Institute of Acoustics

acoustics BULLETIN

Volume 24 No 1
January – February 1999

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

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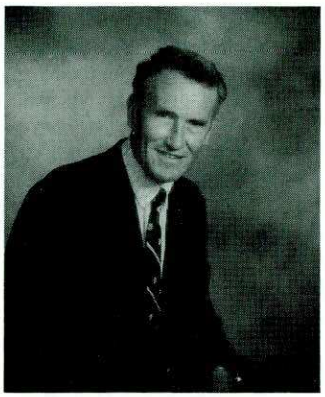

Dear Fellow Member

The New Year celebrations are something special for the Institute this year as they mark the start of our Silver Jubilee. The 25 years that have passed since the IOA was founded have seen a lot of changes; the many technical and administrative initiatives that our members have been involved in through that time have resulted in a breadth of experience that is probably unrivalled in the developed world. The understanding, both theoretical and applied, accumulated from our basic research programmes, noise control engineering projects and environmental control regulations have given the UK a leading position in the acoustics world. The broad vision of those responsible for funding our research programmes and the relentless drive of our citizens for a better acoustic environment have underpinned those advances. We have a solid foundation on which we can consolidate our leading position by continuing to design and manufacture the quietest products and to organise our Communities such that they are protected from the 'noise' of modern life.

This concept of basing our future actions in acoustics on past achievements has been taken as the theme for our 25th Anniversary Conference. To enable as many members as possible to attend, this will be a one-day event held at the London Barbican Centre on the 13th May. The promoters of the meeting realise that with the growing diversity of activity within the acoustics world it is important for members to keep abreast of developments in areas other than their own. The format for the meeting will therefore be a morning session at which each of the Specialist Groups that form the Institute will present a review paper outlining the developments within their area of acoustics over the past 25 years. After a celebration lunch the Conference will break into parallel sessions run by each of the Specialist Groups at which papers will be presented that represent the state of the art.

In all this talk of the UK we must not forget the Institute's contribution to the international stage. We have recently had two important meetings with our European and International colleagues and are continuing to develop our contacts and commitments to them. The European Acoustics Association held its Annual General Meeting in conjunction with the recent Euronoise Conference and at that meeting Prof. Peter Wheeler was elected as the Managing Director to take effect from the spring of this year. We all wish Peter well with his new responsibilities, which with the growing harmonisation of European Regulations will become ever more important to us all. On the inter-continental front we have been contributing to the development of the International Institute of Noise Control Engineering, the body who promotes the very successful Inter-noise series of conferences. A new constitution is now in place and as within I-INCE we have a forum for co-operation between Europe and the Americas, the two major forces in noise control, we look forward to harmonious development of activities.

If not before, I look forward to seeing you at the 25th Anniversary Conference and until then with best wishes for 1999, I remain

Yours truly

Ian Campbell

Editorial

Publications Committee at its meeting on 15 December 1998 agreed that it would strengthen the role of the Acoustics Bulletin as a bridge between the various decision making bodies within the Institute and the membership if a column were introduced to report some of the more important points recorded in the confirmed minutes of meetings of those bodies. It was also decided that the Production Editor would abstract suitable items for publication and her first column in this series is printed below.

This issue which is the first to carry the new Institute logo has an obituary for Bill Allen HonFIOA who was the Institute's second President. I have fond memories of Bill officiating at the Institute's 1976 Spring Conference in Liverpool, the first conference I organised for the Institute.

Also included in this issue is the first instalment of a report of research in progress in Universities. The possibility of running a similar occasional column on research contracts held by other types of organisation is being considered. Perusing the list in this issue provides a timely reminder, should one be necessary, that the sum total of members' interests encompasses far more than noise and its technical and legislative control. The reports on the very successful conferences organised by the Underwater Acoustics Group and the Speech Group reported here add further testimony to that fact.

At around the time this goes to press and from the same stable as the Bulletin and the Members Register comes a new publication, the Institute's Buyers' Guide. Ever since the present arrangement was put in place in 1991, the Bulletin has been produced by the time-honored means of Apple software and camera-ready paper produced in the Publications Office. This is a little antiquated by today's standards but one that was clung onto as a method that was at least understood. The production of the Buyers' Guide is a small step forward in that the printer's films were produced straight from disc. This seems to have been successful and further attempts at being dragged, screaming, into the 1990s are planned.

It has puzzled me for some time why very few notifications of happenings in the wider world of acoustics are sent in for inclusion in the News section of this journal. There must be many personnel, organisational and premises changes that are worth giving an airing. The downbeat conclusion would be that members do not see the Bulletin as the logical vehicle for that sort of thing, but I don't think this is really the case. Equally reports would be welcome on news-worthy events in members' own localities, especially where they are not trumpeted nationally. End of sales puff.

Roy Lawrence FIOA

Points from Some Recent Standing Committee Minutes

Publications Committee 17 September 1998

Reported: The library had been moved to the new premises and amalgamated with material which had been in storage. Material from the Hope Bagenal archive has been offered to the Institute. The Librarian, Mrs Alison Hill, is to visit and report on what is available.

Considered: A report by John Tyler on two meetings of the Proceedings Working Party (intended to improve the standard of papers presented at meetings and conferences, which were recorded for posterity in the IOA Proceedings and to improve the appearance of the printed page in the volumes). **Issued:** A set of draft documentation for comment by members of the committee prior to submission to Council.

Tabled: A set of draft documents by John Tyler as a basis for the rewriting of Institute literature. **Noted:** A graphic designer has been appointed.

Noted: That the matter of the IOA web page will be referred to in a future President's Letter to raise its profile with members and to obtain feedback about its role.

Meetings Committee 22 September 1998

Reported: Meeting on Measurement of Sound Transmission in Buildings, at BRE Garston on 9 September 1998 was successful with 24 delegates attending. **Considered:** Running the event again in 1999.

Considered: The future meetings programme and the numbers registered where appropriate. **Agreed:** There appeared to be no events causing undue concern.

Noted: The search for a location for the 1999 Spring Conference was proving problematical and was continuing. **Agreed**: A Call for Papers would be published in the next issue of Acoustics Bulletin.

Membership Committee 24 September 1998

Reported: Applications received for various grades were as follows (the number recommended for approval, or accepted, are in parentheses)

Fellow 3 (2): Member 26 (21): Associate Member 70 (70): Associate 5 (5): Student 1 (1): Sponsor 2 (2)

Reported: Lapsed members; 69 members in various grades had not responded to the final demand for fees and have been removed from membership.

Considered: The scale of fees for 1999. **Agreed:** The basic pattern of fees across the grades is satisfactory at present. **Noted:** An increase in the level of fees would be required.

Cathy Mackenzie HonFIOA

MEASUREMENT OF AN EFFECTIVE ABSORPTION COEFFICIENT BELOW 100 Hz

X Zha, H V Fuchs, C Nocke & X Han

Introduction

There are two standardized methods for the measurement of sound absorption. The reverberation room method [1] is based on a diffuse sound field in the room. For reverberation rooms with regular sizes of about 200 m³ or more the lower frequency limit lies between 100 and 125 Hz for third-octave measurements.

The impedance tube method [2] on the other hand measures the impedance and the absorption coefficient in narrow frequency bands for normal incidence. This method has its low frequency limits due to the longitudinal dimensions of the tube. The results of both test procedures show a considerable influence of the respective mounting conditions for the test specimen within the respective boundaries. Any application of such laboratory data under varying room acoustic circumstances therefore always requires some practical experience, particularly so at the lower frequencies.

On the other hand, it is the absorption efficiency of acoustic materials at very low frequencies which is of growing interest in noise control and room acoustic design tasks. All measurements of sound absorption in regularly sized rooms at low frequencies below 100 Hz have to realize and accept the physics of the modal sound field [3, 4]. This contribution describes a method of measuring the effective sound absorption at low frequencies in an ordinary rectangular room within its modal sound field. The sound absorption of specially designed low frequency absorbers [5, 6] is presented.

Measuring Absorption with Low Eigenfrequency Density

Decomposition of the frequency band

The sound field at low frequencies in a room is determined by a small number of eigenfrequencies in a certain frequency band, eg third-octaves. If this number is too small the condition of a diffuse sound field is not fulfilled. Therefore the whole frequency range is split into three ranges wherein different measuring techniques are applied:

- at one-third octaves comprising more than 20 eigenfrequencies the standardized measuring technique is applied. This frequency range extends down to that limit given in the standard [1], (compare with Figure 1).
- at one-third octaves with an eigenfrequency density between 5 and 20 the standardized method is modified. The excitation of the sound field as well as the measurement of the reverberation time with and without the test object are performed in the corners of the room where all eigenfrequencies in this frequency range are excited and can be registered. The absorption coefficient can be calculated by using the formula given in the standard [1].
- at one-third octaves with 5 or less eigenfrequencies each eigenfrequency of the room is excited separately with a sine wave signal. The decay times at a particular eigenfrequency without and with the test object in the room are measured. From these the (effective) absorption coefficient at this particular eigenfrequency of the room can be calculated according to the well known equation (1):

$$\alpha_{eff} = 55.3\left(\frac{V}{Sc}\right)\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \qquad (1)$$

with the decay (or 'ringing') times T_1 and T_2 in the empty room and the room with test objects, respectively, volume V of the room, speed of sound c and surface S of the test objects.

The effective absorption in the modal sound field does not only depend on the absorber itself but also on the geometry of the room and the position of the absorber therein. With the following model calculation [6] this behaviour can be displayed theoretically. In a rectangular room with acoustically hard walls the sound energy density for all

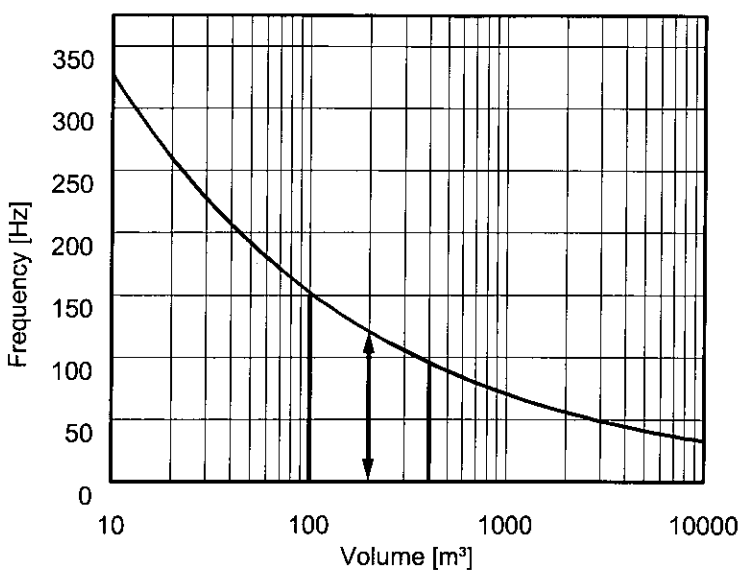

Fig. 1. Volume of a reverberation room required according to DIN EN 20 354 and DIN EN 23 741 for a given lower limiting frequency.

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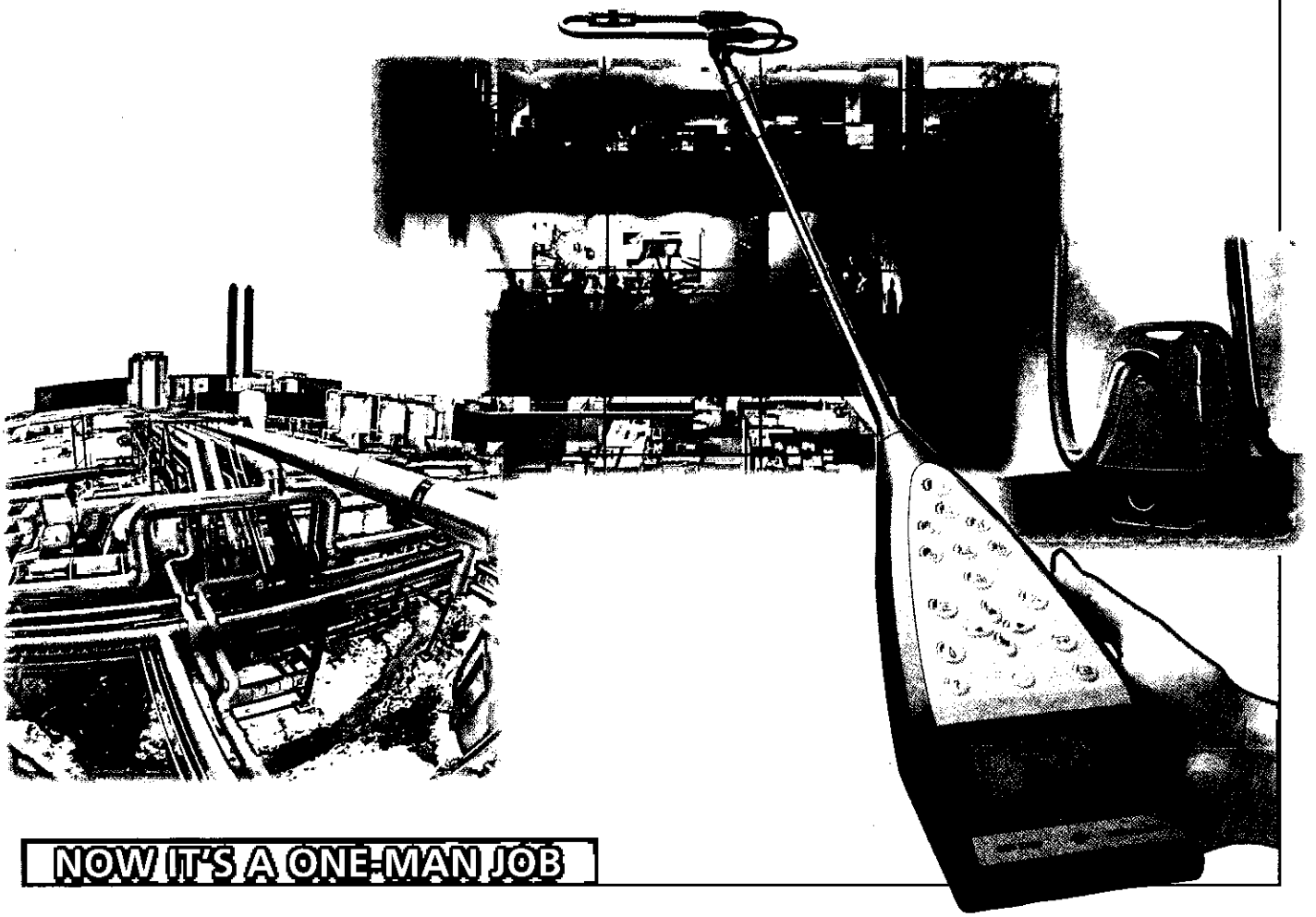

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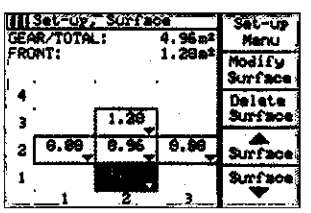

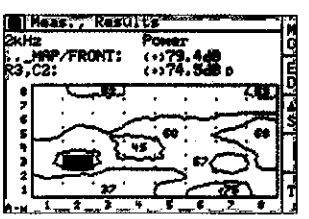

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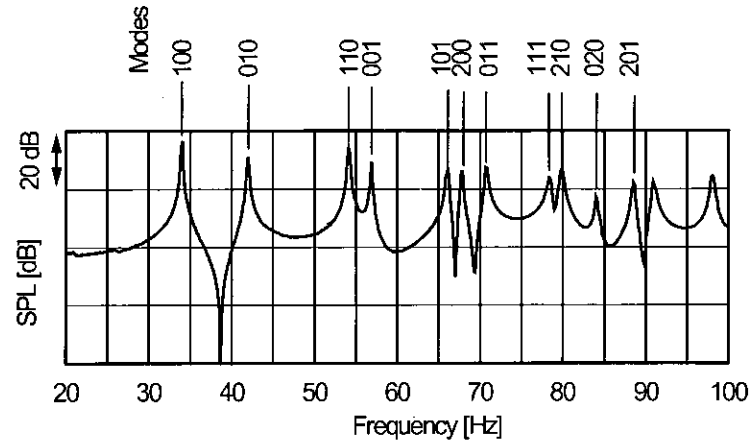


Fig. 2. Transfer function and eigenmodes of the laboratory at the IBP.

axial modes in x-direction ($n_y = n_z = 0$) in, for instance, a volume of $\lambda/8$ thickness, $V_t = (\lambda/8).l_y.l_z$ is given by:

$$\underline{w}_{(n_x,0,0)\lambda/8} = \frac{\underline{p}^2_{max}}{\rho c^2 V} \int_{x=0}^{\lambda/8} \int_{y=0}^{L_y} \int_{z=0}^{L_z} \cos^2 \frac{n_x \pi x}{n_x \lambda/2} \cos^2 \frac{0\pi y}{L_y} \cos^2 \frac{0\pi z}{L_z} \, dz \, dy \, dx \quad (2)$$

$$= \frac{\underline{p}^2_{max}}{\rho c^2} \left(\frac{1}{2}\right)\left(\frac{2+\pi}{\pi}\right) \quad (3)$$

The mean sound energy density averaged over the whole room for all axial modes in the x-direction is obtained by integrating equation (2) from x = 0 to ($\lambda/4$):

$$\underline{w}_{(n_x,0,0)mean} = \frac{\underline{p}^2_{max}}{\rho c^2}\left(\frac{1}{2}\right) \quad (4)$$

The ratio of the sound energy density (3) and the mean sound energy density (4) yields a parameter characteristic of all axial modes (n_x,0,0), (0,n_y,0), (0,0,n_z),

$$\frac{\underline{w}_{(n_x,0,0)\lambda/8}}{\underline{w}_{(n_x,0,0)mean}} = \left(\frac{2+\pi}{\pi}\right) = 1.64 \quad (5)$$

For another finite thickness of the absorber a similar calculation yields the same amplification parameter for the efficiency of compact absorber modules in a modal sound field. When thin sound absorbers that react on the sound pressure are placed in areas of high sound energy density, this parameter shows why so much higher absorption may be expected than in a diffuse sound field. For tangential modes (one of the mode indices = 0) a factor of 2.68 can be calculated, for oblique modes (none of the mode indices = 0) a factor of 4.38 is reached for the same integration limits. This calculation is only applicable for low frequencies with wavelengths much bigger than regular sized absorbers placed in areas of high sound energy density.

Measurement set-up

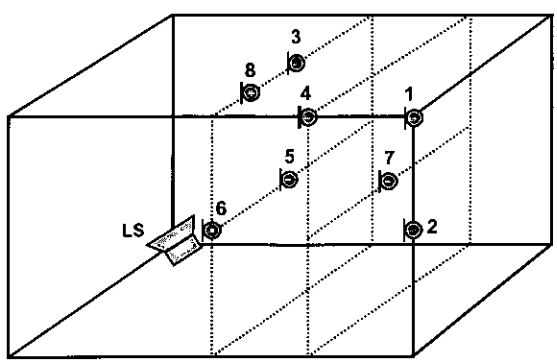
The eigenfrequencies in the room are deduced by measuring the transfer function of the empty room from one corner to the opposite corner. The transfer function and the eigenmodes of the laboratory of the IBP with the size of 5 m x 4 m x 3 m [7] is displayed in Figure 2.

The eigenfrequencies can be calculated with the well known formula [8]:

$$f_{(n_x,n_y,n_z)} = \left(\frac{c}{2}\right)\sqrt{\left(\frac{n_x}{L_x}\right)^2 + \left(\frac{n_y}{L_y}\right)^2 + \left(\frac{n_z}{L_z}\right)^2} \quad (6)$$

with the modal indices n_x, n_y, n_z and the dimensions of the room in the x-, y-, z-directions L_x, L_y, L_z. With the modal indices of the calculation and the eigenfrequencies of the room the modal shape of the eigenfrequencies in the laboratory can be obtained.

In order to be able to excite all eigenfrequencies in the laboratory, the loudspeaker is placed in one corner of the room. The registration of the decay time of the eigenfrequencies can be achieved in principle by positioning one microphone in a corner of the room, where high sound pressure of all eigenmodes exist. Even though there are not many eigenfrequencies in a frequency band some of them lie very close together which can lead to beating effects in the decay curves. This makes it difficult to measure the decay times individually. To better separate the decay times of the different eigenfrequencies, microphones have been installed at well-selected specific positions in the laboratory, where the neighbouring eigenfrequencies have a sound pressure knot (low sound pressure) and cannot disturb the measuring



Microphone position	Mode (x,y,z)	Frequency [Hz] measured	calculated
1	1,0,0	34,0	33,6
1	0,1,0	42,0	41,8
2	1,1,0	54,1	53,7
3	0,0,1	56,9	56,8
4	1,0,1	66,1	66,0
5	2,0,0	67,8	67,2
4	0,1,1	70,6	70,5
1	1,1,1	78,4	78,1
6	2,1,0	79,9	79,2
7	0,2,0	84,0	83,7
8	2,0,1	88,5	88,0

Fig. 3 Sketch of the laboratory with the loudspeaker and microphone positions and list of the eigenmodes with the eigenfrequencies in the empty laboratory.

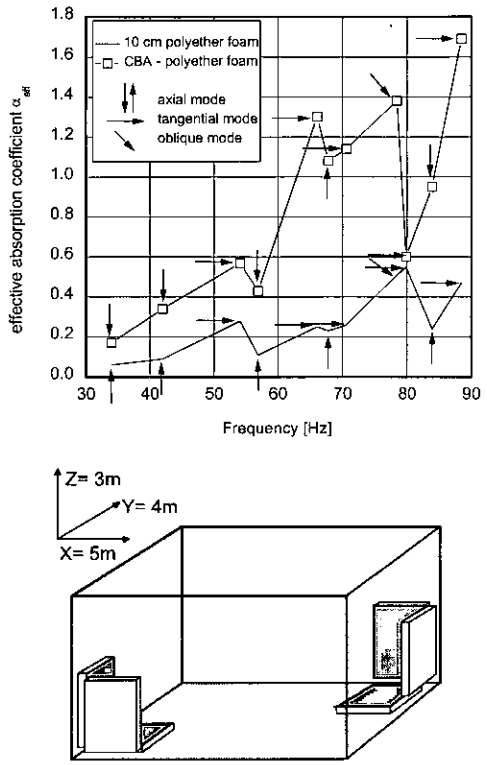


Fig. 4. Effective absorption coefficient of a compound baffle absorber (CBA) in comparison with a foam absorber of the same size. Placement of the 6 measured absorbers in the laboratory.

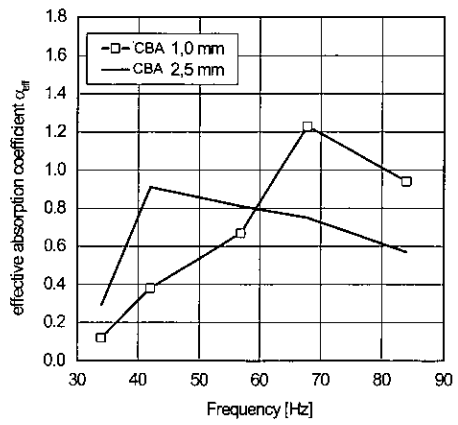
results. Figure 3 shows the microphone positions of the laboratory at the IBP and the measured and calculated eigenfrequencies of the laboratory without absorbers.

Due to the installation of sound absorbers the structure of the modes and the eigenfrequencies in the room may slightly change. Nevertheless, with an adequate small number of absorbers this effect is negligible and the effective absorption coefficient of the absorber at the eigenfrequencies can be determined using equation (1).

Results of Measurements

Figure 4 shows absorption coefficients of compound baffle absorbers (CBA) [5] developed at the IBP and a foam sample for comparison. The CBA consist of a metal plate in close contact with a foam plate. The different modes are indicated by arrows. The results show a considerable dependence of the effective absorption coefficient on the type of mode at the respective eigenfrequency. Axial modes give systematically lower effective absorption coefficients than tangential modes and oblique modes typically reach a relatively high value. The foam, for comparison, shows much less effective absorption at these frequencies.

By measuring at different microphone positions in the room it is possible to distinguish between the different eigenfrequencies. Installing the absorbers only in one direction at a time (see Figure 5) and doing this in all three directions, one can present the absorption coefficient for the axial modes with the absorbers perpendicular to the mode orientation. This method makes it



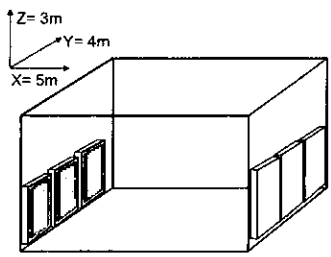


Fig. 5. Different compound baffle absorbers (CBA) measured at the axial modes of the laboratory and placement of the 6 measured absorbers in the laboratory.

possible to eliminate the influence of the different types of modes on the results. Measurements of different types of CBA absorbers are shown in Figure 5. The depth of all CBA is 10 cm, the surface area of each absorber is 1.5 m². The number (1.0 mm/2.5 mm) indicates the thickness of the metal sheet of the CBA. The positioning in x-direction is also displayed in Figure 5, in all other directions the procedure was analogous.

The use of heavier metal sheets shifts the higher sound absorption to lower frequencies as expected. The effective absorption coefficient reaches sufficiently high values for practical applications.

These measurements are much easier understood because they are made at the axial modes of the room and there is no influence of the different mode structures. On the other hand, there are not many eigenfrequencies to measure at. As this type of absorber is a highly damped baffle resonator with a wide band absorption property it is possible to gain information about the absorbers by applying this method. The few measuring points, however, make it impossible to evaluate the frequency of maximum absorption exactly. Narrowband absorbers as Helmholtz resonators also would be difficult to analyse with this method.

Nevertheless this specific experimental tool displays the performance of sound absorption in small rooms at low frequencies. It is helpful for the design and testing of new low frequency sound absorbers and has been successfully applied as a valuable means to select suitable acoustic materials and handy compact modules especially for room acoustic design tasks in acoustically demanding audio-rooms [9 – 13]. Figure 6 shows the mounting of CBA-modules at the walls and ceiling of a mastering room in a professional studio. The reverberation time and transfer function characteristics obtained in this 53 m³ large room are presented in Figures 7 and 8. The client was fully satisfied by these results.

