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CONTENTS

EDITORIAL

ACOUSTIC. The word springs from French and Greek origins through AKOUEIN to hear and AKOUSTIKOS relating to hearing. As a noun, "acoustic" is a medicine or agent to assist hearing. Acoustics has come to mean the science of sound to cover the production, transmission and the effects of sound. The extent to which these effects infiltrate into many fields is shown by their interaction with the life sciences, the arts, architecture, engineering and the earth sciences.

No one in modern society is remote from or untouched by the sound made which occurs as a consequence from the needs of that society. Even primitive man was acutely aware of sound and used it not only to enhance his pleasure but also for his defence and in search of the daily meal. Today, man's pleasure and food supply are far more canned and in reasonable supply. It may not always be of the right kind to suit the whim of the individual at the particular moment, as this depends greatly on the make-up of the consuming homo-sapien. Furthermore, in his defence, he has turned more and more to measures for his protection as the unwanted by-products of this modern age migrate to every corner of his earth. Noise, the word having an old French origin, has leap-frogged into the twentieth century and causes a great deal of concern. Measures to abate the unwanted are being put to good use. However, Man has yet to learn the proper balance he must seek in a world full of problems of his making. Some contribution to his achievements and to the coping with some of the problems caused by him come from the efforts of the membership of the Australian Acoustical Society. There is now a good opportunity to have these reported in the appropriate manner through articles and brief notes. The voice of the Society should be heard through the Bulletin and this depends on "rank and file" reporters to spread the message to all corners of this Continent. A sound response, brief and to the point is wanted. There must be many items of general and technical interest in the hands of members which should ring through the Society - if not an "acoustic" may need to be administered. Due acknowledgement of course, is made to Websters, the source of all sound advice.

A.A.S. ACTIVITIES

6TH TECHNICAL MEETING - VICTORIA

Dr. Ian Bourne, R.A.A.F. Academy, spoke on "The Development of Audio Echo Sounding Techniques for the Determination of Temperature Gradients in the Atmosphere".

Graeme Harding reports:-

Ian Bourne explained that the techniques started from a request for a method for measuring the size of rain drops, as it was thought that an audio sounding radar system could be used to measure the Doppler Shift of the sound reflected by the rain drops.

The work and techniques were developed jointly with the Weapons Research Establishment and the National Bureau of Standards at Boulder, U.S.A.

The work is part of a post graduate research programme required by the University of Melbourne as a requirement for the M.Sc. course at the R.A.A.F. Academy. The equipment was built by the R.A.A.F. Academy, and transmits short bursts of very narrow band noise with a centre frequency of 1 kHz and band widths adjustable from 1 Hz to 10 Hz. The sounder consists of a Plessey horn loaded transducer mounted vertically to project its output down towards a parabolic fibreglass reflector. The input power to the transducer is 100 watts, and the transducer efficiency about 60%.

The parabolic reflector and sounder are mounted at the bottom of a pit approximately 10 feet deep which gives an improvement of 35 dB in the signal to noise ratio. The same transducer is used for transmitting and receiving with the received power about 10^{-20} of the transmitted power, that is, about 200 dB below the transmitted power.

The reflections are recorded on a paper chart recorder calibrated as height versus time. The system actually measures, not only the temperature gradient, but irregularities or discontinuities in the temperature gradient and is virtually insensitive to wind shear.

Ian showed the audience slides illustrating actual recordings which are used to predict cloud height, temperature inversions, top of fog layer, type of cloud formation and cold fronts.

The equipment has been sent up in a balloon to study successfully inversions at very high levels. The advantages of the systems are its ability to detect irregularities up to 10,000 feet, its low cost (a few thousand dollars), and its unique ability to determine rapidly from a ground station the atmospheric effects described.

The limitations of the system are the high audio powers required, and the requirement of low background noise at the location of the installation.

In the future it is expected that similar systems may be used for the measurement of air pollution, air turbulence, and wind velocity, and that high powered units of 5 kilowatts could be used.

FIRST FELLOW OF THE SOCIETY

H. VIVIAN TAYLOR, M.B.E., L.F.R.A.I.A., F.A.A.S.

All members of the Society will be delighted to hear that at the sixth meeting of Council held on Friday 29th September 1972, Mr. H. Vivian Taylor was elevated to Fellowship of the Society. He is the first Fellow of the Society and the Society generally extends to him its sincere congratulations in gaining this mark of high distinction.

NEW MEMBERS

At the sixth meeting of Council held on Friday 29th September 1972 the following were admitted to membership and affiliated to the Victoria Division.

