Carleton University | Accessibility Institute

Informing Standards for Acoustics and the Built Environment

Executive Summary

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Carleton University | Faculty of Engineering and Design

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The project *Informing Standards for Acoustics in the Built Environment* was carried out by a cross-functional team of researchers from the Accessibility Institute and the Faculty of Engineering and Design at Carleton University, with funding from Accessibility Standards Canada (ASC). The project goal was to investigate the role of the acoustic environment on persons living with disabilities and explore technologies that can contribute to the reduction and elimination of acoustic barriers. Sound and noise can impact the everyday activities and the experience of persons with disabilities, whether due to hearing loss, mental health conditions, autism spectrum, neurological injury, or aging. Identifying and understanding these effects can help improve comfort and functioning in the built environment.

The research objectives of the project were to:

- Identify key challenges and key accessibility barriers due to the acoustics in the built environment;
- Explore the role of existing and emerging technologies that can reduce barriers related to sound and acoustics;
- Advance the state of research and identify areas for future exploration to improve the acoustic experience of people with disabilities; and
- Identify key considerations and best practices relating to acoustics, and strategies for the use of technology to further acoustic accessibility in the built environment.

To meet these objectives, the team conducted a literature review, a co-design project, surveys and interviews of people with lived experience of disability, and engineering technology explorations. The interacting sub-projects focused on different areas of the problem space with both engineering and accessibility perspectives.

The literature review covered accessibility, engineering, and acoustic standards literature to produce a summary of the current state of acoustic accessibility. The review included the roles that sound and noise play in daily activities, the acoustic barriers created by the built environment for persons with disabilities, and how current standards and technologies try to reduce these barriers.

The review of standards was used to develop the co-design project, where persons with a variety of lived experiences of disability created stories to explore how the existing standards apply to their daily lives, and to identify gaps where barriers are not being addressed.

The role of assistive and personal technology in reducing acoustic barriers was explored through surveys and interviews with students with disabilities. The student feedback guided the engineering exploration of emerging technologies and their potential for reducing barriers. Our research findings revealed a need for an increased awareness of the importance of acoustic accessibility, including a broader definition that goes beyond communication barriers associated with hearing loss. Participants and literature often mentioned challenges with the mental aspect of sound processing such as blocking out noise or listening to a single person in a group. Noise does not need to be loud to create a barrier and have negative impacts on focus, concentration, stress, and mental health. Group conversations or discussions in noisy environments can be difficult even for people who can hear well in quiet or one-on-one settings. These challenges exist for persons who are deaf and hard of hearing, including those who use hearing aids, as well as for persons with other, often invisible, disabilities. For these individuals, difficulties with sound processing may receive less attention because it is considered a side-effect of another condition. Some participants expressed frustration with this situation, and a feeling that they had no good strategies to manage the impacts of sound and noise. The participant concerns highlight the importance of echo and noise control, even in more spaces where it has not been traditionally seen as necessary, and the importance of access to quiet spaces to recover from noisy environments.

Our technology explorations showed the importance of a layered strategy for accessible spaces, such as amplifying sound with loudspeakers while also providing information in visual or alternative formats. These strategies complement one another and recognize the diversity of functioning and disability. Assistive technology is another layer that plays a role in overcoming barriers. Increasingly this role is being filled not by specialized assistive devices, but by consumer devices such as cellphones customized with assistive applications and accessories, and noise cancelling headphones used for personal sound control. This repurposing of technology for accessibility purposes is evolving rapidly, and more research is needed to maximize the benefits and understand the impacts.

This report translates these research findings into detailed recommendations for focus areas that should receive special consideration when designing acoustically accessible spaces, as well as some best practices for acoustic design. These recommendations can be summarized as:

- Design for diversity;
- Identify and support the roles of sound;
- Identify and reduce the effects of noise;

- Assess and re-assess acoustic accessibility; and
- Normalize and support the use of assistive technology.

The recommendations cover the lifecycle of a built space: from design, through construction, and ongoing use. They aim to help lead to the creation of a shared built environment where acoustics and accessibility are not just features, they are core properties of the space.