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acoustics BULLETIN

Volume 25 No 2
March – April 2000

acoustics BULLETIN

Volume 25 No 2
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Advertising:
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Published and produced by:
The Institute of Acoustics, 77A St Peter's Street, St Albans, Herts. AL1 3BN
Tel 01727 848195 Fax 01727 850553
e-mail ioa@ioa.org.uk
Web site http://ioa.essex.ac.uk/ioa/
Printed by:
Unwin Brothers Ltd, UBL International, The Gresham Press, Old Woking, Surrey GU22 9LH.

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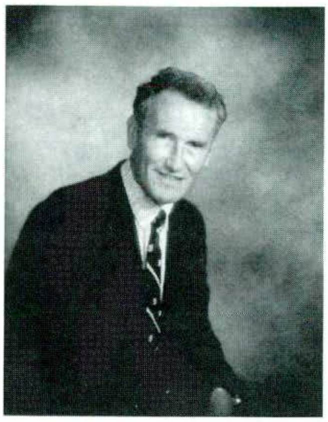

Dear Fellow Member,

Time flies when you are having fun; it seems hard to believe that this letter is the last of my term as President. The past two years have been an interesting time in the development of the Institute with many new initiatives designed to strengthen the position of the acoustic professional and these have only been possible due to the efforts of those who volunteer to serve on our committees and to the staff at the office who action their decisions. Without the support of these people it would not be possible for the President to function; many thanks for your efforts and long may they continue.

Action points that need special mention at the moment come from the Membership and Education area. In the last letter I spoke about the meeting of the Groups and Branches representatives and one of the outcomes of this was that each of the regional branches should have a person on their committee responsible for membership matters. This person would be advised of all new membership enquires from their region and liase with the potential members to guide them through the application procedure. With such a system in place we should get a better "conversion rate" from the expressions of interest we receive and also be better placed to deal with more! If each member could look around their work place and identify potential members and put them in contact with the office we can take it from there; the results will be to the benefit of both the individuals concerned and the Institute.

We have been speaking a lot recently about the development of our activities in the Education area with many new development projects under way. We should not however forget the routine work that is ongoing; on that front we are just starting the regular review of the syllabus for the Diploma. It is important that we keep abreast of developments and the Chief Examiner would welcome comments and observations from members regarding topics that should be included, excluded or revised. Certainly from my own point of view when I think back to the early days of the Diploma there are now many topics that feature in our everyday working life today that were not even known about then; strategic noise control and noise mapping being the first that come to mind.

In closing I would like to wish Mark Tatham every success in his term as President and look forward to working with him and the new Council to continue to develop the IoA as the voice of the Acoustics Professional.

Yours truly,

Ian Campbell

CHARACTERIZATION OF INDIVIDUAL WHEEL NOISE DURING TRAIN PASS-BY

Johan Van Keymeulen

Introduction

This article describes work undertaken within a study of the noise generated by the wheels of high speed railway trains. The particular purpose of the study was to develop and use a methodology for comparing the source characteristics of wheels of different design whilst the train was moving across a measurement point at high speed.

Interesting challenges within the project involved the speed at which the train passed, the influence of the Doppler Effect, the presence of many other noise sources on the train and the fact that on the test train only two bogies carried the wheels under test.

Measurement

Standard measurements using one microphone are incapable of separating the noise generated by different sources, especially when these are passing at very high speeds, so a microphone array technique is required to isolate and quantify the noise emission.

An ETR470 Pendolino train from FIAT Ferroviaria was equipped with the special Lucchini damped prototype wheels, known as 'Syope' and ran at various constant speeds between 50 kph and 220 kph on the test-site of FS (Ferrovie dello Stato) at Renacci, on the high-speed railway line between Florence and Arezzo. A linear array of 21 microphones was positioned at 3.30 m from the track, at track level, see Figure 1. An accelerometer measured the rail vibration, and a far field microphone was positioned at 7.50 m from the nearest railway track, at a height of 1.20 m.

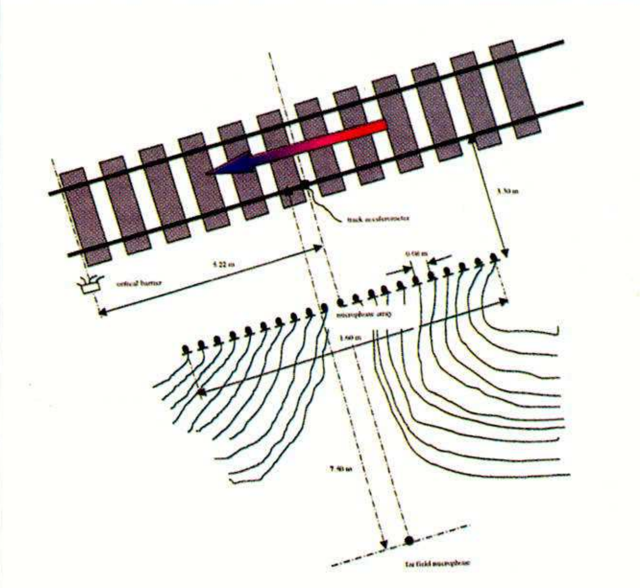

Fig. 1. A linear array of 21 microphones was positioned at 3.30 m from the track, at track level.

An optical barrier was used to trigger the 12 kHz data acquisition. The exact speed of the train and the position of each wheel for every time sample were derived later. On the train, a mid-frequency volume velocity source emitted a pure sine tone at 2 kHz in order to check the validity of the technique; it would also help in signal de-Dopplerization.

Typical results during pass-by are shown in Figure 2. One can clearly observe the pass-by of the bogies, the increased vibration levels on the track and the sound levels. Notice also the dynamic pressure field created by the train entering and leaving the array: after high-pass-filtering to remove these shockwaves, the data now correspond to normal pass-by noise levels.

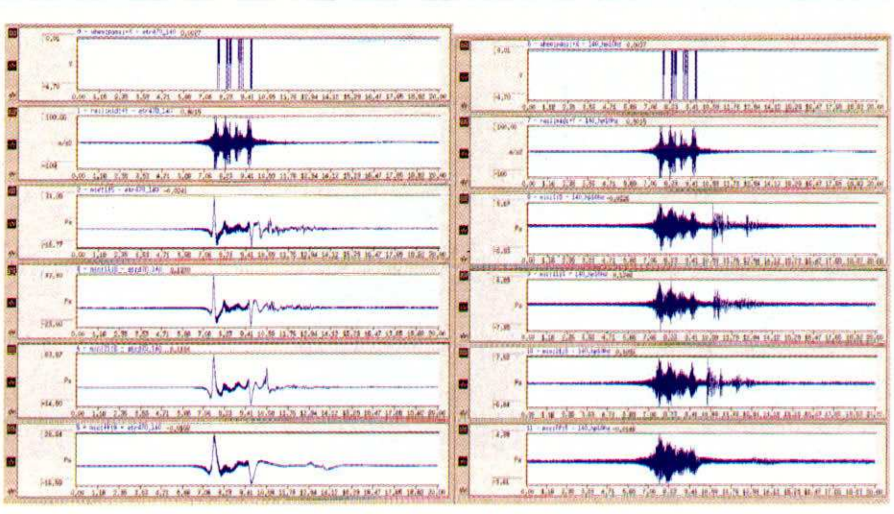

Fig. 2. Example of original pass-by data at 140 kph (left), high pass filtered at 10 kHz to remove shockwaves (right). From the top: light barrier, track vibration, first, centre and last microphones in the array, and far field microphone

Conventional Data Analysis

The first way of analyzing the data was to calculate an autopower spectrum corresponding to the points of time during which the individual wheelsets (or bogies) are passing by. In this way it was possible to quantify the emitted noise of four groups (considering different wheels together).

Figure 3 shows the selected segment for one conventional group (black) and the Syope group (purple). The analysis was performed on a segment selected to include the pass-by of all wheelsets defined by a group. One can clearly observe that there is no clear frequency information, as Doppler effects remain in the data, and as it was impossible to track individual wheels. A global reduction can be seen, however, this result was very sensitive to the selected time segment and was as such not very useful.

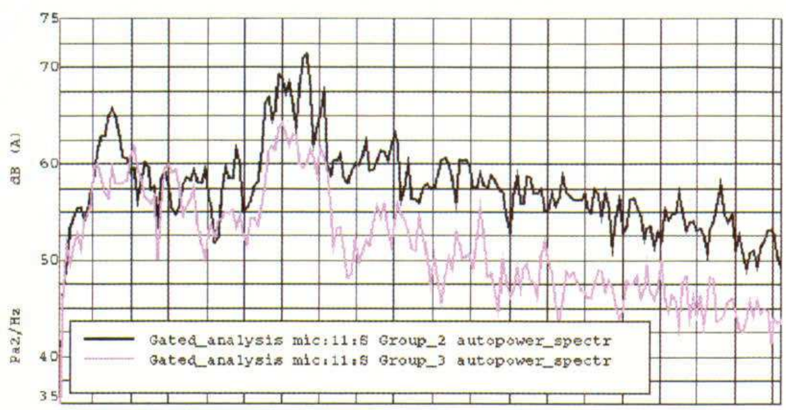

Fig. 3. Selected segment for one conventional group (black) and one Syope Group (purple)

When a time/frequency analysis was performed, one can clearly observe four phenomena, corresponding to the four groups as defined earlier. It is also clear that the noise levels of the third group are lower when compared to the second group, especially high frequency (above 1.5 kHz). Note the clear presence in Figure 4 of the sine tone at 2 kHz as the train was arriving. This signal has a clear Doppler effect, as the nearing frequency was 2256 Hz and the leaving frequency dropped to 1796 Hz. The second harmonic of this sine tone was also present.

From all these graphs, one can conclude that the separation in time of individual wheels remains impossible, and that there was still no correct frequency content information available for potential sources like bogies.

Phased Array Analysis

Intuitively, when one listens to a sound one uses both ears to locate the nominal source, moving one's head to track its movement. A microphone array approach uses the same principle, in this case 21 widely spaced microphones achieve far superior results than two. Of course, it would be impractical to turn such a large array to track a source on the train, so it is moved electronically, in an approach sometimes referred to as a 'phased array'. The microphones do not move, but use progressively varying time delays between the microphones to 'point' the array centerline to a 'virtual' location (assuming monotonic signal). In general, off-center sources tend to interfere and cancel out, while the coherent source is time averaged and enhanced.

By varying the delays between the microphones for each time sample, the array can be steered and pointed at the nominal target as it traverses the track. It is then a matter of repeating the analysis for each of the wheels, and for each frequency in the bandwidth of interest. Also note that the Doppler effect would be removed by an adaptive resampling technique prior to this phased array analysis, so correct frequency information would be obtained. Altogether, a massive amount of non-trivial digital signal processing was involved.

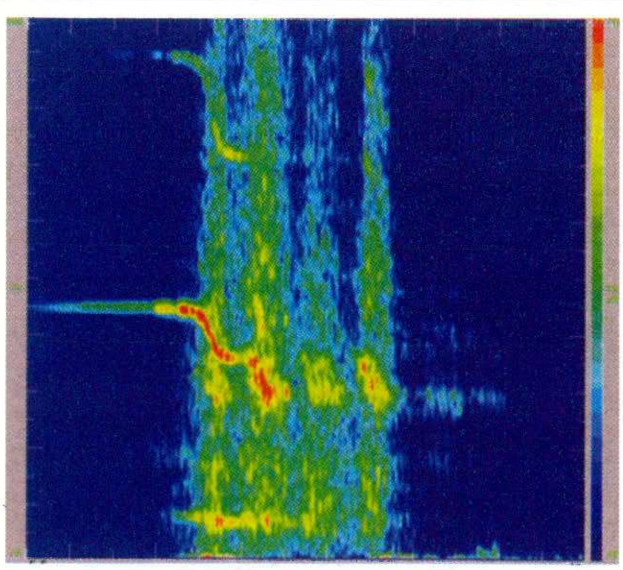

Fig. 4. Short term FFT waterfall of 140 kph pass-by. The 4 wheelsets can be identified and a large Doppler shift of the 2 kHz tone; little else is of significance

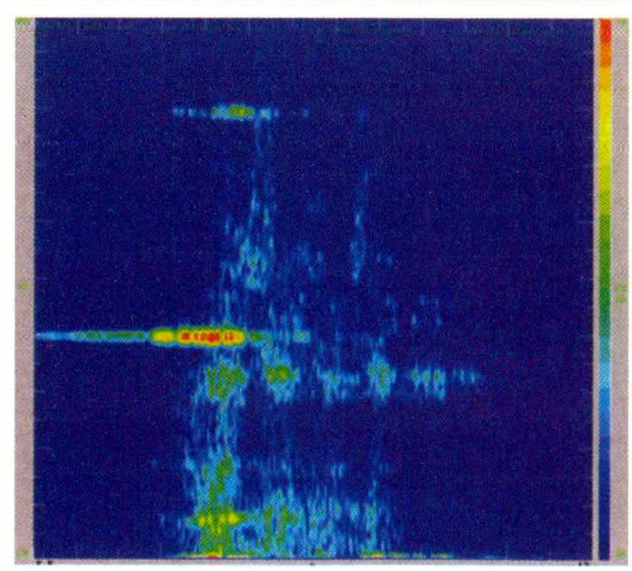

Fig. 5. Validation of the phased array process: the signal is de-Dopplerised and the time averaged signals tend to zero.

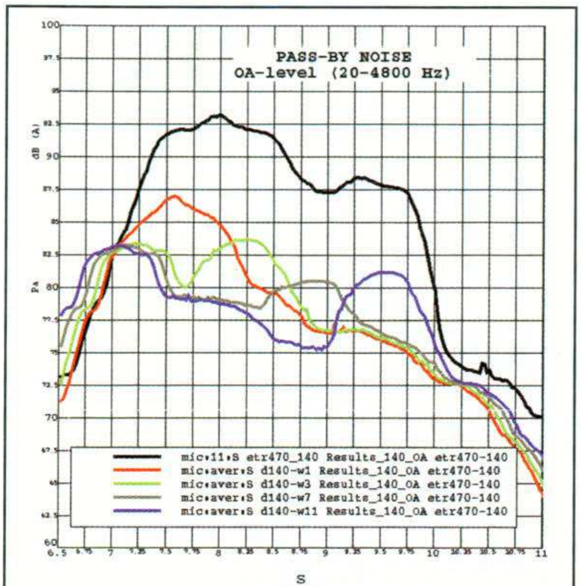

Fig. 6a

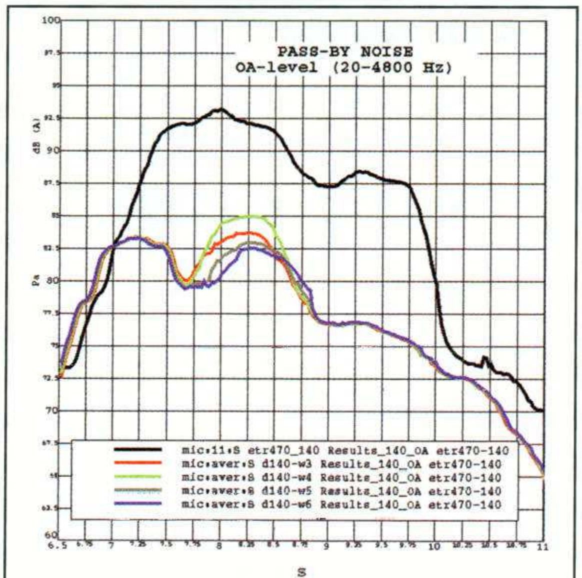

Fig. 6b

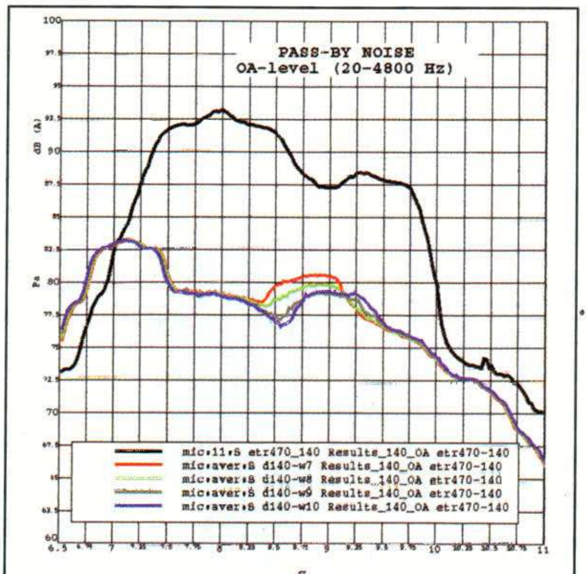

Fig. 6c

The analysis was carried out in a batch mode using a User Program developed by LMS Engineering Services. In this case, the microphone time signals were delayed for 12 individual wheels, corresponding to the contact zones between the 12 wheels and the railway track. In addition, the six bogies were also tracked, as well as the sine-tone source on the train to give a reference to correct the position information and to check the validity of the procedure: it was verified that the procedure and software works well, as energy level decrease of the tone was minimal (0.5 dB). Figure 6a shows the OA level of the central microphone signal compared to the first wheel in every wheel group, ie wheel 1, 3, 7 and 11. On the black curve no clear separation of the individual wheels can be seen. All other curves clearly show a more focused picture on the tracked virtual sound source. The Syope wheel (gray curve) is the most silent of all at 80.5 dBA, and when compared to a standard wheel (green curve) a reduction of 4 dBA in OA-level can be observed, which is a clear improvement on pass-by emission noise.

Figure 6b shows the results in OA-level for all standard wheels in the 2nd wheelgroup, ie wheels 3, 4, 5 and 6. Finally Figure 6c shows the same data but now for the 3rd wheel group containing the Syope wheels.

The difference between each of these wheels can be explained by the near presence of auxiliary equipment or other sound sources on the train.

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ACTIVE NOISE CONTROL: NOW A FULLY EMERGED TECHNOLOGY

Geoff Leventhall FIOA

Introduction

Having progressed steadily through more than 20 years of development during its current 'modern' phase, active noise control can now claim to be a fully emerged technology. Active noise control provides solutions to a wide range of applications ranging from ear defenders to HVAC, industrial fans and pumps and to aircraft interiors, whilst there are additional applications in various stages of incubation. Some current applications are described below.

Ear Defender and Communication Headsets

These are similar in concept. Commercial systems are mainly based on analogue electronics, as this works well in the small enclosed volume of a headset. There is a bewildering choice of communication active noise reduction (ANR) systems from over 20 manufacturers, mostly aimed at the private and commercial pilot market. Some airlines, for example SAS and American Airlines, provide ANR headphones to their Business and First Class passengers, in order to enhance the quality of the in-flight entertainment systems.

Active ear defenders are particularly useful in environments where there is a high level of low frequency noise and can remove the requirement for the uncomfortable use of both earplugs and ear defenders together. Figure 1 shows an arrangement in which the external noise is detected and cancelled in the cavity. Figure 2 indicates the additional attenuation produced by the active system. The attenuation extends from the low frequencies up to several hundred hertz or higher, thus complementing the passive attenuation of the headset's ear seal and shell. It is possible to obtain low frequency attenuation from passive headsets, but at a cost of considerable discomfort to the wearer. The weakest point is the ear seal, which can be improved only by a very tight fit, and this is not acceptable for long-term use. The attenuation of the shell must also match the attenuation of the ear seal. However, when attenuation of higher frequencies is not an issue and the attenuation is focussed on low frequencies, open-back active headsets are available, for example as a consumer product to reduce low frequency noise when travelling or listening to a Walkman. These are light in weight and comfortable to wear.

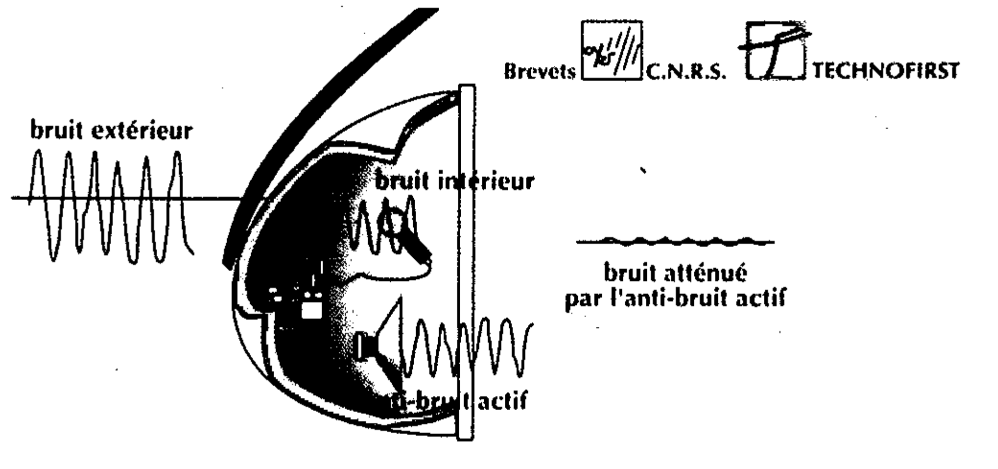

Fig. 1. Schematic of Active Noise Reduction Headset. The intruding noise is detected by an internal microphone, processed and added in antiphase. (TechnoFirst)

HVAC Duct Silencers

The basic (SISO – single input single output) active duct silencer in the ACTA configuration is shown schematically in Figure 3 and operates on the plane wave mode in a duct. Consequently it has a theoretical frequency limit of $f_c = c/2\,l_{max}$ where f_c is the cut-on frequency of the (1,0) mode, c is the velocity of sound and l_{max} is the greatest dimension of a rectangular duct. Thus, in a duct of 600 mm section, active attenuators will operate up to over 250 Hz, at which frequency absorptive attenuation can take over. For a circular duct of diameter d, $f_c = 1.84c/\pi d$ is the cut-on frequency of the first mode. Attenuation of higher modes is possible with more complex systems (MIMO – multiple input multiple output). The highest mode known to have been attenuated in a commercial MIMO installation is the (0,2) mode in 3 m rectangular ducts, which is at about 110 Hz and was a potential problem in causing vibration of sensitive components in the large clean-room in which the installation took place.