Conclusions

This measurement method allows measurements of the effective absorption coefficient at low frequencies. It is related to the standardized method but takes care of the unavoidable influence of modal sound fields. This method allows us to compare the effective absorption coefficients of different types of absorbers, to develop new sound absorbers and to optimize components in small rooms. Presently an attempt is being made at the IBP to qualify standard reverberation rooms for measurements below 100 Hz by introducing a small number of low-frequency absorbers in its lower corners which adequately damp the room resonances to enable α measurements otherwise strictly according to the standardized measuring procedure [1]. The results, so far, seem to confirm the findings presented in this paper. These investigations are an integral part of an ongoing larger effort to extend our existing building and room acoustic measuring and qualification standards for construction elements in the range of frequencies below 100 Hz, possibly down to 50 Hz.

Fig. 6. Bass absorber modules mounted on the walls and ceiling of a mastering room in a music studio.

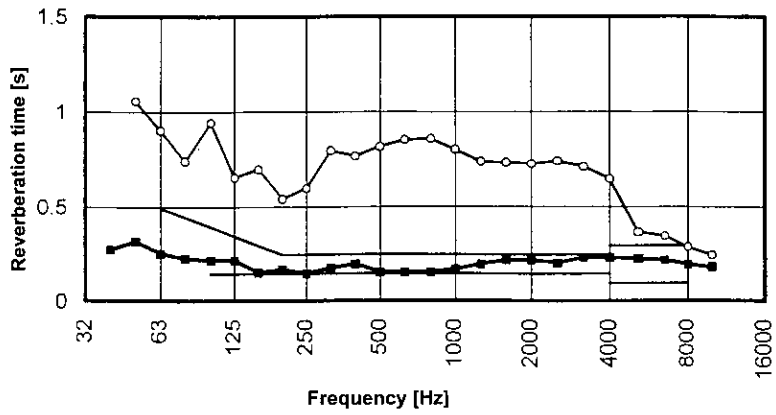


Fig. 7. Reverberation time as measured before and after a comprehensive acoustic treatment of the mastering room depicted on Fig. 6. —o— before treatment —■— after treatment —— ITU recommendation

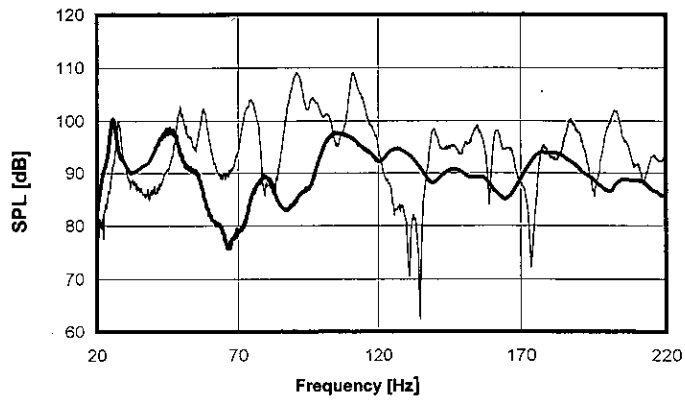


Fig. 8. Transfer function as measured before and after a comprehensive acoustic treatment of the mastering room depicted on Fig. 6.
—— before treatment ——— after treatment

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This is an extended verion of a paper presented by the first-named author at Euro•Noise 98, Munich, p781-786. The authors are at the Fraunhofer-Institut für Bauphysik (IBP)(Director: Prof Dr-Ing habil Dr hc mult Dr Eh mult K Gertis), Stuttgart, Germany. ❖

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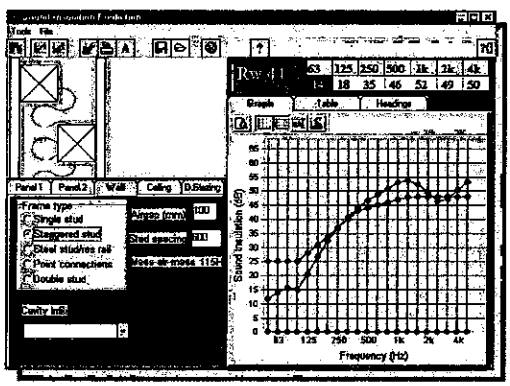

INSUL can be used to quickly evaluate new materials and systems, or to investigate the effects of changes to existing designs. It models materials using the simple mass law and coincidence frequency approach and models more complex partitions using work by Sharp, Cremer and others. It has evolved over several versions into an easy to use tool that takes advantage of the Windows™ environment, and has refined the theoretical models by continued comparison with laboratory tests to provide acceptable accuracy for a wide range of constructions.

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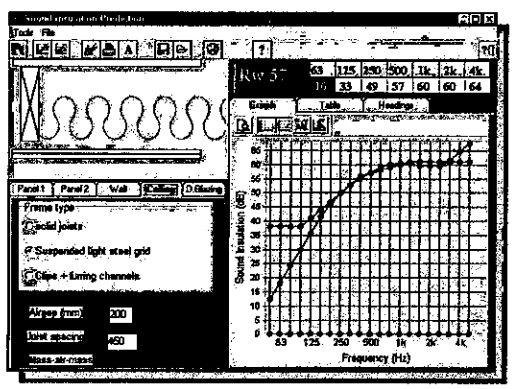

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HEALTH EFFECT- BASED NOISE ASSESSMENT METHODS

Bernard F Berry FIOA, Nicole D Porter MIOA & Ian H Flindell MIOA

Introduction

Because there are often severe technical, economic and social constraints on what can be achieved in practice, noise control is not simply a matter of setting targets and then taking action as required. The assumed benefits of noise control action must be carefully weighed against these costs, and this is hard to do when the most widely used indicator of noise effects is simply 'annoyance'. It is clear that a general change-over to some more tangible indicator of effects such as effects on health, might enable the setting of future noise targets with greater transparency. The European Commission is already moving in this direction as suggested in the 1996 EC Green Paper 'Future Noise Policy' [1]. This refers to the possibility of a Directive establishing target values, and an obligation to take action to reach such targets.

It is against this background that the National Physical Laboratory (NPL) together with the Institute of Sound and Vibration Research (ISVR) began a project in January 1998 for the UK Department of the Environment, Transport and the Regions (DETR) to review noise standards used for assessing the health impact of environmental noise. The objectives of the project were to consider existing information to establish noise levels at which there may be particular effects on the population, and from this, to advise on the feasibility of establishing effects-based standards which could be used to inform the setting of objectives and targets.

In short, DETR wanted to know how, or even whether it is possible, to derive robust health effect-based noise standards. They needed to know whether health effects actually exist at typical levels of environmental noise and if they can be reliably quantified. Additionally they needed to know what other factors should be considered in establishing practical effect-based assessment methods. This paper explains how the work was carried out, summarises the conclusions, and puts forward an approach to using the information acquired in the study.

Work Strategy

The work was divided into two phases, review and feasibility study.

Phase 1 – Review

The review phase was split into three stages;

1. *A review of literature on the effects of environmental noise.*

An analysis was made of existing review literature on the effects of environmental noise. Much of the work had already been done in the extremely comprehensive study undertaken by a committee of experts on behalf of the Health Council of the Netherlands, and published in 1994 under the title Noise and Health [2]. In the interests of efficiency of effort and in view of the short time available, our review took the 1994 report as its starting point. A number of key review papers since 1994 were then identified and have been used to varying degrees in the course of this work.

2. *A review of current standards and noise criteria/limits in operation in the UK and other EU countries.*

The aim of the review of noise criteria was to summarise the standards and limits used to control environmental noise, and where possible to find out the origin and justification for the numerical noise limits. The starting point for this review was two key publications. In 1994 Dieter Gottlob of the German Federal Ministry of the Environment presented the results of an extensive review of community noise regulations [3]. In 1995 work was completed at NPL on a review of national practices on the assessment of industrial noise [4]. For this project, requests for updated and additional information were sent to representatives in EU countries. In the requests, the aims of the project were described and information was sought in three main areas related to the measurements and assessment of environmental noise: the legislative or regulatory framework, the noise limits where specified (and units), and a brief history of research findings or any other basis against which the standards and/or noise limits were developed.

3. *A review/critique or 'guide to interpretation' of the 1995 WHO Community Noise Guidelines document.*

This was used to highlight the difficulties of setting over-precautionary noise limits based on scientific evidence alone.

Phase 2 – Feasibility study

This phase considered whether effects-based standards can realistically be set in the UK context. The findings are based on;

- The extent to which there is general agreement on the existence of an effect due to noise.
- The extent to which there is general agreement on the noise-exposure relationships and how reliably these can be used to set threshold indicators for effects.
- The uncertainties associated with combining separate effects to determine an overall impact on health.
- The role of other factors apart from noise exposure level in setting practical, useful and attainable noise criteria.

Outcome of the Study

The detailed results of this review study are provided in a report, copies of which are available from NPL [5]. The results are reported in three main sections, summarised as follows;

An examination of the scientific evidence for health effects due to noise

There are a number of definitions and defined requirements for (good) health but it is concluded that a descriptor that can be used to assess the impact on health, and can provide a framework on which to base a method to balance costs and benefits, is the most useful to the decision maker.

The literature confirms that there are a number of potential effects of noise on health, although the evidence in support of actual health effects other than those based on reported bother or annoyance and on some indicators of sleep disturbance is quite weak. The available literature tends to be contradictory. In general, it is often the research studies with the least control over bias and confounding factors which show the strongest effects. There are serious methodological difficulties involved in being able to carry out definitive research. This also means that significant effects amongst the most susceptible minority of the population remain scientifically plausible, even if unproven.

On examining existing information on exposure-response relationships based on scientific evidence, we can draw some conclusions from the primary research. Since the evidence in support of potential health effects other than annoyance is either contradictory or controversial, we cannot at present define any precise exposure response relationships for any effects other than annoyance, and there is some uncertainty even for that effect. There are many non-acoustic factors involved in both annoyance and other effects, each of which undoubtedly adds to the general variability in the data. The scientific evidence suggests thresholds below which it is possible to infer that there are no significant health impacts. Equivalent thresholds at the upper end of the scale above which definite health impacts are likely are much more difficult to determine.

The possible links between observable and mostly short-term effects and longer-term impacts on health are even more problematical. How might one effect modify another? What precise role is played by effects-modifiers and confounding variables such as diet and lifestyle. What makes one individual more susceptible than another? Are there any hidden costs of adaptation remaining so far undiscovered because they have not been previously looked for?

An investigation of the practical noise criteria used to assess environmental noise

Practical noise targets are a compromise between the desirable and affordable. The desirable relates to the thresholds suggested by the scientific evidence below which no effect is expected. The affordable involves weighing the costs and benefits in monetary and social costs. Practical noise limits are usually set above these lower desirable thresholds.

On reviewing environmental noise regulations and standards in the UK and in other EU countries, we find that existing standards and regulations usually take the results of primary research into account to some extent, but social, political and historic factors are at least as

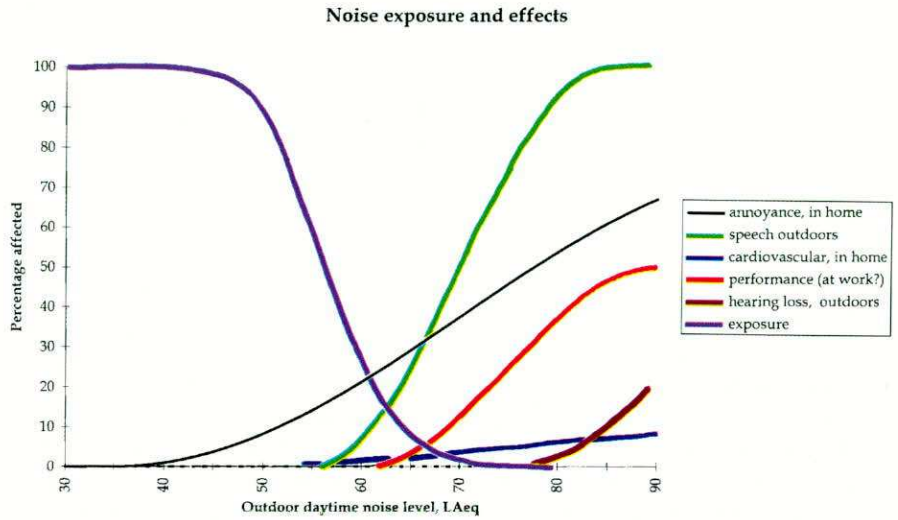

Fig. 1*. Day time noise exposure and effects.

important. It is very important to be clear about the role played by these factors in the development of current standards and regulations and their likely role in future developments.

A guide to the interpretation of the WHO guidelines

In view of the uncertainties involved in setting standards, there are moves within Europe to adopt a precautionary approach when setting future noise standards and regulations to protect against possible health effects. An example of this is the way in which the recent 1995 WHO guidelines [6] have been interpreted in some quarters. It is necessary to consider the wider consequences of any over-precautionary approach in the context of potentially unacceptable impacts in other areas, such as costs or limits on the freedom to travel.

Many individuals might consider a certain amount of noise to be a fair price to pay in exchange for the personal freedom granted by the motor car, yet the quickest way to cut environmental noise levels at a stroke would be to ban cars.

Further Interpretation

In this section we suggest an approach to the interpretation of the information arising from the review which might be used to indicate the relative importance of various effects and which could be useful in the process of setting standards. Figures 1 and 2 illustrate the general position in the UK in relation to the percentages of the population of England and Wales exposed to different noise levels measured outside their homes [7] and the likely percentages of those populations affected by noise in different ways. Each effects curve is forced to a generic S-shape with the centre, slope and maximum effect varied in accordance with professional judgement. The precise positions of the various effects curves cannot be considered to be definitive at this time for two reasons. First, there is uncertainty in the literature regarding the shape of the various exposure-effect curves. Second, there is some uncertainty regarding the units in which each effect is measured.

For example, the generic daytime annoyance curves as shown could be considered as representing the percentages describing themselves as either moderately or extremely annoyed. This ought to make a great difference to the political interpretation of any results, yet different researchers continue to measure such effects in different ways. As another example, should the hearing loss and sleep disturbance curves represent either the slightest detectable effect or effects of such magnitude that they have a particularly significant effect on an individual's quality of life?

The issue of clinical significance is relevant here [8]. If the problems of confounding factors could be overcome, then epidemiological research may reveal weak but statistically significant associations between exposure and effect, for example elevated blood pressure and noise

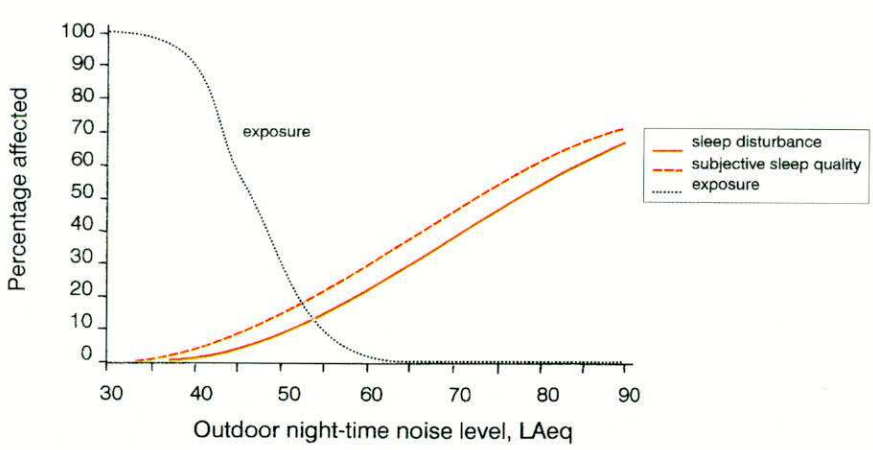

Fig. 2*. Night-time noise exposure and effects.

exposure outdoors. But this does not of itself mean that these small changes necessarily have any clinical significance. Finally, it is important to note that the available information on some of these effects relates to noise exposure at the receiver and not to the magnitude of the effect when residents are indoors and possibly protected by noise insulating facades at the higher outdoor noise levels.

Figures 1 and 2 clearly show that the relative significance of the different noise effects varies considerably in terms of the percentages of the overall population potentially affected. For example, the generic annoyance curve on Figure 1 shows around 20% affected by some degree of annoyance at 60 daytime L_{Aeq} measured outdoors but it is important to remember that this is 20% of the 26% exposed at that noise level (ie around 5%) and not 20% of the whole. Moving up the scale, we have possibly less than 5% of exposed persons subject to weak cardiovascular effects at 70 daytime L_{Aeq} measured outdoors, which is less than $^1/_{10}$ of a percent of the population as a whole. While noise induced hearing loss can constitute a major disability, there would seem to be virtually nobody at risk of even the slightest degree of deafness caused by environmental noise.

Figure 2 shows a similar pattern with respect to night-time noise. According to the notional curves shown, only a very small percentage of the overall population would appear to be in locations where night-time outdoor noise levels are high enough to cause major disturbance.

It is also clear from the figures how existing guidelines such as the often quoted 55 L_{Aeq} recommendation from the 1980 WHO criteria document [9] fit into the overall scheme of things. Clearly, only a small percentage of the population exposed at 55 daytime L_{Aeq} measured outdoors are affected by annoyance, and virtually none of them are affected in other ways. On the other hand, something over 65% of the population are exposed at this level. This illustrates both the conservative nature of the 55 L_{Aeq} guideline value in terms of effects and also the likely difficulty in being able to do anything about it anyway.

Subject to the general uncertainty regarding the precise shape of the various exposure-effects curves, this analysis leads to the general conclusion that health effects other than reported annoyance, and some relatively moderate degree of sleep disturbance might only be a problem for a small proportion of the overall population. This conclusion does not diminish the importance of those effects for individuals, but it might influence government when establishing priorities for future noise control effort.

Of course, the only way to overcome this existing uncertainty is to carry out carefully targeted research. However it is difficult to avoid the conclusion that any such research is unlikely to come up with any more definitive results than in the past unless some considerable ingenuity in terms of both methodology and theory is brought to bear. The case for first attempting to find some way of selecting the most susceptible individuals from the general population before proceeding to any more general research is made all the more clear by this analysis.

Conclusions

Given the present state of knowledge, it would be unwise to base future environmental noise standards and regulations on what are at present hypothesised non-auditory health effects until future research can make the present confused situation clearer. There could be greater transparency in the way in which future standards and regulations are developed so that the public can become more aware of both the strengths and limitations of these standards. An increased emphasis on non-auditory health effects, as opposed to annoyance, as the outcome variable may lead to this greater transparency, although there is considerable doubt at the time of writing as to the magnitude of these effects due to environmental noise. To ensure that non-auditory health effects are included in the development of future standards, research is required. This must be carefully designed, not only in terms of its planning and execution, but also in terms of setting precisely defined and achievable objectives.

*** Note: whilst the shapes of the curves in Figures 1 and 2 are based on the literature, they are only intended as notional examples, and should not be taken as definitive.**

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VOICE EVACUATION FOR MANCHESTER AIRPORT TERMINAL ONE

Paul Malpas MIOA

Introduction

Manchester has by far the busiest UK airport outside London, with nearly three times as many passengers in 1996 as Glasgow or Birmingham (see Table 1). Terminal One has been developed to increase this capacity by 25% and to provide an extra 25 retail outlets.

Early in the project, Architects Nicholas Grimshaw & Partners, Engineers Ove Arup & Partners and Contractor Bovis-Lehrer McGovan took office together on site with the client, Manchester Airport plc. This large team set about designing, engineering and constructing the massive transformation of the departures area of Terminal One.

Included in this work was the upgrading and extending of emergency systems in this area, including the Voice Alarm (VA) evacuation system. Arup Acoustics were asked to give electroacoustic design input to the loudspeaker layouts and to specify the systems.

This account describes a number of design issues concerned with VA design in airports and relates them to the work at Manchester Airport involving Arup Acoustics (AAc) and the Manchester office of Ove Arup & Partners (OAP). In the first section, airports are described in general to set the context to the project and to highlight a number of aspects of VA design in terminal buildings. Following that is an overview of the total works and a summary of the starting point for the VA design.

After that, two sections explain the functional and electroacoustic design methods respectively. To illustrate the account of the electroacoustic design, some example spaces have been chosen to examine the loudspeaker layout options considered, the chosen design solutions and the resulting installed performances.

An Introduction to Airport Terminals

It is important to bear in mind that the main function of airport terminal building design is to facilitate passenger movement in large numbers. An appreciation of this point is a great help in digesting the complexities of the plans, and in identifying the spaces for special electroacoustics attention. Figure 1 illustrates the principal passenger routes of a typical, international and domestic airport terminal.

AIRPORT	TERMINAL PASSENGERS
London (Heathrow)	55,722,800
London (Gatwick)	24,106,100
Manchester	14,484,700
Glasgow	5,471,600
Birmingham	5,352,500
London (Stansted)	4,811,400

Table 1 UK's busiest airports, 1996

With consideration to evacuation systems, airport terminals can be characterised as follows:

- They are usually very large buildings containing voluminous spaces.
- Periodic expansion often complicates the layout and passenger routes.
- They often have very large numbers of occupants.
- Most occupants are unfamiliar with the layout of the buildings.
- Evacuation planning must avoid the possibility of security breaches and must address all safety issues.
- The building form and compartmentation is derived principally from passenger flow.

Some specific terminology is involved and a glossary of terms is included on page 20.

Building Works and Building Layout

Before design work began in 1995, Terminal One consisted of T1 International and T1 Domestic. T1 International contained most of the accommodation and has now been extended, remodelled and refurbished to create Terminal One Central (T1C). Work included the extension by 17 m of the 120 m main frontage onto the apron, the addition of a new airside lounge to the west and remodelling of most of the departure area. The new lounge connects to the first Harrods store in the UK outside London. The T1C contract covered around 20,000 m² and was valued at £23 million.

T1 Domestic had comprised a small combined arrivals and departures hall, some baggage sortation and the domestic Pier A. Under the separate Terminal One East (T1E) contract, Pier A become a flexible pier (domestic/international) and the terminal was extended to the east to create Terminal One British Airways – the combined domestic and international terminal for BA and its partner airlines. This £68 million project was opened in the summer of 1998, is the biggest BA operation outside London, and its first to be branded in the new British Airways 'World Image' livery. This part of the terminal alone has been designed to ultimately handle up to 6 million passengers per year and expects to be handling over 4.5 million passengers by 2001.

As the family of airlines partnered by BA at Manchester has extended, the distinction between the parts of the terminals has become less clear to passengers, and there are already plans to rename Terminal One British Airways as Terminal Three.

Figure 2 is a photograph of a model showing the extent of new and refurbished areas of T1C and T1E.

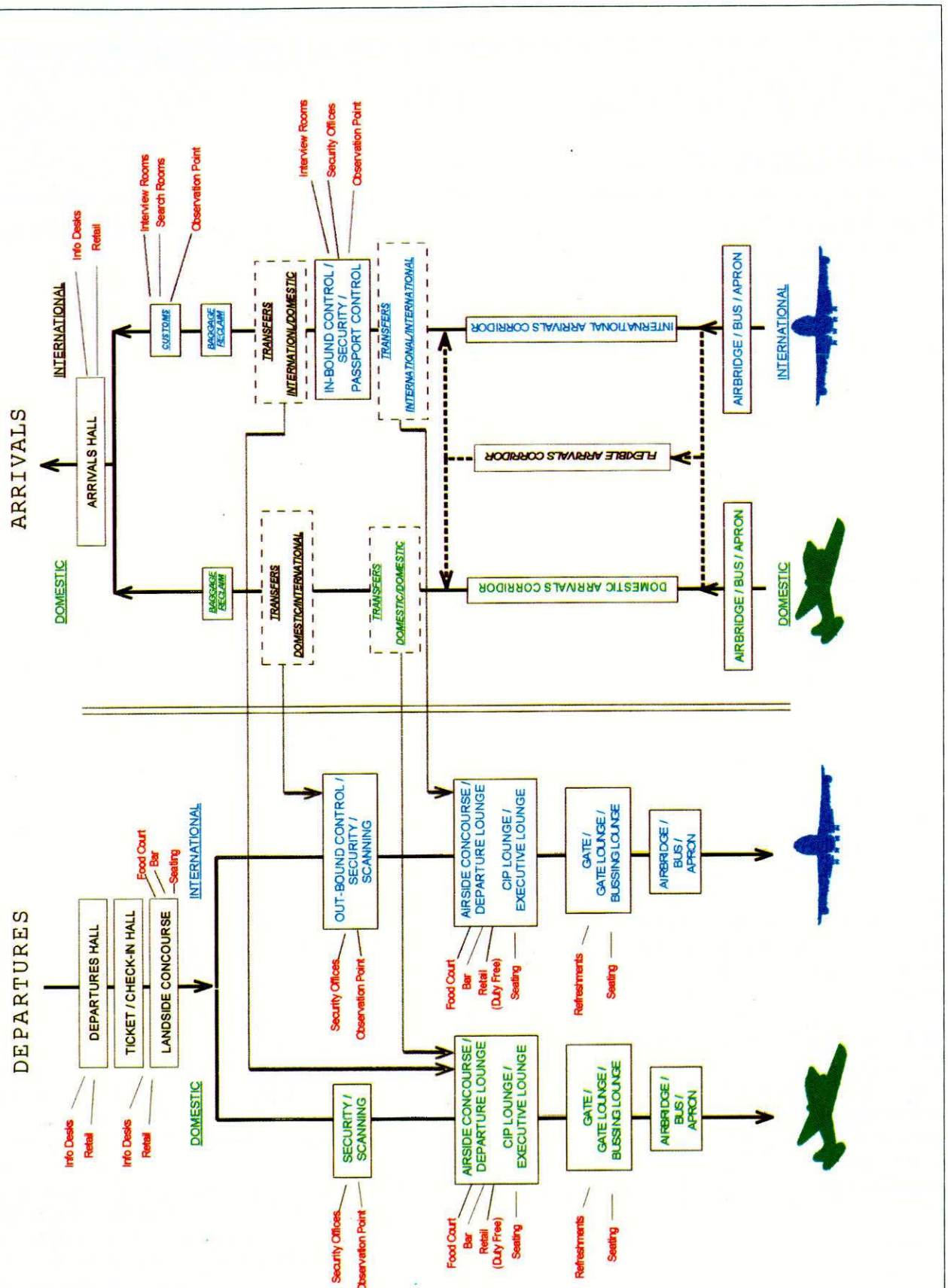

Fig. 1. Principal passenger flow routes through a generic international/domestic airport terminal

Voice Alarm Systems – Works Overview

The building is covered by two discrete systems: Terminal One Central and Terminal One East.

