

The Use of Acoustic Materials for Moveable Silence Booth to Support Remote Work in Office Facilities

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ABSTRACT

Acoustic performance is a critical consideration in spatial design, particularly in shared and open office environments where noise can interfere with work activities. This study examines the design application of acoustic materials in a moveable silence booth developed to support remote work activities within office facilities, a need that has increased significantly since the prolonged global pandemic. Contemporary office interiors often lack dedicated spaces that adequately accommodate acoustically sensitive activities such as online meetings and focused individual work. To address this issue, the research explores material selection and design strategies for enhancing sound control within compact, movable work enclosures. The study adopts a qualitative approach that includes literature review, online observation, and online interviews, followed by a design development process consisting of conceptualization and final implementation. The findings indicate that the integration of sound-absorbing acoustic panels and sound-insulated tempered glass contributes to improved acoustic comfort, reduced noise disturbance, and enhanced user concentration and productivity. The results suggest that the application of appropriate soundproofing elements in moveable silence booth design offers a practical solution for providing private, acoustically controlled workspaces in modern office environments.

Keywords: acoustic materials, moveable silence booth

1. Introduction

Acoustic conditions within a workspace play a crucial role in influencing user comfort, concentration, and productivity. Previous studies have shown that excessive noise in office environments can significantly reduce employee performance and work effectiveness, particularly in spaces that are not acoustically optimized [1]. As contemporary office layouts increasingly adopt open-plan configurations, controlling noise levels becomes more challenging, especially when diverse work activities occur simultaneously. An effective workspace therefore requires an acoustic system that is carefully designed in accordance with the function of the space and the needs of its users. Individual differences in work behavior further emphasize this requirement, as some users are able to work effectively in noisy environments, while others require quieter conditions to maintain focus.

In response to these challenges, interior design solutions must address the growing demand for spaces that support acoustically sensitive activities, such as online meetings, focused work, and confidential communication. One emerging solution is the use of moveable silence booths, which provide enclosed, private spaces within larger office environments. The acoustic performance of such booths is strongly influenced by

the selection and placement of materials, as material properties such as surface density, thickness, and porosity directly affect sound absorption, reflection, and insulation. Various types of acoustic materials commonly applied in interior design, including porous materials, sound-absorbing panels, and resonator systems, are summarized in Table 1, which outlines their characteristics and typical applications based on established acoustic principles [2][3].

Table 1. Characteristics of Acoustic Materials

	Characteristic	Material
Porous Material	Efficient sound-absorbing material. Capable of converting incoming sound energy into heat energy in the pores. Cellular membrane with interconnected pores	fiberboard, soft plasters, mineral wools, rock wool, glass wool, felt
Sound Absorbing Panel	Materials that can absorb low frequencies efficiently. Used in the support layer but separated by a cavity located at the bottom of the wall. This material has the characteristic of vibrating when it hits a sound wave.	Wood panel, hardboard, gypsum board
Helmholtz / Resonator cavity	Very effective when absorbed because it consists of a closed amount of air bounded by walls for sound resonance and connected by a narrow opening to the surrounding space which can cause sound waves to propagate	Membrane

Among these materials, resonator-based systems such as the Helmholtz resonator are particularly effective for absorbing specific sound frequencies through enclosed air cavities connected by narrow openings. The working principle of this type of resonator is illustrated in Figure 1, which demonstrates how sound waves interact with the resonant cavity to reduce noise levels within a space [4]. In addition to sound absorption, sound insulation is also essential in enclosed workspaces. Research has shown that laminated and double-glazed glass systems provide superior sound insulation compared to conventional single glazing, with noise reduction performance reaching approximately 70% higher under certain conditions [5]. The structural composition of acoustic laminated glass using a PVB interlayer is shown in Figure 2 [6][7], while an example of acoustic double-glazed laminated glass application is presented in Figure 3 [8][9].

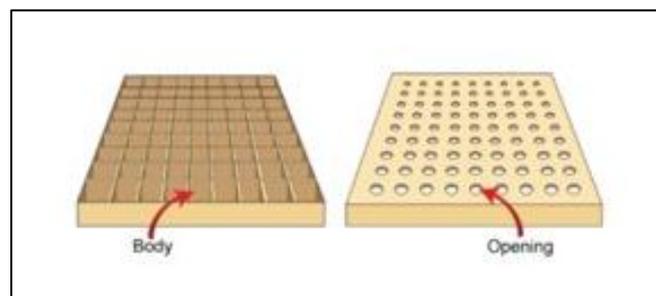


Figure 1. Helmholtz Resonator [4]

