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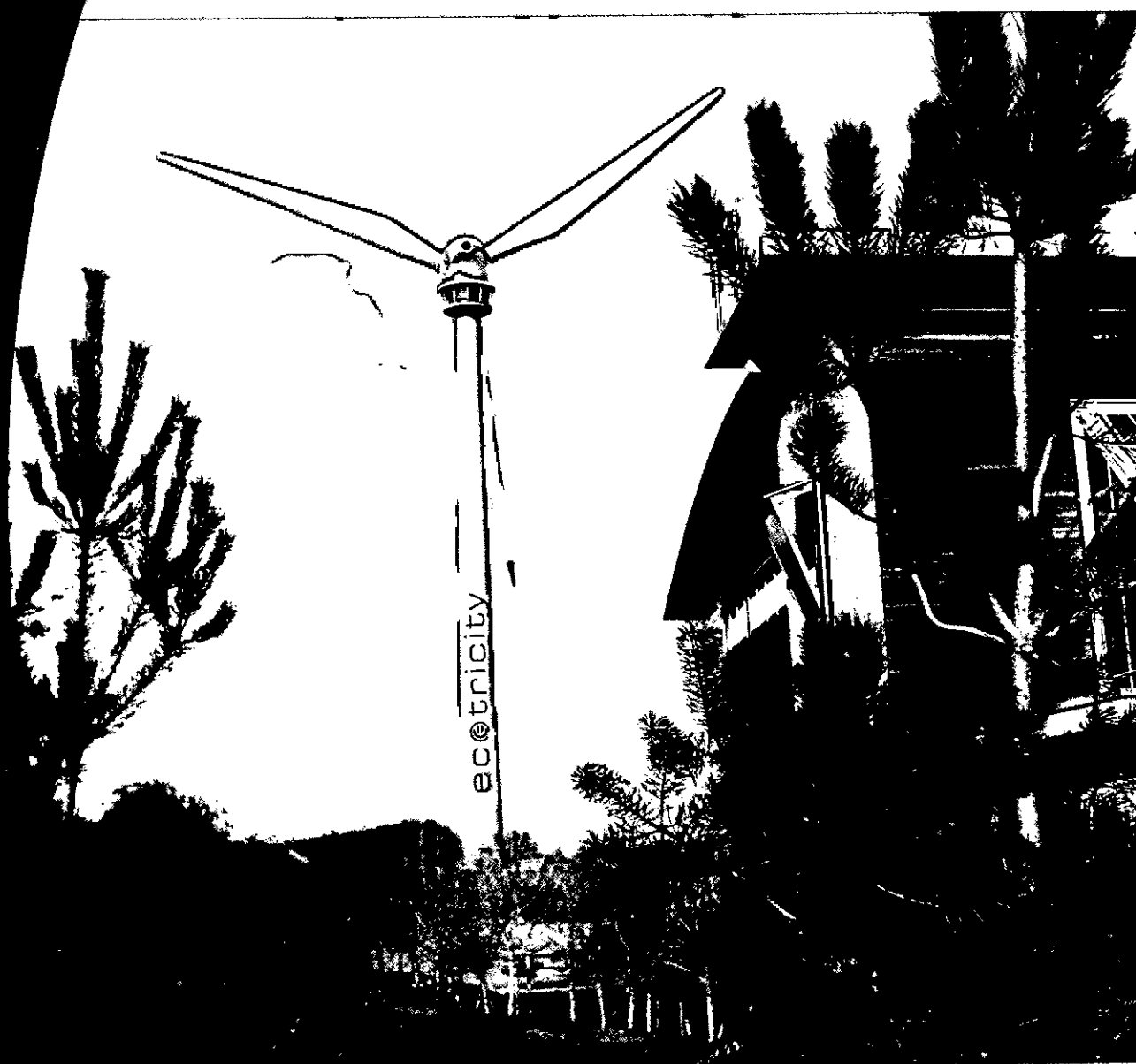
ACOUSTICS BULLETIN



in this issue...

IoA's third one-day conference on wind farm noise

plus... **Designer Noise: Pink is the New Black?**

From 'knocking ghost' to excellent acoustics

Controlling vibration in brown field sites

Pioneers of Acoustics: Harry F Olson

Institute of Acoustics

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ACOUSTICS BULLETIN

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Contents

The **front cover photograph** shows the older of Ecotricity's two wind turbines at Swaffham, Norfolk. It is an Enercon E66, with a rotor diameter of 66 metres, rated at 1.5MW, which when it was built in 1996 was the tallest onshore wind turbine in the UK. It remains unique on account of the public viewing platform directly below the nacelle.

The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It was formed in 1974 from the amalgamation of the Acoustics Group of the Institute of Physics and the British Acoustical Society.

The Institute of Acoustics is a nominated body of the Engineering Council, offering registration at Chartered and Incorporated Engineer levels.

The Institute has over 2700 members working in a diverse range of research, educational, governmental and industrial organisations. This multidisciplinary culture provides a productive environment for cross-fertilisation of ideas and initiatives. The range of interests of members within the world of acoustics is equally wide, embracing such aspects as aerodynamics, architectural acoustics, building acoustics, electroacoustics, engineering dynamics, noise and vibration, hearing, speech, physical acoustics, underwater acoustics, together with a variety of environmental aspects. The Institute is a Registered Charity no. 267026.

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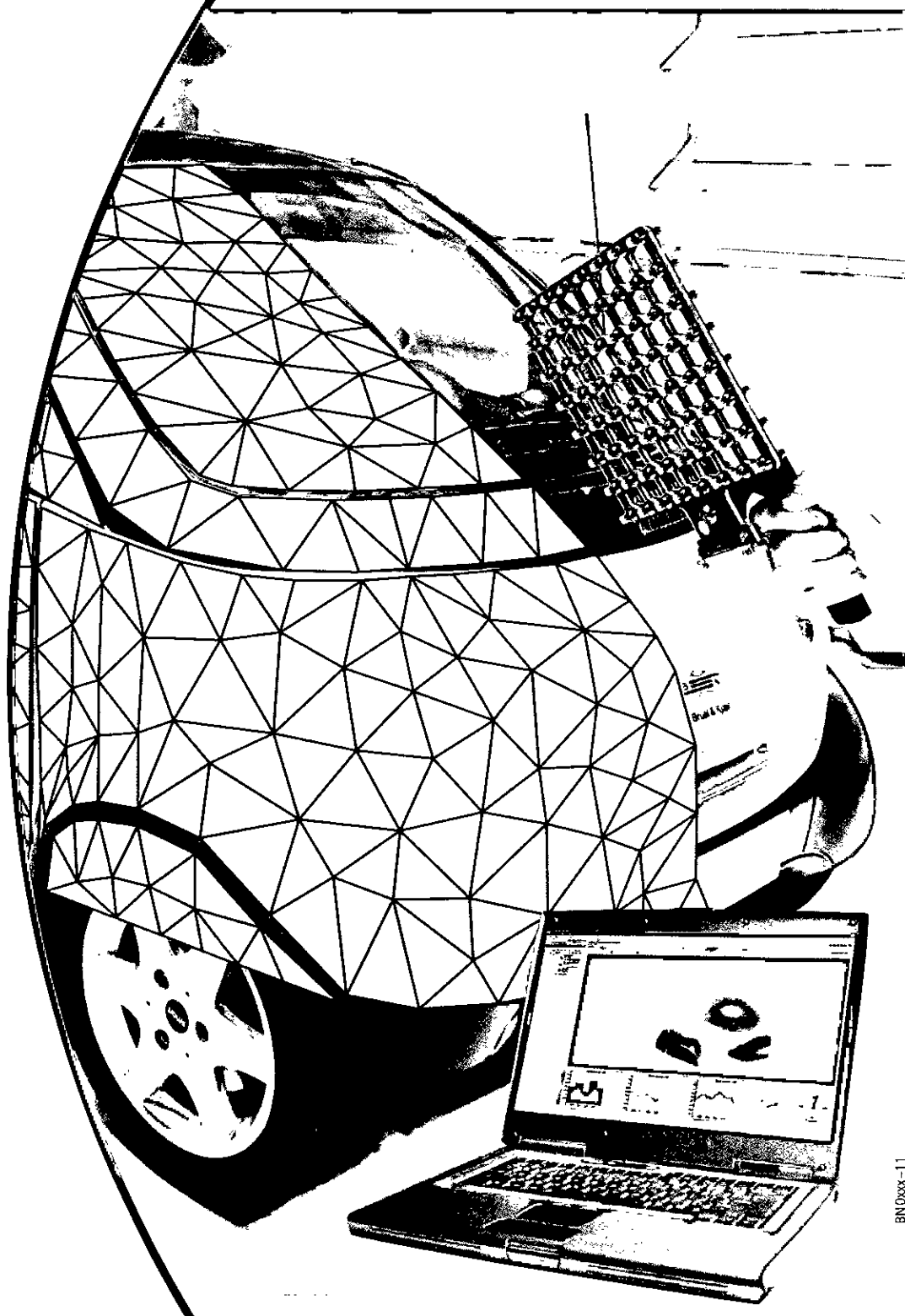

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Dear Members

At our recent Council meeting we accepted the annual report and accounts and these will now be put to the AGM on 5 June for approval. I was delighted to see that we had again had a very successful year, both in terms of delivery of services to members and also financially. It is the Institute's steady growth that allows us to develop our range of services for members. Our publications are a vital way in which we disseminate information and knowledge to members and our financial success will now allow us to recruit another member of staff at St Albans who will provide specific support to the Publications Committee in particular.

Our conference season got under way in Loughborough with the Fourth International Symposium on Bio-Acoustics. As President I have the huge privilege of attending all of our conferences and witnessing the high quality work undertaken by members. The conference was a great success and attracted delegates and expert speakers from all around the world. This conference was one that my professional life would not have led me to attend, but to my surprise and relief as a non-specialist in the field, I found the papers both accessible and informative. I was struck that the benefits of research in one area could lead to unexpected benefits in others, and the cross-fertilisation of ideas between the various interest groups present was remarkable. I reflected that this is true of so much of our work. I would urge you all to make the effort to attend local branch meetings, even when the subject appears not to be relevant to your immediate area of work – the benefits can well outweigh the small investment of time.

The Bio-Acoustics Symposium showed just how diverse are the interests of the Institute's membership. The numbers of members working in the various aspects of acoustics differs widely and it is sometimes difficult to sustain activities in the smaller groups. One group, the speech and hearing group, has been dormant for some years, but I am delighted to learn that this group has now reformed and is planning a one-day meeting in the near future. I am grateful for the hard work put in by Stephen Turner to bring this about, and I wish the group every success.

Finally, I mentioned in my last letter that Council has been concerned for many years about the falling numbers of students entering our profession. I was delighted, therefore, to read last month that applications for science and engineering courses had risen this year by ten to 13 percent depending on the subject. The concerted efforts to attract students to these subjects may finally be paying dividends.

Colin English

PRESIDENT

Meeting report

William R Martin. Northwest Branch

'Challenges in teaching hearing impaired pupils with additional complex needs' was the title of a meeting held at the Royal School for the Deaf and Communication Disorder, Cheadle Hulme, where we were entertained by Jane Douglas (Clinical Audiologist) and Rob Phillips (Educational Psychologist) on 6 February 2007.

RSDCD is a day and residential, co-educational, non-maintained special school and college. It offers specialist provision for students from 2 to 22 years of age who have severe and complex learning difficulties combined with significant communication difficulties which include little or no oral language. These learning difficulties may arise from a combination of sensory and multi-sensory impairment with severe and/or profound and multiple learning difficulties, autistic spectrum disorders and physical and medical conditions such as cerebral palsy. The school offers a range of residential provision to suit individual learners and their families up to and including 52-week care.

Whilst some places are funded by local education authorities, social services and the learning and skills council, the school is also funded by a charitable trust who would no doubt appreciate any generous donations.

The talk focused on a number of case studies of individual children, highlighting a range of acoustical issues. Hearing impairment is a complex area resulting from physical (cochlear) or auditory processing impairment, or both. The early and correct diagnosis of hearing impairment is an important factor in the treatment of students.

A number of cases were highlighted where learning and communication difficulties had originally been mistaken for physical hearing impairment. ABR (auditory brainstem response) audiometry is most commonly used on infants or individuals with communication problems. In some cases where the ABR results had been grossly abnormal and physical deafness was initially presumed, the cause had subsequently been diagnosed as an auditory processing problem.

Standard audiometry tests undertaken off-site (typically within ENT departments) have provided quite erratic results which are more often influenced by 'conditioning factors' associated with the change in environment. Consequently all audiometric testing is now conducted at the school, except ABR which can only be conducted in a hospital environment.

Some children arrive at the school having already developed specific phobias of hospitals, audiometric tests and equipment and hearing aids. By providing audiometric expertise in familiar surroundings this allows the staff to start challenging some of these problems.

The audiometric testing of children with communication difficulties can present particular problems with respect to their ability to communicate. By using a range of complex assessment methodologies it is possible to determine the nature of the hearing impairment and develop individually tailored solutions to meet the student's needs.

The descriptions for hearing loss are described in the table below:

level of hearing loss (dB)	description
25 – 39	mild
40 – 69	moderate
70 – 94	severe
>95	profound

For some students, simple amplification of noise will provide an adequate solution. However, where a student is wrongly diagnosed as having a physical hearing impairment, there is a risk that over-amplification can result in damage to the otherwise healthy hearing.

For one student who is particularly sensitive to high noise levels, simple amplification was not an acceptable solution. The Phonak 'I-link' product was found to be effective: it consists of a direct wireless link between the teacher's microphone (on a neck loop) and the student's hearing aid. Combined with noise reduction capabilities, the system makes it much easier for staff to communicate with the student without the need for amplification.

One blind student who had previously been under-stimulated had resorted to 'self-stimulation' by instigating noise feedback through his hearing aid. The provision of a new tamper-proof hearing aid was instrumental in weaning the child off feedback and onto more normal sounds. The child now gets a great deal of enjoyment from a range of rich musical sounds and auditory stimuli such as speech.

Few students at the school have cochlear implants, which are apparently more common in the Czech Republic and Cuba than in the UK. Cochlear implants are most commonly recommended for children under 4 years old. After this age the hearing nerve may have deteriorated through lack of stimulation, rendering it difficult to re-train. An implant later in life could provide some environmental awareness but is unlikely to provide hearing in its fullest sense. A number of exceptions are those people who have a memory of what sound is like, such as those who have developed language skills with assistance of a hearing aid, and those born with good hearing who developed language skills before going deaf.

Background noise was repeatedly cited as an issue, including noise from ICT equipment and buzzing fluorescent lights, which sometimes simply detracts from speech intelligibility, but can potentially be distracting and disturbing for some students. Interestingly, complex shapes (rooms or fixtures) and patterns (eg on wallpaper) can also be disturbing to some students and should be avoided.

Teachers and therapists are given an enhanced avenue in which to educate and stimulate the students. Some children were given the opportunity to recognise and experience music for the first time. Intensive interaction with students, incorporating music and sound from the 'musician in residence' has been effective, providing stimulus and reaction from some of the most hard-to-reach students.

The Gamelan room containing a number of Indonesian musical instruments tuned to a non-western musical scale appeared to be very popular with students. It was suggested that the Gamelan scale was such that most notes, however combined or arranged, provided a high degree of consonance. Some children were said particularly to enjoy the vibration from the gongs. Some members of the Halle Orchestra have also visited to provide entertainment, on one memorable occasion by playing a trombone underwater in the school swimming pool!

'Tomatis' type music therapy is used at the school, but there are mixed opinions of its effectiveness. In some cases (mainly certain types of autism) it is thought to calm students whilst also providing stimulus and improving their focus. This therapy appears to involve the heavily filtered music of Mozart, at a tempo of 50-60 beats per minute, played over binaural headphones. The stereo signal is further processed to provide spatial effects such as the rotation of sound around the head. It is no surprise that this therapy is a thoroughly unpleasant experience for neurologically normal subjects.

It was noted that whilst some students, at times, benefited greatly from acoustical and musical stimuli, others were more in need of relative peace and quiet. Some students are hypersensitive to noise and others hyposensitive to noise.

There was also concern that as more deaf children were being educated in main-stream schools rather than special schools, some students could be disadvantaged if the acoustic environment was not properly addressed (BB93).

For more details about the Royal School for the Deaf and Communication Disorder see **www.rsdmanchester.org**.

Meeting report: Central Branch

David Boaden. Steve Chadwick signals the changes to EcoHomes

The latest Central Branch evening meeting, held on 28 November 2006 at the NHBC offices in Milton Keynes, opened with the inaugural Branch Annual General Meeting.

The Chairman reported a good start for the branch, with four meetings already held, a total branch membership of 78, and an average meeting attendance of 23. The Central Branch had also been at the forefront in providing volunteers and developing resources to promote acoustics in schools. The ad-hoc committee was elected unopposed and the meeting approved the future plans to build on an encouraging first year.

Steve Chadwick, a licensed EcoHomes assessor from NHBC Sustainability Services then gave an interesting and enlightening presentation entitled 'A "sound" understanding of EcoHomes'. The presentation outlined the main drivers for the EcoHomes assessments together with an overview of the categories that are considered.

The meeting heard how the assessment process is based on the environmental credentials of the new building rather than considering the whole of the building's life, which caused one questioner to ponder whether the required regular repainting of timber windows may in fact be a greater cost to the environment than installing low maintenance alternatives such as uPVC windows.

Unsurprisingly, of the eight categories considered in the EcoHomes scheme, it was 'health and well being', which includes sound insulation performance, that drew the liveliest interest from the attending members.

The basic premise of achieving greater EcoHomes credits for improved sound insulation performance has remained in the latest assessment guidance. There has however been a slight shift in the numbers of tests to be conducted with this now being limited to a maximum of 30 tests of a type in each group or sub-group.

There was a significant amount of incredulity at the notion of credits being obtained merely by expressions of intent - it appeared to be unnecessary to demonstrate that such worthy intentions had actually been achieved. Steve then gave a brief outline of the post-construction review that is an optional addition to the design stage assessment and is sometimes specified by housing associations and other end clients.

After the meeting a number of the attendees continued the discussions at what is reputed to be the largest Indian restaurant in Europe.

National Science and Engineering Week

Pupils challenged by giant tetrahedron

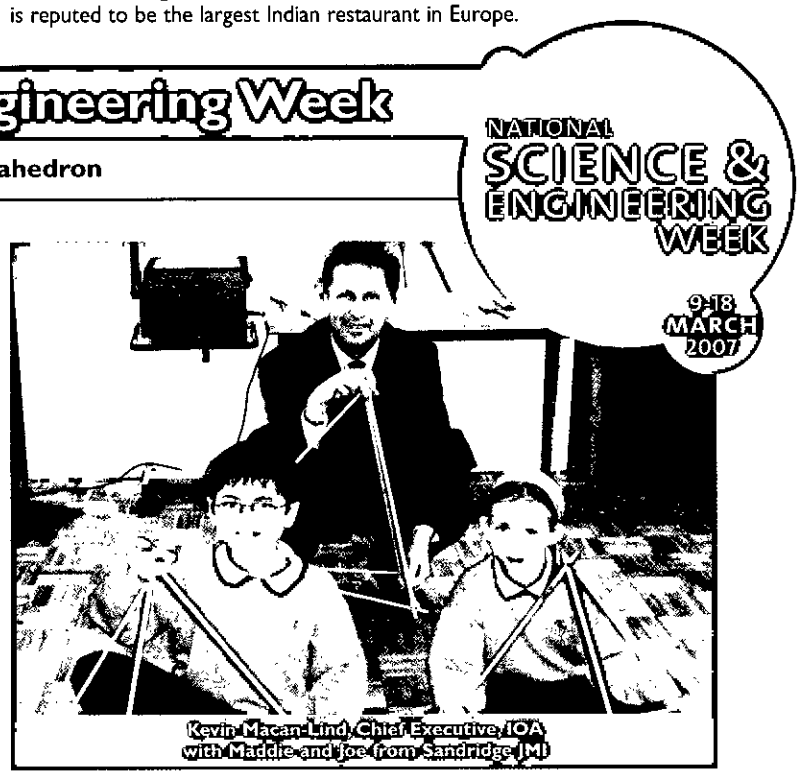
How do you construct a giant tetrahedron large enough to contain a class of over thirty children? This was the challenge faced by pupils at Sandridge JMI, St Albans, on Friday 9 March as part of activities to support National Science and Engineering Week from 9 to 18 March 2007.

In a two-hour workshop, Key Stage Two pupils worked in a team to construct tetrahedra from dowel and elastic bands, gradually putting them together to form an impressive four-metre tall structure. When finished the massive structure only just fitted into the assembly hall. 'It looked like great fun and really challenging' said Anne Main, MP for St Albans, who had been invited to witness the proceedings and encourage the pupils. Anne Main, an ex-teacher herself, clearly enjoyed watching and occasionally helping pupils during her visit. She commented 'The children seemed to be learning a great deal from it'.

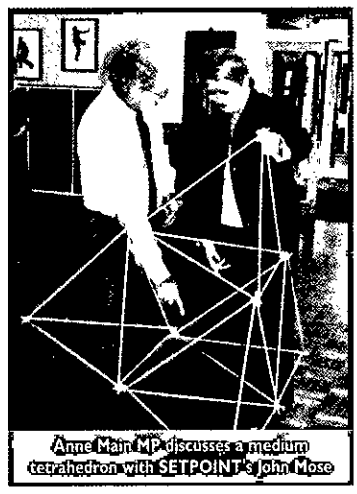
The event was sponsored by the Institute of Acoustics (IOA), itself based in St Albans. Kevin Macan-Lind, Chief Executive of the IOA said that on the first day of National Science and Engineering Week he was delighted to have the opportunity of witnessing, at first hand, a group of enthusiastic pupils coming to grips with scientific and engineering tasks. He added that the workshop was excellent, covering aspects of maths, science and design, and the children enjoyed learning about tetrahedra and how to build them. He judged the day a huge success.

The aim of the workshop, which was presented by Setpoint Hertfordshire, was to provide a short, focused task with an exciting conclusion. Setpoint Hertfordshire (formerly Hertfordshire SATRO)is an educational charity, whose aim is to inspire young people about science, engineering and technology. Setpoint achieves this by engaging young people in memorable experiences and by enriching their lives through exposure to impressive people who work in science, engineering or technology. Everything they achieve is in partnership with others. Setpoint Hertfordshire is part of a national network of Setpoints and is a member of Setnet, a national organisation for the promotion of science, engineering, technology and mathematics. The website at http://www.setpointherts.org.uk/ gives more information.

National Science and Engineering Week is an opportunity for people of all ages to take part in science, engineering and technology activities. It is coordinated by the British Association for the Advancement of Science, funded by the Department of Trade and Industry, and works in partnership with the Engineering and Technology Board.



Kevin Macan-Lind, Chief Executive, IOA with Maddie and Joe from Sandridge JMI


Anne Main MP discusses a medium tetrahedron with SETPOINT's John Mose


Pupils of Sandridge JMI inside the giant tetrahedron

Meeting report: London Branch

Nicola Stedman. AGM and evening meeting

The AGM and first London Branch evening meeting of the year were held on Wednesday 21 February 2007, at Capita Symonds. Attendance was high, with 37 people attending in total, including six non-members. During the AGM the London committee was introduced and the forthcoming spring programme was highlighted, with a call for potential future topics. The AGM was followed by a presentation by the guest speaker, Darran Humpheson of RPS, who provided an interesting presentation entitled 'Do you really know how to model aircraft noise?'.

Darran began by discussing the basics, such as why aircraft noise needs to be modelled and the level of accuracy required, followed by an overview of the relevant guidance documents and the principles of aircraft noise generation. When modelling aircraft noise the key issues include aerodynamics, engine type, whether the aircraft is landing or taking-off, fleet mix, stage length (principally aircraft weight), and flight path dispersion.

Obtaining sufficient data appears to be a major influence on final accuracy. For example, there is often insufficient data on the fleet mix: either the data set is incomplete, or the information provided is too complex for modelling. Operational factors such as local procedural requirements, noise abatement, and runway modal split may also influence flight paths and dispersion patterns. Darran noted that dispersion has a negligible affect on arrivals, but can marginally affect the results of the model by up to 3dB for departures. Stage length depends on the flight trip distance. With a few exceptions, long-haul flights are heavier than short-haul with more passengers, more luggage and more fuel: this in turn affects thrust and the departure profile. Aircraft weight has a marginal affect on arrivals noise, but can significantly affect the results of the model by up to 8dB for departures.

Darran also emphasised that the quality of the results is very much dependent upon the reliability of the input data, especially any assumptions made by the modeller. He warned that it was important to verify the results of any model by comparison against long term measured data and if necessary adjust the models to 'fit' the measured data. A case study was cited whereby both the model's approach and departure procedural data had to be adjusted by up to 5 dB to fit the measured data.

The presentation was followed by a question and answer session, where the audience took full opportunity to draw on Darran's aircraft noise modelling experience.

Meeting report: Midlands Branch

Kevin Howell. Industrial applications of ultrasonics

The Midlands Branch held their first get-together of 2007 on 24 January at Atkins' offices in Birmingham. Mike Swanwick took on the challenge of presenting the potentially difficult topic of ultrasonics, using a minimum of mathematical expressions, with great success.

Mike began by explaining what the term 'ultrasonics' described and introduced a few bits of basic physics, covering the transmission and detection of ultrasonic waves through various media.

He then went on to describe the very wide range of current practical applications of ultrasonics - wider than most of those present might have though. The applications included: dimensional measurement and inspection; porosity and crack detection; material analysis and computed tomography; guided transmission and leak detection; component and assembly cleaning; ultrasonic disintegration; modulated ultrasound and communications; sonar range and direction finding; and scale model acoustic testing.

Mike concluded his talk by encouraging everyone to consider the information he had just presented and see what other innovative applications of ultrasonics they could come up with. This provoked a lively question-and-answer session to end the meeting.

Thanks are offered to Mike for a very enjoyable presentation, and to Atkins for once again providing the excellent facilities.

Meeting report: Central Branch

Rachel Canham. Appropriate noise levels inside new dwellings for external noise – WHO knows?

An evening meeting of the Central Branch took place on Tuesday 3 April 2007 at the NHBC offices in Milton Keynes. Its title was 'Appropriate noise levels inside new dwellings for external noise – WHO knows?'. At last year's Institute of Acoustics Autumn Conference, internal noise levels inside dwellings formed the basis for various presented papers and was a hot topic during the afternoon discussion session. Unfortunately, time ran out at the conference before all the issues could be discussed, so the aim of this Central Branch meeting was to continue the debate.

The meeting started with a general brain-storming exercise to identify appropriate guidance documents. Not surprisingly, WHO and BS.8233 were top of the list although other sources of guidance and information were mentioned.

The discussion was varied and involved many topics including the status of the WHO guidelines, differences between current and previous WHO guidelines and other guidelines, issues of redeveloping noisy 'brown field' sites, conflicts due to costs or aesthetics, unreasonable planning conditions, Local Planning Authority requirements, ventilation issues, the assessment of entertainment and sporting noise, use of inaudibility criteria, daytime and night-time maximum noise levels, numbers of events, effects on internal sound insulation, use of soundscaping andnoise mapping, and sustainability and carbon emissions issues.

Following the discussion the consensus was that there was no single correct approach, and every case should be considered on its own merits. The guidance documents were felt to be useful benchmarks but required flexibility in their application. What was abundantly clear is that this subject area can certainly generate a lot of debate. Appropriate noise levels inside new dwellings? Who knows indeed!

Thanks are extended to Dani Fiumicelli (Faber Maunsell) for becoming an impromptu 'key speaker', and to Tony Jones (AIRO) for taking notes.

Meeting report

The Art of being a Consultant

Another in the series of meetings aimed at young consultants, those new to the profession, and students who are considering a career in acoustics was held on Tuesday 6 March 2007 at the Royal Society, London. The subject matter covered a wide range of day-to-day issues that any consultant would need to address.

The speakers were all practising consultants and were able to offer an extensive combined knowledge of the industry.

David Watts of AIRO first addressed the question 'what is acoustic consultancy?'

Philip Dunbavin of PDA then provided an insight into negotiating contracts in acoustical consultancy, and he was followed by Jeff Charles, Bickerdike Allen Partners, whose subject was 'doing the job'.

BDP Acoustics' Duncan Templeton discussed working with design teams. After lunch, Stephen Turner of Bureau Veritas gave his ideas on how a report should be written

Quality issues were addressed by Ed Clarke, Alan Saunders Associates, and the well-known consultant Rupert Thornely-Taylor dealt with the 'rules of the game' in a presentation setting out the ethical issues involved in consultancy work.

A lively discussion session followed the tea interval.

Another similar meeting will be held on Tuesday 5 June 2007 at the Town Hall, Manchester. For more details or to book a place please contact Linda Canty at the IOA office, St Albans, tel: **01727 848195** e-mail: **linda.canty@ioa.org.uk**

(L-R) Stephen Turner, Rupert Thornley-Taylor, Jeff Charles, David Watts, Philip Dunbavin, Ed Clarke, Duncan Templeton

Meeting report: Eastern Branch

Clive Pink. Ray Scholey and his colleagues demonstrated an outstanding award-winning development in fibre-optic acoustics

The anechoic and reverberation chambers at BT Research Laboratories, Martlesham were for many years a regular visit for IOA Diploma students of Colchester Institute, but that was back in the 1980s. So, for many of the more mature Eastern Branch members, the trip on 28 March to BT's Adastral Park premises was considered a bit of nostalgia, and it was perhaps more of an opportunity for the younger members to see a top-rate anechoic facility.

