Practical Application of ISO 22955 for Acoustic Design in Open-Plan Offices

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Introduction

ISO 22955 [2], initially published in 2021, offers guidance on assessing the acoustic quality of open-plan offices. The standard provides recommendations including sound level differences between livelier work areas or areas with increased communication and areas to be protected. Recommendations are given depending on the respective use of the transmitting and receiving workspace.

Drawing on an extensive dataset of measurements acc. to ISO 3382-3 [1] conducted in various open-plan offices, this analysis determines required distances between the speech sound source and the protected area. These distances are theoretically necessary to meet the recommendations if no additional shielding measures are taken. It is evident that the recommendations can only be met by using shielding elements with sufficient sound insulation.

Acoustic simulations are used to discuss approaches to optimize the design of open-plan workspaces to meet the recommendations of ISO 22955 [2]. In particular, the shielding potential of fabrics in comparison to conventional partition walls is being investigated.

ISO 22955

While several standards and guidelines, such as ISO 3382-3 [1] and in Germany VDI 2569 [3], are commonly used to assess the acoustic quality of office environments, they are primarily suited for reasonably homogeneous office structures. With the increasing implementation of activity-based open-plan offices, which combine diverse functions within one space, ISO 22955 [2] was published in 2021 to provide an extended framework for characterizing their acoustic conditions. The parameter of in situ acoustic attenuation of speech $D_{A,S}$ is introduced. It is defined as the difference between the A-weighted sound pressure level of speech measured at a distance of 1 m from the source in a free field and the corresponding level at a given receiving point ($L_{p,A,S,1m}$ = 57,4 dB).

$$D_{A,S} = L_{p,A,S,1m} - L_{p,A,S} \qquad [dB] \qquad (1)$$

This contribution focuses on space type 6 as defined in ISO 22955 [2], which refers to open-plan areas that accommodate multiple activities within a shared space.

Potential $D_{A,S}$ ratings

For this room type 6, ISO 22955 [2] provides indicative values for the in situ acoustic attenuation of speech $D_{A,S}$, depending on the combination of functional zones. The lowest recommended value, 12 dB, applies to interfaces between two acoustically active areas, such as informal meeting zones and circulation areas. The highest recommended value, 32 dB, is associated with the combination of highly active social spaces and areas intended for focused individual work. Further recommendations are provided for various combinations of zones characterized by differing levels of communication activity and background noise.

Derivation of $D_{A,S}$ based on $D_{2,S}$ and $L_{p,A,S,4m}$

Available measurement data include values for $D_{2,S}$ and the A-weighted sound pressure level at a distance of 4 m from the source $L_{p,A,S,4m}$. Based on these parameters, distances required to achieve selected values of $D_{A,S}$ were estimated by extrapolating the regression line derived from sound pressure level measurements along measurement paths acc. to ISO 3382-3 [1] within typical office spaces. This simplified approach allows for a practical approximation of spatial acoustic conditions and is conceptually comparable to the derivation of distraction and privacy distances from STI [1]. Calculations were carried out for $D_{A,S}$ values of 12, 18, 26, and 32 dB.

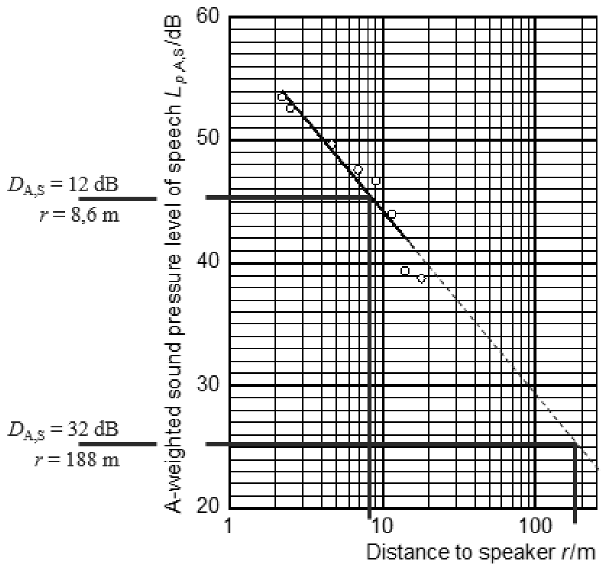

figure 1: Extrapolation of the regression line based on measured sound pressure levels of speech along a standardized path in an open-plan office acc. to ISO 3382-3 [1]. The diagram illustrates the distances required to achieve selected values of $D_{A,S}$ (12 dB and 32 dB) derived from measured values of $D_{2,S}$ and $L_{p,A,S,4m}$.