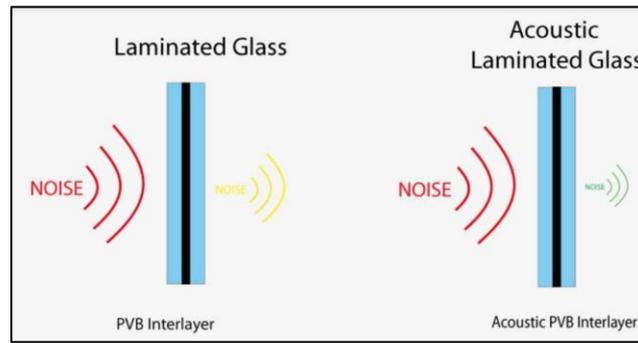


Figure 2. Acoustic PVB Interlayer [6]



Figure 3. Acoustic double glazed laminated glass [8]

Beyond technical acoustic performance, contemporary workspace design increasingly integrates biophilic design principles to enhance user well-being and psychological comfort. Biophilic design emphasizes the connection between humans and nature through natural lighting, ventilation, organic forms, and the use of natural materials. Studies have demonstrated that such design approaches can reduce stress, improve mood, and increase productivity in work environments [10][11]. This approach is particularly relevant in the context of post-pandemic work patterns, where remote and hybrid work arrangements have intensified the need for flexible, comfortable, and health-supportive office facilities [12]. The integration of acoustic design strategies with biophilic principles therefore offers a holistic approach to workspace design, addressing both functional performance and human-centered well-being [13][14][15].

Based on these considerations, this study focuses on the application of acoustic materials in the design of a moveable silence booth intended to support remote work activities within office facilities. The study aims to explore how appropriate material selection, combined with biophilic design concepts, can enhance acoustic comfort, privacy, and user productivity in contemporary office environments.

2. Method

This study employed a qualitative research approach to explore the application of acoustic materials in the design of a moveable silence booth intended to support remote work activities in office environments. The qualitative method was selected to allow an in-depth understanding of user behavior, spatial needs, and material performance related to acoustic comfort. Data collection was conducted through behavioral observation, documentation, literature review, and case study analysis, focusing on office facilities that support individual work and online meeting activities.

Behavioral observation was carried out to identify patterns of work activities, levels of noise disturbance, and user responses to existing acoustic conditions within office spaces. The observed participants consisted of office employees who regularly engage in focused work, online meetings, and individual communication tasks.

These observations aimed to capture real conditions of space usage, including user movement, duration of activities, and interaction with the surrounding environment. Documentation in the form of photographs and visual records was used to support the analysis of spatial configurations and material applications relevant to acoustic performance.

In addition to direct observation, interviews were conducted to investigate user perceptions and preferences regarding acoustic comfort, privacy, and productivity. The interviews provided qualitative insights into the challenges faced by users in open-plan offices and their expectations for enclosed or semi-enclosed workspaces. The findings from observations and interviews were then combined with a literature review on acoustic materials, sound insulation, and biophilic design principles to establish a comprehensive theoretical and practical foundation for the design process.

The collected data were systematically analyzed using the fishbone diagram method to identify key factors influencing acoustic comfort and work productivity. This analytical framework helped clarify the relationships between material selection, spatial design, user behavior, and environmental noise control. The structure and application of the fishbone diagram used in this study are illustrated in Figure 4, which demonstrates how various contributing factors were categorized and evaluated to inform the design decisions of the moveable silence booth.

