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Designing MUSH Facilities

CONSTRUCTION CANADA

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Photo © Ed White Photograph

A Case Study in Resiliency

The Teck Acute Care Centre at B.C. Children's Hospital

By Victoria Nichols, AIA, LEED AP

Photos © Ed White Photograph

Health care industry leaders are increasingly turning to a model of resilience to ensure their facilities remain operational during natural disasters in a changing climate. The Teck Acute Care Centre (TACC) at B.C. Children's Hospital, Vancouver, is one of the latest examples of resilient design going beyond code requirements.

Most West Coast residents are familiar with the Cascadia Subduction Zone, a fault line from Vancouver to northern California that will bring the greatest impact and devastation when 'the Big One' strikes. Globally, chronic climate-influenced catastrophes from a warming planet, including hurricanes, flooding, fires, and disease outbreak, present a growing challenge to infrastructure and human safety. These environmental factors, combined with aging infrastructure and a growing population, have brought resilient design to the forefront of considerations for the built environment.

Designing for resilience reduces risk and supports recovery in the advent of disaster, helping futureproof communities for an increasingly uncertain world. This is why the B.C. government is making investments in modern, safe, and resilient infrastructure projects throughout the province. TACC is an example, providing specialized care for the most seriously ill children and complex obstetrical patients in the region. The facility replaces aging infrastructure and provides much-needed space for larger care teams and new technologies required to treat today's chronic and complex illnesses.

Public spaces at the Teck Acute Care Centre (TACC), B.C., feature natural wood elements to add warmth and make patients and their families feel more at home.

ZGF Architects, in association with HDR and Affiliated Engineers, designed the eight-storey, 59,400-m^2 (640,000-sf) children's and women's inpatient tower, which debuted in 2017. The project marks the completion of the second phase of the B.C. Children's and B.C. Women's Redevelopment Project, a three-phase, multiyear initiative that began in 2011. It includes 230 inpatient beds, imaging and procedural suites, emergency, hematology, and oncology departments, a high-risk birthing suite, neonatal intensive care units (NICU), and a pediatric intensive care unit (PICU). Built to last well into the future, the facility accommodates greater demand, as the province's population continues to expand.

Resiliency measures

One measure of a community's resiliency is its ability to serve society's most vulnerable citizens—including babies and children—in the event of a disaster. These populations experience the greatest risk of having serious and unmet issues during emergency response and recovery. With this in mind, the provincial health authority wanted to ensure TACC could withstand a natural disaster. The design team worked closely with caregivers, staff, and patients to develop a design that improves care delivery while enhancing resiliency. Heavy emphasis was placed on the effective integration of operations.

Architectural accommodations for disaster include the capacity for rapid response, ability to cohort infectious outbreaks, adaptable space for an emergency operations center, and provision for future expansion. The TACC design team employed a variety of creative solutions to achieve this.

Surge populations

Resiliency planning must account for demand surge on emergency operations due to disruptive events and illnesses associated with climate change, such as an increase in pandemic outbreaks. These are provided in every dimension of care delivery, from facility access to emergency department operations, bed requirements, food and medicine supply, and waste management. The majority of rooms at TACC have double headwall capacity to provide for surge populations, a 50 per cent increase.

Decontamination

The ambulance canopy can be converted quickly into a three-lane mass decontamination shower with cold, warm, and hot zones. It is equipped to hold 45,000 L (11,900 gal) of water. The decontamination suite provides additional storage for disaster/ambulatory supplies.

Infection prevention and outbreak control

Six patient wings can be easily converted into pandemic outbreak control zones that can be isolated with partitions and doors, and negatively pressurized from the surrounding areas to mitigate the spread of airborne infections during an outbreak event. These zones are provided as follows:

- one 12-bed pod on level six surgical inpatient floor;
- one 12-bed pod on level seven medical inpatient floor;
- one 12-bed neighborhood on level two NICU;

The underwater MRI wall graphic welcomes visitors to medical imaging and to the first floor's ocean theme.

Infrastructure is modular to aid the daily workings of each bed unit as well as support future flexibility as care delivery models and patient censuses change.

• two 10-bed neighborhoods on level four PICU; and
• 16-bed position on level one emergency department.

During an outbreak of a communicable disease, TACC may need to restrict access to specific departments, floors, or even the entire facility. With outboard public access elevator cores on the exterior of the buildings, levels one through eight have the option to restrict the entry of persons exhibiting signs and symptoms of an infection, whether in an outbreak scenario or as standard practice.

The design allows the public to be prescreened for airborne or droplet communicable disease risks at either a reception area or greeter stations located immediately adjacent to the public elevator vestibule on all inpatient floors. Staff may also direct patients to use protective equipment such as masks and gowns to protect staff and others as needed.

Emergency operations centre

A conference room, two computer labs, and a classroom are fitted with equipment and storage that anticipates their conversion into an operations hub during an emergency. They include folding room partitions, moveable furniture, lockable storage and floor boxes for power and data, an AV cabinet, projector and screen, wall-mounted monitor, and card reader access.

Seismic resilience

Seismic design is vital in preventing catastrophic building collapse and ensuring structures behave in a predictable manner in the event of an earthquake. Building design for various earthquake loads is addressed in the 2005 *National Building Code (NBC).* In active seismic regions, however, designing to code may not be enough.

The *Vancouver Building Bylaw (VBBL),* which regulates the design and construction of buildings, requires health care facilities to meet 'post-disaster' requirements. It requires more stringent wind and seismic importance factors for life-safety mechanical systems, including a seismic importance factor of 1.5 instead of 1. According to the City of Vancouver, its ability to adopt its own building bylaw is unique in British Columbia, and offers authorities the opportunity to quickly respond to issues having an impact on building safety within the city.

Gardens are incorporated throughout the design to provide visitors with natural light, fresh air, and connections to nature. Elements of discovery and whimsey engage children of all ages.