MIMO systems have some disadvantages of complexity. An alternative approach is to use a matrix of independent SISO systems to fill the cross-section. This may have its own problems if the active components are

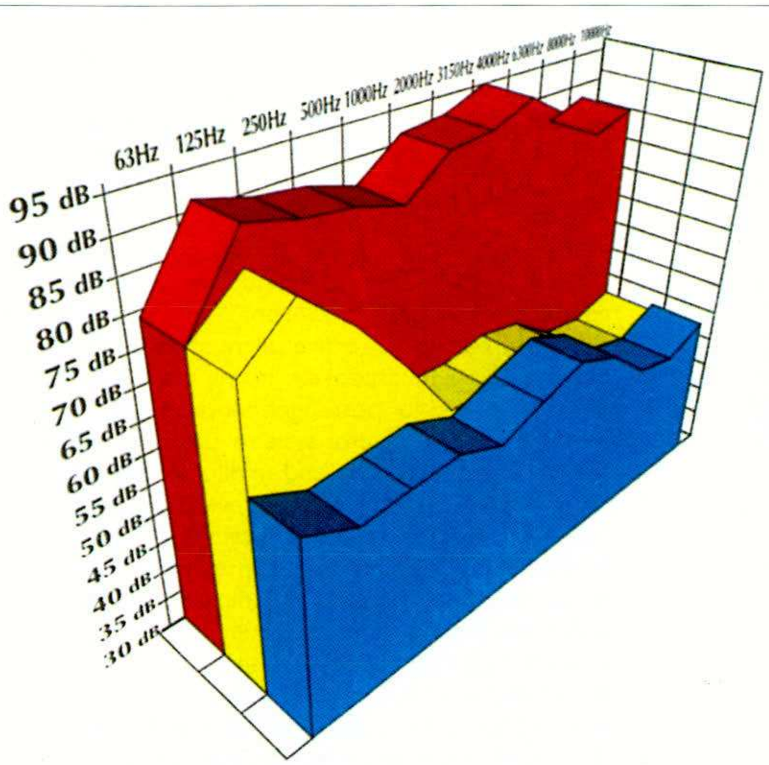

Fig. 2. Performance of ANR Headset. The highest graph is the external noise. The middle graph shows the action in the passive mode, whilst the front graph indicates the additional attenuation produced actively.

mounted externally to the duct, but the ACTA system from ALDES and TechnoFirst has the components mounted internally, in a pod, which incorporates passive absorption. These can be stacked up to fill any required space as indicated in Figure 4. There is more blockage to the airflow than with externally mounted components, but this is much lower than with a conventional splitter silencer. Investigations have shown, [1], that the splitter silencer is the greatest single contributor to pressure loss in normal duct systems. For example, in the investigation of [1], the particular silencer used had a pressure loss about ten times that of a square mitred bend. Poor airflow conditions at the entry or exit of the silencer will increase the pressure loss further. It should be noted that all manufacturers' published test data is for ideal conditions, which may not be realised in practice.

Turbulence can affect the operation of an active attenuator by giving false readings from the upstream and downstream microphones (Figure 3). Ideally, there should be perfect correlation between the two microphone outputs. It can be shown

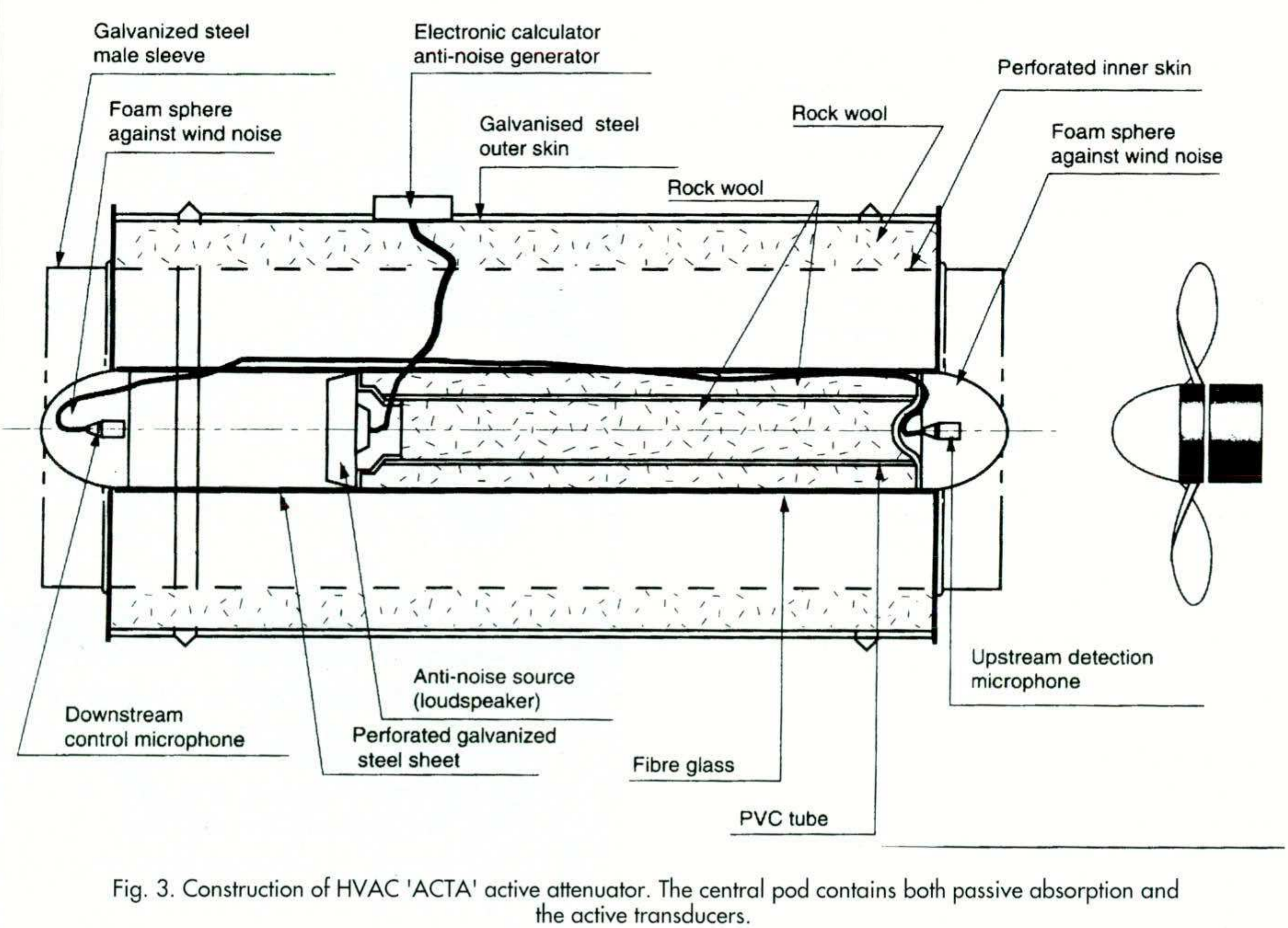

Fig. 3. Construction of HVAC 'ACTA' active attenuator. The central pod contains both passive absorption and the active transducers.

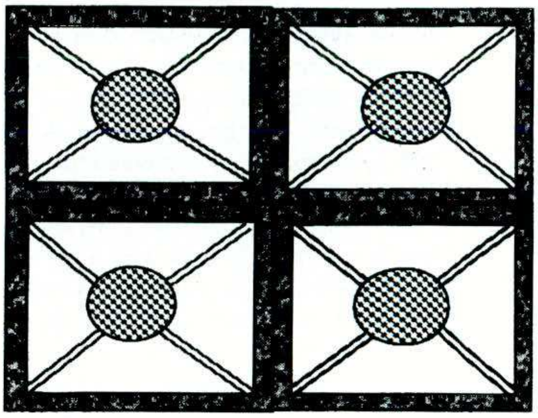

Fig. 4. Stacked ACTA active silencers to fill a large duct or aperture. The absorbent pod, which is supported centrally in the silencer, contains the active components, whilst the perimeter lining adds further high frequency absorption.

that the maximum theoretical attenuation is

$$A = 10 \log_{10}(1-\gamma^2)$$

where γ^2 is the coherence function between the microphone outputs [2]. Thus, a coherence of 0.9 or greater is required to give attenuations greater than 10 dB.

HVAC silencing has become an important application for active noise control and will continue to develop and be adopted for both initial installations and retrofits. Active silencers are available as standard items from HVAC companies [3] and give attenuations in excess of 10 dB in the difficult 31.5 Hz, 63 Hz and 125 Hz bands.

Industrial Silencing

Fans and compressors discharging to atmosphere through ducts or stacks cause many industrial noise problems. These can be treated in a similar way to air conditioning ducts, although the discharge atmosphere is likely to be more hostile. This leads to the selection of special transducers, for example high temperature loudspeakers and microphones and protection of the transducers from the flow. Figure 5 gives the performance of an active noise control system on a dust collector fan.

Where necessary, a bank of active silencers, as in Figure 4, can replace acoustic louvers if these are not sufficiently effective at low frequencies. Applications are typically for noisy, hot processes such as boiler rooms, foundries or paper making etc, which rely on natural ventilation for air supply and to lose heat to the atmosphere.

Transportation

Road Vehicles

There have been a number of successful prototype active systems for vehicle mufflers and for reduction of car interior noise. These are available to vehicle manufacturers, who continue to show interest, but are concerned at the marketing problems. An interior system can use the existing audio system loudspeakers, requiring additional microphones and a controller. It is possible that, when installation of digital radio develops for vehicles, the surplus digital power of the radio will be used for active control, thus requiring only additional microphones.

Aircraft

Active headsets are used regularly on some commercial aircraft, both to reduce fatigue for the crew and to enhance passenger's enjoyment of the audio system, as described earlier. An active attenuation aircraft seat has the cancelling loudspeakers in the headrest, thus eliminating the need for passenger headsets, [4].

Global active control systems are a standard accessory for some turboprop and smaller jet aircraft eg Beech King, Saab, Cessna. There are several approaches to the use of active noise control in aircraft [5].

- The interior control system uses an array of microphones and loudspeakers to control noise over a volume within the seating areas. Typically, 16 or 32 loudspeakers and microphones may be used.
- The engine vibration control approach recognises that much cabin noise is due to structural transmission from the engine and uses active vibration control in the engine pylons in order to reduce transmission.
- The fuselage control approach uses arrays of vibration transducers on the fuselage to control general fuselage vibration, thus reducing noise radiation into the cabin.

The largest aircraft for which commercial systems are available as a regular product are the DC9 and MD80.

Whilst active noise control adds some weight to aircraft, this is very small compared with the weight of passive materials which would be required to achieve similar results.

Pulsed Flow in Fluid-filled Pipes

The control of pulsed flow in pipes has application to compressors, diesel engines, pumps etc [6]. These machines create periodic pressure pulses for which passive mufflers are inefficient at low frequencies. Active control using loudspeakers as the cancelling source have been developed, but these may not always be able to produce the peak levels required in large systems and may be affected by high temperatures and corrosive gas flows. A newer development is to use a butterfly valve in the duct or pipe, Figure 6. Controlled oscillations of the valve around a mean position produce a pressure fluctuation in the pipe, which acts to reduce the low frequency pulsations. The valve introduces a pressure loss given by

$$p = {}^{1}/_{2}\, \lambda\, \rho\, \upsilon^{2}$$

where λ is a non-dimensional head loss coefficient, which depends on the angle, θ, which the valve makes to the axis of the pipe, ρ is the fluid density and υ the fluid velocity. Figure 7 shows the performance of an oscillating valve attenuator. Attenuation is obtained on very high-levels of components (up to 150 dB). It is likely that an early commercial application of this system will be on mufflers for heavy trucks.

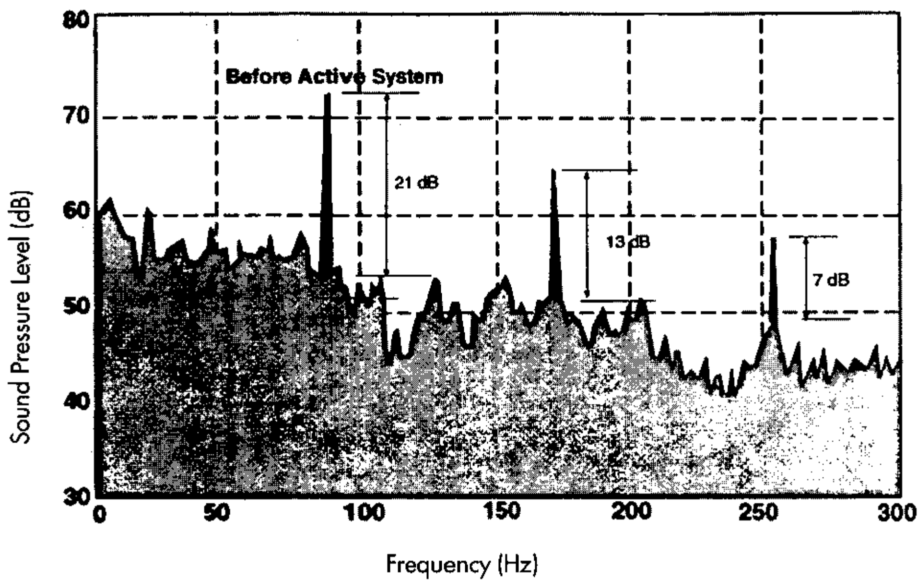

Fig. 5. Performance of active noise control system on dust collector fan. Measurements at about 350 m from the fan.

Selecting the Correct System – Active or Passive

A prospective user may have to make careful decisions on specific applications. There are a number of factors to be considered, including:

• Technically appropriate solution – is it really the best? Here it is necessary to compare the advantages and disadvantages of active and passive, recognising that there are applications for which passive methods are to be preferred and that there are others in which passive methods are not as effective as active. Active control may be the only feasible solution for some retrofit applications. And, of course, these would not have fallen into the retrofit category if the need for active control had been recognised during the design.

• Long-term reliability – is there convincing historical data? Installations have been in operation for well over 10 years, although the most rapid growth has been in more recent years. The digital systems are as reliable as any other well-designed box of electronics, but attention must be given to correct choice and use of transducers.

• Cost – how does the first cost and the lifetime cost compare with other solutions? For retrofits the cost is often lower than redesigning or replacing a system which has not met its noise specification. For new installations, for example for fan noise, there is the potential for energy saving on reduced pressure loss, which can contribute to balancing an initial greater cost. *

Conclusions

Active systems have been used for a wide range of installations, whilst new applications are developing. An informed estimate is that there are around 1000 installations, many for HVAC and industrial fans or compressors. Additionally, there are unknown numbers of active headsets in everyday use and fleets of aircraft installed with active systems.

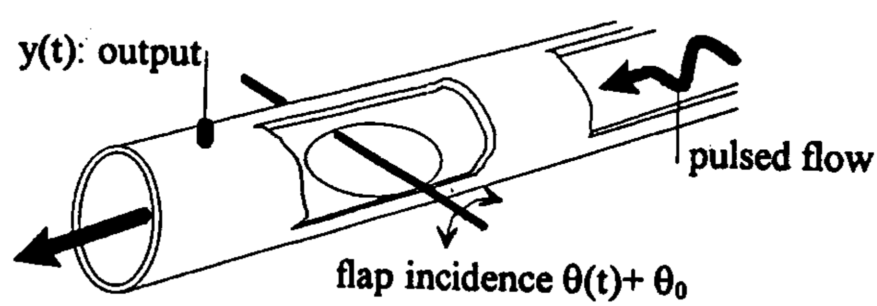

Fig. 6. Schematic of actively controlled butterfly valve to cancel low frequency pulsations.

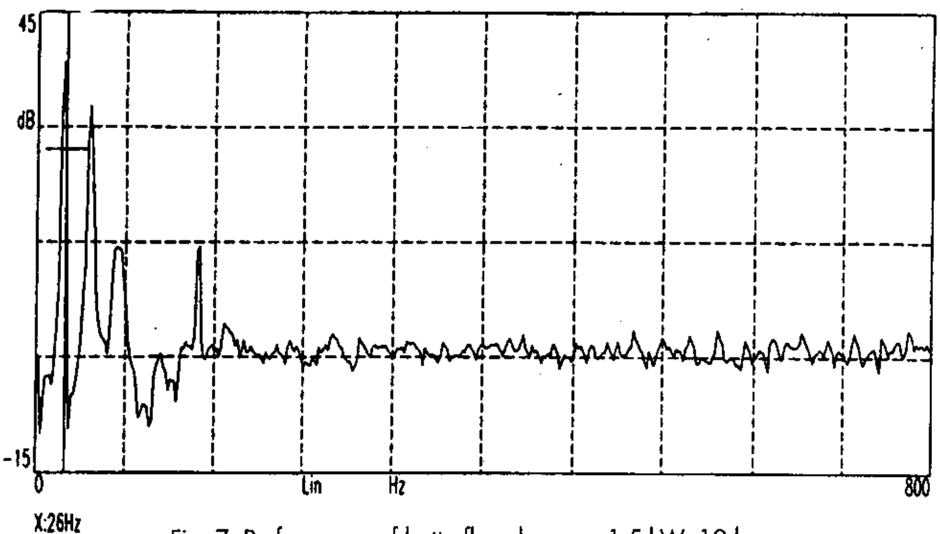

Fig. 7. Performance of butterfly valve on a 1.5 kW, 10 bar compressor. Fundamental at 25 Hz is reduced by nearly 40 dB.

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[2] *Active Noise Control Systems*, Kuo and Morgan, 56-57, Wiley, (1996)
[3] For details of active systems for HVAC try, for example, www.technofirst.com
[4] CARME, DELEMOTTE, MONTASSIER, 'ANR (Active Noise Reduction) in Turbo-prop Aircraft', Proc Active '95, 607-618, (1995)
[5] Manufacturers of aircraft systems include Lord Corporation (USA), Barry Controls (USA), Ultra Electronics (UK) and GEC-Marconi (UK)
[6] RENAULT, MICHEAU, TARTARIN, BESOMBES, 'Industrial Applications of Active Control of Pulsed Flow', Proc InterNoise 96, 1061-1066, (1996)

* The energy cost of a pressure loss Δp Pa is given by

$W = (\Delta p\, Q)/\eta$ Watts

Q is the flow rate in m^3/s and η is the efficiency of the motor-fan system. As the energy use of powering an active system for HVAC is typically 20 – 50 watts, at a flow rate of about 3 m^3/s and an efficiency of 0.8, this is covered by a saving in pressure loss of 10 – 15 Pa. Any further saving is an energy bonus.

Dr H G Leventhall FIOA is a former President of the Institute and presently has a consultancy in the UK with the French active noise control company TechnoFirst at h.g.leventhall@dial.pipex.com. ❖

FLIGHT OF FANCY OR THE NEW PEACEKEEPER

Stephen Gosling MIOA

Introduction

On February 14, visitors to CTS Studios, London were given a demonstration of Meyer's high definition X-10 loudspeaker. Incorporating military technology from the B2 stealth bomber, the design approach represents a departure from that of typical loudspeakers.

Technical Development

When assessing the quality of reproduced sound, audible defects may originate anywhere in the signal chain from microphone to loudspeaker. Distortion caused by the chain's electronic devices (CD player, amplifier) is negligible when compared to devices that contain moving parts, such as the loudspeaker. This is because a speaker's sub-components such as the magnet and suspension usually behave differently to the voltage driving them, introducing non-linearity.

Most domestic loudspeakers are passive. A passive loudspeaker works by splitting the signal to each of the drivers after the amplifier, by components within the box. This approach leads to difficulties, a principal of which is the inherent non-linearities within a passive crossover.

Many specialists consider that careful control of the amplifier/loudspeaker interface is the central foundation for improved sonic performance. This is reflected in practice by the fact that the majority of large studios, whose demands for volume and clarity are supreme, use active loudspeakers.

The designer of an active loudspeaker enjoys a number of advantages over his passive counterpart. For instance, the maximum working limits of an active system can be fully exploited to provide a higher sound pressure level by tailoring each of the amplifiers for the driver's power rating and sensitivity. In addition, no arguments (or large profits) need arise concerning the use of esoteric loudspeaker cables. With a suitably low source impedance, balanced line signals can operate at low loss at distances over 100 m. Finally, an active system lends itself to use of motional feedback, allowing the mechanical and magnetic non-linearities to be taken into the control area of the power amplifier.

To reproduce low frequency sound at a sufficiently high volume, the current trend in modern studios is to use loudspeakers containing dual 15" or 18" woofers. When these units operate above 250 Hz, interaction between the drivers causes areas of interference, known as comb filtering effects, to occur. If a crossover below 250 Hz is chosen to minimise comb filtering, the system will need more than two drivers, perhaps three or four. There are no high quality tweeters which work reliably at 250 Hz.

However, use of more drivers may not be the smartest move as further difficulties arise with crossover (or phase) distortion; low frequencies today, high frequencies tomorrow.