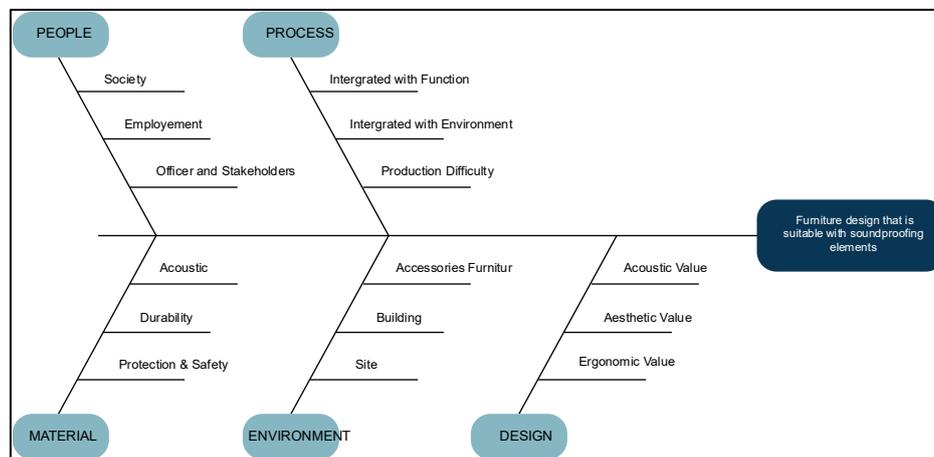


Figure 4. Fishbone diagram method

Based on the results of the qualitative analysis, design criteria were formulated to guide the selection of materials, spatial dimensions, and supporting elements for the moveable silence booth. These criteria emphasized acoustic performance, user comfort, flexibility of placement, and compatibility with biophilic design concepts. The integration of qualitative findings into the design process ensured that the proposed moveable silence booth responds directly to user needs and real office conditions, while maintaining relevance to contemporary workplace challenges associated with remote and hybrid working patterns.

3. Result and Discussion

The results of this study demonstrate that the integration of appropriate acoustic materials with biophilic design principles can significantly enhance acoustic comfort and functional performance in a moveable silence booth designed for remote work activities. The proposed design applies sustainable and health-safe materials, including plywood with HPL finishing for the main structure, sound-absorbing acoustic panels for walls, ceilings, and floors, foam with polyester fabric finishing for seating elements, and sound-insulated tempered glass for enclosure components. These materials were selected to support both acoustic performance and user well-being, ensuring that the booth provides a calm and comfortable working atmosphere while minimizing noise transmission between the booth interior and the surrounding office environment [2].

The application of organic forms in the design contributes to the biophilic concept by visually and psychologically connecting users with natural elements. The form development, inspired by leaf structures, emphasizes curved and flowing geometries that reflect patterns commonly found in nature. This design approach is intended to reduce visual rigidity and create a more relaxing spatial experience, which is particularly beneficial for focused and cognitively demanding tasks. The conceptual form development and its relationship to biophilic principles are illustrated in Figure 5, which shows how natural elements were translated into the booth's overall geometry.

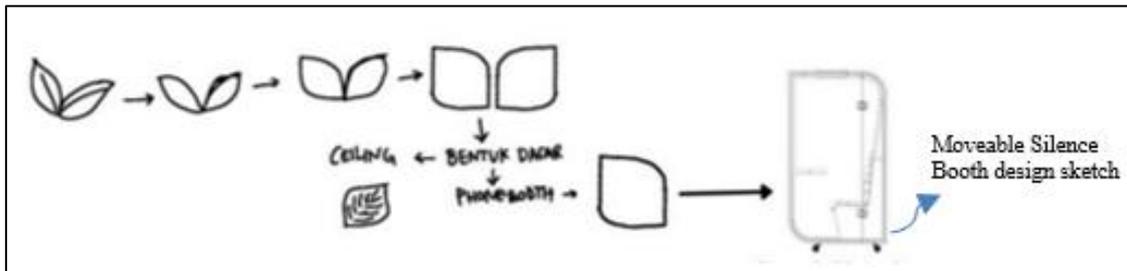


Figure 5. Form design study

From an ergonomic and anthropometric perspective, the moveable silence booth was designed to accommodate individual users engaging in online meetings and focused work activities. The spatial dimensions of the booth, as well as the proportions of interior elements such as the table, bench, and shelving, were determined based on ergonomic standards to ensure comfort during prolonged use. These spatial configurations aim to support neutral body postures and ease of movement within the limited enclosure area. The application of ergonomic considerations in the booth design is presented through technical drawings in Figure 6, which illustrate the dimensional relationships between interior components.

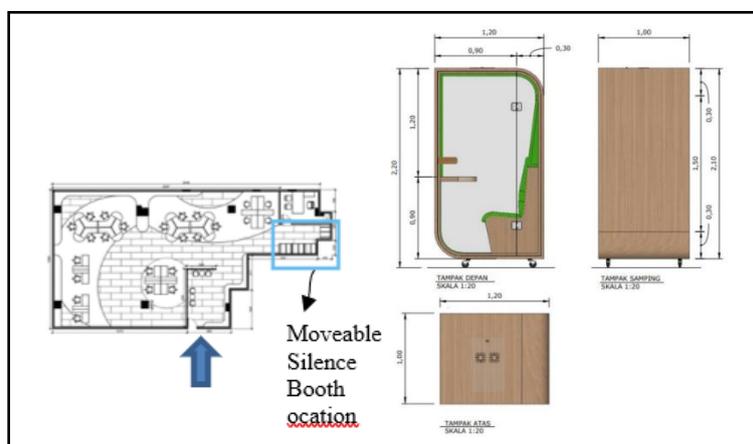


Figure 6. Technical drawing

Color selection also plays a role in shaping the psychological experience of users within the booth. The use of primary colors such as red, green, blue, and yellow was intended to create an atmosphere that is vibrant, cheerful, and stimulating, thereby supporting creativity and maintaining user alertness during work activities. When combined with organic forms and natural material textures, these colors contribute to a balanced visual environment that avoids monotony while remaining comfortable for short- to medium-duration use. The applied color scheme and its integration into the booth interior are shown in Figure 7.



