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SOUND MANAGEMENT

Speech Privacy Systems: Above or In Ceiling?

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Direct field speech privacy and sound masking systems are displacing conventional systems with loudspeakers mounted in the plenum. This paper discusses the relative advantages of the two systems.

A recent survey of workers by the National Research Council of Canada clearly demonstrates that office workers in a typical open plan environment are satisfied with their office acoustics only if the ambient background sound is in the range of 45 dBA-47 dBA. If sound levels are below this range, intruding speech sound from adjacent offices and circulation areas is sufficiently distracting that most workers find it difficult to easily concentrate on their work. If levels exceed 47 dBA, the ambient sound itself is judged obtrusive and unpleasant to many workers. Only if ambient sound from the heating and ventilating system is fortuitously of the correct loudness, correct spectrum (frequency distribution), steady throughout the day, and uniform spatially throughout the office, can the user be provided background sound from mechanical sources within this very narrow range. This is rarely possible, largely because HVAC engineers usually design office mechanical systems to provide typical operating sound levels at least 5–10 dBA below this range to assure that they do not exceed 47 dBA under the highest anticipated heat loads and air velocities. Other factors leading to insufficient ambient sound from the mechanical system design are the inability to reliably predict initial HVAC operating noise levels precisely and to design for both even sound and air distribution, and the normal slow decline of several decibels in sound output as filters age.

Electronic sound masking systems are a particularly cost effective way of assuring that background sound is maintained within acceptable limits. The cost of a masking system is normally a small fraction of the cost of any architectural changes that might be contemplated to significantly improve speech privacy. In most cases, sound masking is considerably more effective than any architectural noise control treatment, although both may be required in certain cases, depending on existing room surface treatments and furniture configuration.

A typical sound masking system using loudspeakers above the suspended acoustical ceiling is easily adjustable to provide the correct frequency distribution and precise operating level of ambient sound, but only if considered on an average basis throughout the space. Achieving adequate spatial uniformity of ambient sound is a serious challenge faced by masking system designers, and one that few are able to provide consistently using loudspeakers above the ceiling. Even a 3 dB variation from one workspace to another can have a dramatic effect on speech privacy, yet the performance of most systems varies by more than that, particularly because the sound attenuation characteristics of typical ceiling and plenum materials and openings varies substantially from point to point. Masking sound originating from the loudspeakers above the ceiling is attenuated differently at different locations within the space, accounting for this variation. Theoretically there are some measures that can be taken to mitigate the problem, such as providing each loudspeaker with a volume control, using many more loudspeakers, and providing sound attenuating “boots” at each opening in the ceiling: realistically these measures are rarely employed because of the resulting costs. More commonly, the provider will claim that a wider spread in masking sound level is acceptable, if the issue is addressed at all. The unfortunate result is that the system is either operated at a level that causes annoyance to many users, or conversely that it is operated at a lower level that fails to provide good privacy throughout the office.

In contrast to the uniformity of sound required in the open office, people working in closed offices normally require about 6 dB less ambient sound than those in open offices. In fact there are usually serious complaints if the closed area sound level is the same as that considered optimum in the open space. Unfortunately a common type of office construction is to omit a separating wall in the plenum between the open and closed spaces, ie there is a common return air plenum for both. While this construction has good reasons from a mechanical system economy standpoint, it also results in about the same ambient sound level in both offices if the speech privacy system is installed in the common plenum. Unwanted sound intended for the open area bleeds through to the closed area. In fact, due to normal reverberant buildup in the small room, the sound level normally increases above that in the open office, unless mitigating measures are taken, such as installing costly barriers in the plenum or a different ceiling material in the closed offices with higher acoustical isolation (NRC Rating). Otherwise, even measures such as installing different zones or volume controls on the closed office system will prove largely ineffective because it is the sound serving the open area that controls what is heard in the closed offices.

Recently several manufacturers have introduced a type of ceiling mounted system that is able to provide much better uniformity of masking sound throughout the typical open plan office. These systems use loudspeakers which radiate sound directly into the occupied space below, rather than into the above-ceiling plenum. Their principal advantage is that the non-uniformity caused by HVAC openings in the ceiling or ventilation slots in lighting fixtures, or by building structural elements, fireproofing, and large ducts or other mechanical components in the plenum no longer have any significant effect on the spatial distribution of masking sound. The system designer can assure very uniform coverage simply by providing a well-defined and simple layout of masking loudspeakers, without a precise knowledge or consideration of above ceiling building elements. These systems also assure that the frequency distribution of sound is optimum because there are no significant frequency-dependent acoustical attenuators between the loudspeakers and users: hence their overall description as direct field or in-ceiling systems. To the user this means that the system is able to provide effective masking at considerably lower sound level and potential for annoyance, and that the acoustical effectiveness is maintained throughout the building. The in-ceiling system also completely avoids the problem of inability to obtain different ambient sound levels in open and closed offices because there is no bleed in the plenum from one area to the other. Because of these acoustical advantages as well as economic factors, direct field systems have gained increased acceptance in the marketplace.

