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Designing with Stone Wool

Ceiling Panels for Educational Facilities

By Chris Marshall

How students learn, how faculty teaches, and how staff interacts is constantly changing in the academic world. These changes also affect how educational interiors are designed and built. Ceiling selection plays a critical part in meeting the needs of all occupants and the performance requirements of each learning space. An increased focus on collaboration and flexibility of the modern academic environment is reflected in the increased use of exterior and interior glass, large floor plans, and contiguous ceilings with a monolithic appearance.

For the past 60 years, suspended ceiling systems (or 'drop ceilings') have been the preference for most specifiers and designers in nearly every commercial and institutional application. They consist of a metal grid comprising cross-tees and main runners suspended by hanger wires from the structure above, with wall channels or angles providing a clean look around the perimeter. Panels, air diffusers, lights, and other components are then placed within the modular system. These components conceal the plenum—hiding the visible structure, suspension system, HVAC, and other equipment, while providing simple access for future maintenance.

Historically, the function of suspended ceiling systems frequently dictated their appearance. For many specifiers and designers of academic facilities, these ceilings have become synonymous with the gridwork of fissured, fibrous ceiling panels aged by stains and broken corners. Today's acoustic ceiling panels are no longer limited to the dated look of mineral fibre or fibreglass panels. Stone wool panels offer a clean, neat appearance and durable performance with sustainable benefits.

This can be seen in the new $52.5-million Environmental Science & Chemistry Building (ESCB) on the University of Toronto Scarborough Campus (UTSC), designed by Diamond Schmitt Architects. The firm's Nigel Tai, M.Arch., OAA, MRAIC, LEED AP, said he found acoustic stone wool ceiling systems to be "cost-effective and esthetically pleasing with good performance."

Academic performance

Located on the north campus, ESCB's science and education research hub offers master's and doctoral programs addressing environmental issues, such as climate change, groundwater pollution in urban settings, restoration of degraded environmental

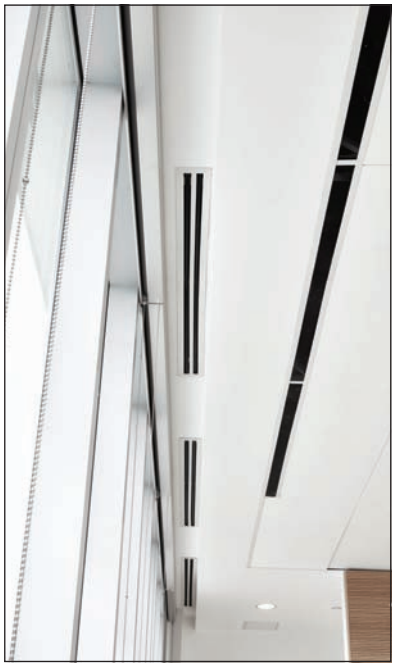
> Due to its inherently open porous structure, stone wool is a sound-absorptive material. It can help control the ambient noise levels and prevent excessive reverberance—critical acoustic management for classrooms.

systems, and rising sea levels. With respect to the promise of its discipline, the building is designed and built to achieve Gold certification through the Canada Green Building Council (CaGBC) Leadership in Energy and Environmental Design (LEED) program (*i.e.* 2009 New Construction [NC]). Once certified, it will be the second building at the University of Toronto Scarborough to attain this internationally recognized rating.

"Being a building specifically housing the environmental science and chemistry groups within the Department of Physical and Environmental Sciences, there was no question the building would have to operate as efficiently as possible," said UTSC Facilities Management Department's project manager, Hovan Stepanian, M.Sc.

"It was a mission of mine to achieve the highest possible level of efficiency for this type of energy-use intensive building prior to the design team and contractor coming on board," he continued. "Initially, we targeted Silver—however, working with the design team, we were able to fine-tune the various sustainability initiatives to target Gold."

Aside from Diamond Schmitt, ESCB's design-build team included EllisDon Corporation. Inspired by nature, the 11,779-m^2 (126,788-sf) new building reflects the academic pursuits housed within the facility, as well as its setting on the edge of a ravine. The five floors of laboratory space rely on a modular approach for flexible adaptation to future academic and technological needs.



