DISPUTATION

ACOUSTIC DESIGN WITH REGARD TO HUMAN PERCEPTION

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Abstract

Ordinary public rooms, such as classrooms and offices where complex tasks such as learning or following long chains of thought are performed, require a good acoustic environment. The acoustic design in these types of rooms were studied in this PhD, taking both objective and subjective perspectives into account.

Experiments were performed in a classroom mock-up using different configurations of absorbers and diffusers. The effects on the room acoustic parameters reverberation time, T_{20}, speech clarity, C_{50}, and sound strength, G, were measured. Further, the subjective experience of the different configurations was investigated. From listening tests, people's experience of uniformity, using pairwise comparison, as well as preferences of speech, in terms of sound quality, attributes and ratings, were evaluated. From an objective perspective, a calculation model was evaluated with a focus on its sensitivity in quantifying the scattering from objects, an aspect that can greatly affect the acoustic environment.

The results show that an absorbent ceiling is a good acoustic baseline. However, additional treatment was needed in order to achieve a satisfactory sound environment for people. People's preferences of sound was best reflected in C_{50}, with increasing values being more appreciated. In addition to the ceiling, absorbing treatment was most efficient at increasing C_{50}. However, diffusers were important for the uniformity throughout the room. It should be noted that diffusers also contribute to higher C_{50} values.

This research shows how different solutions alter different room acoustic parameters and thus the experience for people in these ordinary public rooms. The choice of solution depends on the requirement, i.e., the activity. The effects that the different solutions have can be calculated using the model investigated, which was shown to give estimations of the acoustics that related well to the acoustic measurements and was sensitive to the scattering of objects.

Key words
acoustic design, listening test, perception, room acoustics, absorbers, diffusers, speech clarity, reverberation time, sound strength

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