Terminal One Central (T1C) was already covered by a PA system suitable for VA operation. VA had been installed in recently developed areas during subsequent chapters of the building's history. This system preceded recent VA and fire alarm design codes.

The head-end (ie centrally located) equipment for the PA/VA in T1C had been upgraded previously by Audix Communications. This included fault monitoring and battery back-up in readiness for upgrading the loudspeaker layouts and cabling. The latest work at the terminal gave the opportunity to change the loudspeaker layouts in a large majority of spaces.

AAc and OAP specified the loudspeaker types and locations by applying zoning requirements set by MAplc. Audix were awarded the contract to upgrade their own part of the central equipment to deal with the additional number of loudspeaker zones and loads. The overall electrical and mechanical services (E&M) contract went to ABB-Steward.

The upgraded T1C system comprises 748 loudspeakers, 34 zones and 90 amplifiers of 8.5 kW total capacity.

Terminal One East

This area was predominantly new-build and was to operate almost independently of the remainder of Terminal One. Under a separate contract, the existing VA system was replaced by a new VA system, specified for the whole of T1E. This was facilitated by the fire compartmentation design.

The airport specified all zoning requirements, operational microphones, pre-recorded messages and areas of coverage. AAc/OAP produced from this a full technical specification as part of the E&M contract documents, and Audix Communications was again awarded the contract, this time against one competitor.

The new T1E system comprises the following equipment:

Inputs: A total of 58 in number, made up of:

- 1 fire microphone
- 1 evacuation message
- 1 coded suspect packet alert
- 20 security, management and information desk microphones (including 5 in other terminals, connected via structured cabling)
- 23 gate microphones + 6 pier expansion inputs
- 2 pre-recorded announcements
- 3 further spare inputs
- 1 test message / test source input

Outputs: A total of 41 in number, comprising

- 36 main loudspeaker zones
- 5 common evacuation stair loudspeaker zones

(658 loudspeakers, 87 amplifiers, 6 kW total.)

Equipment:

- 2 Input and routing racks;
  - pre-amplifiers

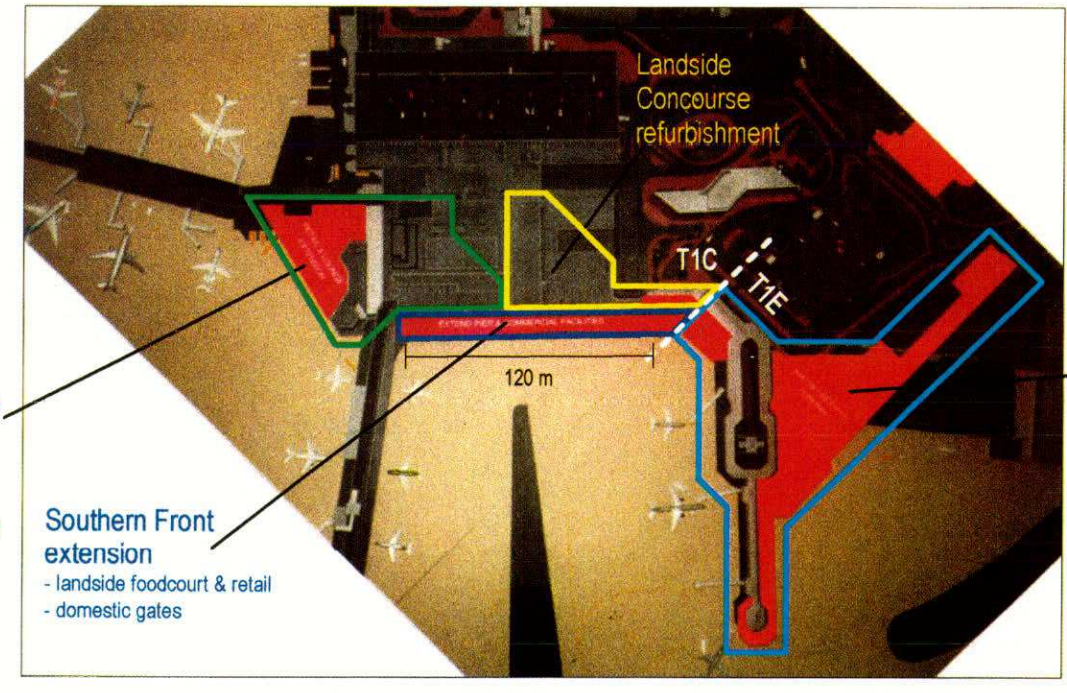

Fig. 2. Photograph of a model showing the extent of new and refurbished areas at Manchester Airport Terminal 1 (1996-1998).

- matrix/controller (V32 and microprocessor controllers)
- ambient noise sensing (ANS) controllers
- equalisers
- fault monitoring and reporting
- fire alarm interface

4 power amplifier racks
1 battery & charger rack

Design Principles

System Design

In addition to the normal requirements of BS 5839 (Part 8 was released after award of the contract) and BS 7443 (now effectively BS EN 60849) together with the basic requirements of MAplc led to the following principles being applied to the design of the T1C upgrade and to the new T1E system:

- VA zoning must relate directly to the evacuation plan, whereas PA zoning must be for operational purposes (ie paging areas). The resulting loudspeaker zones are based on the 'lowest common denominator' between the PA and VA requirements, including any essential rationalisation to avoid over-complication
- Careful consideration must be given to emergency zone sizes and boundaries (evacuation is usually to the adjacent compartment, but many evacuation routes are on to the apron and unnecessary evacuations must be avoided for safety and port management reasons)
- The zone division must be kept simple to avoid the creation of many small loudspeaker zones. One of the most effective methods is to cover staff areas with conventional fire alarm sounders (perhaps 'pulsed' for alert). This principle is supported by the fact that airport staff are generally highly trained in safety issues, and there is less benefit of voice alarm over conventional tone than there is in public areas.It is usually not advisable to include a public alert stage as areas are so extensively linked (may cause unnecessary evacuations). Coded alerts or low flash rate beacons are sometimes used to warn staff of possible incidents.
- Tenanted areas (concessions, duty free shops, food court preparation areas, carriers' lounges etc) must ultimately be covered by the system. The interface with the tenant's space can be made in a number of ways, including:

  Solution 1: The entire concourse is covered by overhead loudspeakers. Tenancies are constructed of part-height, open-top cabins. On commissioning of the tenancy, the individual loudspeakers above are PA-inhibited. Note that this solution provides some difficulties to the fire engineering (sprinklers, smoke extract) as the tenant cabins provide the major fire load on a concourse.

  Solution 2: Provide VA junction boxes (alongside junction box for the fire alarm detectors). Large areas of tenancies on a separate loudspeaker zone to adjacent non-tenanted areas, for protection and for separate PA requirements. This solution was applied at Manchester.

Electroacoustic Design

The mechanisms of achieving speech intelligibility in electroacoustic design is now well documented [1]. In acoustical terms, intelligibility is a function of direct-to-reverberant ratio (D:R), signal-to-noise ratio (S:N, noise referring to occupational background noise levels) and Reverberation Time (RT). D:R is in turn a function of the loudspeaker types and locations, room geometry and RT.

Figure 3 illustrates why loudspeaker layouts and room acoustic control are essential and interrelated considerations in achieving sufficient speech intelligibility.

For a given space there will be a maximum reverberation time (RT) beyond which no practicable loudspeaker layout will be able to achieve the speech intelligibility criteria set. On the other hand Figure 3 also shows that over-restriction of the scope for loudspeaker layout design (eg architectural constraints) may result in unachievable room acoustic requirements.

Between these extremes, there is a balance to be struck between the loudspeaker layout design and the

Glossary of Airport Terminology

Landside/Airside
Outgoing passengers have 'gone airside' once they have passed through outbound security. Incoming passengers have 'gone landside' once they have passed through customs. The Landside/Airside boundary has international significance and has relevance in the layout of the building and the design of the PA/VA.

Landside Concourse
Area where passengers and well-wishers can spend time before the passengers go airside. Also known as public concourse.

Airside Concourse
Lounge for use by all passengers awaiting flights, usually opening onto duty-free shopping, food courts etc. Also known as the Retail Hall.

Uncleared Passengers
Passengers who have landed, but have not yet been cleared through in-bound control.

Airbridge
The covered walkway to the aircraft. The far end is maneuverable by an operator to get a position on the aircraft.

SAT
Stand Access Tower, the fixed part of the access to the aircraft, usually including stairs between arrivals and departures levels, and security controlled doors. May also provide access to the Apron.

Apron
The airside exterior of the terminal building. Passengers may cross the apron to board an aircraft via a stairway.

CIP
Commercially Important Persons

Pier
An extension of the terminal that comprises arrivals and departures corridors (usually stacked above each other), gate desks and corresponding stand access.

Flexible Pier
A pier that can be configured for use as either a domestic pier or an international pier, by the careful arrangement of doors and secure routes. Opening and/or closing of a small number of doors linked to the security system is all that is usually needed to switch uses.

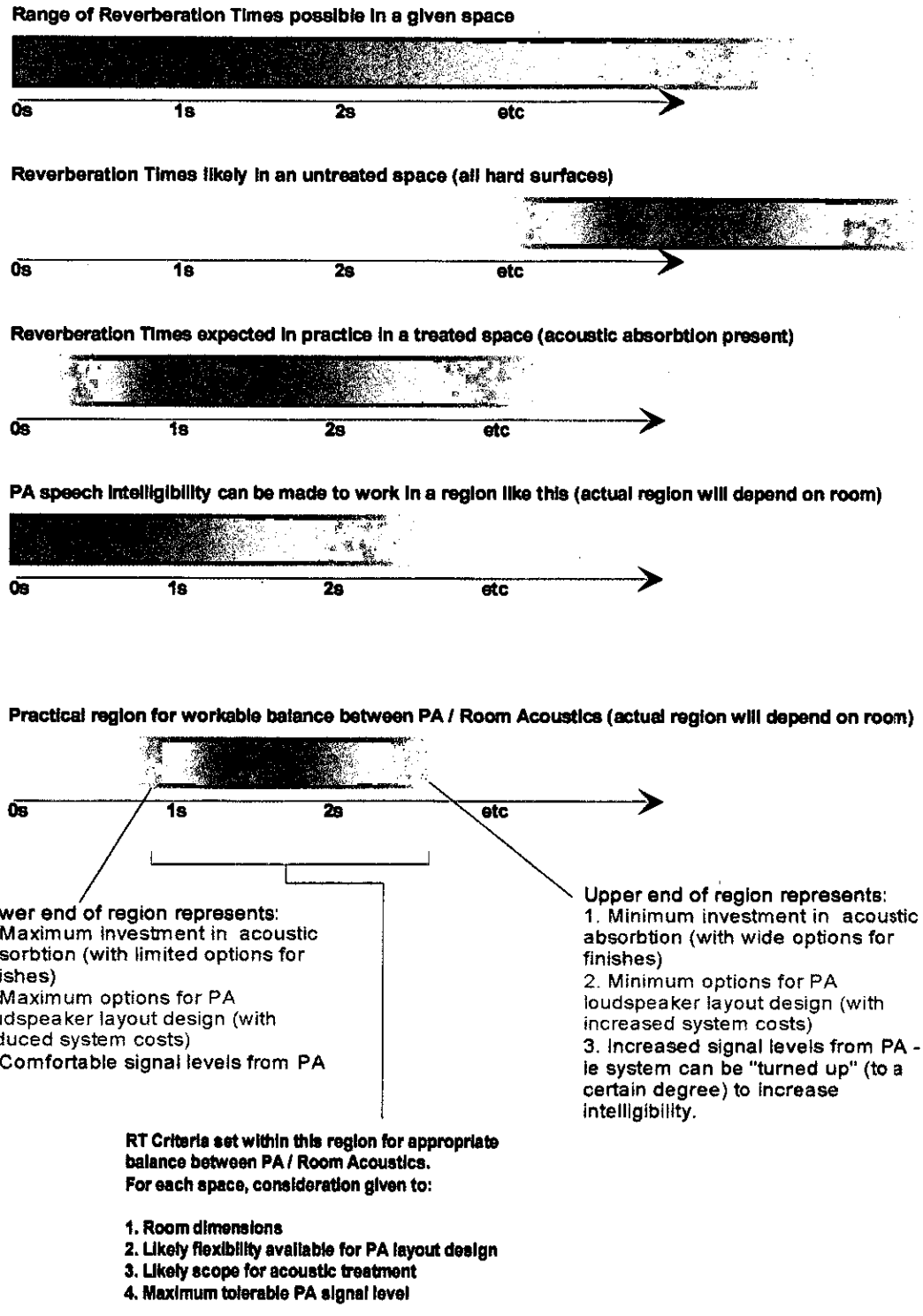

Fig. 3. Illustrating the relationship between loudspeaker layout and acoustic control.

amount of acoustic control required.

The procedure for evaluating a proposed loudspeaker layout for a given space involves a sequence of steps:

- The range and distribution of direct sound pressure levels from the loudspeakers is calculated.
- The applicable room volume and the number of loudspeakers needed to cover it is estimated.
- The reverberation time of the existing space is predicted and from that the reverberant level in the space, allowing for loudspeakers in connected spaces.
- A design signal-to-noise ratio is set, and the corresponding background noise level limit for the space obtained by subtracting this ratio from the total sound level (ie direct + reverberant) at the quietest location.
- The range and distribution of %ALcons is calculated from the Peutz equation [1] and converted to Speech Transmission Index (STI) by the Farrell-Becker equation [1].
- The required reverberation time is then adjusted in the calculation until the STI range meets the design criteria. The result is the design RT for the given loudspeaker layout in the given space.

Example Applications

The Spaces

The electroacoustic design in the following three spaces is discussed in some detail:

Arrivals corridor: an example where electroacoustic design is a simple issue.

BA International Lounge: an example of solutions sensitive to practical loudspeaker locations.

BA Check-In Hall: an example of solutions in voluminous spaces.

Arrivals Corridor

Dimensions: 120 m long x 10 m wide x 2.4 m high

Finishes: Carpet (hard-wearing), perforated ceiling tiles, seating

This corridor is an example of the kind of spaces where the electroacoustic design is typically a simple issue. This kind of space can be characterised as follows:

- room height ≤ 5 m;
- RT[1] ≈ 1s or less;
- loudspeaker layouts have sufficient architectural scope to allow efficient coverage of listener areas only;
- background noise not > 75 dB(A) for periods of 30s or more.

Note that any distraction from the ideal conditions may require a lower RT to achieve the required intelligibility. Such conditions might include:

- loudspeakers not evenly spaced for consistent direct sound level
- loudspeakers not directed squarely onto listener plane
- unusual room proportions
- high noise levels, eg signal-to-noise ratio less than 15 dB, noise levels typically greater than 70 dB(A);
- rooms with significant inter-connection/coupling to adjacent spaces.

Ceiling loudspeakers (100 mm cone diameter) were spaced every 4.5 m. The resulting speech intelligibility was rated at 0.65 STI (as measured by the RASTI method, S:N > 25 dB).

BA International Lounge

Dimensions: Main room – 30 m diameter, 4.5 m high. Rotunda – 19 m diameter, 10 m high, see Figure 4.

Finishes: Carpet (hard wearing), perforated ceiling tiles (at 4.5 m only), seating

This room required special attention to the electroacoustic design, partly because of its size, but mainly because of the preference against placing loudspeakers in the high level ceiling of the rotunda. The rotunda is too wide to serve with ceiling loudspeakers at the circumference, and ceiling or cabinet loudspeakers overhead in the rotunda could not be easily accommodated.

The main design questions were:

- Could a lateral solution work, using the structural columns on the circumference of the rotunda?
- Would the requirements for acoustic control be practicably achievable, particularly compared to an overhead solution?

Two outline loudspeaker designs were assessed in terms of the longest RT that would be acceptable and compatible with the speech intelligibility criteria (Figure 4). In this space, the design intelligibility was set at STI 0.45, to be achieved at 15 dB S:N.

Analysis showed that the two solutions required a similar RT (lateral: 1.6s, overhead: 1.5s). As the difference was small, the lateral (and preferred) solution was specified. Four pairs of medium length (4 drivers) column loudspeakers were placed on each of the four structural columns.

The mid-frequency RT measured in the space was 1.5s, with 1.45s at 2 kHz. The measured STI range was 0.51 – 0.58 with a S:N ratio greater than 25 dB and 0.48 – 0.53 with a S:N ratio fixed at 15 dB in the RASTI meter.

BA Check-In Hall

Dimensions: 50 m long x 13.5 m wide (main space) x 12 m high, overall width 23.5 m, see Figures 5 & 6.

Finishes: Terrazzo floor, perforated ceiling tiles

This space is the largest in the whole of the Terminal One extension. It required special attention to the electroacoustic design because of the practical limits on RT control for such a large volume. Any additional areas of absorption required would constitute significant cost and architectural integration issues.

The main design questions were:

- How much acoustic absorption would be needed?
- How would the balance between acoustic control and loudspeaker layouts be best struck?

Again, two outline loudspeaker designs were assessed: overhead (ceiling) and lateral (Figure 5). The assessments were made in terms of the maximum tolerable RT to achieve the intelligibility criteria, set as 0.45 at 15 dB S:N for this space.

The analysis clearly showed that the lateral solution required significantly less acoustic control (2.0s RT) than an overhead solution (1.6s RT). The lower figure of 1.6s

[1] *Reverberation Time. Mid-frequency mean of 500 Hz, 1kHz and 2 kHz octave bands, unless otherwise stated.*

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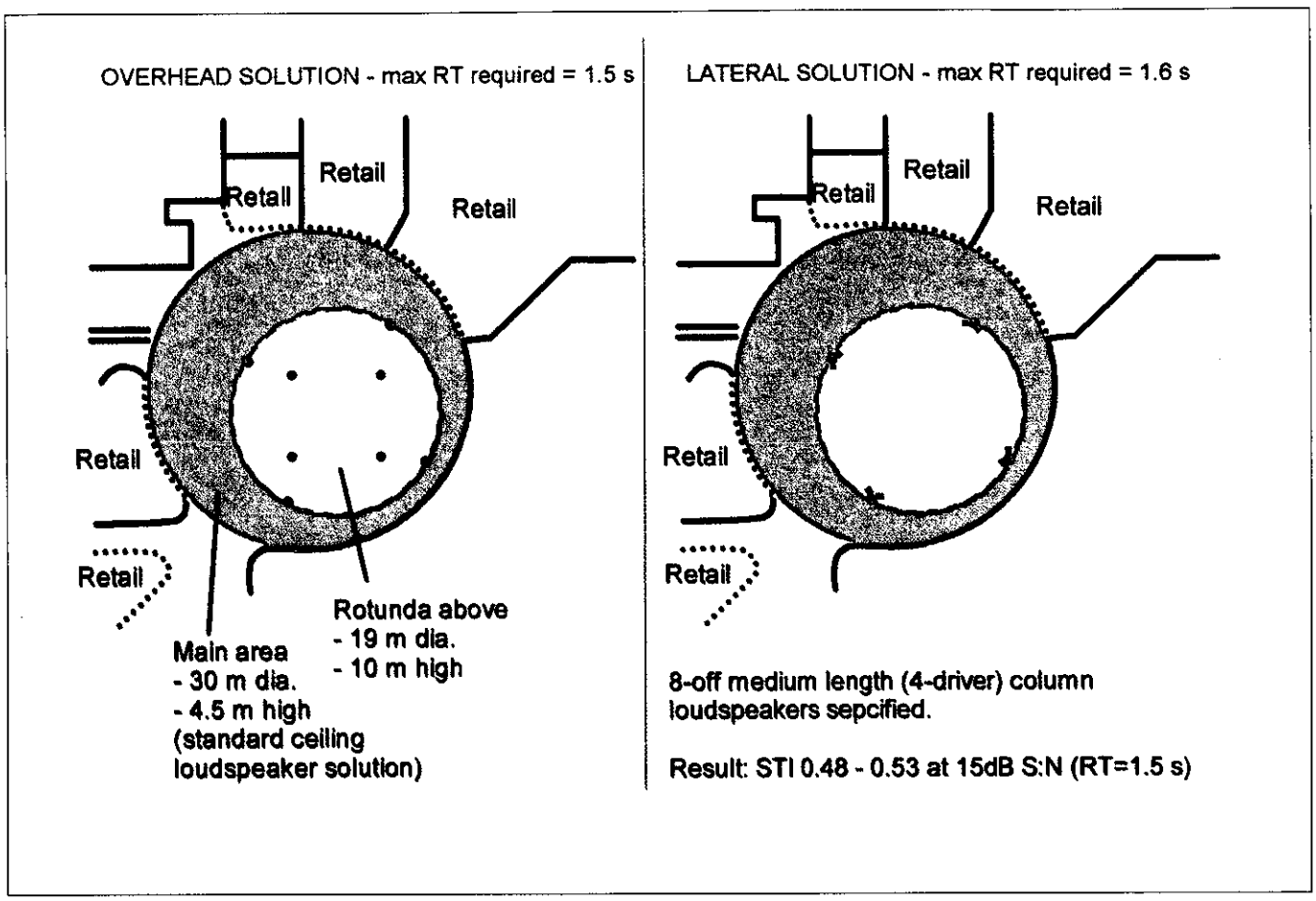

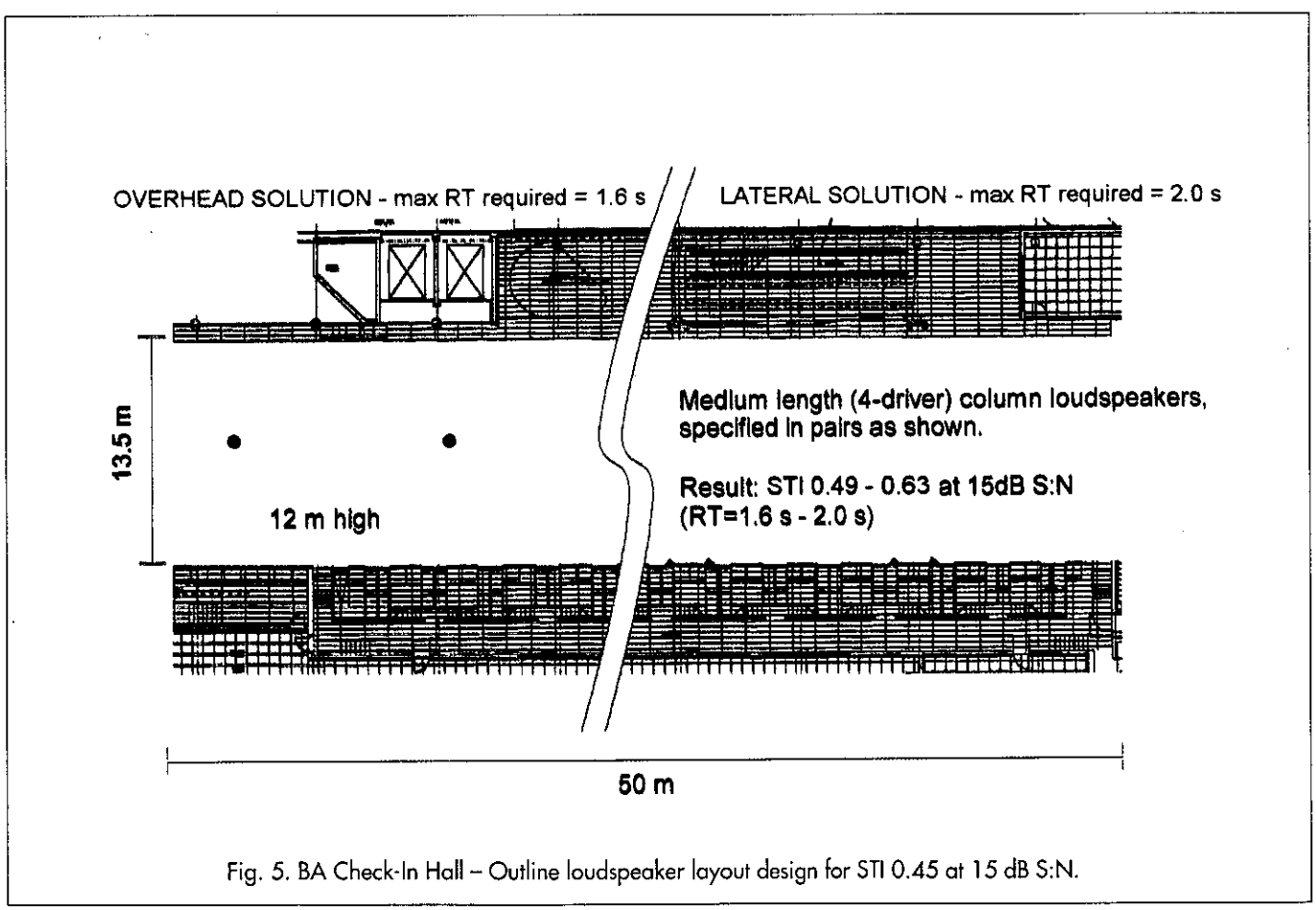

Fig. 5. BA Check-In Hall – Outline loudspeaker layout design for STI 0.45 at 15 dB S:N.