The presentation, however, turned out to be the most amazing 'cutting edge' piece of research I have had the pleasure of witnessing. Ray Scholey and his colleagues at BT demonstrated an outstanding award-winning development in fibre-optic acoustics. This new technology is currently only being marketed for so-called 'long distance' security, whereby a fibre-optic cable can be used to monitor noise sources for distances of up to 3km. However, it was clear for all to see that once someone improves the acoustical sensitivity of the fibre-optic signal, this method of sound recognition has the potential to revolutionise sound capture and even traditional microphone design.

This may sound like a Tomorrow's World exaggeration destined for obscurity, but if not, remember where you read it first!

The second part of the visit was, in comparison, a more mundane presentation, and dealt with design improvement works to mobile phone headsets, but this demonstrated much more clearly the acoustical qualities of the wonderful anechoic facility they have at BT Martlesham.

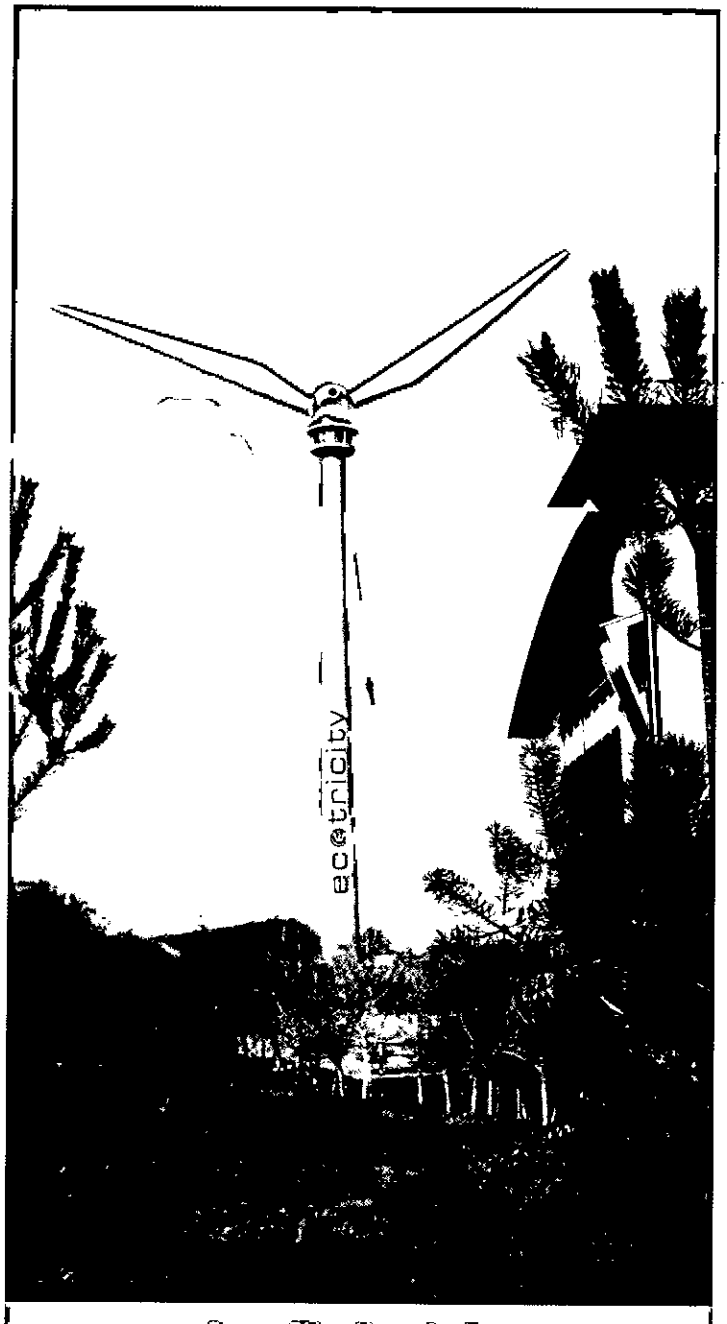
This was an afternoon trip, well attended by 19 members from around East Anglia. I am sure the memories will remain for many years to come.

IoA's third one-day conference on wind farm noise

Andy McKenzie. EcoTech Centre - Swaffham, Norfolk

On Tuesday 20 March the Institute of Acoustics held its third one-day conference on wind farm noise at the EcoTech Centre at Swaffham in Norfolk, chaired by Dr Andy McKenzie of the Hayes McKenzie Partnership Ltd (Salisbury and Machynlleth) a firm specialising in the assessment of noise from wind turbine sites. A range of volunteer and invited speakers made presentations to 70 delegates, who were also given the opportunity to climb the 300 steps to the top of the Enercon E66 1.5MW wind turbine which is installed on the site.

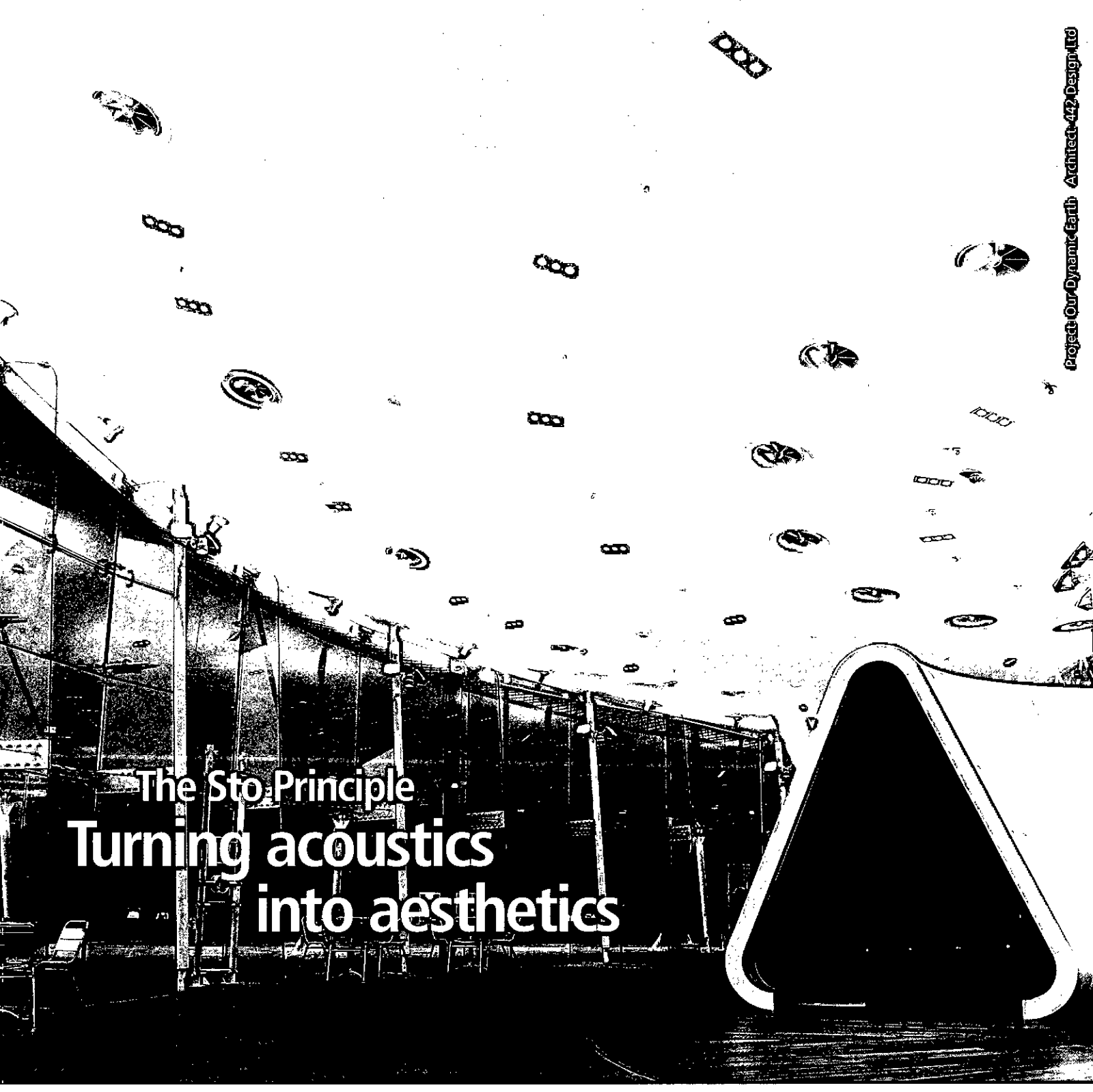
The conference was opened by Georgina Wong from the British Wind Energy Association who gave an overview of the wind turbine industry and its growth in the UK to its present level of installed capacity of over 2GW, with a further 2GW approved and awaiting construction and 8GW in planning. The second speaker was Sabine Schultz from the German wind turbine manufacturer Enercon, who described the major noise sources on wind turbines and the means by which noise could be mitigated without too much loss of power. After coffee Graham Parry from Temple Group described a case study on the use of different prediction models for use in wind farm noise assessment and concluded that because large variations could occur it would be helpful if the current assessment guidance used for turbine noise assessment included a specified methodology for prediction. Dick Bowdler from New Acoustics in Scotland then presented a paper calling for a review of the ETSU-R-97 assessment methodology which he said was out of step with current WHO guidance and did not take account of present generation of wind turbines which could be configured to operate right up against the allowed noise limits. The last paper before lunch was Donald Speirs



Enercon E66 turbine at Swaffham

IOA reception desk

continued on page 12



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IoA's third one-day conference on wind farm noise - *continued from page 10*

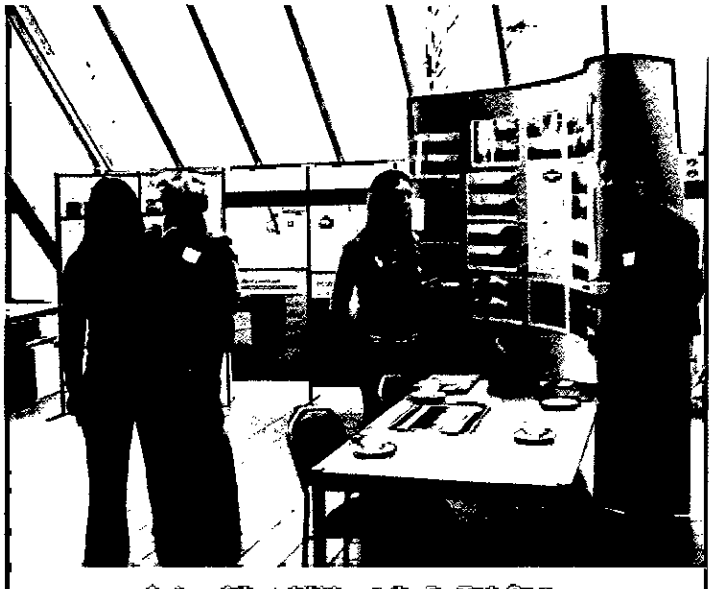
from Natural Power in south-west Scotland, a development company with an impressive track record of over 1GW of consented projects world-wide who discussed noise assessment from the developer's point of view. His view was that noise measurements in general did not necessarily paint a very specific picture of the noise environment with low levels of turbine noise often blending in with background noise causing difficulty in interpretation. He stressed that developments should err on the side of caution and be aware of the prevailing wind direction in order to manage and reduce developer risk during operational phases.

After lunch, which included a trip to the top of the turbine for the first group of ten to 15 delegates, Malcolm Hayes of Hayes McKenzie presented a paper describing the results of a study on the measurement of low frequency noise at three UK wind farms. He explained how this study arose from articles in the press, following claims by two GP practitioners that wind turbines were causing health problems because of infrasound and low-frequency noise content. The study found no evidence of any infrasound from modern day turbines, and although noise which could be classed as low-frequency may be audible on occasion it was always below DEFRA's recommended limits for such noise. The most dominant feature of the noise at these sites was found to be modulated broadband noise from the blades which had been wrongly assumed to indicate a low frequency component. Gwyn Mapp from Bureau Veritas the gave a presentation of noise and vibration issues from domestic wind turbines and a case study he had carried out at a site in London. At this particular location noise was not found to be a problem, but vibration was significant, and his view was that if the wall on which the turbine was mounted had not been strengthened, then it might have collapsed as a result! The final paper was from Mark Jiggins of Hoare Lea Acoustics, who presented the results of work carried out in conjunction with Andy McKenzie of Hayes McKenzie, where two developments were being brought forward simultaneously requiring consideration to be given to the assessment of cumulative impact, especially in the framing of planning conditions, to prevent the combined effect of the two sites from exceeding the normal noise limits.

After a lively discussion session with questions from the floor directed at all the speakers who had been able to stay for the whole day, the meeting finished with two further groups completing the ascent to the top of the turbine now amidst swirling snow. The day was a great success, stimulating debate on various issues including the role of wind energy in meeting emissions targets, mitigation measures which could be employed by manufacturers to reduce noise emissions, the effectiveness of current guidance in preventing noise nuisance, and role of small scale domestic turbines in raising awareness of energy consumption.

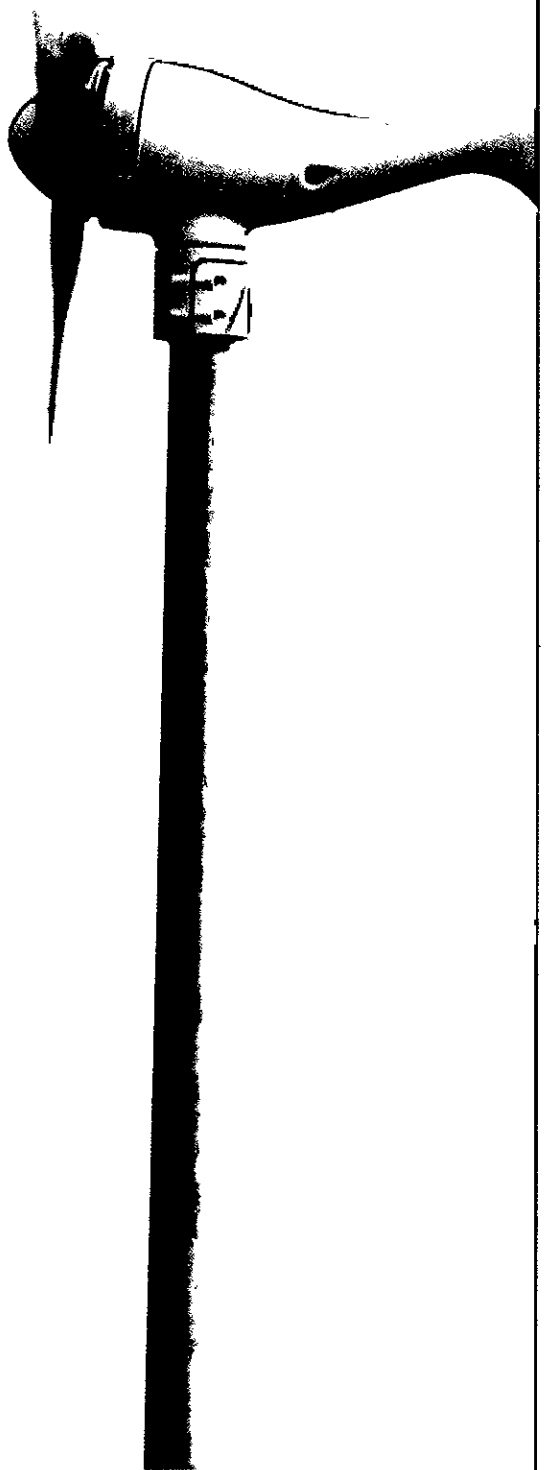
Inside the EcoTech Centre

Another view inside the EcoTech Centre



A view of the exhibition at the EcoTech Centre

A discussion over coffee



All a question of scale: a typical modern microturbine

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Eminent researcher in ocean acoustics awarded A B Wood Medal

Dr Aaron Thode

Dr Aaron Thode, an eminent American researcher in ocean acoustics, has been awarded the Institute of Acoustics' prestigious A B Wood Medal for his innovative, interdisciplinary research in ocean and marine mammal acoustics.

The A B Wood Medal and prize is awarded to research acousticians, usually under the age of 35, for distinguished contributions to the application of underwater acoustics. The medal and a certificate were presented by Colin English, President of the Institute of Acoustics, during the Institute's Fourth International Conference on Bio-Acoustics, which took place from between 10 and 12 April 2007 at Loughborough University.

On receiving his medal, Dr Aaron Thode said that it was an honour and pleasure to receive the A B Wood Medal. Three of his colleagues, Myrl Hendershott, Mike Buckingham and Grant Deane, had also been honoured this way. He had also worked with several other recipients including Nick Mukris, Mike Collins and Mike Porta. To be included in such company was both gratifying and humbling.

He added that working at sea was tremendously difficult yet supremely rewarding. He was delighted that an award like this existed to recognise and encourage the efforts of acousticians who, like the ancient sailors, had been lured by the sounds of the sea.

Dr Aaron Thode receives the A B Wood Medal from Colin English, President of the IOA

Dr Thode has established himself as an independent and innovative researcher in ocean acoustics. He has rigorously applied inventive signal processing methods to the acoustics of biological systems. His work in bio-acoustics has received international acclaim: in particular his pioneering work on the exploitation of multi-path effects tracking of cetaceans has established his reputation as world-class acoustician. His research efforts have demonstrated how cetacean vocalisations can be used to extract geoacoustic parameters and to derive expressions for the fundamental limits on the performance of match-filed processors. He has studied at Stanford University and Massachusetts Institute of Technology (MIT) and is currently working at the Marine Physical Laboratory, Scripps Institution of Oceanography. His work shows excellence in theory, simulation and experimentation, and his skill and leadership have been demonstrated during many sea trials.

Nominations invited for the A B Wood Medal 2008

An award for young innovative underwater acousticians

The Institute of Acoustics, the UK's leading professional body for those working in acoustics, noise and vibration, is inviting nominations for its prestigious A B Wood Medal for the year 2008. As well as the award, the recipient is presented with a citation of their work and a forum to present their research at a major IOA conference.

This award, which had previously only been open to scientists from the UK or USA, is now open to underwater acousticians from the European Union. The A B Wood Medal and prize is presented to an individual, preferably under the age of 35 in the year of the Award, for distinguished contributions to the application of underwater acoustics. The award is made annually, in even numbered years to a person from Europe and in odd numbered years to someone from the USA/Canada.

Nominations should consist of the candidate's CV, clearly identifying peer-reviewed publications, and a letter of endorsement from the nominator identifying the contribution the candidate has made to underwater acoustics. In addition, there should be a further reference from a person involved in underwater acoustics and not closely associated with the candidate. Nominees should be citizens of a European Union country for the 2008 Medal. Nominations should be marked confidential and addressed to the President of the Institute of Acoustics at 77A St Peter's Street, St. Albans, Herts, AL1 3BN. The deadline for receipt of nominations is 31 July 2007. The nomination form can be found on the IOA's website at **http://www.ioa.org.uk/medals.asp**.

Colin English, President of the Institute of Acoustics, says that A B Wood was a modest man who took delight in helping his younger colleagues. It is therefore appropriate that this prestigious award should be designed to recognise the contributions of young acousticians.

Albert Beaumont Wood was born in Yorkshire in 1890 and graduated from Manchester University in 1912. He became one of the first two research scientists at the Admiralty to work on antisubmarine defence. He designed the first directional hydrophone and was well known for the many contributions he made to the science of underwater acoustics. The medal was instituted after his death by his many friends on both sides of the Atlantic and was administered by the Institute of Physics until the formation of the Institute of Acoustics in 1974.

Meeting Report

Dr Hardial Sagoo. Southern Branch

Wind farm noise, its generation, propagation and assessment was the title of the latest Southern Branch meeting, where the speaker was Andrew Bullmore of Hoare Lea Acoustics. Held on 22 March 2007, this was a very popular 'topic of the day' and drew a high attendance from across the disciplines and from a wide area. About 40 people turned up and this was certainly a record turnout for the last couple of years.

Andrew gave a highly entertaining presentation in which he explained that the noise is only one of the factors that are considered in the decision for a proposed wind farm development. The presentation included a lot of information on measurement standards, describing their development with hands-on practice. The main standard is that published by the Energy Technology Support Unit of the DTI, ETSU-R-97, and Andrew discussed various issues with regard to this document.

He also gave a brief mention to some other sources of noise and their generation mechanisms, the calculation of noise propagation for each, and their likely impact at large distances.

The presentation was followed by an eagerly awaited question-and-discussion session. A lively debate ensued, led by a lawyer and other acousticians who had had personal involvement with wind energy developments, and could boast hands-on experience in turbine noise measurement and public inquiries.

Past recipients of the A B Wood Medal

1976	P A Crowder	UK	1992	C H Harrison	UK
1977	P R Stepanishen	USA	1993	M D Collins	USA
1978	A D Hawkins	UK	1994	T G Leighton	UK
1979	P H Rogers	USA	1995	N Makris	USA
1980	I Roebuck	UK	1996	Not awarded	UK
1981	R C Spindel	USA	1997	G B Deane	USA
1982	M J Buckingham	UK	1998	M A Ainslie	UK
1983	P N Mikhalevsky	USA	1999	M V Trevorrow	USA
1984	M J Earwicker	UK	2000	G J Heald	UK
1985	T K Stanton	USA	2001	J A Colosi	USA
1986	P D Thorne	UK	2002	S D Richards	UK
1987	D Chapman	Canada	2003	A P Lyons	USA
1988	V F Humphrey	UK	2004	E Pouliquen	Europe
1989	M G Brown	USA	2005	A Thode	USA
1990	A P Dowling	UK	2006	Not awarded	Europe
1991	M B Porter	USA			

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Designer Noise: Pink is the New Black?

Andy Munro MIOA.

As Per Bruel put it so succinctly at Reproduced Sound 21, the development of standards is not always based on true science but more often on a consensus of minds:

'The result is that all over the world we use not only an incorrect frequency weighting, but also a wrong scale for noise levels, for which it was not intended in the first place'.

So it is with the standards pertaining to the background noise levels in recording studios and any enclosed space designed for the reproduction of sound.

I have been aware for some time that the measured data obtained in the rarefied atmosphere of such places does not always concur with the subjective impression of the noise, and that on occasions there is a serious discrepancy between the two.

The reasons for this are varied and involve an understanding of both time and frequency domains with respect to auditory thresholds.

Work done by Tempest and Bryan [1] attempted to equate the integration time constant of the ear with the equivalent threshold shift in decibels. Although their work did not explore particularly low frequencies they did show that the integration time of the hearing process increases as frequency decreases, to the point where an event of at least 210ms would be required to register the same stimulation at 250Hz as a much shorter time at higher frequencies, with the shortest time (predictably) where the Fletcher Munson curves show greatest sensitivity. By simple extrapolation it follows that very low frequencies will not sufficiently stimulate a hearing response unless they have a duration of at least 500ms. While this may not be of any great relevance to steady state or slow variance noise, such as that from ventilation systems, it could and does matter greatly in the case of impact noise and vibration-induced background noise.

I can think of a number of instances where consultants and clients have used L_{max} (fast response) readings to define studio noise levels, especially when claims and litigation are involved, and these invariably involved the assessment of sound levels below 125Hz.

The other relevant domain is, of course, that of frequency, and that leads naturally to the concept of masking and critical bandwidth.

Critical bands are frequency ranges in which one pitch will mask another pitch. Critical bands occur because a wave striking the basilar membrane disturbs the membrane over a small area beyond the point at which the wave strikes, exciting the nerve endings over the entire area. Thus, frequencies close to the original frequency do not affect the sensation of the loudness of the sound much, even if the intensity of the sound is thereby doubled.

The sensation of loudness is not affected in this way when a frequency outside the critical band is added to the mix.

A critical band can be thought of as a frequency selective 'channel' of psychoacoustic processing: only noise falling within the critical bandwidth can contribute to the masking of a narrow band signal. The mammalian auditory system consists of a whole series of critical bands, each filtering out a specific portion of the audio spectrum.

According to Moore [2] the analytical expression for critical bandwidth can be simplified to:

Critical bandwidth (Hz) = $24.7[4.37f+1]$

where f is in kHz.

This would yield a critical bandwidth of 32Hz for a centre frequency of 63Hz, which is considerably less than is given in general literature: a minimum bandwidth of 100Hz or more is often claimed. What really matters is that a good dose of ventilation noise in the right frequency band can do wonders for masking a breakthrough of traffic noise in the same band. This could be the reason why some studios feel (subjectively) less prone to intrusive noise disturbances than others. Of course, a sound level meter will blindly measure whatever noise is present and the only weapons of discrimination are filters and integrators, both generally fixed in their response characteristics.

The combination of fast and slow reading with subsequent frequency analysis can extract a wealth of information. Figure 1 shows a measurement of the 'subjectively inaudible' noise intrusion into a studio with a specified noise floor of NR15. It can be seen that the 'fast' reading (125ms) value is almost 3dB higher than the 'slow', but both exceed the reference third-octave value of 42.5dB. It is clear that the time duration of the exceeding event has an important bearing on the detection ability of the hearing mechanism. There can be no question of noise masking in this case, as the general background noise was equivalent to NR5. The event was simply too short to hear, even though there was a technical failure to conform to ISO1996 and to other criteria, set over many years of broadcasting and recording.

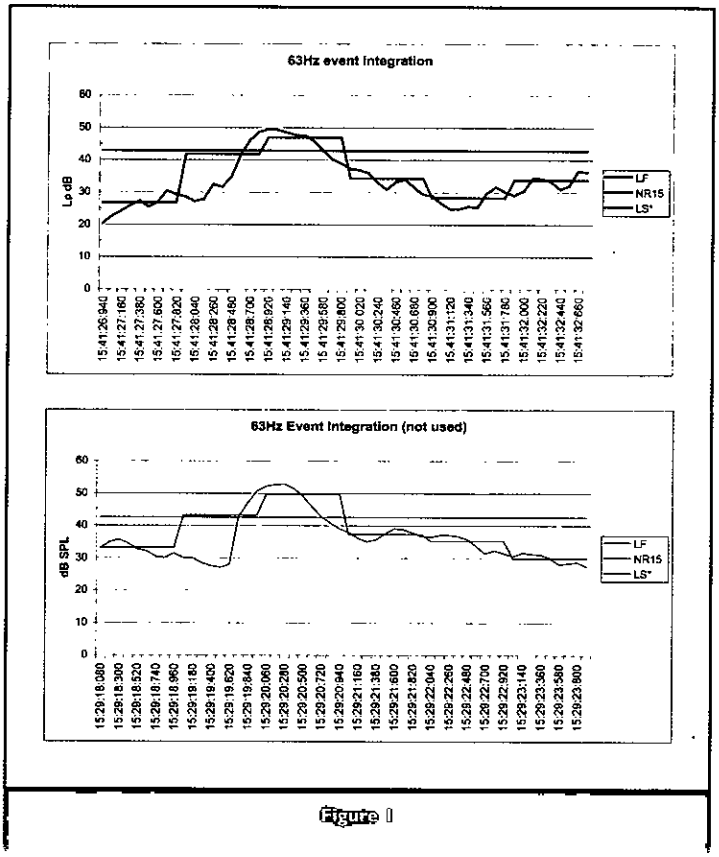

Figure 1

Comparison of fast and slow logging of 63Hz band background noise

The duration of the exceeding sound is 1s in both fast and slow integration and this is considerably more than the 300ms time constant postulated by Hempstock *et al* [3]. It would seem, therefore, that there is more to the perception of low frequency noise events than meets the ear (or meter).

Figure 2 shows a different event in the same studio, one which was distinctly audible, although still (subjectively) very quiet. The measurement sampling period is longer in order to capture the whole event, and this is the key difference: the exceeding duration is more like 4s, even though the L_{max} value is almost identical. The conclusion is inescapable that two separate events which 'look' almost identical in simple sound level and frequency analysis terms, are

(a) clearly audible

(b) not audible at all.

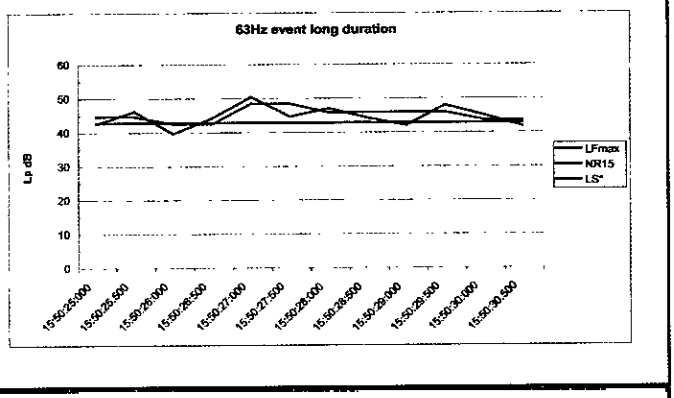

Figure 2

Long duration noise sample

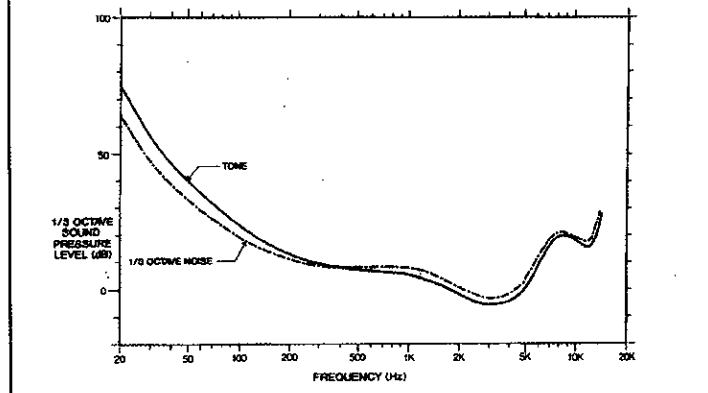

Figure 3

Recording noise criteria (after Cohen and Fielder)

It would seem that even a one-second slow reading third-octave analyser is not sufficiently powerful to determine the true audibility of an event that has its energy almost entirely within one narrow band, even if there is no significant masking by a critical bandwidth. In the presence of masking noise, it would be even more difficult to obtain an objective assessment by measurement alone.