MEMBER:

Alfredson, R.J.	7 Stradella Ave., Forest Hill, Vic. 3131
Buntine, J.D.	15 Sunhill Ave., Ringwood, Vic. 3134
Kearley, E.J.	35 George St., East Bentleigh, Vic. 3165
Kent, B.R.	133 Mt. Pleasant Rd., Highton, Vic. 3216
Koss, L.L.	75 Alma Rd., St. Kilda, Vic. 3182
Rickard, J.T.	94 Speight St., Thornbury, Vic. 3071
Sawley, R.J.	39 William St., Hawthorn, S.A. 5062
Smith, B.	1 Doolan St., Werribee, Vic. 3030
Snow, R.	189 Williams Rd., South Yarra, Vic. 3141
Stevenson, D.C.	60 Straven Rd., Christchurch, New Zealand.

AFFILIATE:

Howells, P.M.	52 Austin Rd., Seaford, Vic. 3198

SUBSCRIBER:

Aston, F.	27 Wridgway Ave., Burwood, Vic. 3125
Fricker, W.N.	11 Tunstall Ave., Nunawading, Vic. 3131
Nevill, C.J.	15 Linacre Road, Hampton, Vic. 3188
Park, R.	12 Beech St., Surrey Hills, Vic. 3127

NEWS AND NOTES

NOISE, SHOCK AND VIBRATION CONFERENCE

May 1974 at Monash University. The planning for this conference is already under way and it is hoped to bring speakers from overseas to participate in its programme.

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Australian Acoustical Society
Monash University

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The National Committee on Applied Mechanics, The Institution of Engineers, Australia.

ANZAAS - PERTH - AUGUST 1973

The lines of communication are humming with the idea that a session revolving around "Living in a Noisy World" should be organised. It should appeal to many and the experts both active and acoustic in the West will surely find keen support for the venture.

NEED THE POT OF KNOWLEDGE BE INSIPID SOUP ?

In the October 1972 issue of the Southampton Institute of Sound and Vibration Review a statement by Professor Elfyn Richards is given of a broad brief recently sent to him by the British Secretary of State for the Environment. It was to take a ten year look at the growth or reduction of the noise nuisance in Britain during the next decade.

The following account was then given of how Professor Richards saw the interaction of the Institute with the National problem and the contribution it continues to make through its diverse programme. He said "The National picture is one which gives cause for great concern, whilst at the same time presenting a series of great challenges; the number of persons in our urban communities subject to a traffic noise level greater than 70 dB (A) (A Scale) for more than 10% of the time is - at present - 8,500,000.

Since at this level, as many people complain about traffic noise as do not, this implies that above 4,000,000 are disturbed in urban areas. If nothing is done to halve the growth of such noise, this can be expected to rise to 14 millions by 1980, or to 7,000,000 people if no increase in noise is allowed on any one vehicle.

It is further estimated that 2,000,000 people live within the 35 NNI contours around Heathrow, and some 500,000 are seriously disturbed; equally disturbing is the recent disclosure that 600,000 people work in a noise environment which is likely to give rise to substantial deafness over a number of years.

If we add to this an unspecifiable - but large - number of persons disturbed in their neighbourhoods by miscellaneous noises, it is not an overstatement to say that noise is now our premier pollutant.

The whole matter might sound hopeless if it were not that our socio-acoustic researches have put us into a position where we can fairly accurately predict the effects of noise reductions on the environment. For example, the effect of halting the trend for diesel engines to become more noisy and to replace them (power for power) by engines (and their associated vehicles) which are 10 dB quieter would reduce the population disturbed by traffic from 14,000,000 to less than 500,000.

What a challenge this is to the ISVR. Its programme on diesel engine noise is of enormous importance both in terms of science and sociological return. I would go so far as to say that the "low noise diesel engine truck" programme being carried out jointly by ISVR, MIRA, and the Department of the Environment is the most thrilling applied research and development programme in any University today.

But this is just one of the exciting projects going on. I asked earlier what had ISVR succeeded in doing during the last ten years. Apart from its development into what is still a unique educational system in all aspects of acoustics, it has prepared the way for many of the advances now being introduced industrially. Its work on fan noise is providing dividends in the RB211 engine and its work on the effect of impulsive noise on deafness and on annoyance has helped greatly to pinpoint the nature of the factory deafness and the acceptability of the sonic boom. But what will the next decade produce? The Institute is at a crossroads now and must before long choose its new path.

