DESIGN QUARTERLY

ISSUE 16

Stantec

CLIMATE RISK

An informed approach to building resilience

DESIGN QUAR-TERLY

ISSUE 16

THOUGHTS, TRENDS AND INNOVATION FROM THE STANTEC BUILDINGS GROUP.

The Stantec Design Quarterly tells stories that showcase thoughtful, forward-looking approaches to design that build community.

IN THIS ISSUE:
CLIMATE RISK

More and more of us are feeling the pervasive effects of climate change, including extreme weather events and changing precipitation patterns. Climate change means risk to businesses, organizations, healthcare providers, and society. To truly respond to climate change and its side effects, designers must look beyond sustainable design to strategies that enhance resilience over the long haul. Designers and engineers must respond to the disruption of life as we know it by considering how it will affect the resilience of projects in decades to come. In this issue, we look at how designers are considering sustainability, resilience, wellness, and extreme weather events in projects ranging from science to high school education to civic buildings.

mission driven

Designing a living example of respect for nature

BY MICHAEL BANMAN

A client's mission as reflected in the organization's culture is always at the forefront of our design considerations. When that mission intersects with our passion for innovation that contributes to low-carbon, sustainable buildings in our communities, it sparks inspiration.

Find out more about how FortWhyte Alive connects humans with nature.

With the design complete for Buffalo Crossing, a new visitor center for our client FortWhyte Alive, we're looking back on the design approaches that helped us find inspiration, realize our client's mission, and yield extraordinary results.

Here are eight approaches we applied in design for Buffalo Crossing to advance FortWhyte Alive's mission.

ONE

Understand the client's identity, mission, and goals.

FortWhyte Alive is a nonprofit environmental education and recreation organization in Manitoba that teaches children and the public about the natural world, the impacts of climate change, and encourages sustainability. Its campus, located in southwest Winnipeg, includes an interpretive center, reception center, and FortWhyte Farms—a social enterprise that instructs Indigenous and urban youth about market farming, business, and woodworking. The final piece in its campus plan is the addition of a new visitor center and event space to act as a gateway to its extensive trail network.

FortWhyte Alive doesn't build often and needed a trusted partner to help create something lasting and effectual within a budget.

Not only did our design need to forward FortWhyte Alive's educational mission, but it also needed to exemplify a low carbon approach, ideally one that could be used to educate and inspire action.

T W O

Design for project principles and objectives.

FortWhyte Alive requested an 18,000-square-foot, passive house-certified visitor center, with parking, educational space—indoor and out—a bridge over one of the lakes on site (the reclaimed industrial site sits on the Canada Cement Company's former clay and gravel mines), an observation tower, and an accessible dock for canoes and kayaks.

Project goals were ambitious. The visitor center project will not only expand programming capacity, but the client wanted the building to generate revenue as an educational and event space, connect community members to each other and with nature, and act as a highly visible living exhibit of FortWhyte Alive's values—to motivate the community to action. FortWhyte Alive wanted to influence design and building culture itself by demonstrating the impressive possibilities for low carbon design, providing an example that other organizations can follow with their future developments.

T H R E E

Think 100 years ahead.

The client asked us for a building that would last a century. Therefore, resilience—in the face of a changing climate—was a major determinant for our design. Currently, Manitoba's extreme climate zone averages

temperatures of -33 °C in winter and +29 °C in summer, but experts predict that in 60 to 80 years the average will change, resulting in warmer, wetter winters and longer, warmer, and drier summers. To achieve an enduring and resilient building design, we had to anticipate these varying climate extremes.

F O U R

Let a low carbon approach lead the way.

The client's goal for a low carbon, passive-house building led the way to an architectural and engineering solution. The entire project team (client, designers, and construction manager) took a course in passive house design to make sure everyone was educated and ready to apply design thinking to reduce the building's energy load.

Passive house basics include a highly insulated building envelope including insulating glass, ventilation heat recovery, extreme air tightness, absence of thermal bridging (such as building corners), compact building shape (low surface area to volume ratios), and a building orientation that optimizes solar energy harvesting.