So why not use a more straightforward two-way system with a single bass driver? Because there's a catch. Whereas a two-way system benefits from no comb filtering effects and minimal crossover distortion, it cannot produce the peak levels demanded by modern studios.

Or so it was widely believed. In 1998, John Meyer, head of Meyer Sound – a Californian loudspeaker manufacturer – set about producing a 2-way system capable of reaching sound levels produced by larger multi-way systems. Since then, together with researchers from the University of California, and technology borrowed from the military, they have been working to produce a two-way loudspeaker capable of reproducing such levels. A few weeks ago, at CTS Studios in London, he revealed how it works.

John Meyer speaks with attendees at the CTS Studios launch (Credit Mal Stone)

The Product

The production loudspeaker unit, Meyer's X-10 active studio monitor, comprises a high frequency horn and (the clever bit) a single 15" low frequency driver fitted with a closed-loop feedback system (up to 500 Hz).

Closed loop-feedback involves measuring the position or motion of the loudspeaker via a sensor (in this case, a microphone, located 1" in front of the bass driver) and, after making a small correction, relaying this signal as quickly as possible back to the loudspeaker. The process then repeats itself, ad infinitum (or as long as the speaker is in use). Figure 1 outlines the principle of operation.

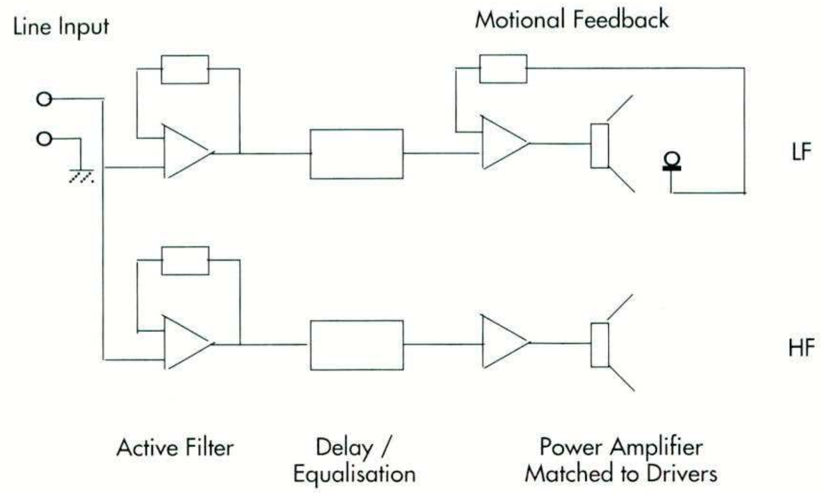


Fig. 1. Overview of closed-loop feedback system

The speed at which the feedback circuit works is a central issue and is also why previous attempts to design a motional feedback device have failed. Questions over stability arise if the upper limit of the controlled frequency range is too high.

The feedback signal is detained for a short time because the process involves evaluating a non-linear mathematical function. Using a look-up table of pre-calculated results can speed things up, but at the expense of accuracy; and the accuracy of the look-up can be improved (by mathematical trickery) only at the expense of speed. Speed limits the upper frequency of control, accuracy limits the perceived sound quality.

John Meyer's approach is to use every bit of digital processing power available to him. Meyer's system, Pressure Sensing Active Control (PSAC), uses cutting edge computer hardware (ie, the fastest processors housed in the box) to provide the answers to high-order correction models, pre-calculated in turn using the California University's fastest parallel computers.

The result is a loudspeaker system that exhibits (essentially) flat amplitude and phase responses capable of reaching a sustained 126 dB (pink-noise, broadband) with an impulse response quicker than that of an electrostatic loudspeaker.

A significant challenge for modern studios is to reduce the influence of the central mixing console on the room's natural acoustic. With this in mind, the horn has been designed to 'beam' the sound over the top of the console. John Meyer told of how the horn's geometry was formed. Initial impressions were formed used boundary element and finite element analysis, although he soon found out that this could only tell him where to start.

The dispersion characteristics from the horn are reported as constant with frequency. Meyer's engineers were amazed to find how tiny geometric changes (in some cases less than 2 mm) could significantly affect the dispersion pattern.

Discussion

Questions from the floor centred on the suitability of a microphone as the feedback sensor. Both background noise (especially at very low frequencies) and large changes in room pressure (eg closing or opening a door) have the potential to bias the data sampled by the microphone.

Visitors were given a demonstration in a mixing room with a chance to listen to their own material. How did it sound? It was hard to be sure; undoubtedly, the units performed well, demonstrating very low distortion, hence sometimes fooling the ear as to the actual level, as the ear uses distortion as a cue for loudness.

A destructive test, using an uncompressed bass synthesiser at a very high volume, finally caused the units to distort. The power lift required by the processor was greater than that available causing the feedback loop to break and the system to fail dramatically. The distortion, kept very low until this point, was similar to a CD player when skipping a chunk of data. Happily, after a couple of seconds to re-compose itself, the system sprang back into life. This feature is useful to engineers who usually have the task of determining the threshold of distortion.

The final consensus seemed to be that the sound was good (stereo definition was superb) if a little dry. However, the dryness was probably related to the natural acoustics of the listening room and, perhaps, the twenty or so people congregated within the room.

With the endless march of hardware processing power and a little bit of old-fashioned luck, Meyer's new technology could act as a catalyst for other leading loudspeaker designers. Whether a better loudspeaker makes for a better class of recording quality remains to be heard.

Stephen Gosling MIOA is with Alan Saunders Associates at Westgate House, 39-41 Romsey Road, Winchester SO22 5BE, who are members of the Association of Noise Consultants. ❖

NOISE ON THE NET NO 3 – ROADS AND RAILWAYS

Matthew Ling MIOA

This is the third article written with the aim of introducing you to some of the sources of information on noise and acoustics available on the Internet. To complement the information on aircraft related noise this article aims to give an overview of road and rail noise sites.

UK Policy

Chartered Institute of Environmental Health (CIEH)
http://www.cieh.org.uk/about/policy/policy/trans99.htm
The CIEH has produced a policy document for transportation and the environment. It makes recommendations for the reduction of transport related noise, which includes the development of a National Noise-Reduction Strategy which would ensure that noise reduction is part of the local transport planning process.

Department of Environment, Transport and the Regions
http://www.detr.gov.uk/
The DETR aim *to improve the quality of life by promoting sustainable development at home and abroad, fostering economic prosperity and supporting local democracy.* Its brief includes a wide range of policy and policy related research of which noise is one. Noise information at a number of places on the site including: Environmental Protection – Air and Environmental Quality (AEQ)
http://www.environment.detr.gov.uk/airq/nnp/noise/index.htm
The noise and noise nuisance policy unit gives details of current research projects and initiatives. The site contains a number of downloadable reports, including The Birmingham Noise Maps
http://www.environment.detr.gov.uk/noisemaps/birmingham/report/index.htm

Roads and Traffic
http://www.roads.detr.gov.uk/
This includes construction, maintenance and operation of motorways and other trunk roads, and funding for local authority roads. Also road safety aspects such as road calming and its effect on noise.

Highways Agency
http://www.highways.gov.uk/
An executive agency of the DETR aimed at contributing to sustainable development by maintaining, operating and improving the trunk road network in support of the Government's integrated transport and land use planning policies.

National Society of Clean Air and Environmental Protection (NSCA)
http://www.nsca.org.uk/
The NSCA has identified the importance of UK Noise Policy, and highlights the concern that there is no coherent policy to tackle noise in the UK. The Society is therefore calling on the Government to draw up a National Noise Strategy for the UK. One of their current concerns is transport noise, specifically in the context of the Transport White Paper.

Royal Commission on Environmental Pollution
http://www.rcep.org.uk/
The RCEP proposed specific objectives and targets to provide the basis for a sustainable transport policy, outlining eight clear objectives of a sustainable transport strategy, one of which is to reduce noise pollution from transport. Note this site was out of action at the time of writing.)

European

Community Development and Information Service (CORDIS)
http://www.cordis.lu/
The CORDIS site serves as a useful starting place for information on European Union research activities that are implemented under multi-annual research, technological development and demonstration (RTD) framework programmes. The information covers current Fifth RTD Framework Programme (1998-2002) and the previous Fourth RTD Framework Programme (1994-1998), with additional access to information on a number of other research-related programmes and initiatives from outside the RTD Framework Programmes.

CORDIS project report on quiet road surfaces
http://www.cordis.lu/austria/english/newslett/letter68.html

European Conference of Ministers of Transport
http://www.oecd.org/cem/
The European Conference of Ministers of Transport (ECMT) is an intergovernmental organisation established in 1953. Its intention is to provide a forum in which Ministers responsible for transport, and more specifically the inland transport sector, can co-operate on policy through open discussion on current problems. The outcomes are intended to be agreement upon joint approaches aimed at improving the utilisation and at ensuring the rational development of European transport systems of international importance.

Research and Development

UK

Building Research Establishment (BRE)
http://www.bre.co.uk/
BRE is the UK's leading centre for research into all aspects of buildings and construction, and the prevention and control of fire. The Acoustics Centre at BRE carries out a range of research activities including the interaction of noise and buildings. It has been involved in work combining assessment of road traffic noise, window design, ventilation and PPG 24, and has conducted surveys of motorway barrier performance using sound intensity techniques. BRE is also currently undertaking the Noise Incidence Survey and Noise Attitude Survey which measure the noise incidence and attitude of people in England and

Wales to a wide range of environmental noise sources, including road and rail.
Cambridge University, Department of Engineering
http://www-g.eng.cam.ac.uk/energy/tyre.html
The Department have been involved in developing a mathematically-based model to predict the exterior noise generated at the tyre-to-road interface under various conditions of traffic operation. The collaborative work has been carried out with Dunlop Tyres Ltd, Rover Cars, Transport Research Laboratory, EPSRC and Cambridge European Trust.
Institute of Sound and Vibration, Southampton University
http://www.isvr.co.uk/dept/Jan2000/Welcome2.htm
The Dynamics Group at ISVR conduct research into the prediction, measurement and control of structural vibration, currently including all forms of land, marine and space vehicles. The area of interest extends to structural integrity under oscillatory loads, vibration transmission, sound radiation, passive and active vibration control, and machinery monitoring. ISVR also contains the Automotive Design Advisory Unit that acts as a consultancy for matters relating to engines and vehicles.
Motor Industry Research Association (MIRA)
http://www.mira.co.uk/
MIRA is an independent provider of engineering development and research services to the worldwide automotive industry; extensive services and product development in vehicle Noise, Vibration and Harshness (NVH) working for both vehicle and component suppliers alike.
Transport Research Laboratory (TRL)
http://www.trl.co.uk/
TRL is an independent, internationally recognised centre of excellence, with a primary focus on surface transport noise; primarily road and rail noise. Current research includes noise modelling and mapping, traffic noise barriers, low noise road surfaces, quiet vehicles and tyres, traffic calming and the community impacts of traffic noise. The web site is currently being updated and includes various TRL papers on a range of topics and has links to sites concerned with transport noise.

International

French National Institute for Transport and Safety Research (INRETS)
http://www.inrets.fr/index.e.html

Road and Road Transport

Tractor noise at HUT, Finland
http://bekesy.hut.fi/~pantse/projects/tractornoise/
Institute of Safe, Quiet & Durable Highways, Purdue Univ
http://widget.ecn.purdue.edu/~sqdh
Highway Noise Control Program, Center for Transportation Research, The University of Texas at Austin
http://www.me.utexas.edu/%7Emicrobot/noise.html
Highway Noise Subcommittee, Committee on Transportation-Related Noise & Vibration (National Academy of Sciences/National Research Council/Transportation Research Board)
http://www.tiac.net/users/a1f04/roadlist.htm
Noise and Traffic Web Site by M Van de Berg, Netherlands
http://www.xs4all.nl/~rigolett/ENGELS

Trains and Rail Transport

Government Sites

Railtrack
http://www.railtrack.co.uk/
Railtrack's environment commitment statement on noise can be found at:
http://www.railtrack.co.uk/corporate/crr/text/enviro/4b.htm
and their 1998/99 actions to reduce noise and vibration:
http://www.railtrack.co.uk/corporate/crr99/addressing/addressing2.html
US Department of Transportation Federal Railroad Administration
http://www.fra.dot.gov/horns/
Details of a new proposed rule to set a maximum sound level for locomotive horns, limit sound directed to the side, prescribe when and how to sound the horn, and provide an opportunity for communities to establish a quiet zone.
Rail / Mass Transit Noise Subcommittee, Committee on Transportation-Related Noise & Vibration (National Academy of Sciences/National Research Council/Transportation Research Board)
http://www.tiac.net/users/a1f04/raillist.htm

Pressure groups

H.O.R.N. (Halt Outrageous Railroad Noise)
http://www.nonoise.org/quietnet/horn/index.htm
HORN is committed to the safe and quiet operation of trains, and is a volunteer non-fee paying organisation

Software

Soundplan
http://www.soundplan.com/
Comprehensive noise and air pollution prediction and mapping software. The package implements a wide range of European procedures and standards.
WS Atkins Noisemap2000
http://www.noise.wsatkins.co.uk/software/nmap_p.html and
http://www.noisemapping.com
A noise mapping software package, which uses the UK standards for noise prediction.
FHWA traffic noise prediction model (FHWATNM) which will replace STAMINA and OPTIMA. Announcement at:
http://www.tfhrc.gov/trnsptr/rttmar96/rd960065.htm
with details of how to obtain the software from
http://www-mctrans.ce.ufl.edu/featured/trafficNoise/
The software was designed by HMMH
http://www.hmmh.com/highway04.html

And finally...

If you know of sites that have passed me by, then let me know at lingm@bre.co.uk and I'll list them at a later date.

Matthew Ling MIOA is Senior Researcher with the Acoustics Centre, BRE, Watford

QUARTERLY ARTICLE FOR INSTITUTION JOURNALS – FEBRUARY 2000

Malcolm Shirley

Much of 1999 was dominated by the necessary, but time-consuming work of the Engineering Council's *Activity Review* – an appraisal of the continuing relevance of the Council's work. All but completed in 1999, we have successfully refined our activity base, restructured organisationally and put in place considerable efficiency measures to move into the year 2000 and beyond. The ultimate aim of the Review was to give the Council's 260,000 registered engineers, from whom it receives about 80% of its income, more direct benefits and a greater return for their annual subscription. I am glad to report that we have frozen registration fees for this year at least and created headroom in our resources for new activities. For example, the year 2000 will see the launch of Recognising Excellence, a campaign to promote the benefits of Institution membership and professional registration through the Engineering Council to employers and ultimately to engineers and technicians.

As a result, at the start of this new decade, we are well positioned to be able to respond more rapidly to change. A critical success factor for the engineering profession, hence for the Engineering Council, is its ability to remain relevant and flexible in the face of constant change. Our business world today is characterised by megamergers and increasing globalisation – and there's no escape for the engineering sector. A key ingredient for business success is clearly the need to adapt to this increasing speed of business and technological change. I'm reminded of some recent research by a team from the Warwick Business School who report that firms who are prepared to continually change their structure, processes and boundaries, will be the ones with the highest performance. We're seeing examples of this happening every month. A few years ago, a significant part of GEC's turnover relied on heavy industry and defence, but over a very short space of time, it has reinvented itself as Marconi, a major telecommunications and systems player.

The pace of technological change is dramatically altering established patterns and creating exciting opportunities for all engineers. Recently, three Physics and one Computing student from Nottingham Trent University sold a part of their company – an Internet guide to college courses, accommodation and publications – to a US firm for £10m. It's remarkable to see now the City's love affair with anything 'dot.com' related has exploded. This is yet another facet of the revolution taking place in engineering. Having stressed to the City over the years the value of engineering to UK plc, perhaps it's time once again to open their eyes (and many others) to the broader influence of engineering both within and on our economy. Certainly, I believe we are making an increasingly significant contribution in promoting the wider understanding of engineering.

It is against this background that at the request of Lord Sainsbury, the Engineering Council and the DTI have set up a small working group (The Hawley Group), to explore the role of the Engineering Council in today's rapidly changing world. Under the leadership of Dr Robert Hawley, Chairman of the Engineering Council, the Group is considering how the Council can add value to the broader engineering community in such areas as the promotion and standards of engineering. The Group aims to build on existing synergies with other organisations in order to position engineering as a major contributor to the knowledge-driven economy.

If The Hawley Group is to succeed, it needs to consult as widely as possible across – and even beyond – the engineering community. This has already been done for the first stage and is vital not only to keep everyone informed of the developing ideas of the review, but also to receive input to those ideas from all interested parties. This will ensure that the small review team will be best able to develop a mechanism for the Engineering Council to serve the needs of all of us. The Group completed its first stage of developing strategic objectives on schedule at the end of January, but over the next six months, it will need further contributions from all organisations being consulted if the ambitious programme is to succeed.

So what is the Group looking at? A starting point has been to define the wider 'engineering community' and to develop communication channels with that community to establish commitment, bring coherence and act as a forum to bring people together.

Other objectives are likely cover the need for effectiveness of the promotion of the understanding of engineering and its contribution to the knowledge economy and sustainable development, the definition of the present and future skills needs of industry and the means to fulfil these needs, all education issues relevant to engineering and the knowledge of developments abroad, especially in the EU.

The Hawley Group will also wait with interest to see the results from another working group, set up by the Council with The Royal Academy of Engineering. A result of the ever-increasing technological change is the need to explore the horizons of engineering and feed valuable information into the broader consultation process.

But the key to all of this is the profession's continuing relevance in the changing marketplace of business and the need for engineers to be more adaptable and more multi-skilled. They must be prepared to take risks, have well-developed communication skills, and be wholly committed to updating regularly their knowledge base. Much of this is enshrined in the new *Standards and Routes to Registration* and demonstrates the vital role for the Council and the engineering Institutions.

At a recent professional development conference which we ran in conjunction with the IEE, many of the speakers highlighted the urgency for engineers and importantly, their employers to embrace 'lifelong learning' as central to their careers and to business success. In 1970, it was predicted that a graduate engineer would require formal updating every twenty years. In 1980, that dropped to ten years and then to five in 1990. The latest estimates suggest that this has now fallen to just three years – a need for truly continuing professional development. In today's competitive, global economy, capital is mobile and technology can migrate quickly. To secure the future of engineering in the UK, we must produce and retain better 'home-grown' engineers who are drivers of professional excellence, innovation and business success. The rate at which engineers learn and then act is, as David Brown, Chairman of Motorola said at the conference, the last sustainable competitive advantage that companies will have in the future. The Engineering Council and its partner Institutions are crucial to ensuring this professional development of engineers. Lifelong learning is a key focus for us all and an important philosophy to be developed across the profession.

With such exciting developments afoot in the Council over forthcoming months, you would be forgiven for thinking that all our energy has been spent on driving forward these programmes. But our underpinning work still goes on as usual. Thirty new or re-elected members are now in place on our Senate, drawn from a broad spectrum within and outside the profession. Among the newly-elected members is the MP for Lichfield, Michael Fabricant (Conservative). Along with re-elected MP for Crosby, Claire Curtis-Thomas, (Labour) the engineering profession now has a strong voice in parliament, with representation in each of the main political parties. We're also very pleased to have Lord Puttnam of Queensgate CBE joining the Senate as a Privy Council nominee. Lord Puttnam is Chairman of the National Endowment for Science, Technology and the Arts (NESTA), an Oscar-winning film maker, and now Chairman of the General Teaching Council, the recently-created body responsible for setting and enforcing professional standards for teachers.

In December we ran a Forum on Innovation Management, an intensive one-day conference, opened by Lord Sainsbury, which attracted over a hundred delegates and high profile speakers from both industry and academia. Forums are part of our Industry Affiliate programme and our next one takes place on 22 June on the subject of risk management.

Young Engineer for Britain, our annual competition giving young people the opportunity to demonstrate their ingenuity and inventiveness, has come round again and entry forms are now available. It's the biggest event of its kind in Europe and offers a showcase to education and industry of the wealth of innovation and creativity amongst young people in UK schools and colleges. I am grateful for the support it gets from the Institutions. The 2000 Environment Award for Engineers is also underway. This is the only award which recognises the achievements of individual engineers in their work to protect or enhance the environment and to resolve environmental problems.

Overall, as we work ever closer with the Institutions, it is exciting to see how the many existing activities are developing. I am also greatly looking forward to the new ones which are in the pipeline, and with more emphasis on effective and efficient communication to the engineering community and beyond, it's also important to mention the launch of our new website which is to be found at www.engc.org.uk. Watch that virtual space – perhaps it's the only one capable now of keeping up with the ever-changing developments in our world!

Malcolm Shirley is Director General, Engineering Council ❖

ACOUSTIC DESIGN OF THE LYRIC THEATRE, THE LOWRY, SALFORD

Kyri Kyriakides FIOA, Ian Knowles MIOA & Laurence Haslam FIOA

Introduction

This paper describes the acoustic design of the new Lyric Theatre in the Lowry, Salford. It outlines the key acoustic design parameters and describes the integration of the architectural aesthetic with the acoustic requirements. The building will open on 28 April 2000.

The Lowry

The Lowry will accommodate facilities for both visual and performing arts in an exciting, stimulating venue for education and recreation. Bordered by the Manchester Ship Canal and facing a new triangular public plaza it will be the landmark focus of the redevelopment of Salford Quays. The Plaza will be a sheltered and lively venue for community activity, gathering together three primary approaches to the Centre, including the terminus of the new Metrolink light rapid transit system. A commercial development will enclose the remaining sides of the Plaza, and waterside promenades provide pedestrian routes from the building entrance to the Quayside (see photograph 1).

