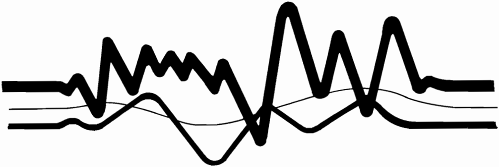
The Bulletin

OF THE AUSTRALIAN ACOUSTICAL SOCIETY

Volume 8, Number 1, April 1980



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W.A. Division: Dr. I.H. Bailey, Department of Physics, W.A.I.T., Hayman Road, Bentley, 6102.

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Volume 8, Number 1, April 1980

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FROM THE PRESIDENT

The main aim of the Society is "to promote and advance the science and practice of acoustics in all its branches and to facilitate the exchange of information thereto". There is no doubt that in Australia the Society has met this aim by the organisation of conferences and the holding of technical meetings and our most important accomplishment will be the 10th International Congress on Acoustics to be held in Sydney in July this year in combination with a series of symposia, conferences and meetings to be held in other centres in Australia and in New Zealand.

1980 is "THE" year for acoustics in Australia and if the response from overseas and local acousticians to the call for papers is any indication, we are heading for a major success. When the distances and costs are taken into account, this is surprising and must be due to the attractions offered by Australia and the growth of acoustical expertise in this country since the formation of the Society.

While the organising committee is to be congratulated, so must the general membership since without their moral and financial support this result would not have been possible.

Although the 10th ICA and supporting conferences will have a great impact on acoustics in this country, there is still much for the Society to do. Members may not be aware that in recent years a sub-committee of Council chaired by Carolyn Mather and supported by Bruce King, John Irvine, Richard Heggie and Bill Davern has been planning the future activities of the Society. The sub-committee reported its findings to the 23rd Council last September and briefly its recommendations covered involvement of more of the membership in the activities of the Society, the raising of finances to put us on a more substantial basis and means for obtaining greater recognition for the profession of acoustics and for the Society by the general community.

Action already in hand or being considered is to:

1. Remove routine tasks and administrative detail from overworked volunteers by establishment of a professional secretariat.
2. Improve the flow of information between sectors of the Society by means of this secretariat.
3. Evaluate courses teaching acoustical subjects in Australia and relate these to the requirements for various categories of membership in the Society.
4. Promote education in acoustics by awards, prizes and other incentives.
5. Maintain a register of firms and individuals providing various services.
6. Provide assistance with the development of new acoustical processes and products.
7. Raise further finances to achieve the above results.
8. Upgrade the Bulletin to a full technical journal or produce such a journal in association with another Society.

A number of the recommendations bearing on membership structures and financial matters will require careful consideration as they may involve the first series of changes to the "Articles of Association" of the Society since its incorporation.

The completion of the report is timely as it will assist the Society to gather further momentum from the 10th ICA and ensure progress through the eighties. Our thanks to the sub-committee for a substantial contribution to the Society.

R.A. Piesse
President

EDITORIAL

The start of a new year is a time for taking stock; a time for reviewing progress (or lack of it) and a time for looking to the future. Like most people, members of the Editorial Committee have been indulging in this exercise.

In many respects 1979 can be regarded as a successful year for us. Whether by good luck or good management (we prefer to think the latter) the three editions of The Bulletin appeared on time and the process of being introduced to the mysterious world of publishing was not too painful. The response from advertisers was excellent and the articles published were generally of wide interest, although there were times when we wondered where our next item of copy was coming from. So much for reviewing progress. What of the future?

In looking to the future we have mainly been preoccupied with the question of what direction The Bulletin should take. Should it try to emulate the more learned journals or should it primarily serve as a means of disseminating information about local events and issues? We feel that a balance between the two extremes is required, perhaps with a bias towards local news. However, The Bulletin is for all members of the Society and we would like your views on this matter which you can express by writing to the Editor at the address shown on the cover.

Irrespective of which direction The Bulletin takes it can only function with your support in the form of contributed articles. There are many members of the Society who could make interesting contributions. For example, consultants must have unusual case histories they could relate (without naming clients) and I am sure members would be interested to hear of the work being undertaken by regulatory authorities.

R. Law
Editor

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NEWS & NOTES

VENSAC NOISE WORKING GROUP

The existence of this body is probably not well known and its work may be of interest to members.

The Vehicle Emissions and Noise Standards Advisory Committee (VENSAC) was formed in 1977 under the Australian Environment Council (AEC) which is composed of the State, Territory and Commonwealth ministers responsible for the environment. The membership of VENSAC is comprised of departmental representatives of these ministers.

The main function of VENSAC is to recommend technical bases (model regulations) for the control of noise and gaseous emissions from new and in-service vehicles in Australia, with the aim of achieving uniform regulations among the States and Territories (the Commonwealth cannot legislate in these areas). The Noise Work Group is naturally responsible for preparing technical bases and providing advice relating to motor vehicle noise.

The first task undertaken by the Working Group was to prepare a technical basis for regulations for the control of in-service vehicle noise. This document has been endorsed and published by the AEC and is largely based on the Victorian EPA regulations which first came into effect in 1976. Similar regulations have since been adopted in New South Wales and Tasmania. The test procedures for in-service vehicles involve simple stationary tests and are intended to complement the more complex procedures applied to new vehicles.

A technical basis for regulations for the control of noise from new vehicles has also been prepared. It was recently endorsed by the AEC and is in substantial technical alignment with Australian Design Rules 28 and 28A.

Projects currently in hand are as follows:-

Study of noise from engine and exhaust brakes - a $10,000 contract has been awarded to a firm of acoustic consultants to undertake limited research. It is hoped that the results of this study will assist the Working Group to recommend means of controlling this form of noise from heavy vehicles.

Review of controls on noise from in-service vehicles - alternative approaches to the control of in-service vehicle noise are being investigated with a view to providing more stringent and more efficient controls.

Development of a close proximity test for in-service trucks - the current test procedure requires the microphone to be placed 7.5 m from the truck. A new procedure, which is soon to be finalised, has been developed to facilitate road-side testing and involves placing the microphone 1 m from the exhaust outlet.

Revised procedures for testing new motor cycles - the current procedures in use in Australia and overseas are felt to be inappropriate. The Working Group is monitoring the progress of work being undertaken in the USA to develope new procedures and when these are finalised it is intended to conduct a modest evaluation program to determine their applicability for Australia.

R. Law

PIPE ORGAN FOR MONASH UNIVERSITY

What began as a pipe dream several years ago has finally been realised. The Louis Mathison Pipe Organ is currently undergoing its final voicing and turning in the Robert Blackwood Hall at Monash University. The inaugural concert, planned for late April, will be of interest to acousticians for several reasons.

Firstly from a musical point of view it is a most significant instrument. The organ was built by Jurgen Ahrend of West Germany - his 100th. It has 4 manuals and a pedalboard which together control some 3097 pipes. The action is mechanical throughout. The manuals are incredibly responsive and the action remains light and decisive even under full organ conditions. The pedalboard is similarly responsive. Its flat, parallel configuration however will cause many organists, more accustomed to a concave radiating configuration, some concern. The overall sound is exceptional. The principals are perfect, the flutes are fantastic, the strings are superb, but it is the reeds which are really remarkable.

From an acoustical point of view there are a number of additional features of interest. The reverberation times for the hall typically vary from 2½ seconds at low frequencies to 1 second at high frequencies. Some would consider these times to be one the low side for organ music. The impression, with an empty hall, is that the reverberation is just about adequate particularly for contrpuntal music.

A second feature has been the raising of the Halls overhead sound reflectors so that there is an uninterrupted view of all the pipes. Again the impression is that this has not been detrimental - the lateral reflections seem to be more important.

Finally the air intake for the blower is located in one of the waiting rooms below stage level. Ahrend considers the large amount of cigarette smoke that could accumulate in that room will not be puffed out of the organ pipes.

Robin Alfredson

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FLOW INDUCED SOUND

A fluid flowing in a duct past a series of tubes or a flat plate can generate loud sounds at certain velocities. The sounds disappear when the velocity is changed.

Known as acoustic resonance, these sounds can be very annoying and even damaging to human health. In some situations they cause structural vibration with very expensive consequences.

Clearly, there is a need to know more about the physics of what produces and sustains acoustic resonance so that designers of such diverse things as chemical and power plant heat exchangers, truck and car radiators, gas turbine engines and air conditioning ducts can avoid costly or damaging design failures and high noise levels.

Work performed by Mr. Martin Welsh and Dr. Don Gibson at the Division has shown that the loud 'whistling noise' encountered while testing an automotive radiator in a wind tunnel is an acoustic resonance generated by vortex, shedding, i.e. shedding of small eddies of air, from the tubes. They actually performed their experiments on a single strut in a wind tunnel to reduce the problem to its essential elements. Their study revealed that during resonance the character of the flow around the strut can change completely, without mechanical vibration of the strut.

The first researcher to explore resonance phenomena in detail, but with a bank of plates, was Dr. Ralph Parker of the Department of Mechanical Engineering at University College of Swansea, U.K. Because of Parker's considerable experience in this field of research, Welsh went to Swansea for 4 months in the first half of 1979 to collaborate with him.

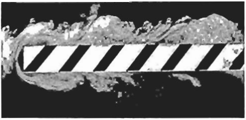
In an effort to locate the source of the sound and the relationship between sound and fluid flow, Welsh, Parker and a third researcher from Swansea, Mr. Stewart Stoneman, concentrated on flow visualization techniques.