The Provincial Health Services Authority (PHSA) also put forth a list of post-disaster requirements in addition to VBBL regulations for the project, including an absolute energy target and three days of potable water storage. As a result, TACC is designed to exceed seismic code to ensure the building remains operational after an earthquake. The hospital can operate at post-disaster capacity for three full days by using emergency generators, while underground systems for potable water and sewage collection enable its continuous operations.

Energy and water conservation

For mission-critical facilities such as health care buildings, it is imperative to plan for extended durations of infrastructure interruption. Energy and water conservation strategies are key to reducing resource needs in immediate post-disaster operations. During normal operating conditions, they offer the benefit of reduced utility costs and greenhouse gas (GHG) emissions.

Many health care facilities strive toward islanding capabilities, where a distributed generator continues to power the building when the grid is down. While expensive, allowing parts of the building to go dark can tip the scale to enable critical facility operations when municipal electrical services fail.

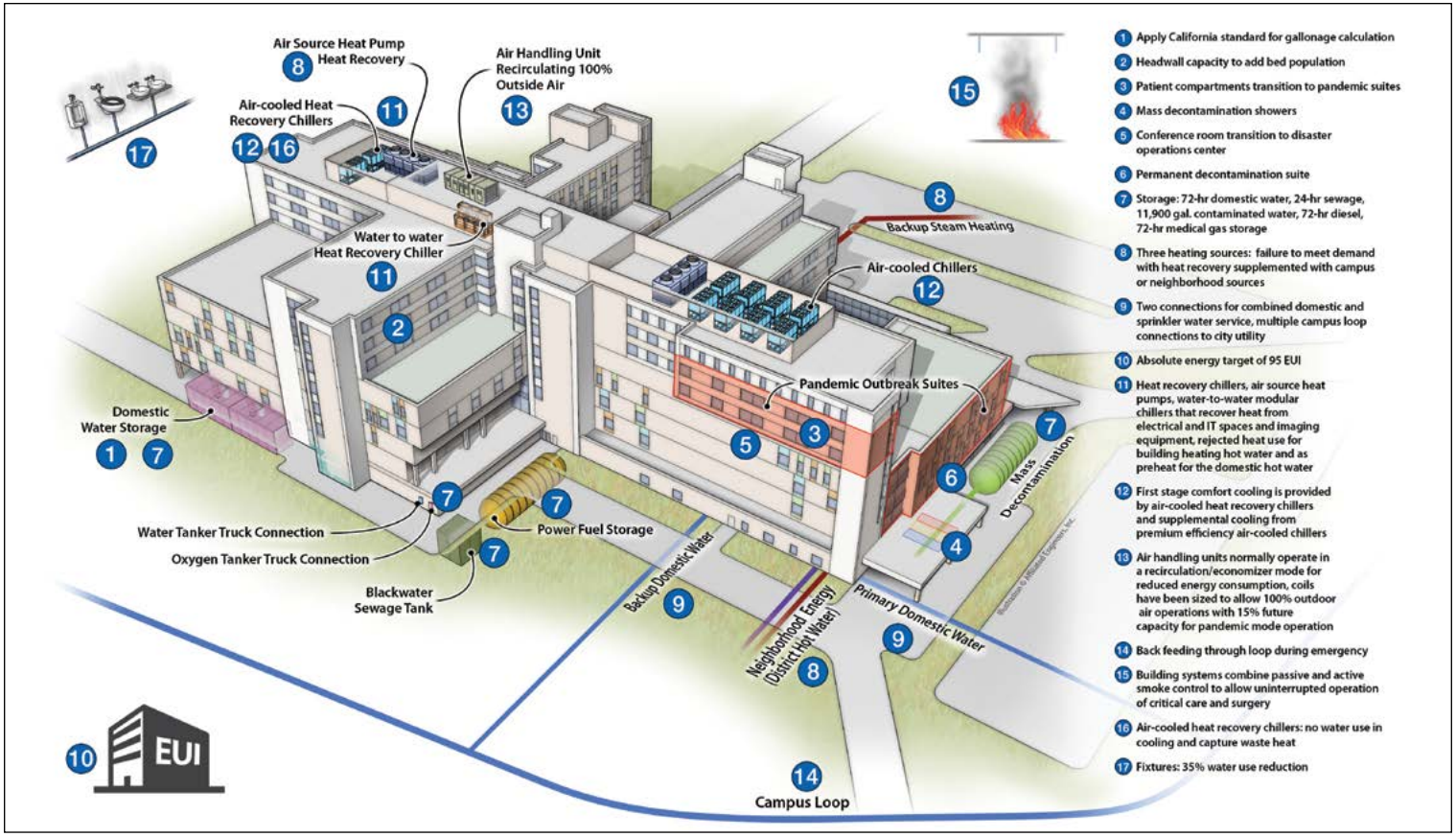
Water storage to provide for occupant needs during interruption of municipal drinking water supply is also an obvious concern, but most codes do not offer a measure of how much water to store. In the design of TACC, Affiliated Engineers looked to the California Office of Statewide Health Planning and Development (OSHPD) standard for acute care facilities, which requires approximately 189 L (50 gal) of potable water storage per day per inpatient bed. The TACC's domestic water storage design consists of two tanks holding a day-and-a-half worth of water and can be refilled quickly with pumper trucks.

The plumbing system is also designed to use 35 per cent less water than the Leadership in Energy and Environmental Design (LEED) baseline building. The mechanical plant consists of all air-cooled or water-to-water heat recovery chillers, and air-source heat pumps mounted within the warm exhaust air, to increase efficiency. As a result, there is no demand from a cooling tower, further reducing the building's water storage requirement. An additional water savings strategy includes chilled water effluent cooling on the sterile processing autoclaves. The waste heat from the effluent is then captured by the heat recovery system and used as the first-tier building heating and domestic water pre-heat. District hot water and campus steam are the second and third tier supplemental heating sources, respectively.

