, University of Leeds).

(v) The Non-stated Preference elements of the study were peer reviewed by Mr Peter Havelock (Environmental Research and Consultancy Department, Civil Aviation Authority) and Mr Stephen Turner (Acoustics and Vibration Group, Bureau Veritas).

7 February 2008
Industrial Health and Safety: Noise

Bob Russell: To ask the Secretary of State for

Work and Pensions what guidance he gives to operators of sports stadiums on the volume of recorded music and public announcements; and if he will make a statement.

Mrs McGuire: The Control of Noise at Work Regulations 2005 require employers to reduce risks arising from noise at work to as low a level as is reasonably practicable. HSE guidance booklet Controlling Noise at Work provides advice on these regulations and their application. Further advice is provided in 'The Guide to Safety at Sports Grounds' published by the Department for Culture Media and Sport. This provides general advice on safety at sports grounds including the operation of public address systems.

18 February 2008
Aviation: Pollution

Mr Gummer: To ask the Secretary of State for Transport what recent research her Department has *(a)* commissioned and *(b)* evaluated on the effects of aircraft (i) air pollution and (ii) noise on populations underneath a flight path.

Jim Fitzpatrick: The Department for Transport has not, in recent years, commissioned research on air pollution or noise under flight paths that are some distance from airports. Air quality impacts from aviation are believed to be quite localised with limited ground level effect from emissions above 100m.

The Secretary of State announced the conclusions of the 'Attitudes to Noise from Aviation Sources' (ANASE) study (commissioned in 2001) on 2 November 2007, including a letter of explanation to all MPs. The full report and related papers are available in the Libraries of the House, and on the Department' website at: **http://www.dft.gov.uk/pgr/aviation/environmentalissues/Anase/**

The Secretary of State launched the consultation 'Adding Capacity at Heathrow Airport' on 22 November 2007 which runs until 27 February 2008. This reports on the outcome of a three-year programme of assessment of the environmental impacts in the Heathrow area.

18 February 2008
Noise: Health Hazards

Dan Rogerson: To ask the Secretary of State for Environment, Food and Rural Affairs pursuant to the answer of 22 January 2008, *Official Report*, column 1940W, on noise: health hazards, whether the Noise Strategy for England will have regard to the results of the Salford University study into Research into Aerodynamic Modulation of Wind Turbine Noise commissioned by his Department.

Jonathan Shaw: The Noise Strategy for England will be a high level document that sets out the Government's policy on neighbourhood and environmental noise. It would be premature to state whether the strategy will single out the aerodynamic modulation of noise from wind turbines. The Government have stated that they will keep the issue of aerodynamic modulation of noise from wind turbines under review.

19 February 2008
Wind power: Noise

Mr Gale: To ask the Secretary of State for Environment, Food and Rural Affairs what assessment the Environment Agency has undertaken of the noise produced by the WS 1200 wind turbine; when that assessment will be published; and if he will make a statement.

Malcolm Wicks: I have been asked to reply.

Under the Microgeneration Certification scheme, the Government are working with key stakeholders, including industry, to develop installation and product standards for micro wind turbines. These standards will address issues to do with airborne and structural vibration noise.

Professor P O A L Davies

Obituary

One of the founders of ISVR, Professor P O A L Davies MIOA, passed away on the morning of 14 February 2008. He was born in Sydney on 4 October 1922, and educated at Canberra Grammar School and Sydney University, from which he graduated with first class honours in Mechanical and Chemical Engineering in 1947. His time as a Radar Officer in the RAAF from 1941 to 1945 interrupted his education, to which he returned after his period of service. He was awarded a Charles Kolling travelling scholarship by Sydney University in 1948 for research on hydrodynamics at Cambridge University, who awarded him a PhD in 1951. Whilst at Cambridge, he was a member of the Cambridge University Air Squadron, undergoing flying training. It was here also that he met his first wife, Margaret (Meg) Pite, a fellow student who had coincidentally also served as a Radar Officer in Royal Electrical and Mechanical Engineers from 1942 to 1945.