The hairline shiplap and smooth white surface of the ESCB's acoustic stone wool ceiling panels presents the specified architectural appearance. The ceiling's bright surface reflects up to 86 per cent of available light—dispersing natural light more effectively can lower light loads and reduce cooling costs. Unlike standard mineral fibre panels with fissures, stone wool ceilings can have a homogenous surface without any visible holes or perforations; their high diffusivity limits hot spots and glare for increased comfort.

Also shown on page 8 and above, the new Environmental Science & Chemistry Building (ESCB) at University of Toronto Scarborough Campus (UTSC) is designed and built to achieve Gold through the Canada Green Building Council (CaGBC) Leadership in Energy and Environmental Design (LEED) program. Once certified, it will be the second building at the University of Toronto Scarborough to attain this international rating.

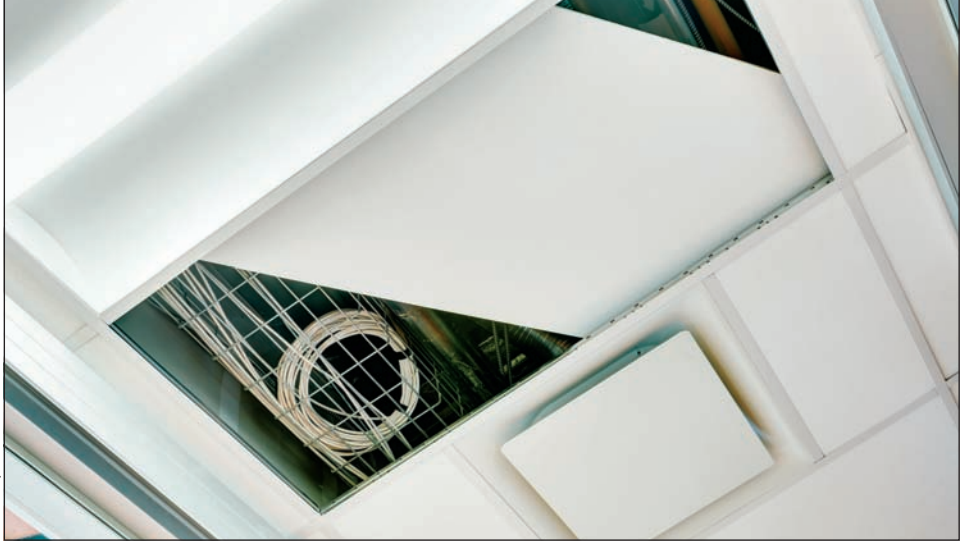
Smooth finish, high light reflectance

Conceived as a highly flexible research and teaching space, ESCB connects laboratories and academic offices around a five-storey, sky-lit atrium. Within the atrium, boardroom, and meeting rooms, the ceiling features acoustic stone wool panels in special sizes with shiplap edge details set into an exposed 24-mm ($^{15}/_{16}$-in.) ceiling suspension system. In total, Nelmar Drywall installed 190 m^2 (2045 sf) of ceiling systems in the atrium alone. An additional 1750 m^2 (18,837 sf) of ceiling panels were installed through the corridors, as well as in faculty offices.

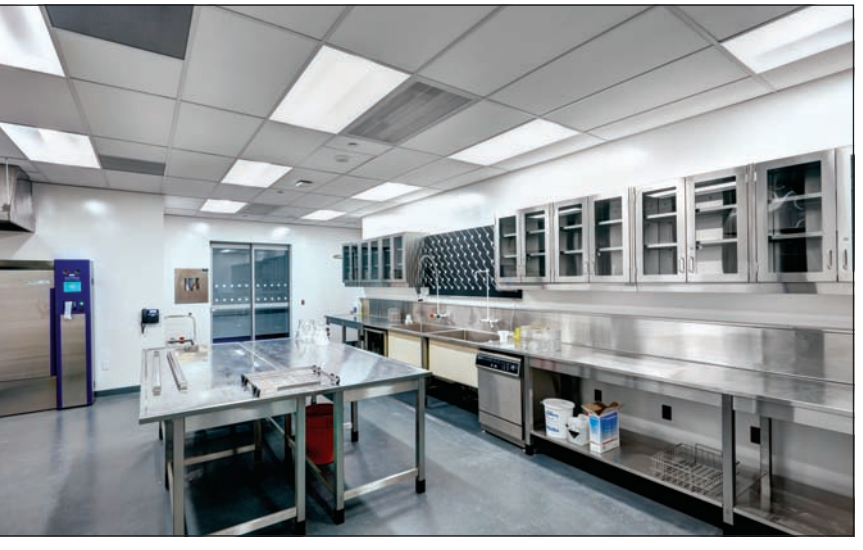
"We wanted a sharp, clean look for the ceiling surface. The hairline shiplap joint detail was important to us, along with the custom 2 x 5-ft [*i.e.* 0.6 x 1.5-m] proportion," said Tai. "Smooth finishes and good light reflectance were critical. We use the ceiling finishes as a reflective surface to bounce light around in the meeting rooms and boardrooms."

