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MODEL STUDIES IN ACOUSTICS
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The dispersal of sound is a function of its wavelength. By modelling a portion of existing or proposed environment to a convenient scale and transmitting signals whose wavelength is similarly scaled we are able to simulate the way in which traffic noise is radiated, reflected, diffracted and attenuated throughout a real situation.

In spite of the many simplifications which this mode of analysis or prediction suffers in practice it has been found to give very reasonable results and to compare more than favourably with current methods of computation and extrapolation.

Our aim at Liverpool has been to develop a design aid rather than a research tool. The facility we have developed could be set up in a planning office and used directly by planners to optimise noise conditions during the design process by manipulating the shape and placing of building bulk while watching the rise and fall of noise levels at various locations of interest.

To achieve this degreeof flexibility it has been necessary to eliminate all those complexities of real situations which would not substantially affect design decisions. We have had therefore to devise studies of various factors such as atmospheric conditions, surface characteristics, shortcomings of instrumentation and simplifications of procedures with a view, not of taking account of them but ignoring them.

In our earlier system (as described in "The New Scientist" of December 1968) we used a model table of 3m x 2m surrounded by heavy sound absorbing curtains. Vehicles, ten or twelve in number were simulated by small transducers each driven by separate sound generators at frequencies ranging from 20 to 100 KH_z according to the scale in use. Buildings and other solid objects were simulated by agglomerations of small polished timber building blocks and the distribution of soundthroughout the models was detected by ⅛" and ¼" B & K condenser microphones associated with B & K metering amplifiers. Filtering at the operating frequencies inhibited the effects of intrusive noise. The greatest difficulty experienced was that of developing suitable small omni-directional high power, high frequency transducers capable of activating the very small and hence very insensitive microphones and their associated amplifiers at levels sufficient to override the inevitable presence of electronic circuit noise. This was found to be most easily overcome by the use of resonant ceramic transducers of hollow spherical form and about 3 cm in diameter. These were driven by sine wave oscillators at around 100 KH_z, each drawing about 4 watts of electrical power. It was thus possible to detect intelligeable signals in the shadow of model buildings at a distance of 3m., representing 300m to 1/100 full size.

So long as we were concerned with simulating the spread of steady state noise from roads i.e. the 90% time levels and were satisfied to examine at a single frequency, this system was satisfactory. However, with the growing realisation that the dynamic character of road noise is perhaps as important as its average power level and that its frequency content, governed by vehicle type and speed also warranted consideration, we set about developing our present system.

We are now experimenting with a set up in which we use only one mock vehicle, fed with a closely tailored band of noise and moved along the several traffic lanes of the model.

With the microphone in a location of interest, as the vehicle moves a signal is synchronously plotted on a graphical plotter. The signal level recorded rises and falls according to the geometry of the environment. A trace is plotted for each lane.

From the signal traces relating to each traffic lane we are able to sample peak or 10% levels and ambient or 90% levels. The number and spacing of samples is determined by the speed and density of traffic and the samples are summated.

Because the signal transmitted approximates in frequency profile and relative intensity to real vehicle noise and because the filters inserted in the monitoring chain approximate to the A weighting network transposed to high frequency, we are able to estimate relative T.N.I. levels and our results will thus reflect relative annoyance levels.

Once again the main problem has been the development of a suitable mock vehicle. Power requirements are greatly increased by using only one transducer and because we now use a band of noise it is not possible to use a resonant unit.

We have devised an electrostatic unit and have tailored its polar distribution characteristics with a carefully shaped reflector. High voltage drive for this is derived from a modified B & K Noise Generator and mechanical motivation along the model roads is derived from the drive cable on the B & K Graphical Recorder.

At the time of writing it is only fair to say that this system is only in its early phase of development and that while we have gone far enough to be convinced of its ultimate feasability we shall need to spend some time improving various elements. Notably elaborations to the transmission filters to simulate a variety of road conditions, more accurate tailoring of the measuring amplifier filters to the transposed A weighting network characteristic - building a more powerful wide band drive source and devising a more direct and automatic computation system are all necessary before a programme of field verification is embarked on.

Progress is inevitably slow in pursueing developments of this kind in a School of Architecture where research is a part-time activity and where financial support is hard to come by.