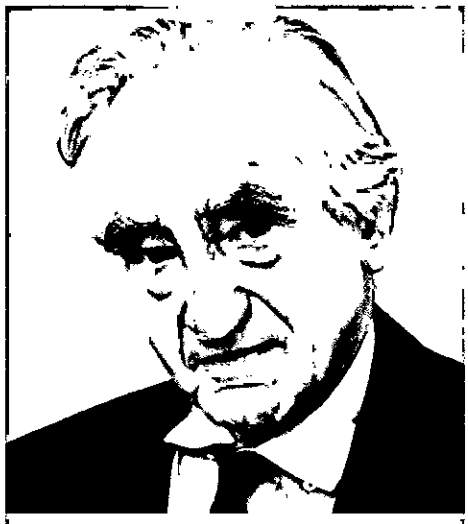
They returned to Adelaide where Peter was appointed lecturer, then senior lecturer in fluid mechanics at the University from 1950 to 1956. During their six years at Adelaide, Peter and Meg had three children (two girls and a boy).

Peter returned to the UK (where he and Meg were to have two more daughters) as senior research fellow in aeronautics at Southampton University in 1956. Then in 1963 he became one of the founding members of what shortly became, and is today, the world's leading research centre in all aspects of sound and vibration, namely the Institute of Sound and Vibration Research (ISVR), which became Peter's professional home for the remainder of his career, and beyond. Appointed to a readership in ISVR in 1962, Peter was awarded the personal chair of experimental fluid dynamics in 1972. He remained one of ISVR's most active members, and recognisable figures, and (although he retired in September 1988) he remained fully involved in ISVR and active in research until his death. From early research in experimental studies of turbulent shear flows and free turbulence (in particular, as related to jet noise generation and control), his recent work included studies of sound propagation in discontinuous flow ducts, sound generation by coupled flow acoustic effects and source identification. At the end of 2007, when the UK undertook the largest nationwide assessment exercise in seven years of university research, several of Peter's recent learned papers were entered into the assessment exercise, and ISVR will no doubt receive credit and support for research in the years to come in part as a result of his involvement. Young staff in particular benefited from this outstanding contribution, made at the age of 85. Not only did he maintain an international reputation for cutting-edge research excellence, he made a considerable contribution to acoustics consultancy for industry and other clients through P & E Davies Enterprises Ltd, of which he was a director since its formation in May 1989. His international expertise in noise generation from flow has been applied to solve numerous technical problems, ranging from noise generation in aircraft engines to the design of automotive exhausts and the generation of speech through the human vocal tract.

In addition to his membership of the Institute of Acoustics, he was a member of EuroMech and of the International Institute of Acoustics and Vibration, and a Fellow of the Institution of Mechanical Engineers. In 2006 he was chosen as the member of ISVR senior staff to go to Buckingham Palace to receive the medal and award from HM Queen Elizabeth II when ISVR was recognised for sustained excellence and outstanding achievements in research with a Queen's Anniversary Prize for Higher and Further Education. The citation made reference to the work in Peter's field.

Sadly, Meg died of cancer in December 1979, and their eldest daughter Marianne also died of cancer in December 1994, survived by Brian and three teenage children.

Peter is survived by his second wife, Shirley, whom he married in 1982. Shirley already had two daughters and six grandchildren, so family gatherings became sizeable affairs. Peter was an exceptionally proud father and grandfather. His son moved to France as an electronic engineer, his younger Australian daughter became a vet on the staff of Melbourne University and the other three are married (two to engineers, with eight grandchildren between them). In retirement he and Shirley remained active in their hobbies. Shirley achieved a diploma in fine arts (painting) with honours in 1994 and received commissions, whilst Peter was for years a prominent member of Hampshire's musical scene, a bassoonist in many local chamber groups and orchestras, including the University Orchestra and Marchwood Orchestra. He was particularly proud of his Heckel bassoon, and was playing it in orchestral concerts until a few weeks before his death. He was a very generous musician, both to his orchestral colleagues and to younger musicians: he was particularly proud of his contrabassoon, but when he no longer had the energy to play it, he gave this rare instrument on long-term loan to younger players for their use.