Since applied research invariably leads to the need to understand the fundamental nature of physical and sociological phenomena, it would be excusable if established workers in the field fell to the temptation of confining themselves to basic problems - after all, pure research is so easy to finance and to justify. But scientists who have eschewed practical problems have, in the past, filled the pot of knowledge with some pretty insipid soup. I still believe that the best and most taxing knowledge is that of "how to use knowledge" no matter how much the purists like to look down upon it.

The alternative road, that of "development", whilst harder to follow is more likely to be productive. It needs larger scale experimentation and the money to go with it; it needs collaboration with outside bodies in industry and government, and it must await some awakening by the Research Councils to the fact that "big engineering" is just as important as "big physics" and it needs special systems of funding.

It also needs a wide-awake University to recognise that in interdisciplinary institutes of the ISVR type may lie the embryos of future university teaching developments in transportation, medicine, town and environmental planning, instrumentation and pollution control.

The ISVR is now large enough to tread several paths. The important thing is to realise that these are paths and that they lead to known, but very different, destinations."

A WEDGE FOR AN ANECHOIC CHAMBER

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SUMMARY

This article outlines the procedures used in producing a wedge of rock wool suitable as a lining for an anechoic chamber. The apparatus used was restricted to the acoustic impedance tube and associated equipment.

BACKGROUND THEORY

Acoustical Properties by the Impedance Tube

The normal-incidence absorption coefficient α_N may be determined with the impedance tube (1) using

$$N = 1 - \left[\frac{10^{L/20} - 1}{10^{L/20} + 1}\right]^2$$

where L is the standing wave ratio.

It is also an advantage to plot the resulting impedance curve, that is the inter-relation between the specific acoustic resistance ratio $r/\rho c$ and the specific acoustic reactance ratio $x/\rho C$, following the method suggested by W. Davern of CSIRO (2). From this curve it is possible with some degree of confidence to forecast the changes required in the absorbing system to achieve a superior acoustical performance. Although from the same chart it is possible to read off the absorption coefficient, it should be remembered that this will be the statistical absorption coefficient α_{stat} which differs from α_n.

PERCENTAGE REFLECTION R

The percentage pressure reflection coefficient r_r is given by $\alpha_N = 1 - r_r^2$, so that $R = 100\sqrt{1 - \alpha_N}$. Convenient graphs may be constructed, as a function of L, both of R and of α_N.

For an enclosure to be considered anechoic it is generally accepted (3,4) that there should be an energy absorption of at least 99%, corresponding to a maximum R value of 10% (for which α_N = 0.99 and L = 1.74 dB). The frequency above which these conditions are always met is termed the cut-off frequency f_c. Davern has shown (5) that for R of 10% the value of $r/\rho c$ should lie between 0.818 and 1.222, and that $x/\rho c$ (for $r/\rho c$ = 1.020) should lie between $\pm$ 0.202.

Many workers have investigated (both theoretically and experimentally) the use of gradual transition structures as possible linings for anechoic chambers, and have commented on the effect of various parameters on the acoustical performance.

EXPERIMENTAL WORK

The material chosen for the wedge was rock wool of approximate density 160kg/m^3 and of 305mm square base. The parameters investigated (see Figure 1) were the total length, the base length, tip truncation and the taper angle.

The concrete-walled impedance tube was of 308mm square (internal) section and of free length 5 metre, thus restricting the valid range of frequencies (1) to between 63Hz and a little over 500Hz. The wedge was firmly held by bolts and a rigid backing of 6-ply wood and lead sheeting. Figure 2 shows details of the equipment used to determine the acoustical performance for any chosen single frequency.

In addition to finding the cut-off frequency and the variation of R with frequency, impedance curves were plotted at each stage in order that subsequent changes in the wedge could be estimated.

RESULTS

1. Slight density variations in the sample wedges produced no significant changes in the acoustical properties.

2. From the study of some 20 wedges no significant statement could be made concerning the effect of changing the total length, since other parameters were not constant. It was not possible to conclude that f_c is an inverse of the total length (6).

3. A reduction in the base length seemed to have reduced f_c (without greatly modifying the mid- and upper-frequency response), thus confirming the trend stated by Venzke & Sonntag (7). However, a base-length reduction will increase the engineering problems in ensuring the installed wedges will remain firmly in position.

4. Truncating the wedge tip produced lower f_c values, though should truncation exceed about 10mm the R values at higher frequencies will approach the critical 10% value (and might well exceed it should investigations extend beyond say, 550Hz). A truncated wedge is also an advantage in that extremities are less likely to sustain damage from people in the anechoic chamber.

