Abstract

PRIVACY PREDICTION IN LANDSCAPED OFFICES

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This is an abbreviated version of a 13 page report plus 26 pages of appendix, presented at the Canadian Acoustical Association 1974 Symposium, Edmonton, Alberta by the author.

A computerized procedure for considering the following variables in the open office plan is described:

1. Speech level, in 1/3 octave bands between 200 and 5,000 Hz.
2. Multiple reflections from the floor and ceiling, with a variable ceiling height.
3. Diffraction/reflection from a beam or lighting fixture in the ceiling, with a given average absorption coefficient.
4. Absorption coefficients of floor and ceiling, as a function of frequency.
5. Presence of a barrier of variable height and location.
6. Variable distance from the source.
7. Possible additional multiple sound paths involving reflection from a wall or window, of given average absorption coefficient.
8. Effect of speech directivity on each sound path.
9. Background masking level, as a function of frequency.

The prediction method computes diffraction effects over the screen and around images of the screen in the floor and ceiling. It also computes diffraction effects from the lighting fixture or beam. Diffraction effects are computed directly from the Fresnel integral.

Specular reflection data for the absorption coefficients is employed in the program, where available.

From these data, the Articulation Index and Sentence Intelligibility are calculated by the method of ANSI Standard S3.5 - 1969. A summary table of the signal to noise level at each frequency may be printed, to identify those frequencies contributing most to intelligibility.

The results demonstrate that frequencies at 2 kHz and above are major contributors to intelligibility, even where a lighting fixture or a beam does not provide a specular reflection.

The presence of a reflection from a beam or lighting fixture is seen to significantly increase the sentence intelligibility.

With a well designed plan, good acoustic ceiling, and an optimized background masking spectrum, it is shown that masking levels in the order of 52 dBA are required to reduce sentence intelligibility

to 20%, assuming speech levels as given in ANSI Standard S3.5 - 1969.

The acceptability of these masking levels is dependent on occupant activity and on a well shaped spectrum. Both a background masking sound system and a very good acoustic ceiling are generally indicated to be necessary for privacy.

It has been Barron & Strachan's experience, that background masking levels of 47 dBA provide adequate privacy in the normal open plan office situation. This is attributed to an average speech level at least 5 dB below that given in the ANSI Standard.

A separate study of statistical speech levels is included, and it is shown that 1% levels, measured with an impulse response of 50 milliseconds, are 10 to 11 decibels above the long term energy average. Further, it is shown that the L10 levels when measured with a slow integration time are approximately 3 decibels above the long term energy average of speech. These measures show excellent correlation to the ANSI Standard S3.6 - 1969 for confirmation of Articulation Index. Other combinations of statistical level and impulse response time are shown to give significantly poorer correlation with the bases used in the ANSI Standard.

Summary

The paper identifies the following significant observations:

1. Normal speech levels are lower than the ANSI Standard.
2. Frequencies above 2 kHz are major contributors to speech intelligibility in all practical situations.
3. Reflections from lighting fixtures, columns, and other relatively small surfaces having low absorbent coefficient, can significantly increase intelligibility.
4. For acceptable privacy, it is imperative that a highly absorptive ceiling material be used. Barriers hanging from the ceiling, which do not block the ceiling from view at an angle of 30 - 45 degrees, are of little benefit if the basic absorption properties of the ceiling are inadequate.

These factors do not appear to be widely recognized in many current evaluations of open office acoustics, and are considered to be primary reasons for poor success in many instances.

A copy of the full paper is available from the author on request.