This involved the introduction of smoke into the air flow upstream of the plate in the duct and the use of a stroboscope to hold the flow pattern visually stationary, or allow it to move slowly in the direction of the flow.

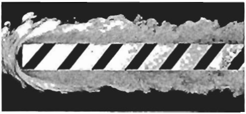
They studied plates with either square or semi-circular leading and trailing edges and showed that acoustic resonances are produced when the vortex-shedding frequency equals an acoustic resonant frequency.

Once an acoustic resonance has been established, the vortex-shedding frequency and the acoustic resonance frequency remain locked together, gradually increasing with increasing flow velocity until resonance ceases.

The results they obtained also showed that the paths followed by the air particles can be quite different from what was formerly thought, i.e. the vortex shedding is not necessarily always associated with the trailing edge (see diagram).



(a) with resonant sound



(b) no resonant sound

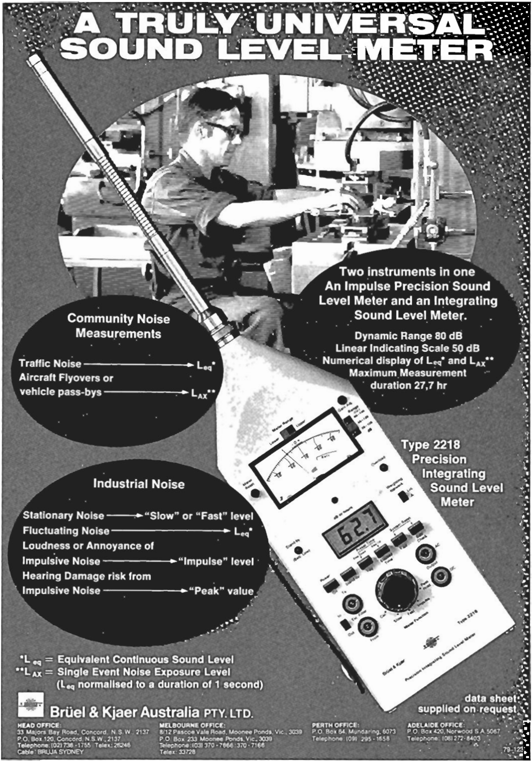
They were able to make a videotape of their experiments - an increasingly popular method of publishing experimental results of this nature. Later, they were invited to present their results at the Euromech Colloquium on Vortex Shedding from Bluff Bodies which was attended by invited specialists from around the world.

One of Welsh's conclusions from his trip was the need to inform not only acoustic specialists of the results of his work, but also to make non-acoustic people aware of the effect an acoustic resonance can have on fluid mechanics. For example, acoustic resonance has changed the pressures acting on a thick plate in a wind tunnel by as much as 80%.

Since Welsh has returned to the Division he has modified his wind tunnel to enable him to carry out further flow visualization experiments. He is also collaborating with Dr. Nick Stokes, CSIRO Division of Mathematics and Statistics, who is developing a mathematical model of the interaction between the resonant sound and the fluid flow.

It is hoped that this will lead to a greater understanding of the source of the sound and provide further understanding of the interaction between plate vibration, vortex shedding and acoustic fields, so that designers can more confidently avoid unwanted acoustic resonances.

(Reprinted from CSIRO EngEvents December 1979).



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CONTROL OF NOISE FROM INDUSTRY IN VICTORIA

The Noise Control Branch of the Environment Protection Authority of Victoria has been in existence since 1972. The Branch has grown over the years and we now have 20 professional and technical staff.

Within the Branch a group of 6 staff form the Noise from Industry Group. This Group is involved in the development of legislative controls for noise from all industrial, commercial and trade premises. The E.P.A. deals only with environmental noise, hearing conservation being within the preserves of the Health Commission.

The Environment Protection (Noise Control) Act 1978, has been passed but not as yet proclaimed. It is hoped that it will be proclaimed in the near future, enabling the EPA to place Noise Control Notices on any premises other than those used exclusively for domestic purposes or primary production.

The provisions of the Act can only be enforced via a State Environment Protection Policy or Regulations. The Noise from Industry Group has prepared a draft Policy titled "Control of Noise from Commercial, Industrial or Trade Premises within the Melbourne Metropolitan Area" which was issued for public comment in March 1979. Comments have been received and the document is now under review for finalisation.

The Group carried out applied research into many aspects of the measurement and assessment of industrial and commercial noise in order to develop the draft Policy. Studies carried out and forming part of the document include:

(i) the development of a noise zoning system which can be applied objectively rather than subjectively,

(ii) background sound level studies,

(iii) measurement techniques and units of measurement,

In order to set suitable permissible levels for intrusive industrial and commercial noise a major noise survey of Melbourne was carried out in 1977 and has been published as the "Melbourne Noise Survey". Data was obtained on a continuous monitoring basis and from this a general picture of the noise climate of Melbourne emerged. Such first-hand information on background noise levels proved vital in setting the appropriate regulatory levels. The draft Policy nevertheless allows for unusual situations where very high or low background conditions prevail.

The Noise Control Branch has been very fortunate in having access to a system of investigation of noise complaints. The Investigations Branch of the Authority was set up in the early 1970's for the purpose of enforcing the Environment Protection Act and noise inspectors were employed even at the early stages, although there was no existing noise legislation to be enforced. This has meant that over the years a great deal of practical experience has been gained through investigation of noise complaints, of which about 600 per year are received concerning industrial and commercial noise.

The Group developing the controls has been able to apply firsthand various measurement and assessment techniques as these were developed and this has proved invaluable. As a result of this accumulated experience the Noise Control Branch is confident that the draft Policy contains practical and sensible criteria. In the review of the draft, a similar process is being applied with comments received being tested using case studies. It is intended that the Policy will be gazetted during 1980.

One major noise problem area which is not included in the draft Policy is that of entertainment noise. This is being considered separately by the Noise Control Branch as the measurement and assessment techniques applied to industrial noise are not necessarily appropriate for noise such as amplified music. Noise from hotels, discos, cabarets and public halls is becoming an increasing problem in Melbourne and the most frequent complaint is of the low frequency component in amplified music. This is an area which needs further research.

The EPA has achieved quite a deal of success in reducing noise from industrial and commercial premises through the co-operation of companies concerned. Such noise abatement work is always greatly appreciated by residents of the nearby community. Many companies take the commendable attitude that they should not be the cause of noise annoyance. It is hoped that this co-operative approach will continue after the legislation is proclaimed. Naturally the legal controls will allow the requiring of attenuation works where necessary.

The draft Policy applies only to the Melbourne Metropolitan Area at present but it is intended that similar Policies will also be developed for other regional centres in Victoria.

Any queries regarding industrial noise in Victoria should be directed to:

Noise Control Branch,
Environment Protection Authority,
240 Victoria Parade,
East Melbourne, Vic., 3002.

Telephone number: 651 4011

Jillian Hulme
Acting Principal Noise Control Officer

PRICES ARE REDUCED ON NOISE -CON SERIES VOLUMES

In 1973, the first in a series of national conferences on noise control engineering was held in Washington, D.C. The most recent conference, NOISE-CON 79 had the theme "Machinery Noise Control", and was held at Purdue University in West Lafayette, Indiana in the spring of 1979. Proceedings of each conference have been published.

The Institute of Noise Control Engineering has announced that prices have been reduced by 50% on the earlier volumes of the Proceedings of these conferences: NOISE-CON 73 on General Noise Control Engineering, NOISE-CON 75 on Standards, Regulations and Federal Programs for Noise Control and NOISE-CON 77 on Transportation Noise. In addition, an author/subject index to the entire series has been prepared and is available free with orders for any book in the series.

A short description of each volume and ordering information is available in a new flyer which is available from the Institute of Noise Control Engineering. Contact the Institute at P.O. Box 3206, Arlington Branch, Poughkeepsie, NY 12603.

TRAFFIC NOISE ASSESSMENT IN VICTORIA

Members of the Australian Acoustical Society may be interested to know that, in Victoria at least, traffic noise assessment is not something that will begin to happen sometime in the 1980's. It is something that has been happening since 1976.

In September 1976 the Victorian Premier wrote to all Government Departments, Statutory Authorities and Agencies introducing a system of Preliminary Environment Reports and Environment Effects Statements. Any public works proposal developed by a Department, Authority or Agency that could have a significant or controversial environmental effect was to be brought to the attention of the Director of Conservation, the permanent head of the Ministry for Conservation. The Director was then to advise whether an environmental investigation and report were necessary. The full text of the Premier's letter was included in a brochure entitled Guidelines for Environment Assessment which was issued for public distribution in January 1977 by the Ministry for Conservation. Appendix 1 of this brochure listed proposals which might need an Environment Effects Statement. Item 3 in this list covers major engineering works and transport facilities such as freeways, railways and airports.

Effectively this meant that from late 1976, the environmental effects of freeways (and possibly other major roads works) were to be considered in some detail. Traffic noise is often one of the major environmental effects of freeways.

In May 1978 the Victorian Parliament passed the Environment Effects Act 1978 (No. 9135) which gave the Premier's instructions of September 1976 the effect of law. The Act applies to "public works which could reasonably be considered to have or to be capable of having a signficant effect upon the environment."