The Lowry contains a 1730 seat Lyric Theatre, a 466 seat Adaptable Theatre with shared rehearsal and dressing facilities, Art Galleries to display the City's collection of L S Lowry paintings as well as changing exhibitions, artworks, an interactive gallery covering the creativity of the arts, together with bars, café and waterfront restaurant.

The Adaptable Theatre, on an axis aligned with the Lyric Theatre, has a courtyard form to suit various performance arrangements and a curved enclosing foyer with dramatic views across the ship canal. Rehearsal space is provided above the Adaptable Theatre, with the administrative offices located at ground level.

The Lyric Theatre forms the heart of the building with stairs and balconies providing direct access to three auditorium seating levels. A perspective view of the Theatre is shown in photograph 2.

Acoustic Design of the Lyric Theatre

The Design Team's starting point for the development of the Lyric Theatre was a study of the Edinburgh Festival Theatre which has a similar layout and seating capacity. It also stages similar events and has a reputation for excellent acoustics [1]. Other comparable theatres visited included Glyndebourne (1250 seats); the Theatre Royal, Glasgow (1566 seats); and the Grand Theatre, Leeds (1603 seats).

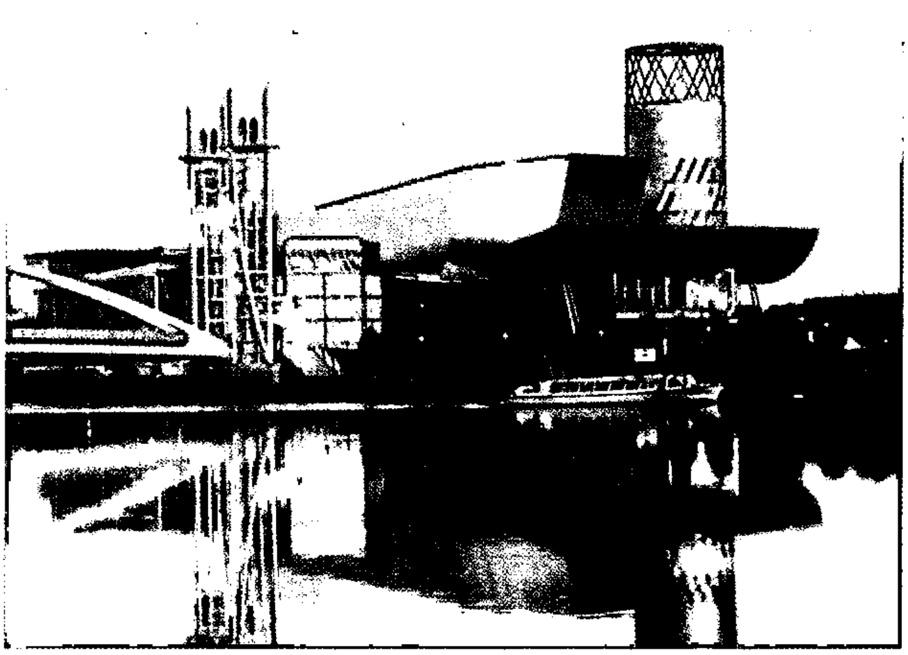
Client Requirements

The Lyric Theatre is intended to be a multi-purpose auditorium so as to serve a wide variety of needs. The Operational Report and Business Plan [2] proposes that key aspects of the programme for the Lyric Theatre should include the country's finest opera, ballet, dance and drama touring companies. Examples of companies envisaged include the Birmingham Royal Ballet, English National Opera, Northern Ballet Theatre, Royal National Theatre, Royal Shakespeare Company, Welsh National Opera, Glyndebourne Touring Opera and the D'Oyly Carte. The programme also includes children's shows, individual artists and commercial shows.

The Operational Report and Business Plan requires the acoustic of the auditorium to be suited to a wide range of uses. The report identifies that for this to be made possible the acoustic will need to be variable.

Variable Reverberation Time

Analysis of the projected uses of the Lyric Theatre, in terms of



View of the Lowry from outside (Credit Duffie White)

their duration over a typical year, and in terms of generally accepted RTs of auditoria for different uses, revealed that two acoustic conditions would be needed [3], [4]. One condition is where the RT would be around 1.3 seconds, (suitable for opera etc) and one where a shorter RT of around 1 second would be more appropriate (for speech). The acoustic design of the Lyric Theatre therefore makes provision for the variation of the reverberation time.

The change in RT is achieved by the deployment or retraction of 600 m^2 of absorption in the form of curtains above the acoustically transparent ceiling line. The curtains are located on 6 separate tracks and are electrically operated. Curtain boxes are provided so that when retracted, no curtain area is left exposed to the theatre.

Auditorium Ceiling

Like other modern and well equipped theatres, The Lyric Theatre of the Lowry is a complex technical space where the integration of many requirements is essential. For example the architecture and aesthetic requirements must be co-ordinated with stage lighting, effects lighting, environmental comfort and of course the acoustic considerations.

The Lyric ceiling plays a key role in the integration of these requirements. It is particularly important in achieving the acoustic requirements specified in the client's brief and in delivering the architect's concept and intimacy for the space.

The ceiling is a suspended perforated metal and mesh surface above the seating which is intended to provide a visual, but not an acoustic, barrier which hides the technological necessities of the theatre that are situated above it. It is a complex shape comprising many overlapping 'petals' each of which is designed to be a flat surface. A lighting arrangement between the petals washes light across their surfaces, the result of which would be to make these acoustically transparent surfaces appear solid when lit. An orthogonal wire mesh in the central area towards the proscenium is intended to provide a visual screen that would hide the lighting bridges above when light is shone across its surface. An area of the ceiling towards the back of the theatre is hinged to allow it to be raised to allow the follow spot above the ceiling surface to light the stage.

The percentage open area of the petals was of particular concern and we tested perforated metals sheets having varying degrees of openness [5] to see how they would behave in the frequency range of interest. For the reasons already mentioned the architect was keen to use panels having the lowest percentage open area compatible with the acoustic requirements.

Eventually we agreed that a perforated metal having an open area of 36% would be acceptable. However, the open area of the ceiling as a whole, ie that of the perforated metal petals and the mesh, would be substantially greater.

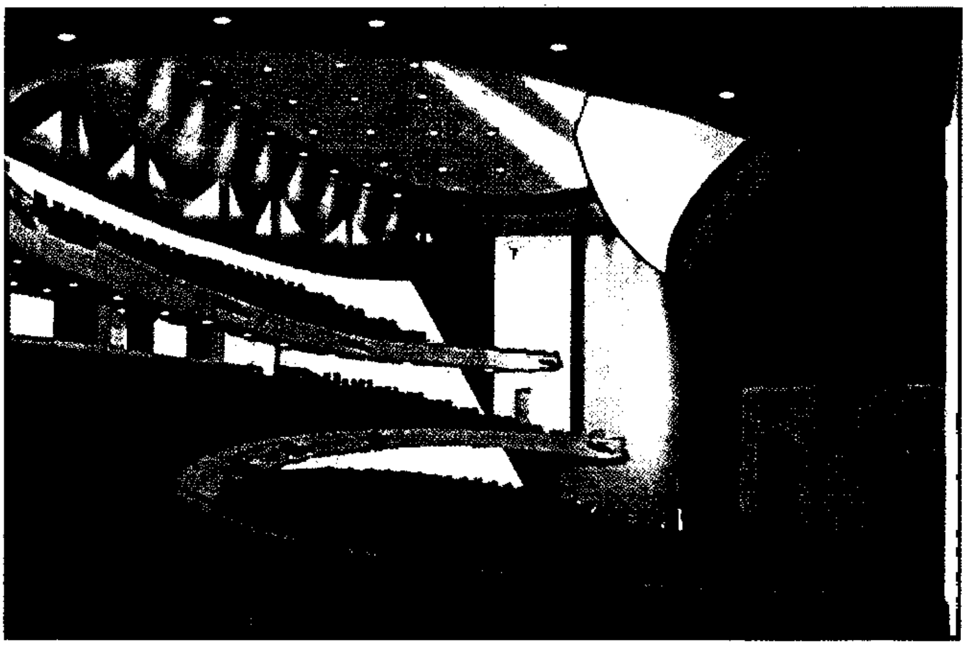
The large quantity of metal forming the ceiling gave concern over the possibility of rattling and resonances in the petals, mesh, support structure and interfaces. The contractor has been made responsible for ensuring that the ceiling does not rattle or produce any attention catching noise. To assist in achieving this, there should be no metal to metal contact – neoprene rubber forms a boundary layer.

To allay concerns over rattling even further, full size mock-ups of each element have been built and tested together with the support structure.

Reflectors

The architectural 'cheeks' on either side of the proscenium have been designed to maximise early reflections. The 'cheeks' are convex and extend full height.

Acoustic reflectors are also provided on the underside of the lighting bridges and above the forestage. These are all above the mesh and perforated metal ceiling and the intention is that they should not be visible from the seating area.



The Lyric Theatre

Orchestra Pit

Particular consideration has been given to the orchestra pit to ensure that excellent conditions are provided for the orchestra. The pit can be varied in size by the use of two elevators. At its maximum it will accommodate up to 90 musicians. Low frequency absorption is provided in the pit to control resonances, and the pit overhang is relatively small, being just 3 m.

Mechanical Services

The background noise criterion for the theatre has been set at NR20. The mechanical services design employs a combination of underseat pedestal diffusers together with low velocity diffusers on the step risers. Extract is provided through the 'crinkle' wall above the visual ceiling line.

The main supply plant for the theatre is located on the top floor of the adjacent tower building, and is ducted through very large builders work shafts into the underseat plenums. Extract plant is located at high level to the sides of the theatre and ducted behind the 'crinkle' wall.

Smoke extract is provided by a ducted mechanical extract system attenuated to maintain the sound insulation of the fly tower.

Sound Insulation

The current external noise environment is not excessively high, but the site is on a flight path. The predicted peak traffic flows on the new roads along the quayside are quite high and ships do occasionally use the adjacent canal.

The shell to the theatre is primarily 200 mm thick reinforced concrete. Around the theatre are buffer zones comprising quiet areas (such as storage rooms). Door lobbies to circulation areas are provided to maintain the sound insulation. The roof to the theatre is concrete with a heavy plasterboard skin supported off the bottom of the roof trusses.

The Lyric theatre is separated from the Adaptable Theatre by two sets of large 55 dB doors either side of a shared scenery store. There is a structural movement joint in the floors and walls separating the two sides of the building. The level of sound insulation provided between the two theatres will allow for the simultaneous use of both with no disturbance in either.

References

[1] L G HASLAM, The Acoustic Design of the Edinburgh Festival Theatre, ProcIOA, Vol 17, Part 1, (1995)

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[4] L BERANEK, *Concert and Opera Halls: How they Sound*, Acoustical Society of America, New York, (1996)

[5] *Acoustical Uses for Perforated Metals*, Industrial Perforators Association Inc.

Acknowledgements

The authors would like to thank the architects, Michael Wilford and Partners, for their help and information used to prepare this paper. Thanks are also due to Alex Burd for his guidance and help throughout the development of the acoustic design.

The authors are acoustic consultants with Sandy Brown Associates, 1 Coleridge Gardens, London NW6 3QH, UK, and 16 West Terrace, South Queensferry, EH30 9LL. Sandy Brown Associates members of the Association of Noise Consultants

This is a revised version of a paper they gave at the IOA Conference in Manchester in October 1999. ❖

MEETING ANNOUNCEMENT

One - Day Meeting

SHAKING ALL OVER

Organised by the Measurement and Instrumentation Group

The Royal Society, London

Tuesday 27 June 2000

This meeting builds on the successful One-Day Meeting 'Getting a Grip on Hand-Arm Vibration' held in June 1999, but seeks to widen the range of topics addressed by including aspects of whole body vibration and the medical problems that can arise, as well as Hand-Arm vibration. Several of the presenters are returning to repeat their original presentations with updates, and other invited authors will discuss the extra subject areas. The meeting will also feature an exhibition of relevant instrumentation.

The interest in human response to vibration and the problems that arise has never been greater. With industrial injury claims increasing and legislation being considered, vibration may well take on the same degree of measurement importance as noise has done in recent years. The Institute of Acoustics is seeking to improve the practice of vibration measurement through a new Certificate of Competence and this One-Day meeting will be of interest to all who either have a responsibility for measurement and assessment or are soon to be involved in this field.

Presentations will include:

Measurement and Evaluation of Human Exposure to Hand-Transmitted Vibration - Recent Work on International Standards *Chris Nelson, Health and Safety Executive*

Measurement Uncertainty in the Evaluation of Hand-Arm Vibration Exposure in the Workplace - an Introduction to ISO 5349-2 *Paul Pitts, Health and Safety Laboratory*

Vibration Measurement and Risk Management for a Public Utility - A Case Study *Iain Critchley, Peninsular Acoustics, and Stephen Barnes, RPS Consultants*

Practical Vibration Assessments, Accuracy and Repeatability *Kenneth Hill, Glasgow City Council*

Frequency Analysis for Hand-Arm Vibration Measurements *Tim South, Leeds Metropolitan University*

Power on the Land - An Environmentally Unfriendly Handshake *Richard Stayner, RMS Test Laboratory*

Assessing Vibration White Finger and Other Vibration Related Problems *Dr I J Lawson, Rolls-Royce plc*

Experience in Assessing Instruments Against ISO8041 'Human Response to Vibration – Measuring Instrumentation' *Liz Brueck, Health and Safety Laboratory*

Certificates of attendance will be available for CPD purposes. The meeting will be followed by the Measurement and Instrumentation Group AGM.

SHAKING ALL OVER - Tuesday 27 June 2000

Name:

Address:

Tel: Fax: email:

Please register me as a delegate.

- ☐ Fee for Authors & Members £95.00 + VAT £116.63
- ☐ Fee for all others £125.00 + VAT £146.88
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CALLS FOR PAPERS

Autumn Conference 2000

INDUSTRIAL NOISE

Organised by the Industrial Noise Group

Stratford Victoria Hotel, Stratford-upon-Avon
10 - 12 November 2000

Meeting Organiser: Jon Richards AMIOA, M W Kellogg

Papers, exhibitions and practical demonstrations on industrial noise are sought in the following general areas:

- Obtaining meaningful noise data
- Low noise design (innovative noise control)
- Nonauditory issues (such as alarms, communication)
- Environmental noise from industrial sources
- Education and training techniques
- Prediction and control of noise transmission
- A management approach to workplace noise and vibration
- Hearing and its protection

Please send abstracts of not more than 200 words, on these or any other industrial noise topics to the Institute office to arrive by 22 May 2000.

16th Residential Week-end Conference

REPRODUCED SOUND 16

Organised by the Electroacoustics Group

this year's theme

Sound Reinforcement

Stratford Victoria Hotel, Stratford-upon-Avon
17 - 19 November 2000

Technical Programme Committee Chairman: Robin Cross FIOA

Papers sought on topics relating to the following:

- Loudspeakers
- Intelligibility
- Signal processing
- Auditorium design
- Multidimensional sound
- Environmental impact

Abstracts of not more than 200 words to the Institute office by 19 May 2000. Notification of acceptance will be mailed by 31 May 2000. Final written papers for the proceedings must be received by 30 September 2000.

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CALLS FOR PAPERS

Underwater Acoustics Group Conference

ACOUSTICAL OCEANOGRAPHY

Southampton Oceanography Centre, 9 - 11 April 2001

The programme of this important international conference will include these Invited Addresses:

- The Coastal Environment *G B Deane (Scripps Institute of Oceanography, USA)*
- The Upper Ocean *D M Farmer (Institute of Ocean Sciences, Canada)*
- Acoustical Oceanography in Perspective *G J Heald (Defence Evaluation & Research Agency, UK)*
- Biological Sensing *D V Holliday (Tracor Aerospace, USA)*
- Environmental Impact *A D Heathershaw (Defence Evaluation & Research Agency, Southampton Oceanography Centre, UK)*
- Seabed Scattering *P C Hines (Defence Research Establishment Atlantic, Canada)*
- Ocean-Scale Acoustics *M D Porter (Science Applications International Corporation, USA)*

Offers of contributed papers are sought and abstracts of less than 200 words should be submitted by 20 April 2000, preferably by email to ac_oc@isvr.soton.ac.uk, stating whether an oral or poster presentation is intended. Successful authors will be notified during May 2000 and notification of acceptance of the full copy of the paper will be made during Novemebr 2000. The final manuscript must be received by 15 December 2000. Up-to-date information can be found at http://www.isvr.co.uk/dept/CONFEREN/INDEX.HTM.

MEASUREMENT OF SOUND POWER

NPL Teddington, 24 October 2000

Contributions to this one-day meeting are sought on all aspects including:

- Determination by Measurement of Sound Pressure or Sound Intensity
- Measurement Techniques
- Specifications and Implications of EU Directives
- Measurement Standards and Test Codes
- Declaration of Sound Power Levels

Contact: Peter Hanes MIOA, NPL, Teddington TW11 0LN Tel: 020 8943 6316 Fax: 020 8943 6217 e-mail peter.hanes@npl co.uk

MEMBERSHIP

The following were elected to the grades shown at the Council meeting on 23 March 2000

Fellow
Heald, G J
Stoneman, S A T

Member
Bentley, C F
Callingham, A J
Clarke, G
Dobson, C J
Dodd, A P
Dolan, A P
Elliott, A G
Finch, K
Fritsch, H B R
Ginnity, B M
Hassett, M J
Haynes, W E
Henderson, A M
Hetherington, A J
Higgins, A S
Irwin, A J
Kerr, N
Lo, K W
McCarthy, G A
Moch, S W
Morgan, B C
Ng, C W W
Parkin, A J
Pickford, S A
Richards, J K
Scarbrough, P H
Scott, S C
Stones, I
Taherzadeh, S
Thomas, S J
Thorne, R
Traexler, A P
Wallace, R

Associate Member
Barnes, A T
Bowland, G M
Brooks, R A
Burton, N J S
Coxell, S C
Davies, M T
Foord, L D
Holmes, I P
Howes, T A
McLaughlin, D P
Meachin, A S
Newman, K J
Scott, S M
Sutton, A L
Tarbert, A P
Taylor, S J
Van Buuren, G L
Walker, P G

Associate
Boyd, K M
Hanlon, R J
Hunt, D
Maddock, P

Student
Mate, S R

INSTITUTE DIARY 2000

17-18 APR
Spring Conference
Acoustics 2000
University of Liverpool

17 APR
Building Acoustics Group AGM
Liverpool

9 MAY
Professional Development Committee
St Albans

11 MAY
Meetings Committee
St Albans

12 MAY
IOA CofC in W'place Noise Exam
Accredited Centres

18 MAY
Publications Committee
St Albans

22 MAY
Engineering Division Committee
St Albans

23 MAY
Electroacoustics Group AGM
St Albans

24 MAY
1-Day Meeting: Sound Insulation After Baxter and Mills, London Branch meeting
London

25 MAY
Membership Committee
St Albans

1 JUN
IOA CofC in W'place Noise Committee
St Albans

6 JUN
Executive Committee
St Albans

8 JUN
Distance Learning Sub-Committee, Education Committee
St Albans

9 JUN
IOA CofC in Env Noise Measurement Exam
Accredited Centres

15-16 JUN
IOA Diploma Exams
Accredited Centres

20 JUN
Diploma Tutors Meeting
St Albans

22 JUN
Medals & Awards Committee, Council
St Albans

27 JUN
1-Day Meeting: Shaking All Over, Measurement and Instrumentation Group Meeting
London

4 JUL
Professional Development Committee
St Albans

6 JUL
Meetings Committee
St Albans

13 JUL
IOA CofC in Env Noise Measurement Committee
St Albans

7 SEP
Meetings Committee
St Albans

14 SEP
Publications Committee
St Albans

21 SEP
Distance Learning Sub Committee, Education Committee
St Albans

22 SEP
IOA CofC in Sound Transmission Within Buildings Exam
Accredited Centres

25 SEP
Engineering Division Committee
St Albans

26 SEP
Membership Committee
St Albans

28 SEP
Executive Committee
St Albans

5 OCT
Medals & Awards Committee, Council
St Albans

6 OCT
IOA CofC in W'place Noise Exam
Accredited Centres

17 OCT
Professional Development Committee
St Albans

19 OCT
IOA CofC in Sound Transmission Within Buildings Committee
St Albans

24 OCT
1-Day Meeting: Measurement of Sound Power, Measurement and Instrumentation Group Meeting
NPL Teddington

26 OCT
Publications Committee
St Albans

27 OCT
IOA CofC in Env Noise Measurement Exam
Accredited Centres

2 NOV
IOA CofC in W'place Noise Committee
St Albans

10-12 NOV
Autumn Conference Industrial Noise, Industrial Noise Group Conference
Stratford upon Avon

17-19 NOV
Reproduced Sound 16
Electroacoustics Group Conference
Stratford upon Avon

19 NOV
Meetings Committee
St Albans

20 NOV
Engineering Division Committee
St Albans

23 NOV
Membership Committee
St Albans

28 NOV
IOA CofC in Env Noise Measurement Committee
St Albans

30 NOV
Distance Learning Sub-Committee, Education Committee
St Albans

5 DEC
Executive Committee
St Albans

7 DEC
Medals & Awards Committee, Council
St Albans

EDUCATION

Certificate of Competence in Workplace Noise Assessment

The following were successful in the February 2000 examination

Bristol
Baker, F M
Darling, S J
Godfrey, T P
Harris, S E
Lee, C D

Colchester
Adams, M R
Beane, T
Chandler, N A
Collins, E
Davies, R
Jessup, B
McGarrigle, J
Richardson, D A
Waine, D M

Staffs
Boyd, D M
Butler, S M
Turner, P J
Wilkes, D J

LEEDS METROPOLITAN UNIVERSITY – DESIGN & BUILD OF NEW ACOUSTIC LABORATORY SUITE

Philip Durell AMIOA

Introduction

Leeds Metropolitan University (LMU) is a well established and respected centre for education in acoustics. This is a brief account of the building of their new acoustic facilities.

