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OFFICE NOISE – Effects and control

Abstract

Introduction. Open-plan office (later: office) is one of the most usual work environments. Noise due to colleagues' speech and lack of speech privacy are among the most dissatisfactory environmental factors in these work environments. Objective measurements in offices as well as questionnaire data support that office noise consists mainly of speech, originating from single or several speakers. Because speech has a standardized level and spectrum, office noise effects can be globally investigated using similar noise exposures and experimental settings. **Effects of office noise.** A recent experiment [1] showed that already a 50-min exposure to intelligible speech presented at 65 dB L Aeq increased stress hormone level in blood compared to silence 35 dB L Aeq. Because long-term stress leads to adverse health effects, the reduction of office noise is highly justified from occupational health perspective. A recent review [2] gives strong evidence that irrelevant speech reduces cognitive performance by 16%. Review presented a model based on vast experimental evidence according to which worker's performance decrement increases with increasing Speech Transmission Index (STI) of a single speaker. Therefore, acoustic design in offices should aim at low STI value. **Room acoustic design.** Because of the crucial importance of STI in noise control, international standard ISO 3382-3 [3,4] describes a measurement method which primarily determines, how STI reduces in the office when the distance between the listener (disturbed occupant in the workstation) and speaker (disturbing noise source) increases. The primary outcome of ISO 3382-3 measurement is distraction distance r_D . It describes the distance where STI falls below 0.50. A recent survey in 21 offices showed that short r_D is associated with smaller probability of high noise disturbance in offices [5]. Small STI value can be reached by high spatial attenuation [6] and sound masking [7]. High spatial attenuation is achieved by covering the room boundaries (ceiling, walls) almost entirely by class A sound absorbers. If screens are used between workstations, they should be high (1.5–1.7 m) and class B sound-absorbing. By following these suggestions, r_D values down to 2.0 meters has been measured in offices. If these suggestions are completely violated, r_D values up to 20 meters has been observed. **Speech privacy pods.** Nowadays, many offices follow activity-based working (ABW) principles and the office consist of open-plan offices, isolated rooms for concentration-demanding work, and virtual meetings, and collaboration / meeting rooms of different sizes. ABW concept usually presumes that occupants do not have a fixed workstation, but they are expected to switch between different workstations or areas according to the needs of their current work task. Because the need of *ad hoc* isolated workspaces increases due to ABW concept, the amount of different kinds of mobile enclosed meeting pods and phone booths and partially enclosed furniture ensembles has increased tremendously in the market. ISO 23351-1 [8,9] was recently published to provide a robust test method to determine the acoustic performance of these products. The integration of this method to acoustic design of offices will probably lead to better satisfaction in offices. **Future research needs.** There is a serious need a simple noise-level based single-number quantity, which predicts the noise annoyance of occupants in an occupied office. This would facilitate the evaluation process of work environments among acousticians, ergonomists, and workplace designers. There is also a serious need of experimental evidence from real workplaces which shows the effects of proper acoustic design on environmental satisfaction, job satisfaction, and organizational performance. This would significantly help the reasoning of expensive noise control investments in offices since voluntary investments on work environments can be better justified by a short payback time. There is also a need of international collaboration of developing harmonized target values since current national target values are not in good agreement.