Professor P O A L Davies

A thanksgiving service was held at Highfield Church on Wednesday 20 February 2008.

T G Leighton

Jerry Hyde

Retirement

After forty-five years in acoustics Jerald R Hyde announced his retirement from acoustical consulting this past December. As a young physics student at UCLA, Jerry started his career in acoustics in 1962 as a lab assistant for the iconic Prof. Vern Knudsen. After graduate school, he started his consulting career by working for seven years with Paul Veneklasen's acoustical consulting firm in Santa Monica California. In 1975, Jerry spent nearly a year in New Zealand working with Harold Marshall during which time he collaborated on the Michael Fowler Centre in Wellington, a 2,700 seat dedicated concert hall. The NFC design was historic as it introduced the world's first use of quadratic residue diffusors (QRDs, also known as Schroeder diffusers) in a performing space. After a survey of the renowned concert halls of Europe, he returned to California in late 1976 and began his own consulting practice in St. Helena in the center of the Napa Valley Wine region. Over the years, Jerry mixed running a small practice with doing personal research in the area of concert hall measurement and analysis, and in his forty years in consulting, gave forty papers before the ASA, IOA and ICA, mostly in the field of concert hall design. In 1994, he was elected Fellow of the Acoustical Society of America, cited "... for advancing the science and practice of concert hall design and evaluation." Then, in March 2002, Jerry was also elected Fellow of the Institute of Acoustics. Jerry can be reached at "**jerry@jerryhyde.com**"

(l to r) Jean Dominique Polack, Jerry Hyde, Raf Orlowski pictured at a recent IOA meeting in Copenhagen

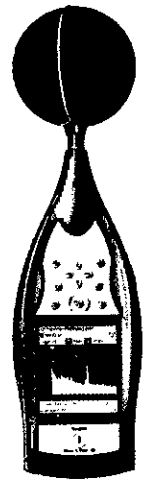
Tonal assessment

Brüel & Kjær

Local authorities and acoustic consultants can reduce time and money spent investigating the existence of elusive tonal noises with sound and vibration expert, Brüel & Kjær's new tone assessment tool. Tonal noise typically contains a noticeable - or discrete - continuous note which can include hums, hisses, screeches or droning sounds: these particular noises are difficult to prove and can quite often be disputed.

Created for use with Brüel & Kjær's 2250 sound level meter, this tone assessment application provides simultaneous measurements of the L_{Aeq} as well as other broadband parameters. It provides on-the-spot calculations for tone-corrected rating levels and the results are displayed in accordance with ISO 1996-2 Annex C. By using ISO 1996-2, which provides an objective method for verifying the presence of tones, the tone assessment methodology produces instant, objective feedback allowing users to determine whether they have identified the problem or need to make further measurements. Bruel & Kjaer's instruments are also equipped with a tone generator so that an audible tone can be compared with the measured sound.

The tonal assessment application is available as an add-on with Brüel & Kjær's FFT analysis software for the Type 2250 sound level meter. The meter is extremely user-friendly with a large dynamic range and frequency resolution allowing the operator to simply position the analyzer in an appropriate location and start measuring. As objective measurement results can be very comprehensive in detail, it is helpful to have a sound recording of the noise for the benefit of a non-technical audience. For this purpose, the tonal assessment tool is also compatible with the 2250 meter's sound recording tool.



Type 2250 sound level meter

For more information about Brüel & Kjær UK's products and services, please visit **www.bksv.co.uk**

01dB

The New BLUE SOLO NNR: Noise Nuisance Recorder from Acoustic1

01dB are back in noise surveillance market. In collaboration with Acoustic1 the release of the Blue Solo NNR is proudly announced. All accessories are stored in one discreet briefcase. The inner 'stealth' case is then left with the complainant.