The existing acoustic laboratory at LMU consisted of a large reverberation chamber coupled onto an anechoic chamber. A transmission panel was present between the two chambers but, in order for the chambers to be used for transmission tests, all of the anechoic chamber wedges had to be removed first! Also present were an audiology booth and a workshop area. However, these premise were reaching the end of their serviceable life and additionally, the entire laboratory had recently been flooded and so an alternative site was required.

Thanks to an unexpected grant, enough funding was available to refurbish an entire section of the 9th floor of C Building on Caverly Street, with a number of classrooms able to be converted into an entire acoustics laboratory suite. The move to a more elevated position was welcomed by all in light of the recent flooding incident.

The proposed new suite would consist of a large reverberation chamber, coupled to a small reverberation chamber as a transmission test facility, an anechoic chamber, an audiometry booth, a human acoustics area, a phonetic room and a general workshop area. The layout for the new suite is shown on Figure 1.

The aim of this report is to present a brief account of the design process to ensure that performance specifications were met, but more importantly to highlight the practical elements of the project, assisted by the use of photographs

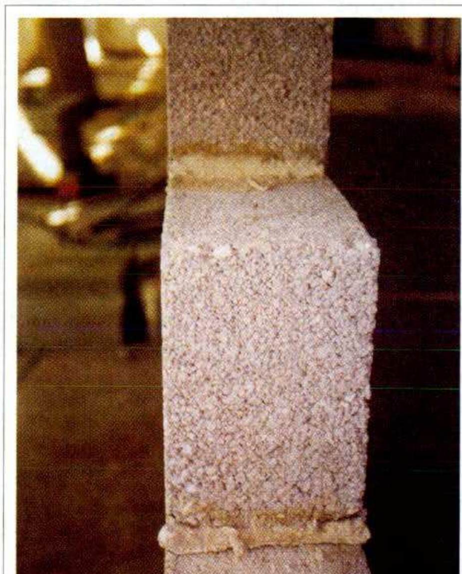


photo 1

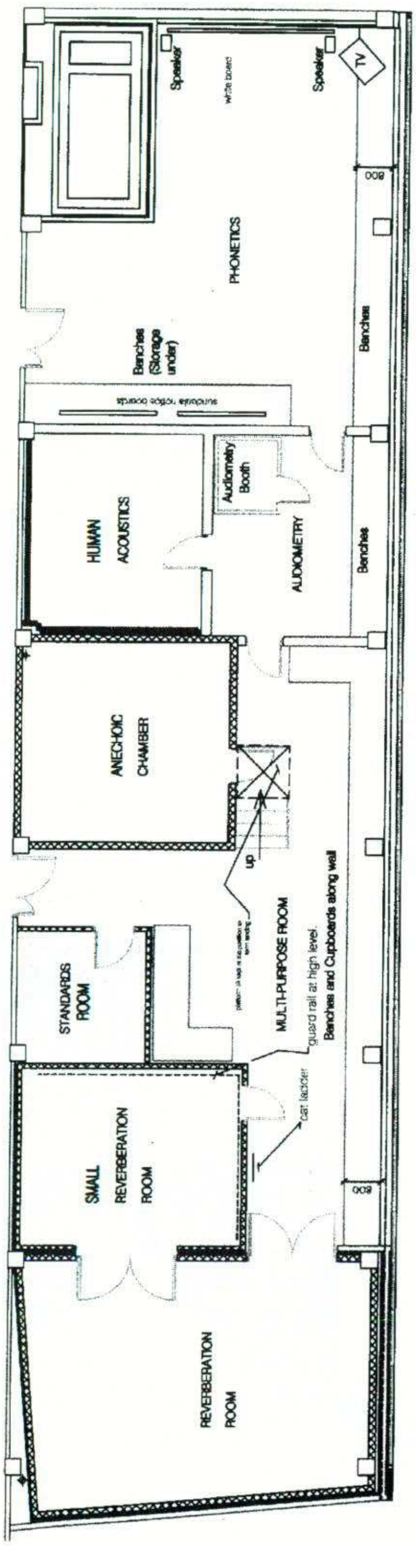


Fig. 1

taken during site inspections. The entire project has been documented as part of my MSc dissertation, however for the purpose of this article I will concentrate purely on the construction and performance of the two reverberation chambers.

Design Criteria

Philip Dunbavin Acoustics Ltd (PDA) were approached to ensure that the acoustic performance targets of the new suite were successfully met.

The fundamental acoustic design aims were largely based on the performance of the existing facilities and compliance with international standards.

Large Reverberation Chamber

The main design criteria for the large chamber were as follows:

- Volume to be a minimum of 200 m^3 to ensure accurate measurements can be made down to 125 Hz octave band or 100 Hz third octave band as per BS 4196 Part 1.
- Reverberation Times:

100 Hz to 630 Hz	greater than 5.0 seconds
800 Hz to 2500 Hz	greater than 4.0 seconds
3150 Hz to 5000 Hz	greater than 2.5 seconds
6300 Hz to 8000 Hz	greater than 1.0 second.

- Maximum acceptable background noise levels to be the same as measured in the existing chamber.

Small Reverberation Chamber

- Maximum acceptable background noise levels to be the same as for the large reverberation chamber.
- Reverberation Times to be as close to, but not to exceed 2 seconds.

Initial Survey Work

A background noise and vibration survey was conducted in order to determine the feasibility of the proposed project. As expected, noise from road traffic was virtually inaudible on the ninth floor, with the main sources of noise being wind noise and occasional overflying aircraft.

photo 2

photo 3

However, a certain amount of low frequency structure-borne noise was detected as a result of operation of the lifts. The effect of this lift vibration noise meant that without suitable remedial measures, the background noise level within the large reverberation chamber would exceed target. However, the only solutions would have been to either prevent the lifts from being used, introduce a vibration break to the structural slab or to construct the entire chamber off a floating slab. Unfortunately, the structural strength of the building would not have been able to cope with the loading of floating slab of the magnitude required and the other options were completely impractical.

It was therefore agreed, that since the large chamber would be the source room for any transmission tests, that a higher level of background noise would be acceptable.

This therefore meant that the small reverberation chamber, ie the receiving room, must be fully isolated from the building structure and also from the large chamber in order to avoid coupling and noise transmission due to flanking. The solution to this was to build the small chamber off a floating slab.

photo 4

Design Specification

Large Reverberation Chamber

To prevent the build up of standing waves, the chamber was constructed with opposing walls and ceiling built at a 5° angle in order to present the sound source with non parallel surfaces throughout. This was a detail that caused considerable consternation to the man who was fitting the wooden framework for the ceiling. Apparently, after agonising for hours since he believed that the chamber would need to be rebuilt, he finally sum-

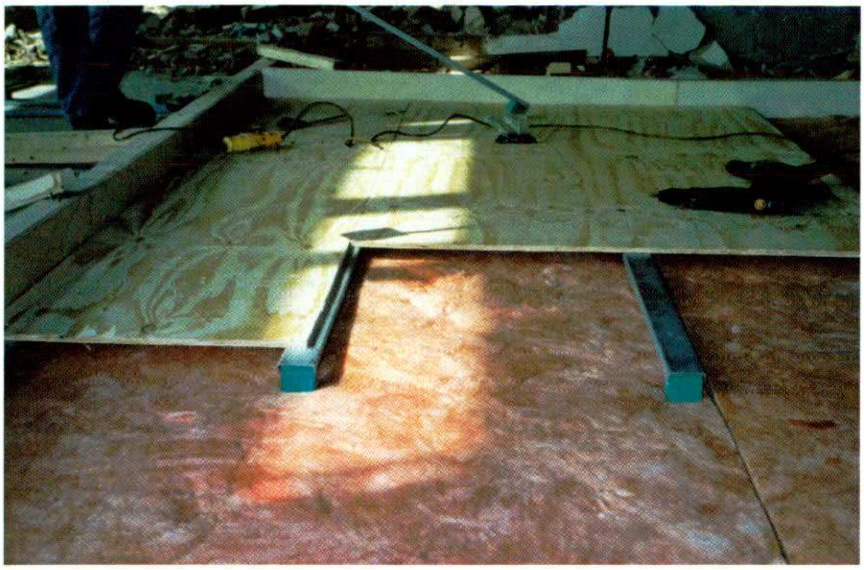


photo 5

photo 6

photo 7

moned up the courage to point out to the site manager that some idiot had not built the room square!

Engineering constraints due to structural limitations mean that the roof of the chamber could not be concrete. Therefore, a twin layer plasterboard ceiling with a minimal void was constructed. A 25 mm layer of sand puggin was fitted into the void in order to introduce mass to the system and to prevent the ceiling acting as a panel absorber.

Small Reverberation Chamber

- To be built off a 100 mm reinforced concrete floating slab with a 50 mm air gap.
- The roof of the chamber must be accessible to enable impact sound insulation tests to be conducted by students. Therefore, the roof was designed to try to recreate the construction of a typical floor, without compromising the performance of the chamber.
- The roof construction consisted of 18 mm thick floor grade chipboard on 50 x 195 floor joists with 80 mm Gypglas 1000 infil with MF5 ceiling section with 12.5 mm thick Gyproc wall board and skim.

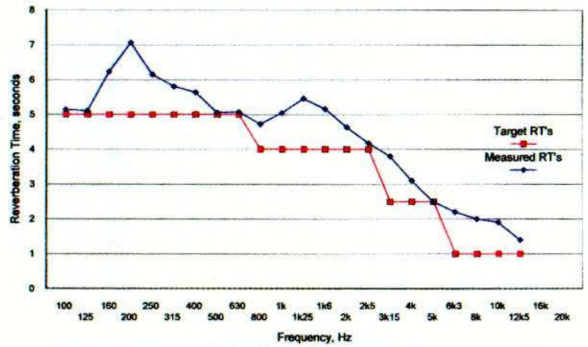
Material Selection and Build Quality

The fundamental construction for all of the chambers was a solid blockwork wall. Good quality blockwork is vital to the acoustic performance of any normal wall, but is absolutely paramount in the construction of any chamber within an acoustic laboratory. Correct block selection is the key, with all blocks being complete with no cracking or pitting. Mortaring must be to an almost fair-faced standard with joints being completely filled. Photograph 1 shows a fully mortared joint.

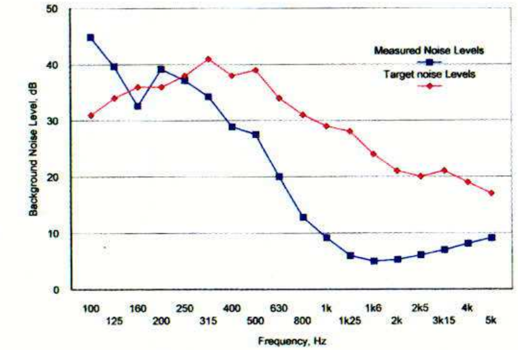
However, problems can still occur even with correctly filled joints. Photograph 2 shows a joint where the mortar has been subject to shrinkage, through no fault of poor workmanship. Although this doesn't appear to be a major problem, photograph 3 shows that the gap extends for over 80 mm, almost the entire depth of the block!

Laboratory Construction

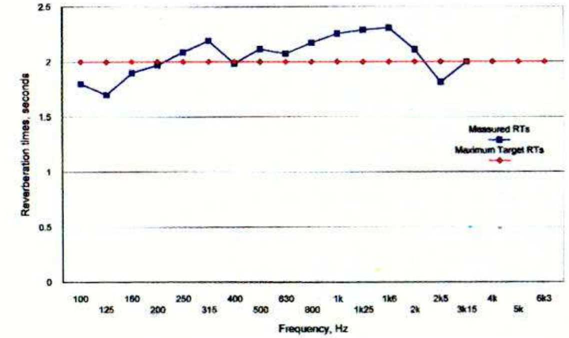
Photograph 4 shows the initial construction of the floating floor for the small reverberation chamber. This photograph highlights the difficulties associated with



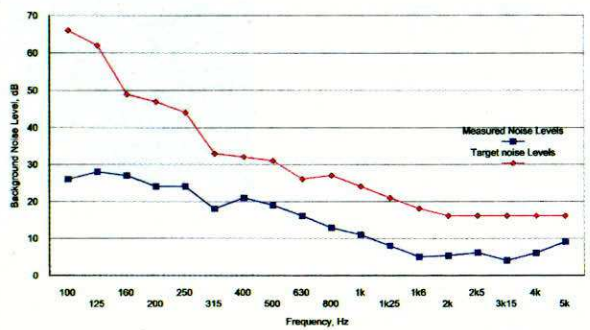
Graph 1. Large reverberation chamber, reverberation times



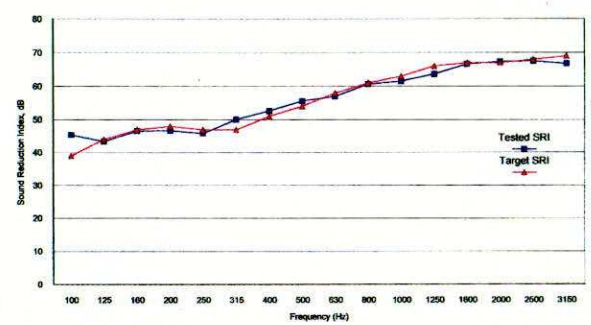
Graph 2. Large reverberation chamber, background noise levels



Graph 3. Small reverberation chamber, reverberation times



Graph 4. Small reverberation chamber, background noise levels



Graph 5. Party wall between large reverberation chamber and electrical repair room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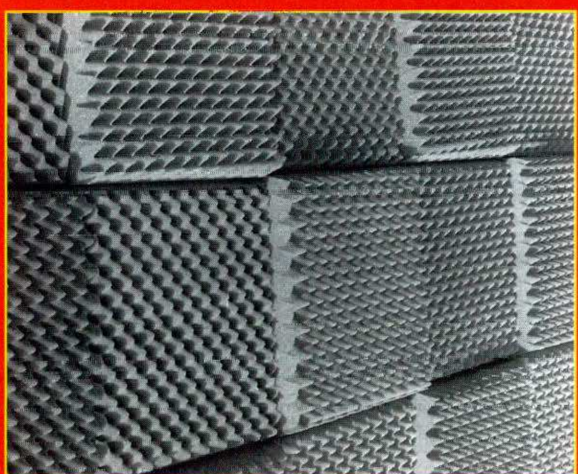


photo 8

ensuring that debris does not accumulate and bridge the isolation system. However, photograph 5 shows that the floor installation was clean. This photograph also underlines the importance of site inspections at critical phases of the construction. In this case, if the inspection had been performed a day later, the floor would have been complete and ready for the pour, as shown in photograph 6. In which case, the only proof that would exist that the installation was clean, would be the word of the installers!

Photograph 7 shows the pouring of the concrete slab. The concrete could not be pumped up to the ninth floor, and so the only alternative was to use barrows.

Unfortunately, the lift could only accommodate two barrows at a time and therefore the pour took approximately five hours! A point worthy of note on this photograph, is the use of a protective boarding placed on the reinforcing steelwork, to ensure that the spacers were not damaged as a result of a direct point load.

Photograph 8 shows blockwork built off the floating slab, with a good clean cavity present thereby ensuring complete isolation.

Photograph 9 shows the ongoing construction of the small and large reverberation chambers approaching completion. Note the good quality of blockwork throughout.

Test Results

Graphs 1 – 4 detail the RTs and background noise levels present within the two reverberation chambers.

Graph 1 shows the RT of the large chamber and it can be seen that the performance criteria has been met or exceeded in all third octave bands. However, slightly longer times were expected at the lower frequencies and it is likely that the reason for the RT drop off is a result of the ceiling acting as an absorber despite the sand puggin.

Graph 2 shows the ingress of low frequency noise as predicted, from structural vibration from operation of the lifts. However, the level of noise is not excessive and does not restrict the capabilities of the laboratory.

Graph 3 shows the RTs for the small chamber. It can be seen that the maximum target value is exceeded in the majority of frequency bands. This was intended, with the view that additional absorption could be introduced in order to 'fine-tune' the chamber.

In practice, this additional absorption is in the shape of an additional student, since students work in pairs within the chamber. The background noise levels within the chamber are shown in graph 4. On comparison with graph 2 the isolation effect of the floating floor is apparent, and demonstrates that the floor is performing correctly with no breaches in the isolation existing.

Graph 5 details the Sound Reduction Index (SRI) of one of the walls of the large chamber. This wall was tested for practical reasons since it was the only non-composite façade.

The results for this wall performance show almost an exact match between the tested and target values and are testament to the high quality of workmanship that existed throughout the project.

Philip Durell is an Acoustic Consultant at Philip Dunbavin Acoustics, Vincent House, 212 Manchester Road, Warrington WA1 3BD who are members of the Association of Noise Consultants. ❖

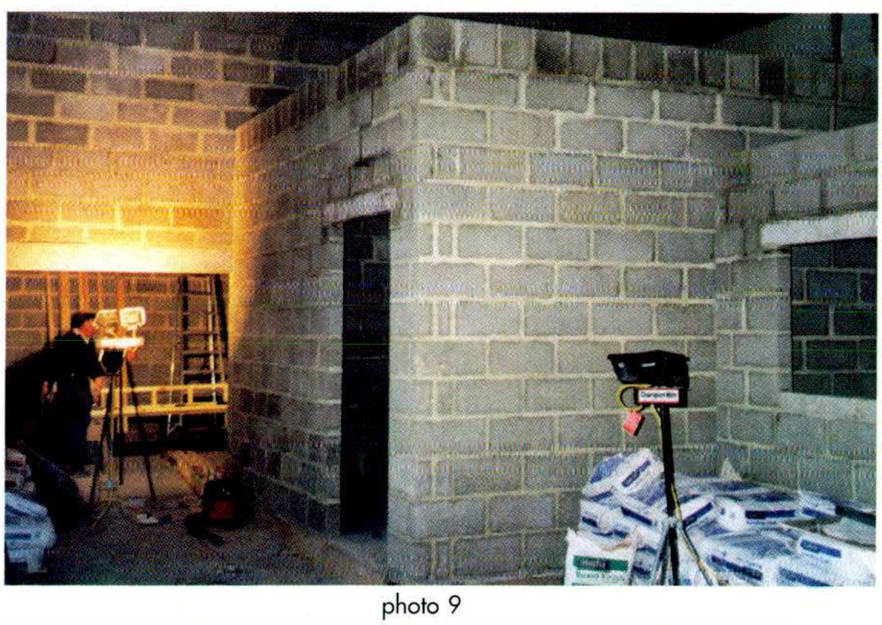


photo 9

SPEECH PRODUCTION AND AUTOMATIC SPEECH RECOGNITION

The University of Birmingham, 14 January 2000

For over a decade statistical methods, and in particular Hidden Markov Models (HMMs), have dominated research in automatic speech recognition. This has led to impressive progress in terms of accuracy and vocabulary size and also to the emergence of the current generation of commercial large vocabulary dictation systems. Although mainstream research continues to focus on HMMs, a number of new approaches to speech pattern modelling have been proposed which, implicitly or explicitly, attempt to include a production-based representation of speech which regulates the relationship between the symbolic and acoustic descriptions. In principle, this production-based representation provides a superior domain for modelling speech dynamics and characterising speaker differences.

The purpose of this one-day Speech Group meeting was to provide a forum for discussing related research in speech production and automatic speech recognition. The meeting began with three invited presentations. Christine Shadle (University of Southampton) started the meeting with a talk entitled *Speech production in 10 easy lessons for speech recognition researchers*. This was followed by talks by John Bridle and Hywel Richards (Dragon Systems UK Research and Development) on their Hidden Dynamic Model approach to acoustic-phonetic speech pattern modelling, and by Mike Tomlinson (20/20 Speech) on techniques for coping with asynchrony in automatic speech recognition.

After lunch there were five short contributed papers. Simon King and Paul Taylor (CSTR, University of Edinburgh) described their work on the detection of phonological features in continuous speech using neural networks. Paula West (Phonetics Laboratory, University of Oxford) talked about the extent of coarticulation of English liquids, and Korin Richmond and Joe Frankel (CSTR) presented a paper entitled *Speech Recognition via Neural Networks, Bayesian Simulation and Electromagnetic Articulography Data*. Wendy Holmes (20/20 Speech) described her work on automatic speech recognition using models of formant trajectories. Finally, William Edmondson (University of Birmingham) discussed problems of timing in his pseudo-articulatory representation.

The meeting was well attended, with almost 70 participants. For more information, including abstracts of some of the presentations, see the meeting website: http://www.eee.bham.ac.uk/russellm/meetings/ioa_meeting.htm

Martin Russell MIOA

STOCHASTIC VOLUME AND SURFACE SCATTERING: RECENT DEVELOPMENTS IN UNDERWATER ACOUSTICS

Robinson College, Cambridge: 14–17 December 1999

Way back in 1986, the Underwater Acoustics Group ran an International Conference on Fluctuations in Underwater Acoustics. At the time, this was a major research area, not only in the field of sonar, but also in radio and radar transmission, laser propagation, and radio astronomy. The keynote speakers on that occasion included Bob Urick, who wrote the standard text book on underwater acoustics, along with Tony Hewish, one of England's leading radio astronomers and Barry Uscinski from Cambridge University, who was single handedly responsible for developing most of the mathematical theory on the subject.

