"ACOUSTICS ON ICE"

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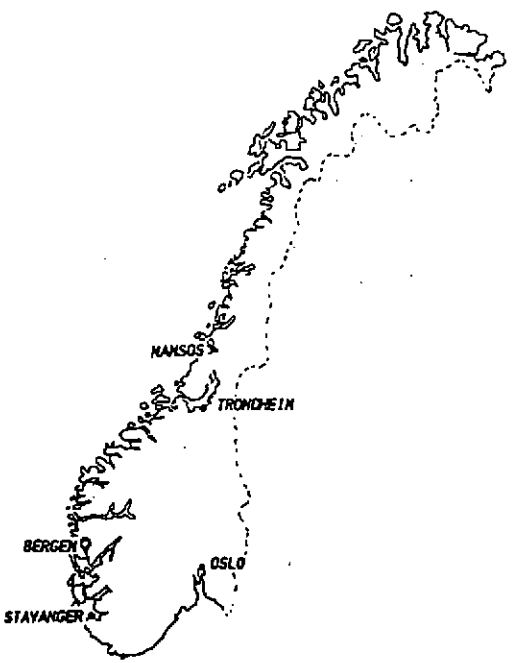
INTRODUCTION

Though Norway has a population of only 4.3 million, the country has a thriving acoustic milieu encompassing all forms of research, development and consultancy. This paper attempts to give an short insight into this by presenting a sample of the work being performed within the field of acoustics in Norway today.

The Norsk Akustisk Selskap



The society which binds all acousticians in Norway together is the Norsk Akustisk Selskap (NAS) or, to give it its international title, The Acoustical Society of Norway.

NAS was founded the 28th March 1955 and has grown to have a membership today of 183 (6 of which are women) It therefore has more members per head of population than the IOA! The members' fields of work cover most areas within building and room acoustics, audiology, noise control, underwater and electroacoustics. The majority are engaged in consultancy though a substantial number work in research. The members are based mainly in the East of the country around Oslo and in Trondheim with 8-10 in the Bergen area, 2-3 in Stavanger and just one member North of Trondheim in Namsos i.e. no acoustic engineers are based in Northern Norway.

The Acoustics Research Centre/ELAB

The Acoustics Research Centre/ELAB in Trondheim is Norway's major acoustics research establishment and at present, its many fields of research include speech synthesis, active acoustic impedance, active sound attenuation, building acoustics and various forms of noise emission.

The department of building acoustics has, under the guidance of Svein Strøm, Asbjørn Krokstad and Svein Sørsdal, become renowned for its work with concert hall acoustics. During the period 1967-1973, the department developed a computer program that was able to predict the propagation of sound in a room, following a particular ray through a number of reflections at several algebraically defined surfaces [1]. This mathematical modelling system was pioneered in the designing of the Grieghallen in Bergen in 1967. Today, this is a recognised technique used by consultants the world over. The department is now researching into how the form of a room and the reflective qualities of its surfaces influence the radiation of sound energy over a period of time.

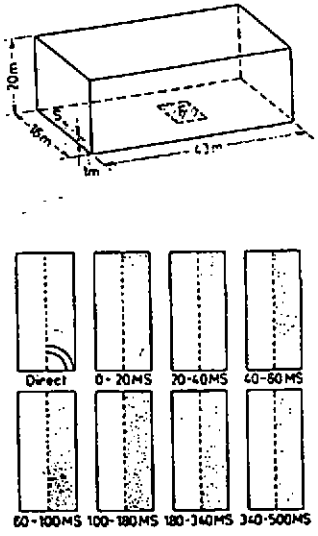


Fig. 1 Diagram showing the computer calculated propagation of sound in a "shoe box" hall using the method developed in Trondheim.
- Left half is shown blank as it would show a mirror immage of the right.
Top: geometrical data for the example.
Bottom: audience intersection points in different time intervals.
(From Cremer)

A large proportion of the work at ELAB is devoted to the study of noise emission from various sources, in particular, road and traffic noise. As stricter noise emission limits for road vehicles are introduced, tyre noise becomes more significant as a contributor to the overall noise level, and as a consequence, research is being carried out to develop a 'low-noise' road surface [2].

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A prototype of a poroelastic material consisting of granulated rubber imbedded in a polyurethane binder was laid on an off-road test track. The noise from vehicles standing on, or passing over the poroelastic material was measured. A dense asphalt concrete acted as a reference surface and a drainage surface was used in the comparisons.

The investigation comprised of engine noise, rolling noise and the total noise from the vehicles and the measurements were confined to one saloon car using summer and studded winter tyres and one medium sized lorry.

It was found that the poroelastic material reduced the engine noise significantly (2.5 - 4.5dBA) and the rolling noise markedly (6.5 - 7.5dBA) at low to moderate driving speeds (30 - 50km/h). When using studded winter tyres, the noise reduction was very pronounced (10 - 12dBA) (see table 1)

Table 1. Pass-by rolling noise, A-weighted relative noise levels, dB.

Test surface	asphalt concrete	drainage asphalt	poro 45mm/ poro 30mm
Test condition			
30 km/h:			
summer tyres	0	+1.3	-7.0 -7.4
studded tyres	0	-1.3	-12.3
50 km/h:			
summer tyres	0	+1.7	-6.5*
studded tyres	0	-1.0	-10.7*

* Measured at the interchange between poroelastic 30mm and poroelastic 45mm.