On board there is a huge data storage capacity with a time resolution to 20ms (including spectra). Audio is stored via remote control in .wav format. With all that data a powerful software package is needed for analysis. The dBTRAIT package, in use since 1988, with detailed graphs, tables, and coding functions enables the user to describe all recorded noise with rich graphics.

The audio recorded can be used with a huge range of post processing options built into dBTRAIT. Yet more, narrow band FFT analysis and signal editing can be accomplished with dBFA.

Contact Steve Thomas on **01269 851749** or e-mail **steve@acoustic1.co.uk** to arrange for a demonstration, pricing or an informal chat.

Silver Platter Service

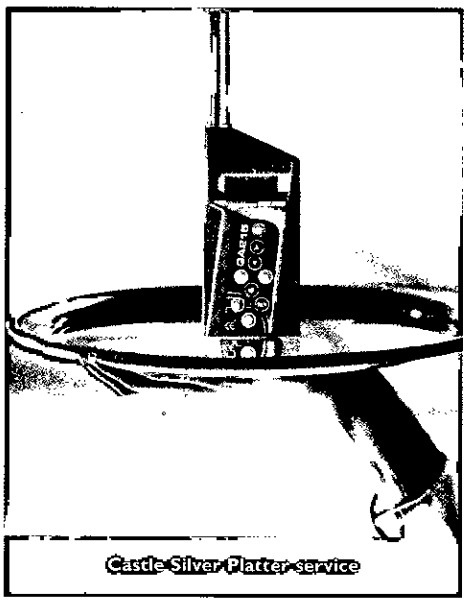
Castle's premier service solution

Castle Group Ltd of Scarborough has been re-inventing its service and calibration package by expanding the range of options and the breadth of equipment covered. From anemometers to accelerometers and sound meters to samplers, Castle now offers calibration on most safety, health and environmental equipment and even more.

With a core competence in the calibration of sound and vibration meters for over 35 years, Castle has been able to apply its ethos of clear, menu pricing, fast turnaround times and ordering simplicity to an ever expanding list of equipment it can tackle. Service manager, Michael Mann says that it is certainly a recurring theme that customers want a fast turn round time, and want to be kept up to speed with any progress. The company has found that addressing these two points is been key to a successful service, happy customers and even to a quieter life.

For companies with multiple pieces of equipment, there is also Castle's 'contract calibrations', an annual scheme to take the hassle out of maintaining equipment certification. Castle will issue calibration reminders, collect the equipment and return it calibrated as soon as possible. This scheme also affords a saving of up to 20% on annual calibration charges. All calibrations come with a traceable certificate wherever possible and for certain types of instrumentation there is a choice of the calibration level, up to a UKAS (United Kingdom Accreditation Service) accredited certificate

For more information: Michelle Uprichard
tel: **01753 858 063**
email: **mu@bulluk.com**
web site: **www.castlegroup.co.uk**



Castle Silver Platter service

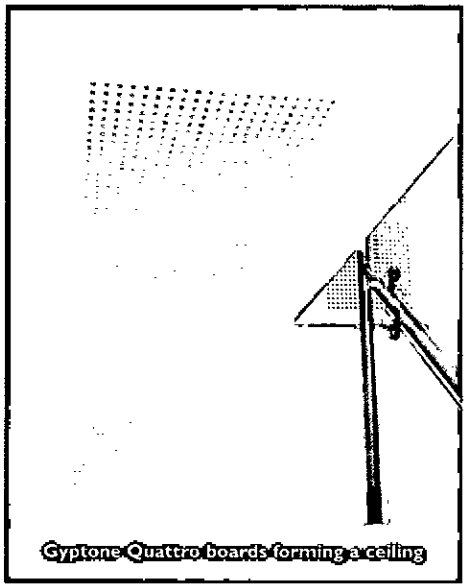
British Gypsum

Acoustic ceiling boards surge ahead

The growth in demand for specialist acoustic ceiling boards has continued to surge since the introduction of Part E, with British Gypsum reporting 60% year-on-year sales growth for its popular Gyptone board range.