The mechanical plant and air-handling system is sized for 100 per cent outdoor air operations with 15 per cent additional capacity, allowing for future clinical or long-term temperature changes. The active smoke control system allows for individual smoke compartments to be pressurized during a smoke event (shelter in place). Thus, procedures can continue and ICU patients can remain in place during an event without the loss of heating and cooling airflow.

Other energy and water features include:

- 24-hour sanitary sewage water storage;
- fire sprinkler water storage;



Resilience is built into the mechanical, engineering, and plumbing (MEP) design of TACC.

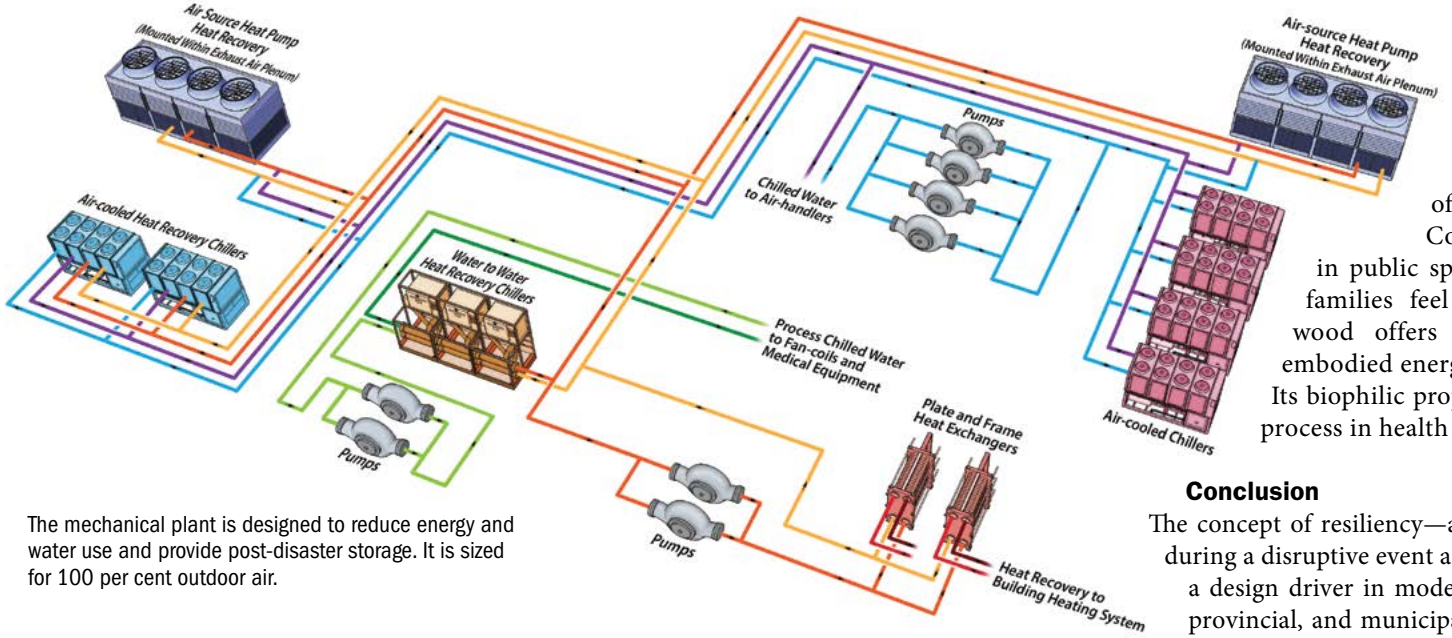
Images courtesy Affiliated Engineers

- 72-hour diesel and medical gas storage; and
- code mandated oxygen reserve.

The building is LEED Canada NC Gold certified.

Patient and family-centred healing environment

Finally, TACC's interior design elements help minimize stress through enhanced wayfinding and positive distraction, which can instill patients and staff with a sense of normalcy during a prolonged event. ZGF's designers were charged with creating interiors that further the mission of healing while minimizing the clinical feel. The aim was to bring together the functional requirements of the building with natural elements that help orient and provide a sense of place. Each design element was incorporated with pediatric patients and families in mind, beginning with the moment they step foot in the building. The message of hope and inspiration communicates a commitment to the care and well-being of the community.



The mechanical plant is designed to reduce energy and water use and provide post-disaster storage. It is sized for 100 per cent outdoor air.

Experiential graphics featured throughout the hospital were informed by a series of studies that helped identify inspiring themes. For each floor, the design team surveyed between 40 and 150 patients, families, and staff to arrive at preferred colour and icon choices. This research phase inspired the overarching design theme of "Our Beautiful British Columbia." Beginning with the parking garage and moving up vertically through the eight floors of the building, each level is assigned a landscape inspired by the region: ocean, harbour, meadow, forest, and mountain.

Children's workshops focused on establishing imagery that would resonate with a diverse population, assessing preferences and associations for place-making icons, and gleaning the type of associations with the natural environment that kids value most.