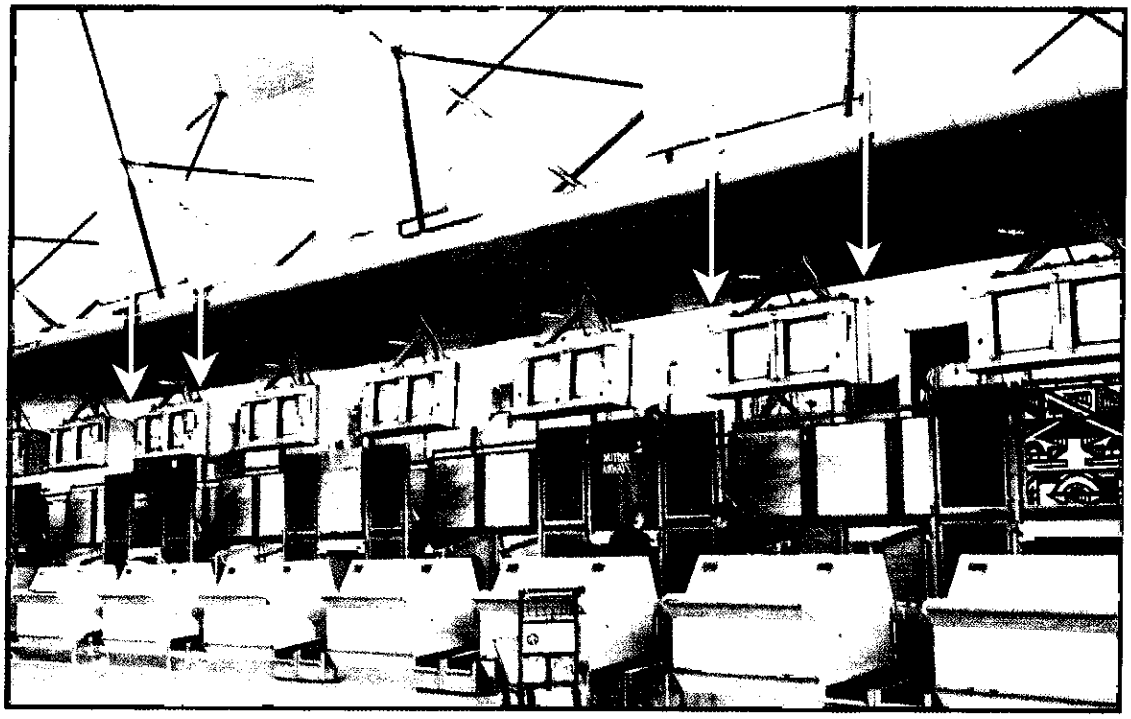

Fig. 6. Completed Terminal 1 BA Check-In Hall showing Penton MC-402 column loudspeakers on the monitor housings.

for the overhead solution was theoretically achievable, but left little margin for unexpected acoustic effects, which are known to crop up in unusually large spaces. An overhead solution could not therefore be proposed with sufficient confidence in its success.

A column loudspeaker solution was specified – units selected were of medium length with 4 drivers. They were located in pairs, spaced at 13 m x 13 m at a height of 3.5 m and angled down at around 15 degrees.

The measured (ie apparent) RT in this space was discovered to be dependent on the distance between source and receiver. At measurement locations close to the source (ie around 10 m), the result was 1.6s at mid-frequencies. However, at longer distances, this rose to around 2.0s. To a listener, some loudspeakers would be close and some further away, and so it is not clear which apparent RT would apply to the expected intelligibility of the space. This aspect of electroacoustic design for extra-large spaces would benefit from further research and collation of experiences.

In this case, the success of the design is borne by the intelligibility of speech through the system in the space. The measured STI range was 0.49 – 0.74 with a S:N ratio > 25 dB and 0.49 – 0.63 with a S:N ratio fixed at 15 dB in the RASTI meter. The success of the visual integration can be seen from Figure 6.

Images and Sounds

Further photographs of the building and the installation can be seen at:

www.arup.com/acoustics/AAc_News.htm.

Audio recordings of the system performance can also be down loaded from this site.

Conclusions

Airports have much in common with most public buildings, except for matters of scale and complexity.

- An understanding of how an airport operates helps break down the complexity.
- Airport PA/VA systems will require unusually high numbers of inputs and outputs, and so some rationalisation of loudspeaker zones may be desirable to avoid over-complication.
- Often, the majority of spaces within an airport can be applied with a characteristic electroacoustic solution. These spaces can be quickly identified on inspection of the plans and sections.
- Acoustically difficult and architecturally featured spaces need identifying, for special electroacoustic consideration. The implications of a loudspeaker design on the room acoustic design must be fully considered, to ensure an overall solution.
- Speech intelligibility modelling methods have shown sufficient precision to influence good design decisions and have given confidence in the specified designs that has been borne out in a successful solution. Extremely large spaces still hold some design challenges, and if further precision is needed, these are the spaces that warrant principle research efforts.

Reference

[1] Davis & Davis, Sound System Engineering, second edition);

Paul Malpas MIOA is with Arup Acoustics, St Giles Hall, Pound Hill, Cambridge. ❖

Speech & Hearing, Autumn Conference 1998

Windermere, 12 – 15 November 1998

The late autumnal shores of Windermere, in the English Lake District, were the backdrop for the thirteenth IOA Speech Group Conference held from 12th – 15th November 1998. The Hydro Hotel, Bowness on Windermere, has become the established venue (this being the conference's eighth visit) for the biennial gathering of acousticians, engineers and academic researchers with a special interest in understanding how audition and speech processing can be coupled to deliver efficient inter-personal, as well as man-machine, communication. Delegates gathered at the conference venue throughout the afternoon and early evening of Thursday 12th November. For many, Thursday's evening meal was an opportunity to renew old acquaintances as well as guaranteeing a few new faces in the form of entrants in this conference's first Young Researchers' Competition.

Three times daily the Hydro catered for the nutritional well-being of delegates, but the conference's organising committee had been equally careful in drawing up a menu of intellectual fayre. Consisting of digestably proportioned oral-presentation courses (each course boasting an hors d'oeuvres delivered by an initial keynote speaker), punctuated by running-buffets of poster presentations (the latter being the medium chosen for the Young Researchers' Competition) the a la carte offerings promised that no enquiring mind would be allowed to go hungry.

Friday Morning

The Chair of the Speech Group, Stephen Cox, brought the gathering to order on Friday morning. Stephen's welcome acknowledged the efforts of all of the forthcoming speakers, poster-presenters and observers, many of whom had made very long journeys from all over the UK – indeed one delegate, Mr Yamazaki, had journeyed from Kanazawa University in Japan. The inability of the weather forecasters (both meteorological and mystic: who were forecasting the appearance of wintry showers during the course of the meeting) was presented as evidence that the travelling experiences of the recent past had not deterred delegates from attending and wishing to make a success of this year's conference.

Friday morning's oral and poster-presentations focused on the topic of speech recognition and began with a keynote presentation from Mark Huckvale (UCL): *Opportunities for re-convergence of Engineering and Cognitive Science accounts of spoken word recognition.*

Mark's lecture began with a retrospective explanation of how Engineering and Cognitive Science models of speech recognition initially came to diverge and, through cultural and methodological differences, even to antagonise each other's best efforts. Skilfully avoiding the temptations of the heated debate across the divide Mark went on to appeal for the replacement of this mode of discourse by a potentially more illuminating conciliatory approach. Acknowledging the successes that have emerged over 20 years from the application of sound goal-driven (eg word-recognition success rate) engineering principles to the problem of large vocabulary speech recognition (LVCSR), the joint endeavour of the two schools (to deliver effective models not only of speech recognition but ultimately to process speech with a degree of understanding) might best be served by a timely reapproachment. Mark's theme struck a chord with the views of many presenters and, whilst some delegates were more guarded in their acceptance of his conclusions than others, his main points stimulated discussion both inside and outside of the conference room.

In the next presentation Martin Russell (Birmingham University) reported on his and Wendy Holmes' (DERA) paper *Progress towards a unified model for speech pattern processing.* According to Martin's account, a fixation with trying to refine complex statistical models by training with ever increasing amounts of training data leads to brittle recognisers whose treatment of speaker variability is to dismiss the variability as noise. Martin and Wendy propose instead, that there should be at least one intervening low-dimensional, adaptive, representational level (drawing upon knowledge of how speech is constrained by the properties of the articulators) which mediates a mapping between the highly variable surface acoustic-features and the symbolic subphonetic representations which form the basis for reliable speech recognition.

The session continued with Sue Browning's (DERA) presentation *Towards a phonetically-motivated pronunciation dictionary for automatic speech recognition.* Sue reported that the aim at this stage was not to demonstrate improved recognition performance in the short term, but to improve the quality and accessibility of expert phonetic knowledge of speech. The ability to readily incorporate such information should lead to benefits in terms of robustness and parsimony in terms of training parameters, the latter being an issue raised in the previous presentation.

Gary Cook (Cambridge University) described how his group's Connectionist acoustic modelling in the Abbot system through its use of a Recurrent Neural Network (RNN) was attempting to avoid classical probabilistic analyses (such as Gaussian Mixture Analysis) of phone-class likelihoods. Following some time-domain acoustic feature extraction using Linear Prediction the RNN delivers phone-class probabilities which are in turn passed on to a Hidden Markov Model (HMM) decoder. The decoder also receives n-gram (typically tri-gram) language model and phone-to-word pronunciation map-

pings as input to finally deliver maximum likelihood word sequences. The RNN architecture inherently exploits phone-context regularities arising in the training data (through its recurrent feedback of time-delayed output state-vectors), but Gary went on to show that the system's performance can be enhanced by incorporating context-dependent acoustic modelling which reflect short-term coarticulatory influences on phone sequences.

Friday morning's coffee break was followed by the first poster session in which work relating to Speech and Speaker Recognition was presented: *Comparative study of F0-based double-vowel identification* by D Yang, G F Meyer and W A Ainsworth (Keele University); *Subspace models for speech transitions using principal curves* by K Reinhard (Cambridge University); *Utilising database information to improve speech recognition performance* by D Attwater, P Durston and M Edgington (BT Laboratories); *An effective sub-band based approach for robust speaker verification* by P Sivakumaran and A M Ariyaeeinia (Hertfordshire University); *Maya: a multimodal spoken language understanding system* by A Breen, S Downey, M Fernandez and E Kaneen (BT Laboratories).

In a parallel poster session the presenters were entrants in the Speech Group's first Young Researchers' Competition: *Feature-based approach to speech recognition* by D J Iskra and W H Edmonson (Birmingham University); *Bilingual model combination for non-native speech recognition* by S Witt and S Young (Cambridge University); *Subspace multiscale simplex ASMs for audio-visual speech recognition* by I Matthews, S Cox, J A Bangham and R Harvey (UEA); *Speech recognition-based computer interfacing and its possible consequences on voice quality: an acoustic study* by C de Bruijn, S P Whiteside, P A Cudd and D Syder (Sheffield University); *Text-dependent speaker verification under non-uniform mismatched conditions* by A M Ariyaeeinia, P Sivakumaran and M Pawlewski (Hertfordshire University); *Using an Auditory Model to determine speech masked by noise* by P Murrin, D Howard and A Tyrrell (York University). The contesting posters would be judged by the committee and the winning author would be announced at the Conference Dinner, the following evening.

Friday Afternoon and Rayleigh Medal Award

Friday afternoon's session began with the award of the IOA's Rayleigh Medal. This year's medal winner was Professor Bill Ainsworth of Keele University. Mark Tatham chaired the afternoon session and in lieu of the President of the Institute Mark, in his capacity as President Elect, also over-saw the medal-giving. In his introduction, Mark commented upon Bill Ainsworth's many years of research and widely published works which have benefited the speech processing community. Bill's research career began at Keele in the 60's under the auspices of the late Donald MacKay and at the inception of digital analysis of speech.

In the Medal-winner's lecture Bill addressed the pervasive influence of pitch upon the perception of speech sounds. Beginning with the nineteenth century controversy over whether or not the pitch of an utterance derived from the harmonics of the vocal chord vibrations or just the resonances of the vocal tract (a controversy resolved by Lord Rayleigh himself), Bill went on to discuss today's prevalent ideas about how the pitch of an utterance contributes to the recognition of speech.

The Friday afternoon session continued with the emphasis upon speech analysis. John Holmes (Speech Consultant) presented *A study of glottal pulses derived by inverse filtering*. John's talk pointed out a shortcoming of popular models of formant-based high quality speech synthesis which fail to take into account the movements of the vocal folds during the period of glottal closure. John presented evidence that the resulting closed-phase air movements can disturb the spectrum of the glottal pulse in the region of the fundamental frequency.

In the following talk, Charles Day (Keele University) presented some results of *Evaluating the reassignment method for speech signal analysis*. This work explores how a modified form of fast fourier transform (FFT) called the reassigned fourier transform (RAFT) can be used to deliver finer spectral resolution than the FFT (for a given signal analysis window size) and whether or not the increased spectral resolution can enhance estimates of pitch derived from a sub-harmonic summation procedure.

Mark Tatham, President Elect and Bill Ainsworth

In the final talk of the session James Angus (York University) reported upon developments in *Fundamental frequency estimation for use with a singing pitch development system for primary school children*. James gave details of an analogue fundamental frequency estimator, developed at York, to exploit technological advances in the hardware and software available with modern PC equipment. These developments combined with the ubiquity of PC technology in schools should further assist the development of singing pitch skills of children in the classroom.

After a short break for refreshments the program continued with the Speech Analysis and Coding poster session which included: *Pitch analysis of concurrent speech* by D Yang, G F Meyer and W A Ainsworth (Keele University); *Improving the accuracy of FM-component estimation by the reassigned method* by D Yang, W A Ainsworth and G F Meyer (Keele University); *Low bit-rate speech coding using a linear-trajectory formant representation for both recognition and synthesis* by W J Holmes (DERA); *Simulated vocal emotions: an acoustic study of two portrayals* by S P Whiteside (Sheffield University); *A voice controlled music synthesis system* by I S Gibson and D M Howard (York University); *Vocal characteristics: a developmental study* by S P Whiteside and C Hodgson (Sheffield University); *Real-time visual feedback and the development of singing pitch skills in primary school children* by D M Howard and J A S Angus (York University); *Dereverberation of speech by power envelope inverse filtering and pitch emphasis processing* by M Yamazaki, S Hirobayashi, H Kimura and Tohyama (Kanazawa University).

Saturday Morning

Saturday morning's programme began with a keynote lecture, *Speech Synthesis*, given by Andrew Breen of BT Laboratories. Andrew's talk once again drew the attention of delegates to the brittleness of systems, in this case speech synthesis systems, where incremental quality improvements are usually data-driven with little or no exploitation of deeper insight or extended knowledge of the problem domain. In recognition of the failings of rule-based and linguistic theory based alternatives Andrew pointed out that to date relatively little research has examined the importance of speaking styles: even though certain speech synthesis systems are very sensitive to the manner of speech which was recorded in their databases. Andrew suggested that one way of increasing the flexibility of synthetic-speech style would be through the incorporation of pitch and duration information into the synthesiser's speech database. (An important drawback of adding this extra information is the potential for dramatically increasing the size of the databases.) Andrew did not waste the opportunity for making a keynote talk on speech synthesis entertaining, judiciously using examples of synthetic speech to illustrate his important points: allowing the ears of conference delegates to evaluate progress in speech synthesis for themselves, hopefully without causing too much upset for lovers of Shakespeare's 18th sonnet.

In the following talk *A comparison of letter-to-sound conversion techniques for English text-to-speech synthesis* Bob Damper (Southampton University) drew attention to

Stephen Cox awarding the Young Researchers' prize to Silke Witt

MEETING NOTICE

Measurement and Instrumentation Group

Getting A Grip On Hand-Arm Vibration

The National Motorcycle Museum, Birmingham

Tuesday 29 June 1999

Hand-arm vibration is now becoming recognised as a significant contributor to long-term health problems like Reynaud's Disease. Many attempts have been made to quantify vibration levels that give rise to health problems but only recently have guidelines been issued. In the UK the Health and Safety Executive has launched a major awareness campaign and published guidelines and action levels. In the EU the Physical Agents Directive, although stalled for some time, now looks set to introduce similar levels that could be covered by legislation. Instrumentation is available to measure the necessary information, but measurement techniques often leave much to be desired, and the difficulty in cross-checking measurements taken is well known.

The aim of this one-day meeting is to present a series of papers describing measurement-making in all its aspects as applied to sources of hand-arm vibration. Problems often experienced and practical methods to solve them will be addressed. Information on the legal and insurance consequences of vibration exposure in the workplace and on the medical effects will be included. There will be an exhibition of relevant instrumentation.

Presentations will include:

Real-world hand-arm vibration measurements versus manufacturer's data, *Peter Barker, Wimtec Environmental Ltd.*

Experience in assessing instruments against ISO 8041 'Human response to vibration – measuring instrumentation', *Liz Brueck, HSL.*

Vibration measurement of power hand tools used in the shipbuilding industry, *Simon Clampton, Marconi Marine (VSEL) Ltd.*

Vibration measurement and risk management for a public utility – a case study, *Iain Critchley, Peninsular Acoustics.*

On-site vibration assessment, accuracy and repeatability, *Kevin Hill, Glasgow City Council.*

A hand-holding guide to the measurement and CE marking of vibrating products, *Neal Hill, European Process Management Ltd.*

Measurement and evaluation of human exposure to hand-transmitted vibration – recent work on International and European standards, *Chris Nelson, HSE.*

Measurement uncertainty in the evaluation of hand-arm vibration exposure in the workplace – an introduction to ISO 5349-2, *Paul Pitts, HSL.*

Frequency analysis for hand-arm vibration measurements, *Tim South, Leeds Metropolitan University.*

Power on the land – an environmentally unfriendly handshake, *Richard Stayner, RMS Vibration Test Laboratory.*

Pains, Trains and Roto-Peens – Implementing a hand-arm vibration management programme, *Graham Twigg & Steve Fitchett, Tecforce Ltd.*

This meeting will be followed by the Measurement & Instrumentation Group AGM.

Getting a grip on hand-arm vibration – 29 June 1999

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Please register me as a delegate. I enclose a cheque for the delegate fee:

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INSTITUTE DIARY 1999

4 MAR
Executive Committee, Medals & Awards Committee Council
St Albans

11 MAR
IOA CofC in W'place Noise Tutors Meeting
St Albans

12 MAR
IOA CofC in W'place Noise Committee
St Albans

17 MAR
London Branch Evening Mtg: Development of Cinema Sound
London

18 MAR
Education Review Committee
St Albans

30 MAR
Midlands Branch Evening Mtg: EU - A New Noise Indicator?
Derby

13 APR
Executive Committee
St Albans

15 APR
Meetings Committee, Publications Committee
St Albans

19-21 APR
Underwater Acoustics Group Conference: Sonar Transducers 99
Birmingham

22 APR
Education Review Committee
St Albans

28 APR
London Branch 1-day Mtg: Advances in Transportation Noise & Vibration
London

6 MAY
Distance Learning Sub Committee, Education Committee
St Albans

13 MAY
IOA 25th Anniversary Conference
Barbican, London

13 MAY
Annual General Meeting

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

19 MAY
London Branch Evening Mtg: Have Dog - Will Travel
London

20 MAY
Membership Committee
St Albans

11 JUN
IOA CofC in Env Noise Measurement Exam
Accredited Centres

12 JUN
Eastern Branch Evening Cruise on a Thames Barge

15 JUN
Midlands Branch Evening Mtg: Dose/Effect - EU Noise Policy Working Group 2
Coventry

16 JUN
London Branch Evening Mtg: Noise Mapping
London

17 JUN
Executive Committee, Medals & Awards Committee, Council
St Albans

17-18 JUN
IOA Diploma Exams
Accredited Centres

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

29 JUN
Measurement and Instrumentation Group Mtg: Getting a Grip on Hand-Arm Vibration
Birmingham

1 JUL
Executive Committee
St Albans

15 JUL
IOA CofC in Env Noise M'ment Committee
St Albans

22 JUL
Meetings Committee
St Albans

9 SEP
Executive Committee
St Albans

16 SEP
Meetings Committee, Publications Committee
St Albans

22 SEP
Midlands Branch Afternoon Mtg: Noise Mapping - EU Noise Policy Working Group 4
Birmingham

23 SEP
Distance Learning Sub Committee, Education Committee
St Albans

30 SEP
Membership Committee
St Albans

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

14 OCT
Executive Committee, Medals & Awards Committee, Council
St Albans

29 OCT
IOA CofC in Env Noise Measurement Exam
Accredited Centres

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

11 NOV
Meetings Committee, Publications Committee
St Albans

11 NOV
Midlands Branch Evening Mtg: Computation & Measurement - EU Noise Policy Working Group 3
Derby

16 NOV
Distance Learning Sub Committee, Education Committee
St Albans

18 NOV
Membership Committee, IOA CofC in Env Noise M'ment Committee
St Albans

25 NOV
Executive Committee, Medals & Awards Committee, Council
St Albans

25th ANNIVERSARY CONFERENCE

Thursday 13 May 1999

The Barbican Centre, London

To mark the 25th Anniversary of the Institute a one-day conference is to be held at The Barbican Centre London, one of Europe's premier arts and conference centres. The programme will be available shortly. Space at the Conference is strictly limited and will be allocated on a first come first served basis. To register your interest as a delegate please contact the Institute office.

CALL FOR PAPERS

London Branch
One-day Meeting

ADVANCES IN TRANSPORTATION NOISE AND VIBRATION

Wednesday 28 April 1999

Commonwealth Conference Centre, London

Papers have so far been offered on:

- Road and Rail Noise Modelling - A Case Study
- Railway Track Isolation Systems - Recent Developments
- Improving Speech Intelligibility in Underground Stations
- Transportation Noise and the Visually-Impaired

Further papers are invited

Please submit a title and short synopsis as soon as possible to:

Roger Tompsett,
W S Atkins Noise and Vibration,
Woodcote Grove,
Ashley Road, Epsom,
Surrey KT18 5BW
Tel: 01372 726140
Fax: 01372 740055
email: krtompsett@wsatkins.co.uk

Institute of Acoustics, 77A St Peter's Street, St Albans, Herts AL1 3BN
Tel 01727 848195 Fax 01727 850553 email Acoustics@clus1.ulcc.ac.uk Registered Charity No 267026

MEMBERSHIP

The following were elected to the grades shown at the Council meeting on 17 December 1998

Fellow
Eade, P W

Member
Arbuckle, I S
Bell, S
Brice, J S
Gent, M L
Greenhalgh, P N
Hunter, D M
Irvine, I A
Nagel, G E
Perkins, R A
Scourfield, P M
Smith, A G
Smith, R W
Straw, R M

Associate Member
Blaze, S
Bodsworth, N
Boland, D J
Castro, S
Charlesworth, P
Cooke, E A
Cox, T J
Crowe, E M
Dandy, M I
Ellerton, D P
Forsyth, B
Gosling, S J
Howard, C
Humpheson, D
Kavuma, R R
Mckee, A J
Mills, J O
Parker, M F
Pearse, P G
Read, K K
Simpson, A
Stump, J J
Teare, S A
Williams, P
Witterick, S L

Associate
King, E
Maslin, A P

Student
Groves, C
Talbot, J P
Taylor, L
Witt, S M

NON-INSTITUTE MEETINGS

March 15-19, 1999 Forum Acusticum and 137th Meeting of the Acoustical Society of America, Berlin, Germany.
Contact: Elaine Moran, Acoustical Society of America, 500 Sunnyside Blvd., Woodbury, NY 11797, USA. Tel: +1 516 576 2360; Fax: +1 516 576 2377. e-mail: asa@aip.org

April 10-12, 1999 AES 16th International Conference on Spatial Sound Reproduction, Rovaniemi, Finland.
Contact: Matti Karjalainen e-mail: aes16@acoustics.hut.fi Fax: +358 9 460 224.

April 28-30, 1999 Vibration, Noise, and Structural Dynamics '99, Venice, Italy.
Contact: D Hill, Staffordshire University, PO Box 333, Beaconside, Stafford ST18 0DF, UK. Tel: +44 1785 353469; Fax: +44 1785 353552. e-mail: vib99staffs.ac. uk

May 17-20, 1999 SAE Noise & Vibration Conference, Traverse City, Michigan, USA.
Contact: M Asensio, Noise & Vibration Conference, SAE, 3001 W. Big Beaver Rd., Suite 320, Troy, MI 48084, USA. Tel: +1 248 649 0420; Fax: +1 248 649 0425.

June 24-26, 1999 International Bekesy Centenary Conference on Hearing and Related Sciences, Budapest, Hungary.
Contact: Motesz Congress and Exhibition Bureau, Federation of Hungarian Medical Societies, PO Box 145, Budapest, H-1443, Hungary Tel: +36 1 311 66 87 Fax: +36 1 383 79 18 e-mail: motesz@elender.hu.

June 28-30, 1999 1st International Congress of the East European Acoustical Association, St. Petersburg, Russia.
Contact: EEAA, Moskovskoe Shosse 44, St. Petersburg 196158, Russia. Fax: +7 812 127 9323. e-mail: kryl.pb@ sovam.com

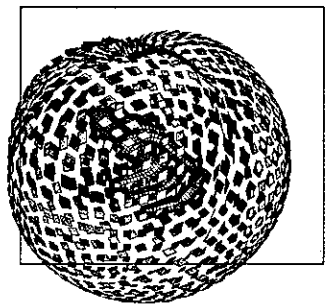
July 5-8, 1999 6th International Congress on Sound and Vibration, Lyngby, Denmark.
Contact: F Jacobsen, Department of Acoustic Technology, Technical University of Denmark, Building 352, DK-2800 Lyngby, Denmark. Tel: +45 4588 1622; Fax +45 4588 0577. e-mail: icsv6@dat. dtu.dk

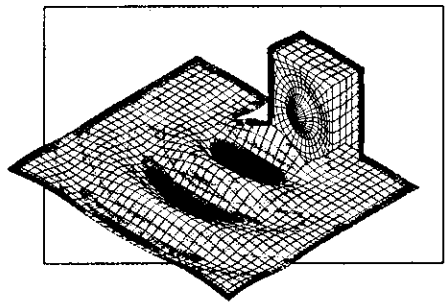
September 15-17, 1999 British Society of Audiology Annual Conference, Buxton, UK.
Contact: B S A, 80 Brighton Road, Reading RG6 1PS Fax: 0118 935 1915 e-mail: bsa@b-s-a.demon.co.uk

November 1-5, 1999 138th Meeting of the Acoustical Society of America, Columbus, Ohio, USA. Contact: Elaine Moran, Acoustical Society of America

December 2-4, 1999 ACTIVE 99, the 1999 International Symposium on Active Control of Sound and Vibration, Fort Lauderdale, Florida, USA.
Contact: Institute of Noise Control Engineering, PO Box 3206 Arlington Branch, Poughkeepsie, NY 12603, USA. Tel: +1 914 462-4006: Fax: +1 914 462 4006. e-mail: INCEUSA@aol. com.