The diagrams in figure 2 show the distances needed to achieve specific $D_{A,S}$ values (12 dB to 32 dB) plotted above a range of measured $D_{2,S}$ values with the four-metre levels corresponding to the colour scale.

While the influence of both parameters is evident, the relative impact of $D_{2,S}$ increases with higher $D_{A,S}$ targets. For high values of $D_{A,S}$ (26 dB and 32 dB), the required distances often exceed the dimensions of typical office spaces, as indicated by the dashed reference line.

These observations lead to two main conclusions: First, achieving high values of $D_{A,S}$ within spatially realistic limits is only possible with effective acoustic shielding. Second, while room acoustic damping is an important planning factor, it alone cannot compensate for insufficient shielding.

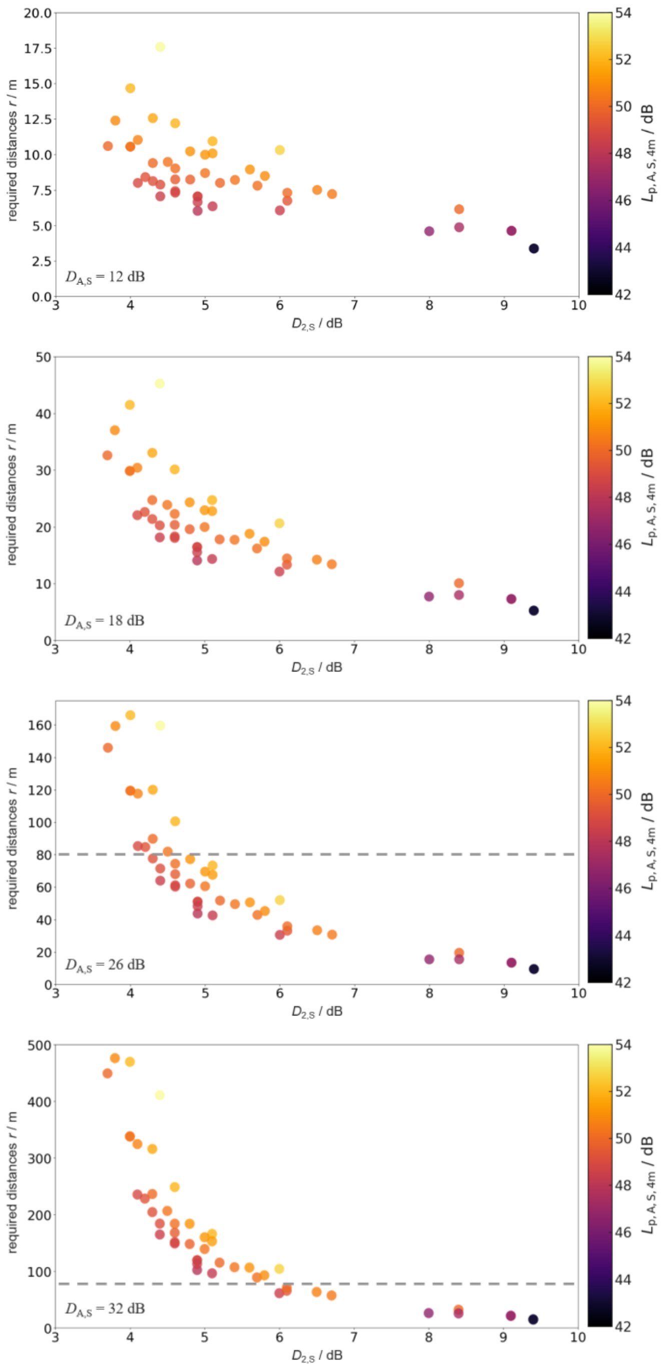

figure 2: Required distances to achieve different values of $D_{A,S}$ (12 dB, 18 dB, 26 dB, and 32 dB) as a function of measured $D_{2,S}$ and $L_{p,A,S,4m}$ values. The dashed line marks a reference for the upper limit of typical office lengths.

