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Architectural Acoustics
Session 1aAAb: Cultivating the Sustainable in Architectural Acoustics

1aAAb4. From felt to fungus: New materials and applications - Focus on sustainability
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A two-part presentation of new materials for use in architectural acoustics. This presentation emphasizes new materials or new applications of standard products that provide acoustic benefit in a highly sustainable context. The companion session is presented in "New Materials for Architectural Acoustics." Current trends in architecture are bringing more organic approaches to the use of natural materials. Exploiting these trends with approaches that have definable acoustic behavior leads to more flexibility in architectural design and yields acoustical application of materials that are not traditionally part of the acoustical treatment vocabulary. Case studies will be presented featuring new materials and/or methods being employed for sustainable acoustic solutions.

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**INTRODUCTION**

Many architectural projects are looking to sustainable design solutions, whether the project is pursuing LEED or other standards for low-energy or sustainable materials certification. This tendency toward renewable materials or limited use of potentially hazardous chemicals in building systems products has spurred the creation of new materials or new applications of standard materials that work within this sustainable design ideal.

Consultants working within the realm of Architectural Acoustics are faced with challenges as well-known products of the past are found unfavorable by these new standards, but they are also finding new materials and approaches to meet the acoustic and architectural demands of this new building paradigm. The best solutions for all design team members and their clients are those in which the entire team works together to research and implement new strategies for truly sustainable design practices.

**Case Studies**

Sustainable design is best achieved when all building design disciplines can embrace design solutions that will achieve the project design goals while achieving the building sustainability goals. This typically requires close coordination among members of the design team, with architects and acousticians working closely with engineers to find solutions. The following case studies highlight these collaborations and the resulting acoustic solutions that meet both the design requirements and sustainable design goals of the projects.

*Innovations in Sound Masking Systems*

A new studio and private art gallery in Chicago\(^1\) will be implementing an innovative sound masking system thanks to the need to reduce heat infiltration through its glass façade and the architectural desire to minimize construction materials.

The studio and gallery sits on a busy street in Chicago, and the sound of passing traffic is problematic. A second pane of glass was determined to be required to reduce energy use in the studio and gallery space, but significant loss of floor area to provide the required airspace for sound attenuation of the street noise was not possible. The innovative solution is to utilize the added pane of glass to radiate sound masking that would not eliminate the street noise but provide a steady noise source at the glass that would reduce the acoustic impact of passing trucks and emergency vehicles.

This work will be accomplished by attaching a solid drive loudspeaker to the glass surface, transforming the new glass pane into a loudspeaker for the sound masking system. This approach eliminates a distributed overhead system, reducing materials and electrical and audio distribution wiring. The directional realism of this approach versus a more typical overhead masking system will add to its effectiveness in addressing the problem at the source rather than introducing masking sound over a broader area.

*New Approaches to HVAC Design*

A number of recent projects are exploring the use of minimal ducted air systems to enhance user comfort while significantly reducing the size and extent of ducted air systems within buildings. This approach presents acoustic challenges as well as acoustic benefits.

The CBST Congregation\(^2\), the Flea Theater\(^3\), and the Blue Barn Theatre\(^4\) are three recent examples of projects that are utilizing HVAC systems delivering only the required outdoor air ventilation to program areas of their buildings. These systems vary airflow according to occupancy levels, reducing HVAC energy use to a minimum when spaces are unoccupied or only lightly occupied. Localized heating and cooling are provided at various areas as required.

The acoustic advantage of these systems is small ductwork and small distribution fans required to move only ventilation air through the building. The acoustic challenge with such systems comes in the distributed fans and piping to provide localized heating and cooling in all areas. The cost benefits, improved comfort, and reduced fan and duct sizes within these systems has proven to be beneficial from an acoustic standpoint and an option worth further exploration for future projects.
Acoustic Diffusion Incorporated into Base Building Architectural Elements

The CBST Congregation\textsuperscript{2} and The Apex\textsuperscript{5} center in the UK are joining other projects in utilizing base construction materials to provide acoustic diffusion. For the CBST, the precast concrete walls enclosing the Sanctuary incorporate acoustic shaping required to control flutter and direct sound energy to aid in communication and congregational response.

![CBST interior design rendering](image)

**FIGURE 1.** CBST interior design rendering

The theatre at The Apex sits within a larger complex, and sound isolation was a key consideration for the design. Space was also a premium on the site, so a wide brick bearing wall was utilized to provide sound isolation, accommodate pathways for HVAC and electrical systems, and accommodate sound diffusion within the Hall. All of the brick was manufactured with a rough surface texture but areas of more highly-sculpted units add to the richness of the acoustic diffusion in the space.

![Brick details at The Apex](image)

**FIGURE 2A AND 2B.** Brick details at The Apex

**Fungus Ceiling Panels**

The desire to create an ecological replacement for Styrofoam\textsuperscript{TM} led to the development of a mycelium-based product that would be 100\% biodegradable. This product came to the attention of the architect designing new office space for the National Resources Defense Council\textsuperscript{8}, and exploration of possible uses of this material as an acoustic ceiling panel began.
Mycelium is grown around agricultural by-products into the shaping required to protect fragile items in shipment, creating an enclosure similar to the ubiquitous Styrofoam™ molded forms familiar to everyone today. This same process for molding could lend itself to the creation of custom ceiling panels. While the mycelium itself does not have sufficient acoustic properties of its own, this material in combination with undulating surface shaping (to increase surface area) and airspace behind the product are proving to be promising. Studies are currently under way and our findings will be published in future papers when available.

**FIGURE 3.** EcoCradle Mushroom Packaging – and potential acoustic ceiling tile

**REFERENCES**

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