Section 4(1) of the Act requires amongst other things that "Before commencing any public works to which this Act does or could apply.......the proponent........shall........ cause an Environment Effects Statement to be prepared, and submit it to the Minister for his assessment of the environmental effects of the works."

The Act is reprinted in full in an updated version of the previously mentioned brochure. The new brochure, entitled Guidelines for Environment Assessment and Environment Effects Act 1978, has been made available to the public and is issued by:

The Ministry for Conservation
240 Victoria Parade
East Melbourne Victoria 3002

Once again, freeways are listed as works which might need an Environment Effects Statement.

The Noise Control Branch of the Environment Protection Authority, an Agency of the Ministry for Conservation, has been called upon to help this assessment work in two ways: firstly to recommend a criterion to be used in assessing the impact of traffic noise, and secondly to provide comment on the traffic noise aspects of some of the Environment Effects Statements submitted to the Ministry. These Environment Effects Statements are generally very detailed, often running to more than five volumes with an entire volume sometimes being allocated to noise effects.

After a comprehensive literature search the Noise Control Branch concluded that the criterion and associated prediction method used in the United Kingdom for assessing eligibility for traffic noise compensation should be used. Accordingly, since November 1976, it has been Authority policy that when considering the impact on residential areas of noise resulting from major road works, due consideration should be given to the Standards specified in the U.K. Noise Insulation Regulations 1975 in the absence of relevant Victorian legislation. The background to this decision is outlined in paper [1] presented to the 1979 Conference of the Australian Acoustical Society. Background to the U.K. Noise Insulation Regulations is provided in an Authority publication [2] first issued in 1978.

The L_{10} (18 hour) scale, the 68 dB(A) criterion and the traffic noise prediction method [3] included in the U.K. Noise

Insulation Regulations 1975 are all supported by very large data bases [1]. Research in Australia [4, 5, 6 and 7] has shown that the U.K. prediction method is sufficiently accurate for use in this country as a planning tool. (The method is not entirely free of anomalies, however. See Reference [5], page 11 which also outlines the positive steps being taken by the National Association of Australian State Road Authorities to assemble a large Australian data base which will enable a comprehensive review of the predictive accuracy of the method to be carried out.)

Reference [6] points out the two considerable advantages the U.K. prediction method has that other methods lack. These are, the ability to account for the complex acoustical conditions generally encountered, and the ability to predict noise levels at heights other than 1.2 m.

John Modra
Noise Control Branch
E.P.A. Victoria

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The Use of an Acoustic Sounder for Atmospheric Monitoring

N.E. Holmes * and M.J. Lynch
Western Australia Institute of Technology

This paper follows a talk presented to the Australian Acoustical Society (Western Australia Division) during April 1979. It reviews briefly the development of atmospheric acoustic sounding since 1946 and discusses the principle of operation of a simple monostatic sounder with reference to a system constructed at the Western Australian Institute of Technology. The ways in which sound interacts with the atmosphere and how sounder records are interpreted are also discussed. Finally, some of the more technically difficult applications, presently under investigation, are described.

INTRODUCTION

Acoustic sounders are the acoustic analogue of radar. The main requirement is to produce an intense acoustic wave train of short duration which can be made to propagate in a well defined direction. Operating frequencies usually lie in the range 0.5 -5 kHz. Working at these high frequencies has the advantage that the background acoustic noise is lower, however this is coupled with increased absorption which reduces strength of echoes. At low frequencies background noise is higher but to compensate absorption is less and the 0.5 - 5 kHz useful band is determined for the most part by these two competing effects.

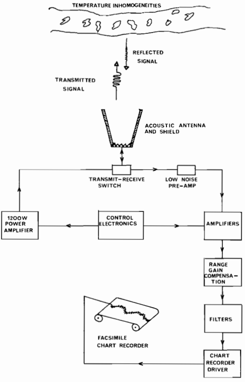


Figure 1. Schematic Diagram showing the Principles of operation of the W.A.I.T. Acoustic Sounder.

The essential features of a typical sounder are shown in figure 1, which although referring specifically to the WAIT instrument, is in fact fairly typical of other sounders in use today.

The most critical part of the system is the acoustic antenna, which uses an array of 57 transducers as shown in figure 2. Each has a rating of 12 W (continuous power), making the total power capability 684 W, which in practice is considerably more than can be achieved with a single transducer and parabola assembly. Because the driving signal is a short duration tone burst it is possible to exceed this rating by a factor of two, without damaging the transducers.

The radiation pattern produced by the antenna at 1.667 kHz is shown in the polar plot of figure 3. An acoustic shield, formed of marine plywood, lined internally with an acoustically absorbent material comprising a foam-lead-foam composite, surrounds the array. The foam material is protected from the weather and sunlight by a thin TEDLAR skin.

Under test conditions with an electrical power input of 500 W, the on axis sound pressure level at a distance of 30 m from the antenna (and on the beam axis) is about 121.5 dB and the overall efficiency on transmission is found to be between 6 and 7% at 1.667 kHz.

After transmitting the tone burst, the antenna is isolated from the power amplifier and switched to a receive mode. The signals produced by weak echoes are then fed to a low noise pre-amplifier, with a fixed gain of about 90 dB, and from there to further amplifiers, filters and other signal processing circuits.

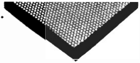
ABSORPTION

SOUNDFOAM

Urethane foam developed specifically to absorb maximum sound energy with minimum weight and thickness. Used to absorb airborne noise in industrial and EDP equipment, machinery enclosures, over-the-road and off-highway vehicles and marine and airborne equipment. Meets UL 94, HF-1 flame resistance test procedure.

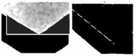
SOUNDFOAM (Embossed)

The surface pattern increases sound absorption performance 25 to 35 percent in the most critical low and mid-frequency bands when compared to other foams of the same thickness and density. Ideal solution for low frequency absorption problem. Meets UL 95, HF-1 flame resistance test procedure.



CABFOAM

An outstanding sound absorbent foam with a tough, abrasive-resistant film surface designed specifically for use where unprotected foams won't hold up, and where appearance is important, such as in over-the-road and off-highway vehicle cabs and equipment enclosures.



SOUNDFOAM (With Films)

Highly efficient Soundfoam acoustical foams are available with a surface of Tedlar, metalized Mylar, urethane film or vinyl film. Surface treatment provides attractive appearance and resistance to various chemicals and sunlight.

SOUNDFOAM (With Perforated Vinyl)

Provides a tough, handsome finish for use in vehicles and other places where appearance is important. Leather-looking surface is bonded to highly efficient acoustic foam.

DAMPING

GP-2 DAMPING SHEET

A thin (0.050") sheet of pre-cured damping compound with pressure sensitive adhesive backing. Easily and inexpensively die cut and shaped to fit and form to flat areas and simple curves.

FOAM DAMPING SHEET

Consists of a thickness of embossed foam bonded to a sheet of highly efficient GP-2 damping material. Provides a single solution to damping and absorption problems.

DYAD

A polymer specifically developed to provide effective constrained layer damping on thick, heavy, metal plates. Applied by cementing the polymer sheet to both the structure being treated and a metal constraining layer.

EPOXY 10

A quick curing resin based damping paste which can be applied by trowel or spray. Completely resistant to severe environmental conditions, including water, acid and alkalis. Popular for marine and outdor applications.

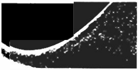
GP-1 DAMPING COMPOUND

A non-toxic, non-flammable plastic which is applied by trowel or spray. Cures quickly in air or oven. A thin coating on steel (1/2 to 1 times metal thickness) removes tinniness and ringing.

BARRIERS

SOUNDMAT LF

Soundmat LF is made up of a vibration isolation layer of foam, a lead septum sound barrier, and a layer of embossed foam to provide maximum absorption, together with noise attenuation.



SOUNDMAT FV

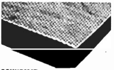
Soundmat FV has 1# limp mass barrier layer bonded to a 1/4 inch layer of acoustic foam. A heavy, scuff-resistant black vinyl skin is optional. Particularly for vehicle cab floors and bulkheads. Also used as pipe lagging.

SOUNDMAT FVP

Consists of a clossed cell, hydrolytically-stable foam isolator and a layer of open cell Soundfoam M, with a lead barrier between the two. The surface is a tough, wear-resistant 1# mass for additional transmission loss.

SOUNDMAT LGF

An acoustic absorption/barrier material with a lead septum sandwiched between two layers of inert glass fibers. Designed for "fire hazard" applications. Will not support combustion or sustain flame. Excellent resistance to organic and inorganic chemicals.



SOUNDMAT (With perforated vinyl)

Has all the characteristics of Soundmat LF, plus a tough, handsome exterior finish for use inside vehicle cabs or other applications where good appearance must accompany noise control.

The above noise-suppression materials are available from:

NYLEX CORPORATION LIMITED

For literature and samples contact your local Nylex Sales Office:

MELBOURNE	SYDNEY	BRISBANE	ADELAIDE	PERTH	HOBART
93 0211	632 0155	371 3066	258 4000	458 8911	34 2311

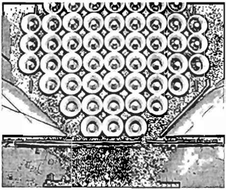


Figure 2. View of the Array of Transducers used as the Antenna.

The most important of these is a range gain compensation circuit which compensates for the fact that echoes from more distance targets weaken inversely as range squared.