Simulation of $D_{A,S}$ in an exemplary office space

In order to further investigate the influence of acoustic design measures on $D_{A,S}$, simulations were conducted based on an exemplary layout of a kitchenette adjacent to an office space of an accounting department (focused individual work, recommended $D_{A,S}$ of 32 dB). The focus was placed on the effects of room acoustic damping and various types of barriers between adjacent functional zones. The simulated scenarios included four types of acoustic partitions — ranging from no barrier, to single- and multi-layered curtains, up to a fully enclosed glass partition with door — each evaluated both with and without an additional sound-absorbing ceiling. The objective was to assess the resulting differences in $D_{A,S}$ and to explore the impact of typical acoustic measures in open-plan office environments. In the simulations the omnidirectional sound source was placed in the kitchenette, approx. 1 m from the coffee counter.

table 1: Simulated variants of barriers and ceiling treatment
Note: variant 1a is based on an actual floor plan and room acoustic design that had previously been analysed through measurements and subsequently served as a reference for validating the simulation results.

Type of barrier	Reflective ceiling	Sound absorbing ceiling (α_w = 0,65)
no barrier	No. 1a	No. 1b
single-layer curtain	No. 2a	No. 2b
multi-layered curtain	No. 3a	No. 3b
glass partition with door	No. 4a	No. 4b

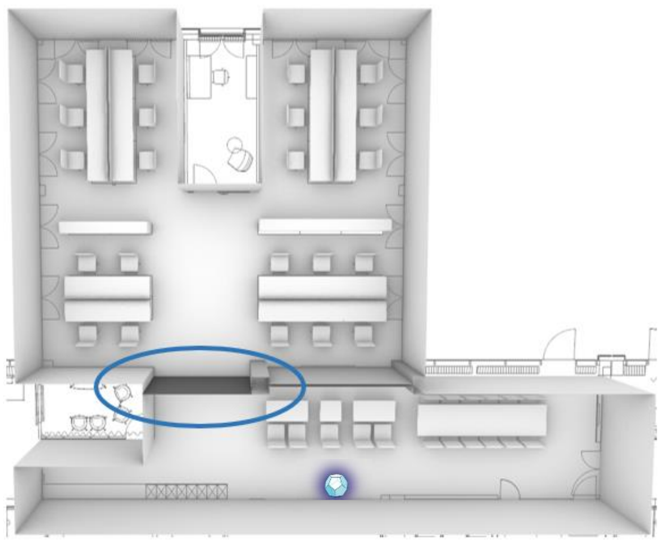

figure 3: Simulation model based on a floor plan previously analysed through measurements.

To determine appropriate input parameters for the curtains in the simulation, additional measurements of their sound insulation properties were conducted. These measurements were carried out in a showroom installation using sound intensity in accordance with DIN EN ISO 15186-2. Where the measurement results indicated significant differences, surface and joint sound insulation were assessed separately and represented accordingly in the simulation.