December 6-9, 1999 INTER-NOISE 99, Fort Lauderdale, Florida, USA.
Contact: Institute of Noise Control Engineering, PO Box 3206 Arlington Branch, Poughkeepsie, NY 12603, USA. Tel: +1 914 462-4006: Fax: +1 914 462 4006.





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Automotive analysts

SYSNOISE, From Structural Response To Acoustic Control

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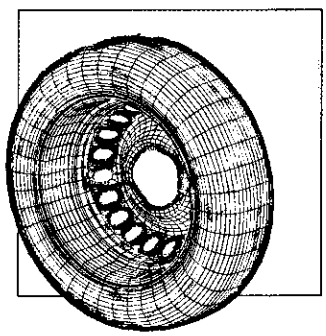

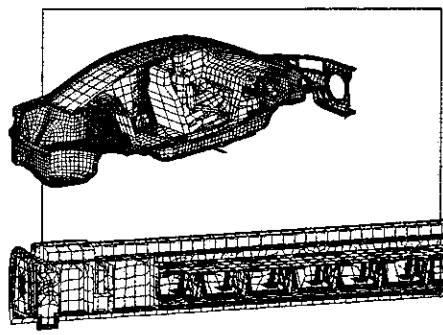

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the fact that although text-to-phoneme research has a long history the problem is far from solved. Furthermore, Bob explained that the various strategies developed to address the text-to-phoneme problem are difficult to evaluate. Accordingly, Bob's presentation contained an evaluation which compared rule-based and data-driven machine-learning strategies. His findings support the claim that text-to-phoneme conversion is still a considerable challenge and, whilst not claiming to be the final word on the matter, demonstrates that some data-driven techniques currently deliver performance which is superior to rule-based methods (contrary to some reports in the literature).

Mark Tatham (Essex University) continued the session with his presentation about the *Assignment of intonation in a high-level speech synthesiser*. Mark and his collaborators have been using their own intonational model for the text-to-speech process. Their model assumes three layers of physical processes (delimited by the extent to which they are cognitively controlled by the speaker). They propose a straightforward correlation between the physical processes of speech production and a symbolic, cognitively meaningful, representation of the speech production process expressed in terms of fundamental frequency and the way in which it fluctuates. Mark stressed that the model has interesting properties for the speech-synthesis problem in that it should generalise well for the production of more than one voice and could pragmatically incorporate emotional and intentional speaking characteristics.

The final presentation in this session, *Emotion in the BT Laureate speech synthesis system*, was given by Iain Murray (Dundee University). Iain's talk described how well the concatenation and re-synthesis of pre-recorded di- and tri-phones, in the BT Laureate test-to-speech system, could be used to produce speech which conveyed emotion.

Importantly, Iain's work involved the generation of emotive speech rather than simply extending the di- and tri-phone database of the Laureate system to include recordings of speech with different affective content. Four emotional deviations from Laureate's default, placidly-neutral, pattern of speech were attempted: anger, happiness, sadness and fear. The subjective evaluation of the emotional Laureate speech is promising and further refinements are being undertaken.

Following a break for tea and coffee and preceding an afternoon for delegates to spend at leisure the Speech Synthesis and Dialogue Systems poster session included: *Generalization in neural speech synthesis* by G C Cawley (UEA) and M Edgington (BT); *Syllable recovery from polysyllabic words* by M Tatham (Essex University) and E Lewis (Bristol University); *A script based speech aid for non-speaking people* by G S Harper, R Dye, N Alm, J L Arnott and I R Murray (Dundee University); *Is it a bird? Is it a plane? No, it's a dialogue system: towards a greater usability in automated dialogue systems* by C Cheepen (Surrey University), J Monaghan (Hertfordshire University) and D Williams; *Macrophonological signalling of text structure and automated spoken dialogue* by J Monaghan (Hertfordshire University) and C Cheepen (Surrey University); *Building an automatic receptionist - a framework for spoken language call steering* by M Edgington and D Attwater (BT).

Saturday Evening: Young Researcher Prize-giving

The Conference Dinner, on Saturday evening, saw the announcement of the Speech Group's first Young Researchers' prize. Stephen Cox, the Chairman of the Speech Group, awarded the prize on behalf of the panel of judges to Silke Witt of Cambridge University for the work described in her poster, Bilingual model combination for non-native speech recognition. The poster (co-authored by Steve Young also of Cambridge University) dealt with the problem of adapting a speaker-independent HMM speech recognition system to interpret speech uttered with a foreign accent. The novel approach to the problem outlined in this work was to combine vector representations of the same utterance drawn from HMMs trained in the speaker's native tongue (the source HMM) and the language in which the speaker is talking (the target HMM). The approach was shown to require relatively little training data and to be computationally efficient.

Sunday Morning

In contrast to the meeting of two years earlier, Sunday morning arrived with the promise of fair weather and in anticipation of a comparatively trouble-free journey home later in the day conference delegates were able to give the morning's poster session, keynote lecture and subsequent panel discussion their undivided attention. The morning's poster session examined the area of Speech Perception and Phonetics and included presentations of the following work: *Vowel perception and colouration from early reflections* by A J Watkins (Reading University); *An evaluation of naturalness in time-domain concatenative speech synthesis* by D S G Vine (Bournemouth University) and R Sahandi; *Patterns of confusion made by a model of double-vowel identification: a comparison with human data* by S J Makin and G J Brown (Sheffield University); *Auditory perception and ethnic group attribution of unknown voices: assessing the robustness of experienced listeners' ratings when confronted with non-native but proficient English speech* by R Todd (Sheffield University); *Acoustic-phonetic qualities of Asian- and Caribbean-English consonant clusters* by R Todd (Sheffield University); *Reduced coarticulation in apraxia of speech: some acoustic evidence* by S P Whiteside (Sheffield University) and R A Varley; *Some acoustic characteristics of speech elicited via a picture-naming task: a study of 6-, 8- and 10-year old children* by S P Whiteside (Sheffield University) and C Hodgson; *A developmental study of voice onset time in 7 to 11 year old children: a sociophonetic perspective* by S P Whiteside (Sheffield University) and J Marshall.

In the final formal session of the conference, Mike Carey (Ensigma Ltd) gave the keynote lecture on the topic of *The Future of Speech Technology*. An important theme

in Mike's assessment was that although speech is one of the most efficient means of inter-personal communication it faces strong competition in the area of human-machine communication: particularly as technological developments make multi-media access to data and information more efficient and user-friendly. Mike's presentation acknowledged the great success of speech coding technology: low bit-rate speech coders being a pivotal component in the rapidly expanding mobile telecommunications industry. The low bit-rate performance of speech coders has worked to the detriment of speech synthesis technology, whose potential now seems strongest when arbitrary spoken messages are required from a system.

Speech-to-text dictation systems are becoming much more widespread and in tandem with interactive dialogue systems and repertory dialling facilities in the, now ubiquitous, mobile phone, speech recognition technology has matured and seems to have a bright future. Speaker, language and gender identification from the spoken word have been successful in specific applications but our inability to seamlessly incorporate such features into applications is likely to place a limitation upon their popularity.

Mike's talk set the scene for an end of conference discussion chaired by Martin Russell. Martin introduced a panel of discussants which included John Bridle (Dragon Systems), Roger Moore (DERA), Denis Johnston (BT Laboratories) and Steve Young (Cambridge University). Each of the discussants were invited to briefly address the audience with their reflections upon the future of speech technology. An important and recurring theme, introduced in Mike's presentation, and stated explicitly by Roger was that semi-conductor technology is advancing so quickly that today's computational techniques will soon take on the appearance of the dark ages of computing.

For speech technology to exploit its full potential in the evolution of information technology speech recognition will have to become increasingly robust with a shift in emphasis to include a degree of semantic interpretation in addition to simple word recognition. Amongst the panel and the audience there was some debate about the future roles of local versus centralised information processing in a future internet environment where wireless mobile end-user telecommunications will predominate. The important role for speech processing technology is likely to be in the mobile, hands-free user interface with a varying degree of data/information downloaded to the handset where speech synthesis and recognition could be important tools for navigating and presenting the information to the user. For applications where centralised data/information processing is appropriate intelligent agents which interact with client requests using speech are foreseen.

Charles Day

International Conference: Sonar Signal Processing

Weymouth, 21–23 December 1998

This conference, which was organised by the Underwater Acoustics Group, formed the seventh in a series on sonar signal processing and was chaired jointly by Professor Hugh Griffiths of University College London, and Gary Heald and Sean Chapman of DERA Bincleaves. Despite the proximity of Christmas it was attended by over seventy scientists and engineers from all over the world, attesting to the continued progress and new ideas in these disciplines. The Conference was opened by Peter Evans, who is Technical Manager, Mine Warfare Weapons and Countermeasures, at DERA Bincleaves.

The substance of the conference was divided into sessions on synthetic aperture sonar, image processing, signal processing, and beamforming/high resolution techniques. Each session kicked off with an invited paper by an expert in the field, to set the scene. It was notable that the level of discussion following each presentation was rather greater than is often the case at conferences, and this reflected the high technical standard of the papers and the presentations.

The first of these sessions demonstrated the enormous current interest in synthetic aperture techniques, and included contributions by Geoffrey Shippey et al of Chalmers University of Technology, from Marc Pinto of NATO SACLANTCEN and from Sean Chapman et al of DERA Bincleaves. All of these noted the importance of motion compensation for high resolution imaging, and showed examples of experimental images.

The invited paper by Ira Clarke of DERA Malvern gave some fascinating – and very convincing – practical demonstrations of blind signal separation techniques using arrays. Peter Dobbins of BAeSEMA presented an interesting application of a technique borrowed from audio engineering to left/right discrimination in towed arrays.

A particular highlight of the conference was provided by the A B Wood Memorial Lecture *Bubbles and the sound of breaking surf*, given by Dr Grant Deane, of Scripps Institution of Oceanography, La Jolla, USA, following his presentation of the A B Wood Medal by the Institute's President, Ian Campbell.

The Conference Dinner was a predictably festive occasion, and was addressed by Dr John Dix of Martech Systems, who gave a highly entertaining series of stories and anecdotes based on his career in underwater acoustics.

The Conference Proceedings are published as Proc. Inst. Acoustics, Vol. 20, Part 7; ISBN 1 901656 15 2; ISSN 0309 - 8117; copies are available from the Institute office.

Hugh Griffiths FIOA ❖

Bill Allen HonFIOA
1914 – 1998

Bill Allen, Honorary Fellow and former President of the Institute of Acoustics died on 14 December 1998 at Welwyn Garden City, aged 84. Bill had continued working internationally up to his sudden terminal visit to hospital. His colleagues working with him during the preceding week at the Calouste Gulbenkian Museum in Lisbon advised that Bill had been in his usual great form, still full of new ideas, and providing the good advice and good humour for which he was renowned.

Bill was an architect who strove throughout his entire career to find and explain relationships between architecture, science, technology and design. He stressed the need to integrate into design the key principles of heat, light and sound. In recent years, he produced a keynote tome on excluding water from buildings (Envelope Design for Buildings, published by the Architectural Press in 1997).

Bill came from a distinguished Canadian family and graduated in 1936 with a Gold Medal of the University of Manitoba. His thesis involved the assessment of the acoustics of the new Civic Auditorium in Winnipeg. Despite family pressure to continue academic training in Canada, Bill moved to England, surviving a treacherous Atlantic crossing on a ship transporting grain and cattle, to work in the office of Louis de Soissons, Planner and Architect for Welwyn Garden City.

Since his days in Winnipeg, Bill had been fascinated by the modernist's catch phrase 'form follows function' and, after work on new housing in the Garden City, he moved to the Building Research Station at Garston. There he worked with R Fitzmaurice and produced in 1940 the HMSO publication, Sound Transmission in Buildings.

During the War, Bill had to divert from his developing interest in acoustics to war-related projects, including design of the Anderson shelter. However, he was able to develop his friendship with Hope Bagenal and continue his training on concert hall acoustics. He continued working at BRS throughout the War and was involved in the preparation of the keynote Post-War Building Studies, Document 14 Sound Insulation and Acoustics. This gave advice for good acoustics in auditoria and sound insulation at home and work. The 1944 report recommended an average airborne sound insulation between living rooms of 55 dB. It advised that the 9" brickwork party wall does not reduce sufficiently the noise of the radio next door, and does not insulate against common impact sounds.

Bill's work continued at BRS after the War, and included one of his most enjoyable periods, working on the Royal Festival Hall design with the architect Leslie Martin (later, Sir Leslie). Bill and his BRS colleague, Peter Parkin, enjoyed the technical challenges of producing the first new concert hall design and working with Hope Bagenal.

Bill's subsequent work on auditorium acoustics, carried out after he had left BRS, included acoustic improvements to the Henry and Edsel Ford Auditorium in Detroit, where he worked with V O Knudsen, the new Great Hall of the Calouste Gulbenkian Museum in Lisbon, the Royal Northern College of Music in Manchester and a small opera house at the Royal Academy of Music, London. The latter two projects were designed by Bill's architectural partner, between 1962 and his death in 1981, John Bickerdike.

Bill rose to the position of Chief Architect at the Building Research Station before leaving in 1961 to become Principal of the Architectural Association School of Architecture in London, forming his partnership with his friend, John Bickerdike, a former BRS colleague, in the following year. The practice adopted Bill's approach to science and design and his attitude to the working environment.

Bill's consultancy work encompassed a wide range of subjects, including sound insulation, planning and noise and auditorium acoustics, as well as other areas of building technology. He appeared at several airport public inquiries, where he relentlessly challenged assumptions. He was in great demand to carry out investigations in buildings, to identify construction faults, make recommendations for their rectification

and act as an expert witness when litigation loomed. Far from protecting his special expertise, he generously disseminated his experience and advice to his fellow architects with a view to improving the design and construction of modern buildings. His influence extended beyond the UK and, for 25 years, he was an advisor to the United States Government on Building and Fire Research in the National Institute of Standards and Technology.

Bill became a Fellow of the Royal Institute of British Architects in 1964 and took on major tasks for RIBA and ARCUK (the Architect's Registration Council of UK). Bill held a deep belief in professionalism and its responsibilities in society and this informed much of his work for the architectural profession. In the mid seventies, he became President of the Institute of Acoustics and helped to start the professional body for practitioners, the Association of Noise Consultants. He was President of the Association at the time of his death. Between 1976 and 1987, he was Chairman of the British Standards Code of Practice Committee for the Code on Sound Insulation.

In the mid-eighties, Bill was appointed to design the new lighting for the Chapel Royal at Hampton Court. This led to a commission to light the ceiling of the Divinity School at Oxford, a gothic building in the Perpendicular style. His lighting career developed quickly and commissions all over the UK and in various parts of the world are now a feature of the practice's lighting consultancy. Among the notable examples of Bill's lighting work are Waddesdon Manor, the Frick Gallery in New York and the Edwardian Chapel of Bishop Grosseteste College, Lincoln, which received an award. His approach to lighting design was disseminated in his concluding address to the international meeting on Lighting in Historic Buildings, held in Williamsburg, Virginia, USA, in 1998.

It seems that everywhere that Bill's career took him, he made an impact and he received many honours of quite unusual international spread. He was an Honorary Associate of the New Zealand Institute of Architects and received an Order of Merit for Portugal in the rank of Commander for his work on the Gulbenkian Foundation Headquarters and Museum in Lisbon. He was an Honorary Fellow of the Chartered Institute of Building Services Engineers, and an Honorary Fellow of the American Institute of Architects. He was, for the last 20 years, a member of the Honorary Scientific Advisors to the National Gallery. In 1977, the University of Manitoba conferred on him an Honorary Doctorate. He received a CBE in 1980.

He will long be remembered by those who worked with him as a friendly and good-humoured architect with an unquenchable interest in science and life in general and a mind which was open to new ideas throughout a career spanning 65 years.

John Miller FIOA ❖

Noise from Pubs and Clubs

The Institute of Acoustics together with the Brewers and Licensed Retailers Association and other representatives of the entertainment trade have been working for the past year towards the production of a Code of Practice for the Control of Noise from Pubs and Clubs. This document should provide guidance and identify good management practice for both the industry and Local Authorities. It is envisaged that the code would be used in complaint situations or for planning and licensing purposes.

A draft document has been prepared which includes chapters on the sources of disturbance, measurements and monitoring, control measures, and contains advice on responding to complaints both by businesses and enforcers. A chapter has also been written on the thorny issue of criteria and noise limits. This was one of the mandates obtained from several IOA workshop meetings before work on the code was started. Therefore the acousticians in the working group have proposed a number of parameters which, from their knowledge and experience, may form the basis for the objective assessment. The criteria covers noise from music, singing, public address systems and people including noise from car parks, access roads, children's play areas, beer gardens etc. It was decided that additional information was needed to ensure that the numbers and criteria identified worked. To this end an appeal was made in the IOA Bulletin and EH News for volunteers from both Local Authorities and consultants to trial the numbers when investigating real life complaint, planning or licensing situations. It was emphasised that the suggested criteria should, under no circumstances, be quoted or used in any action being taken in respect of noise from pubs or clubs. Over 50 Local Authorities and Consultants agreed to participate in the trial which commenced in April 1998 and finished at the end of September 1998. Disappointingly only 11 results were received and these all applied to music noise.

Another IOA Workshop Meeting, on the subject of pubs and clubs noise was held at the University of the West of England in Bristol on 11 November 1998. This was oversubscribed with 60 delegates attending. Brief synopses were given by John Hinton (Chairman of the Working Group) on *Where Are We Now?*, Dawn Connor on *The Trade's View* and Mike Squires on the *Results of the Trial*. The meeting then divided into small workshop groups when the following questions were discussed.

1. Does the poor response to the 'trial by numbers' indicate that pubs and clubs do not produce a significant number of noise problems?
2. In view of the poor response to the 'trial by numbers', should the trial continue? If so, would you change the format and how?
3. Are the noise problems produced from pubs and clubs adequately dealt with without a Code of Practice, ie are we wasting our time?
4. Should a code on the control of noise from pubs and clubs define an optimum situation in numerical terms or should lower (acceptable) noise limits and upper (unacceptable) noise limits be set with general advice for noise levels in between the limits?
5. If optimum levels are set (see Q4) should the levels be different for planning and non-planning purposes?
6. The trade seem concerned about the introduction of a code and particularly a prescriptive code. Are these concerns justified? If not, how can the trade by reassured?

The feedback from these discussion groups showed that:

a. There was a consensus that pubs and clubs do produce a significant number of problems.
b. The trial should continue but become more focused; shorter measurement periods, external measurements (unless complaint property attached).
c. A Code of Practice was necessary both for the 'trade' and enforcers; it would give a 'level playing field'
d. No consensus to Q4 although it was agreed that additional information was needed and that low frequency noise was important.
e. No consensus on Q5 – car and people noise should only be considered in the case of new venues and not existing.
f. Code would produce a consistent approach; and supply best practicable means defence.

It was also stated at the meeting that a number of Local Authorities and Consultants did not know that a trial had been going on.

A further meeting of the working group took place on 18 November 1998 where the results of the trial and the feedback from the above workshop were discussed. It was decided that because the trial had not produced sufficient or conclusive evidence that the suggested criteria worked in practice, a draft document containing this criteria should not be published at this stage although this would remain the ultimate goal of the working group. However, as an interim step, it was decided to produce a draft guidance and good management document (without criteria) for public consultation as soon as possible.

It was also decided that the trial should be relaunched and you will find a copy of a new trial document included in this publication. It is requested that as many of you as possible assist the working group in completing this trial whenever you are involved in a case of music noise or noise from gardens and play areas either from existing or proposed pubs, clubs etc. It is envisaged that the relaunched trial will last for one year ending on the 30 January 2000, when it is hoped sufficient data will be available to produce meaningful and authenticated noise limits.

For further information or to make any comments on the trial please contact:

John Hinton, Birmingham City Council Environmental Services Department, PO Box 5248, 581 Tyburn Road, Birmingham B24 9RF Tel: 0121 303 9942 Fax: 0121 303 9980 email : bham.acoustics@dial.pipex.com

Dawn Connor, Basingstoke and Deane Borough Council, Environmental Health Services, Civic Offices, London Road, Basingstoke RG21 4AH Tel: 01256 845520 Fax: 01256 844702.

Citations

1998 Rayleigh Medal

Professor William A Ainsworth

Bill Ainsworth graduated with a first class honours degree in physics from Kings College, London University in 1960. Following this, he moved to Keele University to undertake research in Communication leading to the award of his PhD in 1963.

After a year as Visiting Research Associate at the University of Illinois, Bill returned to Keele University in 1964 to take up a post as Research Fellow in the Department of Communication. In 1972 he was made Senior Research Fellow, and then in 1989 he was appointed as Reader and since 1994 has been Professor of the Department of Communication and Neuroscience. Over this period, Bill has been an active member of several University Committees including currently the Senate and the Academic Review Committee.

Professor Ainsworth's teaching has encompassed both undergraduate and postgraduate courses, including such subjects as assembly language programming, speech analysis and synthesis, physiological psychology, machine perception and neurocomputing. Bill has been responsible for the supervision of fifteen Research Fellows and also is in demand as an external examiner for various British, Irish, Australasian, Indian and French universities.

Bill Ainsworth has been, and remains, a prolific researcher in the field of speech, involving the formulation of experimental methods for determining speech intelligibility, together with computational and physiological modelling of the auditory system. Among his work, he has researched the influence of various interfering transmission effects and adverse environments on speech intelligibility, and has developed self learning machines for automatic speech recognition systems, speech synthesisers and electronic lipreading devices. Current research interests include evaluating the reassignment method in speech processing and auditory scene analysis by amplitude modulation mapping. Bill Ainsworth's interests and authority range across the whole field of speech production and perception, but latterly it is his influence in spoken language processing and auditory analysis which is significant.

As a result of his extensive research programme, Bill has been author or co-author of over 150 papers, has edited, contributed to or reviewed several books and Proceedings, and is the author of the Institution of Electrical Engineers monograph 'Speech Recognition by Machines'. He has collaborated with industry and the medical profession in Britain, as well as with many overseas research institutes and universities, including a major role in the European Strategic Programme for Research and Development in Information Technology. He has also presented numerous invited seminars and lectures around the world, and has been a member of several national and international committees.

Professor Ainsworth is a Fellow of the Institute of Acoustics, and a Member of the Institute of Physics, of the European Speech Communication Association and of the Acoustical Society of America. He has been involved in the organisation of the Institute's Autumn Conferences Speech Communication and Speech and Hearing since 1979 as well as several other meetings and conferences. Bill has been Secretary and Chairman of the Speech Group, and served on Council as Vice-President from 1988 to 1994 during which period he also Chaired the Publications Committee.

The Institute of Acoustics is pleased to award the Rayleigh Medal in 1998 to Professor Bill Ainsworth for his outstanding contributions to acoustics, and in particular to the fields of speech production and perception.

1997 A B Wood Medal

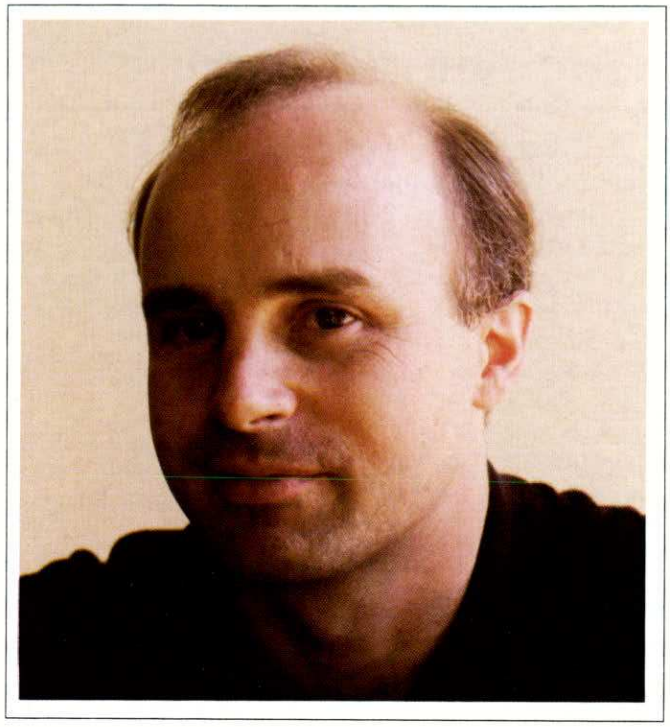
Dr Grant B Deane

Grant B Deane received his BSc in Physics from the University of Auckland in 1982, followed a couple of years later by an MSc in Physics from the same university. Working with Dr Chris Tindle, his research topic was Ocean Acoustics; this was his entry into the realm of range-dependent acoustic propagation, beam displacement, modal interference, horizontal refraction, and other subtleties of underwater sound fields. The research he performed at this time resulted in a widely referenced paper in the Journal of the Acoustical Society of America on sound propagation over a sloping seabed.

Not content with just one line of research, Dr Deane then moved to the United Kingdom to pursue a DPhil at the Mathematical Institute, University of Oxford, where he focused his attention on plasma physics and the curiosities of Reverse Field Pinch Reactors. With Professor L C Woods, he developed a theory of energy and mass transport in fusion reactors that provided a plausible explanation for formerly inexplicable observations. He received his doctorate for this work in 1989.

At that time the world of plasma physics was perhaps too politically driven for his taste, so he decided to return to his original field of interest: ocean acoustics. Luckily, the fact that ocean acoustics also has its political side escaped his notice, and he accepted the offer of a prestigious Mellon Fellowship at Scripps Institution of Oceanography, University of California, San Diego. Dr Deane is still at Scripps, where his main lines of research have been 3-dimensional propagation in the ocean, inversion of ambient noise in shallow water for bottom geoacoustic properties, and more recently the acoustics of surf zone and near shore processes.