The final stage in the signal processing is to display the received information. This is conventionally achieved using a facsimile recorder in much the same manner as with marine echosounders (see figure 1). A pen carrying an electrical signal (whose strength is proportional to the amplitude of the received echo at any instant) is made to traverse an electrically sensitive chart recorder paper, which is blackened by the electrical signal. The degree of blackening depends on the strength of the signal and hence the echo. By synchronising the pen traverse so that it always commences at the instant of transmission, it is possible to obtain a time versus height plot of echo strength. Examples of records obtained are shown in figures 5 (a), (b) (c).

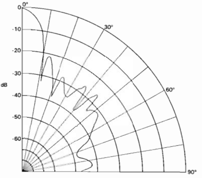


Figure 3. Acoustic Antenna Beam Pattern (with shield), 1667 Hz at 30 m.

THE INTERACTION OF SOUND WITH THE ATMOSPHERE

As a sound wave propagates vertically through the atmosphere it encounters a changing environment; changes in pressure, temperature and humidity all cause variations in the acoustic impedance of the air. The initial attempt to provide a quantitative explanation for the strength of the echoes (Gilman et al, 1946) was based on the assumption that the reflections were caused by smooth changes in acoustic impedance that could be predicted from the general way in which temperature, humidity and pressure vary in the lower atmosphere. This analysis resulted in a wide discrepancy between observed and theoretically predicted echo intensities, indicating that some feature of the atmosphere, other than smooth variations, was responsible for the scatter.

The accepted mechanism for scattering now is that it occurs from small scale inhomogeneities in the temperature and wind field. The theoretical treatment indicates that the inhomogeneities that are most effective as scatters, are those whose size is half the wave length of the propagating wave. Each inhomogeneity makes only a small contribution to the scattered wave. A significant detectable echo can only be produced by a larger population of small inhomogeneities. On the whole, theoretical predictions of echo strength, using this model, compare favourably with observations as reported by Neff (1975) and Asimakopolous et al. (1976).

THE INTERPRETATION OF ACOUSTIC SOUNDER RECORDS

The Products of Temperature Inhomogenieties

In a dry, well mixed atmosphere, which is being neither heated nor cooled, the temperature is found to decrease with height at the rate of about 9.8 Kkm^{-1} (see figure 4 (a)). This lapse rate is called the dry adiabatic lapse rate. Once the dry adiabatic lapse rate is established turbulence cannot produce temperature inhomogeneities. Any vertical exchange of parcels of air will result in adiabatic cooling or heating but once exchanged they will find themselves at the same temperature as their surroundings. This is illustrated in figure 4 (a). As a consequence a sounder set to receive backscattered radiation can receive no signals from those parts of the atmosphere where the lapse rate is dry adiabatic. On the other hand, if for some reason, the lapse rate is different, then a parcel of air moved vertically will still cool or warm at the dry adiabatic lapse rate, but in this case it will find itself at a different temperature from its surroundings. Turbulent mixing of such air will result in the production of temperature inhomogeneities which will scatter sound. This is illustrated in figure 4 (b). Thus in this rather indirect way the instrument is able to determine if the lapse rate is adiabatic or otherwise, and in fact (because the appearance of the records for the two cases differ) it is possible to determine whether the lapse rate is greater than or less than the dry adiabatic rate.

Significance in Air Pollution

The significance of this type of information in air pollution meteorology will be clear from the following simplified discussion. If, as is fairly typical on clear nights, the earth cools and chills the lower layers of the atmosphere, then a situation will arise where warm air overlies cool air (i.e. the lapse rate is greater than dry adiabatic, it may in fact be positive). In this consideration the atmosphere is stable in the sense that a parcel of air moved vertically will cool adiabatically and find itself denser than the surrounding air. As a result it will sink back to the level from which it came i.e. vertical movement is inhibited. The importance of this is that pollutants released into the air will not be mixed vertically and the dilution process is slowed.

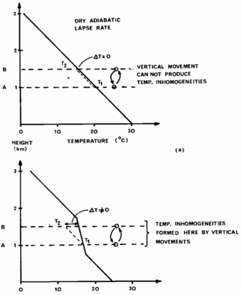


Figure 4. How vertical movement can produce Temperature Inhomogeneities when the Lapse Rate differs from the Dry Adiabatic lapse rate.

The presence of a stable layer reveals itself as an echoing region which shows up as a black line or band, stretching horizontally across the record (see figure 5 (a), (b) and (c)). On some occasions, see figure 5 (b), the layers support quite vigorous wave motions.

The opposite situation exists during the day when the ground, warmed by the sun,

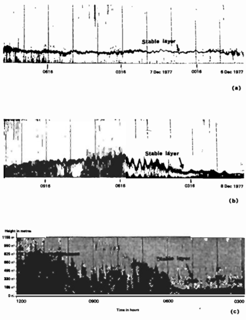


Figure 5. Acoustic Sounder Records.

heats the air near the surface resulting in the unstable situation of warm air beneath cool air giving rise to convective activity. Figure 5 (c) shows the transition between the stable nocturnal situation and day time convection. The features on the record that characterize convection are black vertically pointing marks which are interpreted as echoes from rising columns of warmed air, the necessary temperature inhomogeneities being produced in part by entrainment of the surrounding cooler air into the rising columns, which are referred to as thermal plumes. Frequently convective activity takes place below the stable layer, so the two states of stability and instability exist simultaneously at different heights. The sounder provides a useful record of the development of the mixing layer beneath the inversion.

OTHER APPLICATIONS

So far the discussion has dwelt on the most wide spread and easiest to implement application of the technique, but apart from obtaining information about the location of stable layers and the development of convection it is possible to extract even more information by fairly detailed analysis of the echoes. Three areas to which a signficant research effort has been directed are the measurement of vertical profiles of wind, temperature and humidity.

Wind profiles are measured by determining the Doppler shift in the frequency of the echoes compared with the transmitted signal and applying the normal formula to calculate the velocity of the scatterer. In practical systems it is usual for the sound scattered from a single vertically pointing transmitter to be detected by a number of separately located receivers which can be scanned up and down the transmitted beam to make measurements at different heights.

It is fair to say that the technique is not yet in widespread use as a routine method of measuring boundary layer winds.

Profiles of temperature can be measured using the so called Radio Acoustic Sounding System, RASS (see for example Marshall et al., 1972 and Frankel, 1977). With this technique a vertically propagating sound pulse is launched and its velocity which depends on temperature, is tracked with a microwave radar; the compressions and rarefractions of the sound pulse being the cause of the microwave returns. Once again this technique has been tested in prototype form but is not yet in routine use.

Finally humidity profiles can be measured by making use of the fact that different frequencies have different absorption coefficients. In principle comparing echo strengths at different frequencies will allow a determination of both temperature and humidity (Grunderbeeck, 1975). So far studies on the usefulness of this technique have been inconclusive and Grunderbeeck's work (1975) and work at W.A.I.T. suggest that the signal to noise ratios required to obtain useful accuracy in the humidity and temperature estimates may limit the application.

CONCLUDING REMARKS

Since 1946, and more particularly in the last decade or so, acoustic sounding has developed and now provides information about the temperature structure of the lower atmosphere and for air quality studies. No other technique can offer as cheaply such detailed information about the structure and events taking place in the boundary layer. Recordings of the passage of sea breezes, thunderstorm outflows, the development of convection and the "break up" of nocturnal inversions, all provide useful insights into these processes. There is perhaps one major frustrating feature. This is that the records provide only qualitative information. Although the location and depth of an inversion is of interest to the air pollution meteorologist, so too is its strength. A reliable estimate of this is not available from the sounder record.

It is still difficult to predict what place sounders will have in the range of tools used to investigate the atmosphere. But it appears that the rate of introduction of new developments has slowed. The most sophisticated applications, such as Doppler wind measuring systems, RASS and the humidity profiling, are all techniques still being investigated and assessed. Only the test of time can judge their final usefulness in routine application.

ACKNOWLEDGEMENTS

This work has been funded jointly by the Western Australian Department of Conservation and Environment and the Western Australian Institute of Technology. In addition a significant contribution to the instruments development has been made by technical staff and students of the Physics Department whose help is gratefully acknowledged.

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J. Acoust. Soc. Am., 18, 274-283.

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NOAA Technical Report ERL 322-WPL 38.

LETTERS

Dear Sir,

NEW NOISE AND VIBRATION PANEL

New South Wales members of the Society will be interested to hear that the Sydney Division Mechanical Branch of The Institution of Engineers, Australia has formed a Panel on Noise and Vibration with co-conveners Bryan Major and Campbell Steele.

This panel is a new one and is additonal to that set up by the federal Mechanical College.

The new panel will meet in Sydney and it is envisaged that interest will centre around the design and operational aspects of machine acoustics and vibrations.

Further information is available from the writer 74 Windang Road, Primbee South, NSW, 2504 (Telephone: 042 74-4322).

Yours faithfully,

Campbell Steele

SIMPLIFIED MEASUREMENT OF TRANSMISSION LOSS

Dear Sir,

The AK/4 Committee of the Standards Association of Australia is considering drafting a standard on simplified methods of measuring the transmission loss of walls and building elements.

The U.S. Standard, ASTM E597-77T (Determining a Single-Number Rating of Airborne Sound Isolation in Multiunit Building Specifications) has been considered but it is felt that this method is not sufficiently simple. An alternative method, based on work done at Sydney University, is also being considered.