First, we looked to these passive house principles to minimize energy consumption and loss, then we looked to innovative building systems and operational solutions to further reduce the building's energy demand.

Designing a building where groups of people congregate that also meets stringent passive house standards required the design team to consider the impact of changing occupancy loads on heating and cooling. Working closely as a team we considered the site, climate, building form, systems, and program and quickly realized there were limited options for achieving the high-level energy performance target.

Thus, passive house principles drove much of the design. For example, our design solution avoids windows on the north face (relying on the solar heat gain from south-facing windows) and reduces the number of building corners (which passive house considers thermal bridges where energy is lost). The building also required a strong visible presence from the motorway but needed to be compact and simple to support its multi-use nature while maintaining a low appetite for carbon. Our solution was to reduce the north-facing façade through a triangular geometry with three rounded corners, creating two balconies which offer a view across the site's acres of bucolic naturalized aspen parkland forest.

Passive house principles required the team to look at weather data and solar orientation to position the building for the best energy performance possible. Rotating the triangular building about 27 degrees opened spectacular views, while capturing the sun's late afternoon rays for daylighting and warmth. We validated the triangular geometry through routine energy modeling studies and compared it to other schemes such as a simple stacked box to optimize form, orientation, and glazing for solar gain and views. We discovered, serendipitously, that the design offering the best views with a strong physical presence from the motorway also optimized the building for heating and cooling.

F I V E

Make the systems nearly invisible.

In passive house design, the smaller, simpler, and more compact the heating, cooling, and ventilation system, the better. Our minimalist approach to the system design presents a nearly invisible solution with no unsheltered ducts across the exposed ceilings. A compact centralized service stack connects the lobby to the multipurpose room on the ground floor and the pre-function area to event space on the second floor, where all the ventilation supply and return air is distributed. On the ground floor a heat pump connects to an underground geothermal field to concrete slabs on each floor with in-floor heating and cooling. The heat recovery ventilator is tucked away on a mezzanine above the event space and enables the building to preheat incoming air, add or remove humidity in the winter months, and the reverse on the cooling side during the summer months. These strategies support achievement of a targeted 90% improvement in energy efficiency than Canada's National Energy Code requires.

S I X

Sweat the details.

Passive house was created as a standard to increase the thermal comfort of occupants. This is best achieved by designing to limit the building's initial heating or cooling load.

In a region with vast temperature variations from winter to summer, this project taught us that every little decision matters, especially when trying to reduce thermal bridging and energy transfer. For example, we had to reconsider placing luminaires in

Rounded corners create two balconies with views of the site's forest. At ground level, the building offers visitors a transition from a busy motorway to natural experience.

Passive house 101

Passive house standard presents a holistic approach that seeks to achieve human comfort and energy efficiency. It sets the bar significantly higher than the more common LEED® certification process. Where LEED® is relative, passive house is not. Buffalo Crossing was a rigorous design exercise that had us revisit the first principles of passive house to develop a design that minimizes overall energy consumption.

FIVE BASIC PRINCIPLES OF PASSIVE HOUSE BUILDING DESIGN AND CONSTRUCTION:

- **Thermal insulation**
  Continuous super-insulated exterior envelope around base floor, walls, soffits, and roof.
- **Windows**
  High performance window frames and triple-glazed insulating glass units with two low-emissivity coatings to provide thermal comfort.
- **Energy recovery ventilation**
  Efficient energy recovery ventilation, allowing for enhanced indoor air quality and energy savings. More than 75% of the energy from the exhaust air is transferred to the fresh air by means of a heat exchanger, in both heating and cooling mode.
- **Airtightness**
  Continuous super airtight exterior envelope around base floor, walls, soffits, and roof.
- **Absence of thermal bridges**
  Minimize number of thermal bridges (connections and penetrations) and detail necessary ones to limit heat transfer.

soffits on the exterior because these electrical penetrations could affect airtightness and overall building performance. The result of each seemingly small decision is that each contributes to the broader purpose of successfully achieving a building design that is targeting eight times more airtight than required by Canada's National Energy Code.

SEVEN

Use innovative green materials.