After joining Scripps, Dr Deane became progressively more interested in performing at-sea experiments. He was the Chief Scientist for the Scripps component of the multi-institutional Cordova Channel experiment, conducted in the waters off Vancouver, British Columbia, Canada. Using a multi-element, planar array with an aperture of approximately 0.5 m, he measured the spatial coherence of high-frequency (~ 67 kHz) sound that had propagated through the fully developed turbulence present in Cordova Channel. This was reported at the 128th meeting of the ASA, 1994.



He has developed an acoustic array for long-term monitoring of the ambient noise field in the ocean off Scripps Pier. Already, this has provided a wealth of information on noise processes occurring at time scales ranging from seconds to seasons, including, of course, diurnal and tidal effects. Biological sounds are clearly present in the recordings, as are the acoustic signatures of low-flying aircraft (both fixed- and rotary-wing) and passing storm systems.

In addition to measuring underwater noise, Dr Deane has used the ambient noise in the ocean as the basis of an inversion procedure for determining the geoacoustic properties of the seabed. The vertical directionality or, equivalently, the vertical coherence of the noise is largely controlled by the properties of the bottom boundary. He was able to use this coupling to extract both the compressional speed of the sediment and the shear speed from relatively simple measurements using just two hydrophones located in the water column. This technique has excellent potential as a cost-effective, 'first-look' seabed surveying tool.

His most recent enthusiasm is the acoustics of the surf zone. With various hydrophone arrays, he has acquired data on the acoustic characteristics of waves breaking on a sandy shore. He found that 'hot spots' of sound propagate along with the wave crest, and was able to explain their properties on the basis of a new theoretical model that he published recently in JASA.

Since joining Scripps, Dr Deane has been actively involved in the affairs of the Acoustical Society of America. He is a member of the Acoustical Oceanography Technical Committee and was on the organizing committee for the 134th meeting of the ASA held in San Diego, December 1997.

The Institute of Acoustics is pleased to award the A B Wood Medal to Dr Deane for his outstanding, broad-based contributions to underwater acoustics and acoustical oceanography.

Branch News

Eastern Branch

The 1998 AGM, the 10th to be held by the Eastern Branch, took place at the new factory building of Salex Acoustic Materials in Colchester. The AGM marked the end of the chairmanship of David Bull who had done the job for the last 10 years. David who could not be with us due to being on holiday in New Zealand after attending Inter•noise, had decided to step down because of the time needed for his other IOA commitments. It is safe to say that the Eastern Branch has prospered because of his dedication to making it work. John Hustwick was elected as chairman after serving three years as secretary and Michael Alston will now be the secretary. Some committee members have retired but they are being replaced by new blood so it is hoped that the Branch will carry on thriving and that it will be able to offer members a varied set of topics for the evening meetings.

The presentation given on materials by Bill Frame of Salex after the AGM was very interesting and included a demonstration of their CAD package. This is being used more and more as they are being involved at the concept stage of vehicle design, an area where they are quite well established. Using computer design means ideas can be sent backwards and forwards, across the Atlantic for instance, between Salex and the vehicle designers. This can speed up the whole development process and can make for a very flexible working arrangement.

Various materials, such as the DS90 wall panels for interior design and a selection of preformed vehicle engine compartment noise control panels were brought in to show some of the different techniques involved in their construction, of course without giving too much away. Judging by the questions being asked after the presentation, it was quite a successful evening.

Midlands Branch

The Midlands Branch held their AGM on Wednesday, 3rd November at the Old Council House, Coventry as guests of Coventry City Council. Four members of the Branch Committee had served three years and were due to stand down. As all four were willing to continue and as there were no other candidates they were all re-elected. So the Committee for next year will be John Hinton, Chair: Mike Fillery, Secretary: Deborah Webb, Ron Hawkes, John Shelton and Denis Robinson. They will be assisted by Laura Dibble, daughter of the redoubtable Ken, who is helping with meeting planning for 1999.

At the AGM the Committee unveiled their plans for 1999 meetings (see below). These were generally well received and discussion then moved on to CPD. There was an air of disappointment at the lack of feedback that members had been given over CPD and the Committee were asked to convey these misgivings to HQ.

Following the AGM, Ian Campbell our current President gave the branch a very interesting talk on the use of statistical noise indicators. As well as outlining the problems and pitfalls of using modern statistical measurement, Ian also gave some thought provoking examples of how statistical indicators can provide insights that are not available by other means. Ian's talk was followed by buffet in the Crypt below the Council House. The gothic theme was perhaps appropriate as the buffet was sponsored from beyond the grave by Larson Davis UK.

The branch is taking EU Noise Policy as its theme for branch meetings for 1999. The EU has issued a Green Paper on noise and proposes to implement an EU-wide noise policy in the immediate future. As part of this process a number of working parties have been set up to look at specific areas of noise policy The branch has been fortunate that a number of the UK representatives on these working parties have agreed to address our meetings in 1999 The provisional programme is as follows:

Tuesday 16 March (evening): University of Derby, Dr Ian Flindell, ISVR, *Noise Indicators: Working Group 1*

Tuesday 15 June (evening): Solaglas, Coventry, Bernard F Berry, NPL, *Dose/Effect: Working Group 2*

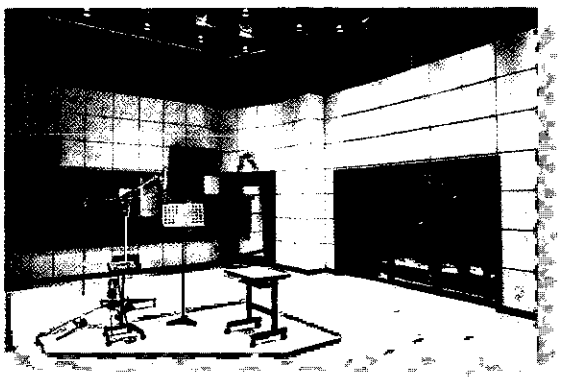
Wednesday 22 September (afternoon): Birmingham City Council, John Hinton, City of Birmingham, *Noise Mapping: Working Group 4*

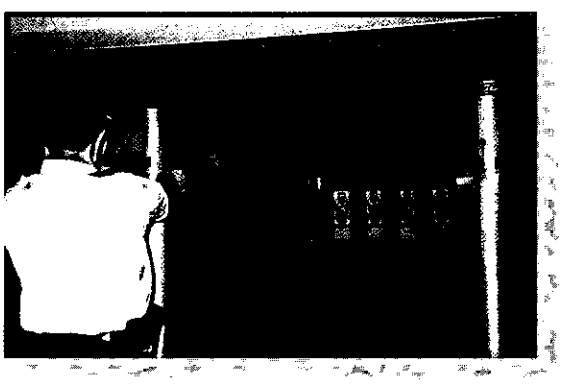
Thursday 11 November (evening): W S Atkins, Derby, Dr Paul Nelson, TRL, *Computation and Measurement: Working Group 3*

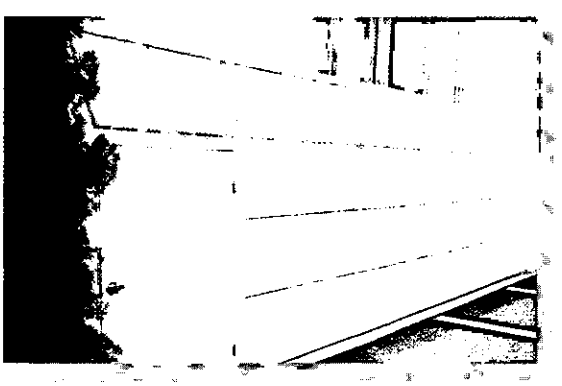
Mike Fillery MIOA

COUSTONE

Acoustic Solutions in a Tough Stone Format







Coustone is a rigid hardwearing material that can provide both high acoustic performance and a practical solution in a wide range of applications both internal and external.

Coustone has a high sound absorption up to **0.95 NRC** and excellent sound insulation properties up to **46.1dB** and has been developed for use where an economical, hardwearing, acoustic solution is required.

Coustone is used in a wide range of applications including schools, swimming pools, recording studios, shooting ranges, audiology rooms, sports halls, gymnasiums, cinemas, hospitals, factories and theatres, and will provide a solution to most noise problems.

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For technical advice or further information please contact our technical department at:

CEP Acoustics Limited, Falcon Court, Clayton Business Park, Clayton-Le-Moors, Accrington BB5 5JD
Telephone 01254 391111 Fax 01254 232020
E-mail: cep@cep-ms.demon.co.uk Website: www.cep-ms.demon.co.uk

THE INSTITUTE DIPLOMA EXAMINATION 1998

Professor Keith Attenborough FIOA

The results in each Module are shown for each centre in the Table of Results overleaf. The names of students completing the requirements for the award of the Diploma are also presented overleaf.

The total number of candidates was 150 (187 entered in 1997) and the overall pass rate was 86% (83.9% last year), including all projects. Candidates who registered to undertake their Project this year and who did not submit their project report by the set date are included, as is normal, among those shown in the table to have failed.

For the elective papers, 114 candidates took Noise Control Engineering, 99 Law and Administration, 52 Architectural and Building Acoustics, 28 Transportation Noise, 9 Vibration Control and 5 Sound Reproduction. As last year there were no candidates for the Measurement paper.

This was my first year as Chief Examiner; it has been an intensive and interesting learning experience. In particular I would like to thank my predecessor (currently Deputy Chief Examiner) Dr John Bowsher HonFIOA for his encouragement and patient, unfailing, assistance. I am extremely indebted to Linda Canty for her vital help at the Institute office. Apart from having to learn the job during this year, I have been involved in several initiatives with the help of Diploma Tutors and the Education Committee and Working Groups. The most tangible of these so far are a set of standardised coursework assignments and a new relative weighting of 70/30 for written examination/continuous assessment for 1999. Previously this ratio had been 80/20. There is progress also towards agreed learning outcomes for the various modules and a syllabus review, bearing in mind the Diploma's postgraduate status and the need to maintain its professional standing.

There will be three changes in the Specialist Module examiners for the 1999 examinations. Richard Galbraith, Andy Moorhouse and Mike Langley have resigned as examiners for Architectural and Building Acoustics, Noise Control Engineering and Vibration Control respectively. I am sure that all colleagues would want to record their thanks and best wishes through this report. We welcome Stephen Stringer (Sandy Brown Associates), Mike Hewitt (AV Technology) and Chris Truman (School of Engineering, University of Hull) in their places for 1999.

The mean marks for the General Principles of Acoustics, Transportation Noise, Noise Control Engineering and Law and Administration paper were roughly comparable. Clearly, however, candidates found the Architectural and Building Acoustics paper rather tough. Several tutors observed that the calculations called for were too long and interdependent for examination conditions; some allowance was made for this by adjusting the Pass and Merit marks. So far there has been only one appeal.

A question on basic concepts was the most popular question on this year's General Principles of Acoustics paper and was answered fairly well. One on microphone performance was the least popular and had the lowest mean mark. A question on hearing loss was fairly popular and returned the highest mean mark. The least popular question on the Noise Control Engineering paper was one on floating floor construction for vibration control and this produced the lowest mean mark on that paper. The best answers on that paper were concerned with sound reduction index and the building envelope and noise control for a chiller on an open forecourt. A question about hall design for variable acoustics was the least popular on the Architectural and Building Acoustics paper and had the lowest mean mark. Impact isolation was the most popular topic on that paper and attracted the highest mean mark.

The performances of Distance Learning and University of Derby students on the General Principles of Acoustics Paper were particularly good this year. Merit grades on that paper were obtained by 25% of Distance Learning students; the continued success of that form of study over the years confirms the feasibility of this method of course delivery and is a tribute to those students and their tutors No students at Derby failed the General Principles of Acoustics Paper.

I have awarded the Institute Prize for the best overall performance to Miss G D Conroy who studied at the North East Surrey College of Technology (NESCOT). Special Commendations have been made to P Tittmar (Distance Learning, Irish Group), R C Mathews (Colchester) and Ms S M Scott (Distance Learning, North-east England Group).

Keith Attenborough FIOA is Professor of Acoustics at the Open University.

1998 Diploma Pass List

Bristol
Blake, R J
Manning, F J
Maudlin, J A
Mellor, S A
Tudball, S L

Colchester
Bradstock, P K
Brooks, J S
Court, M P
Gilbey, T D
Green, I M
Hewett, K R
Matthews, R C
Nothard, M
Pickup, A R
Rattigan, M
Read, K K
Smart, A J
Trollope, E L
Upson, B S
Williams, S
Wootton, M S R
Young, G J

Derby
Brookes, P A
Cooke, E A
Forster, G E
Gooch, D
Gray, A J
Irvine, A S
Kay, M A
Kelly, N C
King, L
Kitto, R E
Klek, S R
Lawton, K M
Lovatt, I
Mallon, C A
McIntosh, F M
Middleton, C J
Mills, J O
Morton, P J
Parkinson, M T
Penny, J A
Rochelle, L
Roseblade, M P
Sheikh, A G
Stanley, N E
Swankie, G N
Tindale, A E
Wardle, W C
Wicks, I

Leeds
Abbott, P J
Barker, J A
Copley, C A
Elsby, R
Hope, S M
Hume, R
Luke, A W
Martin, G J
Simnett, A J
Swainston, J
Wood, T
Yates, P T

NESCOT
Appleton, A C
Burrell, K L
Conroy, G D
Franklin, D P
Grewcock, R L E
Harris, R C
Hughes, P G
Phillips, T A
Reynolds, B S
Rowland, J C
Smith, N L J
Tait, J R
Williams, P

Newcastle
Todd, P H

Tutored Distance Learning
Blakeley, S T
Boland, D J
Brown, R J
Buckley, R R
Cunningham, J R
Dalton, E J
Gallimore, S
Ginnity, B M
Goddard, H M
Godman, A G
Hemming, J C
Hodgson, S C
Hodson, C S
Huffer, P
Kavuma, R R
Land, I R
Martin, G
McDiarmid, A A
Middleton, M S
Milligan, T E
Morris, K S
Parkinson, S G
Phelan, J
Phillips, D J
Pollock, S J
Radford, J C
Robertson, S Z
Rogers, M A
Scott, S M
Sills, A
Southcombe, M J
Stopford, C
Thomas, C
Tittmar, P
Wallace, R M
White, C W
Williams, N J

Ulster
Parkinson, J E

	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	1	5	4	0	0	0	0	3	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	4	1	2	15	5
Colchester	1	17	5	0	0	0	0	17	3	0	0	0	2	16	6	0	0	0	0	0	0	1	2	1	3	19	4	7	71	19
Derby	0	27	0	1	2	1	1	19	0	0	0	0	2	7	1	0	0	0	2	21	1	0	0	0	5	23	1	11	99	4
Leeds	1	19	3	0	0	0	8	17	1	0	0	0	4	17	4	0	0	0	0	0	0	0	0	0	2	11	5	15	64	13
NESCOT	3	16	2	2	5	2	0	15	2	0	0	0	3	10	3	0	0	0	1	3	0	0	0	0	3	11	6	12	60	15
Newcastle	0	0	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	5
Sheffield	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1
Ulster	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Distance Learning	11	28	5	5	27	6	1	7	2	0	0	0	5	25	4	1	2	1	0	0	0	2	2	1	8	31	7	33	122	26
Totals	17	113	20	8	35	9	10	80	9	0	0	0	17	77	20	1	3	1	3	24	1	3	4	2	21	100	26	80	436	88

Diploma in Acoustics and Noise Control
Grades awarded to 1998 candidates from each centre

ENGINEERING COUNCIL QUARTERLY REPORT – JANUARY 1999

As we enter the year of celebrating the end of this millennium, there is a lot of good news for the Engineering profession, which I believe made considerable progress in a range of areas in the course of 1998.

Among the many significant developments, we have seen the creation of the Institution of Incorporated Engineers (IIE), now established as the biggest Incorporated Engineering Institution. The IIE is working hard in conjunction with its fellow Institutions and the Engineering Council to promote the qualification of Incorporated Engineer as a significant and important professional engineering standard. We are starting to persuade both academia and industry of the importance of the Incorporated Engineer to the future of the profession, but there is still much work to do. The creation of the IIE has been a significant move in that direction.

Linked with the position of the Incorporated Engineer is a continuing work on the development and acceptance of SARTOR with the main routes now defined towards registration. While some development work here remains to be done, I am glad to say that SARTOR is now largely regarded as the national standard.

We have also achieved much progress with the promotion of engineering and, in conjunction with the Institutions, have been working hard on raising the profession's profile. We are now engaged in seeking Industry sponsorship for the planned National Marketing Campaign, being mounted in conjunction with the Engineering Employers' Federation and the Engineering and Marine Training Authority. This should be a major boost to our profession and above all to improving its recognition and perception among the general public. One of the key aims of this campaign is to attract more young people of the right quality into the profession and to boost all the good promotional work that is already being done by many organisations, mostly volunteer, across the length and breadth of the UK.

A lot has also been achieved in the last year with raising the status of engineering in the view of Government and parliament and the Engineering Council has played a major part to this end. Again, much support is provided by the Institutions, particularly the contribution of the Institution of Civil Engineers in hosting our regular briefings for Engineer MPs.

The many activities, including conferences, competitions and awards, taking place during the course of the year have also played their part in the continuing promotion of the profession. The Engineering Council's own Young Engineers for Britain competition goes from strength to strength and the Environment Award for Engineers is being further enhanced this year.

There was more good news for the profession with the publication of the Engineering Council's Statistical Review, which shows that engineers have an increasingly firm foothold on the boards of our major companies and overall our salary levels are more than holding their own.

1998 ended on a happy note with a Carol Service in what is now the Engineers' Church of St Peter's in Eaton Square. Now an established event in the engineers' calendar, I hope that more will attend with every year. The Competitiveness White Paper also arrived late in the year and, with encouraging emphasis placed on our engineering and technology base, served as a welcome Christmas present for the profession.

The year also ended with the completion of the Engineering Council Activity Review, the report of which is now before members of Senate. This it is likely to mean a good deal of change within the Engineering Council as it moves forward to serve the profession to better effect. Its aims include reducing costs and creating a more dynamic Council, giving it greater flexibility to take on new tasks, particularly in conjunction with the Institutions.

Whilst identifying all the good news, there remains much to do in 1999, of course, particularly with regard to establishing clear messages which can represent the profession's unity of purpose. One area of anxiety is over possible revisions to the National Curriculum which may further dilute science and technology in schools, and we are working closely with Institutions in making clear our concerns.

We also need to make continuing progress on expanding all classes of the register and the benefits of registration and Institution membership for all engineers. This requirement becomes all the more urgent with the analysis of our statistics of the numbers joining the Engineering Council Register in 1998. Once again we have seen a drop across all categories of the Register. Although small, the downward trend is consistent and is compounded by the high age profile of the registrant population. The biggest fall is in Incorporated Engineers, the very group we should be concentrating on, and one where registration levels have halved in the past ten years.

The need to encourage registration (and at the same time Institution membership) is a shared problem between the Engineering Council and the Institutions, which we need to tackle together if we are going to reverse the decline and assure the future of the profession. This must be the primary task for us all in the months ahead and the Council is developing marketing expertise to take this forward.

The steady improvement in the reputation of the engineering profession will only continue if we all work on all these issues together. This means standing back and ensuring that we all appear as a coherent and united profession, speaking with one voice.

The profession now has a structure that is producing positive results, but building on these successes will only be achieved by commitment from everybody. This will often mean compromising some local concerns in order to serve the greater good.

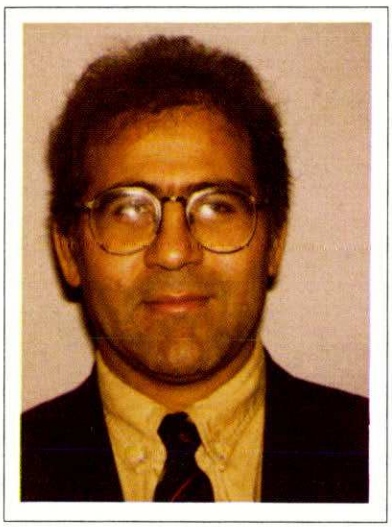
Malcolm Shirley, Director General

New Chartered and Incorporated Engineers

Chartered Engineers

Nass Dadkhah

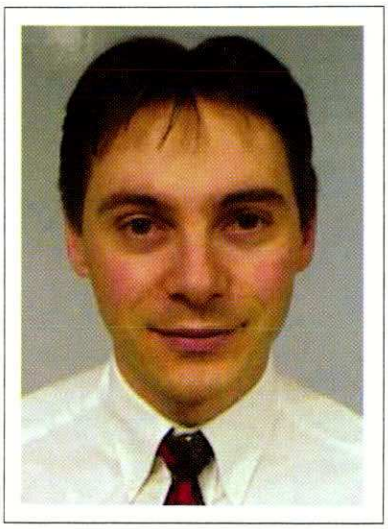
Nass Dadkhah has been working in the field of acoustics for the last 15 years. A graduate in Aeronautical Engineering from Loughborough University, he spent the initial years working in underwater acoustics, specialising in the design and application of transducers. Nass joined Ameeco Hydrospace Ltd (then Plessey Naval Systems Ltd) as a graduate Engineer in 1983, developing acoustic and sonar systems for various applications. He then joined London Underground Ltd (LUL) for an initial period of 3 years working on Rolling Stock dynamics. He joined SDMA (UK) Ltd in 1989 to lead a number of projects developing a new generation of hydrophone and geophone arrays for seismic exploration. Nass rejoined LUL in 1992, as a Consultant specialising in track related noise and vibration and wheel/rail interface. During that period, he developed particular expertise in design and evaluation of resilient trackforms and condition monitoring of railway structures (track, tunnels and bridges). Nass joined Metropolitan Railway Consultants Ltd (MRCL) in April 1997 as a director and senior noise and vibration consultant. He has been carrying out various projects for railway operators, projects, manufacturers and other consultants. Nass is currently a Work Package leader within the European Silent Track project, responsible for overseeing research and development to find optimised solutions to reduce noise and vibration from track.



Peter Hanes

Peter Hanes graduated from the University of Salford's Department of Applied Acoustics in 1989 with a BEng (Hons) degree in Electroacoustics. His study included a year spent at Brüel & Kjær in Naerum, Denmark, researching sound intensity and active noise control. After graduation, he joined the National Physical Laboratory in Teddington, UK, as a Scientific Officer in the Noise Measurement Section and researched measurement uncertainties in the determination of sound power levels of machinery. He also took part in field exercises for the measurement of aircraft noise, and established the laboratory's service for calibration of reference sound power sources.

In 1992, Peter moved to the Acoustical Standards Section of NPL, where he designed and implemented automated systems for the calibration, verification and pattern evaluation of sound calibrators. He is the Booking Officer for this service, which is currently NAMAS-accredited by UKAS.



Peter was awarded an MSc in Measurement Instrumentation and Devices from South Bank University in 1996. Since the inception of the IOA's Measurement and Instrumentation Group in 1995, he has acted as the Honorary Secretary of the Group Committee, helping to organise its series of meetings and tutorials. Peter is currently a Senior Research Scientist in the Acoustical Standards Section at NPL, and Project Manager for NPL's programmes of research on working standard microphones and sound calibrators.

Nick Tinsdeall

Nick Tinsdeall graduated from the University of Nottingham in 1984 with an honours degree in Mathematics with Engineering. Nick then joined Marconi Underwater Systems where he worked on a variety of projects including the calibration of hydrophone arrays, the collection and analysis of sea trials data, the computer control of instrumentation, development of signal processing algorithms and the processing of data for ocean surveys.

In 1991 Nick joined the BRE Acoustics Centre. Whilst working at BRE Nick attended the part time MSc course at South Bank University. Nick graduated with an MSc in Environmental Acoustics in 1994. During his time at BRE Nick has been responsible for the in house calibration of much of BRE's acoustic instrumentation and general consultancy work. Nick has also been involved in projects investigating sound insulation between dwellings This has involved not only the collection of sound insulation data but also the analysis of the subjective impression pro-

vided by the occupants of some of the dwellings investigated. Nick is currently preparing procedures to facilitate UKAS accreditation for sound insulation measurements.

Incorporated Engineers

Jeremy Butt

Jeremy Butt attended Weston-Super-Mare College and was awarded Part Three Mechanical Engineering Technician Certificate in 1981. He has spent over twenty years in the field of air distribution and acoustics. For the past five years he has worked for Acoustic Air Technology Limited (AAT), where he has gained corporate membership of the IOA. He is currently undertaking a Masters degree at the University of the West of England researching aerodynamic noise generating mechanisms. As Sales Director of AAT he is involved with Sales and Marketing, product development and providing technical assistance to customers throughout the industry. His work includes noise impact studies for new projects at planning stage industrial and environmental noise reduction as part of BS4142 assessments and design of noise control solutions.

He has also provided consultancy services for architectural schemes including sound insulation and reverberant noise control. In the field of building services he has carried out product evaluation on manufacturers products as well as design and testwork on the Acoustic Air Technology range of noise control equipment. He has successfully carried out acoustic analysis of building services noise control on many large and prestigious projects as part of the Acoustic Air Technology Total Acoustic Guarantee package.

Richard Crowther

Richard Crowther commenced working for Leeds City Council in the Autumn of 1987 as a technician in the Noise Study Section of the Highways and Transportation Department. His duties at that time involved assessment of road, rail and aircraft noise for planning applications. A major task undertaken during this period was aircraft noise assessment on behalf of the Leeds Bradford Airport for their application to extend to 24 hour operations.

In mid 1989 he took the post of Senior Technician in the Noise Control Section of the Department. Richard's duties here were mainly the supervision of noise insulation contracts and determining eligibility of properties under the Noise Insulation (Amendment) Regulations 1988.

In 1991, shortly after completing an HNC in Civil Engineering Studies at Sheffield Polytechnic, he spent three years on secondment to the Main Drainage Department of Leeds City Council, designing small flood alleviation schemes and Drainage Area Plans. 1994 saw Richard return as Principal Technician to the now renamed Section of Environmental Services. By 1996 he had completed the Diploma of Acoustics and Noise Control at Leeds Metropolitan University. Since then his duties and responsibilities have both steadily increased and diversified into air quality, working to the UK National Air Quality Strategy, Part IV of the Environment Act 1995.