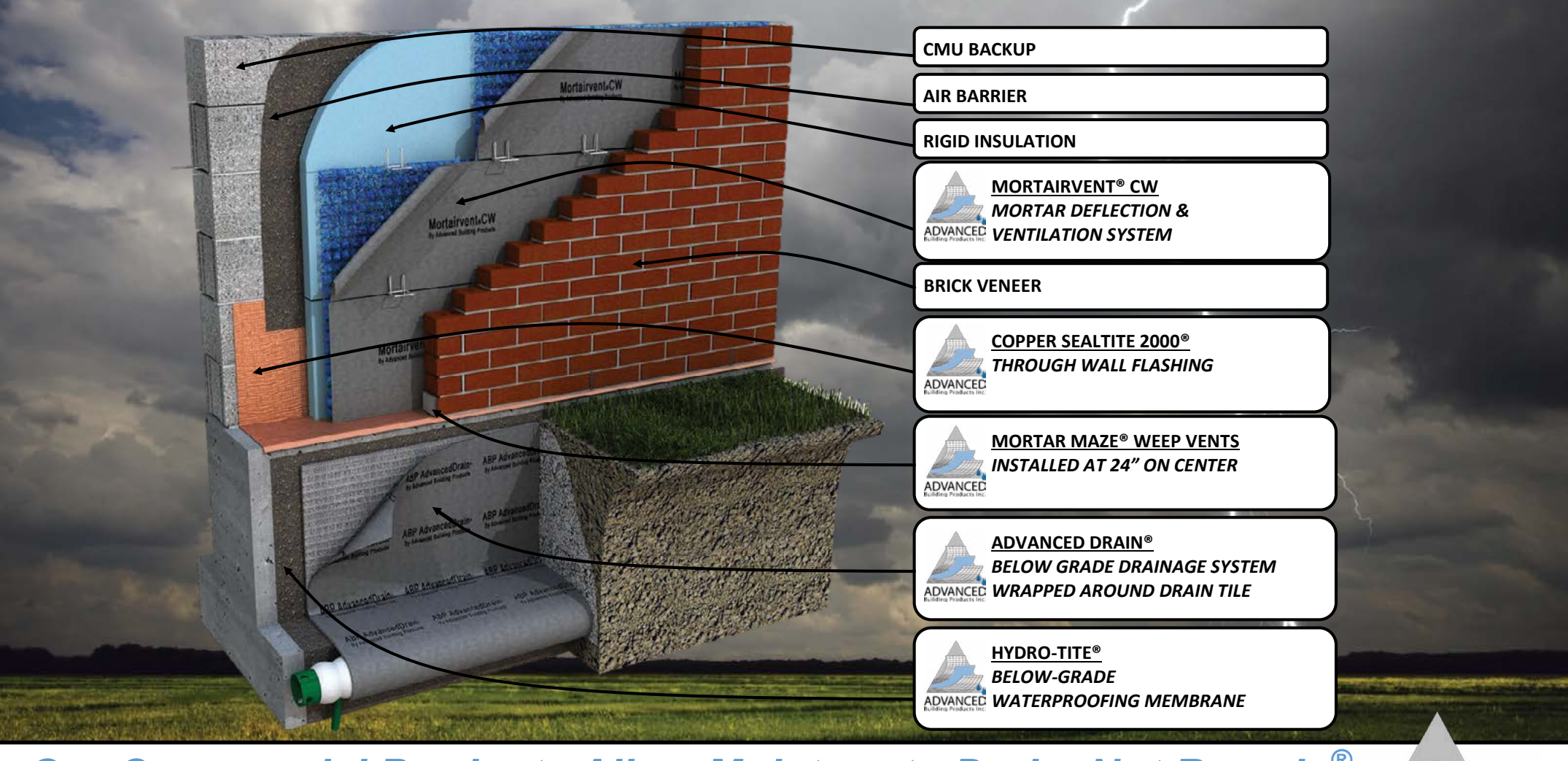
Clear organization and wayfinding strategies are reinforced by visual connections to the outdoors to create a more restorative environment for patients and families. The facility utilizes natural light, outdoor landscaping and gardens, and glare-minimizing, energy-efficient light-emitting diode (LED) lighting elements. Acoustical treatments minimize noise disturbance. Patient and staff-accessible gardens on levels five, six, and eight emphasize calmness and contemplation to enhance the healing process.

Additionally, TACC features extensive use of wood that is consistent with the British Columbia's *Wood First Act*. Natural wood elements in public spaces add warmth and make patients and their families feel more at home. Measured over its lifetime, wood offers several resiliency benefits, including lower embodied energy, fewer GHG emissions, and greater longevity. Its biophilic properties have also proven to enhance the healing process in health care settings.

Conclusion

The concept of resiliency—a facility's ability to operate, in whole or in part, during a disruptive event and to quickly recover afterward—is taking hold as a design driver in modern health care facilities. However, many federal, provincial, and municipal requirements do not go far enough. It is up to health care architects and engineers to chart their own approach to resilient design, and it is up to systems to demand it. TACC will continue to serve as an example of resilient design that goes beyond what is mandated by today's code requirements to best serve its community in the long run.

Victoria Nichols, AIA, LEED AP, is a partner at ZGF Architects with more than 22 years of experience managing the planning, programming, and design of a variety of projects in the health care sector. She brings expertise in facilitating the integrated project delivery (IPD) process, as well as in lean planning and design, which minimizes waste and enhances outcomes both in project delivery and the design of environments. Nichols holds bachelor of architecture and bachelor of science in environmental design degrees from the Ball State University and is a frequent speaker at health care conferences. She can be reached at victoria.nichols@zgf.com.



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A SOUND INVESTMENT in Building Occupant Well-being