Although this second method (the 'sweep' method) has undergone laboratory and field trials, information on the reproducibility of transmission loss results needs to be obtained. In order to do this it is necessary to compare the results of a number of operators using different equipment. This is difficult to arrange however and so it has been proposed that a comparison between 'simplified' and 'standard' transmission loss results be carried out, whenever possible, by consultants and other practitioners engaged in making field transmission loss measurements.

The document published in the Standards and Regulations Section of this issue outlines the simplified test procedure. If your readers can, please would they use the procedure when making field transmission loss measurements. I would be grateful if, during the next six months, they would send the results to me, as soon as they become available. I also need, of course, the STC value obtained using their normal procedure (AS 2253-1979) and a description of the building element tested and the conditions under which the tests were carried out. Comments on the simplified method and a description of any alternative methods they would like the AK/4 Committee to consider would also be appreciated.

Yours sincerely,

Fergus Fricke
Department of Architectural Science
University of Sydney.

GOSSIP

GOSSIP

Confucius says according to the old Chinese Proverb that Gossip Column writers should be very careful to get their facts right. At a recent Bulletin Committee Meeting we looked at the proofs for the last Bulletin and found that we had left an 'e' of Jill Hulme's name and that overleaf we described the Carr Acoustic Group as a new acoutic consulting service. None of this might have been quite so bad if it wasn't for the fact that it was not Jill Hulme of the E.P.A. Victoria who had just returned from a holiday but in fact was Val Bray from the S.P.C.C. in New South Wales. In talking to Jill and explaining that the error was wholly my fault she assured me that we would have nothing to worry about if the Society rectified the matter by sending her on a holiday to the U.K.! And the typographical error would not have mattered if it hadn't been that in the gossip column we had highlighted the same typographical error on somebody's business card.

Many eminent Acousticians will be coming to Australia for the 10th I.C.A. and some will be staying on at various Institutions. Just two that I know of are MR. KOYASU, PRESIDENT OF THE KOBAYASI INSTITUTE OF PHYSICAL RESEARCH AND A MEMBER OF THE INTERNATIONAL STANDARDS ORGANISATION TECHNICAL COMMITTEE 43, SUB COMMITTEE 2 who will spend two weeks at the Royal Melbourne Institute of Technology. MALCOLM CROCKER A FELLOW OF THE ACOUSTICAL SOCIETY OF AMERICA will be coming to Monash early in July and will conduct an advanced course in Noise Control.

Last column we mentioned the S.P.C.C.'s adventure with a striking clock; this prompted someone to tell me about the E.P.A.'s adventures. Apparently the E.P.A. in Melbourne, Victoria received complaints from residents in the Fitzroy/Collingwood area about occasional queer noises. The E.P.A.'s officers had to do quite a bit of work to establish that there indeed was a queer intermittent noise and eventually they did track it down right to their own building! Apparently on the roof of the E.P.A. building they were operating an Acoustic Echo Sounder and I am told that the E.P.A.'s officers were able to go back to the residents and tell them that they had found the noise source and that it was now under control i.e. they had turned off the switch.

In tidying up the other day I came across a cutting from the Melbourne Age dated 1975 November 19. The article titled "Warning; Noise is a Health Hazard" quotes Anita Lawrence as saying "Australia has been slow to introduce Laws governing noise. Although most states now have Noise Pollution Legislation (Regulations for the Victorian Legislation are about to be announced)." If you contact the E.P.A. today they will assure you that their Noise Policy is about to be gazetted.

Finally I must again ask all members to write to me or phone me with any titbits they hear. They should contact me at KNOWLAND HARDING FITZELL PTY. LTD., 22a Liddiard Street, HAWTHORN, Victoria, 3122. Telephone: 819 4818.

Graeme E. Harding.

DIVISION REPORTS

VICTORIAN DIVISION DIARY

As an appropriate close to a decade in which signficant acoustic achievements have been made, culminating in our State Health (Hearing Conservation) Regulations, our Division met with the Audiological Society on the 24th October, 1979 at Prince Henry's Hospital Clinical School Lecture Theatre to discuss the 'contributions of Audiology and Acoustics in Hearing Conservation'. Mr. Ross Armstrong, recently appointed S.E.C.V. Audiologist, member of the Audiological Society and Dr. Len Koss, Lecturer, Department of Mechanical Engineering, Monash University, member of the Australian Acoustical Society, briefly spoke on aspects of Hearing Conservation relevant to their sphere of activity.

Mr. Ross Armstrong centred his remarks on the interpretation of the Health (Hearing Conservation) Regulations, and the specific roles of acoustician and audiologist in implementation of an overall Hearing Conservation program. Dr. Len Koss discussed aspects of Hearing Conservation in terms of Noise Control and referred to noise suppression research in metal press technology. General discussion followed, particularly over refreshments when we took the opportunity of enjoying the hospitality of our Audiological friends.

The Green Room Club was once again our venue for our social end of year function. A Wine Tasting evening was enjoyed by 32 members and guests, as Peter Lewis, mine host 'enlightened us and unravelled the secrets of his wares'. Musical entertainment, provided by an enthusiastic band, obviously keen to impress the Society with their creation of complex and intense acoustic wave forms, encouraged guests to make good use of the dance floor.

A glimpse of our Calendar for 1980, indicates a most interesting and full year with the highlight in July as we head North to attend the Tenth International Congress on Acoustics, or maybe West to attend one of the Satellite Symposia.

By the time we read this calendar, we will already have enjoyed a meeting with the Institute of Engineers, Mechanical Branch members when the topic will be 'Suppression of Vibration in the Melbourne Underground Rail Loop'. A visit to the Underground Loop site will follow in March, to inspect some of the noise and vibration suppression techniques.

In April we plan a 'Standards' Workshop, and in May, along with the Victorian Division A.G.M. we propose to visit Royal Melbourne Institute of Technology and inspect their acoustic facilities. 'Traffic Noise' is the proposed topic for a joint meeting with the Institute of Engineers Environmental Branch in June.

In the second half of 1980, we propose another Workshop, and site visit to the Audiological Centre at Prince Henry's Hospital, finishing the year with a social function with 'a little variation'.

Geoffrey Barnes,
Victorian Division Bulletin Representative

N.S.W. DIVISIONAL REPORT JANUARY 1980

The Committee continued to meet on the first Wednesday of each month, with the exception of January. A recent matter being dealt with by the Committee is the preparation of a National Directory which will include the name, business affiliation, address and field of interest for each member of the Society. A questionnaire sheet has been prepared for distribution by each Division. It is hoped that the Directory will be available at the time of ICA.

The Technical Sub-committee has organised interesting and informative Technical Meetings. In October about 30 attended when Mr. Patrick from Deparment of Industrial Relations and Technology spoke on the N.S.W. Industrial Hearing Conservation Regulations. A spirited question time following his presentation. The November meeting was planned as a Christmas Special Function with a smorgasbord dinner preceeding a talk by Mr. Abe Segal on the Physics of Stringed Musical Instruments. It was a little disappointing that only 25 attended the dinner, however over 30 came to the technical meeting. Abe Segal gave a most interesting talk and his daughter provided musical accompaniment using the various violins. The first Technical Meeting for 1980 will be in February.

Membership applications are being continually received and considered by the Membership Grading Sub-committee. The Education Sub-committee is revising the list of courses in Acoustics as the number of requests for further information continues at a high level.

A small sub-committee has been formed, with Peter Kotulski as convenor, to consider the preparation of a Submission to the N.S.W. Commission of Enquiry into Industrial and Occupational Safety and Health. Although there is not a lot of time for the preparation of this submission it is planned that some members of the Society will be contacted for their opinions on the Submission.

Marion Burgess

The Statistics of Decaying Sound Fields

John L. Davy,
Division of Building Research,
Commonwealth Scientific and Industrial Research Organization,
Melbourne, Australia.

SUMMARY

Theoretical formulae are presented for the uncertainities observed when using the reverberation method to determine the amount of sound absorption in a room. An outline of the derivation of these formulae is given. The formulae are compared with experiment results obtained in a $600m^3$ reverberation room.

INTRODUCTION

This paper presents theoretical formulae for the variance of the decay rate of a band of random noise in a reverberation room. Two types of variance are examined. They are the variance between decay rates measured at the same microphone position (ensemble variance), and the variance between decay rates measured at different microphone positions (spatial variance). Two types of signal averaging are considered. They are exponential averaging (which includes graphic level recorders and sound level meters), and linear averaging over a fixed averaging time (where the interval between the starting time of successive averages is greater than or equal to the averaging time).

THEORY

Let $\langle x \rangle$ denote the mean value of a random variable x. The covariance of random variables x and y is defined to be

$$\mathrm{cov}\,(x,y) = \langle (x-\langle x\rangle)(y-\langle y\rangle)\rangle .$$

The variance of the random variable x is defined to be

$$\mathrm{var}\,(x) = \mathrm{cov}\,(x,x).$$

The subscript e denotes that the mean value is taken over the ensemble of possible outputs from the white noise generator. The subscript s denotes that the mean value is taken over different spatial positions of the microphone.

Decay rate measurements are performed using the measurement system shown in Figure 1. Let P(g(t)) be the output signal of the averaging device for an input signal g(t). An exponential averaging device has the equation:

$$P(g(t)) = k\int_{-\infty}^{t} \exp(-k(t-\tau))g(\tau)d\tau ,$$

where k is the decay rate of the device. This type of averaging device is usually an RC type low pass filter.