Exposed wood has biophilic, sustainable, and resilient properties as well as a welcoming, warm, and comforting aesthetic. So, mass timber was an ideal building material for this project. Plus, mass timber has acoustic and sound-attenuating benefits and can store solar heat during the day and release it at night. Prefabricating mass timber elements, columns and beams offsite also gives us a higher degree of control over the quality and finishing of building components. Our manufacturer harvests and replants its own Douglas Fir, which we have selected for the mass timber components due to its higher structural strength.

Elsewhere we are using carbon capture concrete (concrete injected with carbon dioxide) for the building foundation, the deck, and in the bridge to reduce the project's embodied carbon.

EIGHT

Gateway to nature.

The challenge at Buffalo Crossing was to create a place on the site between the busy motorway and the lake that frames the experience, inspiring visitors to pass through and enjoy the space and natural setting just beyond. We aligned the triangular prism parallel with the road to beckon to visitors and offer a transformational experience to those entering and passing through to Buffalo Crossing's outdoor spaces, recreation amenities, and educational spaces.

Through design for the built environment, Buffalo Crossing visibly demonstrates FortWhyte Alive's commitment to addressing climate change, promoting understanding of the natural world, inspiring action toward sustainable living strategies and a better future for all, all within our community's backyard.

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MORE CIVIC & CULTURAL

From Stantec's Winnipeg studio architect Michael Banman advocates for people-centered design in architecture for cultural, post-secondary and higher education projects as well as the mixed-use, urban, and commercial sectors.

Sandy Spring Friends School
Sandy Spring, MD

→

DESIGNING AMERICA'S FIRST WELL BUILDING-CERTIFIED HIGH SCHOOL

Restoring purpose by creating identities and crafting experiences

BY MATTHEW KAVANAUGH

Research shows a strong connection between healthy spaces and the potential for academic achievement. For example, research by Harvard T.H. Chan School of Public Health links indoor air quality and cognitive function.

In the study, **cognitive scores were 61% higher in green building conditions** and **101% higher in enhanced green building conditions** compared to conventional building conditions.

THE IMPACT OF GREEN BUILDINGS ON COGNITIVE FUNCTION – SUSTAINABILITY AT HARVARD

What tools are available to standardize and promote healthy spaces for students? The WELL Building Standard focuses on building occupants, putting people's health and wellness at the center of design. In recent years, it has emerged as a leading tool for elevating human health in office design. But how does it apply to schools? As one of the first architects to design and successfully achieve certification for a WELL Education pilot project, here is what we learned.

Introducing WELL Education

To date, most WELL Building certified projects have been workplace projects. When our education client Sandy Spring Friends School, a private Quaker school in Sandy Spring, Maryland, told us they were interested in a WELL Building, we viewed it as great opportunity to design a pilot project for WELL Education certification. We designed the new Pen Y Bryn Upper School to WELL Building version one, and the WELL Building Education pilot standards. The school received its WELL Building Gold certification in 2022.

WELL certification requires meeting preconditions and optimizations within categories such as air, water, light, fitness, comfort, and mind. The WELL system considers everything from the availability of natural light to olfactory comfort in spaces, the presence of toxic materials to water quality. Biophilic design, materiality, connectivity to nature, sustainable practices, as well as the organizational culture that a facility fosters all contribute to WELL Building certification. The education pilot includes additional categories such as nourishment (which includes the availability of fruits and vegetables), fitness, and provisions for educational space.

WELL relies heavily on on-site performance verification. For example, with WELL, when our engineers design an efficient HVAC system for a project, rather than requiring that they prove its efficiency on paper, the owner arranges for the WELL assessor to verify that it works as designed in a real-time field evaluation.

Sandy Spring Friends School
Sandy Spring, MD

Client space needs
Sandy Spring Friends School needed the final piece for its comprehensive campus master plan, a singular upper school. The idea was to consolidate classes for high school students previously taught in various buildings around campus into a purpose-built facility. Naturally, this would also free up space in existing buildings for other activities.

Values driven
Sandy Spring Friends School represents the core values that it fosters in the acronym SPICES: simplicity, peace, integrity, community, equity, and stewardship. Sandy Spring wanted to instill these community values into its new classroom building. The project would need to foster stewardship of the environment and support community through gathering spaces, for example. We worked hard to design a school that achieves a holistic expression of these values.