Now, more than a decade later, the long overdue follow-up was held at Robinson College, Cambridge, under the satisfyingly esoteric title of *Stochastic Volume and Surface Scattering: Recent Developments in Underwater Acoustics*. The scientific expertise was provided by the afore-mentioned Barry Uscinski of the Cambridge University Department of Applied Maths and Theoretical Physics, with valuable assistance from Mark Spivack, and the Underwater Acoustics Group presence supplied by Peter Dobbins.

The highlight of the event was possibly hearing the King's College Choir singing Christmas music in the courtyard of the Eagle, one of the oldest pubs in Cambridge, but also worthy of note were two A B Wood presentations and two invited speakers.

Terry Ewart of the Applied Physics Laboratory, University of Washington, gave the opening keynote talk, entitled *Ocean Acoustic WPRM – Where are We?* For the uninitiated, WPRM means Wave Propagation in Random Media, and the talk contemplated in a philosophical way the problems that have been solved, and those that are still awaiting a solution. The second invited speaker, later in the conference, was Eric Thorsos, also from the Applied Physics Lab. His presentation was more down to earth, and talked about practical models for scattering from rough surfaces.

The A B Wood Medal Presentations were by Mike Ainslie of CORDA, New Malden, and Mark Trevorrow of the Institute of Ocean Sciences, Sidney, Canada. Despite our being adventurous by including two medal lectures, they both turned out to be relevant to the theme of the conference, Mike Ainslie's looking at the effects on underwater sound propagation of thin layers of sediment, while Mark Trevorrow's considered the importance of acoustic propagation effects on sonar echoes from fish and schools of fish.

The remainder of the contributed papers naturally congregated under a few main headings. Many of them, of course, were about scattering from the sea-bed, the sea-surface, and the volume of the ocean. These in turn were divided into the very different realms of high frequencies and low frequencies. Not surprisingly, the most interesting high frequency papers were related to minehunting, and one of the best of these was *Coherent Modelling of Wideband Backscatter from Rough Anisotropic Seabeds at Minehunting Frequencies*, presented by Richard Brothers of DERA, Bincleaves. This was primarily about attempts to generate synthetic data representing the outputs from the individual sensors in a sonar array that is statistically indistinguishable from real data.

An interesting presentation about very similar work in the low-frequency domain was given by Chris Harrison of SACLANTCEN, La Spezia, Italy, and was called *Reverberation Stimulation for Sonar Systems Assessment.* This paper touched on the important issue of validation of the synthesised waveforms as well as demonstrating a method of speeding up the calculations. Also applying to the low-frequency domain were two papers about phase conjugation, or time reversal of acoustic signals. The objective is to reconstruct the originally transmitted signal, and the hope is that the degradation due to scattering and fluctuations – the theme of this meeting – is reversible. This work originated in optics, as is apparent in the paper by Ridley, Jakeman and Jones, and is a wonderful example of the potential for cross-fertilisation between different fields which, albeit being interested in wave propagation, do not often find opportunities to interact.

Apart from the technical content of the meeting, Robinson College turned out to be a fine venue for a conference. It has the creature comforts associated with being younger than many of the Cambridge colleges by almost a millennium, but is within ten minutes walk of the city centre, and the staff treat you like a long lost friend. The meals were excellent and the Conference Dinner in particular was magnificent, and we managed to refrain from speeches afterwards.

Finally, the conference concluded with a paper entitled *A Shadowgraph Method for Ocean Acoustics* by Barry Uscinski. Despite its origin in the depths of Academia, this was about simpler, more practical approaches to the acoustic problems considered at this conference and, fittingly, finished with a question about where we go next, appropriately mirroring Terry Ewart's opening talk.

Peter Dobbins FIOA

THE ACOUSTIC DESIGN OF CINEMAS AND LARGE LEISURE COMPLEXES

National Film Theatre, London: 19 January 2000

The day started with a visit to the newly opened IMAX cinema at Waterloo. Peter Henson from Bickerdike Allen Partners (the acoustic consultant for the project) welcomed delegates and took us around the building.

It was clear that this must be the most inappropriate location for such a noise sensitive development, being literally surrounded by traffic noise (it is in the middle of a roundabout) and built over a railway. Peter was able to show us the vibration isolation joints which were used to separate the floated auditorium from the rest of the building. We were able to visit the projection room, complete with the large water-cooled projectors, as well as the 500 seat main auditorium. The screen, at 20 m x 26 m is the UK's largest.

As luck would have it, the cinema was booked for a school showing of an IMAX film about space exploration. There was unanimous agreement to using the time set aside for coffee to watch the show. After a short introduction, by a larger-than-life John Cleese, we were able to experience this amazing film. Amazing is a well-used adjective but entirely appropriate in this instance. The fact that several people started to feel a little queasy as the satellite-mounted camera floated slowly over the space shuttle was testament to the realism that is achieved.

The group then moved across to the National Film Theatre for the main business of the day. It was perhaps appropriate that a meeting to discuss cinemas was held in a cinema at the National Film Theatre. The meeting was well attended with a delegate list of more than 60.

The first paper was from Peter Henson who talked through the design issues of the IMAX. With internal noise limits of NC25 and a requirement for external noise to be 'inaudible' this was clearly a challenge. Peter described the key design features and presented some interesting data on the vibration isolation scheme and the external envelope sound insulation.

James Talbot from the University of Cambridge was the next author and he explained his PhD research into the base isolation of buildings. One outcome from this research was the proposal for isolation systems to be assessed on the basis of the power insertion gain. This looks at the effectiveness of an isolation system in relation to the vibrational power entering an isolated building rather than the simpler 'insertion loss' criteria. The research has so far been looking at natural frequency and damping of bearings with respect to the power insertion gain.

This paper was followed by a contribution from Richard Lyons of Loughborough University concerning sound insulation testing. Most cinema projects require detailed sound insulation tests as part of the handover and obtaining these in a non-ideal environment is of great interest. Richard had been looking at sound insulation testing using impulse response analysis that could be applied for this purpose. With suitable gating of signals, it should be possible to conduct tests on incomplete constructions. However, there are some riders to this approach and some further field validation will be required.

After an excellent lunch courtesy of the NFT, Alan Saunders talked through the various acoustic standards applied by the key cinema operators in the UK, including Warner Odeon Ster Century, UCI and Virgin. He also gave some interesting examples of 'before' and 'after' sound insulation test results which highlighted the dramatic effects poor workmanship can have. Included in the data was one partition which was measured at R'_w42 when initially offered for test. Sorting out leakage paths and making good the shortfall in boarding gave a broadband improvement in sound insulation lifting it up to the desired value of R'_w70.

The next paper, from Ian Thompson of Arup Acoustics, covered the construction and in-situ testing results from various partition types at two different sites, one in Birmingham and one in Bradford. Resilient ties had been used in the party wall build up for both of these projects. The presentation described the types of resilient tie that had been investigated and their costs. Laboratory tests had indicated that improvements of up to 6 dB could be achieved by using a resilient tie. The site testing showed that the performance criteria had been achieved with the ties and that there had been a useful trade-off between the use of the ties and the thickness of board used in the wall construction. The resilient ties also had the benefit of catering for the movement in the floating constructions used for these developments.

Robert Adnit from Cole Jarman Associates then talked through that organisation's extensive experiences with cinema designs in the UK, Germany and Japan. He presented a very useful summary of the various tests they had conducted on cinema party walls. With data derived from field tests of upwards of 20 different samples of each wall type, this gave a very useful insight into the 'real life' performance of different cinema wall constructions.

The afternoon concluded with a short but useful general forum where various practical issues were discussed.

The day was generally agreed to have been very successful and this was in no small part due to the excellent organisational skills of the IOA staff and Linda Canty in particular. Thanks are also due to the speakers who made the event so interesting and varied.

Nick Boulter MIOA

MEASURING NOISE OUTDOORS

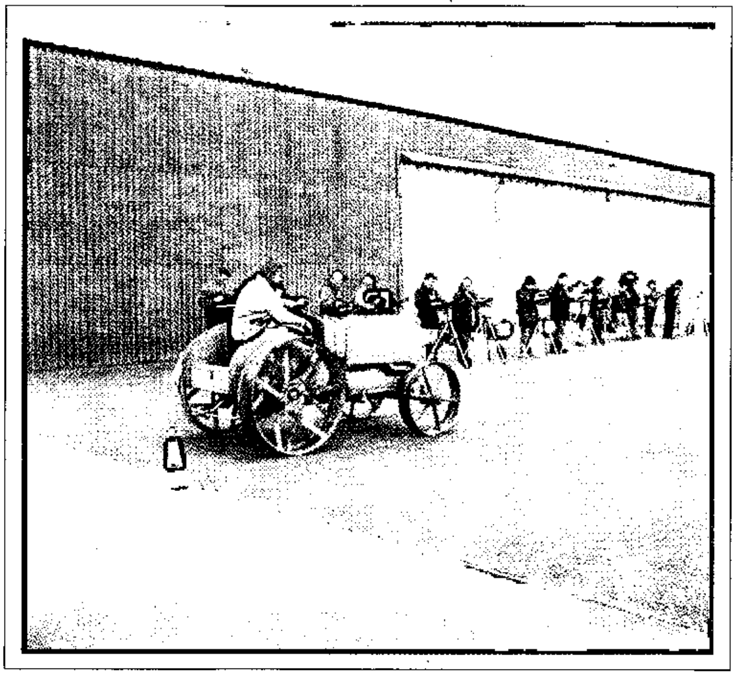
The Shuttleworth Collection, Leicestershire: 1–2 March 2000

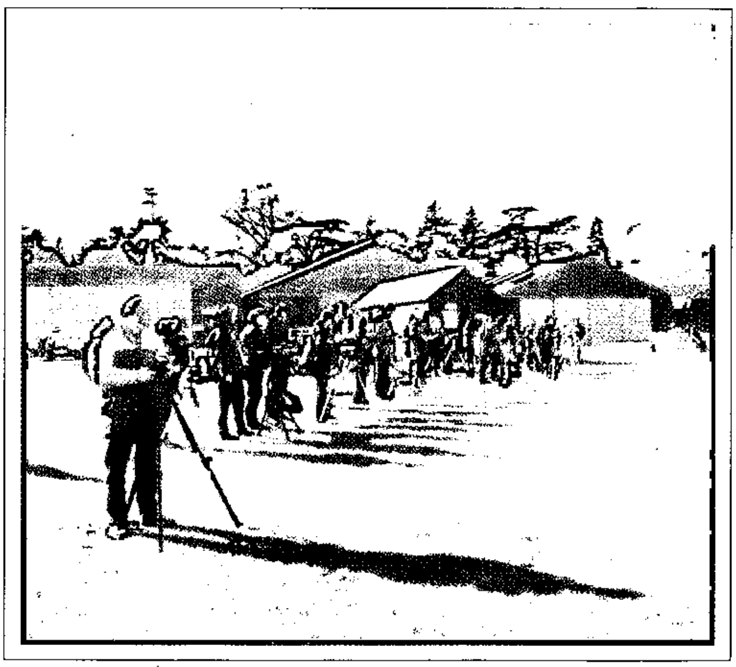
The Measurement and Instrumentation Group held its first 2 day meeting entitled 'Measuring Noise Outdoors' on the 1st and 2nd of March 2000. 34 delegates and 7 authors and organisers assembled at The Shuttleworth Collection in Old Warden, Bedfordshire where a few exhibits from the vintage aircraft and vehicle collection were to be used as noise sources for the measurement exercises. The day commenced with a lively presentation from Ian Flindell of ISVR outlining the practice and purpose of measuring outdoors, referencing many current Standards. Some provocative comments on the validity of some outdoor methodologies and whether computation could replace measurement in some applications together with examples of the accuracy likely to be achieved by measurement produced an informative and thought-provoking presentation.

The rest of the first day was spent conducting outdoor measurements. The weather was clear and sunny but with a significant wind blowing. Over 90% of delegates present had brought their own equipment in order to conduct the 5 different experiments that had been devised. The aim was to examine the spreads of measurement obtained and observe the influence of factors such as direction, reflecting surfaces and environmental conditions on what were essentially fixed noise sources. The first source used was a Tiger Moth aircraft, which was run at near maximum engine revs facing all the measuring apparatus. The plane was successively rotated at 45 degree increments around a complete circle and measures of the levels and spectral content at each position were made. The Tiger Moth was then taken 100 m and 200 m distant, pointing in the same direction each time, and the differences in readings from close by were noted. A World War 2 air raid siren was also placed in the same 3 locations and wound by hand to a near constant speed to give a highly tonal source. An additional distance of 500 m was also used which, with the prevailing wind, proved almost inaudible to most people and instrumentation. Correlation between distance and levels was to be attempted from these readings. The delegates then moved to line the taxiway outside the aircraft hangars to measure a vintage tractor with metal wheels and highly-directional exhaust outlet which was driven between the hangars and the open runway. Measurements were taken both facing the hangars and with the equipment close to, but facing away from, the hangars with the tractor driving past at constant speed to observe both the effects of the source and the hangars. Finally, the tractor was replaced with a small truck, which was driven past at a variety of speeds with the same measurement positions. The use of SEL to assess different traffic conditions was the theme of this experiment.

The inevitable rain showers stayed away until everyone came indoors to receive a guided tour of the Shuttleworth collection from two very knowledgeable guides before the delegates moved on to the Swan Hotel in Bedford to document and complete the measurement exercises.

The second day opened with an analysis of the measurements taken on the previous day. Martin Armstrong





(Brüel & Kjær) attempted to analyse the various results and correlate them with the observations he had made during the measurement session. A very diverse set of answers were often presented, but, allowing for the wind and the space that over 30 sets of equipment occupied when measuring the same source, some reasonable agreement could be seen, especially with regard to the effects of reflection from the hangars, where a 2 dB rise seemed observed by almost all those nearer the buildings. Time did not permit every answer to be scrutinised, and it is expected that a fuller analysis of this data will the subject of a separate article in Acoustics Bulletin in due course. The data is also being made available to Geoff Kerry at Salford University as part of his work writing a Good Practice Guide for the DTI on the assessment of uncertainties in the measurement of environmental noise. The spread of answers produced, often over 10 dB, indicated that thought and care about factors that influence the accuracy of outdoor measurements should be taken, and many delegates seemed surprised at the wide spread produced.

The remainder of the day was occupied by presentations. Andrew Bullmore (ISVR) presented information on measuring noise propagation from wind turbines in various locations that he and Karl Simpson (Hoare Lee & Partners) had been involved with. With the increasing use of renewable energy sources being urged, these devices are likely to become increasingly common, and obtaining accurate measurements of their effects was shown to be a complex undertaking.

Fran Buckle (DTI) then gave an update on the proposed European Directive on Noise Emissions of Equipment Used Outdoors and the requirements for measuring and labelling some 57 different items, (including wheelie-bins, which are now to come under this legislation). It has, however, still to be decided who will enforce this legislation in the UK when it passes into law, expected later this year.

Richard Bines (Sharps Redmore Partnership) then gave examples of Environmental Noise Impact Assessments including rifle ranges and 24 hour factory operation close to domestic accommodation. Practical advice on the assumptions used and their correlation with measurements was given. The meeting concluded with Chris Wood (Stanger Science and Environment) giving some practical advice on construction site measurements. With the benefit of Chris's first hand experience, the difficulties of balancing the needs of the builders with those of the community local to the site, often with no need of measurements at all, were carefully analysed and some methods of achieving the different requirements given.

The meeting topic was wide-ranging and 2 days can never do full justice to all facets of outdoor noise measurement. Nevertheless, the delegates learnt that the variability of results that can be obtained in fairly typical measurements is such that it may be unwise to quote the measurement results to 0.1dB resolution when measuring noise outdoors.

Richard Tyler FIOA, Chairman M & I Group ❖

THE INSTITUTE DIPLOMA EXAMINATION 1999

Professor Keith Attenborough FIOA

The numbers of candidates gaining Merits (M), Passes (P) or Fails (F) in each Module are shown for each centre in the Table of Results. The total number of candidates was 183 (150 entered in 1998). There were 114 candidates for Noise Control Engineering (NCE), 109 for Law & Administration (L&A), 53 for Architectural and Building Acoustics (ABA), 61 for Transportation Noise (TN), 7 for Vibration Control (VC), 5 for Sound Reproduction (SR) and 7 for the Measurement paper (M). The project numbers include November submissions. Candidates who have not submitted their project reports are shown as failed in the Table.

This was the second year of standardized coursework assignments and the first using the new relative weighting of 70/30 for written examination/continuous assessment. There is no doubt that this has helped some candidates to pass the GPA module. Questions 5 and 7 on the GPA paper caused some problems but despite these, and perhaps as a result of the increased weighting on coursework (30%) and standardised assignments this year, the overall performance on the GPA module in 1999 lies between those in 1997 and 1998.

The mean marks on the GPA, Transportation Noise, and ABA papers were roughly comparable. However the mean marks for the Noise Control Engineering and Law & Administration papers were significantly lower. It is clear that the Law & Administration and Noise Control Engineering Papers were found to be particularly difficult this year. On the assumption that this year's cohort of students is not much different from previous years, but that these papers were relatively difficult, low pass and merit marks were adopted at moderation.

In the GPA paper, the question on calculation of sound pressure level in a room from sound power and RT, was the most popular question and answered fairly well despite the fact that the question text omitted the sound power level of the source. The missing information was conveyed to all centres during the examination. Although it was received late at some centres, the mean mark gained by candidates for this question was second highest of all.

Questions about measurement/L_{Aeq} and the hearing mechanism respectively were popular. The question about sound level meter specifications had the lowest mean mark. The question about standing wave ratios, although straightforward, was least popular. The mean marks for NCE questions concerning dissipative and resonant absorption and reverberation and noise exposure in a factory, respectively, were smaller than those for the other questions. The latter question had the lowest mean mark, while being second most popular.

Distance Learning students (yet again), together with those at the Derby, Ulster and North East London (CoNEL), performed relatively well on the GPA paper this year. The DL programme for the Diploma has been kept in place by makeshift arrangements in 1999. Centres have been created where tutors were available and arrangements were made for two 2-day laboratory sessions at Liverpool. All those concerned, particularly Bob Peters, Linda Canty, and Andy Moorhouse, are to be congratulated on the DL results.

The IOA Diploma prize for overall performance (4 merits including project) has been awarded to a DL student, Mr Meachin. Special commendations have been made to Mr Norman (Colchester centre, 4 merits), Mr Lewers (DL, St. Albans, 3 merits), Ms Thompson (NESCOT centre, 3 merits), Mrs Croucher (NESCOT, 3 merits) and Mr Marr (Derby, 3 merits).

Keith Attenborough FIOA is the Chief Examiner for the Diploma and Professor of Acoustics at Hull University.

1999 Diploma Pass List

Bristol
John, A S
Jones, S D
Manning, F J
Wilson, P J

Colchester
Barnes, A T
Brooks, R A
Christie, S L
Gayler, K J
Hale, D J
Hornby, G
Isaacs, T H
McCormick, L
Miller, G S
Norman, L K
Piper, A G
Richardson, M J
Shellard, N T
Smith, R G
Thrower, M
Wye, D

CoNEL
Foord, L D
Gomez, L
Hill, M G
Pennington, S J
Quint, G A

Derby
Allen, C D
Aminian, R
Atkinson, D J
Bartlett, I R
Cannings, S M
Canwell, P
Colburn, S
Coupe, G R
Dangerfield, N
Dean, C J
Flynn, G W
Franklin, A
Gill, A M
Goodwill, A J
Gould, A J
Henshaw, N S
Hughes, G
King, R A
Marr, R
Norris, H
Parkes, P
Pearce, R N
Plaice, G A
Songer, H J
Strange, S V
Taylor, J S
Taylor, S J
Waites, E L
Ward, T

Leeds
Barker, G E
Davenport, H L
Holmes, I P
Ingles, S
Johnston, J E
Macgregor, P D
Morris, E A
Needham, E
Pollard, A
Rasheed, A T
Richards, J L
Rouke, L
Walker, P G
Wallbank, I J
Worth, K D

NESCOT
Andrews, J
Cain, A I
Christian, G
Cope, A P
Croucher, D J
Cushing, A M
Davison, P J
Dommett, S H
Goodwin, K L
Hale, R A J
Hayes, S
Lally, J
Lauezzari, M C
Law, V J
Letley, S P
Martin, A R
Money, L E
Nakiala-Muwonge, S
Percival, K E
Ridpath, J
Rimington, A F
Smith, G P
Sutton, A L
Thomas, S P
Thompson, H S
Wilcock, S R
Williams, F
Willmott, T

Newcastle
Davis, C L
Pickering, C S

Sheffield
Oliver, T
Stevenson, G P

Ulster
Arnold, M
Ashe, C
Stevenson, G P
Donnelly, W N
Furey, B F
Kelly, M G
Magee, B
McDaid, R
McKeown, E P
McManus, B
Morrissey, H S
Nagel, G E
Scullion, K M
Simms, M E

Distance Learning
Basnett, A
Carley, P G
Davies, K T
Davies, M T
Dooley, S A
Francis, K I
Geoghegan, J
Groves, C L
Jackson, P
Lewers, T H
Mangan, K T P
Meachin, A S
O'Brien, G
O'Kelly, G
Penman, J M
Pilliner, N J
Waters, S A
Weathehogg, K

	General Principles of Acoustics			Architectural and Building Acoustics			Law and Administration			Measurement			Noise Control Engineering			Sound Reproduction			Transportation Noise			Vibration Control			Project			Overall		
	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail	Merit	Pass	Fail
Bristol	0	2	1	0	1	0	6	1	1	0	0	0	1	3	4	0	0	0	0	0	0	0	0	0	0	4	5	7	11	11
Colchester	3	12	4	0	0	0	2	11	4	0	0	0	2	14	6	0	0	0	0	0	0	2	2	0	3	11	6	12	50	20
CoNEL	5	6	2	0	0	0	1	5	1	0	0	0	2	7	1	0	0	0	0	8	1	0	0	0	0	5	8	8	31	13
Derby	4	27	2	2	4	2	1	15	2	0	0	0	3	12	1	0	0	0	2	22	2	0	0	0	13	21	1	25	101	10
Leeds	1	16	3	0	5	1	0	12	2	0	0	0	1	17	1	0	0	0	0	1	0	0	0	0	2	14	1	4	65	8
NESCOT	1	30	4	0	3	2	3	26	2	0	0	0	2	7	3	0	0	0	3	21	2	0	0	0	8	17	9	17	104	22
Newcastle	0	5	1	0	5	1	0	2	1	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	2	0	1	16	3
Sheffield	0	4	2	1	3	2	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	1	1	4	2	12	10
Ulster	2	15	0	1	11	0	3	7	0	0	0	0	3	7	0	0	0	0	0	0	0	0	0	0	4	9	2	13	49	2
Distance Learning	9	19	2	3	7	3	0	6	1	2	4	1	2	13	2	1	4	0	0	0	0	2	1	0	5	10	7	24	64	16
Totals	25	136	21	7	39	11	16	85	14	2	4	1	17	86	20	1	4	0	5	52	5	4	3	0	36	94	43	113	503	115

Diploma in Acoustics and Noise Control
Grades awarded to 1999 candidates from each centre

Professional Development Committee

The CPD sub-committee of the IOA is now entitled the Professional Development Committee. The committee has two main aims:

- Promoting the understanding and the process of professional development within the Institute.
- Overseeing and developing the Continuing Professional Development Scheme which is operated by the Institute.