Figure 7. Color scheme concept moveable silence booth design

Acoustic performance constitutes the core functional aspect of the moveable silence booth. Partition walls constructed from plywood and layered with soft acoustic boards function as both sound barriers and absorptive surfaces, reducing sound reflections within the enclosure. In addition, PET felt acoustic panels were applied to the walls, floors, and ceilings due to their porous structure and proven sound-absorbing capabilities [15]. This material selection supports the reduction of reverberation and ambient noise levels, thereby enhancing speech clarity and concentration within the booth. The use of sound-insulated tempered glass further strengthens acoustic isolation by limiting sound transmission between the booth and the surrounding workspace.

The overall technical configuration of the moveable silence booth, including material composition, structural elements, lighting, ventilation, and acoustic components, is presented in Figure 8. The integration of lighting and exhaust systems ensures adequate visual comfort and air circulation, which are essential for maintaining user comfort in enclosed spaces. The combined application of acoustic materials and biophilic design elements results in a flexible and modular workspace solution that can be easily installed within open-plan offices without requiring permanent architectural modifications.

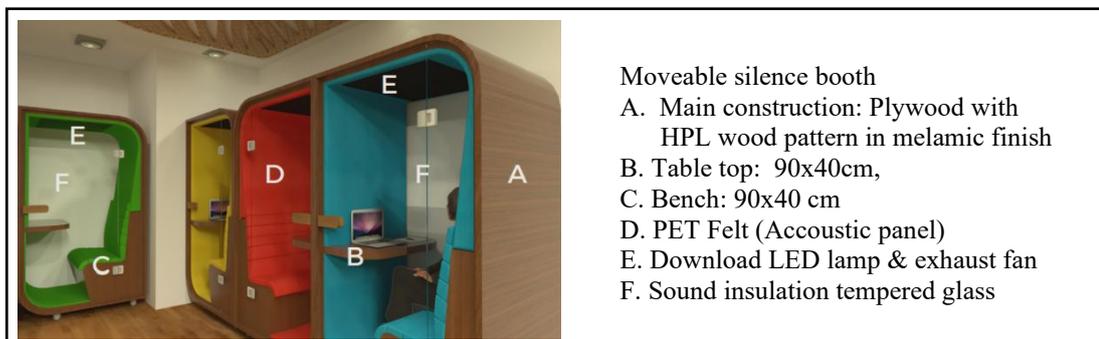


Figure 8. Technical drawing

In discussion, the findings indicate that the moveable silence booth has the potential to address key challenges associated with noise disturbance and lack of privacy in contemporary office environments. By providing a compact, acoustically controlled space, the booth supports individual work activities such as online meetings, phone calls, and focused tasks, which are increasingly common in remote and hybrid working contexts. The design outcomes align with previous research emphasizing the importance of material selection and interior elements in controlling acoustic conditions and improving user productivity [14][15]. Overall, the results suggest that the proposed moveable silence booth design offers a practical and adaptable solution for enhancing acoustic comfort and supporting effective work performance in modern office facilities.

4. Conclusion

Based on the results of research that has been done by researchers from the observation that the material is very influential in the acoustic level of a workspace. A moveable silence booth is a private room facility designed to support remote work activities carried out from a workspace equipped with acoustic features by applying sound-absorbing materials to minimize noise that occurs in the workspace. The moveable silence

booth which is also equipped with a sound insulation tempered glass as a booth door cover might prevent outside noise from entering the moveable silence booth itself and prevent noise coming out of the moveable silence booth so that it will not increase the noise level in the workspace, especially in a workspace with an open plan layout. Therefore, it is expected that the use of the Moveable Silence Booth could potentially support the need for personal privacy from noise in an open space office work area. The booth might offer a relatively quiet space in an open design office, easy to be installed and assembled in any location in the office and could be used for many purposes such as private or online meetings, and phone calls.

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6. Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper. The research was conducted independently without any financial or personal relationships that could have influenced the results or interpretations presented in this study.

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