The smooth white surface of these acoustic stone wool ceiling panels reflects up to 86 per cent of available light, dispersing natural light more effectively. Students exposed to the most daylighting score seven to 18 per cent higher on tests than those who do not, according to a report titled "Windows & Classrooms: A Study of Student Performance and the Indoor Environment" by Heschong Mahone Group.[1]

The better distribution of light means offices can lower their light loads and reduce cooling costs, helping meet LEED's energy-efficiency criteria. This also can mean significant savings



No special tools are needed to remove one or several panels in the ceiling suspension system, gaining access to the plenum to make repairs or upgrades, and returning the panels without damage.



ESCB's laboratories feature stone wool ceiling products selected to meet stringent requirements for air cleanliness in healthcare and cleanroom environments, with finishes that can withstand rigorous cleaning.

for educational facilities' overall operating costs and budgets.

For electric light, ESCB uses solely light-emitting diode (LED) fixtures. The stone wool ceiling panels are lightweight and easily cut so accommodating the numerous light fixtures and sprinklers throughout the facility was simple. With respect to fire safety, stone wool withstands temperatures up to 1177 C (2150 F). It does not melt, burn, or create significant smoke. This improves overall safety, which can limit building damage and give precious extra seconds for emergency evacuation if such an unfortunate event were to occur.

Sound and sustainable

The stone wool ceiling panels installed on the ESCB are UL/ULC-certified for flame spread and smoke development—this is the standard CAN/ULC S102, *Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies*.In addition to these attributes and the high light reflectance, Tai highlights several other performance benefits:

- suitability as return air plenum ceiling;
- easy access to plenum;
- easy-to-clean surface;
- recycled content; and
- a high noise reduction co-efficient (NRC).

Due to its inherently open porous structure, stone wool is a high-performing, sound-absorptive material. Most stone wool ceiling panels have an NRC of 0.85 or higher; those used in ESCB's atrium have an NRC of 0.90 as standard.

NRC is important in areas where people converse in groups and high levels of noise are present. High sound absorption helps control the ambient noise levels and prevents excessive reverberance. This increases speech intelligibility, improves concentration, and mitigates the 'Lombard effect,' where people speak progressively louder to be heard when trying to talk in noisy environments.

Making speech intelligible requires a loud sound source, such as the professor speaking, and strong, early-arriving, acoustic reflections off the room's surfaces that are close to either the speaker or the listener. It also requires attenuation of all noise. In other words, speech intelligibility requires a high signal-to-noise ratio.

Noise can come from many different sources, including from:

- the exterior;
- other interior spaces;
- building systems; and
- late-arriving, reverberant sound that persists inside the room itself.

The appropriate reverberation time for speech—which is typically between 0.5 and 1.0 second (mid-frequencies)—usually enables listeners to hear and understand each word without the sound of the preceding words interfering.

North American classrooms typically have speech intelligibility ratings of 75 per cent or less, meaning every fourth spoken word is not understood. Further, loud or reverberant educational spaces may cause professors to raise their voices, leading to increased vocal stress and fatigue. Considered in the context of academic performance and occupant health, acoustic comfort also can be a factor in LEED certification.