5. Decreases in the taper angle decreased f_c (without other harmful effects), this being in accord with the findings of Ingerslev et al (8) for Sillan.

The optimum wedge dimensions were concluded to be as follows - total length 1 metre, base length 115mm, tip truncation 50mm and taper angle about $17\frac{3}{4}$ degrees. This gave a 71Hz f_c value, with R at 500Hz being 3%. ASTM C384 (1) concludes that a wedge length of 1.2 metre will yield f_c as 71Hz. The theoretical findings of Head (9) are of interest, and the conclusions I reached as to the optimum wedge dimensions are in accord with his work. Shown graphically at Figure 3, is the acoustical performance of the optimum wedge.

The shortcomings of the work carried out are the failure to carry out more exhaustive tests (to increase the reliability), the failure to extend the testing of the wedge beyond 550Hz and the failure to test an assembly of wedges in a reverberation chamber. As has been pointed out in other papers (1,10), it would also have been advantageous to carry out flow resistance tests.

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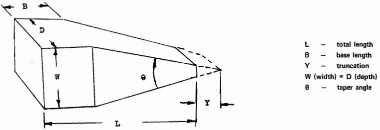

Fig. 1. ESSENTIAL DIMENSIONS OF THE WEDGE

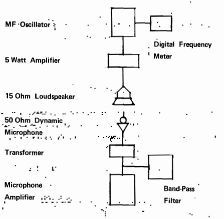

Fig. 2. EQUIPMENT FOR MEASUREMENT OF ACOUSTICAL PROPERTIES.

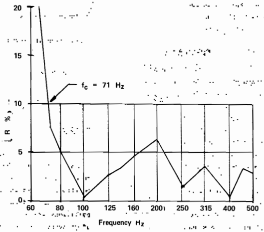

Fig. 3. PERFORMANCE OF THE OPTIMUM WEDGE.

TRANSIENT SOUNDS RADIATED BY IMPACTING SPHERES

L. L. KOSS
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Clayton, Victoria

SUMMARY

An investigation is being undertaken to determine the processes by which sound is generated from the impact of two steel spheres. An understanding of these processes should contribute towards the methods needed to control impactive sounds radiated by industrial machines.

THEORETICAL CONSIDERATIONS:

A theoretical model of the impactive process has been devised. The impact between the spheres is considered to be elastic and Hertzian; neither sphere deforms other than at the point of impact. Each sphere is treated as a finite size transient oscillating acoustic source. The acceleration of each source is given by the Hertzian impact solution. The sound fields radiated by each sphere are then properly summated with respect to time and position in space.

EXPERIMENTAL WORK:

Hard steel spheres (Vickers 880 - 10 Kg load) of the same size are used in the experiment. The two spheres were separately suspended by a thread from a beam, and while one sphere remained hanging the second sphere was lifted through a drop height and allowed to impact the stationary sphere. The impact velocity and the take-off velocity of the spheres were measured by a split laser beam technique. The velocity results calculated for the steel spheres indicated that the impact process is essentially elastic.
The sound pressure was measured by a 1/8-in or 1/4-in B & K capacitor microphone and the signal trace was displayed on a storage oscilloscope.

RESULTS:

A typical sound pulse radiated by the impact process and the sound pulse predicted by theory is compared in Figure 1. The pulse was obtained for the following conditions :

Ball size:	254 mm diameter
Impact velocity:	1620 mm/sec
Position of microphone:	450 mm in front of impacted ball
Microphone	1/4-in B & K microphone without guard and placed at grazing incidence to the wave.

COMMENT

The sound pressure predicted by the model compared well with the measurement, and verifies to a high degree its validity for this measuring position. In the future, measurements and predictions for different size spheres and inelastic collisions are to be made to determine the effects of geometry and inelastic work on the radiated sound field.

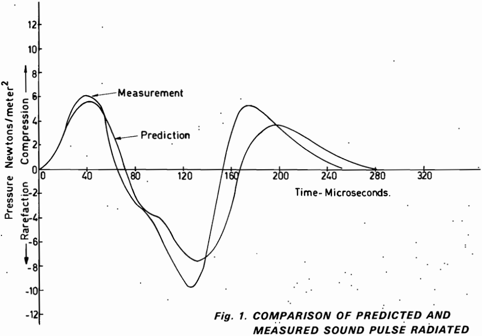

Fig. 1. COMPARISON OF PREDICTED AND MEASURED SOUND PULSE RADIATED BY THE COLLISION OF TWO STEEL BALLS.

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