By Robert Marshall

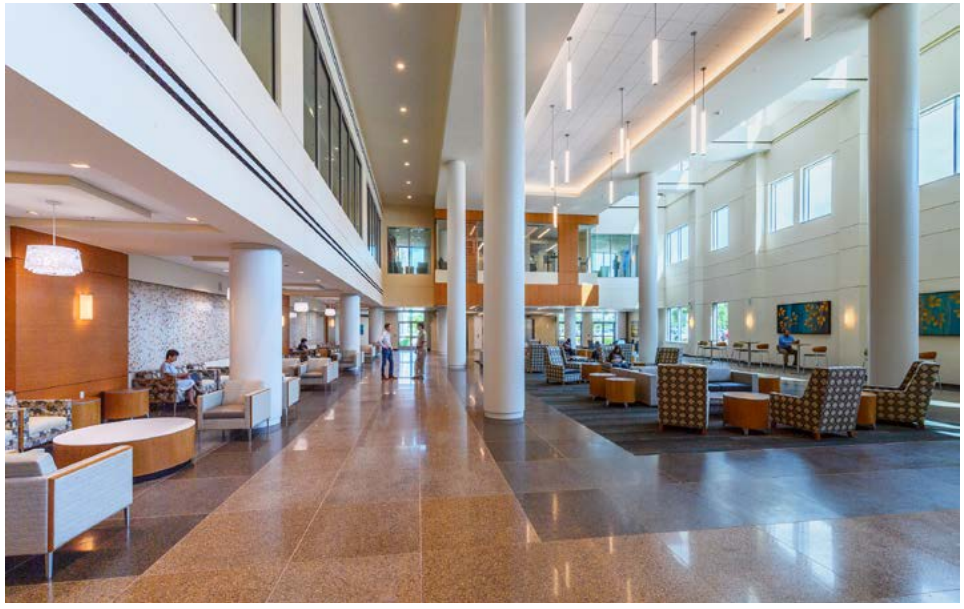
Photos courtesy CertainTeed

Acoustic control and performance continue to influence the design of municipal, university, school, and hospital (MUSH) facilities across Canada. While buildings' demands vary from project to project, depending on occupant activity, they all have one thing in common—the need for acoustically balanced spaces. Reducing excessive noise and sound reverberation in education settings decreases distractions by increasing vocal clarity and decreasing reverberation. It also reduces vocal strain for teachers and professors. For health care environments, enhanced acoustics play an important role in supporting safety, healing, and well-being for all occupants, including employees, patients, and visitors. In municipal buildings, sound acoustics contribute to happier, more productive employees.

In order to enhance speech privacy and quell distracting and disruptive background noise, all while creating dynamic, visually stimulating spaces, commercial specifiers working in MUSH sectors have sought out new materials that combine enhanced acoustic performance with unique visuals, ease of installation, and durable construction.

One building material segment that has responded with a wide range of innovations is the commercial ceiling industry. Monolithic large-format metal panels with rich and inviting wood looks, and high-performance specialty products are helping designers create acoustically optimized environments without sacrificing esthetics or durability.

Studies show poor acoustics and excess noise are major detriments for school children of all ages. It is critical designers working in the education space specify panels to improve vocal clarity and reduce sound reverberation.



Acoustic control in health care environments is just as important for lobbies, waiting rooms, and other common areas as it is in consultation spaces.

Photo © Geoffrey Lyon

Unique set of challenges

From museums to emergency services facilities, municipal building types run the gamut in size, scope, and complexity. While every project presents its own set of problems to solve, the majority of these buildings share a common challenge: a limited budget. Some municipalities are addressing this challenge by building mixed-use facilities that provide leasable space and revenue-generating opportunities. While this trend has certainly grown throughout Canada, it is still far from the norm.

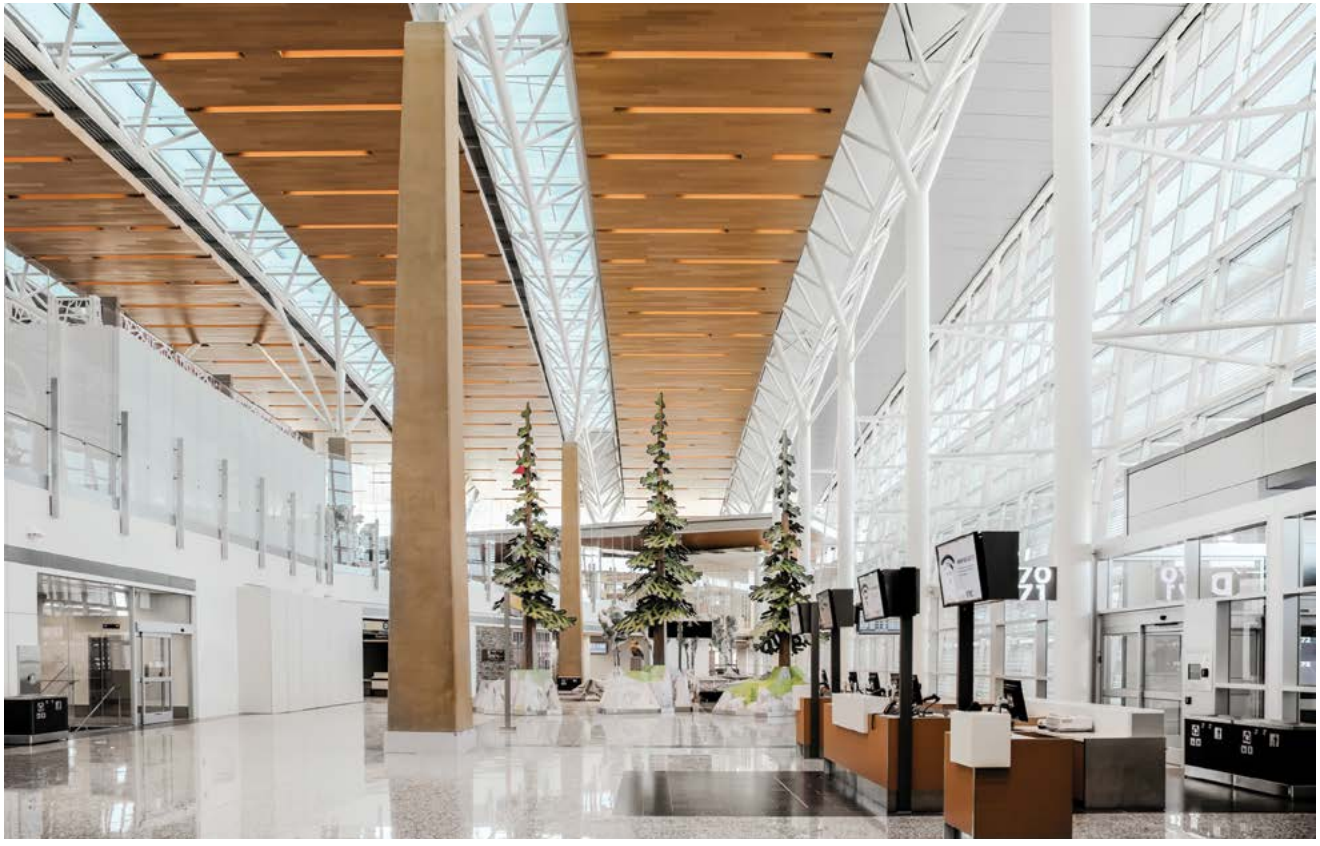
"Budgets just are not as plush as they are in the private sector," explained Chris Bourque, director of marketing at a building materials manufacturer. "While these projects have a lot of space, the budget is not unlimited."