Recycled content is a more obvious consideration with LEED and sustainable design. Stone wool ceiling products are made from basalt rock and contain up to 43 per cent recycled material. (Metal products may contain up to 100 per cent.) In addition

to the ceiling systems' contributions to environmentally sound design, ESCB's other sustainable features include:

- an 'earth tube' system to supply 100 per cent fresh air to the administrative wing;
- geothermal heating and cooling;
- custom-fritted glazing to minimize solar heat gain;
- rainwater collection for irrigation;
- 100 per cent LED lighting along with daylight harvesting; and
- a high-performance curtain wall.

Photo courtesy Rockfon

For Houtens School in the Netherlands, BBHD Architecten noted the ceiling colours helped make the different school functions visible. Stone wool offers an array of hue possibilities to brighten up any space.

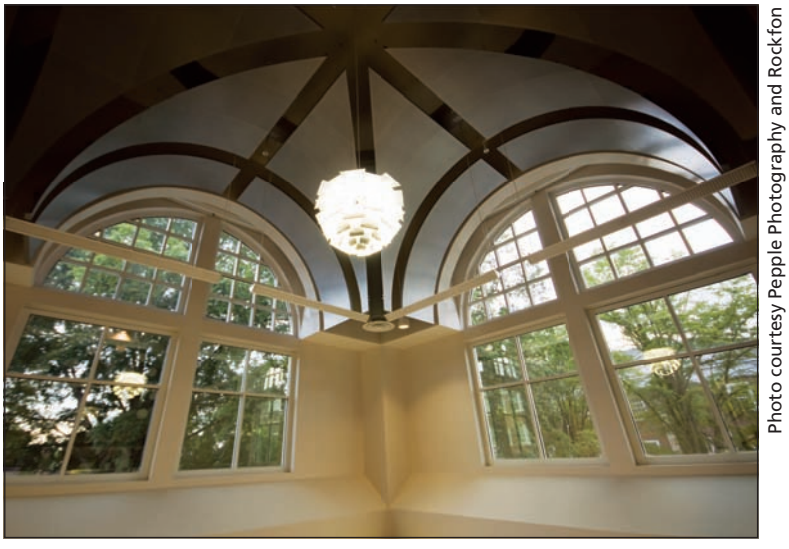


Photo courtesy Pepple Photography and Rockfon

In South Carolina, Winthrop University's Carroll Hall showcases a unique suspended, segmented, vaulted metal ceiling system.

Clean and controlled

Another natural advantage of water-repellent stone wool is that it not only repels damaging micro-organisms, mould, and bacteria, but it also meets stringent requirements for restricting volatile organic compounds (VOCs). Helping improve ESCB's indoor air quality (IAQ), the stone wool acoustic ceiling solutions have UL Environment's GREENGUARD Gold Certification for low-emitting products.

Due to their low particle emission, the ceiling systems installed in the laboratories also meet stringent requirements for air cleanliness in healthcare and clean room environments.

"Where high moisture content is expected, such as the glass-wash facilities, and where the clean room standard is required for sensitive equipment or contamination control, [acoustic stone wool] ceiling tile together with the barrier grid suspension system is used," described Tai.

These ceiling systems were specified and manufactured to meet Bacteriological Class B1 and Clean Room Classifications under International Organization for Standardization (ISO) Class 4, and are resistant to methicillin-resistant staphylococcus aureus (MRSA). Along with helping stop the spread of infection, selected product finishes are designed to withstand rigorous cleaning.

All of ESCB's acoustic stone wool ceiling systems are durable and need only minimal maintenance. When upkeep is required, it is easy to remove one or several ceiling panels to gain access to the plenum and return them without damage. There is no need to use special tools or to start at the wall, removing panels until reaching the desired area.

UTSC's Stepanian agreed having a ceiling that was easy to remove and replace was one of the most critical aspects in selecting the ceiling system. Additionally, he reiterated the importance of acoustic performance and light reflectance, as well as being durable, cost-effective, and esthetically pleasing.

Tai cited the "clean, simple, and crisp" esthetics and "smooth drywall look is definitely something we have in mind when reviewing acoustic ceiling tile options."

In the Environmental Science & Chemistry Building's laboratories, exposed 24-mm ($^{15}/_{16}$-in.) suspension systems support about 1315 m^2 (14,154 sf) of acoustic stone wool ceiling panels.