A visionary client with ambitious goals
Early in the project, our client was broadly interested in sustainability, but didn't have specific goals. They knew they wanted a green building of some kind, so they researched various types of sustainable accreditations from Green Globes to LEED and found WELL, which suited its culture.

The resulting energy efficient building solution conserves resources and promotes wellness for the community and its occupants-supporting our client's values and goals for the project.

Choosing smart, healthy materials
Sandy Spring uses reclaimed ash from the school site itself that was milled, dried, and stored by one of its teachers for our interior wood wall systems. Not only does the exposed wood speak to occupants as a biophilic material, it connects to the institution's values of simplicity and stewardship.

Connection to the outdoors
We know that connecting students to nature, even views of the outdoors can be beneficial. Sandy Spring Friends School is a campus, so it was important to integrate outdoor spaces with the Upper School. The design provides occupants with access to a meditation garden, as well as an outdoor terrace on the third floor.

Students, noting that they would no longer walk outdoors between most classes, suggested the upper school needed additional outdoor space, feedback which inspired the design team to add an outdoor terrace on the third floor.

Sandy Spring Friends School
Sandy Spring, MD
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Sandy Spring Friends School
Sandy Spring, MD
A makerspace opens to provide access to the outdoors.

↓

The Upper School is just downhill from the Quaker meeting house on campus which inspired various aspects of our design. For instance, historic meeting houses often have porches. The cantilever “back porch” we designed for the new school welcomes members of the school community and connects to outdoor gathering areas.

Many voices, including the students

In Quaker meeting houses, decisions are made by consensus and discussion continues until the group reaches an agreement. Conversations about the new school building project began a decade ago. Since then, the design team discussed project goals over dinner at teachers’ homes, conducted numerous collaborative design charrettes, and surveyed an array of stakeholders. The process was long but inclusive, bringing a wide range of perspectives into the mix: board members, administrators, educators, parents, and students. Students and teachers alike had a voice in the design charettes for the upper school, even playing our planning game together. Students, noting that they would no longer walk outdoors between most classes, suggested the upper school needed additional outdoor space, feedback which inspired the design team to add an outdoor terrace on the third floor.

Today’s collaborative pedagogy

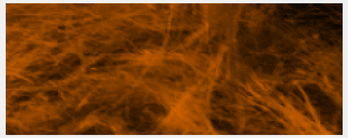
We designed open, flexible spaces for collaboration in addition to classrooms to facilitate today’s style of instruction, group projects, and informal interaction. The new school building features a variety of educational environments—traditional classrooms, open and closed collaboration areas, and social spaces—equipped with dynamic lighting and ergonomic, adaptable furniture.

Net zero ready

Stewardship of the land is a Quaker value. Sandy Spring Friends School had already committed itself to renewables with a large solar array adjacent to the campus to offset campus energy use. They were already on the road to a sustainable, net zero campus. We engineered the upper school’s systems to connect to the solar array.

We designed the school with systems that provide for human comfort efficiently including a geothermal well field for heat exchange and a Variable Refrigerant Flow (VRF) system. We located the dedicated outdoor air units for ventilation on discrete stair towers to leave the rest of the roof free and open for a future solar array.

Using mineral wool and fluid applied air barrier (analogous to a sweater and skin for the building, respectively) as insulation, we gave the Pen Y Bryn Upper School a tight envelope (minimizing air leaks) which allows building occupants more control over their comfort while increasing energy efficiency.



The Importance of Mineral Wool

- Mineral wool is **a byproduct of recycled steel** with numerous benefits as an insulation material.
- **It’s inert, it doesn't emit gases.**
- Animals, critters, and insects **don’t live in it.**
- It retains its R value **(insulating power)** over time.
- It's a **natural firestopping** material.
- It’s **made from waste**.