Lightweight fibreglass panels are an option for some of these spaces because they deliver smooth surfaces, enhanced acoustic control, and a strong value proposition. New designs also offer a level of design freedom and modularity that was once impossible with traditional fibreglass panels.

The superior swing down systems in the new-age designs allow architects to create a variety of modules throughout the space. Each panel that fits the module can be installed anywhere in the building and can easily swing open to allow access to the plenum. The panel does not have to be removed and left on the ground, thus keeping the ceiling in a better condition.

Designer-friendly panels also feature a number of finish options, colours, and faux wood looks and patterns. When installed at high elevations in public spaces, these designs are undiscernible from the materials they mimic.

"When a specifier is looking at a faux wood look sample in their hand, they can tell it is printed," explained Bourque. "However, at [4 to 6 m] 15 or 20 ft, it looks like a real



Hundreds of perforated metal ceiling panels were incorporated throughout the expanded YYC/Calgary International Airport as design juxtaposition. The bright metal finish of the panels combines perfectly with the matte look of the wood.

Photo courtesy CertainTeed

wood ceiling. Maintenance and installation complexity are all improved compared to traditional wood, and the material and installation costs are lower, too."

"Wood ceilings, wood panels, and metal are all on trend in the Canadian market," added Nancy McPherson, an architectural solutions manager with a building materials manufacturer. "We are seeing a lot of perforated wood looks being used to warm up a space. Where it was once white walls and concrete, these darker and more inviting materials are becoming commonplace. While there are some purely decorative panels out there, the acoustic performance is the primary consideration."

An example of this is the Calgary International Airport terminal that opened in 2017. Owned and operated by Transport Canada, the new terminal is a sprawling space with a modern and striking design.

Designers from across Canada worked for several years to cultivate an environment that blended esthetics with functionality and sustainability. The space needed to say "Calgary" without being too literal. Combining natural materials in unique and unexpected ways for an airport environment allowed the design team to play with colours, finishes, and shapes, while still providing the necessary durability required for a high-use facility.

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A key aspect of the design process was to specify and install a modular ceiling system that would assist with wayfinding, help manage acoustics, and mitigate noise, leading to a stress-free and anxiety-reducing travel experience for the airport's 13 million passengers annually.

A perforated wood veneer panel was ultimately specified throughout the airport as it created an esthetically pleasing look, was easy to install, and offered full accessibility to the plenum after the installation. The suspension systems used to support the wood panels give the illusion the panels are floating—tying in well with the overall design theme of the airport, which features open and airy spaces and natural materials.

The more economical mineral fibre and fibreglass ceiling panels are well-suited for office and conference spaces. These panels are available in a variety of noise reduction coefficient (NRC) values of up to 0.80, provide superior finish, and may prevent the need to include full-height partitions since the NRC level is high, thereby saving money in both interior design and build-out.

Focus on acoustic control and mitigation

Universities, schools, and libraries continue to evolve as designers place focus on daylighting, environmentally friendly materials, natural ventilation, and open-concept spaces. This comes with several challenges, mostly in the form of acoustics.

A high degree of speech intelligibility is required in primary schools as children in the back of the classroom need to hear as well as those in the front row.

Since most primary school classrooms are smaller spaces, fibreglass panels are an affordable option.

In cash-strapped school systems, designers can also turn to fissured products. These non-directional panels are low in volatile organic compounds (VOCs) and easy to cut and install, which reduces installation costs. They are humidity- and sag-resistant and offer a long lifespan. High NRC options also comply with the Leadership in Energy and Environmental Design (LEED) v4 for school classroom acoustics, making them an attractive option for designers and architects looking to achieve this status.

"No matter what school you are in, there are kids with colds, young people suffering from allergies, and students who are learning English or French as a second language," explained McPherson. "That is why the focus on acoustics is so important—it truly is amazing how much sound and noise affects their attention span."

In large classrooms and lecture halls, designers must find a way to project the sound from the front of the room and have it rebound in the back of the space in order to increase speech intelligibility. If the entire room is outfitted with sound-absorbing panels, it works as a detriment by killing the sound or absorbing too much noise at the front of the room. Mineral fibre and gypsum solutions are suitable options for large areas and corridors as they provide sound absorption and blocking as well as enhanced cleanability.

On the contrary, neither fibreglass nor mineral fibre products, including clouds and baffles, benefit acoustics in grand public spaces such as atria and lobbies because once a ceiling reaches 8 to 9 m (25 to 30 ft) in height, the installed materials at the top of the space do not do much to absorb excess sound or reduce reverberation.

"By the time sound waves hit a hanging baffle or cloud, it is too late," said Bourque. "You get a very diminished return on your investment, which is why we recommend designers develop strategies to incorporate sound absorption on flat surfaces such as walls."

Perforated wood assemblies and perforated gypsum installed on walls help decrease noise and make conversations in these spaces more intelligible. These materials also provide facility owners with floor-to-ceiling sound absorption systems that have the added benefits of being re-paintable and sustainable. They also bring the unique quality of formaldehyde scavenging to the space by helping to absorb VOCs and other toxic chemicals.