"The primary aspects of the lab design were its functionality and flexibility. Limiting noise from equipment was a significant consideration, given that the research labs are open-concept," emphasized Stepanian.

"The most notable room where [acoustic stone wool ceiling panels were] used is the central sterilization room. This room contains two autoclaves and numerous dishwashers; it is considered to be a higher humidity/wet environment requiring a ceiling system that can be wiped clean," described Stepanian. "So far, we are very pleased with the performance and durability."

Lessons learned

The use of stone wool ceilings in academic projects in the Netherlands, Denmark, and the United States showcases the material's advantages in educational spaces.

Colour

As an accent or alternative to bright-white ceilings, colourful ceiling panels can be used to create boundaries and transitions.

Photo courtesy Rockfon

Visual stimulation can evoke a desired cue and response. This *Henning Larsen Architects chose acoustic stone wool ceilings for its Campus Roskilde at Denmark's University College Sealand. Reflecting the campus individuality and connectedness, the ceiling designs mix panel sizes, directions, colours, and patterns.*

can be of utmost importance in academic environments where varied spaces have different tasks and functions, to avoid any confusion that can cause stress in the occupants.

For Houtens School in the Netherlands, BBHD Architecten's Ronald van Hek, noted "the colours used—including on the ceiling—made the different school functions visible. The choice of materials and colours was very important in the overall design concept."

Acoustic and esthetics

Designed by Henning Larsen Architects, Campus Roskilde of the University College Sealand in Denmark was designed to "facilitate dialogue and random meetings and provide the students with a feeling of being part of a manifold university environment beating with one pulse." The campus specializes in educating nurses, teachers, social workers, and physiotherapists.

Consisting of four square buildings, each turns slightly inward to create a more intimate and varied space around a central square. To ensure this 'many minds, one pulse' design principle did not create a raucous experience in the large indoor spaces, Henning Larsen Architects chose acoustic stone wool ceilings. Reflecting the campus individuality and connectedness, the ceilings designs mix panel sizes, directions, colours, and patterns.

Metal ceiling panels

Expanding academic facilities' ceiling design options, metal ceiling panels may be combined with stone wool panels or, in certain applications (*e.g.* soffits), they may be used alone. Usually, metal panels are fabricated from either aluminum or steel. They can be manufactured with square edges to lay-in to a grid, or they can have reveal edges for a more decorative look. Baked enamel and powder-coat paints can be selected in nearly any colour, including metallics and simulated wood grain patterns. Metal panels can be perforated and have an acoustic backing applied for sound absorption, or left non-perforated when sound reflection is required.

Metal panels also can be curved into customized designs. Winthrop University's Carroll Hall in South Carolina showcases a one-of-a-kind suspended, segmented, vaulted metal ceiling system. With delicate precision, the curved panels were face-mounted to a ribbed, T-bar suspension system. Meeting the FWA Group's architectural vision, the seamlessness of the ceiling creates the illusion it is flat or curved depending on viewer's perspective. Beyond esthetics, the ceiling system also offers the acoustic performance required in the 6.1-m (20-ft) high space.

Conclusion

With thoughtful specification and proper installation, stone wool ceiling panels can meet educational projects' budget, performance and sustainability requirements, while delivering a clean, neat appearance. From ease of installation to ease of maintenance, these ceiling assemblies can address both the short- and long-term goals for academic facilities. Through the years, the durability and versatility of these systems can accommodate future renovations as existing learning spaces adapt to new teaching methods, new purposes, and new technologies.

Notes

[1] For more on HMG's studies, visit the firm's site at h-m-g.com/projects/daylighting/summaries%20on%20daylighting.htm.

Chris Marshall is Rockfon's vice-president of marketing and business development. He helped introduce stone wool acoustic ceiling solutions to the North American market and has worked with specifiers, designers, installers, and manufacturers of stone wool products for more than a decade. Based in Toronto, Marshall earned a bachelor's degree from the University of Windsor in Ontario, and an MBA from Western Michigan University in Kalamazoo. He can be reached via e-mail at chris.marshall@rockfon.com.