At present Richard is responsible for Environmental Impact Assessments and Environmental Statements for both minor and major road, traffic management and landfill schemes. This typically involves Before and After assessments of road traffic noise and vibration, together with predicting the impact of construction noise. Other responsibilities include the day to day running, maintenance and calibration of the Department's two mobile air quality monitoring stations and two Met stations. He is also charged with the setting up and operation of the Emission Data Base for the computerised air quality modelling system.

Hansard

1 December 1998
Aircraft Noise
Mrs May: To ask the Secretary of State for the Environment, Transport and the Regions if he will make a statement on the research on the effect of aircraft noise on sleep disturbance which his Department has commissioned, indicating sites chosen for noise trials.
Ms Glenda Jackson: We have commissioned a research trial on the effect of aircraft noise on sleep disturbance. This trial is to assess analytical techniques and methodology, and their limitations, to help us decide whether to proceed with a full-scale study either of sleep prevention or of total sleep loss, and to determine what should be included in any such study. The trial will involve taking measurements of people sleeping in their own homes and will be based at Manchester Airport, which provides a suitable combination of densely populated communities close to the airport with a spread of aircraft noise throughout the night. It may be extended to Heathrow if actual noise levels in the early morning at Manchester prove insufficient for the purposes of the trial. No specific sites have been selected yet. The steering group for the study includes representatives of the consultative committees from Manchester, Heathrow, Gatwick and Stansted, along with the airport management, airlines and environmentalists.

15 December 1998
Gatwick Airport
Mr Blunt: To ask the Secretary of State for the Environment, Transport and the Regions in which year noise limits were first placed on individual aircraft taking off from Gatwick Airport; and when he expects these limits to be reduced.
Ms Glenda Jackson: Noise limits on aircraft taking off from Gatwick have applied since 1968. On 24 November 1997 we published a consultation paper proposing lower daytime and night-time noise limits for aircraft departing from Heathrow, Gatwick and Stansted and more efficient noise monitoring arrangements. In February 1998 the International Air Transport Association (IATA) submitted an application for leave to apply for judicial review of that consultation paper. The Department subsequently undertook to publish a supplementary consultation paper and IATA withdrew its application for leave to apply for judicial review. We hope to issue the supplementary paper early in the new year. The consultation period will remain open until eight weeks after the supplementary paper is issued. As indicated in the November 1997 consultation paper, if possible the Secretary of State will aim to announce his decision within 3 months of this deadline.

If the decision is to implement the proposals as set out, or with only relatively minor alterations, the Secretary of State would seek to bring them into effect within not less than 2, and not more than 3, months of the date of the announcement. Comments have been invited on these timescales as well as on the proposals.
Extracts provided by Rupert Taylor FIOA

BSI News

BS EN Publications

BS EN ISO 140: Acoustics – Measurement of sound insulation in buildings and of building elements.
BS EN ISO 140- 7:1998 Field measurements of impact sound insulation of floors. Supersedes BS 2750-7:1980.
BS EN ISO 8662: Hand-held portable power tool – Measurement of vibrations at the handle.
BS EN ISO 8662-10:1998 Nibblers and shears. No current standard is superseded.
BS EN 1794: Road traffic noise reducing devices – Non-acoustic performance.
BS EN 1794-1:1998 Mechanical performance and stability requirements. No current standard is superseded
BS EN 1794-2:1998 General safety and environmental requirements. No current standard is superseded.
BS EN ISO 14163:1998 Acoustics – Guidelines for noise control by silencers. No current standard is superseded.
BS EN 60318: Electroacoustics – Simulators of human head and ear.
BS EN 60318-2:1998 IEC 6031 An interim acoustic coupler for the calibration of audiometric earphones in the extended high frequency range. No current standard is superseded.
BS EN 60318-3:1998 Acoustic coupler for the calibration of supra-aural earphones used in audiometry. Supersedes BS 4668:1971 which will be withdrawn on 1 July 2001.

British Standard Implementations

BS ISO 362:1998 Acoustics – Measurement of noise emitted by accelerating road vehicles – Engineering method. Supersedes BS 3425:1966.

British Standards Withdrawn

BS 2750: Measurement of sound insulation in buildings and of building elements.
BS 2750-7:1980 Field measurements of impact sound insulation of floors. Superseded by BS EN ISO 1407: 1998.
BS 3425:1996 Method for the measurement of noise emitted by motor vehicles. Superseded by BS ISO 862:1998.

New Work Started

BS 3539 Sound level meters for the measurement of noise emitted by motor vehicles.
BS 7580 Specification for the verification of sound level meters.
BS 7580-1: Comprehensive procedure.
BS 7580-2: Specification for the verification of sound level meters – Shortened procedure for type 2 sound level meters.

International New Work Started

IEC 60704 Test code for the determination of airborne acoustical noise emitted by household and similar electrical appliances.
IEC 60704-2-X Coffee makers.

European New Work Started

(No number indicated) Test code for the measurement of sound power levels of pumps and motors using sound intensity techniques.

Drafts for Public Comment

98/564136 DC ISO/DIS 3740 Acoustics – Determination of sound power levels of noise sources – Guidelines for the use of basic standards (Possible BS ISO 3740) (Draft revision of ISO 3740:1980).
98/716323 DC ISO/DIS 10816-5 Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – Part 5: Machine sets in hydraulic power generating and pumping plants.
98/715898 DC ISO/CD 8579-1 Acceptance code for gear units – Part 1: Test code for airborne sound.

CENELEC Publications

EN 60318 Electroacoustics – Simulators of human head and ear.
EN 60318-2:1998 (IEC 60318-2:1998) An interim acoustic coupler for the calibration of audiometric earphones in the extended high frequency range.
EN 60318-3:1998 (IEC 60318-3:1998) Acoustic coupler for the calibration of supra-aural earphones used in audiometry.

IEC Publications

IEC 61400-11:1998 Wind turbine generator systems – Part 11: Acoustic noise measurement techniques.

ISO Standards

ISO 389:1998 Acoustics – Reference zero for the calibration of audiometric equipment – Part 1: Reference equivalent threshold sound pressure levels for pure tones and supra-aural earphones.
ISO 1996-2: Acoustics – Description and measurement of environmental noise – Part 2: Acquisition of data pertinent to land use Amendment 1: 1998 to ISO 1996-2:1987. Will be implemented as an amendment to BS 7445-2: 1991.
ISO/TR 4869-4:1998 Acoustics – Hearing protectors – Part 4: Measurement of effective sound pressure levels for level dependent sound restoration ear-muffs. Will be implemented when adopted by CEN via the UAP procedure.
ISO 14163:1998 Acoustics – Guidelines for noise control by silencers NOTE: Implemented as BS EN ISO 14163:1998.

This information was announced in the November and December 1998 issues of BSI Update, copies of which are kept in the Institute library.

Book Reviews

Passive Vibration Control
by D J Mead
Publisher: Wiley
ISBN 0 471 942030
Price £150

This book is the magnum opus of an author who has devoted a long and eminent professional life to the study and research of vibration control in all its aspects. From personal experience I know how extremely meticulous Dr Mead has always been in his approach to this field of study. He has loved this subject and been an inspiration to his many students. All of this is reflected in the excellence of his book.

The book starts with an introductory chapter which is a long and fascinating essay on exactly why engineers need to be aware of vibration problems as they affect both structures and human beings, and, in general terms, what can be done about them. This should be required reading for all students of vibration.

The second chapter is perhaps the only one which contains material to be widely found in other books. It is concerned with the response of structures to harmonic forces and is wider ranging than most other books with material on excitation by pressure fields and on the subject of complex response diagrams (vector plots).

Chapter three extensively describes the concept of dynamic stiffness and its inverse, the receptance. Either of these two quantities (and others too) may be used to describe the dynamic characteristics of a structure. Dr Mead, like the late Dr Bishop, appears to favour the receptance.

Chapter four, a rather short chapter, is concerned with structural response to applied dynamic motion (inexorable motions) as opposed to applied forces. A typical example is the response of a building to an earthquake.

The fifth chapter gives a full account of the excitation of structures by periodic forces, random forces and short transients.

The sixth chapter takes an extensive look at the vibrations of beams and plates and gives an account of many of the special features which crop up in the dynamics of such structures and the modelling thereof. These include the travelling wave approach, effect of single-point excitation, reflections at discontinuities, pressure fields of various kinds acting on plates, multiple supports and a short nibble at the use of Statistical Energy Analysis.

From chapter seven onwards the book is exclusively concerned with vibration control. The first of these chapters is a general one concerned with aspects of structural design which can minimise vibration problems.

Chapter eight describes the effects of 'localised additions', most particularly what are generally known as 'tuned vibration absorbers'. It is a tribute to Dr Mead's meticulous approach that he prefers to call these devices 'vibration neutralisers', for this is exactly what they are. The widely used undamped vibration absorber cannot absorb energy.

The very long chapter nine is devoted to the use of added damping and this reflects the fact that for many years this has been the particular focus of Dr Mead's research. It is a scholarly and complete chapter of great interest to practising engineers.

Chapter ten discusses the treatment of vibration problems by means of isolation using resilient systems. This may seem conventional enough but in fact it explores some important practical questions which are hardly ever raised in other books such as, for example, the optimisation of isolator systems for a structure with a full six degrees of freedom.

The final chapter is a short account of combined control techniques.

I believe that this book will reflect the eminence of the author and become a standard work on vibration control. It is not, however, a student textbook and will appeal mostly to the vibration engineering researcher and the design engineer. This is reflected in the price which, at £150 for just over 500 pages, is a high one. Notwithstanding this, if this subject matter coincides with your work you will want a copy for yourself.

A J Pretlove FIOA

Handbook of Acoustics (Ed. M J Crocker)
Published by John Wiley & Sons. 1998
ISBN: 0-471-25293-X Hardback 1461 pages
Price: £95.00

This comprehensive book clearly illustrates the very broad nature of Acoustics, ranging from erudite theoretical physics through practical engineering applications to how acoustics relates to the human being, both psychologically and physiologically. Although there are some shortcomings in detail the overwhelming impression is of a virtuoso performance by an orchestra consisting of the foremost players in the world. The reviewers of such a volume cannot be expected to be expert in the whole range of the subject and to an extent the appraisal which follows is limited by the reviewers' specialities. The task of this review has fallen to two well-meaning 'experts', the one on road transport noise and the other with a more general view of acoustics and its relationship with vibration. The unusual step of employing two reviewers provides a better chance of a fair and well-judged review, though inevitably it will be somewhat limited.

This is a weighty single volume of some 1400 plus pages comprising 114 chapters in 16 distinct Parts (groupings). However compared with its parent four volume 2000 page Encyclopaedia of Acoustics, also edited by Dr Crocker, it does live up to his description of 'more portable'.

The book is a condensation of the Encyclopaedia (for a review of this, see Acoustics Bulletin for May/June 1997) and many references to the larger work are made to point the reader to further detail. It is intended as a comprehensive source book for engineers, scientists, architects, musicians, physicians, psychologists and all those whose life is touched by acoustics in one way or another. There is an impressive list of members

of the editorial board whose close involvement in the planning and development of the book inspires confidence that the publication reflects state of the art at the time of writing.

That this book appears largely to have succeeded in its aims is a considerable achievement on the part of all concerned. It is a competent and wide-ranging review of acoustics in all its manifestations. Bearing in mind the limitations of size it covers in commendable detail and thoroughness specific areas of the subject under the headings of; general linear acoustics; non-linear acoustics and cavitation; aeroacoustics and atmospheric sound; underwater sound; ultrasonics, quantum acoustics and physical effects of sound; mechanical vibrations and shock; statistical methods in acoustics; noise: its effects and control; architectural acoustics; acoustical signal processing; physiological acoustics; psychological acoustics; speech communication; music and musical acoustics; acoustical measurements and instrumentation; transducers. The only subject covered in the Encyclopaedia but not dealt with in the present volume is bioacoustics.

The quality of treatment and the balance of content will now be considered. The first 23 introductory chapters on acoustic theory, both linear and non-linear, are well written with ample mathematical treatment where necessary. They form an excellent basis for newcomers to the subject and will assist them in understanding the content of the following chapters.

Being more specific the three chapters which include information on road transport noise (the treatment is somewhat fragmented) tend to emphasise the work done in the USA to the neglect of the research effort in the UK and Europe. Out of 29 references in the main chapter entitled 'Surface transport noise' only three were of UK work. Thus the UK government-funded work done by TRL, MIRA, ISVR and several UK universities appears to have been largely overlooked. This important work on engine noise, exhaust and inlet noise, whole vehicle noise reduction and tyre/road surface noise has directly influenced the rate of progress of vehicle noise legislation in the European Union and has informed legislation worldwide.

The balance is better achieved in the chapter on human response to noise where the section on traffic noise indices gives due weight to the extensive work done in the UK by BRS, TRL and NPL. What is covered here gives the general reader a good idea of the causes of surface vehicle noise, both road and rail, the government legislation which attempts to control and reduce the noise in various parts of the world and the research that has been done to inform the legislation.

Most of the major Parts of the book form coherent groupings of subjects but there are occasional lapses, for example, the chapters on Acoustic Emission and on Seismic Exploration do not sit comfortably in Part VI entitled Mechanical Vibrations and Shock. However, in this Part the coverage is generally attractive, interesting, wide-ranging and useful. The later Part VIII, entitled Noise: Its Effects and Control, covers many aspects of Noise Control Engineering. Unlike most other books on this subject the difficult matter of source diagnosis receives several pages of thorough treatment (in addition to the familiar treatment devoted to the effects of the range of medicines that can be administered to the noisy patient).

The book will not necessarily appeal to all of its intended audience. It is somewhat polarised, roughly 50:50, between, on the one hand, theoretical accounts of physical acoustics (which will appeal mostly to academics and researchers) and, on the other hand, a much more practical engineering coverage (which, in turn, will appeal to the consultant and engineer). However, the positive way to view this is to say that there is 'something for everybody'. Inevitably in a first edition book, so crammed with facts, there are going to be detailed errors, some important, others less so. Thus in the introduction to an early chapter there is an erroneous and misleading statement implying that sound waves in pipes will be effectively plane-fronted when their wavelength is short compared with the pipe diameter (the opposite is true). Examples of less important slips are that the Reference specifications are often inadequate (see p372 for two examples out of four) and throughout the book Leo Beranek's unfortunate colleague I L Ver is spelt in various ways and with various initials!

To summarise; although we can and have been critical of some aspects this is a very valuable source book and must be exceptionally good value for money.

J W Tyler FIOA and A J Pretlove FIOA ❖

Research in Progress

University of Edinburgh

Department of Physics and Astronomy

Pulse Reflectometry for Monitoring the Manufacture of Musical Instruments

The technique of acoustic pulse reflectometry is being refined and applied to the measurement of brass and woodwind instrument bores. The aim is to provide a working tool for musical instrument manufacturers.
Supervisors: Dr D M Campbell, Professor C A Greated
Researcher: Dr J M Buick, J Kemp
Funding: EPSRC research grant £82,085, PhD studentship

Measurement of Acoustic Fields in Brass Instruments Using LDA

Flow patterns in the vicinity of the mouthpieces of brass instruments are being investigated. The instruments are excited by an artificial lip reed mechanism and acoustic velocity is measured using LDA.
Supervisors: Dr D M Campbell, Professor C A Greated
Researcher: J Cullen
Funding: PhD studentship

Investigation of Non-Linear Streaming in Ducts

Streaming patterns set up in ducts of square and cylindrical section by intense acoustic fields are being investigated using Particle Image Velocimetry. The results will be compared with recently derived theoretical predictions, and with lattice Boltzmann simulations.
Supervisors: Dr D M Campbell, Professor CA Greated
Researcher: D Rockliff
Funding: PhD studentship

Development of Exhibits for Musical Instrument Museums

As part of a collaborative programme, a set of exhibits and associated software is being developed to illustrate some of the acoustical properties of woodwind, brass and string instruments.
Supervisors: Dr D M Campbell, Dr A Myers, Professor C A Greated
Researcher: Dr H A Wright
Funding: EU research grant £40,000

Development and Modernisation of Wind Supply Systems of Pipe Organs

As part of a collaboration funded by the EU Raphael Programme, problems associated with transient flows and sound generation in ducts and valves of pipe organ supply systems are being investigated using both numerical simulations and laser-based flow measurements
Supervisors: Dr F H Barnes, Dr D M Campbell, Professor C A Greated
Researcher: M Neal
Funding: EU research grant £15,000, PhD studentship

University of Hull

School of Engineering

Modelling Sound Generation and Propagation in Fluid Machinery Systems

(with Technical University, Eindhoven, Royal Institute of Technology, Stockholm, Universite du Maine, Le Mans, TNO Delft, ABB Corporate Research, Sweden, Philips DAP, The Netherlands, Renault, France and Volvo Truck Division, Sweden).
Mathematical modelling of flow duct acoustics, including flow generated noise, dissipative and reactive silencers, structural/acoustic interaction, fan noise and noise source characterisation.
Duration of project: 1997-2001
Supervisor: Professor A Cummings
Researcher: post vacant at present
Funding: EU Brite-Euram; 177,000 ECU for the University of Hull

Sound Generation by Gas Flow in Corrugated Pipes

(with the Department of Mathematics, University of Hull)
Mathematical modelling of the aeroacoustic mechanism of tone generation by airflow through corrugated tubes.
Duration of Project: 1996-1999
Supervisors: Dr J Elliott and Professor A Cummings
Researcher: S J Witty
Funding: EPSRC Earmarked Studentship

Poroelastic Materials for Noise Control

(with the Department of Civil and Environmental Engineering, University of Bradford)
Poroelastic structures for outdoor noise control, eg in traffic barriers, are being studied. Emphasis is placed on the development of predictive design software and the use of recyclable plastic granular materials.
Duration of Project: 1997-2000
Supervisors: Dr K V Horoshenkov, Professor A Cummings
Researcher: Dr P Leclaire
Funding: EPSRC £133,779 total

The Effect of the Cavity and Cavity Absorption on Sound Transmission Through Double Walls

(with the Department of Building Engineering and Surveying, Heriot-Watt University and the School of the Built Environment, University of Nottingham)
This project involves the development of statistical energy analysis models for double wall structures with porous media in the cavity.
Duration of Project:1997-2000
Supervisor: Dr R Wilson, University of Nottingham
Researcher: Dr D Tomlinson
Funding: EPSRC £3,068 for the University of Hull

Computer Aided Design Development in Silencers (LAMPS3)

(with the Department of Mathematical Sciences, Loughborough University).
Advances in the mathematical modelling and development of predictive software for IC engine silencers will be made in this project.
Duration of Project: 1999-2002
Supervisors: Dr K S Peat, Professor A Cummings
Researcher: J Xia
Funding: LINK Inland Surface Transport Programme, Department of Transport, £63,500 for the University of Hull

Passive Acoustic Elements for the Suppression of Combustion Oscillations in Gas-fired Appliances

Advances in mathematical modelling and development of predictive software for IC engine silencers will be made in this project.
Duration of Project: 1998-2001
Supervisor: Professor A Cummings
Researcher: M E Elsari
Collaborator: Carodan Plumbing Solutions
Funding: EPSRC £122,177

The Dynamic Structural Bulk Properties of Fibrous Media
The dynamic bulk structural properties of fibrous sound absorbing media will be modelled from first principles, with as few adjustable parameters as possible. Both stiffness and damping effects will be included.
Duration of Project: 1999-2002
Supervisor: Professor A Cummings
Researcher: to be appointed
Collaborator: Lancaster Glass Fibre Ltd
Funding: EPSRC £152,323

Keele University

MacKay Institute of Communication and Neuroscience, School of Life Sciences

Evaluation of the Reassignment Method in Speech Processing
The aim of this project is to compare the accuracy of fundamental frequency, glottal closure instant and formant frequency estimation of algorithms based on the reassignment method of speech analysis with classical time-frequency methods (Fourier, LPC) and auditory models.
Duration of project: 1996-1999
Supervisors: Professor W A Ainsworth and Dr G F Meyer
Researcher: Dr C R Day
Funding : EPSRC research grant £102,851

Auditory Scene Analysis with Amplitude Modulation
The objective of the project is to evaluate the utility of amplitude modulation maps for the segregation of concurrent speakers. Two grouping cues in particular will be examined: fundamental frequency and common onsets and offsets.
Duration of project: 1997-2000
Supervisors: Dr G F Meyer and Professor W A Ainsworth
Researcher: Dr D Yang
Funding: EPSRC research grant £107,734

SPHEAR: Speech and Hearing Research
The objectives of the network are to achieve a better understanding of the auditory information processing and to deploy this understanding for automatic speech recognition in adverse conditions. The other partners in the network are Sheffield University (co-ordinator), Universities of Bochum, Grenoble and Patras, IDIAP and Daimler-Benz.
Duration of project: 1998-2002
Supervisors: Professor W A Ainsworth and Dr G F Meyer
Researcher: To be appointed
Funding: EU TMR research network contract £100,000

Loughborough University

Department of Aeronautical & Automotive Engineering

Acoustic Fatigue of Aircraft Nacelles
(with Dept of Aeronautics & Astronautics, Univ of Southampton)
Development of computional fluid dynamics techniques to predict the acoustic loading on the inside of a nacelle.
Supervisors: Dr J L Horner, Professor J J McGuirk, Dr G J Page
Researcher: X Huang.
Collaborator: Shorts Bros Plc
Funding: EPSRC research grant: £110,000

Computer Modelling of Forced Mixer Aerodynamics
Prediction of the flow field through gas turbine forced mixers with the objective of providing information on acoustic sources.
Supervisors: Professor J McGuirk, Dr C J Page
Researcher: H Salman
Collaborators: Rolls Royce Plc, DRA
Funding: EPSRC research grant: £130,000

Computional Aero Acoustics
Investigation of discretisation methods for time domain computional aero acoustics.
Supervisor: Dr G J Page
Researcher: to be appointed
Funding: PhD studentship

Studies of Dominating Characteristics for Structural Dynamics of Built Up Systems.
Identification and modelling of substructures of primary and secondary importance for wave transmission.
Supervisor: Professor B A T Petersson
Researcher: J Liang
Funding: PhD Studentship

Acoustic Fatigue of Nacelle Liners
Modelling of the behaviour of a cell in a liner, with the objective of establishing failure mechanisms due to acoustic loading. Investigation of alternative liner designs.
Supervisor: Professor B A T Petersson
Researcher: M J Greaves
Funding: PhD Studentship

Vibration Transmission Through Inhomogenous Materials
Development of models to predict the behaviour of layered media with variable material properties.
Supervisor: Prof B A T Petersson
Researcher: G Dixon
Funding: EPSRC PhD studentship

Source Modelling for Gas-Turbine Exhaust Systems
Identification of acoustic source mechanisms from fluid dynamics computations. Investigation of source models.
Supervisor: Professor B A T Petersson
Researcher: G Kroef
Funding: Rolls Royce Plc

Indirect Techniques for Vibration Transmission Analysis
Investigation of models for non-diffuse wave fields.
Supervisors: Professor B A T Petersson, Dr S J Walsh
Researcher: Y K Ho
Funding: PhD Studentship

Acoustic Characterisation of Aperture Devices
(with the Department of Civil Building Engineering, Loughborough University)
Development of simple models for the acoustic performance of different types of apperture devices.
Supervisors: Dr J L Horner, Dr R Lyons, Professor B A Petersson

Real-Time Learning of Vehicle Ride Control Stategies
Implementation of reinforcement learning on road vehicles, to optimise ride vibration isolation using controllable dampers.
Supervisors: Professor T J Gordon, Dr M N Howell

Loughborough University

Department of Electronic and Electrical Engineering

Synthetic Aperture Sonar
The project is to construct a computer-controlled experimental system that permits high resolution imaging in a test tank. Test signals are passed as input data to a SUN workstation in which algorithm development is carried out, particularly in the areas of auto-focus and three-dimensional reconstruction The project is being carried out in co-operation with University College, London.