Other products making an impact on education design include lightweight, smooth, and large monolithic panels offering custom printing options mimicking school colours, sports team logos, and branding. Available in classic white, vibrant hues, and even wood looks, they allow designers to create esthetically pleasing ceilings on reasonable budgets.

Healing properties of acoustic design

Large-format materials are also making a splash in health care design, where specifiers are constantly looking for new options blending acoustic control with enhanced design prowess.

Longer hospital stays, higher readmission rates, unnecessary medical errors, and high stress among staff are just a few of the consequences of unwanted noise in health care settings. In a survey conducted by the United Kingdom's (UK's) National Health Service, 40 per cent of patients cited noise as a major annoyance during their stay, outranking other factors such as cleanliness, quality of food, privacy, and amount of staff.

As a result, evidence-based design is driving health care facility construction. Designers are not only focusing on patient welfare and satisfaction scores, but also paying more

By using a combination of complementary ceiling products, health care specifiers can achieve a cohesive finish with varying acoustical properties.

Photo © Geoffrey Lyon

attention to the role of sound attenuation in protecting patient privacy, and how new ceiling materials can contribute to LEED v4 status.

"With so many new designs, patterns, and finishes, designers working on common areas, waiting rooms, nurses' stations, and administrative offices have more choices than ever," said McPherson. "These materials are great for municipal and education projects as well, adding to their crossover appeal."

"Think about a hospital waiting area for a moment," added Bourque. "These are typically the most acoustically challenged spaces because you want them to be extraordinarily absorptive to keep doctor-family conversations quiet and confidential. The same thing goes for a variety of other spaces in a hospital or health care facility."

In addition to monolithic panels, cleanable surfaces that add to acoustic performance remain a major component of the design process. Architects and designers should work in concert with health care administrators to find out what level of cleaning regimen is used in each space. This is important for patient, operating, and emergency rooms, along with other cleanroom spaces.

The Facility Guidelines Institute's (FGI's) "Guidelines for Design and Construction of Hospitals" provides minimum design standards for general hospitals, freestanding emergency facilities, critical access, psychiatric, rehabilitation, and children's hospitals, and mobile/transportable medical units.

It also includes specific sections on minimum sound absorption coefficients as well as requirements for ceiling systems in a variety of applications including exam, treatment, and procedure rooms in general hospitals and psychiatric facilities.

Conclusion

Roughly 10 years ago, the ceiling industry was moving toward fibreglass as a medium for nearly all the solutions mentioned in this article. While fibreglass is an excellent sound absorber, manufacturers have been tweaking the performance of mineral fibre to increase its acoustic properties. As specifiers continue to push the design limits in MUSH sectors, it is important to remember new acoustic ceiling materials are better positioned than ever before to help create healthy, comfortable, and acoustically sound spaces.

Robert Marshall is the senior technical manager for CertainTeed Ceilings and a lifelong participant in the commercial ceiling industry. Marshall's family founded the world's first acoustic ceiling contracting businesses in 1927. He can be reached at robert.l.marshall@saint-gobain.com.

Designing for LIFE SAFETY

How rolling doors and grilles help architects protect MUSH facilities and occupants

By Siva Davuluri

Photos courtesy CornellCookson

When designing for municipal, university, school, and hospital (MUSH) sectors, architects and specifiers have a responsibility to protect building occupants and vulnerable assets. From addressing the threat of extreme weather events and designing for day-to-day safety and security to reducing the threat of deadly fire and smoke migration, there are a wide variety of considerations that directly affect life safety.

While many of these factors depend on the geographic location of the facility and its intended use, there are several new safety-driven rolling door and grille solutions that can greatly enhance protection—for Canadian students, teachers, government workers, health care employees, and patients—from life-threatening events.

These advanced new door and grille innovations safeguard building occupants from tornadoes and other extreme weather conditions, restrict the spread of toxic smoke, and allow specifiers to design safer parking structures by improving access point security.

Smoke mitigation technology

Fire is a major concern for building owners and occupants. This is especially true in high-rise buildings that are growing taller than ever in Canadian cities. However, it may come as a surprise that smoke inhalation kills far more people than burn-related injuries.

Storm shelter doors can cover windows and convert an open and airy classroom, cafeteria, or gymnasium into a safe room in just a few seconds.

"When a fire event occurs, it typically produces toxic gases and smoke, which are hazardous or fatal to occupants," explained David Dawdy, director of fire protection and life safety new product development at a door and grille manufacturer. "Smoke is also fully capable of destroying furnishings, finishes, and inventories while promising disruption of business operations far from the source of the fire since it quickly migrates through openings in barrier walls and up common elevator shafts, which can act just like a chimney during a fire event," he added.

There are two primary solutions used to minimize the threat of fire and smoke migration: active and passive fire protection. Active fire protection includes sprinklers and other types of suppression systems used to reduce or extinguish a fire, thereby limiting the amount of heat produced. However, a tremendous amount of smoke can still be generated in a short amount of time.

Buildings rely on passive protection in the form of fire and smoke barrier walls and compartmentation closures—in this case, rolling steel fire doors and shutters—to isolate and restrict the migration of these elements.

Barrier walls often have large traffic openings to which coiling fire doors and shutters are employed to close by activation should a fire occur. However, here is the rub: when fusible links are chosen to activate doors, voluminous amounts of toxic smoke and gas may escape before those links can reach the 74 C (165 F) temperature necessary to melt them and activate a door, and this is only under the broad assumption everything is set up and located properly.

"Fusible links simply cannot respond to the initial stage of a fire event – smoke," said Dawdy. "That is why manufacturers have spent decades developing more sensitive and reliable closure systems that activate fire doors at the first whiff of smoke. The technology is now well developed, affordable, and can be readily integrated into fire protection planning for MUSH facilities."