The second type is a linear averaging device. It has the equation:

$$P(g(t)) = (\int_{t-I}^{t} g(\tau)d\tau)/I ,$$

where I is the integrating time. This is usually approximated by taking N samples $g(t_i)$ during the interval of time I and forming

$$P(g(t)) = (\sum_{i=1}^{N} g(t_i))/N .$$

The variance of decay rate is due to the random ripple on the decay record x(t). The properties of this ripple are described by the covariance function. For an exponential averaging device we have

$$\mathrm{cov}_e(x(t_1),x(t_2)) = (k/(2B))\exp(-k|t_1-t_2|).$$

For a linear averaging device we have

$$\mathrm{cov}_e(x(t_1),x(t_2)) = \begin{cases} (1/(BI))\,(1-|t_1-t_2|/I) & \text{for } |t_1-t_2| < I, \\ 0 & \text{otherwise.} \end{cases}$$

In the above formulae, B is the statistical bandwidth of the band pass filter. If H(f) is the frequency response of the band pass filter, then,

$$B = (\int_0^{\infty}|H(f)|^2 df)^2/\int_0^{\infty}|H(f)|^4 df .$$

If we average all possible decay records at a microphone position we obtain the ensemble average decay record $\langle x(t)\rangle_e$. The spatial covariance of this decay record is.

$$\mathrm{cov}_s(\langle x(t_1)\rangle_e,\langle x(t_2)\rangle_e) =$$

$$(\beta/(2B))\exp(-\beta|t_1-t_2|),$$

where β is the decay rate of the reverberation room. Note that it has the same form as the ensemble covariance for an exponential averaging device.

The mathematical derivation of the above covariance formulae is complicated. It is given in detail by Davy, Dunn and Dubout [1].

The linear regression analyzer fits a straight line to the decay record x(t) using the method of least squares, and outputs the slope β of the straight line. If we have a continuous record for time t between 0 and T then

$$\beta = (12/T^3)\int_0^T(t-T/2)x(t)dt.$$

If we have a discrete point record at times $t_i = a(i-1)$ for i=1,....n, then

$$\beta = (12/(a^2(n+1)n(n-1)))$$

$$\sum_{i=1}^{n}(t_i - a(n-1)/2)x(t_i).$$

Thus for a continuous record the variance of slope is given by

$$\mathrm{var}\ (\beta) = (144/T^6)\int_0^T\int_0^T(t_1 - T/2)(t_2 - T/2)$$

$$\mathrm{cov}(x(t_1),x(t_2))dt_1dt_2.$$

If $\mathrm{cov}(x(t_1),x(t_2)) = (k/(2B))\exp(-k|t_1 - t_2|)$,

we have $\mathrm{var}\ (\beta) = (12/(BT^3))F(kT)$,

where $F(x) = 1-3(1+\exp(-x))/x$

$-12\exp(-x)/x^2 + 12(1-\exp(-x))/x^3$.

Hence we now have a formula for the ensemble variance of decay rate when an exponential averaging device is used. Replacing k with β we obtain a formula for the spatial variance of decay rate.

For a discrete point record the variance of slope is given by

$$\mathrm{var}(\beta) = (12/(a^2(n+1)n(n-1)))^2\sum_{i=1}^{n}\sum_{j=1}^{n}$$

$$(t_i-a(n-1)/2)(t_j-a(n-1)/2)\mathrm{cov}(x(t_i),x(t_j)).$$

$$\text{If } \mathrm{cov}(x(t_i),x(t_j)) = \begin{matrix}\sigma^2 \text{ for } i=j \\ 0 \text{ for } i\neq j\end{matrix}$$

we have $\mathrm{var}(\beta) = 12\sigma^2/(a^2(n+1)n(n-1))$.

We will assume that our linear averaging device produces a discrete point decay record with the time spacing between points greater than or equal to the integrating time. In this case the covariance of different points will be zero, and the variance of a point will be

$$\sigma^2 = 1/(BI)+2/N,$$

where 2/N is a correction for linear averaging devices which average only a finite number of samples. Thus we now have a formula for ensemble variance of decay rate when a linear averaging device is used.

We normally work in decibels rather than natural logarithms. The decay rate in decibels per second is

$$d = (10/\ln(10))\beta.$$

Thus $\mathrm{var}(d) = (10/\ln(10))^2\ \mathrm{var}(\beta)$.

If we determine the decay rate by using the decay record from A decibels to A+D decibels below the steady state level then

$$T = D/d.$$

Thus $\beta T = (\ln(10)/10)D$.

Also $kT = (\ln(10)/10)\gamma D$,

where γ is the ratio of the decay rate of the exponential averaging device to the decay rate of the room.

In the case of the linear averaging device discussed above we will take the first point whose level is more than A decibels below the steady state level and continue taking points until we obtain a point more than A+D decibels below the steady state level. This point will be our last. This means that the average number of points is

$$n = D/(da)+1.$$

Thus our formulae become

$$\mathrm{var}_s(d) = (10/\ln(10))^2(12/B)(d/D)^3$$

$$F(\ln(10)D/10),$$

$$\mathrm{var}_e(d) = (10/\ln(10))^2(12/B)(d/D)^3$$

$$F(\ln(10)\gamma D/10)$$

(exponential averaging device),

$$\mathrm{var}_e(d) = (10/\ln(10))^2 12(1/(BI)+2/N)/$$

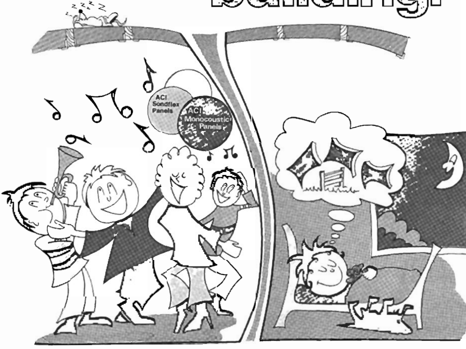
$$(a^2(D/(da)+2)(D/(da)+1)(D/(da)))$$

(linear averaging device),

where $F(x) = 1-3(1+\exp(-x))/x$

$-12\exp(-x)/x^2 + 12(1-\exp(-x))/x^3$.

The low-noise building.



ACI Fibreglass has long been concerned with the problems of noise control.

In fact, we have developed a number of products to help block noise on all sides. On walls, floors and ceilings.

A couple of examples:

Noise Stop Board. A high density acoustic underlay. Designed for use in floors, walls and partitions to reduce noise transmission between outside and inside areas.

Acoustic ceiling panels. A very attractive, decorative noise reduction system. Although designed to absorb noise, they also provide additional thermal insulation.

As you can see from just these two products, ACI Fibreglass has got all sides of the noise reduction problem covered. Your state ACI Fibreglass office would be most pleased to give you more information.

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ACI Fibreglass

EXPERIMENTAL RESULTS

The above formulae have been compared with the results of a statisical analysis of variance on experimental data from four different reverberation rooms in both their empty state and with a highly absorbing sample on their floors. The experimental results and their 90% confidence limits for an empty 600 m^3 reverberation room are compared with the theoretical results in Figures 2 and 3. These results were obtained by performing 20 decays at each of 10 different microphone positions in the 18 third-octave bands between 100 Hz and 5 kHz inclusive using a linear averaging device. Thus the experimental results for spatial standard deviation shown in Figure 2 are based on 9 degrees of freedom, while the experimental results for ensemble standard deviation shown in Figure 3 are based on 190 degrees of freedom. Hence the 90% confidence limits in Figure 3 are smaller than those in Figure 2.

The agreement between theory and experiment in Figures 2 and 3 is considered to be satisfactory. However some of the other results showed evidence of the theory systematically underestimating the experimental results in the low frequency bands where the modal overlap is less than one. This is believed to be due to the fact that the assumptions of statistical room acoustics used in [1] to derive the covariance formulae do not apply for low values of modal overlap.

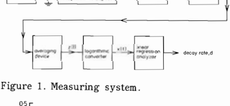


Figure 1. Measuring system.

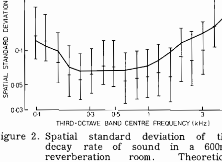


Figure 2. Spatial standard deviation of the decay rate of sound in a 600m^3 reverberation room. Theoretical curve and experimental results with 90% confidence intervals.

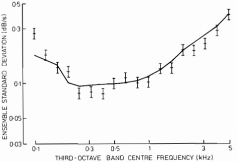


Figure 3. Ensemble standard deviation of the decay rate of sound in a 600m^3 reverberation room. Theoretical curve and experimental results with 90% confidence intervals.

CONCLUSION

The above formulae can be used to predict the precision of decay rate measurements in a reverberation room for frequencies for which the modal overlap is greater than one.

REFERENCE

[1] J.L. Davy, I.P. Dunn, and P. Dubout; "The variance of decay rates in reverberation rooms", Acustica 43(1979), 12-25.

BOOK REVIEWS

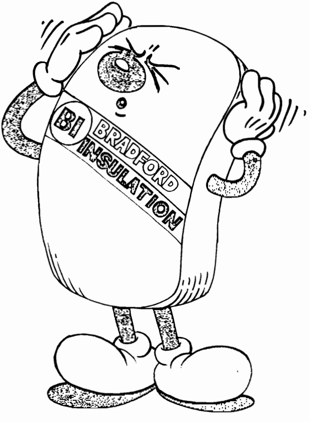
DESIGN FOR GOOD ACOUSTICS AND NOISE CONTROL

by J.E. Moore. The MacMillan Press Ltd., 1978. 213 pages. Recommended price: $25 bound, $12.50 soft cover.