According to Ceilings divisional manager, Steve Wintle, the biggest growth has been in Class C absorbers, which are now required for corridors and common areas in residential apartment developments. Gyptone Quattro 45 has been the most popular board because it has clean geometric lines that co-ordinate well with modern interior décor, and is available in 900mm width, ideal for narrower 900mm and 1000mm corridors, as well the full 1200mm width.

Gyptone Quattro 45 boards, which feature a regular pattern of full depth perforations, are backed with a special acoustic tissue to optimise sound absorption. They are claimed to guarantee compliance with Part E requirements, whilst providing a combination of subdued acoustic environment and modern, eye-catching appearance, which is ideal for entrance areas and corridors. Once jointed, they provide a clean, monolithic ceiling that can be redecorated, without affecting acoustic performance, to maintain its pristine appearance for years to come.



Gyptone Quattro boards forming a ceiling

Gyptone Quattro 45 is just one of a range of acoustic ceiling boards, planks and tiles that provide house builders and developers with a choice of design and performance options to complement modern interiors.

For technical information on products and services:
Tel: **08705 456123**
Email: **bgtechnical.enquiries@bpb.com**
Web site: **www.british-gypsum.com**

NoiseControlleasing for noise control solutions

Wakefield Acoustics

Wakefield Acoustics, the industrial noise control solutions provider has announced that it can offer its customers a range of flexible lease finance options, 'NoiseControlleasing'. It is the first lease programme of its kind designed with the industrial noise control industry in mind. The leasing packages will give customers a real alternative to having to make a cash purchase of a noise control solution, by replacing the need for a capital outlay with much reduced monthly rental payments, thereby giving companies greater choice on additional productivity capital spending.

No matter which tailored noise control solution a customer may require, there is now a lease package that Wakefield Acoustics can offer to help finance it. Jane Dawson, Managing Director of Wakefield Acoustics says that her team recognises and understands that in order to meet their overall objectives, companies often need to balance the investment of capital across all areas of the business including process, people and legislative compliance. It was for this reason they decided to develop a series of affordable lease finance options for customers, thereby offering the opportunity of greater financial flexibility in balancing these priority areas.

The lease packages which can be arranged for up to five-year terms are quick and easy to arrange and provide companies with a tax-efficient alternative to having to make a capital investment in a noise control solution.

Wakefield Acoustics can provide its customers with complete cost effective turn-key solutions from consultancy services for noise assessments and noise control plans through to the design, manufacture, installation and lease finance of any tailored noise control solution.

For more information,
telephone **01274 872277** or visit the web site at **www.wakefieldacoustics.co.uk**

Jane Dawson, managing director of Wakefield Acoustics

Investigating noise nuisance associated with licensed premises

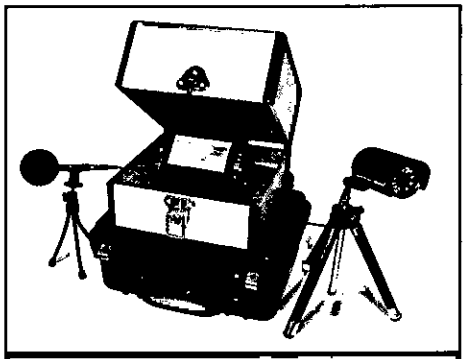
Integrated video recordings and sound level measurements

The rise in complaints associated to licensed premises has continued to rise over recent years but the last six months have seen a significant rise in the already upward trend. This has been largely due to the introduction of the smoking ban in England as of July 2007. Since the ban there has been an increase in temporary and permanent smoking shelters which often result in noise nuisance complaints from nearby residents. Investigating these complaints with officer visits is time consuming and often impractical as the complaints are out of hours and have often resolved themselves before an investigating officer arrives. Using unattended measurement instrumentation is popular where sound levels are logged in parallel with audio recordings. Such measurements can provide useful information however it is not often possible to ascertain which establishment the noise is associated to or indeed whether the noise is from its patrons or from general public gathering in the street.