Conventional fire doors have changed in recent years, becoming more systems oriented in the process. Power-operated systems are simple to use and require virtually zero maintenance. Newer units can be easily and frequently drop tested and will reset and even re-open automatically, reducing the timeline for periodic inspection and testing, saving money in the process.

A major development in fire door design was the introduction of failsafe activation and doors that do not require tension release to close automatically when notified. Facility managers and inspectors no longer have to manually reset the doors and add tension post-test. Battery backup technology has become reliable and affordable as well as virtually eliminates nuisance drops, thereby increasing user satisfaction and reducing ownership costs in one fell swoop.

Another development is the elevator smoke containment door, a system that seals off hoistway openings from vertical smoke migration. These systems are easy to maintain and quick to test, saving building owners and facility managers time, money, and headaches for decades to come, not to mention ensuring high standards of life-safety protection for occupants in MUSH facilities.

While these new solutions and systems can help save lives in health care, education, and municipal facilities across the country, when and where to specify these products can be confusing.

Canada features a wide range of building codes and standards. These include the *National Building Code of Canada (NBC)*, the provincial codes, and local city regulations. The *NBC* reference document for fire doors is NFPA 80, *Standard for Fire Doors and Other Opening Protectives*.

Some rolling grilles do not need as much headroom as traditionally required.

Security grilles are made of interlocking metal links that have a solid rod running through eyelets in each end.

NFPA 80 specifically regulates the installation and maintenance of fire doors and other opening protectives against the spread of fire and smoke within, into, or out of buildings.

One of the most important sections of NFPA 80 pertains to testing and inspections.

Chapter 5, "Care and Maintenance," of NFPA 80 requires annual inspection, drop test, and reset of every fire door in new and existing buildings along with a written record of the assemblies inspected. The standard also provides an itemized list of instructions indicating which components and operations of the fire door assemblies must be evaluated.

Addressing extreme weather

In addition to incorporating rolling doors that mitigate smoke migration and compartmentalize fires, specifiers have another powerful tool when it comes to life safety—maximum protection rolling doors. This includes safe room doors that protect building occupants from tornadoes and hurricanes.

Canada sees its fair share of these natural disasters. In fact, it ranks second to the United States in annual tornadoes, with the vast majority of them touching down in the prairies and Ontario. These regions make up the northernmost border of Tornado Alley, a massive area that produces hundreds of tornadoes each year.

The same stark reality is true for hurricanes and tropical storms, which have intensified in size and frequency in recent years. Just this year, Hurricane Dorian wreaked havoc across Nova Scotia with winds reaching 150 km/h (93 mph), downing power lines, trees, and leaving more than 500,000 people in the dark for days.

Rolling door manufacturers have developed storm shelter doors that can withstand high wind and impact from debris. These products can cover single openings or banks of windows, converting an open and airy classroom, cafeteria, or gymnasium into a safe room in just a few seconds. Since these doors feature compact construction and a sleek design, they are virtually undetectable when retracted since the unit is embedded into precast concrete.

Where tornadoes are common threats, maximum protection rolling doors can mean the difference between life and death in schools and universities. Often, these storms come without warning and building occupants have only minutes to get to a shelter or safe space. While hurricanes and coastal storms allow more time for people to evacuate to safer areas, first responders often ride out the storm in municipal buildings like police and fire stations.

These extreme examples highlight the specific life-safety threats that specifiers can safeguard building occupants against with rolling door products.

Elevator smoke containment doors seal off hoistway openings from vertical smoke migration.

Everyday safety deserves more consideration

Another common application for rolling doors and grilles across MUSH sectors comes in the form of secure parking access. From a safety and security standpoint, the right closure solution can help protect against crime and unwanted intruders posing a safety violation. This goes for health care, education, and municipal buildings.

As college campuses increase security in the wake of rising threats, secure access points are commonplace. From dorm rooms to classroom buildings, security guards and card swipers help keep intruders out. However, parking garages, which have wide openings and are often open 24-7, are often overlooked.

Many garages use parking arms to control access. While these products can deter vehicular traffic, they do little for foot traffic and are easily compromised. Security grilles are a better solution since they offer a combination of speed, efficiency, visibility, and airflow.

Security grilles are made of interlocking metal links that have a solid rod running through eyelets in each end. The links can be manufactured in various metals, sizes, and thicknesses, and are typically arranged in a straight or brick pattern.

Grilles enable enhanced parking garage security without compromising visibility or airflow, which is important when cars are idling in parking structures. They can also be tied to various secure activation systems such as ID cards and radio-frequency identification (RFID) readers. This ensures only approved and identifiable people gain access. Having a controlled understanding of who has access to all areas is critical to maintaining a secure campus, hospital, or municipal building.

While these products are relatively simple solutions for parking facilities with large openings and high ceiling heights, the situation is more complicated for retrofit projects and mixed-use facilities that save space (and money) with low headroom. These projects require specific rolling grille applications that can fit existing bulkheads, while providing a sleek and modern look.

To address this need, manufacturers have developed compact coiling grilles. Some grilles can reduce headroom by nearly 50 per cent while providing the same level of safety and security as a traditional security grille.

"A gap in the parking market began forming several years ago," explained Heather Bender, strategic marketing manager at a door and grille manufacturer. "Companies offered a wide variety of rolling grilles, yet many of them required a bulky 610 mm (24 in.) of headroom, which is standard across the industry and were difficult to fit into parking garages. This is changing, thanks to new innovations in coil design and motor technology."

A traditional rolling grille wraps around the shaft at 45-degree angles. The vertical links stack and stack until the grille is fully rolled up into the head-unit. This creates a significant number of voids and a larger coil. Advanced new products decrease the angle through curved vertical links, reducing the number of voids and tightening the coil in the process, effectively reducing the amount of headroom required.

These advanced new products join a growing lineup of rolling doors and grilles on the market that can help designers of MUSH facilities keep building occupants safe and secure.

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