Duration of Project: EPSRC 1994-1997 and DERA 1995-1998
Supervisor: Professor B Woodward
Research Assistant: Dr T A Rafik
Funding: EPSRC £135,000, DERA £75,000

Underwater Acoustic Biotelemetry
The aim is to provide a means of transmitting the electrocardiogram signal from a patient while swimming. The technique is to sample the ECG signal and transmit the data digitally so that the patient can be monitored remotely in real time without the encumbrance of leads. The patient's ECG can then be related to physical activity, from which clinical judgements can be made.
Duration of Project: 1990-1996
Supervisor: Professor B Woodward
Research Assistant: Dr R S Habib-Istepanian
Funding: ORS Award and Armenian Trust Award £26,000

Underwater Voice Communications
There is a commercial requirement to have a state-of-the-art digital communications system for divers. The research involves a detailed study of speech signals and their spectra which are distorted by speaking into a mask, and the development of algorithms to reconstitute the signals. The aim is to design a compact system, controlled by a digital signal processor, which fits entirely on a conventional diver's mask.
Duration of Project: 1992-1999
Supervisor: Professor B Woodward
Research Assistant: Dr H Sari
Funding: Turkish Government Scholarship £45,000

Underwater Data Communications
The project uses a novel form of modulation involving several frequencies to permit the encoding and decoding of binary data. After initial channel modelling, using different data rates and for different transmitter-receiver geometries and ranges, the aim is to transmit real data in the sea using transducers designed by another industrial partner.
Duration of Project: 1995-1999
Supervisor: Professor B Woodward
Research Student: B R S Darby
Funding: EPSRC/British Gas CASE Award £35,000

Acoustic Characterisation of Undersea Sediments to Initiate Commercial Applications (ACUSTICA)
The project concerns the use of non-linear acoustics to characterise the sea bed, and includes software development for real time stabilisation of a sonar platform. Trials have been conducted on Loch Duich, Scotland and on Edukki Lake, Kerala, India. The aim is to compare the results of the experiments with those predicted by simulation and modelling.
Duration of Project: 1995-1998
Supervisors: Professor B Woodward, A D Goodson and Professor J C Cook
Research Associate: P A Lepper
Funding: European Commission International Scientific Co-operation Programme £48,000

Detection of Embedded Objects (DEO)
The aim of the project is to use a parametric sonar system and a hydrophone line array to detect and characterise objects buried in the sea bed. Static sea trials have taken place on Loch Duich, Scotland and in the Mediterranean at La Spezia, Italy. Initial experiments were conducted in 'free field' conditions to characterise the spectral information scattered from a suspended cylinder insonified from different angles. Further experiments were aimed at insonifying a cylinder filled with air, then water, then sediment.
Duration of Project: 1996-1999
Supervisors: Professor B Woodward, A D Goodson and Professor J C Cook
Research Associate: P A Lepper
Funding: European Commission MAST-III Programme £193,000

Bio-acoustic Signature Analysis
The project is concerned with a very detailed analysis of the frequency modulated whistle sounds made by dolphins in order to study the differences between individuals. In particular, the aim is to identify groups of these animals (pods) or possibly individuals, although this is a difficult task because it is known that they are capable of mimicry. In detail, the technique used involves the isolation and automatic recognition of acoustic transient signals using a variety of digital signal processing and pattern recognition techniques.
Duration of Project: 1993-1998
Supervisors: Professor B Woodward, Dr S Datta and A D Goodson
Research Student: Dr C Sturtivant
Funding. Department of the Environment £30,000

Constant Beamwidth Wide-band Sonar Techniques
The project concerns the development and trials of a circular staved phased array sonar with digital signal synthesis to provide a controlled beamwidth operating over a 30 kHz to 60 kHz band. The main application of this project is the classification and identification of fish schools, a topic of considerable interest to the European Commission.
Duration of Project: 1993-1999
Supervisor: A D Goodson
Research Associate: P A Lepper
Funding: Scottish Office, Agriculture and Fisheries Department £24,000

Prevention of By-Catch of Small Cetaceans in Pelagic Trawls by Technical Means (CETA-SEL)
This project is to investigate the behaviour of small cetaceans around a commercial pelagic trawl operating in deep water at the continental shelf edge in order to develop methods of reducing the by-catch of these species. Sea trials in the Atlantic, off south west Ireland and in the northern North Sea have been carried out using the Dutch research vessel FRV Tridens in order to test a newly developed 3D sparse array hydrophone tracking system. The tracking system records the underwater vocalisations of these animals to determine their position as they swim around the fishing gear.
Duration of Project: 1994-1998
Supervisors: Professor B Woodward and A D Goodson
Research Assistants: C R Coggrave and P R Connelly
Funding: European Commission AIR-III Programme £173,000

Active Acoustic Deterrents
The research concerns a variety of active pingers and transponders for attachment to fishing nets, with the aim of reducing the by-catch of cetaceans (dolphins, porpoises and whales) in general, although the study has concentrated on porpoises for reasons of conservation. A programmable transponding alarm device has been developed for attachment to commercial bottom-set gillnets. This deterrent device can be programmed to transmit complex acoustic waveforms and can be triggered into

activity by the approach of a vocalising cetacean and/or by emissions from similar nearby devices.
Duration of Project: 1997-1998
Supervisors: Professor B Woodward, A D Goodson and Dr S Datta
Research Assistant: D Newborough
Funding: Danish Institute for Fisheries Research (DIFRES) £10,000

Sediment Identification for Geotechnics by Marine Acoustics (SIGMA)
The aim is to investigate the relations between the acoustic parameters of marine sediments (reflection coefficient, sound velocity, attenuation, dispersion etc) and their geophysical and geotechnical properties (sediment type, grain size distribution, cohesion, gas content, etc). The acoustic parameters are estimated from wide band measurements, using a steerable parametric sonar array combined with a towed array of hydrophones.
Duration of Project: 1997-2000
Supervisors: Professor B Woodward, A D Goodson and Professor J C Cook
Research Associates: P A Lepper and P R Connelly
Funding: European Commission, MAST-III Programme £210,000

The Nottingham Trent University

Department of Civil and Structural Engineering

Vibrations generated by trains in layered and inhomogeneous ground
This project aims to model the processes of generating ground vibrations by underground trains taking into account layered structure of the ground and construction details of the tunnel.
Duration of project: 1997-2000
Supervisor: Professor V V Krylov
Researcher: Mrs Lin Qinhua
Funding: Nottingham Trent University PhD studentship £20,000

Investigation of localised elastic waves in immersed solid structures
This project studies the problems of generation and propagation of localised elastic waves in wedge-shaped solid structures immersed in water, with applications to general engineering.
Duration of project: 1997-1999
Supervisor: Professor V V Krylov
Researcher: Dr A Shuvalov
Funding: Nottingham Trent University Excellence Competition research grant £30,000

Transient Ground Movements Caused by High Speed Trains Crossing Soft Soil
(in collaboration with the Department of Civil Engineering, University of Nottingham)
This project involves theoretical and experimental investigations of the effects of soil properties on rail track vertical deflections caused by passing high speed trains. The main aim of the project is to develop methods of predicting dangerous dynamic effects of large increase in track deflection at certain critical speeds which may result in very intensive ground vibrations and possible train derailing.
Duration of project: 1997-1999.
Supervisors: Mr A Dawson, Professor V V Krylov, Dr A. Collop, Dr D Chapman
Researcher: Dr M. Heelis
Funding: EPSRC research grant £129,150

Surface Acoustic Waves in Solids: New Waves, Structures and Methods
This project is dedicated to the theoretical investigation of some general problems of surface acoustic wave generation, propagation and scattering in complex solid structures.
Duration of project: 1997-1999
Supervisors: Not applicable
Researcher: Different researchers from 4 European countries
Funding: The European Commission Research Grant (INTAS) ECU 60,000

Surface Acoustic Wave-Liquid Interactions
(in collaboration with the Department of Chemistry and Physics, The Nottingham Trent University)
This project involves theoretical and experimental investigations of surface acoustic wave scattering by stripes of viscous liquid, with applications in chemistry and biology.
Duration of project: 1997-1999
Supervisors: Dr G McHale, Professor V V Krylov, Dr M Newton
Researcher: Dr J Cowen
Funding: EPSRC research grant £91,924

Development and Validation of the Theoretical Model of Ground Vibration Boom from High-Speed Trains
This project represents further development of the theoretical model of ground vibration boom from high-speed trains and its experimental validation by comparison with the data obtained for high-speed trains in Sweden.
Duration of project: 1998-2000
Supervisors: Professor V V Krylov
Researcher: To be appointed
Funding: EPSRC research grant £79,485

South Bank University

School of Engineering Systems and Design

A Survey of Concert Hall Acoustics
Questionnaire surveys of audiences are being carried out in concert halls around the country to gauge the audience perceptions of the acoustic quality of different halls. The results of the surveys will be compared with objective acoustic measurements of the halls, in order to determine the most important acoustic parameters affecting audience enjoyment in concert hall design.
Duration: 3 years to November 2000
Supervisors: Dr B M Shield and Dr T J Cox (University of Salford)
Researcher: R Richardson
Funding: EPSRC studentship

The Effects of Noise on the Attainments and Cognitive Performance of Primary School Children
Primary schools in inner and outer London which are exposed to a range of external noise levels will be selected. The academic performances of 7 year olds in these schools, as measured by SATs results and specially designed tests, will be examined to determine whether or not their achievements are affected by the noise environment of the school. This project will be carried out jointly by SESD and the Division of Psychology.
Duration: 2 years to March 2001
Supervisors: Dr B M Shield and Professor J Dockrell
Researchers: To be appointed
Funding: Department of Health/DETR £95,000

University College London

Department of Electronic & Electrical Engineering

Texture Analysis in Sonar Images
This work has explored the application of texture models, such as the K-distribution, to high-resolution sonar imagery, for segmentation and detection.
Supervisor: Professor H D Griffiths
Researcher: J Dunlop
Funding: EPSRC (CASE Award), DERA Bincleaves

High Resolution Spotlight and Squint Mode Synthetic Aperture Sonar
This new project will investigate processing and motion compensation techniques for high-resolution SAS systems.
Supervisors: Professor H D Griffiths, Professor R Voles, Professor C J Oliver
Funding: EPSRC, Thomson Marconi Sonar Ltd

University of Wales, Cardiff

Department of Phyics and Astronomy

Acoustical Parameters for Chacterisation of the Function of Classical Guitars
The aim of this project is to measure a number of acoustical parameters of 'quality' guitars which previous psychoacoustical work at Cardiff has suggested are important in determining the musical function of the instrument.
Duration of project: 1999-2001
Project Director: Dr B E Richardson
Researcher: To be appointed
Funding: The Leverhulme Trust £41,790

Further reports from Universities will be published in the next issue. ❖

New Products

Brüel & Kjær

2238 Mediator:

The new 2238 Mediator™ from Brüel & Kjær takes the modern sound level meter well into the next millennium. It may look familiar at first glance but 2238 Mediator is a completely new instrument, made to serve all tasks from on-the-spot noise checks to thorough investigations of sound in the realms of time and frequency.

2238 Mediator is stated to provide all the broadband parameters needed at one and the same time. Parameters may be selected at the time of measurement or later from a stored file. It is possible to have two independent frequency-weighted RMS measurements simultaneously and all the time weightings are provided in parallel.

The process of making timed measurements and periodic reports is said to be easy with 2238 Mediator, with the free selection of parameters to log at short or long intervals an added bonus. External parameters – for example representing wind speed or the number of pass-by vehicles – can be displayed and stored alongside the sound parameters.

The automatically scanned $^1/_1$ and $^1/_3$ octave band filter set facilitates the investigation of tonal components and the evaluation of noise reduction measures.

The 2238 Mediator can be upgraded and adapted to future needs by downloading software; there is no need to return the instrument. Allowing for RMS/Peak and RMS/RMS measurements, in and output triggers, input of external parameters and full control via the standard serial interface, the sturdy hardware is prepared for most jobs. It includes electronic filters to correct for windscreen effects and random/frontal sound incidence, as a standard.

2238 Mediator complies with the following standards: BS EN 60651 Type II, BS EN 60804 Type I, and ANSI SI.43 Type S1. It also fulfils IEC 1672 (Draft) Class 1, the new sound level meter standard soon to supersede the earlier standard. It carries a three-year guarantee.

7825 Protector

This Windows® based PC software extrapolates a full eight-hour exposure from short noise samples according to the requirements of national and international standards, including the draft ISO 9612.2, thereby allowing a complete picture to be built up with minimal field work. An intuitive interface with hierarchical trees, noise profile graphs and automatic data links is stated to remove the headache of noise data management.

Noise problems can be identified from distribution graphs of exposure level versus selected machines or employees. By presenting the same data in bar-graph form, Protector identifies the problems, enabling qualified decisions to be made about reducing the noise.

Measurement data can be imported from sound level meters, noise dose meters and other Brüel & Kjær software thus optimising use of the measurement equipment.

Contact Brüel & Kjær on Tel: 0181 954 2366 or Fax: 0181 954 9504 for more details. Alternatively check their website on www.bk.dk

Brüel & Kjær is a Key Sponsor of the Institute.

W S ATKINS

RailNoise 98 & SiteNoise 98

W S Atkins Noise and Vibration announces the imminent release of RailNoise 98 and SiteNoise 98, the Windows versions of its well-established DOS software, following the release of RoadNoise 98 last autumn.

RailNoise 98 operates in accordance with 'Calculation of Railway Noise 1995', but it also has options for the calculation of L_{Aeq} and L_{Amax} parameters in accordance with the methods used in the Channel Tunnel Rail Link environmental studies. It is used by a number of rail operators and consultancies in the UK and in Hong Kong.

SiteNoise 98 implements the British Standard BS 5228 Part 1 1997 *Procedures for calculating noise from construction and open sites.* It allows for point, line and mobile types of noise source in accordance with the standard. Many items of plant or construction activity can be placed at any of the working locations. The model can include all the topographical features of the site and its surroundings, noise barriers and receiver points. Source data can be taken straight from the BS, or users can enter their own measurements if available. The user can display the contribution of noise from each item of plant, and noise levels can be assessed for different times of day. This is an essential feature when assessing the impact of a site and making changes to meet noise limits. SiteNoise is used by many mineral operators and consultancies in the UK.

All the software is based on the calculation system used by the DOS version giving assurance of robustness and reliability but with a fully-featured CAD-style user interface, familiar to users of any modern software product.

The flagship Enterprise version provides for huge models, for example up to 4,000 railway track segments and 6,000 train services. Models can be entered by a digitising tablet or by tracing over a scanned image on the computer VDU screen. All the noise products share common topographical, barrier and receiver objects, so these do not need to be re-entered when switching between packages. The models are compatible with those used in the DOS version.

Users will appreciate the capabilities of the CAD-style interface. Objects can be moved simply by pointing with the mouse and dragging to a new position. The properties of any object can be shown simply by double-clicking on it, when they can be edited.

There is a powerful 'find' function to allow objects to be located quickly for editing, an essential feature when dealing with the huge models that this system can handle. This is complemented by the ability to make changes to all the chosen objects, either individually or en

bloc. This power is tamed by safeguards such as timed-backup, and archiving functions. Whilst the position of objects can be observed in the graphical display, other 'non-positional' values, such as the speed of a train are equally important. Such values can be displayed by colour-coding the modelled objects.

When changes have been made the results can be displayed on the screen either as a contour map or as spot noise results. These can then be overlaid onto the background scanned image and drawn to scale on any Windows-enabled printer or plotter.

The software has many features to assist in designing quieter projects. This includes the ability to view the contribution of each train service or item of plant at any receiver point, and the ability to adjust the heights of barriers without making permanent changes to the model.

The user is fully-supported by built-in context-sensitive help, an Internet Web site, and a telephone and e-mail query service.

Installation is a straightforward automatic procedure from CD-ROM or floppy disk. Peripherals such as printers, plotters and digitisers do not require separate installation, provided these have already been installed using the standard Windows drivers which all reputable manufacturers supply with their equipment.

The software is provided in three capacities to suit the differing needs of users, ranging from the LT version suitable for small projects, the Standard Version for those with typical schemes, and the Enterprise version for those requiring full professional features and a huge model capacity.
For further information, please contact Richard West at W S Atkins Noise and Vibration, Woodcote Grove, Ashley Road, Epsom, Surrey, KT18 5BW Tel 01372 726140, Fax: 01372 740055 email: noise@wsatkins.co.uk

STARKEY LABORATORIES

Cetera Hearing Aid

Starkey Laboratories has unveiled new technology that is said to be dramatically different from any other used in hearing aids currently available. This technology, introduced at the German Congress, UHA, in Cologne, will be used in Starkey's Cetera digital hearing aid. Cetera is claimed to be the first hearing aid to restore the brain's ability to locate where a sound is coming from, and to focus on one sound or voice even when in a noisy environment. Starkey Laboratories takes hearing aids beyond amplification with the introduction of Cetera. The technology is based on an innovative new algorithm, called TransperaEQ, which features a multi-step digital processing function. The digital equalization filter renders the hearing instrument acoustically transparent, making the hearing aid 'invisible' to the brain. It calculates and removes magnitude and phase effects that occur from the instrument's physical presence in the ear. The result is preservation of open ear interaural time and level differences. The idea is to have a hearing aid designed to preserve the cues that enable the brain to process sound.
For further information, please contact Alexandra Jabbour Tel: 0171 282 1200 Fax: 0171 282 1282.

AUTOMATED ANALYSIS CORPORATION

CAT/COMET

Automated Analysis Corporation (AAC) has just released its latest innovative approach optimizing the product acoustic performance, CAT/COMET. This is the integration of the acoustic analysis capabilities from COMET with CATIA CAD system. The designer or product developer using CATIA can now perform vibro-acoustic analyses from within the CATIA environment.
This new capability represents a transition in the product development process. More often now, acoustic evaluations of products during the development cycle are done by specialists working apart, but alongside, the product development engineer. CAT/COMET is designed to facilitate the transition to acoustic analysis by the developer. The developer can now work in the familiar CATIA environment and be prompted through the necessary steps to perform an acoustic evaluation.

In many organizations today the acoustic analyst does not use the CAD tools of the product development team. Often, IGES or other file formats translate data from the CAD geometry to that needed by the analyst. Such a process is slow, requires duplicate efforts, and makes close interaction between the analyst and developer difficult. Once the analyst has completed the evaluation, recommendations for improvement can only be conveyed orally. Since there is no common geometry, the analyst cannot make changes that can be implemented by the developer.

The CAT/COMET product is aimed at eliminating these difficulties by working in the CAD environment and facilitating collaborative efforts among the development team. The combination permits the use of the powerful CATIA tools such as the automated mesher to make the process even more efficient. Using CAT/COMET, acoustic analysis can begin much earlier in the development cycle and continue throughout. CAT/COMET provides all the fundamental capabilities of COMET; with CAT/COMET one has the full range capabilities for boundary element and finite element analysis.
For further information contact Richard Tyrrell, Automated Analysis Limited, Unit C, Enak House, Redkiln Way, Horsham, West Sussex RH13 5QH Tel: 01403 218718 Fax: 01403 218728 Automated@fastnet.co.uk

News Items

Bill Hines FIOA

William (Bill) Hines former senior partner of W A Hines & Partners, Acoustic Consultants died suddenly on Saturday 14 November. Long since retired from the Practice his sudden death, although at the age of 85, was a shock to his family and many friends for up to his death he was energetic in mind and spirit and enthusiastic in all that he did.

Bill Hines was born in 1913 and began his career in sound engi-

neering as early as 1930 joining a company who specialised in the production of cinema, theatre and church organs. He gained considerable experience at that time in the research and development of organs progressing to the design office until the outbreak of the war.

During the war he was with John Dale Ltd in technical support and in 1950 became general manager of the company's acoustic division, which he developed over the years with his friend and colleague Don Higgins. He became a member of the Acoustic Society of America in 1952.

In 1960 with Don Higgins he formed W A Hines & Partners, which was possibly one of the first acoustic consultancy practices in the UK. He became a member of the British Acoustical Society now the Institute of Acoustics in 1966. The consultancy progressed slowly in the years that followed but with Bill's enthusiasm together with his ability to carry out detailed surveys with the then limited capabilities of the sound measuring equipment and to write comprehensive reports, the Practice become well known and prospered.

With his then expertise and knowledge in the noise control field he wrote many papers finally having a reference book on noise control published in 1974. He became a Fellow of the Institute of Acoustics in 1977. He retired from the Practice in 1978 at the age of 65 and spent his remaining years actively pursuing his interests, in particular his love of marquetry, producing many prize winning pictures.

Bill will always be remembered by his friends and colleagues as a progressive thinker and doer always ready to get on with the job and has left behind lasting memories of his kindness and ability to help others.

Don Higgins MIOA

SAINT-GOBAIN/ SOLAGLAS

Energy Efficient Glazing and Acoustics and Acoustic Glazing

The latest Continuing Professional Development (CPD) technical training modules from Saint-Gobain/ Solaglas, Energy Efficient Glazing and Acoustics and Acoustic Glazing, have been approved by RIBA.

Acoustics and Acoustic Glazing comprises an in-depth guide to attaining effective acoustic insulation with glass and the comparative performances of different products, coinciding with the launch of SGG Stadia Silence, a unique PVB laminated glass.

The one-hour interactive seminars are illustrated with real life case studies. Designed for presentation at architectural practices case notes for architects libraries are available on paper or CD.

Details of all Saint-Gobain/Solaglas CPD units are available from Jo Brooke on Tel: 01753 775 164 or E-mail jo.brooke@solaglas.co.uk.

Saint- Gobain/Solaglas is a Sponsor Member of the Institute

Braunstein + Berndt GmbH

New SoundPLAN Brochure and CD

SoundPLAN is software used worldwide for analysing noise and air pollution from industrial plants, rail systems, airports, inner city transport and highways.

A SoundPLAN CD is now available for those interested in learning about the program and those who desire *hands on* experience using a SoundPLAN demonstration program. Along with demo projects, the CD provides details about SoundPLAN – how it is composed, where it is used, and how it can be used most efficiently.

The CD has many examples of the graphic capabilities for which SoundPLAN in well known. SoundPLAN animations are also available for viewing. The SoundPLAN HANDBOOK is part of the CD with information about documentation and all the international standards which are included with each SoundPLAN package. The INFORMATION CENTRE includes distributor contact information for 20+ worldwide SoundPLAN representatives.

For a copy of the new SoundPLAN brochure and CD, contact Braunstein + Berndt GmbH directly using their dedicated phone service +49 7195 178828, or fax +49 7195 63265, or email SoundPLAN@CompuServe.com

NXT Ltd

Flat Panel Loudspeakers

Revolutionary flat panel loudspeakers that could be hung on walls like paintings are being developed by NXT New Transducers Ltd in a TCS Programme with the University of Birmingham. TCS is a Government scheme which aims to improve the competitiveness of British business by providing companies with valuable expertise from a science, engineering and technology base.

Under this TCS Programme, NXT is developing leading-edge materials for its lightweight, wafer-thin panels which could do away with the need for what some consider intrusive box hi-fi.

These panels can be made from different kinds of materials and have a vast range of applications. For example, a speaker could be fitted in the space between a car roof and its lining, or produced as a door panel or part of a dashboard. In the home, it could double as a ceiling tile or a projection TV screen.

The technology, inspired by Ministry of Defence research on noise-reduction in fighter aircraft cockpits, enables thin flat panels to work as efficient loudspeakers. Verity Group plc took up the idea and formed NXT, a new division based in Huntingdon, Cambridgeshire, to develop the technology and market it through worldwide licensing.

NXT now is working with the University of Birmingham's School of Metallurgy and Materials to measure the acoustic performance of various composite materials which could be used to make the flat panel speakers.

The panels can be made from any number of materials in thickness from less than one millimetre to 20 millimetres and in sizes ranging from 25 sq cm to 100 square metres.

A panel is driven from a single point by a tiny exciter element mounted off centre. The transducer creates vibration modes which radiate across the entire surface of the panel. This means a panel can

operate as an effective full-range loudspeaker without a frame or a pedestal, rendering speakers virtually invisible in a room.

TCS Associate Dr Mike Jenkins, whose PhD is in Metallurgy and Materials, is researching which materials will perform best as a speaker. He is being supported by the University's Dr Jim Hay, an expert in polymer and plastic materials.

The company is using techniques such as Dynamic Mechanical Thermoanalysis and Dielectric Thermoanalysis to predict the absorption characteristics of various materials to see whether they give good quality sound. It is hoped that in the future new materials will be found that will do the job and which will be easier and cheaper to fabricate.

For more information about NXT and its technology, contact Jon Vizor, NXT Ltd, Unit 7, Spitfire Close, Ermine Business Park, Huntingdon, Cambs PE18 6YA Tel: 01480 451777 Fax: 01480 437177 email: j.vizor@nxtco.uk web: http://www.nxt.co.uk

For information about TCS contact Sarah Goodyer, Teaching Company Directorate, Hillside House, 79 London Street, Faringdon, Oxfordshire SN7 8AA Tel: 01367 245217 Fax: 01367 242831 e-mail: s.goodyer@tcd.co.uk. web: http//www.tcd. co.uk

Wimtec Environmental Ltd

The National Britannia Group has linked-up with environmental and ground engineering specialist Wimtec Environmental Limited.

Under a new strategic alliance, National Britannia will take a 50% stake in the former Wimpey subsidiary, which has become a major force in its traditional markets since a management buy out from the construction giant two and a half years ago.

Both firms have national coverage within the UK and National Britannia is active across the globe through a network of 14 overseas joint ventures.

Wimtec will work closely with National Britannia's Environmental Services team which includes some of the UK's leading experts in areas such as water safety, pollution control and workplace monitoring.

National Britannia has grown rapidly during the 1990s as it pursued its strategy of becoming a 'one stop shop' for all environmental risk management services.

Further information from Phil Ellis, Wimtec Environmental Ltd, Iver, Bucks Tel: 01753 737744

Salex Interiors Ltd

Salex Interiors Limited (SIL) has completed a noise reduction application at the Metropolitan Police Divisional Headquarters in Staines, Middlesex.

Because of the introduction of PACE, police forces throughout the country have been working to upgrade the rooms where taped interviews are recorded, to ensure better quality recordings and to help maintain the confidentiality of proceedings.

SIL was asked to supply and install special single leaf 42 dB SALEX timber acoustic door sets for a number of interview rooms at Staines Divisional HQ. These were required to prevent both breakthrough and breakout of noise, especially speech.

The doors were supplied to a standing Metropolitan Police specification, with magnetic door seals on the head and jam, and compression seals on the threshold. A special lobby arrangement, with two SALEX 42 dB doors spaced 1.5 m apart, offered what are stated to be exceptional noise reduction properties.

For further information, please contact: Salex Interiors Ltd, Newcomen Way, Severalls Industrial Park, Colchester, Essex CO4 4YR Tel: 01206 508111 Fax: 01206 852795.

Salex Group is a Sponsor Member of the Institute.

Items for inclusion in this section should be sent to John Sargent MIOA, Oak Tree House, 26 Stratford Way, Watford WD1 3DJ. ❖

Letter to the Editor

The Editor
Dear Sir

Inaudibility and Ian Watson's letter: Night-time Criteria

When I go to sleep at night I do not expect to hear my neighbour's music: I expect it to be inaudible. However despite this view I find much to agree with in Ian Watson's useful letter, and particularly those points covering the technical problems of measuring inaudibility.

However I cannot agree with either of these points: that PPG24 offers a standard we should uphold as good, or that 30 dBA is a very low sound level indeed.

PPG24 uses 35 dB L_{Aeq}, which is based on the criteria of the World Health Organisation from 1980, which derives from research more than 20 years old. As Ian Watson points out *Community Noise*, a document prepared in 1995 for the WHO and edited by Professors Berglund and Lindvall at Stockholm University and the Karolinska Institute, suggests the lower level of 30 dB L_{Aeq}, and it also suggests lower levels still depending on the nature of the noise source. Therefore the criterion used by PPG24 does not represent a good standard, and 30 dBA is not even the lowest level we should consider. I have frequently measured sound levels in bedrooms in the low 20's where noise at 30 dBA would be very disturbing rather than a very low sound level indeed.

30 dB L_{Aeq} should be seen as a desirable maximum where possible rather than a good standard.

So although inaudibility has problems on practical measurement and assessment grounds, I have yet to find a criterion for night-time noise that is to a good, yet reasonable and enforceable standard, and so I welcome this debate.

Yours faithfully
Paul Michel MIOA