The new committee will include members who serve on other IOA committees which have interests in the CPD field. However, the composition of the committee has not yet been finalised, so any member interested in serving on the committee should inform the Institute office.

The committee is presently considering the current Institute scheme and it is likely that it will be changed to bring it more in line with the schemes of some other Institutions. It is also likely that participating members will be invited to identify their goals in the form of a Self-Development Action Plan and then to assess, normally on a yearly basis, their progress and achievements towards these goals. It is intended that correspondence and information will be disseminated by electronic means where possible, and the Bulletin will have a regular article on professional development.

The committee is working on the details and hope to have more information for the next issue.

Sue Bird MIOA

North-west Branch

Evening Meeting, 16 March 2000

Keith Attenborough of Hull University presented a talk on external noise propagation entitled 'How loud will it sound a long way off' to 26 members.

Keith described the complex effects of propagation of noise over short, medium, long and very long distances, looking at models for ground effect for A weighted levels, and comparisons with new short range data together with some tantalising long range Russian data.

Starting with a very descriptive set of curves showing the effect of ground absorption from a helicopter rising, Keith went on to examine the ISO prediction method (ISO 9613-2) and compare it with predictions by Attenborough and Li and semi-empirical methods by Makarewitz. No method was discounted, but the areas and conditions where each works best were described. The variables in propagation were discussed with a particular focus on the importance of ground porosity and roughness. The differences produced by different grasslands and even different ploughing techniques were touched on.

Keith went through a case study of noise for the T5 terminal at Heathrow looking at the practical issues involved in examining ground run up noise at distance and the different approaches taken by the parties involved. The presentation wound up with a revisit of the classic Parkin and Scholes work, with new measurements carried out at Hucknall and examination of Russian data only recently available in the West, for ground running jets for distances up to 3 km.

Nick Antonio MIOA ❖

Hansard

19 January 2000

Community Protection (Airport Noise and Pollution)

Mr David Taylor (N-W Leicestershire): I beg to move, That leave be given to bring in a Bill to require airport operators to reduce operational noise and pollution levels in consultation with local authorities and communities near airports; to enable local authorities to enforce noise and pollution mitigation agreements; to involve communities near airports in the shaping of balanced planning frameworks controlling the operation of those airports; and for related purposes.

There is little effective legislation to control the levels of noise and pollution generated by aircraft and airports. Indeed, the Environmental Protection Act 1990 specifically exempts aircraft noise and emissions from the general nuisance controls that it contains, irrespective of whether an airfield is small and unlicensed or a major national airport.

Tranquillity and air quality are environmental Cinderellas, whose interests have been continually damaged by their ugly sisters, noise and pollution. The aim of my Bill is to give much needed protection to airport communities against the incessant noise and growing pollution that they daily endure.

No hon Member who has a sizeable airport in or near his or her constituency will be unaware of the impact on the local economy. The industry estimates a contribution of £10 billion to the United Kingdom's gross domestic product, and half a million direct and indirect jobs. Only last month, the number of jobs generated by East Midlands airport in north-west Leicestershire went through the 5,000 barrier, and numbers are still rising rapidly.

Nevertheless, the aviation industry tends to overplay its future economic potential. It is apparent that the successful and expanding businesses of the new century are more likely to depend on smart communication systems than on the physical movement of goods, which characterised the industries of the past century.

As with all economic activity, aviation has an environmental downside, which needs to be tackled in the interests of sustainability. As the number of air travellers has grown and the volumes of freight moved have increased, the loss of open countryside, higher pollution levels and the perpetual noise intrusion are the price being paid by the many thousands of people living around and on the flight paths to the nation's airports.

It is in no one's interest to ignore the increasingly widespread anxieties about the environmental impact of air travel. For too long, aircraft noise and air pollution have had a seriously adverse effect on the quality of life of hundreds of airport communities. Projected new laws by the previous Government were shelved time and again. That must not continue. The time is right for the Government to act, and the Bill includes some suggestions for action.

I welcome today's introduction by the Government of a national air quality strategy and I support their existing commitment to drawing up a 30-year airports policy, about which consultation begins soon. However, I urge the Department of the Environment, Transport and the Regions to widen the brief to devise a comprehensive air transport policy.

There is already a specific target of expanding regional airports to take the pressure off the south-east – from where two thirds of passengers fly and where three quarters of airline and airport jobs are located. However, any such expansion should be accompanied – or, indeed, preceded – by a far more effective regulatory framework spelling out the rights and responsibilities of airports, planners and local communities.

All that is underpinned by the pressing need for the Government to accept that there are limits to the number of aircraft movements that the system can tackle and the effects that communities can tolerate. In short, we should abandon the predict-and-provide principle, which has seriously flawed our air transport planning for a generation. We must also abandon the stock DETR belief that the current local plan process is adequate for resolving airport issues. It is not and does not.

Using a projected average annual growth rate of 6 per cent. in demand for flights would lead, over the 30-year strategy period, to a tripling in size of every regional airport. Down that nightmare flight path lies an environmental disaster of unimaginable proportions for already beleaguered airport communities. Air travel and air freight are significant players in our economy. They must be allowed to grow, but only in a responsible and responsive way.

A key principle in environmental policy formulation is that the polluter must pay. However, the aviation industry seems to be excluded from that. It allows – even requires – the wider society and economy to bear the burden of its environmental costs. The aeroplane is the most polluting form of transport, and is responsible for around 10 per cent of all greenhouse gas emissions, yet it is exempt from tax on its kerosene fuel. That problem requires urgent, Europe-wide action.

Airport communities are almost powerless to protect their quality of life against excessive airport noise and must often rely on the good will of their powerful and important neighbour. However, business pressures are such that any voluntary codes of conduct can steadily become ineffective and unsustainable.

The focus of the Bill is raising airports' operating standards, especially in relation to noise limitation. Apart from the designated airports of Heathrow, Stansted and Gatwick, which are subject to specific noise legislation, all the others depend on the lottery of local agreements. The Bill would superimpose a minimum framework, which specified common and enforceable limits that airports would have to observe for renewed Civil Aviation Authority licensing. Those limits would not be part of a voluntary agreement, or reluctantly conceded for planning permission, and they would not lack independent means of monitoring and verification. They would be part of a comprehensive deal, which would aim to protect the quality of life of airport communities.

What needs to be contained in the framework? A prime requirement is the financing and installation by the airport of an appropriate noise monitoring system, relevant to the pattern of noise that it generates. The system would have to be managed independently, with penalties for operators who violated noise, route and other restrictions. The proceeds would be distributed to local organisations by an independent local panel.

Secondly, the airport, local authorities and airport communities would collectively agree noise-preferential routes, especially for departing aircraft, with appropriate restrictions on turning and overflying. Comprehensive mandatory pilots notes on the agreed local regime would have to be produced and incorporated into relevant publications.

Thirdly, there would be a collective agreement about seasonal night flying quotas, with a complete ban on chapter II aircraft, whether hushkitted or not, and on chapter III aircraft above a specified weight, as the heavier ones can be even noisier than the older aircraft that they replace. Fourthly, an independent executive forum of airport owners, operators, local authorities and community groups would monitor and try to resolve any airport environmental problems.

Finally, the Bill would include a range of provisions eg ground running, property soundproofing, complaint logging, public safety zones, control of further development.

The patchwork quilt of regulatory bodies means that a national approach is needed to obtain higher environmental standards for all airports. The comprehensive action needed for noise and pollution mitigation has to be part of a national aviation policy, which is itself the basis of discussion with international aviation bodies and other Governments. Technological and operational measures alone will never obtain that limitation of aircraft noise and disturbance levels which is so necessary for so many people.

My Bill is a meaningful, reasonable and enforceable measure that would produce a more satisfactory framework within which airport operation and development could occur. It would provide a level runway for airports so that they could raise standards in parallel with their competitors and improve relations with the people affected by their operations. It spells out to local planning authorities an unambiguous and enforceable regime based on environmental considerations and would achieve a better balance between commercial airport needs and legitimate local requirements. Finally, it offers to airport communities no less than an environmental charter to control the noise and pollution generated by the aerial motorway over their homes. I therefore commend it to the House.

Question put and agreed to

Bill ordered to be brought in by Mr David Taylor, Liz Blackman, Mr Colin Burgon, Mr. Jim Cunningham, Mrs Janet Dean, Mr Paul Flynn, Judy Mallaber, Mr John McDonnell, Dr Nick Palmer, Mr Andrew Reed, Mr Gareth R Thomas and Mr Mark Todd.

Community Protection (Airport Noise and Pollution)

Mr David Taylor accordingly presented a Bill to require airport operators to reduce operational noise and pollution levels in consultation with local authorities and communities near airports; to enable local authorities to enforce noise and pollution mitigation agreements; to involve communities near airports in the shaping of balanced planning frameworks controlling the operation of those airports; and for related purposes: And the same was read the First time; and ordered to be read a Second time on Friday 21 July, and to be printed [Bill 481].

10 February 2000
Road Noise Reduction
Mr Oaten: To ask the Secretary of State for the Environment, Transport and the Regions what road noise reduction surfaces his Department has recently approved for use.
Mr Hill: I have asked the Chief Executive of the Highways Agency, Mr Peter Nutt, to write to the hon Member.
Letter from Jon Seddon to Mr Mark Oaten, dated 10 February 2000:
The Secretary of State for the Environment, Transport and the Regions has asked me to respond to your question about what road noise reduction surfaces his Department has recently approved for use. In the absence of the Chief Executive I am responding to the question.

In addition to porous asphalt and exposed aggregate concrete which are included in the specification for trunk road construction, to date the Highways Agency has approved, for use on trunk roads in England, fifteen proprietary surfacing products which have been shown to generate significantly lower noise levels than conventional surfaces. Six of these products were approved in the past year. They are already being widely used for surfacing roads that need maintenance.

For the future, a new scheme for approving a range of innovative products has been set up with other highway authorities under which the British Board of Agrément will certify that products meet the specified performance requirements.
Mr Oaten: To ask the Secretary of State for the Environment, Transport and the Regions if he will treat applications in respect of properties on existing roads for double glazing as a method of noise reduction for residents in the same way as such applications in respect of properties on new roads.
Mr Hill: The Noise Insulation Regulations apply to properties affected by existing roads which have been physically altered as well as to new roads. I have no plans to extend the scope of these Regulations to properties affected by unaltered roads.
Extracts provided by Rupert Taylor FIOA

BSI News

BS EN Publications

BS EN 10246: Non-destructive testing of steel tubes.
BS EN 10246-6:2000 Automatic full peripheral ultrasonic testing of seamless steel tubes for the detection of transverse imperfections. No current standard is superseded.
BS EN 10246-8:2000 Automatic ultrasonic testing of the weld seam of electric welded steel tubes for the detection of longitudinal imperfections. No standard is superseded.
EN 10246-14:2000 Automatic ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of laminar imperfections. No current standard is superseded.

British Standard Implementations

BS ISO 6926:1999 Acoustics – Requirements for the performance and calibration of reference sound sources for the determination of sound power levels. Supersedes BS 4196-8:1991.

British Standards Reviewed and Confirmed

BS 5944: Measurement of airborne noise from hydraulic fluid power systems and components.
BS 5944-4:1984 Method of determining sound power levels from valves controlling flow and pressure.
BS 5944-5: Simplified method of determining sound power levels from pumps using an anecohic chamber.

British Standards Declared Obsolescent

BS 3045:1981 Method of expression of physical and subjective magnitudes of sound or noise in air. Obsolete.
BS 4198:1967 Method for calculating loudness. Obsolete.

British Standards Withdrawn

BS 4196: Sound power levels of noise sources.
BS 4196-8:1991 Specification for the performance and calibration of reference sound sources. Superseded by BS ISO 6926:1999.

New Work Started

BS EN ISO 10848-4 Acoustics – Laboratory measurement of the flanking transmission of airborne and impact noise between adjoining rooms – Part 4: Application to all other cases.

Drafts for Public Comment

99/205411 DC IEC 61842 edition 1.0 – Microphones and earphones for speech communication (IEC Document 100C/256/CDV).

CEN European Standards

EN 10246: Non-destructive testing of steel tubes.
EN 10246-6:1999 Automatic full peripheral ultrasonic testing of seamless steel tubes for the detection of transverse imperfections.
EN 10246-8:1999 Automatic ultrasonic testing of the weld seam of electric welded steel tubes for the detection of longitudinal imperfections.
EN 10246-14:1999 Automatic ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of laminar imperfections.
EN 12223:1999 Non-destructive testing – Ultrasonic examination – Specification for calibration block No.1.

CENELEC Publications

EN 60068: Environmental testing.
EN 60068-2-47: December 1999 Test methods – Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests.

IEC Publications

IEC 60068: (Edition 2) Environmental testing.
IEC 60068-2-47: October 1999 Test methods – Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests.
IEC 60068-2-57: November 1999 Tests – Test Ff – Vibration – Time-history method.

ISO Publications

ISO 8041: Human response to vibration – Measuring instrumentation. Amendment No 1:1999 to ISO 8041:1990.
ISO 13475: Acoustics – Stationary audible warning devices used outdoors.
ISO 13475-1:1999 Field measurements for determination of sound emission quantities. To be implemented as BS ISO 13475-1
ISO/IEC 17025:1999 General requirements for the competence of testing and calibration laboratories.
This information was announced in the January and February 2000 issues of BSI Update, copies of which are kept in the Institute library.

Book Review

Sounds of Our Times
by Robert T Beyer
Springer NY, 1999
ISBN: 0-387-98435-6
Price: £37.00

This is a book which has been a pure pleasure to read and which has been for me a rich educational experience. It must be many years now since I last read a history of acoustics, so it was a comfortable experience to read about many of the things that I had half-forgotten and of the truly remarkable achievements of our pioneers.

The second and less comfortable experience was to discover many facts about sound which I had never known before, some of them quite simple things like the conflict between two schools of thought in teaching the deaf; should it be sign language or should it be lip-reading?

The nature of the tale is chronological and largely person-based. Thus the book starts with the state of acoustics in 1800 and makes particular reference to Ernst Chladni and Thomas Young. I was rather sorry that there is no mention of acoustics in antiquity – perhaps there is nothing to report but I had thought that, for example, there was acoustic intelligence involved in the design of Greek theatre.

This first section is followed by a chapter on the period 1800-1850 which covers the significant advances made by Stokes, Fourier, Wheatstone, Doppler and others. Professor Beyer's own work is in non-linear acoustics so there is some emphasis on this in the book. Hence enter my personal Victorian hero, Sir George Biddell Airy.

I first came across this polymath when I was a student of elasticity (Airy stress functions). At some later time I read L T C Rolt's famous biography of Isambard Kingdom Brunel [1]. In this book Rolt rather belittles Airy (and spells his name wrong too for good measure). Airy had been appointed a member of the Royal Commission to investigate the battle of the 'gauges'; namely whether Britain should standardise on 4' 8" or 7' 0" for the gauge of railway lines. At the time, Airy was Astronomer Royal. Rolt says of the Commission .... *but we must remember that it would have been impossible to find a distinguished engineer....!* Anyway, be that as it may, Beyer explains how Airy made a significant contribution to non-linear acoustics, and to my shame I did not know that either.

The work then moves on to the great advances made in the latter part of the nineteenth century, particularly by Helmholtz, Tyndall and Rayleigh but also by many others in the burgeoning field of acoustics. The work of these pioneers is astonishing when one considers how ingenious they had to be to make measurements without electronics. This sense of wonder at the consummate skills of these nineteenth century scientists is lovingly conveyed in this book. As Beyer says about the earlier periods:

In a day when we can scarcely add numbers without a calculator, or perform an experiment without vast arrays of electronic equipment, we can only marvel at the success of their ingenuity and resourcefulness.

The twentieth century is allocated four chapters. These chapters show the progressive part which electronics has played not only in measurement and its accuracy but also in the generation of sound and ultrasonics. These chapters also show how acoustics has grown up to be a fully-fledged science in its own right containing many related branches and linking up with other sciences and with engineering, medicine, architecture, speech and hearing, and music. There is a lot of balanced detail in these final chapters.

In writing this review I have been much impressed by reading in the book a copy of the famous and masterly reviews which appeared in Nature in 1878. These are the reviews of Rayleigh's *Theory of Sound* (two volumes) by Helmholtz. I suppose it was inevitable that I should make comparisons!

This scholarly book contains virtually no mathematics and I am sure that it will appeal to the expert and the layman in equal measure. Tyndall wrote about his famous book [2]:

In the following pages I have tried to render the science of acoustics interesting to all intelligent persons, including those who do not possess any special scientific culture.

If the word *history* is substituted for *science* then this could have been written by Beyer about his book, and he would have succeeded.

This book is enthralling and stimulating and I am glad to recommend it for your bookshelves both at home and at work.

[1] *Isambard Kingdom Brunel*, L T C Rolt, Longmans Green, (1957)
[2] *Sound*, John Tyndall, New York, (1867)

A J Pretlove FIOA ❖

New Products

LMS INTERNATIONAL

Transient Acoustic Holography Module in LMS CADA-X

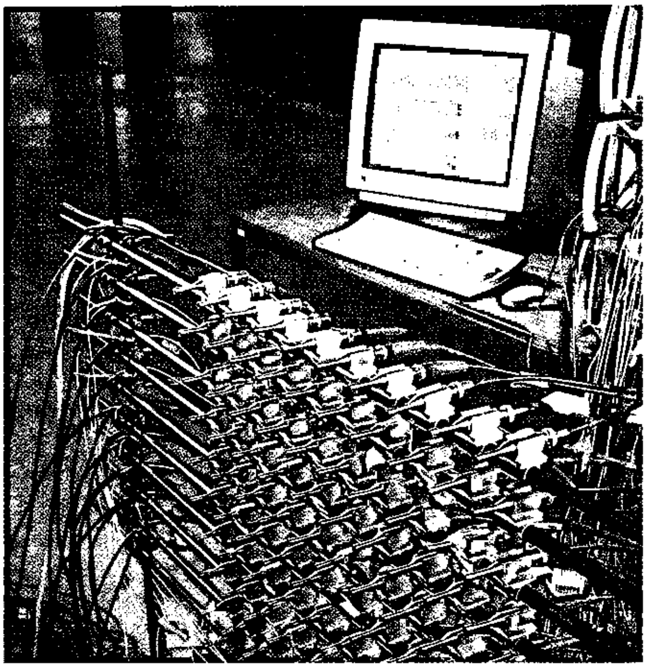
LMS International has announced the release of its new Transient Acoustic Holography module within the LMS CADA-X Noise & Vibration testing software suite. Acoustic holography is an industrially proven technique that uses the measurements taken in one plane to predict what the readings would be in any other plane. As such it is ideal for source location, especially in multi-source environments, like in full vehicle NVH troubleshooting.

Until now acoustic holography has mainly been applied to stationary conditions. In order to analyse transient or pseudo-stationary conditions, LMS introduced Transient Acoustic Holography. This new tool enables the user to look at pressure changes at particular frequencies/orders as a function of time/rpm. It is therefore the ideal tool to localize, quantify and rank sound sources on transient sound signals such as engine run-ups.

The new LMS CADA-X module has been implemented in such a way that it does not require all data to be measured simultaneously saving large amounts of money on microphones and high channel count systems.

