دراسة وضوح الصوت في الحجرات

Speech Intelligibility in Rooms

Collected Papers By:

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Articulation Loss of Consonants as a Basis for the Design and Judgment of Sound Reinforcement Systems*

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The concept of Al_{cons} is used for the design and judgment of sound reinforcement systems. In this procedure the relative levels of the direct sound field, the reverberant sound field, and background noise play an important part. Especially the role of directivity index and number of sound sources is enlightened.

INTRODUCTION: The usefulness of the articulation loss of consonants Al_{cons} in expressing the speech intelligibility in a room has been shown elsewhere [1]. It appeared that Al_{cons} is a function of the ratio of direct sound to reverberant sound and of the reverberation time T of the room if the distance to the source is smaller than a critical distance D_c. At distances larger than D_c, Al_{cons} depends on the reverberation time and on the ratio of reverberant sound to background noise. The critical distance $D_c = 0.2\sqrt{V \cdot Q/T}$, where Q is the directivity factor of the source and V is the volume of the room. In Fig. 1 the relation between Al_{cons} and the direct-to-reverberant sound ratio is represented. Fig. 2 represents the relation between Al_{cons} and the signal-to-noise ratio in the reverberant sound field. In practice Al_{cons} is small, and consequently the intelligibility is good if the direct sound is important relative to the reverberant sound and if background noise is negligible.

Long practice with speech intelligibility measurements with a standardized (recorded) speaker has shown that Al_{cons} in a room has to be less than about 15% to represent good listening conditions. If listening tests in a room or predications based on Figs. 1 and 2 result in an Al_{cons} of more than 15%, it is desirable to do something to improve the speech transmission.

DESIGN CONSIDERATIONS

Before deciding to install a sound reinforcement system, it is wise to trace the cause of the bad speech transmission. In general the direct sound will appear to be too low relative to the reverberant sound and/or the reverberant sound will be too low relative to the background noise. From Figs. 1 and 2 this general statement can be translated into three possible (eventually combined) reasons for the bad transmission:

1) the background noise level may be too high,
2) the reverberation time may be too long, or
3) the distance from source to listener may be too large relative to the critical distance.

Very often improvement is possible by acoustical means, especially in the design stage (silenced ventilators, more room absorption, sound reflectors near the speaker). If improvement is made with electroacoustical means, these shall be related very closely to the acoustical properties of the room.

If the background noise level in the room is too high,

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