Sandy Spring Friends School
Sandy Spring, MD

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While this pioneering WELL design effort was initially made possible by a client with ambitious goals for its new high school building, the fundamental lessons of Sandy Spring Friends School Pen Y Bryn Upper School are not unique. We can promote student wellness and human resiliency, low carbon, and long life with designs that are simple, elegant, and make use of natural and resilient materials while connecting to organizational culture and values. Sandy Spring shows that design for wellness is well within our reach.

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FIND OUT MORE ABOUT USING THE WELL BUILDING STANDARD ON YOUR NEXT PROJECT

Matthew Kavanaugh designs high-performing and sustainable educational projects from Stantec's Charlottesville, VA studio.

What's driving building retrofits?

RISK

A nudge in the right direction

BY KATIE FORMOSO, YASMEEN SULTANA & NORMAN SHIPPEE

Buildings account for a significant portion of greenhouse gas emissions in North America. For years, researchers have argued that making buildings more efficient is the most affordable way to reduce overall emissions. What does it take to move the needle? We've identified three trends nudging organizations and businesses to invest in retrofits (and highly efficient new buildings).

Firstly, cities such as New York and Toronto have passed new laws to encourage property owners to make their buildings more energy efficient. If they don't, they risk penalties. Secondly, many corporations and large organizations now conduct ESG (environmental, social and governance) reporting, and the "e" means they track and share information on various aspects of their carbon footprint. Unsustainable practices are considered risks by many investors. Thirdly, federal government regulations in Canada increasingly ask for risk assessments for climate change. The government wants to ensure that it is getting buildings that are prepared to adapt to more extreme weather.

New city regulations

BY KATIE FORMOSO

Buildings account for approximately 66% of all greenhouse gas emissions in New York City. The city passed Local Law 97 (LL97) in 2019, requiring buildings to meet new energy efficiency and greenhouse gas emissions, starting in 2024, with stricter limits coming into effect in 2030, and again in 2035. With this new legislation, New York is targeting 40% reduction in aggregate greenhouse gas emissions from buildings by 2030 and an 80% reduction in citywide emissions by 2050.

Many of New York's building owners do not know about LL97 yet or how it may impact them, so we focus on educating them.

ENERGY TARGETS

New York established its Greenhouse Gas Emission limits on a square foot basis by type of building occupancy. There are penalties for building owners if their buildings don't meet emissions goals—modest ones beginning in 2024, with more stringent penalties thereafter.

ENERGY GRADES

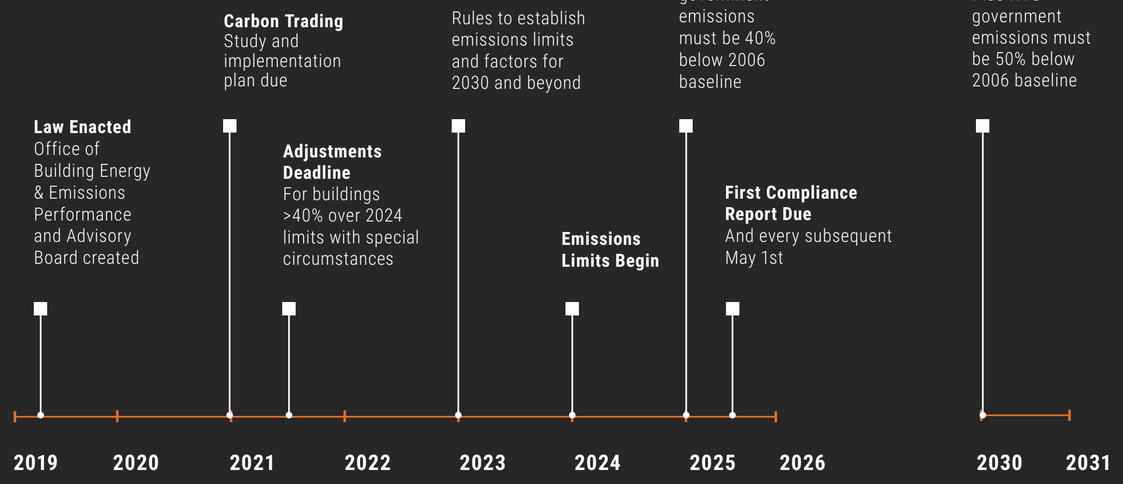
New York's existing local laws were a prelude to new mandates. Local Law 33, an amendment to Local Law 84, mandates all buildings over 25,000 SF (and city buildings over 10,000 SF) must submit annual energy usage, which is graded and displayed in the lobby window. Scores range from A to F, with A being the most efficient, and D being the least efficient. An F grade is given to any building that refuses to comply with the mandate. Right now, when walking around the city we are seeing a lot of poor grades, as many owners haven't done much to reduce their buildings' energy loads. The intent of the energy scores is to inform the public about the building's energy performance.