Building design implications

By analysing a large number of projects, it has been possible to ascertain that the frequency band most likely to cause uncertainty, in both construction design and performance measurement, is 63Hz. There are several causes:

(a) Most heavy, thick walls have a resonance in the region of 63Hz

(b) Traffic noise tends to peak at 63Hz or, more likely, does not get any louder

(c) Hearing sensitivity decreases exponentially below 63Hz

(d) Recording equipment is, or can be, filtered at lower frequencies

(e) Low level sources such as speech can be filtered below 63Hz.

The combination of all these conditions conspires to make 63Hz the 'headache' frequency for urban or roadside locations. To take a worst-case scenario the background noise criteria expounded by some acousticians should be examined.

Cohen and Fielder published an AES paper [4] that puts forward a very

continued on page 18

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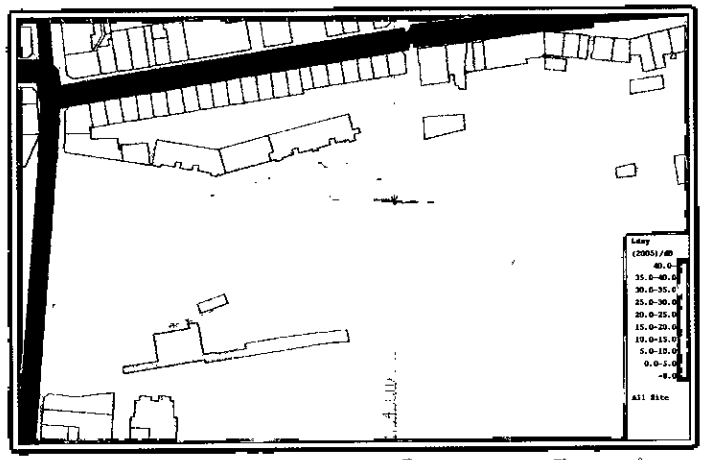

Noise contour showing amount that construction noise exceeds traffic noise

NOISEMAP

Designer Noise: Pink is the New Black? - *continued from page 17*

forceful argument for a 'recording noise criterion' of 0dBT. This is an even quieter curve than the Fletcher Munson 'threshold of hearing' limit, by virtue of including the perception of critical bandwidth noise, as opposed to the sine waves used in the original studies.

This places the background noise level at 63Hz (third-octave) at 29.6dB, and this is the reference level by which all auditoria should be valued. No account is taken of temporal shifts and to be fair this is stated as being a steady state requirement.

Given that most auditoria are located where traffic is an issue, and that air-conditioning of concert halls can be a major concern, it is hard to imagine how this value can be achieved in a practical design.

The paper goes on to cite several 'state-of-the-art' facilities, including the famous Skywalker scoring stage and the Dolby reference screening room in San Francisco. In both cases the ventilation system noise is between 45 and 50 dB at 63Hz (third-octave) and this would clearly go a long way to mask any extraneous noise that might find their way into the rooms. Interestingly, all the concert halls considered have a good dose of masking noise and this would almost certainly reduce the effect of extraneous noise 'events'.

Further more, a selection of ten home theatre listening rooms, presumably professionally built and tested, show an averaged noise peak at 63Hz, although the exact sound level can only be estimated (about 42dB at that frequency). This is actually reasonably quiet, and no doubt reflects the splendid isolation of the American audiophile's domestic arrangements.

Practical solutions

An impasse seems to have been reached whereby a minimum sound isolation of 60dB at 63Hz D_{nT} would be required to eliminate all likely noise ingress, but with a reasonable degree of masking noise most facilities would work perfectly well with at least some short duration noise intrusion. The limit of that intrusion remains to be determined.

Figures 4, 5 and 6 present examples of analysed noise intrusions from road traffic, all of which were inaudible within the studio.

Extrapolation from the data (and many more measurements) suggests that an intrusion of 50dB at 63Hz will be inaudible provided that the duration of the event is no more than 1s. This will be the case regardless of critical band masking and it is therefore purely a temporal artefact. It could be argued that an increase in background noise to the NR15 threshold would allow louder noise intrusions without noticeable 'annoyance'. It must be said at this point that steady state noise at NR15 is just perceptible in itself, although in general it is considered acceptable for all but the most critical recordings.

Cost analysis

When all is said and done nobody would deliberately design a facility that was any noisier than strictly necessary. However, in a cost-driven world where it seems price is the measure of everything, there appears to be a fine line to be trodden between satisfactory performance and difficult (sometimes impossible) specifications. There is much more work to be considered than there is space for in this article, but it is to be hoped that some interesting debate will ensue.

General conclusions

It has been the habit of some consultants to use L_{max} (fast) as the preferred method of measurement for intrusive noise but, as most intrusions are short in duration, this can lead to an overstatement of the maximum levels attained. An analysis of many such events shows an average difference of 3dB and occasionally up to 5dB, between L_{max} (fast) and L_{max} (slow).

There is further clear evidence that intrusions of up to 10dB above NR15 will remain inaudible under some conditions of duration and bandwidth. The exact reason for this is not entirely clear, given that researchers have determined that the temporal resolution of the hearing mechanism appears to be shorter than the events in question. One possible answer could be critical bandwidth masking, but this appears not to be a factor in the given examples as the background noise is considerably lower (around NR5).

Many standards have been proposed for studio noise levels, but most seem to concentrate exclusively on steady state conditions, and do not

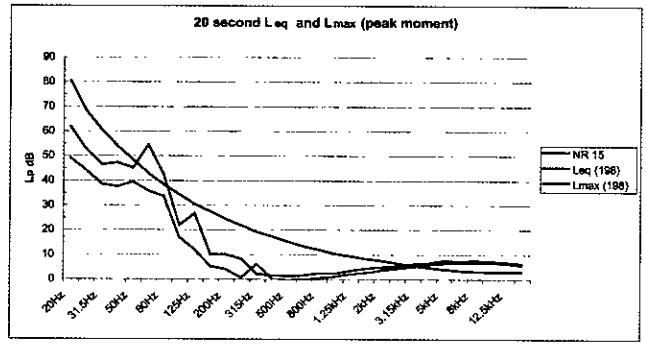

Figure 4

Noise spectrum peak and steady state (ignore HF noise)

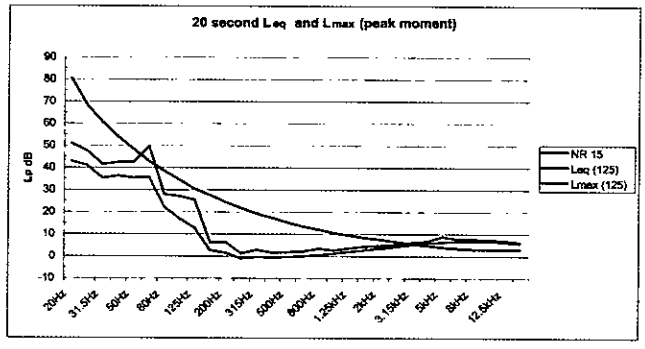

Figure 5

Noise spectrum peak and steady state

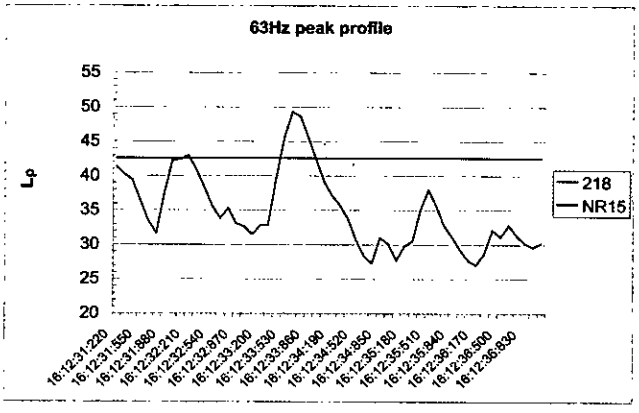

Figure 6

Time-logged 63Hz event duration

Auditoria (int)	NR25	L_{max} (slow)		
	NR30	L_{10}	NC30	L_{10}
	NR30	L_{max} (slow)		
Auditoria (ext)	NR30	L_1		
	NR25	L_{10}		
	NR30	L_1	NR25	L_{10}

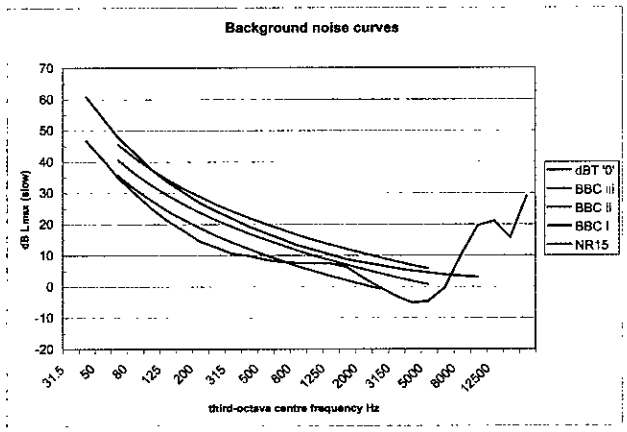

Figure 7

Comparison of background noise limit curves

consider the effects of integration time and critical bandwidth.

Other standard methods of measurement are used in appropriate circumstances. Cinema operators specify noise in various ways and this has been well documented by Saunders [5] as shown in the Table.

He points out that at low frequencies there could be a difference of 10dB between L_{max} and L_{10}.

Although these levels are considerably higher it does show (based on a wealth of experience) that L_{max} (fast) is not a preferred measure of venue noise.

When all else fails it is useful to compare any noise measurement criteria with the BBC 'White Paper' [6].

This is a collection of papers and internal memos that fuel the design process for BBC radio and television. There is a sensible spread of 10dB between the most demanding studio specifications and those for general presentation studios. The method of measurement is specifically noted as L_{max} (slow) or equivalently L_{eq} (1s). Short-term variations are simply restricted to 5dB above reference, regardless of duration, masking or subjectivity of any kind. This is entirely understandable but it is interesting to note that some recent BBC projects have changed the criteria by which studios are judged, to a more subjective (pragmatic) basis.

A comparison of the various 'high performance' curves reveals a wide range of values and it should be duly noted again that no allowance has been entertained for short duration noises in the presence of masking, critical bands or mean variations.

In conclusion, the isolation and hence cost of construction of a large concert hall could vary by several millions of pounds depending on the approach taken to the predicted background noise. On the one hand, a target of dBT=0 with no possible allowance for masking or temporal auditory 'blindness' will result in an isolation requirement of 60dB at 63Hz. On the other, a carefully shaped noise floor of NR15, with a well-damped construction giving 45dB isolation at 63Hz and a carefully calculated 'intrusion masking strategy' could result in a satisfactory performance outcome.

Of course, either strategy might be relaxed to some extent, but an erroneous mixture of the two will be less satisfactory than either - and much more expensive.

Andy Munro MIOA is a director of Munro Acoustics Ltd, London.

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From 'knocking ghost' to excellent acoustics

K-H Lorenz-Kierakiewitz and M Vercammen.

the new Tonhalle Düsseldorf: innovative design of a concert hall refurbishment

Introduction

The Tonhalle Düsseldorf was rebuilt in 2005: an ideal chance to solve acoustical problems. The main problems were the huge echoes caused by the domed shape, but the problem was how to remove the echo whilst respecting the architecture. The Peutz consultancy proposed a creative solution referring to the building's former use as planetarium. The idea was to install a visually opaque, acoustically transparent dome. Behind it, reflectors would avoid sound focus points, with the sound being redirected upwards as far as possible. Over the course of many scale model measurements a reflector geometry capable of reducing the echo was evaluated. To maintain the appearance of a hemisphere, it was necessary to find a visually opaque material for the new inner dome which still maintained acoustical transparency. At the same time, the podium acoustics were improved to optimise the contact between the musicians. The chairs were optimised, too, resulting in a greater reverberation time in the hall. The acoustical design was realised together with HPP architects and the other engineering bureaux, integrating all the new technical installations into a very complex geometry. The realisation of the project was a challenge which had to be completed in record time of only six months, but the result is an architectural and acoustical improvement. Besides exorcising the 'knocking ghost' the Tonhalle Düsseldorf now can compete with other concert halls with its exceptional acoustical properties.[1]

Problem analysis and starting points

The acoustical problems of the original Tonhalle were caused by the shape of the hall: it was almost a hemisphere of 15,000m³ volume, 40m diameter and 24m high (see Figure 1).

The main problem was the very strong echo in the main audience at ear height, which was caused by the domed shape of the hall: the concave geometry meant that sound foci were formed as if by a concave mirror. In these foci all the reflections from all directions, *ie* from every part of the dome, added up because they coincidentally had identical delay times (Figure 2) and thus formed echoes. In the 250Hz and 500Hz octave bands the echoes were up to 20dB stronger than the direct sound. Even worse, because of the physics of the space, for every source point on the stage a mirror focal point could be found where the echo was enormous!

The list of requirements for the refurbishment contained as the most important aim the reduction of the noticeable echoes (those perceived as disturbing) as far as possible. Consequently, the starting point for acoustical consultancy during the modernisation of the Tonhalle was the development of a concept to suppress the dome echo.

The definition of the character of events planned in the new Tonhalle was crucial: about 65% of the events would be symphonic music, chamber music and choral music. The reverberation time of the occupied hall therefore had to be increased from its previous 1.35 seconds to an ideal (for symphonic music) of 2.0 seconds.

Concept for removal of the echo

The room acoustical consultant Peutz proposed an innovative concept to solve the echo problem: a visually opaque, but acoustically transparent new inner dome. Behind this, a new shell of carefully directed reflectors would break up the hemispherical shape and avoid coincidental energy summation, as shown in Figure 3.

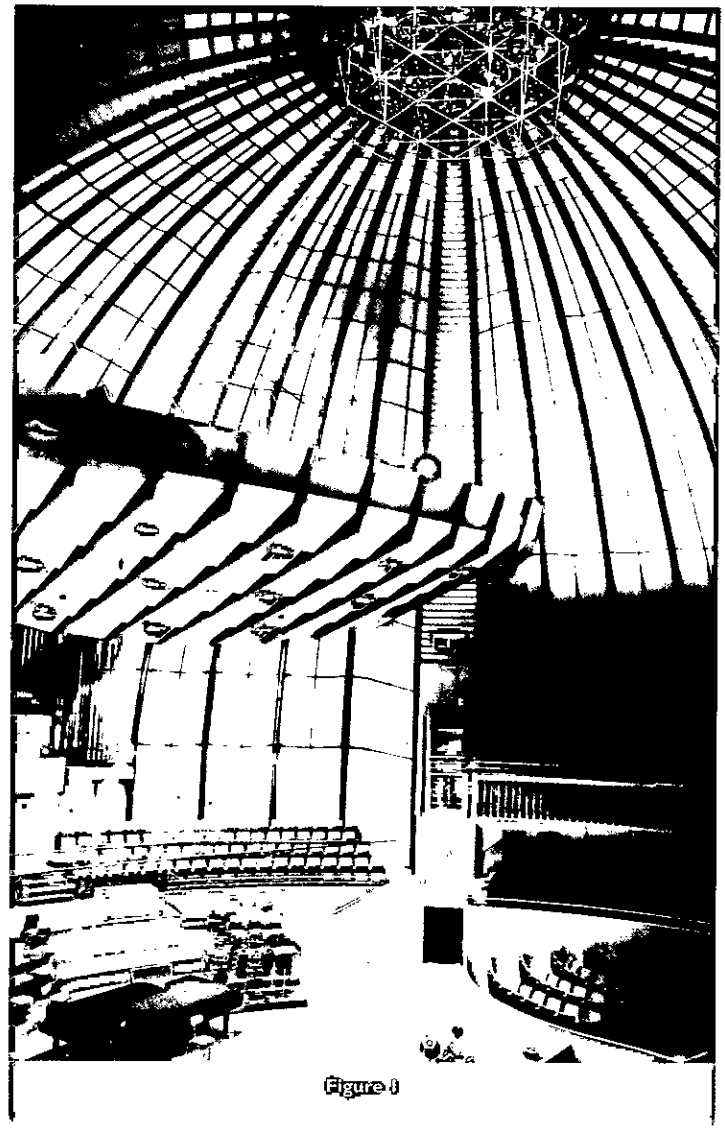

Figure 1

Inner view of the Tonhalle Düsseldorf before refurbishment

Scale model measurements

Because the low frequency focusing properties of concave surfaces cannot readily be modelled accurately in computer simulations, it was necessary and practical to perform measurements in a scale model of the auditorium. An acoustical 1:12 scale model of the original auditorium was built (see Figure 4) to be able to evaluate (and auralise) in frequency bands from 80Hz to 4kHz (1kHz to 48kHz in model frequency range).

For scale measurements, special model sources were developed to

continued on page 22

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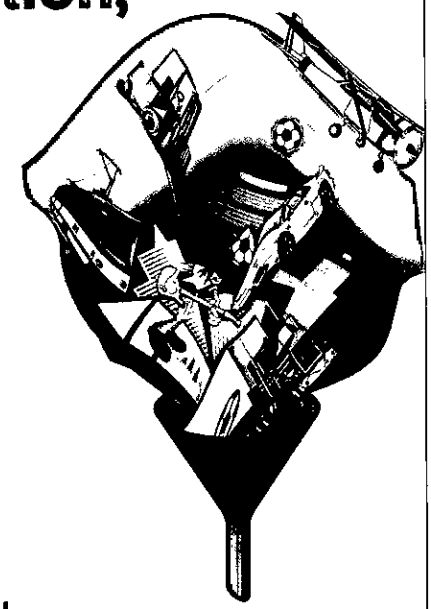

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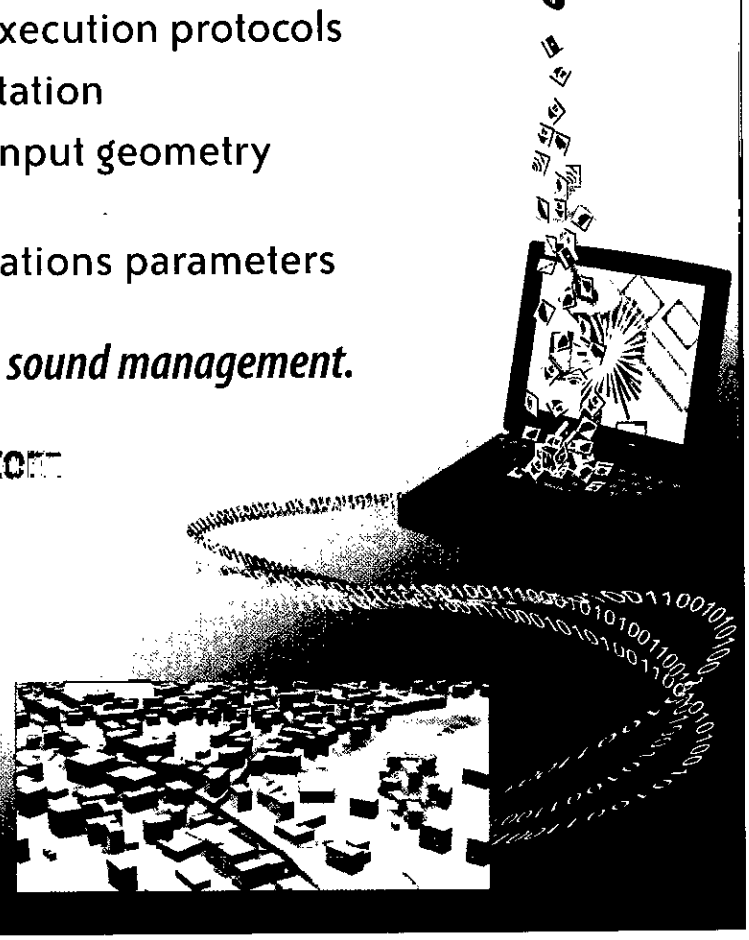

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From 'knocking ghost' to excellent acoustics - *continued from page 20*

radiate sound as omni-directionally as possible in the relevant frequency-transformed transmission range. The miniature microphones were specially selected to meet the specifications of linear frequency response and omni-directionality in the model frequency range. In every model variant, impulse responses were measured by means of a maximum length sequence analyzer[2,3] at 14 constant microphone positions and three source positions, resulting in a total of 29 transmission paths. From the impulse responses (with a time constant of τ = 20ms) the smoothed ETC was calculated for the five octave bands between 125Hz and 2kHz.

First, the existing conditions in the hall were verified in the model. Then 182 different variants were built and examined. Every new variant was changed only in one aspect of its geometry, to allow comparison with the preceding variant. The ETC's and the parameters calculated from them were compared, variant by variant, in order to assess the echo suppression.

By this method of testing the effects of small geometry changes, the echo-forming mechanism was identified and the echo reduction of any constructional measure could be tested in the model before changing anything in the real hall. The main structure of the new hall was ready before the start of the internal refurbishment, but the model was nevertheless helpful during the refurbishment too, because small details in reality differed slightly from the model: the effect could be tested and optimised.

Most importantly, in order to control remove the echo it was found that placing even 'ideal' diffusers could not solve the echo inherent in a hemispherical shape in general: diffusers still reflect a certain amount of energy in a reciprocal (mirror) direction, according to Snell's Law, and therefore into the focus. This had to be avoided: no energy was permitted to add up at the same delay time in the foci. This aim cannot be achieved with diffusion, but only with carefully directed reflecting surfaces.

Experiments with diffusers and reflector geometries

In order to develop geometries that scatter as much sound energy as possible out of the specular direction and as little as possible into the foci, the directional scattering characteristics of many different diffusers and reflector geometries were examined in form of 1m square panels in an anechoic chamber (*ie* anechoic for high frequencies). In a specialised measurement setup[4-7] the impulse responses reflected from the samples were measured by a MLS system using 19 microphone positions radially distributed in the half-circle round the sample, each ten degrees from its neighbour (see Figure 5).

From the measurement results it was found that the dimensions of the reflecting surfaces had to be at least 3.5m to be effective down to a frequency of 200Hz, where the echo level was highest. An optimum angle of 30° to the tangent of the cupola was estimated, resulting in a constructional depth (depth variation) of more than 1.5m. One geometry meeting these specifications was a set of periodically repeating prisms.

By means of the acoustical scale model the findings were used to develop a very specialised and complex geometry. This new shell forms the new acoustical enclosure of the concert hall. With optimally formed, directed and folded reflectors the shell avoids the reinforcement of sound in foci. Instead, the reflectors redirect the sound coming from the podium upwards into the cupola, where the sound waves are reflected several times before reaching the audience.

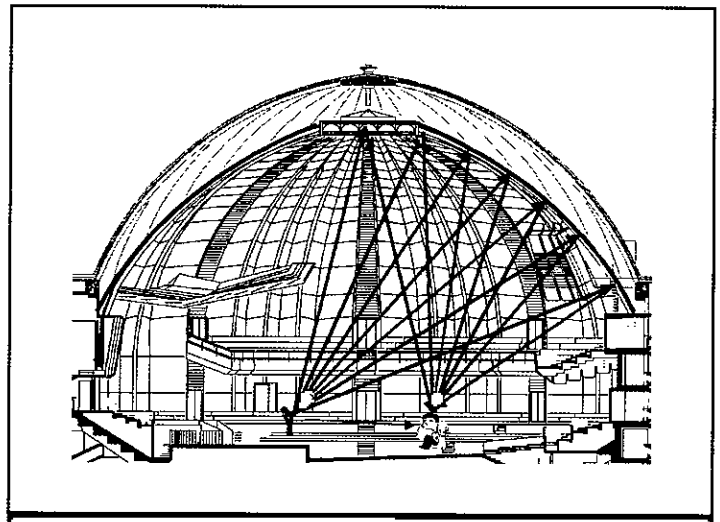

Figure 2

Cause of the 'knocking ghost': simultaneous reflections arriving at the audience

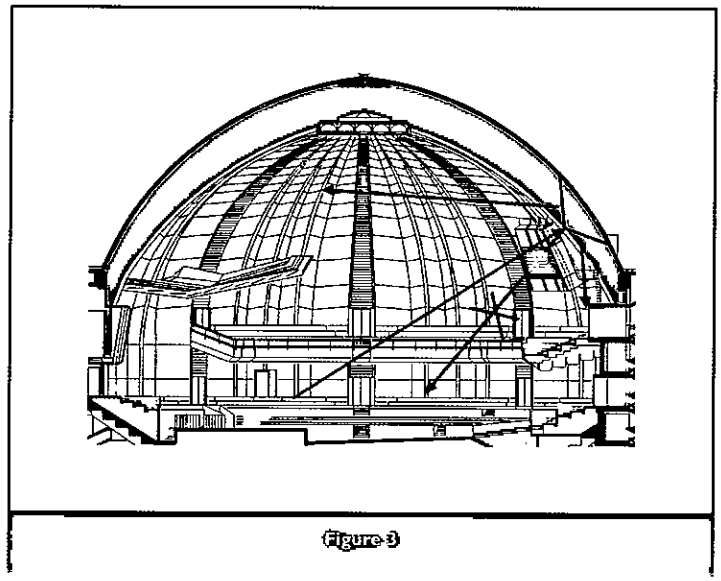

Figure 3

Principle of the solution: sound-transparent inner dome with reflectors behind

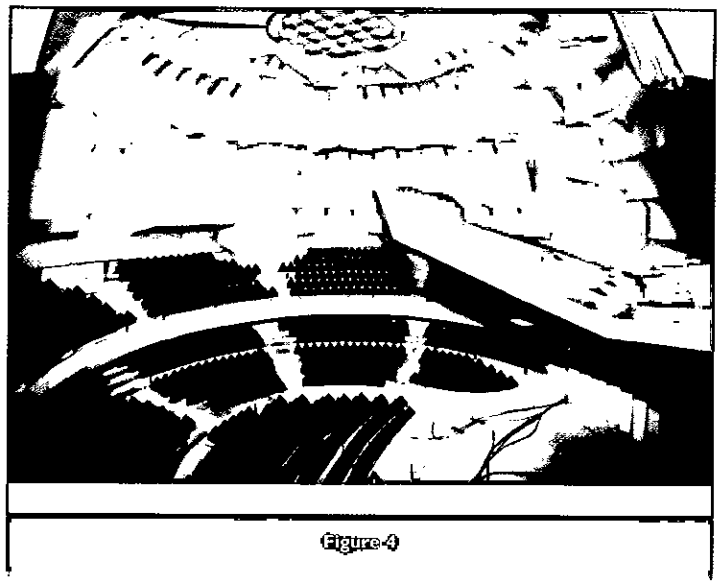

Figure 4

View of the scale model in the final, echo-suppressing geometry

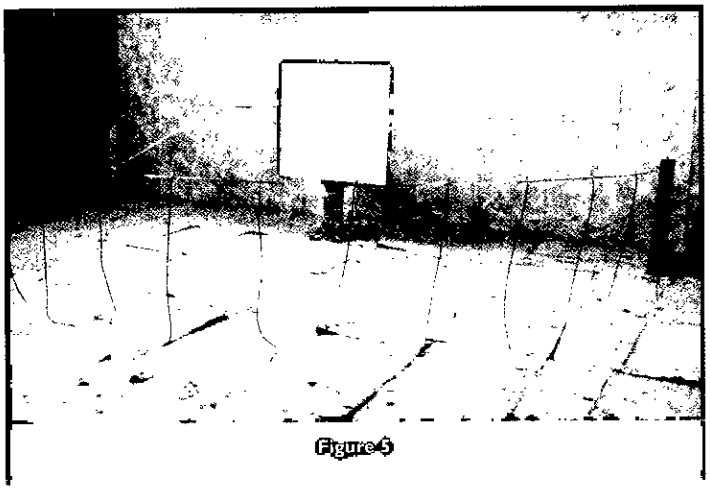

Figure 5

Setup for reflection measurements in an anechoic chamber

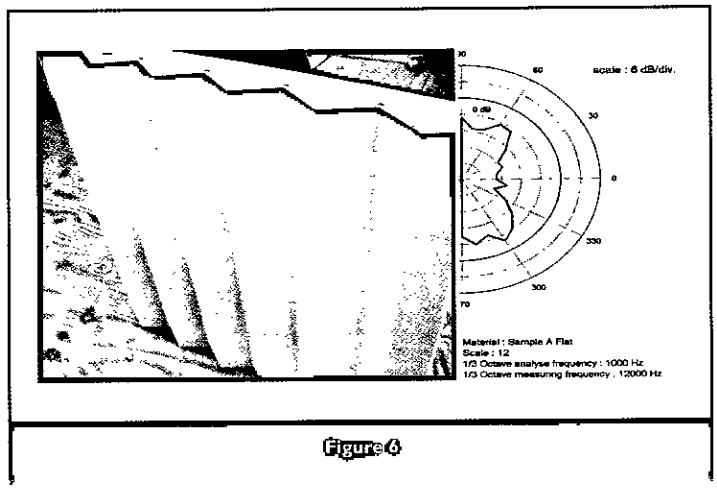

Figure 6

View of the geometry of 30°prisms with scattering plot at 1kHz

Experiments with acoustically transparent materials

By means of laboratory measurements an appropriate, acoustically transparent version of the existing massive inner dome had to be developed. The wooden echo-causing panels of the inner dome had to be replaced by a material which was transparent enough to the passage of sound that the reflectors of the new shell behind it would be effective. After some preliminary consideration, some form of woven metal appeared the most promising. To find out what kind of woven metal could be sufficiently transparent, intensive measurements were performed in the anechoic chamber of the Peutz laboratory[8]. These measurements turned out to be less than straightforward, because sound reflections near zero had to be measured. This meant that the time responses of the room and the measurement setup had to be subtracted from the measured impulse responses in the time domain, in order to identify those reflections from the sample and the sample frame which were already low in comparison with the direct sound.