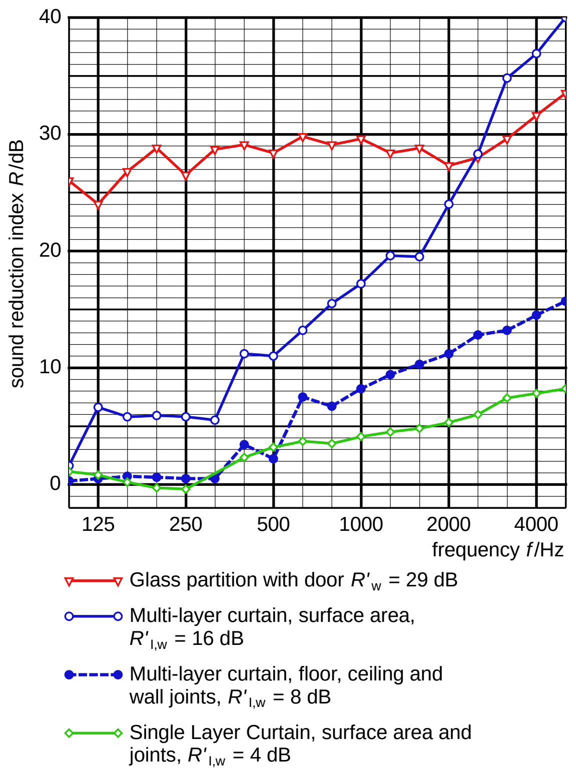

figure 4: Sound insulation of the barriers included in the simulations. Note: the multi-layer curtain has a nominal sound insulation rating of $R_{l,w}$ = 18 dB, as determined under test stand conditions.

The following figures present the simulation results in the form of sound mappings showing the distribution of $D_{A,S}$ values across the office layout. Each configuration is displayed both with and without the inclusion of a sound-absorbing ceiling.

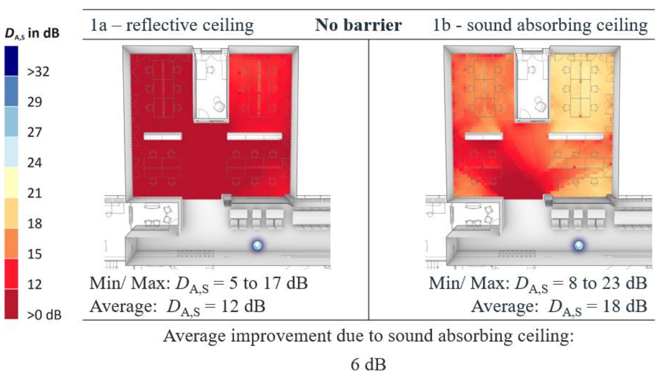

figure 5: Sound mapping results for the configuration without barrier (Variants 1a and 1b. While the addition of a sound-absorbing ceiling (Variant 1b) leads to an average improvement of approximately 6 dB in $D_{A,S}$, most values remain below the recommended levels defined in ISO 22955 [2], except for selected zones which might be suitable for less noise-sensitive activities.

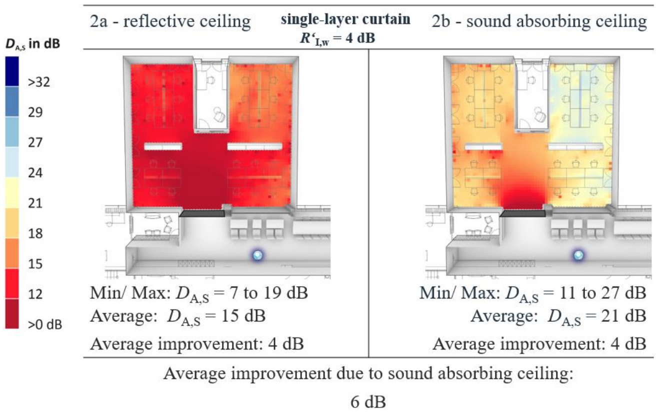

figure 6: Sound mapping results for the configuration with a single-layer curtain, shown both with and without a sound-absorbing ceiling (Variants 2a and 2b). Compared to the corresponding variants without a barrier, the curtain yields an average improvement of approximately 4 dB in $D_{A,S}$.

