Wood Specification:
Acoustics

Wood Innovation and Design Centre, Prince George
Architect: Michael Green Architecture
Photo: Brudder

For centuries, wood has been the material of choice for architects and designers intent upon delivering the highest quality of acoustic performance. From a violin to an entire concert hall, wood plays a role in delivering memorable acoustical experiences. Wood produces sound by direct striking and it amplifies or absorbs sound waves that originate from other bodies. For these reasons, wood is an ideal material for musical instruments and other acoustic applications, including architectural ones.

Why Acoustic Performance Adds Value

- Architects and designers have a responsibility to design functional and safe environments. It is very difficult, if not impossible, to meet these goals without considering acoustics. Moreover, it is extremely challenging to deal retroactively with poor acoustic environments. Doing so can severely impact a building's value.
- Privacy is a major issue for building occupants. Designers must provide for adequate levels of sound insulation. Acoustical problems arise when sound transmits through the structure or when reverberation occurs via hard reflective surfaces. Sometimes fire safety design features can have deleterious effects on sound transmission because of the requirements for hard, non-combustible materials, wall and floor penetrations, etc.
- Post-occupancy evaluations of buildings have revealed that poor acoustic performance is a common problem in buildings with large areas of hard, acoustically reflective surfaces. Such surfaces are frequently found in green buildings where the use of absorbent surfaces is often minimized due to indoor air quality concerns.
- Wood is not as acoustically lively as other surfaces and can offer acoustically absorptive qualities. Generally, a wood-finished building is not as noisy as a complete steel or concrete structure.
- Most green building rating systems do not recognize the importance of acoustic performance.

Richmond Olympic Oval Roof
Architect: Canon Design
Photo: Martin Tessler

How to Include Acoustic Performance in Design

- Acoustics are integral to the functioning of almost every type of indoor environment, from open offices to worship centres. Some building environments can even become dangerously loud and therefore unsafe for the occupants. In order to effectively address these issues, building acoustics should be considered in the design phase.
- Optimal acoustic design must consider a wide range of factors, such as building location and orientation, planning and location of sound-sensitive functions, adequate insulation of partitions, insulation or spatial separation of noisy mechanical equipment, and measures to enhance audibility.
- To determine the effects of a material's surface on the acoustics, the acoustic absorption and scattering properties of the material's surface are measured. Any unabsorbed sound energy is reflected back into the space. Not only does the amount of sound energy reflected by a surface affect the sound field, but where the energy is reflected to is also a major factor. The extent to which sound energy is scattered over a defined area, relative to absorption, is of importance to acousticians.

Terminology

Sound Transmission Class:
determined in accordance with American Society for Testing and Materials' ASTM E 413 Standard Classification for Rating Sound Insulation.

Impact Insulation Class:
calculated according to American Society for Testing and Materials' ASTM E 989 Standard Classification for Determination of Impact Insulation Class.

Post-occupancy evaluation:
involves systematic evaluation of opinion about buildings in use, from the perspective of the people who use them. It assesses how well buildings match users' needs, and it identifies ways to improve building design and performance, and fitness for purpose.

Resources

www.acoustics.com:
Provides a comprehensive range of resources including a database of products, design guides, and best practices.

Canadian Wood Council
www.cwc.ca
Provides resources on wood's acoustic performance.

Wood Specification: Acoustics

What to Ask Suppliers

- Acquire Sound Transmission Class and Impact Insulation Class ratings for key components and assemblies, and for any potential interior finishes used as acoustical controls.
- Learn about any synergistic environmental benefits, such as indoor air quality performance and whether the product is certified by a third-party forest certification system.

Procedure

- Consider ambient noise issues during schematic design: site the building, and the zone spaces within the building, to provide occupants with protection from undesirable outside noise.
- Specify in the contract documents an appropriate Sound Transmission Class rating of perimeter walls in terms of response to external noise levels.
- Provide noise attenuation of the structural systems and implement measures to insulate primary spaces from impact noise.
- Mitigate acoustical problems associated with mechanical equipment, and mitigate noise and vibration associated with plumbing systems.
- Specify acoustical controls to meet the acoustical privacy requirements.
- Specify measures to meet speech intelligibility requirements for the various spaces and activities.
- If in doubt about any acoustical issue, retain the services of a qualified acoustics expert.

Standards and Best Practices for Acoustic Design in Buildings

Building codes used in the United States generally require sound isolation for multiple occupancy dwelling units. A Sound Transmission Class (STC) of not less than 50 is commonly specified. However, it is recognized that sounds may still be audible, though speech not understood, on the other side of a wall insulated to STC 50. For this reason, an STC of 60 is recommended in sensitive areas. Canadian research has identified the following sound-insulation objectives for multi-family buildings.

- Inter-unit walls and floors: Sound Transmission Class 55 or higher
- Inter-unit "hard" floors: Impact Insulation Class 55 or higher
- Inter-unit carpeted floors: Impact Insulation Class 65 or higher

Sources:International Building Code (Model Code), Chapter 12. Burrows, J. and Craig, B. 2005. Sound Control in Multi-Family Wood-Frame Buildings. (http://www.soundivide.com/uploads/content_file/multi-family_sound-control-en-277.pdf)

Architect: Hughes Condon Marler Architects
Photo: Nic Lehoux

West Vancouver Aquatic Centre

The expansion of the West Vancouver Aquatic Centre, located in greater Vancouver, British Columbia, was undertaken by Hughes Condon Marler Architects (www.hcma.ca) and combines the refurbishment of an original 25-year-old aquatic facility with the addition of a new leisure pool, accessible hot pool, 65-ft (20-m) water slide, family change rooms, multi-purpose room, fitness areas, and public viewing areas. The project is an excellent example of how design can leverage the multiple advantages of wood, and thereby limit the need for complex assemblies. The structure of the new pool space is primarily glulam beams and purlins. The innovative structure of the eastern wall of the new pool space uses a glulam glazing system that accommodates glazed overhead doors and a series of electrically operable solar shading devices. Acoustically, because wood absorbs sound, the building is not as noisy as one constructed completely of steel or concrete. The architects were able to combine wood's acoustic properties with its suitability to the demanding atmosphere of an aquatic centre. In a pool or arena, wood helps mitigate problems associated with humidity. Wood is able to tolerate the high humidity levels, whereas steel tends to corrode and water drops are created.

Wood Provides Excellent Acoustics

Where sound insulation is important, wood can be a high-performance choice. A study by the Canada's National Research Council's Institute for Research in Construction (NRC-IRC) shows when it comes to acoustical performance, a properly designed and constructed wood floor/ceiling assembly performs on the same level as other construction types.

Wood is not as acoustically lively as other surfaces and can offer acoustically absorptive qualities. Generally, a wood-finished building is not as noisy as a complete steel or concrete structure.

Vancouver Convention Center
Architects: Musson Cattell Mackey Partnership
Architects Designers Planners; Downs/Archambault & Partners; LMN Architects
Photo: KK Law