With help of this method a woven metal material was selected which met the specification that the reflection in the specular direction must be minus 20dB relative to a perfectly reflective plate (below 8kHz).

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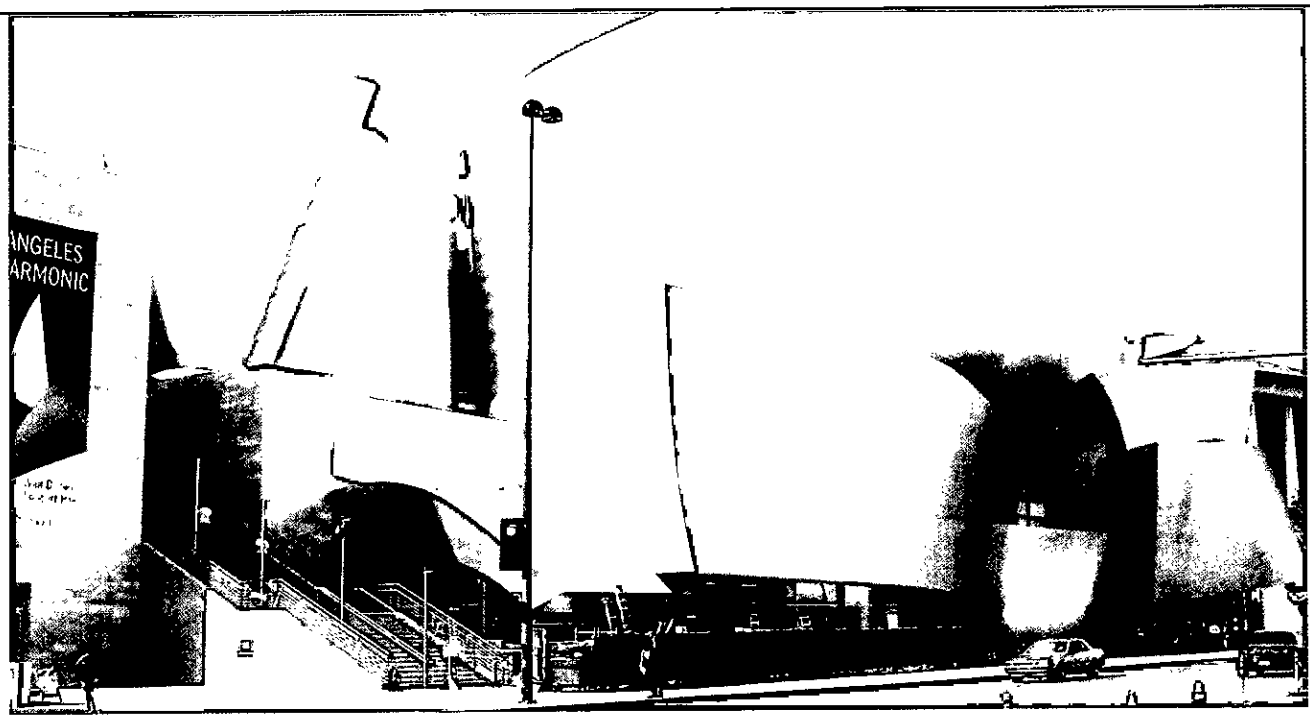

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From 'knocking ghost' to excellent acoustics - *continued from page 23*

Realisation of the concept

The folded reflectors behind the acoustically transparent woven metal screen changed the reflection structure in the echograms dramatically in almost all the measurement paths examined. In Figure 7 the typical improvement of the ETC is given in the 500Hz octave band: where the old hall showed an enormous dome echo, the new hall no longer has a disturbing echo.

After the reflector geometry and the sound transparent material for the new inner dome had been decided, an architectural concept was developed by the architects HPP in record time. All the new technical installations had to be integrated into the already complex geometry of the building. By intensive and close teamwork with HPP and the other consultants, the whole refurbishment - rather a daring exploit - was a success, being completed in the record time of only 6 months.

Peutz monitored the development process with laboratory, model and field measurements to ensure the correct installation of all measures. This even extended to on-site testing every other day of the newly built surface parts of the new shell.

Increasing the reverberation time

A very important aspect of the refurbishment was to increase the reverberation time of the auditorium in its occupied and unoccupied states: another problem in the old hall had been a reverberation time significantly too low for symphonic music. The low values were a result of the specific volume, which was too low, and the mechanism of the dome geometry which directed all the sound into the absorbing audience by the first reflection. By adding a large part of the volume behind the inner dome, which was formerly separated from the auditorium by the wooden panels, an increase in the specific volume from approximately 7m³ per person to approximately 8m³ per person was achieved. The acoustically effective volume was increased by ten per cent.

The new folded reflector shell, developed in the scale model and forming the new acoustical enclosure of the hall between outer and inner dome, is built of double gypsum boards with a surface weight of 20kg m^{-2} and sealed with non-porous varnish.

All 1950 seats in the hall were to be replaced, and were also objects of acoustical interest because the absorption of the occupied hall had to be minimised: the new design of the seating was optimised in every detail. By means of laboratory experiments in the reverberation chamber, the absorption properties of different seat variants were examined, and every occupied seat in the new Tonhalle has the minimum acoustic absorption. Together these measures led to a significant reduction of acoustic absorption in the hall at frequencies above 200Hz. The reverberation times of the new Tonhalle were increased significantly above 200Hz, with the result that the hall has now a very well-balanced timbre.

Conclusions

The whole refurbishment of the Tonhalle Düsseldorf was rather a daring project, completed in an extremely short period of only six months. The design, planning and realisation of the modernisation programme all had input from acousticians, and the result is very successful.

The acoustical scale model was an extremely valuable tool in developing measures to improve the acoustical conditions in the new hall: the suppression of the echo by the new geometrical reflectors was precisely predicted in the scale model. Comparative measurements in the auditorium before and after the refurbishment verified the model measurement results: the new Tonhalle no longer acts as a concave mirror, but the new 'folded' geometry acts as a resonator to create a regular, homogeneous reverberation.

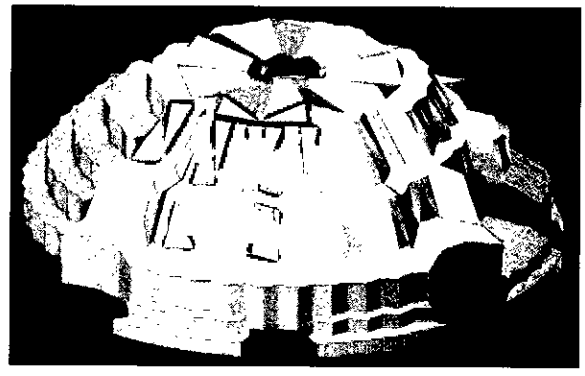

Figure 7

View of the final, echo-suppressing geometry in a 3D-visualisation

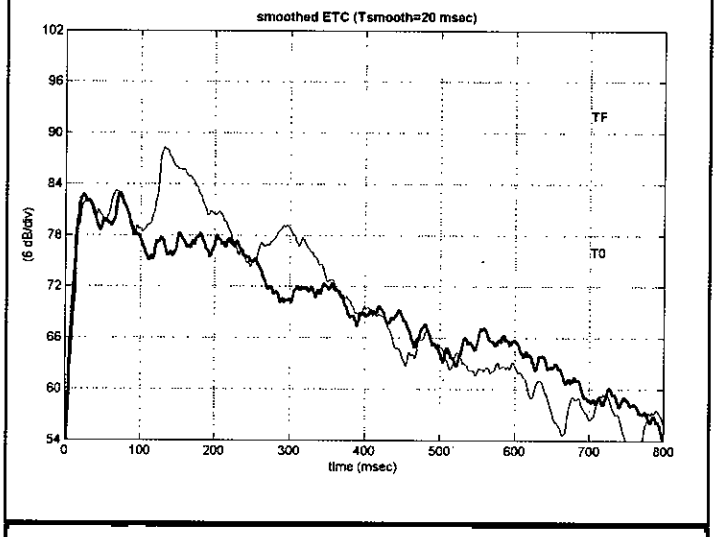

Figure 8

Reflection structure of a typical echo path (500Hz) before and after refurbishment

Even more important than the exorcism of the 'knocking ghost' echo was the remarkable improvement in the acoustics. Listeners, critics and artists have received all the classical music concerts since the re-opening on 4 November 2005 very positively: average ticket sales have increased from 60% of capacity before the project to more than 90%. The Tonhalle Düsseldorf is nowadays able to compete with other concert halls with first-class acoustics. The modernisation is an architectural and acoustical regeneration of the hall, but also an enrichment of the state capital Düsseldorf.

K-H Lorenz-Kierakiewitz is with Peutz Consult GmbH, Düsseldorf, Germany

M Vercammen is with Peutz bv, Mook, Netherlands.

Figure 9

View of the acoustical reflectors behind the sound-transparent inner dome

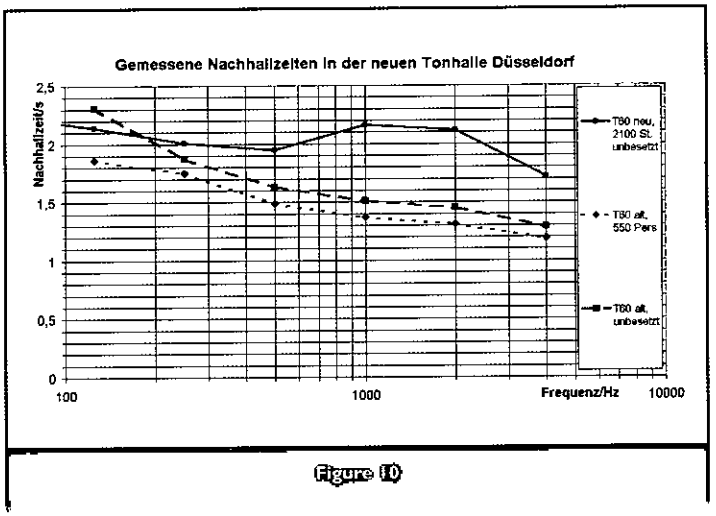

Figure 10

Comparison of the measured reverberation times before and after refurbishment

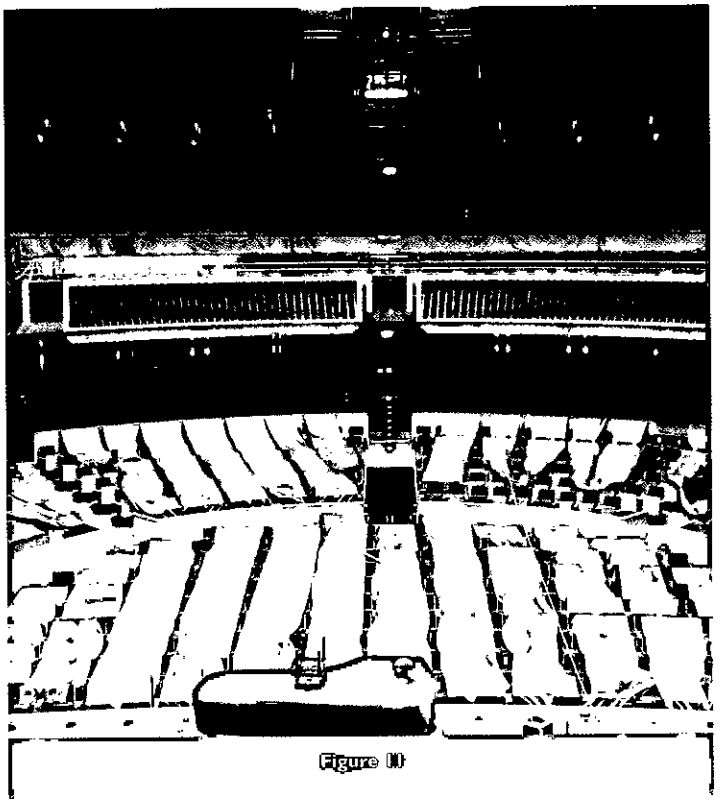

Figure 11

View of the completed new hall during measurements with simulated audience absorption

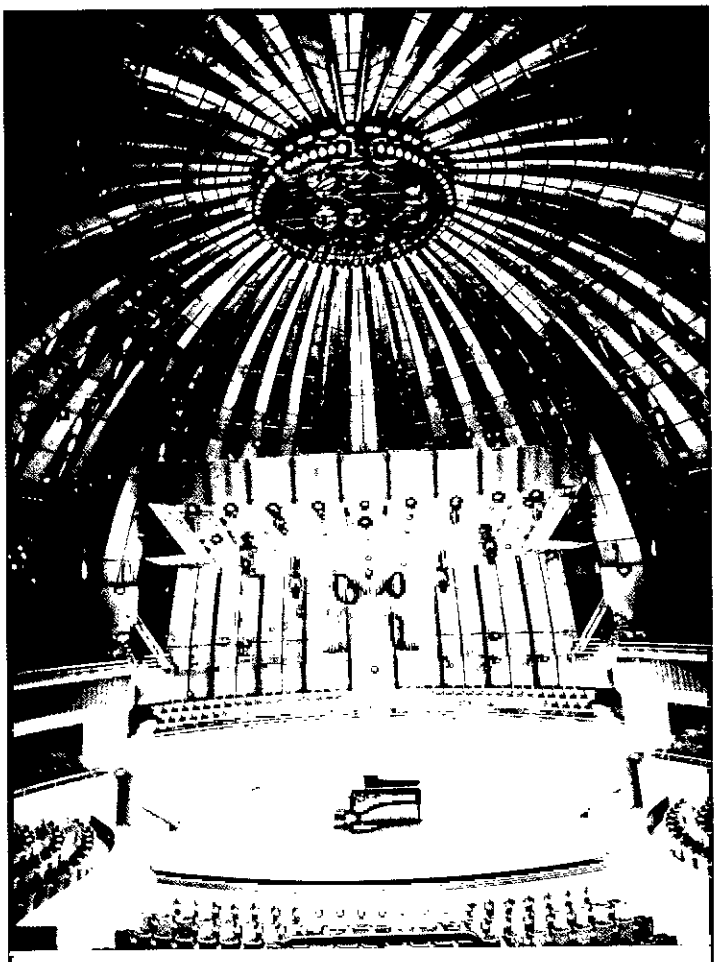

Figure 12

Interior view of the Tonhalle Düsseldorf after refurbishment

Refereneces

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Virtual reconstruction of the ancient Roman concert hall in Aphrodisias, Turkey

Jens Holger Rindel.

Introduction

About two thousand years ago one of the world's earliest and most beautiful concert halls were built in the city Aphrodisias, named after the goddess Aphrodite. It was a rich society, renowned for its marble and mastery in sculptures. Like many other cities in the Roman Empire there was an open-air theatre for plays and a roofed theatre - an odeon - for concerts (from the Greek *odeion*, a hall for song and declamation with music). In an EU-funded project the odeon or concert hall was reconstructed in a virtual environment, visually and acoustically. The audience capacity of the hall was around 1000. There was been some uncertainty about the original height of the ceiling; but with the suggested reconstruction the reverberation time with a full audience is around 1.6s at middle frequencies. The influence on the acoustics of various architectural elements was also studied. The virtual reconstruction, including some auralisation examples with reconstructed music, was made with the ODEON room acoustic modelling program. From January 2006 the reconstructed concert hall has been open to visitors, albeit in a virtual environment.

The ancient Greek and Roman theatres are famous for their excellent acoustics. However, it is not generally well known that different kinds of theatres with different acoustical conditions were built for different purposes. The method adopted in the EU-project ERATO was to make computer models of the spaces, first as they exist today, and then adjust the acoustical data for surface materials by comparison with acoustical measurements from some of the best preserved examples, namely the Aspendos theatre in Turkey and the South theatre in Jerash, Jordan. The next step was to complete the computer models in accordance with archaeological information, in order to make virtual reconstructions of the spaces. It was found that the Roman open-air theatres had very high clarity of sound, but the sound strength was quite low. In contrast, the odea had reverberation times like a concert hall, relatively low clarity, and high sound strength. Thus, the acoustical properties reflect the original different purposes of the buildings, the theatre being intended mainly for plays (speech) and the odeon mainly for song and music.

With the advantage of modern computers and room acoustical simulation software, we can nowadays get further information about the theatres by modelling them in a virtual environment. The ERATO project is to provide a virtual reconstruction of the acoustics in the Roman period, both in large open-air theatres and in smaller, roofed theatres. For the first time, this makes it possible to listen to these historical buildings as they sounded in the past.

Computer models

The acoustical models of the theatres in the ERATO project were made using three different software packages at various stages: the ODEON modelling language, IntelliCAD, and 3DStudioMax.

An important source for the reconstruction was the book by Izenour[1], with its suggested reconstructions. However, the building was assumed to be less high than was suggested by Izenour. The degree of detail needed in the construction of the models and the influence of the seating area on the acoustics was determined by previous studies, and the models were previously compared with measurements[2].

The absorption and scattering properties of the materials were indirectly estimated by comparing simulations of the present-state models with these in-situ measurements and with the available literature. The model was first created based on the current remains on site, and then the reconstruction was added to reproduce the odeon as it was originally built (to the extent that this is known). The acoustical simulations were carried out with ODEON 7 acoustical simulation software.

The Aphrodisias odeon as reconstructed has a volume of 20190m^3 and a seating capacity of approximately 1700. The archaeological site is shown in Figure 1. The computer models of this odeon, shown in Figures 2, 3 and 4, are based on the reconstructions suggested by Izenour[1] and the number of surfaces in the acoustical model is 5058. The roof is carried by a timber structure with a suspended coffered ceiling. It was tested in order to determine how the coffered structure influenced the acoustics in comparison with a flat roof, as shown in Table 1. The windows in the real theatre were usually open, but had wooden shutters that could be closed when the weather so dictated. The acoustical effect of closing the windows was also studied.

Theatre Configuration	Acoustical Parameters				
	T30 (s)	G (dB)	C80 (dB)	STI	DL2 (dB)
reference model	1.61	5.61	2.22	0.54	3.47
flat ceiling	1.66	4.84	2.49	0.55	4.08
closed windows	1.80	6.10	1.46	0.52	2.89
absorbing orchestra	1.54	5.07	2.97	0.57	3.32

Table 1

Simulated acoustical parameters averaged over the 500 and 1000 Hz octave bands for the Aphrodisias odeon with audience, averaged over 15 receiver positions in different configurations.

Simulation results

The simulations in the Aspendos open-air theatre were made with 500,000 rays, and those in the Aphrodisias Odeon with 100,000 rays. The greater number of rays in the open-air theatre was necessary because of the simulated 'open-air' effect, whereby a totally absorptive roof was introduced representing one third of the total surface area.

The theatre models were simulated as fully occupied in order to be able to make comparisons with existing concert halls. Unlike today's halls, Roman theatres had dramatically different acoustics full and empty, because the seats were not upholstered.

In all the simulations the sound sources are omni-directional, and are placed on the acting stage. There are 15 receivers distributed in two radial lines diverging from the orchestra. The parts judged to be of acoustical interest could then be subtracted one at the time from the reconstructed model. The reconstructed model is the 'reference model' in Table 1.

Figure 1

Photo from the archaeological site of the Odeon in Aphrodisias

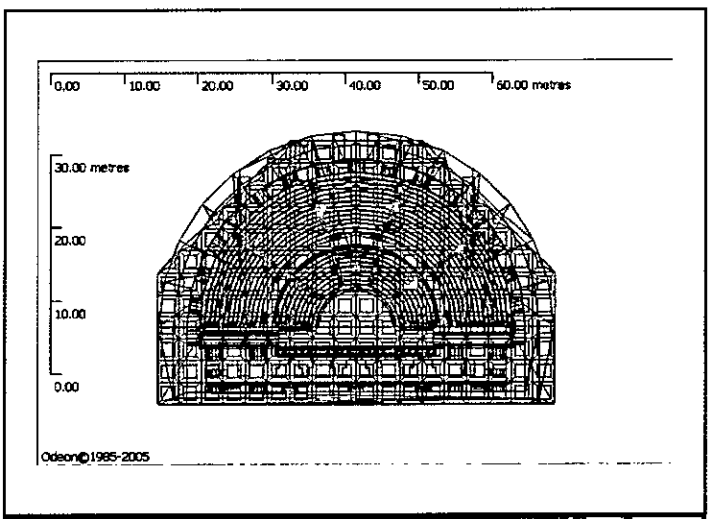

Figure 2

Plan of the reconstructed Odeon

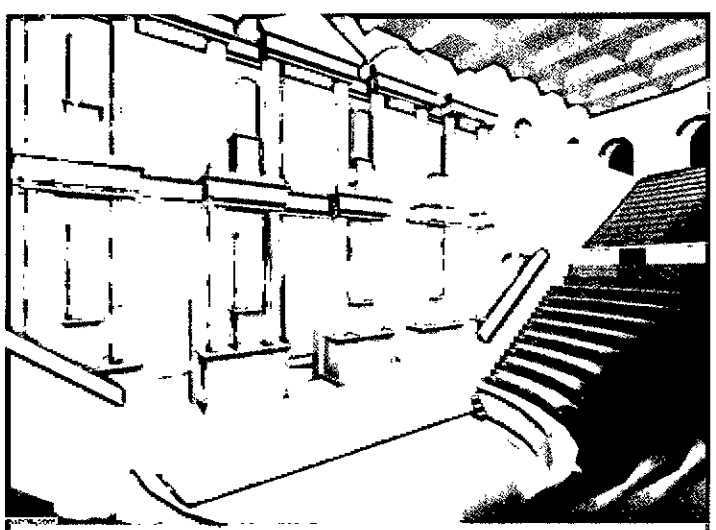

Figure 3

View into the acoustical computer model

The reconstructed model includes a coffered ceiling and open windows. All the simulations in this odeon show similar tendencies, with a long and constant reverberation time at lower frequencies and an abrupt fall toward the mid-frequencies. At higher frequencies the audience and air absorption make the differences between the curves smaller. At mid-frequencies and high frequencies the reverberation time of the reconstructed model suggests that it is a room suitable for musical performances.

By closing the windows with wooden shutters a considerably longer reverberation time is obtained: it is not very different from the reverberation times of modern concert halls of similar volume. Linked to the higher reverberation time are an overall higher strength and lower clarity, although in general the clarity seems to be good in any of the configurations.

Omission of the reflections coming from the orchestra does not cause dramatic changes but gives a higher clarity. In general it can be stated that reflections from the stage wall and the roof are more important than the reflections from the orchestra.

The STI seems to be good in all configurations, making this room a suitable place for both music and spoken word.

Anechoic recordings and auralisation

Music

As part of the ERATO project four different musical instruments were reconstructed: aulos, kithare, tympanon and scabellum. Examples of musical pieces were composed in accordance with the musical style of the period around the first century CE. Some pieces included solo song and chorus, performed by an ensemble as shown in Figure 6. The newly developed multi-channel auralisation technique was used. This implied that four microphones should be used for the anechoic recordings in order to capture some of the directional characteristics in the recording. The technique makes it possible to give the source acoustical width and depth when applied in the auralisation. In addition it is even possible to reproduce acoustically the movements of the performers in the auralisation, which taken all together gives considerable realism.

In the case of the odea the simulations show that the highly reflective rooms with marble surfaces have similar acoustical properties to modern concert halls when the windows are closed, even though the only absorption is provided by the audience. The roof has shown to give more satisfying results when using a coffered ceiling rather than a plane surface. The results were presented in the Forum Acusticum 2005 Conference, Budapest.

Plays

Anechoic sound recordings of a group of ten actors from Yildiz Technical University, Istanbul were made in June 2005. The two Greek dramas *Antigone and Agamemnon*, as well as the sound of an audience crowd in different moods, were played. These performances were recorded with a four microphone setup and filmed with a video camera to capture the movements.

The anechoic sound recordings of the plays and the previously recorded music pieces were auralised in ODEON software using the following procedure[4]: First the sound source position in the virtual room was placed on the stage, and the source was split into four parts (front, left, back, right) corresponding to the four microphone directions used for the recordings. Then each signal was fed to each part and its contribution to the room calculated separately. Finally a listener position was chosen in the sitting area and all the calculated contributions were added together at this

continued on page 28

Virtual reconstruction of the ancient... - *continued from page 27*

position. The sound of the performance in the simulated room can be listened to over headphones and the movements of the actors during their performance can be heard, particularly when the receiver is near the stage.

Crowd sounds

For the auralisation of the audience crowd a different approach was used. This task was rather difficult since the anechoic recordings only included the sound of ten people and the capacity of the Odeon was around a thousand. The procedure for the crowd simulations was the following.

Ten people in an anechoic room were told to perform as an audience in different moods: applauding, supportive, hostile, crying, laughing, surprised, and idly talking. Each of the moods was recorded separately and the signals were auralised in a computer model of the theatre.

A random distribution of 20 sources (the maximum number of simultaneous calculations in ODEON) was generated in the audience area. The anechoic sound signal for a selected emotional reaction of the crowd was fed to each of the sources, and the contribution of each source to the sound heard at a chosen receiver was calculated. All the sounds from each of the sources were then mixed together and attenuated and delayed randomly to create a greater sense of mixture.

In order to create the impression of a bigger audience and get more diversity, the different crowd signals were edited in AUDITION software. Using a multi-track set-up, the different crowd reactions were displaced in time, filtered, and finally mixed with the play or music. It was thus possible to fit the reactions of the crowd to the action on stage in the different parts of the play as well as during the music.

The number of final sound files with the crowd and music or action for the integration was 61 in total. In the integration process the auralised sounds of the crowd and actors were used to synchronise the visual actions of the virtual humans.

Conclusion

The simulations show that the highly reflective (marble) surfaces in odea rooms give similar acoustical properties to modern concert halls, even though the only absorption is provided by the audience and the open windows.

Some short examples of different performances can be experienced in the virtual reconstruction, and auralised sound examples can be heard at the ERATO website[5].

Acknowledgement

The ERATO project (Contract Number ICA3-CT-2002-10031), is financed by the European Commission under the fifth Framework INCO-MED programme. The visual reconstructions were made by the project partners from EPFL, Lausanne and MiraLab, University of Geneva. The archaeological and architectural research was made by the project partners from The Hashemite University, Jordan and Yildiz Technical University, Istanbul, Turkey. The reconstructions of music and plays were created by the music department of Yildiz Technical University, Istanbul, Turkey. Acoustical measurements and sound recordings were made in collaboration with colleagues from the University of Ferrara, Italy. Evaluation and subjective testing of results were made by AEDIFICE, Lyon, France.

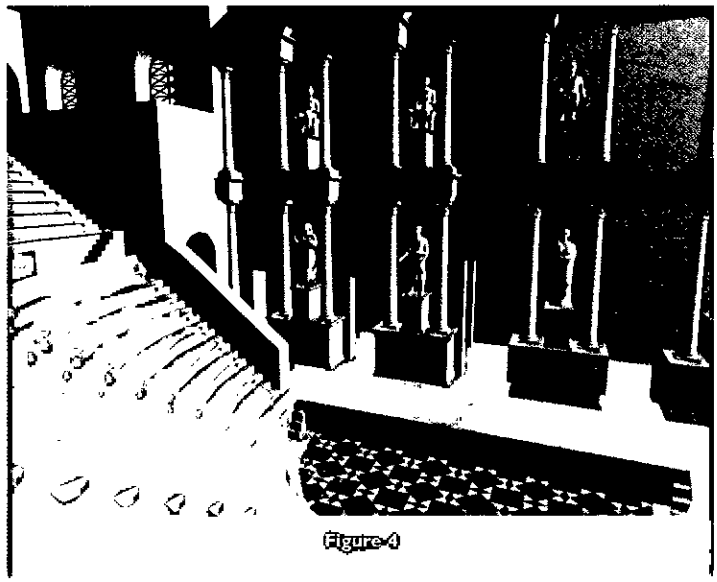

Figure 4

View into the visual computer model

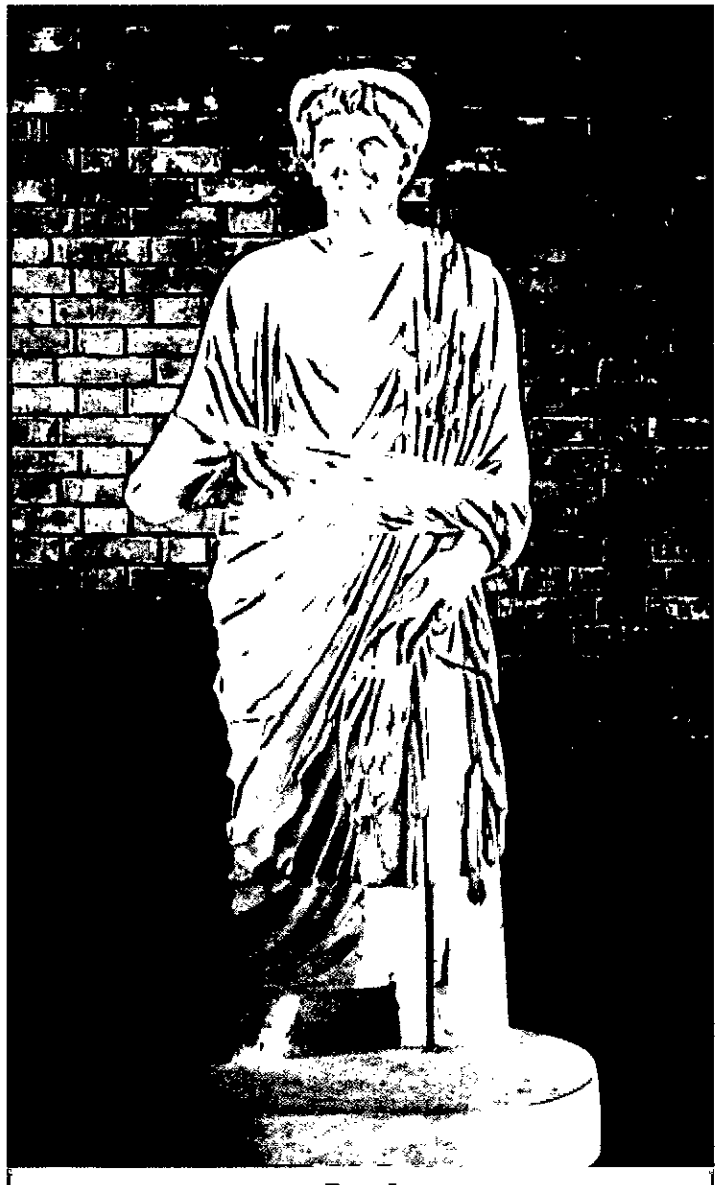

Figure 5

One of the original statues from the Odeon

Figure 6

From the anechoic recording of music with reconstructed musical instruments

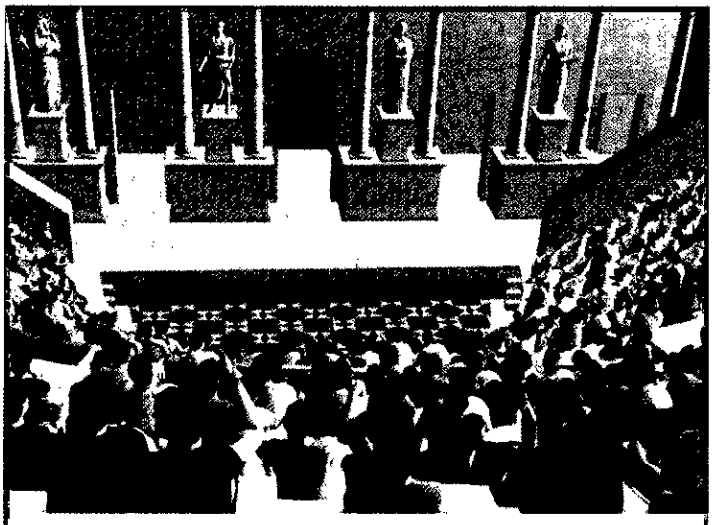

Figure 7

View from a performance in the virtual reconstruction of the Odeon in Aphrodisias

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Controlling vibration in brown field sites

Paul Lafone.