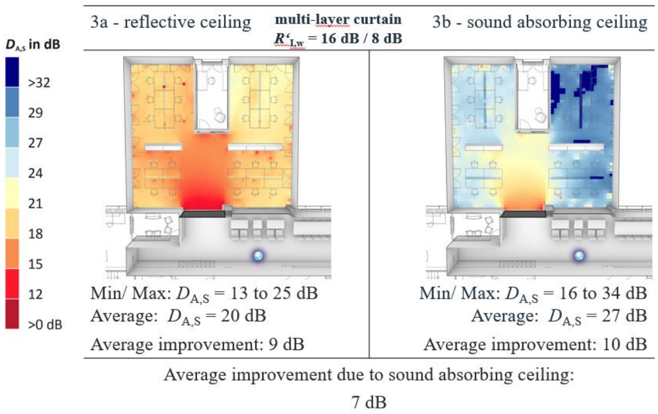

figure 7: Sound mapping results for the configuration with a multi-layered sound-insulating curtain, shown with and without a sound-absorbing ceiling (Variants 3a and 3b). Compared to the respective variants without a barrier, average improvements of 9 dB and 10 dB in $D_{A,S}$ were achieved. In some zones, values approach the ISO 22955 [2] recommendation of 32 dB for this type of spatial configuration.

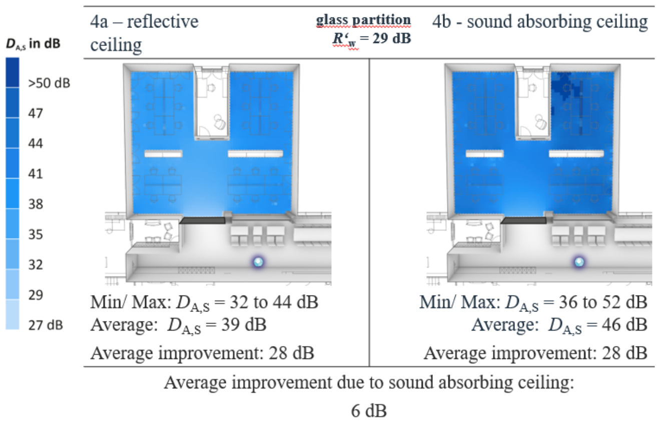

figure 8: Sound mapping results for the configuration with a full-height glass partition wall and door, shown both with and without a sound-absorbing ceiling (Variants 4a and 4b). In this scenario, a $D_{A,S}$, value of at least 32 dB was achieved at all workstations, independently of the ceiling design.

The simulations show clear differences in the effectiveness of the tested acoustic barriers. As expected, the single-layer curtain leads to only modest improvements in $D_{A,S}$, offering limited shielding performance. The multi-layered curtain achieves significantly higher values; however, these remain somewhat below what might be expected from its nominal sound insulation rating of $R_{I,w}$ = 18 dB in the test stand. The target values are not fully reached throughout the office space, most likely due to sound transmission through joints, which is not negligible in practice.

The most effective configuration was the structural separation by a glass partition wall, which enabled a $D_{A,S}$ of at least 32 dB at all workstations, regardless of ceiling treatment. While this setup ensures compliance with the highest acoustic requirements, it no longer reflects the concept of an open-plan office and thus limits flexibility in spatial design.

Conclusion

The in situ acoustic attenuation of speech proves to be a valuable parameter for the acoustic assessment and planning of open-plan offices, particularly in multi-use environments. Its application complements established acoustic metrics and enables a more differentiated evaluation of spatial configurations with varying activity profiles.

Effective acoustic planning must begin with the layout and zoning of the space. Highly active zones should not be positioned directly adjacent to quiet areas intended for focused individual work. Instead, buffer zones with lower communication demands and reduced sensitivity to noise should be employed to mediate between functions. Without such zoning, the only viable solution may be a full structural separation, which contradicts the open-space principle.

To enable a functional mix of uses within a shared office environment, sufficient shielding is essential. This can be achieved using mobile elements such as curtains or partitions - provided they offer adequate sound insulation and are designed to minimise transmission via joints and flanking paths.

References

[1] DIN EN ISO 3382-3:2012-10, *Acoustics – Measurement of room acoustic parameters – Part 3: Open plan offices*

[2] ISO 22955:2021-05, *Acoustics – Acoustic quality of open office spaces*

[3] VDI 2569:2019-10, *Sound protection and acoustical design in offices*