The book is intended firstly as a textbook for students of architecture, interior design, town planning and surveying, and secondly as a handbook for use in later practice of their professions.

As regards the first of these aims, the author has chosen the right topics for inclusion, and has in most cases dealt with them in suitable depth and in logical order. The treatment is appropriately non-mathematical, well illustrated and easily read. The result is a very compact package of material well able to support lecture courses in community noise control and/or auditorium acoustics, for students in the four disciplines mentioned. For architecture students, the whole book could be course-related. For students in the other

RINGING EARS?



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three disciplines, either part 3 or part 4 would presumably serve only as interesting extra-curricular reading. However the price penalty so imposed on them would not be high.

A slender reference handbook that actually gets used by a practitioner not specializing in acoustics is more beneficial to the community than a library of weighty and expensive ones that gathers dust on his or her shelf. Established practitioners who have had little benefit of formal course work in acoustical implications of their profession would do better to buy and use this small book, than to ignore the subject completely, as the reviewer is convinced many do at present. Those who may use this book while students would be quite likely to enter practice possessing only this book as their guide. There is a good chance that they would use it, and thereby avoid most of the 101 classical acoustical mistakes.

It has one shortcoming in this regard. The bibliography is quite extensive, but in the text there are few specific references suggesting where best to seek further reading on particular topics. Also, for use by Australian students, a lecturer might feel obliged to issue an adapted bibliography.

The book is arranged in four sections. The first two, (1) Properties and Behaviour of Sound (36 pages) and (2) Subjective Aspects of Sound (15 pages), introduce the necessary concepts, terms and definitions. Each topic is treated to a short discussion to ensure understanding, many being further developed in following sections.

The remaining two sections deal with application, viz in design for (3) Noise Control (81 pages) and (4) Good Room Acoustics (64 pages). The first of these would be more accurately titled Community Noise Control, and the second Auditorium Acoustics. Inevitably the latter presents only one school of thought, with which some specialists are bound to disagree on some details. However, they would have to acknowledge that the package though small is comprehensive and systematic.

Only three faults in the manner of presentation of material in the book struck the reviewer, as follow.

In Section 1, the term "sound insulation value" is introduced, ostensibly to "avoid confusion" (between STL and SRI). Grasping the nettle by choosing one or the other of the latter, would have been preferable to introducing a third term to dodge the issue. Ironically, it turns out in Section 3 that the quantity thus newly christened, and quoted for a variety of building elements in Table 34, was the Normalized Level Difference (0.5s) after all! For use as a single-number index of insulation performance, only the arithmetic average "sound insulation value" is mentioned. However, adequate warning is given to its shortcomings.

The measurement of sound, and meters for the purpose, are topics not dealt with until Section 3, and then only perfunctorily. Australian lecturers would probably prefer to introduce them as early aids in putting Section 1 across.

The topic of sound attenuation with distance is well introduced in Section 1. However, the opportunity for developing it further in Section 3, accurately and convincingly, has been muffed somewhat by reintroducing it there two pages too soon. A more realistic discussion of departures from slopes of 3 dB, and 6 dB per distance-doubling could have been presented after the L_{10} concept, and ground effects, were discussed.

Paul Dubout

ROOM ACOUSTICS

by Heinrich Kuttruff, Applied Science Publishers Ltd., London, Second Edition, 1979.

This is the second edition of Kuttruff's book. The first edition was published in 1973. Although there are a number of changes, especially in the second half of the book, the second edition is very similar to the first edition. If you already own a copy of the first edition I would advise you not to rush out and purchase a copy of the second edition. However if you do not already have a copy of the first edition, I highly recommend this second edition to you. I have made extensive use of the first edition.

Kuttruff is Profession of Technical Acoustics at the Technical University of Aachen in the Federal Republic of Germany. He is the author of many papers in acoustics and is one of the three assistant editors of "Acustica". The first edition was translated into English from the German manuscript by Professor Peter Lord of Salford University who is the editor of "Applied Acoustics". He has also critically reviewed the manuscript of the second edition.

The first half of the book treats the theory of room acoustics and sound absorbers. Wave, modal and ray tracing approaches are considered. There is a good discussion of Kuttruff's research on alternatives to Sabine's Reverberation Formula.

The second half of the book covers subjective effects, design procedures, electro-acoustics, and measuring techniques.

The book is easy to read and there is a nice balance between the descriptive and mathematical approaches.

John Davy

STANDARDS & REGULATIONS

PROPOSED SIMPLIFIED METHOD FOR FIELD TRANSMISSION LOSS ASSESSMENT

The AK/4 Committee of SAA is considering a new test method. The proposed method is similar to all others in that it requires sound levels to be measured on either side of a wall when a source of sound is operating in one of the rooms. In other respects the method differs from conventional methods: the diffuse field and normalization conditions are not used, the source signal is a swept tone (rather than white or pink noise) and a single dB(C) measurement is made on the source side and a single dB(A) measurement made on the receiver side.

Theoretically the method cannot give the same result as a standard STC measurement. In practice however there appears to be a good correlation between STC and dB(C) - dB(A) values measured using the simplified procedure. (It would seem that the systematic errors introduced by the above simplifications are of the same order of magnitude as the random errors encountered in the standard measurement method.)

The measurement details are given below:

(i) Sound Level Measurement

The method requires at least one and preferably two General Purpose (AS Z37-1967) Sound Level Meters (Precision SLM's could of course be used). The sound level meters are placed 1 m either side of the test partition and 1.2 m above the floor. (These distances are not critical and can be varied by ±10%.) Both sound level meters should be close to the centre of the test wall.

The source side level is measured in dB(C) and the receiver side level in dB(A). Measurements may be made simultaneously on both sides of the partition, or sequentially. Care should be taken not to shield the microphone from the source. The receiver side level should not be affected by background noise.

(ii) Source Signal

The source signal proposed is a swept tone because it allows the use of a smaller amplifier and speaker (for the same degree of signal distortion) than a white or pink noise signal. The signal is swept from 100 Hz to 5000 Hz, in half a second, using a linear sweep. Figure 1 shows a circuit diagram for a suitable swept frequency signal generator.

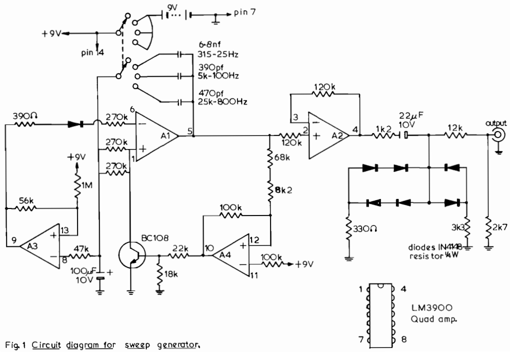

Fig. 1 Circuit diagram for sweep generator.

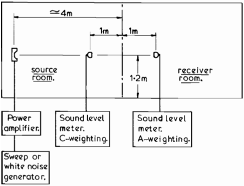

Fig.2 Schematic diagram of simplified transmission loss test method.

The swept signal need not be used in these tests but it would be preferable to do so. If it is not possible to use the swept signal a white noise or pink noise signal may be used.

(iii) Speaker

A single speaker in a baffle or enclosure is used. It should be placed directly opposite the test wall, preferably 4 to 6 m from the wall (in many domestic buildings the distance will have to be less than 4 m). The speaker, which should face the wall and the microphone, should be approximately 1.2 m above the floor.

Editors Note: Please read Dr. Fricke's letter to the Editor about this test method.

ACOUSTICAL SOCIETY OF AMERICA PUBLISHES NEW STANDARDS

In March, 1970 the International Organization for Standardization (ISO) began work on a new series of standards to be used for measuring the noise emitted by machinery and equipment. The series of standards, all based on sound power, was produced by Subcommittee 1 (Noise) of ISO Technical Committee 43 on Acoustics. Development of the standards was by Working Group 6, Noise Emitted by Machinery and Equipment.

Shortly thereafter, American National Standards Committee S1 began preparation of a series of American National Standards covering the same area, and American National Standard S1.21-1971 has been available for eight years. It is the current national counterpart of ISO 3741 and ISO 3742.

A series of seven standards has been under development within the S1 Committee; the Acoustical Society of America holds the S1 Secretariat. The first two of the seven standards have now been approved by the American National Standards Institute and are now available from the Society. Work on the five additional standards is proceeding rapidly, and ANSI approval of the remaining documents is expected before the end of 1979.

American National Standard S1.30-1979 introduces the remaining six standards which specify various methods for determining the sound power levels of machines and equipment. Guidelines for making decisions concerning the type of test and the specific details for mounting and operating the equipment are provided in the standards. Also covered is a synopsis of each of the six standards which, when approved, will carry the designations ANSI S1.31-S1.36.

American National Standard S1.35-1979, Precision Methods for the Determination of Sound Power Levels of Noise Sources in Anechoic and Hemi-Anechoic Rooms, contains information on microphone arrays, instrumentation, installation and operation of a source, procedures for calculation of sound power level, directivity index and directivity factor. Measurements made according to this standard must be performed in a laboratory environment. Other standards in the series cover measurement methods in a reverberant environment, measurements in a free field, measurements in a special test room and in situ measurements.