A marked increase in the number of inner city residential and commercial developments has brought the issues of ground-borne noise and vibration to the fore. These developments are often constructed on 'brown field' sites near main line railways or above an underground tunnel. This leads to the risk of repeated exposure to ground-borne vibration from the passing trains, and the consequent structural noise generated from the resonating building structure.

For these construction projects to be viable, it is necessary to control the unwanted impact of noise and vibration. This can be achieved by isolating the actual building structure, by reducing vibration at source, or using a combination of both.

This article outlines the main considerations and treatments required in relation to controlling noise and vibration in brown field sites.

The nature of noise and vibration

The technical terms commonly used in the context of noise and vibration relate to the variables which determine the level and impact of vibration.

Natural frequency

Natural frequency refers to the frequency at which something will vibrate. Every structure, material and even the human body has its own natural frequency. In the case of an isolator or isolation system, the natural frequency is a function of stiffness of the isolator or system and the mass being supported by it. Natural frequency is commonly abbreviated to f_n.

Transmissibility

Transmissibility is the ratio of the output vibration to the input vibration. If the ratio is greater than one, vibration is amplified. If the ratio is less than one, it has been reduced or attenuated. Figure 1 depicts a region where vibrations are amplified and a region where vibrations are isolated. In order to reduce vibration effectively, the skill lies in selecting an isolator that has a frequency well below the disturbing frequency.

Resonance

There is no single frequency at which a structure will resonate. The numerous frequencies at which parts of the structure vibrate are referred to as structural resonances, and are functions of the material, dimensions, shape and end conditions (the method of support). Resonance may occur when the exciting or disturbing frequency is the same as, or close to, the natural frequency of the structure. If a state of resonance occurs, the structure will begin to shake. Treatment either involves a change in structural mass or stiffness to shift the natural resonance outside the generated vibration range, or the addition of damping material.

Isolation

When approaching noise and vibration control, isolation measures reduce the transmission of vibration from one object to another. The measures may involve the isolation of a vibration source, for example a machine, from adjacent structures, or the isolation of a whole building or of sensitive equipment from externally generated vibrations and shock. The basis of vibration isolation is, in general, to mount the mass involved on a suitable 'spring' system.

The word 'spring' here is a generic term for an isolation mount manufactured from steel coil springs, rubber bearings with steel interleaves, polyurethane (PUR) foams or rubber granulate materials.

Brown-field sites: ensuring viability

Vibration isolation is one of the crucial elements to achieving planning approval and acceptance by building control. It is important, therefore, that vibration isolation is considered from the outset of a project and designed-in at the planning stage. Where vibration has not been accounted for, it may only emerge after completion that the building is uninhabitable. Moreover, if vibration isolation is not addressed at project inception, the budget cannot be accurately allocated and the construction may not be financially viable. Building isolation represents a major project cost, which is why it is essential to allow for expenditure as early on as possible.

The most effective way - and arguably, the only way - to ensure that vibration is adequately controlled is to conduct a site examination. A vibration survey report can be produced that determines the intensity and frequency of the transmitted ground borne vibrations, whether this be from rolling stock, underground trains, roads or tunnels.

When considering a problematic brown-field site for development, best practice would indicate a need for a site assessment before the land is even purchased. Only by doing this can the viability of the site be determined. A vibration survey of this nature is also used as guidance for general planning consent. Sites also need to be considered for environmental impact, access and location as these can all have an impact on the final planning consent.

While brown-field sites are subject to Building Regulations, these do not specifically cover vibration control. In the absence of legislation, guidance exists in the form of BS.6177:1982 'Guide to selection and use of elastomeric bearings for vibration isolation of buildings'. This document will generally be referred to when considering the isolation of a building structure.

The latest European standard to emerge in this field is BS EN 1337. It covers bridges and structural bearings, and will come into effect in the UK in June 2007. Although similar to the earlier BS.5400, the new standard clearly states that rubber with fabric reinforcement should not be used for the structural isolation of buildings. Instead, rubber with steel interleaves is identified as the preferred method when high loads are present.

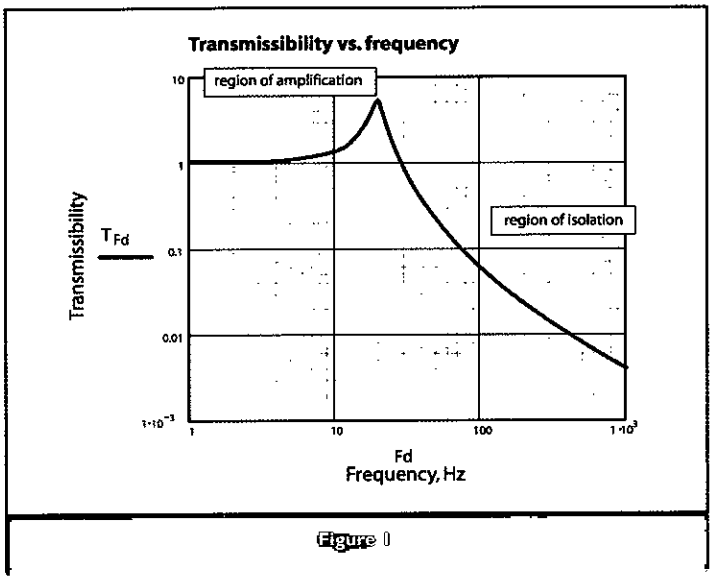
Support structure controls

Building isolation is not a new concept, and structural bearings are the usual approach. Generally constructed of natural rubber with steel interleaves, structural bearings offer a high load-bearing capacity while retaining a good shape factor, giving minimal creep and achieving natural frequencies as low as 7Hz. The shear characteristics of structural bearings generally deliver the required degree of expansion and contraction. Where there is too much shear, or the potential for high wind loads, side restraints will often need to be incorporated into the design.

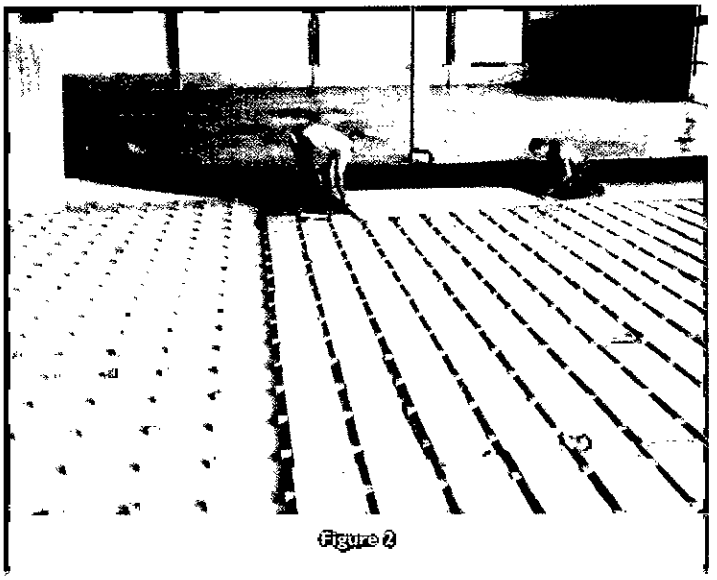
Where a natural frequency in the region of 2 to 5 Hz is necessary, steel coil spring mounts are often used in place of standard structural bearings. However, given the relatively high expense of spring coils, they tend to be used only in more sensitive building areas, such as cinemas and high end apartment developments.

Whether using structural bearings or mounts, the method effectively uncouples and isolates building foundations from ground-borne vibrations generated by external forces. In the case of brown-field developments, these are likely to be rail rolling stock or underground infrastructures.

Although the required natural frequency will often be the deciding factor when identifying which isolation material to use, there are a number of other technical and environmental criteria which will impact on the final selection.



Theoretical transmissibility for a system with a natural frequency of 20Hz



A typical floating floor construction

The design and size of the building will determine the method of isolation at the outset. Low-rise buildings of just a few storeys will commonly use strip or trench foundations, whereas larger high-rise buildings require deep piled supports or large area raft foundations. The most appropriate isolation system for the specific project requirements can then be designed.

Low-rise

As the load in low-rise buildings is much lighter than in high-rise, the foundations do not have to provide the building with as much support. In turn, the isolation measures do not have to carry as high a load. Isolation for these buildings simply involves pouring the strip or trench foundations on to specially selected anti-vibration materials. When installing materials of this sort it is imperative that the perimeter edges are isolated from the backfilled earth.

High-rise

Tackling vibrations in high-rise buildings is generally more complex and expensive than in low-rise as the support structures go below foundation level. Isolation at column head or pile cap level is the most common design when 'floating' high-rise structures. They are generally isolated using structural bearings or spring isolators.

The selection of elastomeric structural bearings will depend on a number of factors.

- Load
- Disturbing frequency
- Natural frequency
- Available area
- Shape factors
- Horizontal shear forces
- Wind loads
- Creep characteristics

In addition, when determining the correct method of isolation, the structural element of the bearings must be assessed with specific reference to the steelwork, which must possess adequate fail-safe abilities. In the event of a fire, or failure of the bearings, the building will lower on to the fail-safes, resulting in minimal damage to the structure.

Once the structural bearings are in place the slab can be cast above it. The building will then 'float', meaning that the disturbing frequency has no direct path into the structure as the energy is absorbed by the bearings.

Irrespective of whether the building is low-rise or high-rise, the most cost-effective route to achieving effective isolation is to make provision for vibration control at design stage. Evaluating foundation type in tandem with the isolation method is critical to achieving optimum performance and minimising expenditure.

Building measures

Vibration control is not limited to foundation isolation. There are a number of treatments which can be implemented to prevent vibrations generated inside a building from travelling into the main structure. The source of the vibration in this instance may, for example, be a plant room or other general machinery space.

Floating floors

A true floating floor uses nominal two-inch or three-inch high resilient mountings to create separation between the floating floor slab and the structural slab. This then creates an air gap of between 50 and 75 mm, which is filled with a mineral wool to remove the damping effect of trapped air between the slabs: STC readings as high as 73 have been achieved.

Although the potential disadvantage of this system is that it increases the overall floor depth, it is sometimes the only solution for some critical applications, most commonly where virtually complete freedom from transmitted sound and vibration is required. Cinemas, bowling alleys and recording studios are just some examples.

continued on page 32

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Controlling vibration in brown field sites - *continued from page 31*

Machine isolation

In the case of machinery such as mechanical presses, vibration rather than noise is the predominant challenge. The exception to this rule is when the machine is an inherent noise generator, for instance the hydraulic noise arising from pumps.

Vibration can of course generate high noise levels, particularly at the resonant frequencies of a building. The most obvious treatment is to reduce the vibration at source. While this is often the first course of action, in practice there are limitations.

Whether using isolation or damping, the method must be evaluated and determined at the building design stage. Equipment design is a consideration, although the impact of unwanted vibrations can be minimised by simply adopting a common-sense approach. Identifying the most appropriate location for equipment in relation to noise-sensitive areas is the most cost-effective way of reducing the potential vibration nuisance. Whilst plant is often located on a roof, it is certainly not appropriate to place it directly on top of a library or bedroom!

Rooftop isolation

Most plant such as chillers and air-conditioning units are situated at roof level, particularly in the case of high-rise buildings. In practice this is the best place for them in order to minimise the impact of airborne noise they generate, but the method poses a vibration control challenge as the energy must be prevented from travelling into the main structure.

In the first instance, plant equipment can be supplied with anti-vibration mounts. These are designed to decouple the forced frequencies and avoid structure-borne noise. The approach offers some level of vibration control, but more often than not it is not sufficient to satisfy the environmental demands. It is advisable, therefore, to apply a secondary damping membrane.

A secondary damping membrane might simply be an anti-vibration pad material between the plant support plinth and roof slab, or the mechanical fixings might be isolated using elastomeric pads, collars and washers.

Given that penthouses are at the top of a building, in the case of residential developments a combination of anti-vibration pads and mechanical fixings is common. This ensures the vibration is kept to a minimum and the apartments are fit for purpose.

When selecting any anti-vibration mount, pad or material, it is imperative that they do not have the same natural frequency as the plant. This would result in resonance and cause discomfort to the occupants of a building.

Controlling the environment

The challenge of controlling vibration is not only encountered when redeveloping land in brown field sites. Changes in the physical environment, either as a result of new transport infrastructure or plant machinery, can result in unwanted vibration causing significant disturbance to people already occupying buildings, or damage to existing structures in the area.

When the unwanted vibration is the result of installing new equipment, the most cost-effective method is usually to isolate the machine. This will prevent the vibration from propagating into the surrounding areas.

In the case of a printing press, for example, the machine might have to be fixed to a foundation block. The foundation block is cut out of the existing structure, and a new, slightly smaller block is cast. As this involves several independent stages, it is critical that vibration treatments are accounted for at design stage. For example, the foundation pit must be isolated using appropriate materials, accounting for the load, the required finished surface level and the natural frequency. At surface level, the machine may also require isolation in order to achieve sufficient reduction of vibration.

The main principle behind equipment isolation is to reduce the transfer of noise and vibration into the main structure, but in certain circumstances it is necessary to protect the equipment from external sources of vibration.

Vibration isolation in practice

Brown field site development

Paddington Central is a new business, retail and residential district in central London. An eight-metre high concrete podium deck forms part of the second phase foundations, with a CrossRail track running directly beneath.

To prevent train-generated ground-borne vibrations entering the main building structure, the acoustical consultant specified that the podium

Figure 3

Achieving viable high rise construction in a brown field site

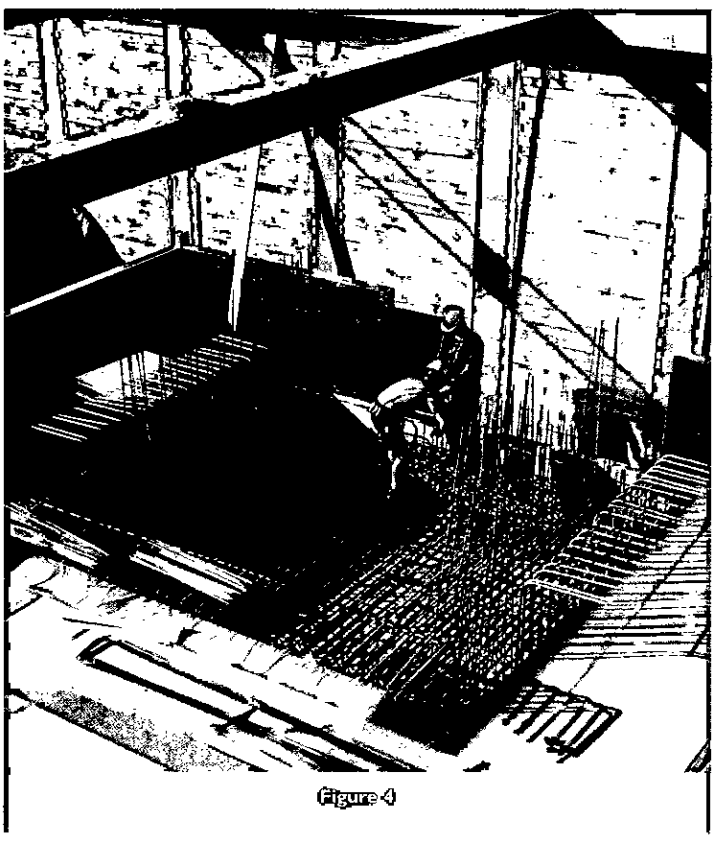

Figure 4

Foundation isolation

deck be isolated with a high performing anti-vibration material. This was crucial in order to eliminate structural noise and potential damage to the concrete foundations from trains soon to operate on the CrossRail track.

Speed of installation of the anti-vibration system was critical as future Paddington Central phases had to be completed around the CrossRail works. Regupol RAV100, a heavy-duty slab isolation system with a maximum load bearing capacity of 5000kg/m², was used to isolate the entire podium deck.

Controlling changes in the environment

Potsdamer Place is a large commercial development situated both above and below ground. Office buildings and a casino are at ground level while a retail complex is located underneath the entire floor area.

To prevent noise and vibration generated on the roads and pavements from transferring into the adjacent buildings, or down into the development below, it was necessary to implement appropriate anti-vibration measures. To isolate the roads and pavements, 15,000mÇ of Regupol RAV200 was installed directly under the surfaces. Designed with high-load bearing characteristics, the isolation material was able to withstand the pressure of ongoing traffic and reduce the impact of noise generated.

Paul Lafone is with CMS Vibration Solutions

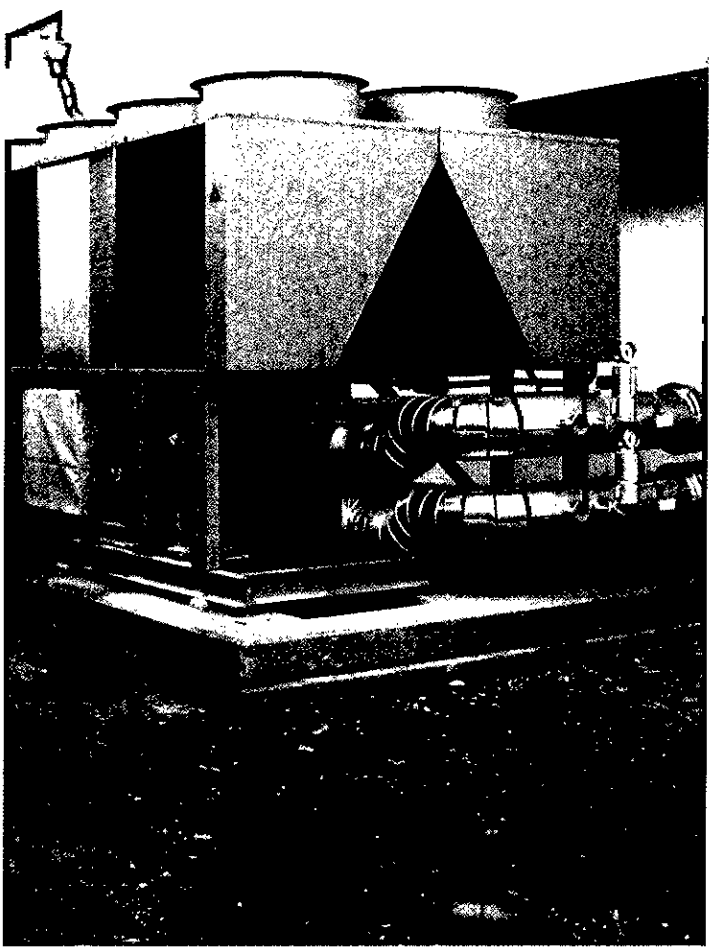

Figure 5

Isolation of rooftop mounted equipment on a plinth

References

BS EN 1337-3:2005: 'Structural bearings. Elastomeric bearings.'

BS 6177: 1982 'Guide to selection and use of elastomeric bearings for vibration isolation of buildings.'

BS 5400-9.1:1983: 'Steel, concrete and composite bridges. Bridge bearings. Code of practice for design of bridge bearings.'

Quick guide to: structural bearings

The selection of a structural bearing will ultimately depend on the load that must be carried. Advice must also be sought from the manufacturer prior to product selection. However, a broad indication in terms of load suitability is offered as follows:

- High quality PUR foam isolation materials: load capabilities up to 0.4Nmm²
- High quality rubber granulate materials: load capabilities up to 1.5Nmm²
- Springs or structural bearings: for loads greater than 1.5Nmm²

PUR foam isolation material

PUR foams such as Regufoam are commonly used for machinery isolation within buildings or plant rooms, owing to their ability to offer very low natural frequencies under light loads. The material is also used for structural isolation, but only where loads are light. While a number of different types and grades of PUR foam are available, the benefits of using this material in anti-vibration applications are generally:

- It can be used as simple anti-vibration mounts or for structural isolation
- It can be used for very light loads, achieving high damping ratios and low natural frequencies
- It has excellent recovery properties
- The material has a long life span and is 100% recyclable.

Rubber granulate materials

Rubber granulate materials such as Regupol can be used in most types of structural isolation applications. However, rubber granulates are most appropriate when complete foundation isolation is required.

Materials of this nature are often supplied in rolls but can often be delivered ready cut into pads or strips to suit individual specifications.

Rubber granulates generally offer the following benefits.

- They are environmentally friendly, being made from fully recycled materials, and are sustainably produced
- Their natural frequency is low, and a high degree of isolation results
- The products are relatively inexpensive.

Elastomeric structural bearings

Elastomeric structural bearings are suitable for use in any building where the structure needs to be isolated from a source of vibration.

The construction of structural bearings will vary according to individual project requirements. However, a typical bearing manufactured to BS EN 1337 from vulcanised natural rubber will be characterised as follows.

- The product is constructed from moulded natural rubber with steel interleaf reinforcement
- Its effective thickness will depend on the required natural frequency. When undertaking a project the material manufacturer or supplier should advise on the thicknesses required and deflection expected.

Larger loads may mean bearings are used in clusters rather than as single units, in order to gain the optimum performance from standard bearings. For example, a pile cap with a vertical load of 8000kN could require 16 bearings each of 250mm square plan dimensions. This may mean that the pile head has to be flared to allow enough area for bearings, fail-safe devices, fire protection and dowel bars for location.

Pioneers of Acoustics: Harry F Olson (1901-1982)

John Tyler FIOA.

In the 'Pioneers' series we appear to have rather neglected the audio engineering side of the histories, with no substantial coverage of the subject since the article on Alan Blumlein in October/November 2003: this is surprising, considering your author's lifetime interest in the subject.

When examining the possibilities for the next Pioneer for treatment, the name Olson shone through as a very deserving case for exposure in this occasional series.

Harry F Olson is generally recognised, particularly in his home country the USA, as a pioneer and leading authority in acoustics and electronic sound recording. His history makes fascinating reading.

Summary of Olson's life

Harry F Olson was born in Mount Pleasant, Iowa, on 18 December 1901, the first of two children of Swedish immigrant parents. His father was a farmer and his mother a talented amateur artist. Harry showed an early interest in science and technology and his parents encouraged him by giving him a workshop and laboratory. While still in primary school and without any technical knowledge on the subject he built and flew model aircraft. In high school he built a steam engine with a wood-fired boiler which he used to drive a direct current generator made from a car generator, rewired to produce 110 volts. He progressed from school to the University of Iowa where he gained a bachelor's degree in electrical engineering followed by a MA degree with a thesis on acoustic wave filters. For his doctoral thesis, Harry Olson carried out research on the polarisation of resonance radiation in mercury and achieved his PhD in 1928. As a result of his association at university with G W Stewart, head of the physics department, and with Dean Carl E Seashore, who specialised in the psychology of music, Harry developed an interest in music, acoustics and sound reproduction. As a result of this interest and soon after his successful academic career, he joined the Radio Corporation of America (RCA) in 1928 and remained there for almost 40 years. For the first two years he worked with the Engineering Department of the Photophone Division of RCA in New York City, and then moved to the Acoustical Research Laboratory in Camden, New Jersey.

In 1934 Olson became responsible for all acoustical research at RCA. In 1942 his Acoustical Research Laboratory moved from Camden to the newly constructed RCA Laboratories in Princeton, New Jersey. There he supervised the construction of a well-equipped acoustical facility. This included an anechoic chamber, which was the world's largest at the time, a reverberation chamber, and an 'ideal' listening room.

He worked on a wide range of projects which included developing microphones for the broadcasting and motion picture industries, improving loudspeaker design, and making significant contributions to magnetic tape recording.

During World War II, like so many engineers of his generation, Olson made significant contributions to military technology, particularly in the fields of underwater acoustics and anti-submarine warfare. This work included significant improvements to sonar transducers, the development of an acoustic proximity fuse for depth charges, and voice communication transducers for use in noisy environments.

Olson was a prolific inventor and won more than 100 patents for the various types of microphones, loudspeakers, recording equipment, gramophone (phonograph!) pickups, underwater sound equipment, sound technology in motion pictures, and public address systems that he developed. He was also an enthusiastic author and wrote 135 articles and ten books, of which probably the best known are his Acoustical Engineering and Dynamical Analogies.

Dr Olson received many honours for his achievements including the Modern Pioneer Award of the National Association of Manufacturers (1940), the John H Potts Medal of the Audio Engineering Society (1952), the Samuel L Warner Medal of the Society of Motion Picture and Television Engineers (1955), the John Scott Medal of the City of Philadelphia (1956), the Achievement Award of the IRE Professional Group on Audio (1956), the John Ericsson Medal of the American Society of Swedish Engineers (1963), the Emil Berliner Award of the Audio Engineering Society (1965) and the Institute of Electrical and Electronic Engineers Mervin J Kelly Medal (1967), Consumer Electronics Award (1969), and the Lamme Medal (1970).

Figure 1

Harry Ferdinand Olson

He received the first Silver Medal in engineering acoustics from the Acoustical Society of America in 1974, and in 1981 was given the Gold Medal of the Society 'for his innovative and lasting contributions in acoustic transduction, sound reproduction, electronic music and speech synthesis, and his service to the Society'. He was President of the Society 1953/54, having been vice-president from 1942 to 1944 and President-elect from 1951 to 1952. He was, also, associate editor of the Journal of the Acoustical Society of America for thirty years.

Harry Olson was a member of the American Society of Motion Picture and Television Engineers, a Fellow of the American Physical Society, and a Fellow of the Institute of Electrical and Electronic Engineers. Many of his patents are considered to be fundamental, for example, those on the velocity and cardioid microphones, functional sound absorbers, the electronic music synthesiser, the air suspension loudspeaker and the electronic sound absorber.

Harry retired in 1967 but continued as a consultant to RCA Laboratories for several more years.

He died on 1 April 1982 in the Princeton Medical Centre at the age of 81. He was survived by his wife Lorene whom he married in 1935. In their early years Lorene had helped him to prepare the manuscripts for his many books and articles. She, like his mother, was an amateur artist and he displayed many of her oil paintings in his offices throughout his career.

Thus ended the life of a true pioneer of acoustics, for whose efforts in the audio field many present-day applied acousticians still owe a debt of gratitude.

Olson's research output

Microphones

When motion pictures with sound were commercialised in the mid 1920s one

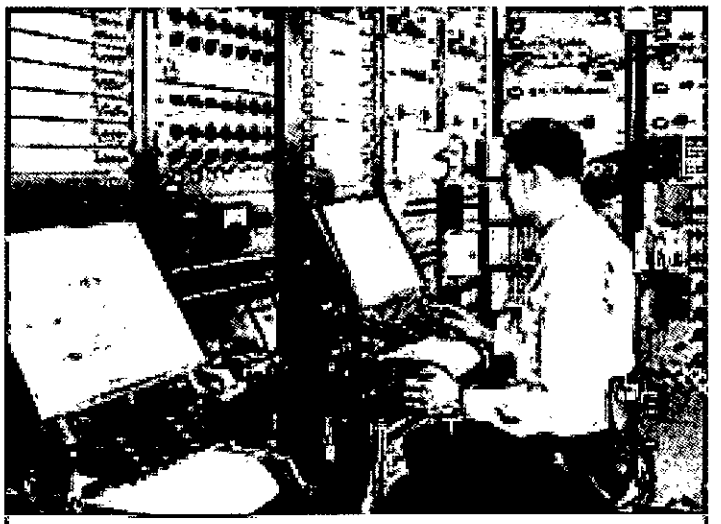

Figure 2

The RCA MKII synthesiser at the Colombia-Princeton Electronic Music Centre 1956

of the problems was sound pick-up with the microphone out of the picture. This required long distances between the stage and the microphone which resulted in much ambient noise and reverberation in the recorded sound. The obvious solution was a directional microphone which would discriminate between noise and reverberation, but such microphones did not exist at that time. Olson tackled the problem by developing the velocity microphone which had a figure-of-eight characteristic. However he realised that a better solution would be a unidirectional device and he developed a microphone with a cardioid characteristic using a ribbon active element. This instrument was known as the RCA 44A Ribbon Velocity Microphone and was developed over the period 1933 to 1944. This microphone was used for broadcasting and recording purposes. Other microphones developed for the same purposes included the RCA 77-C1 directional ribbon.