Campbell Associates and Norsonic have worked closely with local authorities over the last year to provide a system designed to assist in these investigations. The system Nor-140/VID is a system which integrates video recordings, sound level measurements and full fidelity audio. The system logs sound levels constantly but video and audio is only collected when a user hand switch is activated. This saves considerable time when analysing measurements as video is limited to when the complainant sees there is a problem. Standard CCTV systems normally record constantly which requires extensive officer time finding areas of interest and correlating sound level information. The video recordings also have a pre trigger to store video and audio one minute before the hand switch is activated to assist in catching impulsive events.

When reviewing the measurements with the PC software supplied you simply click on the desired recording and press play. The cursor moves through the measured sound levels on a trace and plays the video and audio which is date and time stamped. It is very simple and it illustrates well issues such as doors of an establishment being left open with amplified music escaping, anti social behaviour and problems associated with closing time.

The Nor-140-VID system is very valuable for establishing the extent of an alleged nuisance. If a noise nuisance complaint is verified then it provides professional evidence for all parties in licensing reviews and or action against the licencee.



The Nor-140-VID system

The system can also be activated by trigger sound levels and also installed as permanent city centre monitors with data being collected automatically by wireless network connections.

For more details:
Justin Barker, tel **01371 871030**,
email **justin@campbell-associates.co.uk**
web site **www.campbell-associates.co.uk**

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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 2008

DAY	DATE	TIME	MEETING
Thursday	6 March	10.30	Engineering Division
Tuesday	11 March	10.30	Diploma Examiners
Thursday	**13 March**	**11.30**	**Council**
Thursday	3 April	10.00	Meetings
Tuesday	8 April	11.00	Research Co-ordination
Tuesday	22 April	10.30	CCWPNA Examiners
Tuesday	22 April	1.30	CCWPNA Committee
Thursday	8 May	10.30	Membership
Wednesday	21 May	10.30	CCENM Examiners
Wednesday	21 May	1.30	CCENM Committee
Thursday	22 May	11.00	Publications
Tuesday	3 June	10.30	CMOHAV Examiners
Tuesday	3 June	1.30	CMOHAV Committee
Thursday	5 June	11.00	Executive
Thursday	**19 June**	**11.30**	**Council**
Thursday	26 June	10.30	Distance Learning Tutors WG
Thursday	26 June	1.30	Education
Thursday	3 July	10.30	Engineering Division
Tuesday	8 July	10.30	ASBA Examiners
Tuesday	8 July	1.30	ASBA Committee
Thursday	10 July	10.00	Meetings
Tuesday	5 August	10.30	Diploma Moderators Meeting
Thursday	4 September	10.30	Membership
Thursday	11 September	11.00	Medals & Awards
Thursday	11 September	1.30	Executive
Thursday	18 September	11.00	Publications
Thursday	**25 September**	**11.30**	**Council**
Thursday	2 October	10.30	Diploma Tutors and Examiners
Thursday	2 October	1.30	Education
Thursday	16 October	10.30	Engineering Division
Thursday	30 October	11.00	Research Co-ordination
Thursday	6 November	10.30	Membership
Tuesday	11 November	10.30	ASBA Examiners
Tuesday	11 November	1.30	ASBA Committee
Wednesday	12 November	10.30	CCENM Examiners
Wednesday	12 November	1.30	CCENM Committee
Thursday	13 November	10.00	Meetings
Tuesday	18 November	10.30	CMOHAV Examiners
Tuesday	18 November	1.30	CMOHAV Committee
Thursday	20 November	11.00	Executive
Thursday	27 November	11.00	Publications
Tuesday	2 December	10.30	CCWPNA Examiners
Tuesday	2 December	1.30	CCWPNA Committee
Thursday	**4 December**	**11.30**	**Council**

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

Conferences and meetings:

Diary 2008

5 March
London Branch
Noise Nuisance
London

12 March
Environmental Noise Group
Transportation Noise Update
Birmingham

10-12 April
Spring Conference 2008 - Widening horizons in acoustic research
Reading

16 April
Measurement & Instrumentation & Electroacoustics Group
Playing Safe – meeting to Control of Noise at Work Regulations 2005 in Music and Entertainment
London