The durability of this poroelastic surface is now being studied as the national requirement for using studded tyres in the winter months in Norway means that roads need to be re-surfaced regularly.

Research along similar lines is presently being conducted at the Transport and Road Research Laboratory in England.

Oslo Helserâd

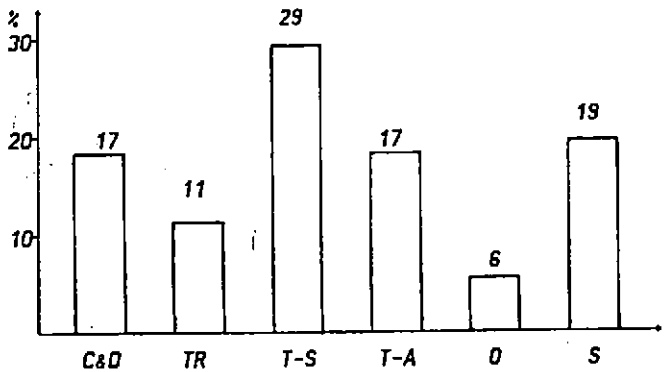
Oslo Helserâd (City Health Department) contains a section of the hygeine division with a staff of 7 full-time engineers and technicians in charge of noise abatement in the city. The tasks of the noise abatement section are:-

- Preventive work: Reviewing of town planning and applications for building licences.

- Improvement of existing situations: Treatment of complaints and enquiries concerning noise, routine noise inspections, development of regulations and programs against noise, research into and realisation of a noise abatement program against road traffic noise.
- Various: Control of sound insulation in new buildings, partaking in national noise abatement programs.

Possibilities for expansion of the city of Oslo are limited by the fact that the city is bordered to the North, East and West by mountain woodland, and to the South by the fjord. This results in the majority of the residential areas being exposed to noise originating from roads, railways or the airport. Oslo Helserâd receives several noise complaints a year (147 in the period January - August 1984) all of which are handled carefully. Table 2 shows the percentage distribution of cases.

Table 2. Percentage distribution of the cases handled by Oslo Helserâd.



C&D - Construction and demolition
TR - Traffic
T-S - Technical installations (Lift, water drainage and waste disposal equipment, fan, heater). Source on same building as complaint.
T-A - Technical installations. Source in/on another building.
O - Other sources
S - Sound insulation

Det Norske Veritas

Det Norske Veritas, established in 1864, is one of the major international classification societies and a high-technology centre with a wide and varied spectrum of technical services. It establishes rules and guidelines for classification of ships, mobile offshore platforms and other floating structures aswell as issuing rules and technical notes for classification, certification and verification of fixed offshore installations. Inspection and quality assurance are carried out for ships, structures, installations and systems and research and development are undertaken in support of all these activities.

Of the total staff of approximately 2,600, 15 are based in the Ship Division working with all forms of acoustics related to the shipping industry. Their research and consultancy projects cover everything from room acoustics inside the ship and design of public address systems to the study of the structural response of the vessel to noise and vibrations generated by the engines. A large proportion of their work has been devoted to researching the use of sandwich constructions to reduce noise and vibration and the study of low-noise propellor design.

Their most recent major contracts have included work for a new ship for the Norwegian Navy -MCMV (Mine Counter Measure Vessel), the world's newest and largest cruise ship, presently being built in France for Royal Carribean Cruise Lines and the noise and vibration consultancy for the refitting of the QE2.

100M has been spent on replacing the gas turbine engines with nine new diesel engines and completely refitting the drive system (propellor, drive shaft etc.) The Ship Division of Veritas has been involved in controlling all the noise and vibration levels throughout the ship. This has included design of a new low-noise propellor, vibration isolating mountings for the engine components and noise control within the whole of the vessel.

The newly-fitted QE2 has its trial run on April 9th 1987 and will be taken into normal service again shortly afterwards for an "Easter Cruise".

Concluding Remarks

As can be seen, the acoustic environment in Norway is highly active, involved in a wide range of fields and supported by the activities of NAS.

At least once every two months, acoustic engineers in Oslo, both consultancy and research based, meet to discuss common interests and developments and to arrange forms of cooperation between themselves such as renting of equipment or exchanging of journals etc. This helps to keep the consultants and researchers in contact with one another and aware of each others activities and requirements within the field.

Aswell as producing literature and information with regards to international conferances and courses taking place, NAS arranges an annual national conference every Autumn hosts the Nordisk Akustisk meeting every eighth year (joint meeting of the acoustical societies of Norway, Sweden, Denmark, Finland and Iceland).

Finally, it must be mentioned that NAS has applied to host 'ICA' in 1992. As the last Nordic meeting was held in Norway in 1984, a successful application will mean that these two meetings would coincide with one another - an occurence that even the Swedes could warm to !!

REFERENCES

[1] - A. Krokstad, S. Strøm, & S. Sørsdal, J.Sound & Vib. 1968, 8 (1), s.118

[2] - S.A. Storeheier, 'A preliminary investigation on a poroelastic material used as a low noise road surface', report no. STF44 A87021, ELAB, Trondheim, Feb. 1987.