Loudspeakers

After World War II Olson continued his pre-war work on sound reproduction and carried out an experiment, now regarded as a classic, to determine the preferred bandwidth of reproduced music. Previous work had found that listeners to reproduced music seemed to prefer a high-frequency cut-off of 5000Hz. In Olson's experiment a small orchestra sat behind a visually opaque but acoustically transparent screen. The screen incorporated a concealed low-pass acoustical filter having an upper frequency cut-off of 5000Hz, and which could be opened and closed. The listeners were asked to select their preference from the two conditions. There was an overwhelming preference for the full frequency range. Then the orchestra was replaced with a sound reproducing system where the loudspeakers were located in the same position behind the screen as the orchestra. When the sound system was free of distortion (for the time of the experiment!) the listeners preferred the full bandwidth, but when small amounts of nonlinear distortion were introduced the restricted bandwidth was preferred, thus demonstrating the importance of high quality in audio systems. A similar experiment carried today would find the audiences much less tolerant of distortion.

Direct radiator loudspeaker enclosures

In 1951 in the Journal of the Acoustical Society of America, Harry Olson wrote the following about the direct radiator loudspeaker:

'Direct radiator loudspeaker mechanisms are usually mounted in cabinets. Most of the considerations concerning the design of cabinets for direct radiator loudspeaker mechanisms have involved the volume or overall dimensions of the cabinet which together with the loudspeaker mechanism determines the performance of the combination — in the low frequency range. There is another important factor in the design of direct radiator loudspeaker cabinets, namely, the exterior configuration of the cabinet. The configuration of the outside of the cabinet markedly influences the response in the mid-frequency and high-frequency ranges owing to diffraction effects. These effects are usually overlooked and the anomalies in response are unjustly attributed to the loudspeaker mechanism. Therefore, in order to determine the effects of diffraction, it appeared desirable to obtain the performance of a direct radiator loudspeaker mechanism in such fundamental shapes as the sphere, hemisphere, cylinder, cube, rectangular parallelepiped, cone, double cone, pyramid and double pyramid, and variations and combinations of these fundamental shapes. The results of these tests indicate that the outside configuration of the housing introduces variations in the response frequency characteristics of as much as 12dB'.

This work is just an example of Olson's thoroughness in his work on improving loudspeaker design; another was the air suspension cabinet speaker which involves fully enclosing a speaker with very compliant suspension. I personally remember a Post Office Research Laboratory article in the late 1940's which described the design of a completely enclosed cabinet speaker. Did that design

continued on page 36

Figure 3

Harry F Olson in 1956 at the keyboard of RCA Mk II

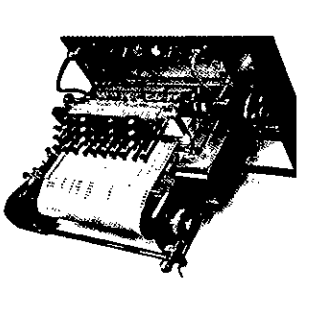

Figure 4

The punch-paper keyboard input of the RCA MKII

Figure 5

An RCA Mk II Synthesiser at the Colombia-Princeton Electronic Music Centre. 1956

Figure 6

The RCA Mk II showing the lacquer disk cutters

Pioneers of Acoustics: Harry F Olson - *continued from page 35*

pre-empt Olson's work, or was it concurrent or as a result of Olson's designs?

I seem to remember that the first fully enclosed commercial cabinet speaker in the UK was the tiny Goodmans Maxim which was soon followed by several other manufacturers' products.

What is not in doubt is that Olson's research on loudspeakers made significant improvements in linearity and uniformity in frequency response of loudspeakers that were commercially available at the time. However this fact does not diminish the achievements of designers in Britain and Europe during the same period.

Two vintage Olson fully enclosed acoustic suspension speakers were offered for sale recently on e-bay!

Magnetic tape recording

Shortly after WWII the magnetic tape recorders developed by the Germans were demonstrated in the USA. Very soon after that a number of American companies, including RCA, designed and produced audio tape recorders. Early experiments at the RCA laboratories indicated that if breakthroughs in tape quality and in recording heads could be made it should be possible to record television signals on this new medium.

Thus it was that early in 1950, RCA asked Harry Olson to develop a team in his laboratory to make significant improvements in magnetic tape recording that could lead to the magnetic recording of television signals.

The significant improvements needed to accomplish this task resulted in RCA approaching the 3M Company to collaborate in producing the special tape needed for this new process. In May 1956, after several years of development, the system was completed and was moved from Olson's laboratory in Princeton to the NBC studios in New York City, where it was used to provide the world's first broadcast of tape-recorded colour television signals. Olson then started a project in tape coating technology in his laboratory which, when finally developed, was transferred to RCA's newly created Magnetic Products Division in Indianapolis. Here it was used in the commercial production of magnetic tapes.

Music synthesisers

Harry Olson's interest in musical acoustics led to the development, with the cooperation of Herbert Belar, a fellow RCA electronic engineer, of the RCA Electronic Music Synthesiser. The first RCA device was constructed from the components of the time, *ie* vacuum tubes (valves!) and relays, rather than present-day transistors and integrated circuits. However this first synthesiser was used by composers at the RCA Laboratories in Princeton and at the RCA Records Division in New York to compose a number of musical selections, some of which were issued on a 45rpm album that is now regarded as a collector's item.

While electronic musical instruments, such as the theremin, had been designed before, the RCA Mark I was much more complex. It had a bank of 12 oscillator circuits which used valves to generate the 12 basic tones of a musical scale. These basic sounds could be shaped in virtually limitless ways by passing them through other electronic circuits, including high-pass and low-pass filters, envelope filters, frequency dividers, modulators and resonators. The Mark I was demonstrated in 1955 and impressed those who heard it. It was 'played' by laboriously programming a sequence of notes to be played, along with information about how the sound of each note was to be shaped, by punching holes into a long roll of paper, similar to the kind used on a player-piano. The roll was then fed into the machine and the music played.

The success of Mark I led to the creation of Mark 2 which had twice as many tone oscillators and gave the composer more flexibility. In 1957, RCA gave the Mark 2 to a new consortium between Princeton and Columbia universities to create the Columbia-Princeton Electronic Music Center. One of the most

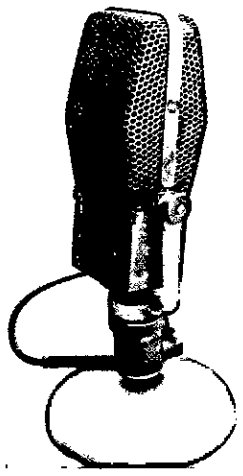

Figure 9

RCA 44A Ribbon Velocity Microphone - 1933-44

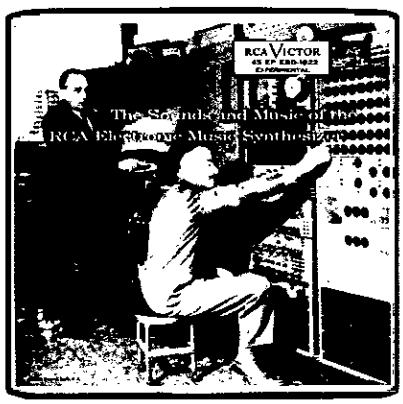

Figure 10

The cover of the 45rpm LP produced to demonstrate the Mark II synthesiser.

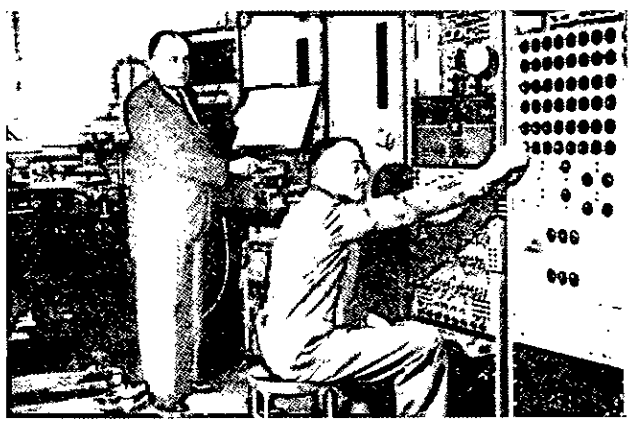

Figure 11

An RCA MkII synthesiser at the Colombia-Princeton Electronic Music Centre, 1956: Harry Olson standing

Figure 7

RCA 77-C1 Directional Ribbon Microphone

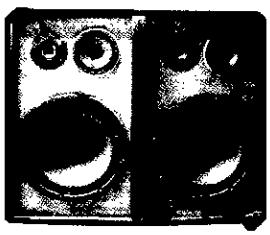

Figure 8

Vintage Olson acoustic suspension loudspeaker system Model SP-450 (x2)

(Recently on sale on e-bay)

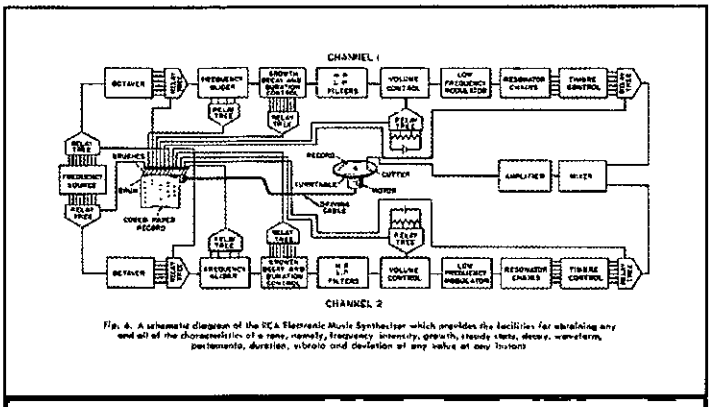

Figure 12

A block diagram of the RCA synthesiser

famous works composed for the RCA Mark II was Charles Wuorinen's 'Time Enconium of 1968' later performed by Wendy Carlos and included on the sound track of the Stanley Kubrick film ***A Clockwork Orange***.

Figure 13

1956: RCA "Hear See" video player presented to David Sarnoff: Harry Olson on left

Video players

Harry Olson was RCA's original video player pioneer, conducting extensive research in the 1950s on using magnetic tape or disc media for video storage. He presented David Sarnoff, the then RCA CEO, with a prototype 'Hear See' video player on the occasion of Sarnoff's 50th anniversary in the broadcast industry in 1956. Also at this time Olson was engaged in theoretical discussions with William Webster, then Manager of Advanced Development for the RCA Semiconductor and Materials Division, on signal-to-noise ratio in recorded media.

Conclusions

Space does not allow more comprehensive coverage of Harry Olson's achievements with RCA: we have not discussed his work on electronic noise cancellation techniques in the early 1950's, where he postulated the advantages, for example, for air passengers in reducing engine roar thus facilitating conversation. We have also neglected his work on functional sound absorbers, the design of high fidelity phonograph components and electronic colour television, but what has been covered will confirm his well-deserved position as a pioneer of acoustics.

John Tyler FIOA is Associate Editor of ***Acoustics Bulletin***.

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Parliamentary reports

From Hansard

Commons Written Answers

19 February 2007: Nightclubs: Noise

Mr Leech: To ask the Secretary of State for Work and Pensions if his Department will carry out an assessment of the damage caused to people's hearing by dangerous high levels of noise in nightclubs.

Mrs McGuire: The Department has no plans to do so as the duty to assess the risks of hearing damage from loud noise lies with individual employers, who have a specific duty to do so for workers under the Noise at Work Regulations 1989 as well as a duty of care to members of the public under the Health and Safety at Work etc Act 1974.

However, the Health and Safety Executive published a review of the literature in 2002 to establish what was known about noise levels and noise exposure to workers in pubs and clubs. This was taken into account at European level during negotiation of the Physical Agents (Noise) Directive and in the 2005 report Noise in figures by the European Agency for Safety and Health at Work.

New regulations, the Control of Noise at Work Regulations 2005, will come into force for the music and entertainment sectors on 6 April 2008 and industry representatives are working with HSE to develop practical guidelines on the control of noise in these sectors, including nightclubs.

Noise: Pollution

Julia Goldsworthy: To ask the Secretary of State for Transport what steps his Department is taking to reduce noise pollution caused by vehicle exhausts; and if he will make a statement.

Dr Ladyman: Powers are available under existing legislation to enable enforcement bodies to take action against excessively noisy vehicles. The legislation requires that vehicle exhaust systems and silencers are maintained in good and efficient working order and not altered so as to increase the level of noise emissions.

As an aid to roadside enforcement the Department is considering whether a sufficiently robust in-service metered noise test might now be feasible. Such a test would enable enforcement bodies to stop vehicles and conduct noise tests at the roadside to identify excessively noisy vehicles. The Department will be letting research later this year to inform policy development.

22 February 2007: Wind farms

Mr Whittingdale: To ask the Secretary of State for Trade and Industry what representations he has received on noise limits for onshore wind farm developments.

Mr Darling: My Department regularly receives representations on onshore wind farm noise limits.

27 February 2007: Heathrow Airport: Noise

Justine Greening: To ask the Secretary of State for Transport (1) how many noise monitors have been put in place for monitoring the noise of aeroplanes entering and exiting Heathrow airport in the last 12 months; where such monitors have been placed; and if he will make a statement; (2) what noise monitor procedures are in place in relation to aeroplanes landing at Heathrow airport; and if he will make a statement; (3) what monitoring there was of noise in the London borough of Wandsworth caused by aeroplanes entering and exiting Heathrow airport in 2005 2006; what monitoring has taken place in 2007; and if he will make a statement.

Gillian Merron: Noise from departing aircraft is continually monitored by BAA at ten fixed sites under the departure tracks at Heathrow. The monitors are put in place to gauge whether aircraft comply with the departure noise limits specified in the noise abatement notice for Heathrow under Section 78(1) of the Civil Aviation Act 1982. The noise limits apply at a distance of 6.5 kilometres from aircraft start-of-roll, so the location of the fixed monitors is relatively close to the airport and does not extend to Wandsworth. Compliance is reviewed regularly through the Noise and Track Keeping Working Group, and data is published annually in BAA's Flight Evaluation Reports. There are no equivalent limits for arriving aircraft. Data from the fixed monitors, together with additional mobile noise monitors, is used to validate a noise exposure model for the 16-hour daytime summer period. The Civil Aviation Authority, on behalf of the Department, uses the model to produce annual noise contours at Heathrow airport, representing noise from both arriving and departing aircraft. (ERCD Report 0406, available on the CAA website, shows the location of both fixed and mobile monitoring sites over recent years.) The 2005 noise contours were published last December and are available on the Department's website.

Justine Greening: To ask the Secretary of State for Transport on how many occasions BAA imposed fines when aeroplanes exceeded noise limits when (a) entering and (b) exiting Heathrow airport in each of the last five years; and if he will make a statement.

Gillian Merron: Airlines who infringe noise limits (which are for departures only) are surcharged by BAA Heathrow, in the form of a noise supplement. Details are reported annually in BAA Heathrow's Flight Evaluation Reports. The relevant data for the last five years is as follows:

year	number by night	number by day	total	total fines £
2001-02	233	139	372	191,500
2002-03	201	77	278	182,500
2003-04	113	82	195	112,500
2004-05	117	15	132	73,500
2005-06	168	42	210	120,000

12 March 2007: A50 road traffic

Mr McLoughlin: To ask the Secretary of State for Transport what the last five noise level readings were for the A50 Doveridge bypass; and when each was taken.

Dr Ladyman: Noise level readings are not routinely taken for trunk roads and none have been taken for the A50 Doveridge bypass.

Roads: Noise

Chris Grayling: To ask the Secretary of State for Transport how many lane kilometres of the motorway and trunk road network have been resurfaced with a lower noise surface since 1997.

Dr Ladyman: The Highways Agency's policy to use quieter surfacing materials as a matter of course whenever a road is resurfaced has been in place since 2001. Given this, we have no separately recorded information on quieter surfacing delivered prior to this date. A total of 8240 lane kilometres of quieter surfacing was delivered between 2000-01 and 2005-06. The agency is forecasting to deliver a further 1100 lane kilometres during 2006-07.

19 March 2007: Aviation

Martin Horwood: To ask the Secretary of State for Transport what assessment he has made of the potential effect on the level of (a) flights, (b) passengers, (c) noise pollution, (d) carbon emissions and (e) global warming of the draft Open Skies aviation agreement reached between the EU and the US; and if he will make a statement.

Gillian Merron: The Government considers that the best way to tackle the environmental impacts of aviation is through the programme of measures it is pursuing including the addition of aviation in the EU emissions trading scheme, promoting technological developments and working closely with

operators to make improvements through operational changes. This is a strategic environmental approach which is not dependent on negotiations on individual bilateral air service agreements.

Martin Horwood: To ask the Secretary of State for Transport what assessment he has made of the effect of the draft Open Skies aviation agreement reached between the EU and the US on the ability of the UK and EU to develop legislation on (a) air pollution, (b) greenhouse gas emissions and (c) noise pollution; and if he will make a statement.

Gillian Merron: The proposed agreement does not affect the existing ability of the UK or the EU to take additional legislative measures to deal with the impact of aviation on the environment.

22 March 2007
Work and Pensions:
Orders and Regulations

Tony Baldry: To ask the Secretary of State for Work and Pensions what his most recent estimate is of the (a) one-off cost and (b) recurring costs of implementing the Control of Noise at Work Regulations 2005 and the Control of Vibration at Work Regulations 2005 to businesses and the regulators.

Mrs McGuire: The information is as follows. The total costs of implementing the Control of Noise at Work Regulations 2005, in the first year were estimated to be between £117 million and £203 million. Costs were estimated, in present value terms, to be between £478 million and £676 million over the first 10 years. Costs were estimated to be £1130 million to £1940 million over 40 years, in present value terms. The additional costs to health and safety regulators were not considered to be substantial. There were pre-existing regulations, implemented in 1989, and ensuring compliance with the new requirements would be subsumed into current inspection activities.

The first year costs of implementing the Control of Vibration at Work Regulations 2005 were estimated to be between £201 million and £358 million. Over the first 10 years, total costs were estimated, in present value terms, to be between £2377 million and £4300 million. The initial costs to regulators were estimated to be around £65,000 for training inspectors (mainly HSE) and around £300,000 for conducting research into whole-body vibration exposures to assist industry by producing generic risk assessments for machines expected to cause higher exposures.

Enforcing the regulations is unlikely to increase costs because enforcement action will be absorbed as part of the full range of inspection duties carried out by inspectors.

The information in this reply was drawn from the final regulatory impact assessment for the legislation that is available in the Library or on the HSE website at:
http://www.hse.gov.uk/ria/index.htm.

The Government and the Health and Safety Executive (HSE) are committed to meeting the Better Regulation challenge. HSE is constantly reviewing what can be done better to ensure that people are protected at work while avoiding unnecessary burdens on business.

Lords Written Answers

7 March 2007:
Environmental noise

Lord Hunt of Chesterton asked Her Majesty's Government whether they had made an assessment of the likely impact of the Environmental Noise Directive on effective co-ordination with local and regional development and transport plans; and what resources they would make available for local and regional implementation of action on noise.

The Minister of State, Department for Environment, Food and Rural Affairs (*Lord Rooker*) replied that existing guidance already described how the control of environmental noise was to be co-ordinated with development and transport plans. This was set out in Policy Planning Statement 1 on Planning for Sustainable Development; Planning Policy Guidance 13 on Transport; Guidance on Local Transport Plans; and Planning Policy Guidance 24 on Planning and Noise. The Government intended to produce further guidance on the development of Environmental Noise Directive action plans later in the year. Resources would be determined through future national budgeting rounds.

13 March 2007:
Compensation claims

Lord Lofthouse of Pontefract asked Her Majesty's Government whether they had assessed the cases of those retired miners who successfully pursued industrial deafness claims against the former British Coal Corporation and who have had the compensation, awarded to them by the Department for Trade and Industry, withheld by their solicitors by reference to the case of Myatt and Others (Petitioners) v National Coal Board (Respondents); and what action was proposed to provide redress for these miners, particularly with regard to the intervening report issued by the Legal Services Ombudsman.

Lord Truscott replied that following the decision in Myatt, all outstanding noise-induced hearing loss (NIHL) costs claims had been reviewed. In many cases the department had compromised the claimants' solicitors' costs, which should have removed any impediment to the claimants receiving their damages. However in other cases the department had concluded that there remained an issue as to the reasonableness of the costs being claimed. Those cases were being progressed through the courts in the usual way.

Where a claimant has had his costs settled but has had monies withheld by his solicitor, and he is dissatisfied with his solicitor's conduct, he should either seek independent legal advice or refer the matter to the Solicitors Regulation Authority.

Lord Lofthouse of Pontefract asked Her Majesty's Government whether they would respond to requests made of the Department for Trade and Industry by the Board of the Legal Complaints Service seeking disclosure of contact details in respect of past claimants in the British Coal Vibration White Finger Litigation, British Coal Respiratory Disease Litigation and British Coal Industrial Disease Litigation; or whether they would instruct the department's claims handlers, Capita, to relay communications from the Law Society to such claimants.

Lord Truscott replied that the department and the Legal Complaints Service (LCS) were working together to find the best way to publicise the work that the LCS was undertaking on this issue. However, the Data Protection Act prevented the department passing claimants' details to the LCS.

26 March 2007:
Marine environment:
seismic detonations

Baroness Miller of Chilthorne Domer asked Her Majesty's Government what assessment they had made of the scientific evidence on the distances over which acoustic disturbances, caused by seismic detonations in oil surveys in the oceans, could affect marine life.

The Parliamentary Under-Secretary of State, Department of Trade and Industry (*Lord Truscott*) responded that since 1999 Her Majesty's Government had made frequent assessments of the nature, spatial extent and potential effects on marine life of noise from oil industry seismic surveys, both in response to specific applications for consent to undertake such surveys and as part of the DTI's programme of strategic environmental assessments (SEAs) prior to further oil and gas licensing. The latter assessments were documented in the environmental reports for each SEA, and each subsequent report was updated to include any relevant new information on noise characteristics, propagation, receptors such as marine mammals, potential effects and mitigation measures, including the results of research commissioned by HMG. All the SEA environmental reports and the underpinning studies were available from the website **www.offshore-sea.org.uk**.

Brüel & Kjær

Joins Global UGS PLM Partner Program

Brüel & Kjær, world leader of sound and vibration equipment and services, has announced its partnership with leading provider of product lifecycle management (PLM) software and services, UGS Corporation.

Brüel & Kjær joins the UGS Program as a software partner to develop, market and sell integrated NVH, sound and vibration test and measurement equipment that are seamlessly interoperable with UGS NX digital product development software. Wim Buyens, Director of Aerospace, Brüel & Kjær says that his company's first priority had to be the customers it had in common with UGS. The partnership is about long-term commitment by both companies and a vision that focused on continuity, added value, and improved testing and simulation quality. It was the better of two worlds, complementing each other and leading to improved engineering. B&K could offer unique value to its aerospace customers and this would lead to improved processes and efficiency while taking into account the investment climate of the industry.

Alun Crewe, Product Marketing Manager for the PULSE data acquisition and analysis platform, added that the benefits of uniting two leading platforms in testing and simulation was more than the sum of the parts. The efficient validation of product design required close cooperation and communication between physical and virtual engineering, and this alliance gave a platform to build the solutions that engineers required to increase productivity.

As a leading global provider of sound and vibration measuring systems, Brüel & Kjær was a welcome addition to the UGS Partner Program, according to Chris Kelley, vice president, Partner & Platform Marketing, UGS. The ability to use Brüel & Kjær sound and vibration technology in combination with the NX and Teamcenter Lifecycle Simulation solutions would enable many UGS customers to work more efficiently. This partnership further illustrated UGS's commitment to providing a truly open design and simulation framework for CAE partners.

Brüel & Kjær, together with Maya HTT of Montreal, Canada, acquired from MTS Systems the former I-deas Pro product suite (also known as I-deas Test) that they support and sell globally, therefore guaranteeing continued compatibility between the UGS I-deas Simulation suite and the Test applications suite for I-deas.

The next step will be to secure a smooth transition for NX users working with testing applications, where software functionality will be added to increase the value of the current test applications suite for both NX and I-deas users. Both companies are working together with UGS to develop a long-term product plan, which will innovate the way the PULSE testing and NX digital simulation worlds will work together, improving the overall product development process.

The UGS Lifecycle Simulation applications suite provides robust tools for multi-CAD geometry-based abstraction, FE modelling, automated meshing and CAE results visualisation within an open simulation framework. UGS NX and I-deas advanced simulation applications also provide direct access to a common multi-physics environment for performing structural, durability, thermal, flow and combined flow/thermal simulations leveraging NX NASTRAN as well as access to a number of leading third-party solvers, such as ABAQUS, ANSYS, LS-DYNA and MSC.NASTRAN.

For further information please contact
Heather Wilkins, Brüel & Kjær UK Ltd
Tel: **01438 739000**, fax: **01438 739099**,
e-mail: **ukinfo@bksv.com**
web site: **www.bksv.com**

Bowling club gives neighbours the silent treatment

A novel approach to increase ceiling mass

Residents in the small Scottish town of Largs are sleeping easier at weekends thanks to a noise-blocking ceiling tile from acoustic specialists, Sound Reduction Systems.

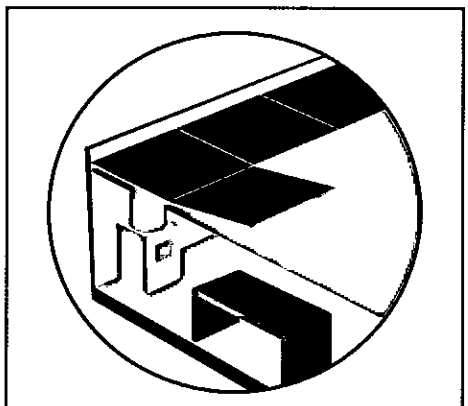
Halkshill Bowling Club faced losing valuable income from weekend events after neighbouring residents complained to the Environmental Health Department about ongoing weekend problems caused by music at the club.

Desperate to solve the problem, club secretary Charlie Hill turned to the internet and quickly found Bolton-based company Sound Reduction Systems. At their suggestion, a second suspended ceiling was installed 300mm below the existing ceiling, and overlaid with SRS's Soundblocker 25. SoundBlocker 25 is specifically designed for applications where the highest levels of sound insulation are required, such as in clubs and discos. As well as SoundBlocker 25, a product called SoundStop was used in the void between the two ceilings to further inhibit the passage of sound. This is a versatile acoustic curtain that can readily be cut and shaped.

Mr Hill said that with two functions looming and an ultimatum from the environmental health people, the club had to act fast and effectively. From putting in the order to completion of the job took just 14 days so they could not have been more pleased. As soon as the last tile was in place the doors were closed and the music turbine up to its highest volume. They were absolutely delighted, and more than a little relieved, to hear the 'sound of silence' outside. Since the installation the club has had no noise problems at all.

Formed from a rigid attenuating layer bonded to an acoustic foam which absorbs reverberant sound within the ceiling void, SoundBlockers are very easy to install and competitively priced, with four different options available to suit individual needs. There are other products in the SoundBlocker range: SoundBlocker 16, which is ideal for stopping or reducing cross talk through the ceiling in a standard office, and SoundBlocker 19, which is suitable for areas where slightly higher room-to-room sound insulation is required. SoundBlocker Plus provides the highest level of sound insulation, reducing high noise levels through floors and preventing breakout of environmental noise through roofs.

Details of the full product range are provided in a brochure which has a handy reference guide to which SoundBlocker is appropriate in different situations. It also includes details of the extensive range of sound insulation products SRS offer to combat noise in this sort of application.



Tiles are installed over a lay-in ceiling grid

For further details of the full range of products available from Sound Reduction Systems call **01204 380074**,
email **info@soundreduction.co.uk**
or visit the SRS website at
www.soundreduction.co.uk

Sixtieth anniversary

of the National College of Heating, Ventilation, Refrigeration and Fan Engineering (HVRFE)

The National College of Heating Ventilation Refrigeration and Fan Engineering will be celebrating its sixtieth anniversary on 18 June 2007 at London South Bank University (LSBU).

Since its inception in 1947, the college has been renowned for its close links with the industry it supports and the high standards of its teaching and research.

To mark its diamond anniversary a special celebration event is being held, and LSBU is delighted to invite all National College alumni and supporters to celebrate its work and reputation.

The event will consist of an early evening reception, the opportunity to tour the buildings that house the National College laboratories and ample opportunity to meet up with other past students, staff and people in the industry. There will be keynote speeches by LSBU's Vice-chancellor Prof Deian Hopkin, visiting fellow Prof Mike Farrell, and Terry Wyatt, a partner of Hoare Lea Consulting Engineers.

Places are limited, so anyone interested in attending should please e-mail Paul Leech on **leechp2@lsbu.ac.uk** with contact details. These details will be kept on record and information about the celebration will be forwarded at a later date.

Complicated convex curves and elusive ellipticals

Secondary acoustical glazing with a difference

Renowned as the spiritual home of the Vintners Association, Five Kings House has recently undergone major refurbishment.

