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Challenging Designs

Royal Conservatory of Music aims for a noise-free environment

Architects and sound engineers find harmony in dampening vibrations

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The Royal Conservatory of Music's (RCM) new $110 million centre aims to create a noise-free environment for its inhabitants -- no easy task considering its busy midtown Toronto location.

The rumble of a subway line, vibration of a neighboring building's cooling system chiller and a host of other noisy factors have kept the design/construction team busy devising ways of controlling and/or eliminating noise.

John O'Keefe, principal of Toronto-based Aercoustics Engineering Limited, says several "very different" acoustical solutions were required for various spaces at the RCM (to be called the Telus Centre for Performance and Learning), which includes 80 teaching studios, a large rehearsal hall and a 1,000-seat concert hall.

Aercoustics is associate consultant at the RCM to Sound Space Design Ltd., of London, England, the firm which headed the design for Toronto's new opera house – the Four Seasons Centre for the Performing Arts.

Aercoustics's contract includes site supervision, designing for noise control and engineering a means of isolating vibration from the chiller in the adjacent stadium and from the Bloor St. subway line.

O'Keefe says one of the toughest challenges is at the teaching studios.

The objective is to "contain" the sounds within each studio by essentially making "a room within a room. The idea is to make sure the walls of each room are not connected to anything else in the building."

By comparison, the acoustical design of the concert hall is straightforward. The key is to buffer or separate the concert hall from external sounds with a network of corridors and sound and light locks. "We can't do that with the studios because they are side-by-side."

To meet the "box in a box" specifications for the teaching studios, the wall's studs are on neoprene pads and there is a gap where doors and walls meet. A drywall "barrier" ceiling is supported from the walls of the inner box, explains O'Keefe.

The barrier ceilings (sometimes mistakenly called floating ceilings) are unlike floating ceilings because they provide a complete barrier to sound.

Floating ceilings often have an edge reveal or opening that permits sound transmission, he points out.

The barrier ceilings consist of two layers of 5/8-inch drywall on steel and neoprene (anti-vibration) springs. The space above is packed with glass fibre insulation.

Typically, lights, ductwork and other utilities are housed in a separate T-bar ceiling below a barrier ceiling but at the RCM the architect (KPMB Architects) came up with a different solution: “an island in the ceiling” that contains lights and other utilities.

To prevent sound traveling from studio to studio through ductwork, each duct run is extended as long as possible from a main trunk in the corridor.

In addition, a “silencer” installed in the ducts absorbs sound, says O’Keefe.

But as good as an acoustic design might be, any trade working on site can compromise the design.

“The thing is everything goes into these walls: fire protection, plumbing, electrical and mechanical ductwork,” he says. “Anything in the wall could cause noise problems. The walls within walls have to move freely of each other.”

The acoustical challenge at the concert hall is quite different. One of the chief concerns is the concert hall is in a narrow and tall space. The high ceilings look good but don’t allow the sound to reflect back to the musicians, says O’Keefe.

Typically concert halls feature a lower ceiling over the musicians called an acoustical canopy.

Designing a canopy that doesn’t come off as an architectural blemish – the term “flying saucer” has been coined by some critics – is a challenge many acoustical design consultants face.

Some designers engineer a canopy that can be raised so as not to be a visual distraction to the audience when it is not needed. But hydraulic lifting mechanisms are costly solutions because canopies typically weigh in the range of 10 to 65 tonnes, says O’Keefe.

At the RCM, the musician’s canopy is fixed, however, it is not “very noticeable” to the audience because of its design. “The ceiling looks like it is all at one level but in fact over the stage it’s a lower solid ceiling for the musicians. Above the audience it is transparent (a series of twisted timber strips).”

To halt vibration from the subway line and chiller from penetrating the rehearsal and concert halls, Aercoustics designed a series of vibration rubber isolators which are installed under the foundation of both halls. The vertical and lateral isolation pads made of rubber and steel are similar to bridge bearing pads but designed to absorb more vibration.

“These kinds of buildings are some of the most complicated things to build. The only thing I can think of that is more complicated is a hospital,” says O’Keefe.

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