Popular scientific summary of master's dissertation in engineering acoustics, LTH, Lund University.

The effects of furniture on room acoustic parameters and its dependence on the sound absorbing properties of the ceiling

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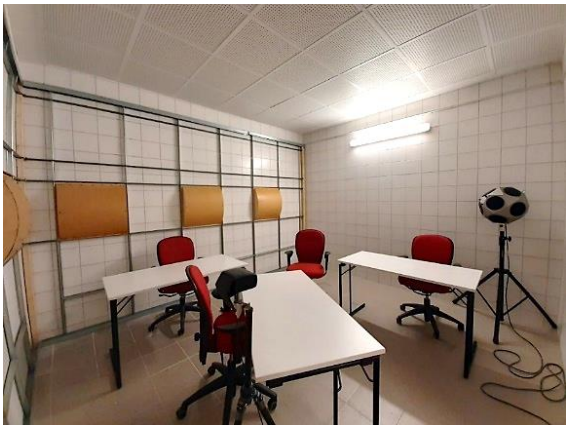
Abundant amount of research shows that an unsatisfactory sound environment in ordinary public rooms such as classrooms, healthcare facilities and offices can negatively affect both speakers and listeners. The baseline acoustic solution for this type of space is a sound absorbing ceiling. Once the room is furnished, the objects will also contribute to the sound environment in the room.

The design process for ordinary public rooms often relies on calculation of reverberation time according to existing standards. However, the method introduced in these documents, Sabine's formula, was derived in the early 1900s under a very different condition than most modern public rooms. Moreover, the effects of furniture on the sound environment will change depending on the ceiling types. In other words, this method is less accurate for design of a furnished room with sound absorbing ceiling. Another calculation model, SEA model, is instead employed and evaluated in this project.



Measurement set-up in the reverberant room

The goals of the master's dissertation were to investigate the following:

- Calculation method for the effects of furniture in existing standards.
- The effects of furniture on reverberation time, speech clarity and sound strength.
- The correlation between the equivalent scattering absorption area and the absorbing efficiency of the ceiling

Method A series of sound measurements were conducted in a reverberant room with varying degrees of furniture. Seven ceiling configurations ranging from highly reflective to highly absorptive were installed to assess the impact on the room acoustic parameters. Using the SEA model, the effect of furniture was quantified and a correction factor for this was derived. Data from previous measurements in a mock-up classroom was also used to assess the possibility of estimating with this correction factor.

Results Measurement results demonstrate that objects such as furniture has a scattering as well as an absorptive effect that influence room acoustic parameters namely reverberation time, speech clarity and sound strength. The scattering effect depends on the absorbing efficiency of the ceiling and it is more pronounced in rooms with a highly absorptive ceiling. The scattering and absorptive effects of furniture can be quantified in the parameter equivalent scattering absorption area. A correction method is presented to account for the influence of the ceiling absorption efficiency on the equivalent scattering absorption area. Finally, the effect of furniture should be excluded if Sabine's formula is used.

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