Five Kings House: the 1910 façade

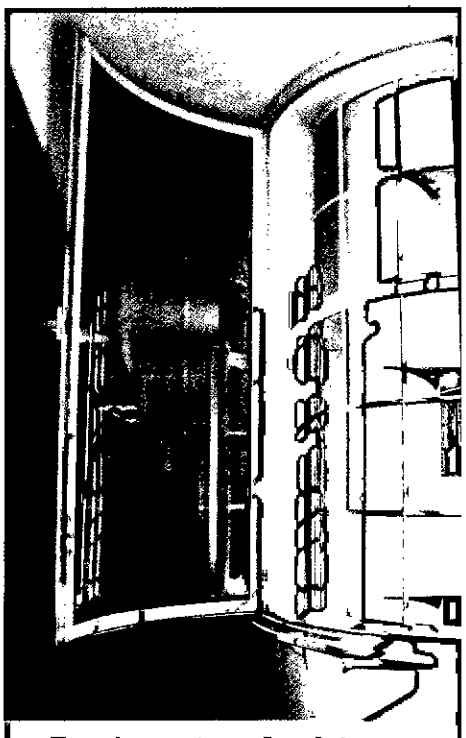
Standing on the site of the original Vintners Hall dating back to 1446, it succumbed to the Great Fire of London and was rebuilt in 1671; it suffered another blow in 1822 with the loss of several rooms and its facade during the widening of Upper Thames Street. The present facade dates back to 1910.

When surveyors CB Richard Ellis approached Selectaglaze to handle the secondary glazing , an essential part of the brief was to produce a convex curved on plan hinged unit to match the contours of a number of the existing primary windows.

This particular treatment, using slimline secondary windows systems, had always been thought difficult because of the very tight tolerances required for the curved glass and the need for a multi-point locking mechanism to ensure a good seal. With the encouragement and cooperation of the surveyor and main contractors, Overbury, Selectaglaze undertook a succession of tests based on their Series 40 side hung casements, which resulted in another groundbreaking 'first' for the industry.

At the same time, Selectaglaze was asked to produce an elliptical unit – again, a design not previously considered feasible. This was also successfully achieved by modifying the company's existing Series 45 lift out units.

This unique project required a total of 99 units, including round bulls-eyes and the more conventional horizontal and vertical sliding systems.



View of a curved secondary glazing pane

Contemporary standards

The benefits of secondary glazing systems are not only in thermal and acoustic insulation. The company also offers a suite of Security windows providing certified protection against blast, physical and ballistic attack, and fire.

Secondary glazing systems are purpose-made and arrive fully assembled to allow rapid installation with minimal disruption. They need very little maintenance and will continuously contribute to energy savings.

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

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Hepworth Acoustics

Funds scholarship in MSc Environmental Acoustics at University of Salford

Independent acoustics consultancy Hepworth Acoustics is funding a full fees scholarship for study on the MSc Environmental Acoustics, a new course offered by the University of Salford. The scholarship, worth £3700, is for the 2007/2008 academic year, and applications are currently being invited.

Peter Hepworth, managing director of Hepworth Acoustics explains the firm's motivation for funding the scholarship. 'Ours is a rapidly growing sector and there is a great need to ensure we produce the acoustics professionals of tomorrow. As an expanding business, graduates are Hepworth Acoustics' main resource, so it is very important that they come to us with a solid academic background. The MSc Environmental Acoustics at Salford is particularly suitable and if by providing this scholarship we can encourage more students to take up study in acoustics, it will help to increase the pool of potential consultants for the future'.

The MSc Environmental Acoustics is offered within the University's Acoustics Audio and Video discipline, which has been running degree courses in acoustics for more than thirty years. The course provides graduates with specialist skills and knowledge to work in the field, whether in consultancy, government or in research. Course tutor Dr Andy Moorhouse commented that there was currently a skills shortage in acoustics, so graduates successfully completing this course would be in a very strong position in the jobs market. The University was delighted that Hepworth Acoustics valued the course so highly and was very appreciative of their funding for this extra place.

Full information on the MSc Environmental Acoustics can be found on **http://www.acoustics.salford.ac.uk/applicants/pg/msc_ea/index.htm**.

Hepworth Acoustics is one of the largest independent acoustics consultancies in the United Kingdom. The head office is in Warrington and the company operates from seven regional offices. The company specialises in environmental and building acoustics as well as noise mapping. More information on noise maps and all aspects of acoustics consultancy is available at **www.hepworth-acoustics.co.uk**.


Peter Hepworth

Contact Peter Hepworth, tel **01925 579100**, e-mail **peter.hepworth@hepworth-acoustics.co.uk**

Dockside break for cetacean research vessel

***Song of the Whale* gets updated equipment**

In the shadow of London's Tower Bridge, St Katharine's Dock provided the winter mooring for the research vessel *Song of the Whale* operated by the International Fund for Animal Welfare (IFAW). The boat returned to its home port for the first time since 2004, when it was launched in 2004 by the wife of former James Bond actor Pierce Brosnan. Captain Richard McLanaghan is using the break to complete routine maintenance and install new equipment such as tracking equipment for porpoises, before the vessel leaves the port for its next scientific voyage.

IFAW has been operating in the field since 1987 and the two boats that have borne the name have visited more than 25 countries. The first *Song of the Whale* was a converted 14-metre luxury yacht which travelled more than 400,000 ocean km up to 2003. The full complement of eight crew, together with their food, communications equipment and scientific instruments, meant that conditions became very cramped, especially on longer voyages.

The replacement vessel is primarily powered by sail, and was designed especially for the tasks of researching the movement and behaviour of marine mammals, particularly whales. A great deal of effort was expended in making the engine and power generation systems as quiet as possible. The boat has a specially designed propeller owing more to submarine practice than surface vessel technology, the engine and generator are on very soft rubber mountings, and the engine room is very thoroughly sound insulated. The captain says that as far as possible, sail power only is used, in order to reduce the amount of noise they transmit into the water. The reason is simple: the crew is listening to whales.

The sound emitted by the whales and other large marine mammals is used to locate and count them. Few people know very much about this subject area, so the vessel is continuously adding to present knowledge.

Traditionally, whales were counted by ships steaming back and forth along a straight-line course with observers on deck. These counts had a high degree of uncertainty because the creatures spend most of their time underwater. Using their acoustic expertise, the crew will be spending the summer counting sperm whales in the Mediterranean Sea. It is expected that a baseline figure for sperm whales in the different regions of the Mediterranean will be determined by this work. At present it is not possible to state whether the numbers are up or down, because no-one really knows how many there are in the first place. It is known, however, that sperm whales are threatened in the Mediterranean because there are problems of entanglement in fishing gear, collisions between whales and ships, and the wide threat of marine pollution.

The crew will use hydrophone arrays to carry out the count. These devices consist of two microphones three metres apart at the end of 200m of cable, and are able to detect whales up to 32km away.

Using software developed especially for the project, it is possible to count the individual whales automatically: in the past an operator had to sit with headphones on and manually count them. Besides carrying out the count, the team will also photograph the whales' tails (in order to identify them) and collect skin samples. Being an animal welfare organisation, benign and non-invasive research techniques are continually developed and promoted by IFAW. Part of the reasoning behind this standpoint is that some nations, Japan being a prime example, conduct what they refer to as 'scientific' whaling. *Song of the Whale* is trying to demonstrate that very good scientific research can be completed without harming the animals.

To overcome the problems in collecting a skin sample without physically touching the whale, Richard McLanaghan explained that the mammals shed skin as they swim along, and leave a slick when they dive. When they dive, the boat remains about 100m behind them, and as soon as the whale disappears the boat is moved up alongside the slick. Two research diver can then get into the water with nets, and scoop up bits of skin which are then placed in test tubes. Thus, samples are obtained without ever having to touch the whales.

During the summer count, the *Song of the Whale* crew will be complemented by various researchers from the participating nations. While on board, they will be trained to use the techniques needed to carry out the survey. This means that when a big, multi-vessel survey takes place in the future, there will already be a number of people who are familiar with the system.

Faber Maunsell

Mike Hewett appointed director to lead team in Altrincham

Faber Maunsell has appointed Mike Hewett as an associate director to head up the Building and Architectural Acoustics Group in Faber's Altrincham office. Mike's role is to manage and develop the already successful team currently in place, serving the north-west of England.

Mike has an established track record in acoustic consultancy, in particular in industrial and power generation noise and vibration control. This will fit well with the building acoustic services that the Group currently provides. Mike has worked on high profile projects ranging from the Whitehall district heating scheme and the Transco gas transmission upgrade to the Birmingham-Solihull water link main and the Al-Marafiq utilities project. Mike's involvement with these projects included acoustics feasibility studies, noise impact assessments, noise control diagnostics, acoustic design and compliance testing.

Mike is a former secretary and chairman of the IOA Noise and Vibration Engineering Group (formerly the Industrial Noise Group) and a former examiner for the IOA Diploma Noise Control Engineering module.

He says he is looking forward to joining an organisation with such an excellent track record and bringing his experience to the young and dynamic Altrincham team. The firm was determined to maintain and improve quality and delivery of imaginative and flexible design solutions while building the team to provide regional coverage.

Mike Hewett

Senior acoustic consultant joins SLR Huddersfield

Chris Chittock arrival confirms the firm's commitment to providing quality acoustics services to the region

SLR Consulting, a leading environmental consultancy, has appointed a new senior acoustic consultant in its Huddersfield office.

Chris Chittock has six years' experience in environmental noise and building acoustics design, and will cater for the increasing demand for noise and vibration assessment and design in Yorkshire and the North of England.

Mike Brownstone, SLR's head of acoustics, said that Chris's arrival confirmed the firm's commitment to providing quality acoustics services to the region.

Before joining SLR, Chris worked for Sound Solution Acoustic Consultancy where he provided technical reports for residential and industrial planning applications, acoustic design of large developments, outdoor concert noise assessments and environmental impact assessments. He also has experience working for RPS, SRL and Bureau Veritas.

Huddersfield is one of five new regional offices to open in the past 12 months, bringing SLR's UK bases to 13. It employs 280 specialists across all environmental disciplines.

SLR Group web site:
www.slrconsulting.co.uk

Chris Chittock

Wakefield Acoustics

Industrial noise control specialists appoint Martin Rayns as head of new division

Wakefield Acoustics' position as a leading provider of bespoke noise control solutions has been further boosted by the appointment of experienced acoustics industry professional, Martin Rayns. He will head up the Noise Consultancy Division established in 2006, and brings with him over 25 years experience and expertise in the acoustics industry, holding senior roles in manufacturing, production and sales.

Wakefield Acoustics' Noise Consultancy Division was established in 2006 in response to market and customer research, following the introduction of the Control of Noise At Work Regulations in April 2006. The division, which has seen significant growth since its inception, offers an extensive range of services from noise audits, risk assessments and surveys, to providing advice on controlling noise through low cost in house solutions, as well as more conventional noise control measures.

Jane Dawson, managing director of Wakefield Acoustics commented that the appointment of Martin Rayns further strengthened the division and continued the expansion of the company's range of noise control solutions. Customers would not only receive the most appropriate technical solution from one single source, but that same company would take complete responsibility for all aspects of their noise control.

The new team member said that he was very excited to be a part of Wakefield Acoustics' future growth plans. The company was already recognised as a market leader in its field, and this had not happened by accident, but because it worked with its customers and responded to market feedback. The new noise consultancy division would further strengthen that position.

Martin is a member of the Institute of Acoustics and holds a diploma in acoustics from Derby University.

New appointment Martin Rayns checking noise levels

Norsonic AS

Sound power measurements allowing purchasers to make the quiet choice

EU Directives 2000/14/EC etc on noise labelling of many types of machinery, both domestic and industrial, are now implemented into UK law. They require products to carry a noise label that gives the sound power level. The way in which sound power is related to the sound pressure is analogous to the temperature rise in a room resulting from a given power level of a heater, where the final temperature in the room will depend upon both the size of the room and its thermal losses. Acoustically, a larger room results in a lower sound pressure but the lower the acoustic losses (absorption, transmission through the walls etc) then the higher the sound pressure level that will result. Knowing the sound power level, the consumer can choose the product with the lower noise emission, and the expert can calculate the actual sound pressure level that will be generated in any given acoustic climate.

The methods for the determination of sound power are defined in a series of British Standards, the EN ISO 374x series, controlling the measurement and presentation of sound power data for a wide range of machinery. These can be quite complex, requiring a number of measurements and a detailed knowledge of the acoustic climate in which the measurements were made. The procedure has now been simplified by the introduction of a new software package from Norsonic AS of Norway, one of the world's leading sound level meter manufacturers. It implements the exact requirements of the standards and guides the user through the set up of the instrumentation, controls the measurement procedure and post-processes the results to give the overall sound power level.

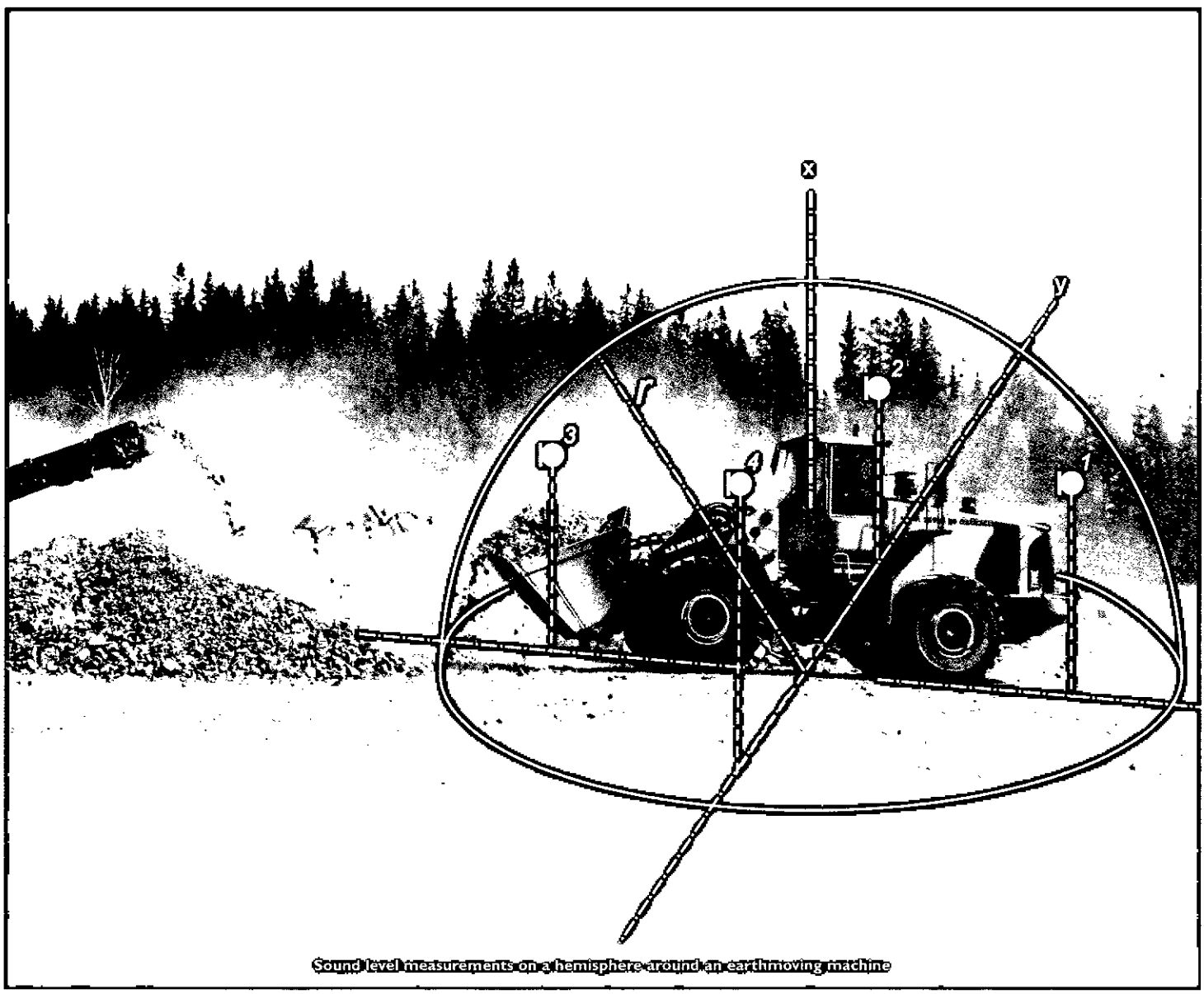
It will be of use to machinery designers or importers who have to keep technical files documenting the noise emission of their products for CE marking regulations.

Background information can be found at **www.norsonic.com**.

Campbell Associates is the sales and calibration resource for the UK and Eire, and operates an instrument hire service. See **www.campbell-associates.co.uk** and **www.acoustic-hire.com** .

Nor-1035 NorPower software was first introduced in March 2007.

For more information on technical matters e-mail **ian@campbell-associates.co.uk**



Sound level measurements on a hemisphere around an earthmoving machine

Casella CEL Ltd

Launches intrinsically safe CEL-350 dBadge

Casella CEL Ltd, the UK manufacturer of workplace monitoring technologies including noise, dust, gas and indoor air quality, launches its new ATEX approved, Intrinsically Safe (IS) CEL-350 dBadge personal noise monitor for use in flammable atmospheres at the Safety & Health Expo, NEC, Birmingham (Stand no.F70, Hall no.9) from 22 to 24 May 2007.This follows the huge launch success of the original CEL-350 dBadge in May 2006. Products on display will include:

Intrinsically safe monitoring

IS CEL-350 dBadge

The IS version of the CEL-350 dBadge is versatile because it is cable-free, is totally reliable owing to the digital technology used, and is ahead of its time with a robust, small and lightweight (68g) ergonomic design. The dBadge measures all occupational noise parameters and is ATEX-approved for use in potentially explosive atmospheres. The unit stores the time history of an individual's noise exposure throughout the day. It has integral NiMH batteries that give an unprecedented 32 hours of operation, and can be recharged in under 90 minutes using the intelligent charging system.

Its companion product, the IS Apex, is a personal and area sampling pump for dust, fumes, gases, vapours and VOC's in potentially explosive atmospheres. Samples obtained with the device can be sent to laboratories for weighing and analysis. This easy to use, versatile and robust pump is fully compliant with both UL 913 ANSI and ATEX 100 standards (directive 94/9/EC).

Dust monitoring

Microdust Pro is a portable real-time aerosol/dust monitor for assessing concentrations of suspended particulate matter. It has a real time numerical graphical display, ideal for instant walk through surveys and an integral logger for allowing all data runs to be stored, downloaded and analysed using the graphical software package. As well as having a wide measurement range (0-2500mg/m?), this monitor can be used for real-time presentation and analysis purposes. It also has a versatile, removable sampling probe. It comes with universal mains with UK, USA and Euro adapters, four rechargeable batteries, download software and cable, zero calibration bellows and span calibration insert.

Weather station

The portable automatic Nomad weather station is a high specification monitoring system designed for ease of transportation, rapid deployment and quality measurement. Sensors include wind speed and direction, temperature and humidity, rainfall, barometric pressure and solar radiation.

Full details of the event including Casella CEL's exact stand location can be found at **www.safety-health-expo.co.uk**.

For further information tel: **01234 844100** or e-mail: **info@casellameasurement.com** web site: **www.casellameasurement.com**

AVI Acoustic & Vibration Instruments

Introduces new NoiseLog system for monitoring noise nuisance

AVI Acoustic & Vibration Instruments has introduced a new noise nuisance recording system designed to speed up the logging and identifying of potential noise nuisances.

The system does not require the use of a sound level meter, and uses a Compact Flash card recorder to record the noise using full CD-quality sound with a dynamic range of more than 70dB complete with date and time stamp. The system can be supplied with different grades of microphone to suit all applications and comes in a robust, lockable aluminium case with a simple start/stop recording control handset. Using the 1 GByte card supplied as standard, over three hours of continuous recording is possible with larger cards offering additional recording time pro-rata.

Following the recording of the noise, analysis of the data is made using the specially-developed NoiseLog software. Data is transferred from the card either by USB link from the recorder or by plugging the CF card into the PC directly. Once transferred, the data can be viewed on screen as a graph of level against time, either *rms* fast or short L_{eq}, and the software identifies the maximum level and time of occurrence immediately. Three user-definable percentile levels can be set to cover the whole file, or any section of the file, and the data can be exported in a report format either directly to a printer or saved as a file to import into other documents, such as a Microsoft Word report. The file can be listened to directly on the PC (or on the recorder if required) and unwanted sections can be ignored or erased to retain only the sections of relevance.

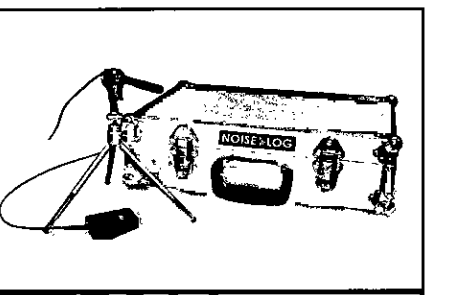
The system is supplied in three versions, or as an upgrade to existing DAT recorder systems. Versions are available that meet the same requirements as a Class 1 or Class 2 sound level meter, and these can be verified by UKAS calibration of the entire system in the sister calibration laboratory, AV Calibration Ltd (see **www.avcalibration.co.uk** for details). Alternatively, a budget version is offered where the main purpose is to identify the type and level of noise being experienced.

Upgrades to existing DAT recorder systems, where re-use is made of the microphone (and possibly the sound level meter if one was fitted previously), or upgrades to other recording systems, can be carried out by AVI. The NoiseLog software can be used to analyse any .wav file, and can be supplied separately if required for use with any system that produces this file format.

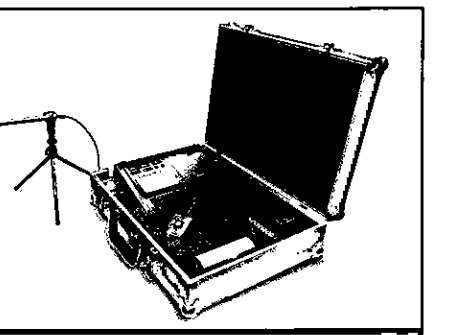
Prices for NoiseLog systems start at only £1455. Prices for upgrades will be quoted when details of the equipment to be re-used are supplied.

For more details visit the web site at **www.avinstruments.co.uk** or contact Richard Tyler at AVI Ltd.

Tel **01462 638618,**
fax **01462 638601,**
e-mail **sales@avi.f2s.com**



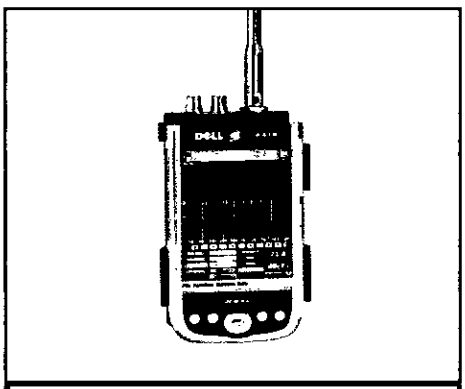
AV NoiseLog



Inside the AV NoiseLog case

Ivie

Additional features to Ivie IE-35 Audio Analysis System



The Ivie IE-35 Audio Analysis System

The IE-35 from Ivie is a second-generation, calibrated, hand-held audio instrument delivering a broad range of acoustical measurements displayed in full colour. In-the-field functions include real time analyser measurements (RTA), sound pressure level (SPL) measurements, seat-to-seat level variation measurements, strip chart recordings of sound level over time, polarity checking, oscilloscope measurements, Noise Criteria (NC/NR) determinations, a built-in signal generator, audio level volt meter, RT60 reverberation time and more.

Delivering accurate measurement data in a highly useful format, it provides great convenience in a feature-rich package that fits comfortably in the palm of one hand, at a very affordable price.

Since the launch of the Ivie IE-35 audio analyser in January 2006, Ivie has added a number of options and software improvements, including:

- Recording software (.wav files)
- STI-PA speech intelligibility software
- L_{eq} software for IE-35
- L_{eq} PC Companion: PC Software for Ivie L_{eq}
- Integrated type 1 microphone option (contact the company for more information).

Existing users can get the latest software updates for the IE-33 and IE-35 at Ivie, where user manuals, data sheets and application notes can also be downloaded.

Friendly advice is freely available on **01564 825145**.

Brüel & Kjær

Updates range of measuring microphones

Brüel & Kjær introduces new, state-of-the-art models in its range of measuring microphones and related equipment for the measurement of sound in the latest version of its Microphones & Conditioning catalogue.

In response to customer requests, the 2007 catalogue includes connection charts for the extended ranges of microphones (diffuse-field, pressure-field, low-noise), amplifiers, cables, and power supplies. It also includes information about acoustical, regulatory and related standards, plus a glossary of acoustical terms.

New to this version are articles about different branches of acoustical measurement and selecting the right microphone for individual applications. It outlines the operating principles of current microphone technologies, signal conditioning equipment, power supplies and calibration equipment.

With Brüel & Kjær being both a long-time pioneer and a continuing innovator of sound measurement, the catalogue includes modern equivalents to old, discontinued models as well as new models like the Type 4955 low-noise microphone. The catalogue also provides information about the services offered to maintain end-users' equipment and to ensure acoustical measurement integrity throughout the lifetime of their products.

Type 2699 A-weighted Deltatron pre-amplifier has two engraved rings

Type 2699 combines a Deltatron preamplifier and an A-weighting filter in one unit. This is useful for in-car measurements in the presence of large low-frequency components. The fact that A-weighting is applied is contained in the Type 2699's Transducer Electronic Data Sheet (TEDS) and to eliminate testing errors the two rings engraved on its shell visibly differentiate the Type 2699 from other pre-amplifiers without A-weighting.

New free-field microphones

Free-field microphones are particularly suitable for making measurements away from reflecting surfaces, for example, when making outdoor measurements with a sound level meter, or in an anechoic chamber or other acoustically well-damped indoor environments.

Three new free-field microphones are being introduced:

Type 4955 half-inch low-noise microphone and pre-amplifier is a half-inch all titanium TEDS microphone with a guaranteed noise floor less than 6.5dB(A). It is optimised for sound power measurements to ISO 3745 and for characterising the noise floor of anechoic chambers.

Type 4950 half-inch pre-polarised free-field for 2250 light conforms to standards IEC 61672 Class 1 and ANSI S1.4 Type 1. Its optimised frequency response (±2dB) is 4 to 16 kHz, and its dynamic range (with pre-amplifier type 2669) is 14 to 142 dB(A).

Types 4954 and 4954A quarter-inch pre-polarised free-field microphones conform to standards IEC 61094-4 WS3F. The optimised frequency response (±2dB) is 4 to 80 kHz, and the dynamic range (with pre-amplifier type 2670) is 40 to 164 dB(A). Type 4954A has an integral DeltaTron preamplifier and is identical to type 4954 in all other respects.

New array microphone and cable

Array applications are gaining popularity for noise source identification. Types 4957 and 4958 are high sensitivity array microphones and each features an integral DeltaTron pre-amplifier. Each microphone's amplitude and phase corrections are individually measured and stored in the TEDS. When used with a measurement system that supports amplitude and phase correction, noise sources can be identified with greater precision.

Type 4957 quarter-inch array microphone 17mV/Pa 50 to 10kHz: The 4957 quarter-inch array microphone has a nominal sensitivity of 17mV/Pa, and an optimised frequency response (±2dB) 50 to 10kHz.

Type 4958 quarter-inch array microphone 17mV/Pa 20 to 20kHz: The specification of the 4958 is identical that of the 4957, but the microphone has a different optimised frequency response (±2dB) 20 to 20kHz.

Free web seminars

Brüel & Kjær offers free sound and vibration online training. Forthcoming topics include: news in automotive testing; calibration of microphones, accelerometers and sound-level meters; checking NVH variability of production vehicles using a 2250 hand-held analyser; fundamentals of measuring sound; and accelerometer mounting techniques. For further information about free web seminars visit **http://www.bksv.com/4125.asp**

For more information contact Heather Wilkins, Marketing Coordinator, Brüel & Kjær UK Ltd

Tel: **01438 739000** fax: **01438 739099**
e-mail: **ukinfo@bksv.com**
web site: **www.bksv.com**

Audio analyser offers higher-bandwidth converters

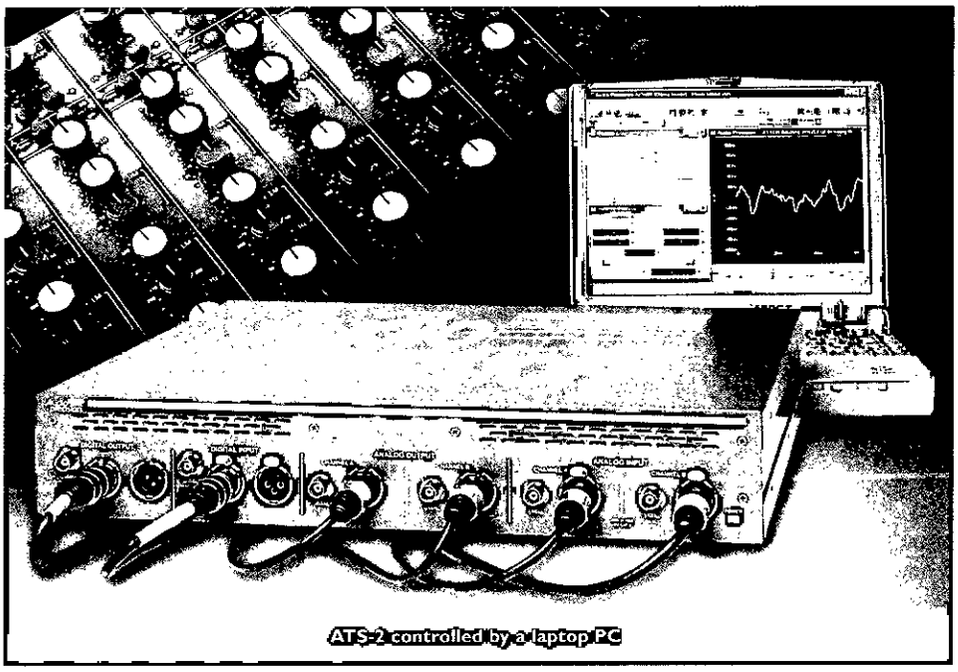
Thurlby Thandar Instruments Ltd

The ATS2-PERF performance option for Audio Precision's successful ATS-2 professional audio analyser is now available in the UK exclusively from TTi (Thurlby Thandar Instruments).