3-5 October
Building Acoustics Group
Auditorium Acoustics 2008
Oslo, Norway

14-15 October
Underwater Acoustics Group
Underwater Noise Measurement, Impact and Mitigation
Southampton

21-22 October
Measurement & Instrumentation Group
Autumn Conference 2008
Oxford

November
Electroacoustics Group
Reproduced Sound 24

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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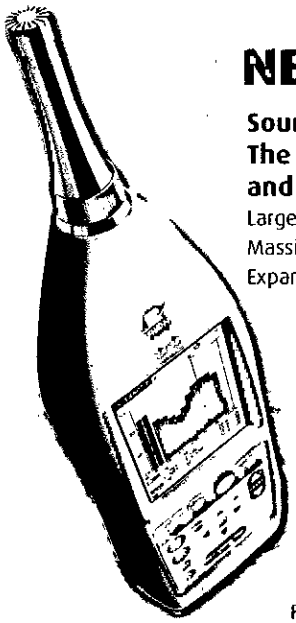

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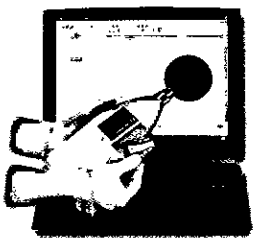

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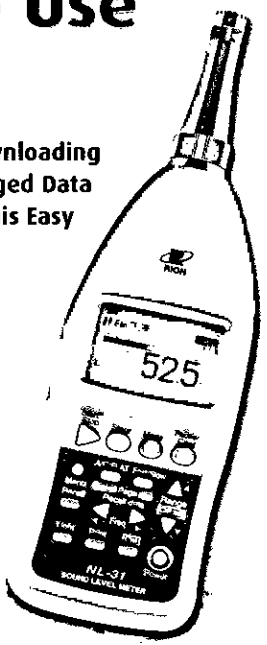

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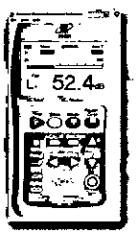

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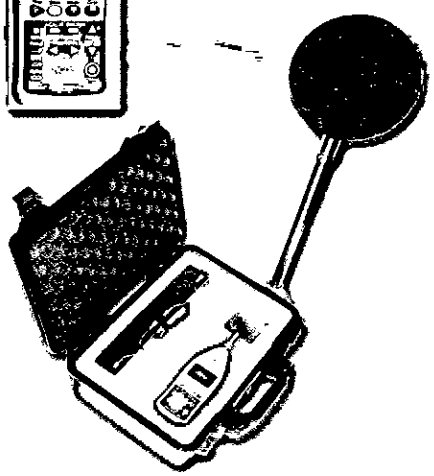

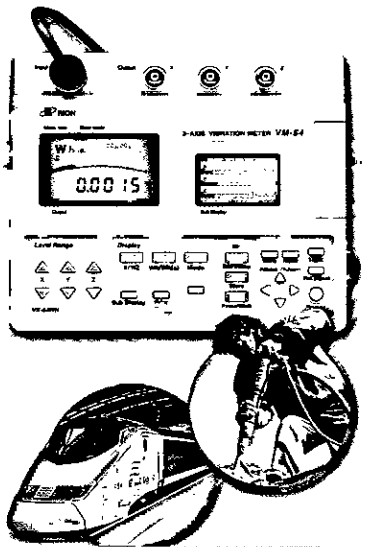

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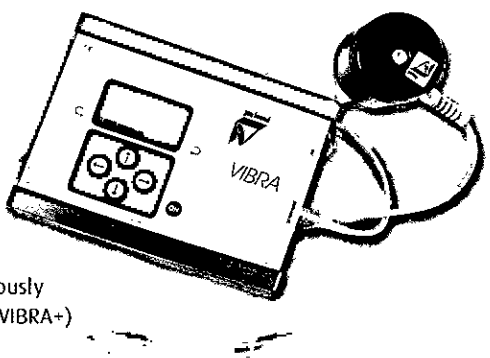

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