Some of the key features of the new Transient Acoustic Holography:

- The following analysis selections as function of rpm are available: a frequency range, a single order, a sum of single orders or a range of orders. These selections permit respectively the study of resonance, order, and modulation phenomena, as well as component studies.
- Back and forward propagation to predict acoustic fields anywhere from the source to the far field in a plane parallel to the hologram (measured) plane.
- Pass-by noise predictions: one can predict pressure, intensity and velocity along an axis of a simulated moving source
- Simulation of source attenuation: one can define multiple sources and attenuate/amplify them individually or simultaneously for parallel or pass-by noise predictions.



With the upcoming Revision 3.5.C of LMS CADA-X, a time domain module will extend the acoustic holography family, which will be particularly suited to the study of very short transient phenomena (for example, less than a second). Typical applications in automotive development include the analysis and troubleshooting of a car door slam, gearshifts and starter motor noise.

For more information contact: Bruno Massa, Marketing Communications Manager, LMS International, Leuven, Belgium Tel: +32 16 384 200 Fax: +32 16 384 350 email: bruno.massa@lms.be web: http://www.lmsintl.com

SOUND REDUCTION SYSTEMS LTD

Soundblocker Range

Sound Reduction Systems have added further accessories to complement their range of high performance solutions to combat room to-room-noise.

The accessories provide treatment where apertures or penetrations occur in the ceiling. For instance, the Soundblocker Acoustic Lighting kit is specially made to give acoustic treatment to lights installed in the ceiling, preventing sound leakage and thereby ensuring the highest overall performance.

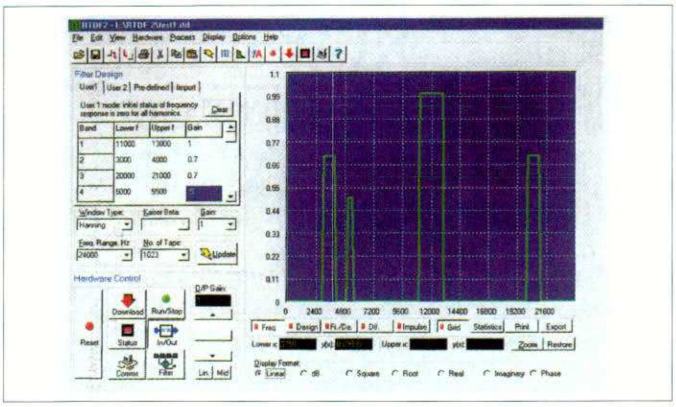
Soundblocker Recessed Downlighter Acoustic Hoods are placed over the fitting in order to minimise sound break out, whilst allowing air to flow through the fitting itself. One standard size is available which accommodates most fittings.

Soundblocker Air Diffuser Acoustic Hoods are for use where air is vented via the ceiling void through grills within the ceiling. Unless acoustically treated, sound will travel through the void reducing the acoustic performance of the ceiling. Also available are perimeter self-adhesive strips, for sealing around the perimeter, and for small gaps and openings, at partition heads, for example, there is Soundseal, an expanding foam strip supplied in rolls in varying widths and lengths.

Soundblockers provide one of the most comprehensive systems available for reducing the break-out of sound through suspended ceilings. Soundblocker 16 is ideal for stopping or considerably reducing cross talk through the ceiling in a standard office, while Soundblocker Plus reduces high noise levels through floors and the break out of environmental noise through roofs. Formed from a rigid attenuating layer bonded to an acoustic foam, Soundblockers are ideal for installation in both lay-in-grid and metal tray ceiling systems.

Details of the full product range are provided in a brochure which also has a handy reference guide as to which Soundblocker to use in each different situation.

For further information contact Eddie Williams at Sound Reduction Systems Ltd, Adam Street, off Lever Street, Bolton BL3 2AP Tel: 01204 380074 Fax: 01204 380957 email: info@soundreduction.co.uk website: www.soundreduction.co.uk



KEMO LTD

Real-time Digital Filter

The KDF-1 is a new real-time digital filter developed by UK manufacturer Kemo in conjunction with UMIST. Designed to provide versatile filtering and signal conditioning in data-acquisition and instrumentation systems, the new filter allows the user to set almost any filter characteristic required, including responses that are not possible with analogue units.

Easy-to-use Windows software can create user-definable filter shapes, including bandpass, notch and multiple cut-off characteristics. ASCII files can also be imported to define filter shapes, and inverse transfer functions can be implemented.

The KDF-1 has a frequency range from 5 Hz to 20 kHz, and features very sharp filter cutoffs up to –80 dB at 1.05 times the cutoff frequency. The new filter is a portable unit operating from a 9-30 V DC power supply.

For further information contact: Robert Owens, Kemo Ltd, 3 Brook Court, Blakeney Road, Beckenham, Kent BR3 1HG Tel: 020 8658 3838 Fax: 020 8658 4084 web: www.kemo.com

PROSCON ENVIRONMENTAL LTD

HVM100 Human Vibration Monitor

Whole-body and hand-arm vibratioan measurements per ISO standards and EU Directives are said to be made simple with this new portable instrument from Larson Davis Industrial.

Supplied as a complete package including sensors and adapters if desired, yet compatible with virtually all types of existing accelerometers, this device measures and integrates all three axes (x,y,z) of vibration simultaneously. With on-board data-logging of RMS average, minimum, maximum and peak values plus programmable AC and DC outputs, virtually any analysis requirement can be accommodated. This robust, battery powered device features a clear LCD display, and provides multi-lingual display prompts.

New GSM Modem System

ProsCon Environmental Ltd have announced the release of their new GSM Modem System for use with Larson Davis Model 812, 820 and 870 Type 1 Environmental Sound Level Meters.

The System is based on a GSM9OO Modem togetber with specially adapted ProsCon Software for instrument setup, control and data download. Various parameters can be monitored on-line, including SPL, SEL, Interval Data and L_ns. The system also allows for remote control of the instrument for start/stop function as well as checking battery power. All of this is managed using a PC and supplied land-line modem.

The package also includes a custom all-weather case for the GSM modem battery and sound level meter.

Further information from ProsCon Environmental Ltd, Abbey Mill, Station Road, Bishops Waltham, Southampton SO32 1GN Tel: 01489 891853 Fax: 01489 895488 e-mail drpclark@proscon.com.

CIRRUS RESEARCH PLC

Portable Environmental Noise Analyser

The new CR:245/4 Portable Environmental Noise Analyser from Cirrus Research is a versatile noise measurement tool.

The instrument provides the same measurement functions as the larger CR:245/3 unit, including environmental periods, recognised noise events and noise profile data. The standard version of the instrument can operate for up to 7 days with the internal battery, and for longer periods if extra power is provided.

The instrument has a single 120 dB dynamic span to Type 1, has PTB Approval and is supplied with a 10 m microphone extension cable as standard.

The CR:245/4 can be fitted with a range of options and accessories including automatic calibration, as well as external power options such as solar power or additional batteries.

To receive further information on this and other Cirrus products, contact James Tingay at Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire YO14 0PH Tel: 01723 891655 Fax: 01723 891742 e-mail: sales @cirrusresearch.co.uk Web site: www.cirrusrescarch.co.uk

Cirrus Research plc are Key Sponsors of the Institute.

NEWS

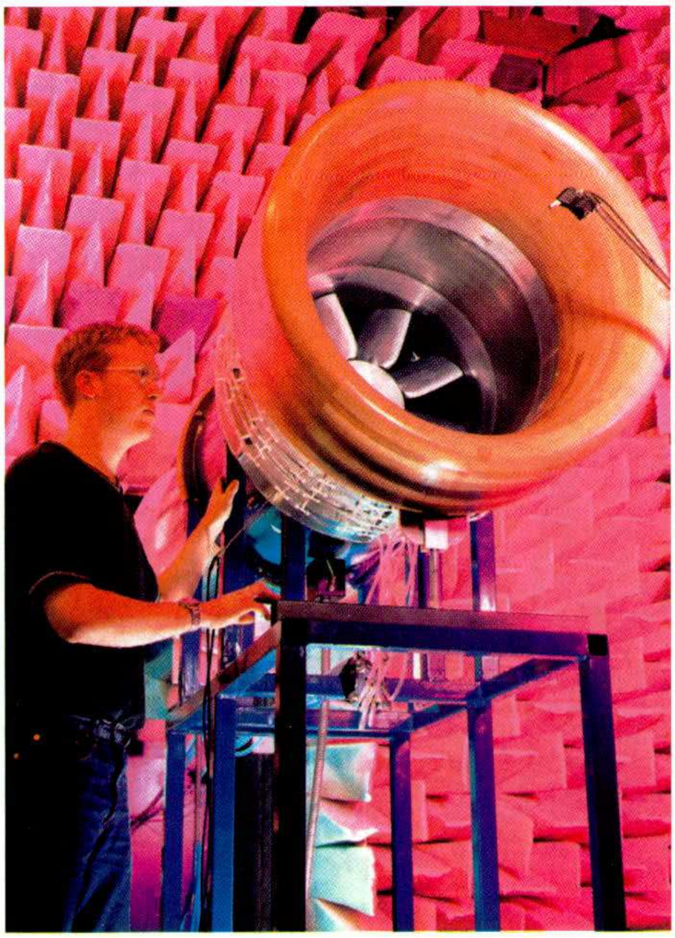
COMPAIR UK LTD

'Change of Heart' Scheme compressor supplied to ISVR

CompAir has supplied two VMHD 500 oil-free reciprocating compressors to ISVR. The two CompAir units were installed with associated dryers and filters by authorised CompAir distributor Motivair of Eastleigh, Hampshire.

The confined nature of the plant room meant that Motivair had to lift the compressors into place by crane. One of the VMHD 500 compressors was supplied under CompAir's 'Change of Heart' scheme. The 'Change of Heart' programme involves fitting a replacement compressor block, built to the latest specifications, that can be quickly and cost effectively installed into existing V-Major and V-Compact units.

ISVR uses compressed air for various applications at its test facilities. High pressure compressed air is used to generate levels up to 190



decibels in a reverberation chamber which is used to test the structural integrity of satellite components, ensuring that launch stresses are tolerated. Other applications include supplying high pressure air to wind tunnels and an anechoic chamber featuring an acoustic tunnel used for testing jet engine noise caused by turbulence.

Further information from CompAir UK Ltd, Hughenden Avenue, High Wycombe, Bucks HP13 5SF Tel: 0800 731 6469.

SANDY BROWN ASSOCIATES

New Partner

Sandy Brown Associates are pleased to announce that Stephen Stringer is to become a partner of the practice with effect from 1 April 2000. Stephen joined SBA in 1991 and became an associate in 1994 following experience with Oscar Faber and Travers Morgan. He has a rare and valuable combination of qualifications in both acoustics and building services having achieved a BEng [Hons] in Building Services Engineering at the University of Liverpool and an MSc in Environmental Acoustics at the South Bank University. Stephen has played a lead role in many key SBA projects – primarily in the fields of architectural acoustics and building services noise and vibration control including advice on vibration isolation of sensitive structures. He also continues to apply his skills in projects involving environmental and construction noise and vibration. He is examiner in Architectural and Building Acoustics for the Institute of Acoustics.

Stephen's partnership comes at a time when the practice's project portfolio is rapidly expanding particularly in the middle-east and far-east. His experience and abilities complement those of the current partners and are a welcomed addition at the helm of the practice as they embrace the new millennium. For further information about Sandy Brown Associates visit their web site at www.sandybrown.com

SYMONDS GROUP

The Dome

As overall acoustic consultants working on the Dome project, a wide number of acoustic issues needed to be considered, including the performance of the voice alarm system, the natural acoustics within internal spaces and the likely environmental impact to surrounding residential areas.

Symonds Group were able to make recommendations to their client, the New Millennium Experience Company, on each of these issues by using the RAYNOISE acoustic modelling software, which is able to predict both internal acoustic parameters and sound transmission effects. It is proposed that more details of this extensive project will feature in future issues of this Bulletin and also at Institute seminars during 2000.

For more information, contact Jim Griffiths at Symonds Group, on 01342 327161. RAYNOISE is developed by LMS in Belgium and marketed in the UK by Dynamic Structures & Systems Ltd, Sheffield.

CASELLA CEL

Casella Group Launches New Website

The Casella Group, which includes Casella CEL, Casella GMSS and Casella Science & Environment, has just launched its brand new website. Bringing all its products and services under one roof has been a major incentive for the company, which aims to be 'a one-stop shop' for all environmental needs.

The site offers details on the groups' instrumentation, training, consultancy services and public analyst laboratory, as well as background information on the company's 200 year history, and much more.

The site provides direct links to the Casella group offices throughout the UK, in USA and Spain, and to the worldwide network of distributors, working on their behalf. Interested browsers can obtain further information on products or services by clicking on the enquiry basket facility, while a quick-list of all items available from the group is shown on the On-line catalogue. The Casella Group website is at www.casella.co.uk.

Information from Debbie Worthington, Casella CEL Ltd, Regent House, Wolseley Road, Kempston, Bedford Tel: 01234 844100 Fax: 01234 841490.

Casella CEL Ltd are Key Sponsors of the Institute.

ECOMAX ACOUSTICS LTD

New Media Centre

Tufsound panels have been used as part of the acoustic design for a new media centre at the University of Lincolnshire and Humberside. Featuring a mineral wool sound absorbent core, Tufsound is rated non-combustible according to ISO 1182. Each Tufsound panel is finished with tissue on both sides and features impact resistant steel outer facing to protect against accidental knocks.

Within the televisions studios, Tufsound was installed as wall panels plus internal linings and as suspended ceiling baffles. Tufsound was also installed as an internal wall lining in the numerous multimedia rooms and editing suites while a series of hinged Tufsound panels treats noise problems in other areas of the centre.

Information from Ecomax Acoustics Ltd, Gomm Road, High Wycombe, Bucks HP13 7DJ Tel: 01494 436345 Fax: 01494 465274.

Ecomax Acoustics Ltd are Sponsor Members of the Institute.

Items for the New Products section should be sent to John Sargent MIOA, Oak Tree House, 26 Stratford Way, Watford WD1 3DJ email: j_w_sargent@hotmail.com❖

The Editor
Dear Sir

Single Number Rating?

Being fairly new to noise assessments I am always reading further into various aspects related to noise and its effects. During recent contact with hearing protection manufacturers I noticed they kept making reference to the SNR when explaining the adequacy of their particular product.

As I spoke to more people within this industry, this term seemed to be used as a leading statement when recommending which hearing protection you should be using. Although I usually calculate the suitability using the octave band frequency I was curious to this popular reference.

This system of provisionally calculating the suitability of hearing protection using the SNR seemed too straightforward and simple. However, after making reference to the formula given in the appendix of the NAWR I was somewhat concerned to realise that the manufacturers that I have spoken to are deducting the SNR from the dBA and not from the dBC.

For the most recent noise survey that I had carried out, I purposely took readings in both A weighting and C. When deducting the SNR from both readings it is clear that there can be a significant difference between the overall figure.

Surely this is misleading for the user if manufacturers are to use the term SNR, when it appears some of them are calculating this incorrectly.

Yours faithfully
Adam Rowley,
Assistant Safety Advisor,
British Airways, Heathrow.
26 February 2000

The Editor
Dear Sir

Salaries

Perhaps now that the IOA is a fully fledged member of the Engineering Council, the Institute could publish in the 'Bulletin' the latest figures from the Engineering Council concerning average earnings of engineers. For your information these numbers are:

Chartered Engineer	£44,450
Incorporated Engineer	£32,842
Engineering Technician	£29,942

published February 2000 in *Engineering First* the Journal of the Engineering Council, based on 8,891 responses. It would be useful for those of us in the acoustic consulting engineering profession to see how we rate against these figures.

Indeed, for myself, as a Senior Consultant, I am still a way off counting as an Engineering Technician! So, when I hear of employers bemoaning the 'crisis' in recruitment, the apparent handful of fresh graduates entering the profession, and the significant number of young consultants contemplating leaving acoustics altogether, perhaps we should all reflect on the above earnings.

When it is further revealed that only 3.1% of engineers earn less than £20,000, a salary I am sure the majority of acoustic consultants under 30 work below, perhaps employers should not be so surprised after all. Whilst I am sure employers will argue that acoustic engineers cannot command the same fee rates as, say, structural engineers or mechanical engineers (an argument I doubt), do our clients really undervalue our work so much that we can only command perhaps half the salary of our peers ?

This is a situation that should not be allowed to continue, and it is time that employers recognised the professionalism and commitment of their employees, lest they find themselves even more over-worked and undermanned. For the Institute, this must surely be a matter of some long term concern if the membership amongst younger people were to begin to decline.

Yours faithfully,
Name and address supplied
(for obvious reasons)
13 March 2000

The Editor
Dear Sir

Management of Occupational Exposure to Hand Arm Vibration

I wish to comment on a few important points concerning the above proposed new course details of which were published in the November / December 1999 issue of the Acoustics Bulletin.

No information was given on the experience and qualifications required for participants in this course. There is no possibility of giving adequate training for vibration measurements, vibration reduction and risk assessment for VWF during a course lasting one week, unless the mature students already have extensive engineering and vibration experience and qualifications. The need to protect employees from the painful and debilitating disease makes it essential that the measurements and assessments are controlled by a Chartered Engineer. The actual measurements may be made by a suitably trained technician but he/she must be supervised, and the report authorized by a Chartered Mechanical Engineer with experience in vibration measurement and control.

The reduction, prevention and treatment of VWF require an engineering and medical input. The engineering responsibilities include measuring the actual vibration exposure, assessing the risk of VWF, reducing the vibration levels and/or exposure time, advising the senior managers and directors on the regulations and on ways to reduce the risk, etc. Not many companies have staff with the inhouse experience and qualifications to carry out this work properly and competently. Hence, the course should be directed at Noise and Vibration Consultants who have at least one Chartered Mechanical Engineer in their staff. The medical input is mainly concerned with diagnosis and treatment of the disease. Engineers are in the forefront of preventing the disease. Errors in their measurements, analysis and judgement could have dire consequences for many employees.

If the participants in the course have the necessary background experience and qualifications in engineering as assessed by being accepted as a Chartered Mechanical Engineer, the course syllabus, as outlined in the Acoustics Bulletin, would be a valuable contribution to helping to publicise the dangers of excessive vibration exposure and of reducing the risk of Vibration White Finger.

If those attending the course do not have the necessary engineering and vibration experience, the result could be a disaster. Remember the saying – 'A little knowledge is a dangerous thing' .

Yours faithfully
Ian Watson FIOA
SNV Consultants
Blanefield By Glasgow
17 January 2000

The Editor
Dear Sir

Sound Insulation and the Mills and Baxter Judgement

I refer to the law report reprinted from the Times in the November / December issue of the Bulletin.

As I understand it, the House of Lords found that pre-existing poor sound insulation cannot be a failure to provide quiet enjoyment of a tenant's property; they also found that normal day to day occupation of a flat cannot be deemed to be an actionable nuisance at common law, provided that it is done with due consideration.

Nowhere in the judgement, was there any mention of The Environmental Protection Act, and hence there was no discussion of the application of the judgement to statutory nuisance cases. However, the question now arises as to whether their lordships' judgement prejudices the taking of actions under Section 80 or 82 of The Environmental Protection for poor sound insulation. Certainly, there are a number of local authorities who believe that this course of action is now disbarred, and we know of two that will not enforce even existing notices on this basis.

The relevant EPA actions are normally taken under Section 79(1)(a), which defines a statutory nuisance as *any premises in such a state as to be prejudicial to health or a nuisance.* Section 80(2)(b) [84(4)(b)] provides that the Notice [Order] should be served on the owner of the premises where the nuisance arises *from any defect of a structural character.*

Firstly, it appears likely that the Mills and Baxter Judgement cannot apply if it is being alleged that the poor sound insulation renders *the premises in such a state as to be prejudicial to health.* Dani Fumicelli discussed this point in his letter to the Editor in the July/August 1999 Bulletin; however, he felt that *the nuisance limb has now been closed* in statutory nuisance actions. However, this may not be the case.

In *A Lambert Flat Management Ltd v Lomas [1981] WLR 898* the Court found that the one respect in which the tort of nuisance was relevant to a statutory nuisance action, was the issue of whether *noise amounting to a nuisance* exists (it was a Control of Pollution Act case). Indeed the judgement went further, and accepted the contentions on behalf of one of the parties that *..whereas liability at common law rests with who created the nuisance, or the land owner if he knew or ought to have the facts constituting the nuisance, liability under the statute is determined by section 58(2) and the definition of person responsible... a notice requiring the abatement of the nuisance and the execution of works may be served on the owner of the premises from which the noise is emitted even though he is not the 'person liable' and may know nothing about it... the only relevance of the common law is in deciding the question whether the noise amounts to a nuisance.*

The *A Lambert Flat Management* judgement specifically considered the question of common law nuisance influencing statutory nuisance actions, and found that it was only of relevance in deciding whether the noise was a nuisance.

In the Mills and Baxter case, it seems clear that their lordships found that there was a significant interference with the use and enjoyment of residents' properties, but they found that because of the manner in which it was caused, the nuisance could not be actionable at common law.

By contrast, when there is a structural defect causing statutory nuisance, the EPA requires the owner of the building to carry out the works; it also recognises that the owner may not even be *the person responsible for the nuisance* (contrast the wording of 80(2)(a) and 80(2)(b)).

In summary, it is my opinion that the Mills and Baxter judgement does not alter the ability of The Environmental Protection Act to deal with poor sound insulation; firstly if the EPA actions are taken on the basis of *prejudicial to health* and secondly because of the findings contained in the A Lambert Flat Management judgement.

Yours faithfully
M A Kenyon MIOA
Martec Environmental Engineering,
Skelmersdale, Lancs
10 March 2000 ❖