The new option provides higher-bandwidth converters for superior analysis capability (up to 120kHz), and adds digital interface (bitstream) analysis features.

The Audio Precision ATS-2 is a high-quality PC-controlled audio test and measurement system that offers many of the same features found in the company's earlier 2700 Series. It provides design engineers and technicians with the ability to choose performance capabilities to match specific needs and budgets.

The interface measurement capability within the ATS-2 determines whether or not the signal from a digital device meets standards and is compatible with other devices. High-performance measurement capabilities include jitter and FFT of jitter, pulse amplitude, word width, bit activity, sample rate and high-level decoded status bits. Interface stimulus features simulate real-world degradations to measure the effect on the device during testing.



ATS-2 controlled by a laptop PC

The multi-tone analyser used in the ATS-2 provides comprehensive solutions to a range of audio testing challenges by executing five performance tests in a single acquisition: two-channel frequency response, noise versus frequency, total distortion versus frequency, inter-channel separation versus frequency, and inter-channel phase response. The system collates all the data required to plot on a graph any test result in less than one second.

Most ATS-2 settings and readings can be designated as independent or dependent variables, and can be plotted against one another using the comprehensive ATS-2 sweep and graph functions. Extensive attribute controls allow a wide variation in the visual appearance of the graphs, including colour, axis dimensions, and size. Flexible export capabilities allow integration of graphs into various report programs.

For further information please contact:
Mark Edwards,
Thurlby Thandar Instruments Ltd

Tel: **+44 (0) 1480 412451**

Fax: **+44 (0) 1480 450409**

E-mail: **sales@tti-test.com**

http://www.tti-test.com

http://www.tti.co.uk

Low-frequency noise

Brüel & Kjær

Most Local Authorities receive complaints about low-frequency noise, but subsequent investigations are notoriously difficult and time-consuming to make.

With the introduction of modern noise monitoring instruments, such as Brüel & Kjær's Type 2250 hand-held analyser, with built-in sound recording and logging third-octave frequency spectrum, the procedure for practical assessment (developed by Drs Moorhouse, Waddington and Adams at Salford University) has been simplified.

A new application note now available on Brüel & Kjær UK's website (**www.bksv.co.uk**) outlines how to make these assessments using its Type 2250 noise analyser:

The parameters to be measured:

- the $L_{eq,\,5mins}$ values in each third-octave frequency band over a frequency range of 10Hz to 160Hz, and
- the $L_{10,5min}$ and $L_{90,5min}$ values in each third-octave frequency band over a frequency range of 10Hz to 160Hz, and
- continuous logging of the short term L_{Aeq} values.
- It is advisable that the complainant should have the ability to record the actual sound when the noise is present.

For details of the required procedure visit Brüel & Kjær's website at:
http://www.bksv.co.uk/?ID=3555

The website also features:

- Additional field guides on how to perform other common measurements
- Frequently asked questions (FAQs) on our products
- Schedule of courses offered in the United Kingdom and Ireland
- Latest list of web-based training

For further information:

Heather Wilkins, Marketing Coordinator, Brüel & Kjær UK Ltd

Tel: **01438 739000**, fax: **01438 739099**,
e-mail: **ukinfo@bksv.com**
web site: **www.bksv.com**

Brüel & Kjær's Type 2250 hand-held analyser

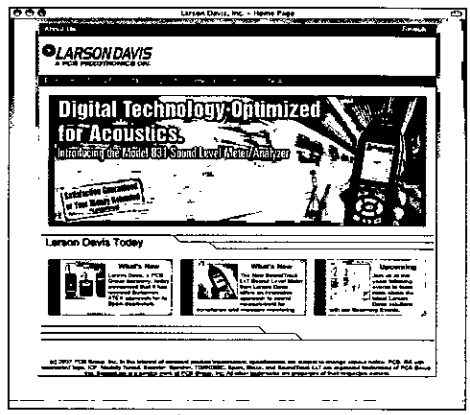
Redesigned home page for Larson Davis

www.larsondavis.com

The Larson Davis division of PCB Piezotronics has announced the redesign of its web site at www.larsondavis.com. The new site provides updated tools to aid customers in selecting the right sound, noise and vibration monitoring products for their application requirements.

The Larson Davis home page offers a new look that includes organisation by products, services sales support and news information. The fully searchable product database is broken down into various product groups: sound level meters including the SoundTrack LxT and the new model 831; data acquisition systems such as the LMS Pimento and DSS; human vibration meters such as the HVM100 and IHVM100; Spark dosimeters; acoustic calibrators; microphones and accessories; and software products such as Blaze and DNA. Product pages include all necessary products and specification sheets, with all applicable information software and technical specifications within each page.

Celebrating 40 years of products, innovation and customer service, PCB Piezotronics is a global leader in the design and manufacture of force, torque, load, strain, pressure, acoustic and vibration sensors, as well as the pioneer of ICP technology. Core competencies include ICP and charge output piezoelectric, piezoresistive, strain gauge, MEMS and capacitive sensors and instrumentation. The organization boasts 24-hour customer support, direct sales offices throughout Europe and Asia, and an established global distribution network.



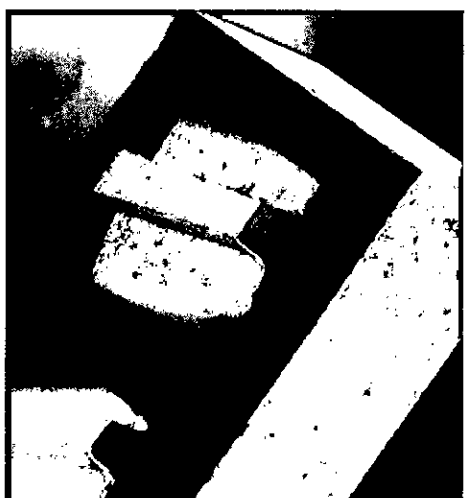
New blocks dramatically reduce acoustic wall costs

Sound Reduction Systems Ltd

Leading acoustic insulation experts, Sound Reduction Systems Ltd, are delighted to announce the sole GB distribution rights for a unique, high performance, acoustic building product, Alphacrete acoustic blocks.

SRS was chosen by Acheson & Glover to distribute the new acoustic block product because of the company's reputation for customer service and quality within the UK building acoustics market. SRS was also selected for its industry-leading technical department, all of whom are members of the Institute of Acoustics and have relevant graduate qualifications.

The partnership between SRS and Acheson & Glover sees two market-leading companies, with decades of experience and success in the fields of building acoustics and masonry block manufacture, join forces to provide the a full service for specifiers and customers.



Alphacrete is a hollow acoustical block

Internally, Alphacrete acoustic blocks are the perfect answer to acoustic absorption in large auditoria where acoustic reverberation can cause problems, such as gymnasia, swimming pools, atria, concert halls, canteens, public halls and plant rooms. The product can also be used to meet the standards of BB93, the legislation which sets out the reverberation times of rooms within schools, and SRS is able to offer a free consultancy and measurement service to specifiers to ensure the regulations are met. The versatile blocks are also perfect for rooms where music or speech intelligibility is vital, such as studios and police interview rooms.

The real 'added value' of the Alphacrete acoustic block from SRS is the significant cost savings that can be made. Once constructed the blocks form a durable, decorative, acoustic wall, without the standard block or brick construction's need for plastering, painting or the addition of separate acoustic wall panels.

Externally, the product can be used to construct environmental noise barriers to combat noise pollution from cars, trains and air traffic.

For further information:
Sound Reduction Systems Ltd,
tel: **01204 380074**,
e-mail: **info@soundreduction.co.uk**

Brüel & Kjær's PULSE

will interface to VXI Tech hardware

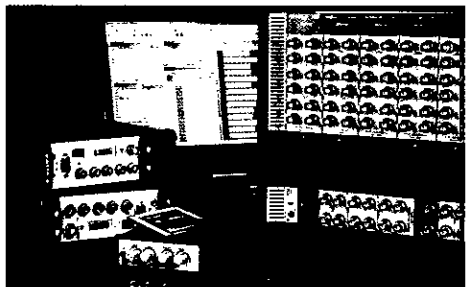
Global leader of sound and vibration equipment and services, Brüel & Kjær, has announced its PULSE data acquisition and analysis platform will support VXI hardware (from leading VXI Bus manufacturer, VXI Technology) for its I-deas Test customer base.

At the beginning of 2005, Brüel & Kjær, together with Maya HTT, acquired the I-deas Test Suite, which is also known as I-deas Pro. I-deas Test products have always supported multi-vendor hardware platforms.

In addition to full support of its own PULSE hardware, Brüel & Kjær's PULSE software platform will also support VXI hardware. Its shared objective is to provide customers with added value by securing continuity and connectivity of their data acquisition solution.

For further information please contact Heather Wilkins, Brüel & Kjær UK Ltd

Tel: **01438 739000**, fax: **01438 739099**,
e-mail: **ukinfo@bksv.com**
web site: **www.bksv.com**



Typical B&K PULSE-based system

Cirrus Research plc

New acoustic calibrators

Cirrus Research plc has announced the introduction of a new range of acoustic calibrators. Key features of the new CR:514 and CR:515 are:

- IEC 60942:2003 Class 2 and Class 1 performance
- 94dB sound pressure level output
- Suitable for use with half-inch microphone capsules
- Automatic power switch off with user override giving long battery life
- Robust case with ergonomic design.

Cirrus is an award-winning pioneer in acoustic technology. Further details can be found on the company's web site at www.cirrusresearch.co.uk. The CR:514 and CR:515 are high performance acoustic calibrators designed for the field and laboratory calibration of sound level meters and other noise measurement equipment. The units are simple to operate and meet the requirements of the latest IEC 60942:2003 standard for Acoustic Calibrators with performance to Class 2 (CR:514) and Class 1 (CR:515) .

The calibrators provide an output level of 1kHz at a sound pressure level of 94dB and are suitable for use with half-inch microphone capsules.

Easy access to the battery for replacement as well as a robust design allow the CR:514 and CR:515 units to be used for both field calibration of sound level meters as well as for precision calibration of other sound measurement equipment.

A single push button is used to switch on the calibrator and the unit will automatically switch off after three minutes to conserve battery life. The user can override the automatic switch off allowing the unit to be used for longer periods if required.

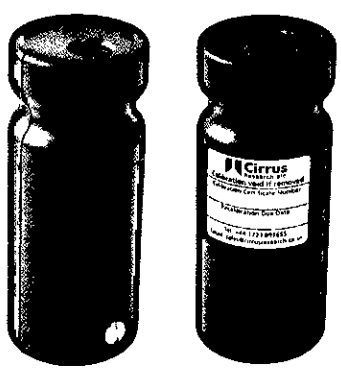
The calibration of sound level meters and other noise measurement equipment is vital to ensure that any measurements taken are accurate and comply with any regulations and guidelines that are being followed.

The CR:514 and CR:515 Acoustic Calibrators provide a simple and reliable method of carrying out both field and laboratory calibration of noise measurement equipment. They can be ordered as individual units and each is supplied with a user manual, certificate of calibration and a battery.

The updated doseBadge and all of the new accessories will be on display throughout 2007 at a number of exhibitions and conferences including:

- Safety & Health 2007, NEC, 22 to 24 May
- Hillhead 2007, Buxton, 27 to 28 June
- A+A 2007, Dusselfdorf, 18 to 21 September
- Health & Safety Northern, Reebok Stadium, 10 and 11 October.

Contact James Tingay, Cirrus Research plc, tel: **01723 891655**, e-mail: **james.tingay@cirrusresearch.co.uk**



Cirrus CR:514 and CR:515 acoustic calibrators

EDUCATION MANAGER

(Part-time)

A successor is sought for Peter Wheeler, who plans to stand down from his role as Education Manager later this year.

The key tasks of the job are to:

- Manage and develop the Diploma and Certificate programmes
- Extend alternative methods of Course delivery including Distance Open Learning
- Develop new market opportunities within the UK and overseas

The post is based in St Albans and the successful candidate will have recent experience of the development and delivery of undergraduate and postgraduate courses in the field of acoustics and a knowledge of the quality assurance framework in UK HE.

The Education Manager works in close co-operation with the Chief Executive and the Chairman of the Education Committee.

Applications with C.V. should be marked 'Private and Confidential' and addressed to:

Kevin Macan-Lind
Chief Executive
Institute of Acoustics
77A St Peter's Street
St Albans
Herts AL1 3BN

Institute of Acoustics

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1 year full-time, 2 years part-time

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Both the MSc and PgDip include specialist taught units in measurement and behaviour of sound, subjective and environmental acoustics, noise control, architectural acoustics and environmental space, plus general units on research methods and management.

The MSc also includes a major project in any area of acoustics of interest to the student, often related to current university research or consultancy activities.

Entry requirements: An honours degree in Science, Engineering, Music Technology, Audio Engineering, Building Services Engineering, Environmental Health or other relevant discipline, or IOA Diploma in Acoustics and Noise Control, or relevant life/work skills.

For more information please contact Dr Stephen Dance on 020 7815 7672 (dances@lsbu.ac.uk) or Professor Bridget Shield on 020 7815 7658 (shieldbm@lsbu.ac.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 2007

DAY	DATE	TIME	MEETING
Thursday	10 May	10.30	Membership
Thursday	24 May	11.00	Publications
Tuesday	5 June	10.30	CMOHAV Examiners
Tuesday	5 June	1.30	CMOHAV Committee
Tuesday	**5 June**	**4.15**	**AGM**
Thursday	7 June	11.00	Executive
Tuesday	19 June	10.30	CCENM Examiners
Tuesday	19 June	1.30	CCENM Committee
Thursday	**21 June**	**11.30**	**Council**
Thursday	28 June	10.30	Distance Learning Tutors WG
Thursday	28 June	1.30	Education
Thursday	5 July	10.30	Engineering Division
Tuesday	10 July	10.30	ASBA Examiners
Tuesday	10 July	1.30	ASBA Committee
Thursday	12 July	10.00	Meetings
Tuesday	7 August	10.30	Diploma Moderators Meeting
Thursday	6 September	10.30	Membership
Thursday	13 September	11.00	Medals & Awards
Thursday	13 September	1.30	Executive
Thursday	20 September	11.00	Publications
Thursday	**27 September**	**11.30**	**Council**
Thursday	4 October	10.30	Diploma Tutors and Examiners
Thursday	4 October	1.30	Education
Thursday	11 October	10.30	Engineering Division
Thursday	18 October	11.00	Publications
Thursday	1 November	11.00	Research Co-ordination
Tuesday	6 November	10.30	CCENM Examiners
Tuesday	6 November	1.30	CCENM Committee
Thursday	8 November	10.30	Membership
Tuesday	13 November	10.30	ASBA Examiners
Tuesday	13 November	1.30	ASBA Committee
Thursday	15 November	10.00	Meetings
Tuesday	20 November	10.30	CMOHAV Examiners
Tuesday	20 November	1.30	CMOHAV Committee
Thursday	22 November	11.00	Executive
Thursday	29 November	11.00	Publications
Tuesday	4 December	10.30	CCWPNA Examiners
Tuesday	4 December	1.30	CCWPNA Committee
Thursday	**6 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.

Examination dates 2007

DATE	EXAMINATION
27 April	Certificate in the Management of Occupational Exposure to Hand-arm Vibration
14/15 June	Diploma Examination
22 June	ASBA Examination
5 October	Certificate of Competence in Environmental Noise Measurement
19 October	Certificate in the Management of Occupational Exposure to Hand-arm Vibration
3 November	ASBA Examination
9 November	Certificate of Competence in Workplace Noise Assessment

Conferences & meetings

Diary 2007

23 May 2007
Underwater Acoustics Group
Workshop on Measurement of Underwater Radiated Noise - NPL, Teddington

5 June 2007
Environmental Noise Group
The Art of being a Consultant - Manchester

11 July 2007
Measurement and Instrumentation Group
It's practically a quality measurement - are your measurements fit for purpose?
NPL, Teddington

18-19 September 2007
Underwater Acoustics Group
Detection and Classification of Underwater Targets - Edinburgh

26 September 2007
Measurement & Instrumentation Group
Perception, Consideration and Closure... a better way of dealing with noise from aircraft - Birmingham

17-18 October 2007
Noise and Vibration Engineering Group
Autumn Conference 2007
Advances in Noise and Vibration Engineering - Oxford

29-30 November
Electroacoustics Group
Reproduced Sound 23 - Hall of Sound: Audio for live events - Oxford

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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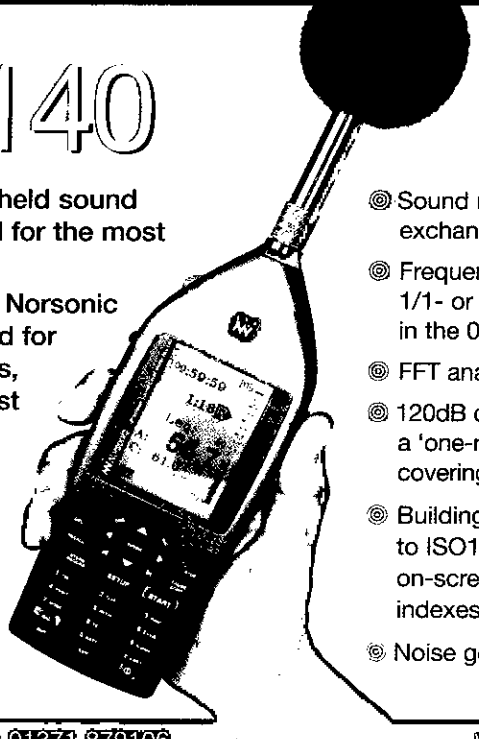

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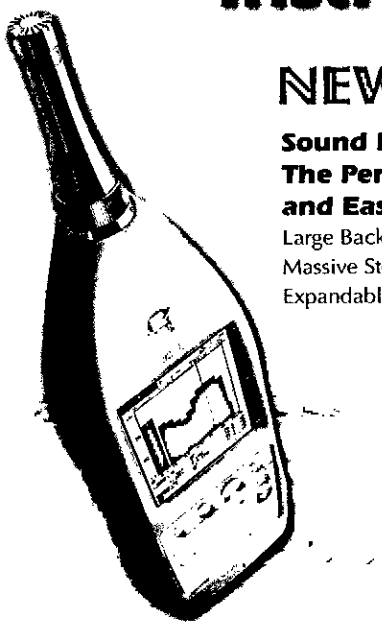

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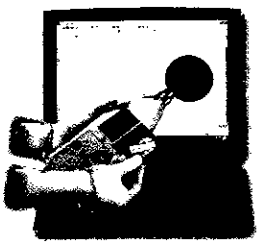

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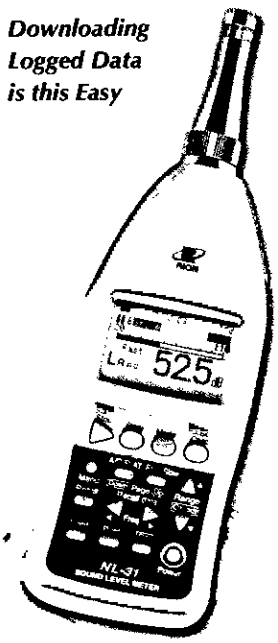

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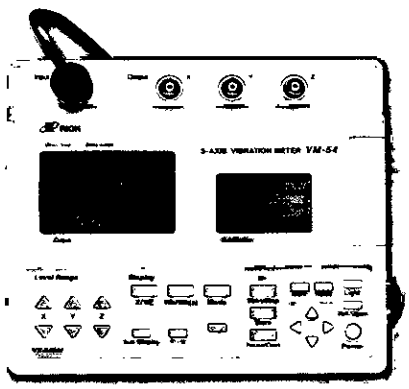

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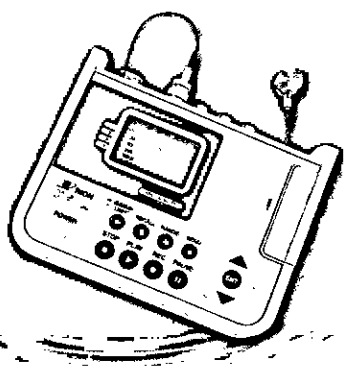

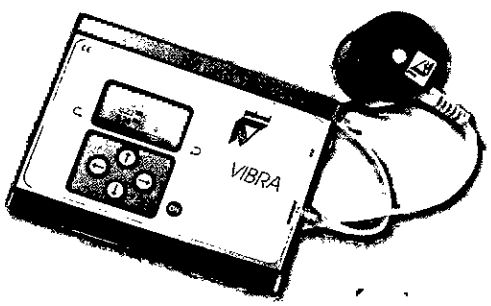

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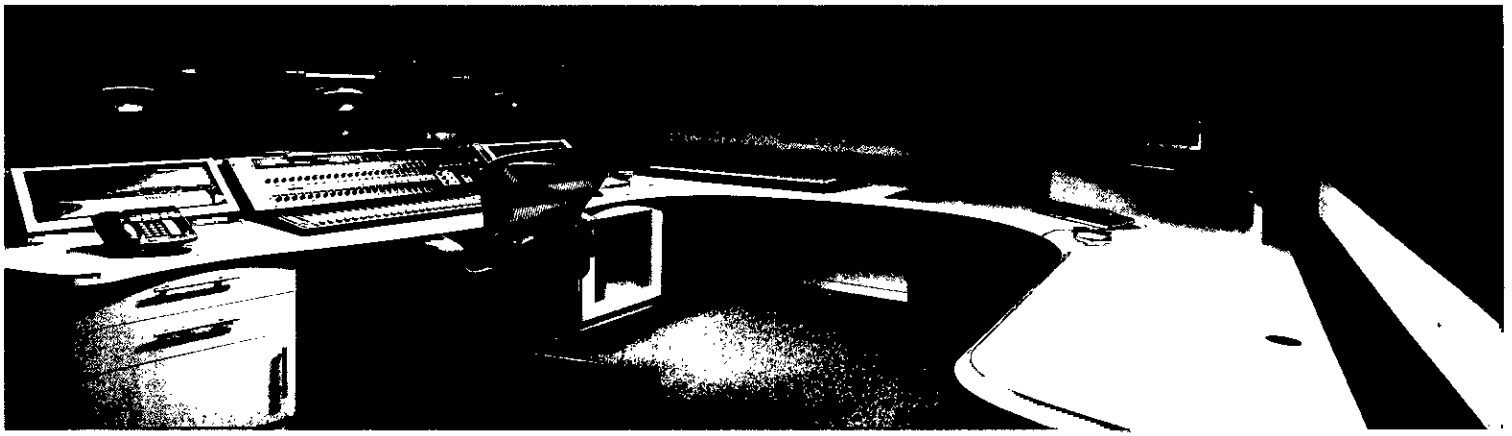
Quietly moving forward...



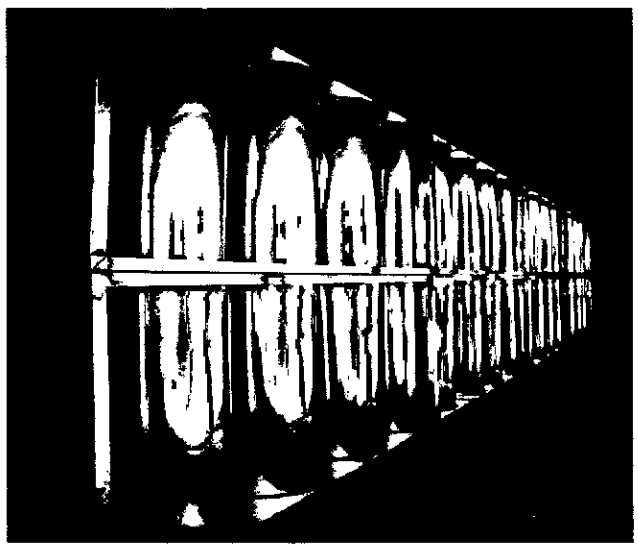
POSITION: ACOUSTIC ENGINEER

We have a close-knit group of dedicated engineers and consultants and are looking to recruit a similar likeminded, dynamic and self motivated person to join our team.

Preferably, you should have an acoustics related degree or diploma. Previous experience would be an advantage although not essential.

The position will require field testing within the UK, so a full driving licence is essential. Candidates should be familiar with common Microsoft Office packages such as Word and Excel.

The role will generally encompass all the disciplines described here and full training will be provided where required.



EEC Ltd was founded 17 years ago with a core team of engineers with experience in all aspects of noise and vibration control. Working primarily within the construction and mechanical services industry, we design and manufacture bespoke noise control solutions.

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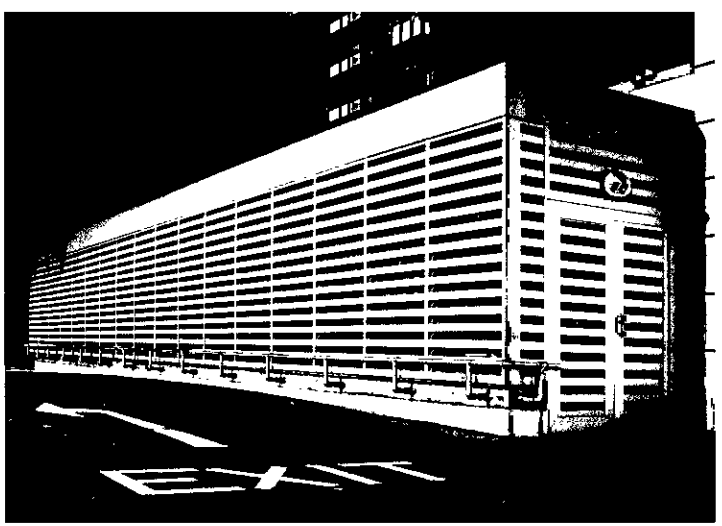
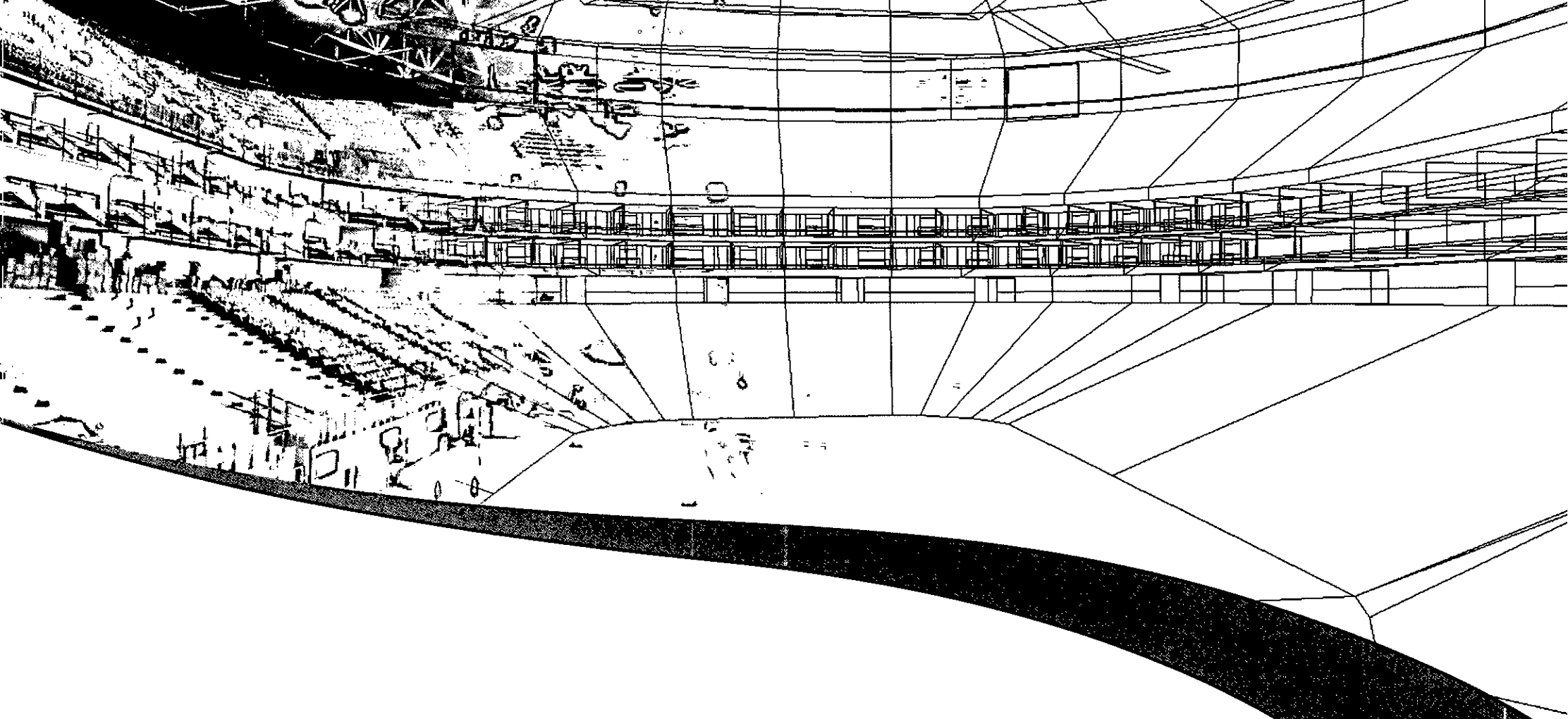
Surrey
KT12 2TP

Tel : 01932 230940
email : tim@eecnoisecontrol.co.uk





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