Copies of ANSI S1.30-1979 and ANSI S1. 35-1979 are available for $25.00 and $29.00 respectively.

In 1977, the Computer and Business Equipment Manufacturers Association (CBEMA) recommended the formation of an S1 Working Group to prepare a standard covering noise emissions of computer and business equipment. The Working Group completed preparation of the new standard, S1.29-1979, in 1978.

The Standard defines uniform procedures for measuring and reporting the noise emissions of computer and business equipment. The sound power produced by the equipment is determined and reported using the Noise Power Emission Level (NPEL) in bels. The standard also covers sound pressure level measurements at the operator's position, general methods for installing and mounting equipment and procedures for identifying the presence of discrete frequency components and impulsive noise. The new standard, ANSI S1.29-1979, American National Stanard Method for the Measurement and Designation of Noise Emitted by Computer and Business Equipment is available for $15.00 from the Acoustical Society of America.

Contact DEPT STD, Back Issues Department, American Institute of Physics, 335 E. 45th St., New York, NY 10017 for each of these Standards. Orders not accompanied by payment will be billed for a $2.00 handling charge.

TENTH INTERNATIONAL CONGRESS ON ACOUSTICS

PROGRESS REPORT - 10 ICA PLANNING - JANUARY/FEBRUARY 1980

Nearly all of the Technical Exhibition space is now firmly booked mainly by overseas manufacturers, but there is some Australian industrial involvement and governmental departments also. There has been no need to extend the exhibition space beyond the ground floor of the building.

We are pleased to report that important sub-committees and working groups of IEC TC29 and ISO TC43 have decided to meet in Sydney immediately after the Congress and this has brought an inflow of influential experts who will add to the prestige and value of the Congress.

The technical programme sub-committee has been enlarged to nine persons including Anita Lawrence as Chairperson. They have now sorted the main batch of 584 abstracts already received and allowance for mail delays will also enable most of the remaining 198 promised abstracts to be included in the programme if they arrive in the next month. Many abstracts have arrived from those with whom we had no previous contact and, when their names are added to the list, the total number of potential delegates rises to approximately 1,600.

Details of the abstracts and offers of contributed papers is:

Subject	Abstracts & Offers
Speech	92
Physio, & Psych.	84
NOise	176
Shock & Vib.	42
Arch. & Blds.	67
Bio.	20
Altrasonics, etc.	59
Underwater	44
Physical	61
Aero	19
Music	28
Tranduction	41
Measurements	46
Miscellaneous	3
	784

Further abstracts now arriving at the rate of approximately 25 per week.

Satellite symposia in Adelaide and Perth have gone through a period of trepidation due to tardy response to calls for papers, but it is expected that, as with the main Congress, these fears will disappear as the signs of success grow.

As guided by the Commission we have offered assistance with travel funds to a few acousticians in South-East Asia, but are looking for potential promoters of acoustics in the Phillipines, New Guinea, Fiji and New Caledonia with a view to possible assistance.

Support from industry has been lower than expected, despite the continuing efforts of our special fund-raising sub-committee, but government support seems to be possible both by provision of services and direct financial contribution.

After receiving requests from trade organizations for permission to include pamphlets in delegates satchels, we have decided to permit this for a fee of $200 and that this fee will also apply for the display of literature advertising journals, etc.

The first delegates have already registered and we are particularly pleased at this early response as their fees, together with the technical exhibition deposits, will ease our liquidity problems.

We have made arrangements for special banking facilities to be available to Congress delegates, but the Rural Bank which is the main bank located on the University of N.S.W. compus warns that, as many overseas credit cards are not recognised in Australia, it would be best if delegates came with Australian currency or travellers cheques in U.S. Dollars, Sterling or West German Marks.

(J.A. Rose),
Chairman
Executive Committee

* *

HAVE YOU WRITTEN YOUR COMPLETE ICA PAPER YET?

IF SO, WHY NOT SUBMIT IT TO THE BULLETIN FOR AUSTRALIA-WIDE PUBLICATION.

* *

NEW PRODUCTS

NEW NOISE DOSE AND ENVIRONMENTAL ANALYSER UNITS TO BE RELEASED AT SYDNEY ICA

Hard copy from personal dosemeters and an environmental noise analyser that does almost everything are two advances from Metrosonics, Inc. of Rochester.

That Company's earlier 301/651 Dosemeter-Printer combination has now been extended by the 652 METROREADER.

The 652, together with its 301 pocket dosemeter, lists among its advances -

. a 64 dB dynamic range for "A" weighted slow response.

. range of either 30-93 dBA, 40-103 dBA, 60-123 dBA or 80-143 dBA by PROM selected by user.

. printouts in Leq and dBA.

. 4 samples/second sampling rate.

. full 8 hours of data storage kept for 5 days.

. 100 hours operation from single battery for personal dosemeter.

. printout of time history or statistical distribution data (according to PROM selected) on 63 mm paper.

. battery-mains operation as standard on 652 Metroreader.

. outputs to XY Plotter or computer interface as options.

. Metroreader take-anywhere weight of 7 kg.

. rugged transit case contains both dosemeter and reader.

Another Metrosonics extension is in the 601/602 Environmental Noise Level Analysers. The 601/602 Series already used in Australia will soon be extended by the production of the Model 603.

The 600 Series from Metrosonics is designed for either on-site or off-site printout by a companion printer. This obviates the inevitable problems due to printers being left unattended in outdoor environments and expected to work at all times, many times they don't!

Other features of the 603 are -

olsolescence prevention by modular circuit design allowing software and hardware upgrades to suit user or legal demands.

. 120 dB "no-switch" dynamic range.

. SPL, Leq, Ldn, Lax, Lmax, CNEL, Ln and Pl all available both in real time and stored for printout, as is time of day.

. multiple interval analysis of Leq, Lmax, L10, L50, L90 and L99 plus two other selectable LN values. Specific time interval values are stored. The time interval can be from 1 minute to 99 hours.

. single event exceedance is also stored.

. data output can be in real time or extracted from store when required.

. series or parallel ASCII data is for 20 or 60 column printers.

. will accept all conventional microphone systems.

. realistic "noise floor" for worthwhile low level outdoor night-time noise measurements.

The 603 is due for release mid 1980 and will appear first at the Sydney ICA.

ANECHOIC TEST CONDITIONS

An instrument combination comprising a small anechoic chamber and special audio analyzer, primarily for testing hearing aids and small microphones, has been developed by Bruel & Kjaer.

The Type 2116 Audio Test Station is a combined signal generator, analyzer, and chart recorder for frequency response, harmonic distortion and intermodulation distortion measurements, primarily on hearing aids and small microphones. A special feature of the instrument is a digital memory capable of storing a correction curve before making measurements. This is then used to regulate the test signal at a constant level. Special emphasis has also been placed on ease of operation. Frequency range is 100 Hz to 10 kHz.

The Type 4222 Anechoic Test Chamber, which replaces the earlier Hearing Aid Test Boxes, is a small anechoic chamber with a built-in sound source for testing all types of hearing aids and small microphones under controlled conditions. The chamber's special design gives a high degree of insulation from external noise and provides anechoic conditions above approximately 400 Hz, making it suitable for measurements on velocity as well as pressure sensitive microphones.

The generator supplies a test signal over a 40 dB range, selectable in 5 dB steps. The analyzer's dynamic range is 100 dB.

INFORMATION FOR CONTRIBUTORS

Items for publication in the Bulletin are of two types

(a) Shorter articles - which will appear typically under the heading 'News and Notes'

(b) Longer articles - which will appear as refereed technical articles.

The closing dates for the receipt of these articles are as follows:

Vol. 8 No. 2 Longer articles: Mid May; Shorter articles: Mid June
Vol. 8 No. 3 Longer articles: Mid September; Shorter articles: Mid October

Articles may be sent directly to the editor or via the local State Bulletin representative.

There are no particular constraints on "shorter articles" except that they should be of relevance to the Society and be received on time.

Attention to the following matters will assist when processing "longer articles".

(i) Length - typically from 3 to 4 pages when printed.

(ii) Title and Authors Address - the title should be concise and honestly indicate the content of the paper. The author's name and that of his organisation together with an adequate address should also appear for the benefit of members who may wish to discuss the work privately with the author.

(iii) Summary - The summary should be self contained and be as explicit as possible. It should indicate the principal conclusions reached. That should be possible in less than 200 words. Many more members will read the summary than will read the paper. Everybody seems to be busy these days.

(iv) Main Body of the Article - This should contain an introduction, and be followed by a series of logical events which lead finally to the conclusions or recommendations. The use of headings greatly assists the reader in following the logic of the paper. The conclusions should of course be based on the work presented and not on other material.

(v) References - Any standardised system is acceptable - for example those used by Journal of Sound and Vibration, Journal of the Acoustical Society of America, or The Institution of Engineers, Australia. Page numbers and dates are important, particularly when referencing books.

(vi) Tables and Diagrams - As a general rule, Tables are best avoided. Diagrams may need to be redrawn during the editorial stage. They ought to be totally self explanatory, complete with a title, and with axes clearly labelled and units unambiguously shown.

The papers generally will be subject to review but this is not intended to discourage members. The author no doubt would prefer to have any anomaly drawn to his attention privately rather than to gain notoriety by having errors published widely.