LIGHTING LAW

New York City has also passed Local Law 88 which requires that property owners for all buildings over 50,000 SF upgrade their lighting systems and install submeters to comply with the 2010 NYC Energy Conservation Code (2010 NYCECC). Since lighting loads in non-residential buildings account for

Source: *GBCI*

Timeline for LL97 implementation



18% of carbon emissions in NYC, compliance with this law will set buildings on a course to meet LL97's goals.

EDUCATION NEEDED, THEN RETROFITTING

Many of New York's building owners do not know about LL97 yet or how it may impact them, so we focus on educating them.

As engineers for low carbon buildings, we are prioritizing how best to get the word out. Our first recommendation, as advisors, is to perform an LL97 Assessment for the property. This study focuses on energy consumption and emissions, present day. Once we understand the building's current emissions, we can produce a year-by-year, step-by-step, upgrade-by-upgrade plan to reduce emissions. Getting an early jump on this is so important. The first Annual Building GHG Emission report is due by May 1, 2025, with reporting based on 2024's operating data. While some building owners may be interested in reducing their carbon imprint (to reduce energy bills or position themselves in the market), these government-mandated requirements will largely drive existing building retrofits.

BIG TICKET ITEMS

Many building owners are overwhelmed with where to start. Our recommendation is to look at lighting first. A significant percentage of NYC's multifamily buildings and office buildings are still illuminated by incandescent or first-generation fluorescent lamps. These inefficient lights also burden cooling systems with their high heat output. Upgrading the lighting systems to comply with LL88 and meet the 2010 NYCECC will help building owners reduce electric use, bring the electricity coefficient down in the emissions equation, and comply with LL97.

Steam is another big item that building owners can target. Many properties have already begun phasing these systems out, which is helping significantly to reduce carbon emissions.

And then there are just old, inefficient systems that are coming due for replacement. Replacing or retrofitting outdated systems to meet the new emissions requirements will help property owners with LL97 compliance, while also saving money.

PENALTIES, ALTERNATIVES

As of now, there are several violations for non-compliance. Failure to file with the city will result in a monthly penalty that is calculated based on the building's covered area in SF, multiplied by $0.50. Failure to meet the emissions limits is calculated based on the difference between the building's annual emissions limit and its actual emissions, multiplied by $268. Penalties are expected to grow in the coming years. Alternatively, building owners can purchase renewable energy credits, greenhouse gas offsets, and energy storage.

WIN-WIN

Although property owners are frustrated with the growing number of new local laws, they should see mandates such as those in New York City as a potential win-win. They will get a more efficient building that costs less to operate, even when energy prices are volatile. Additionally, commercial building owners are going to come away with a building that has a low carbon story to tell. They can talk about the steps they're taking to reduce emissions and use their high-scoring building grade as a selling point for potential tenants.

The BEAT
Boston, MA

ESG goals in the corporate world

BY YASMEEN SULTANA

ENVIRONMENTAL, SOCIAL, AND GOVERNANCE

(ESG) emerged from the world of sustainable and responsible investing. It's an umbrella term for a set of disciplines describing how companies do business and how that impacts the world. ESG covers issues ranging from ethics and sustainability to diversity and security. Investors use this approach to determine a company's risk resilience, which can have a direct impact on future financial performance.

IT'S ABOUT RISK.

ESG risks are now considered business risks. A company's ESG rating indicates its long-term environmental, social, and governance risks. Investors want to see a prioritized assessment of the risks to the company. For example, if a company has high greenhouse gas emissions and does not take action to reduce them, it risks disinvestment from funds which screen for environmental issues.

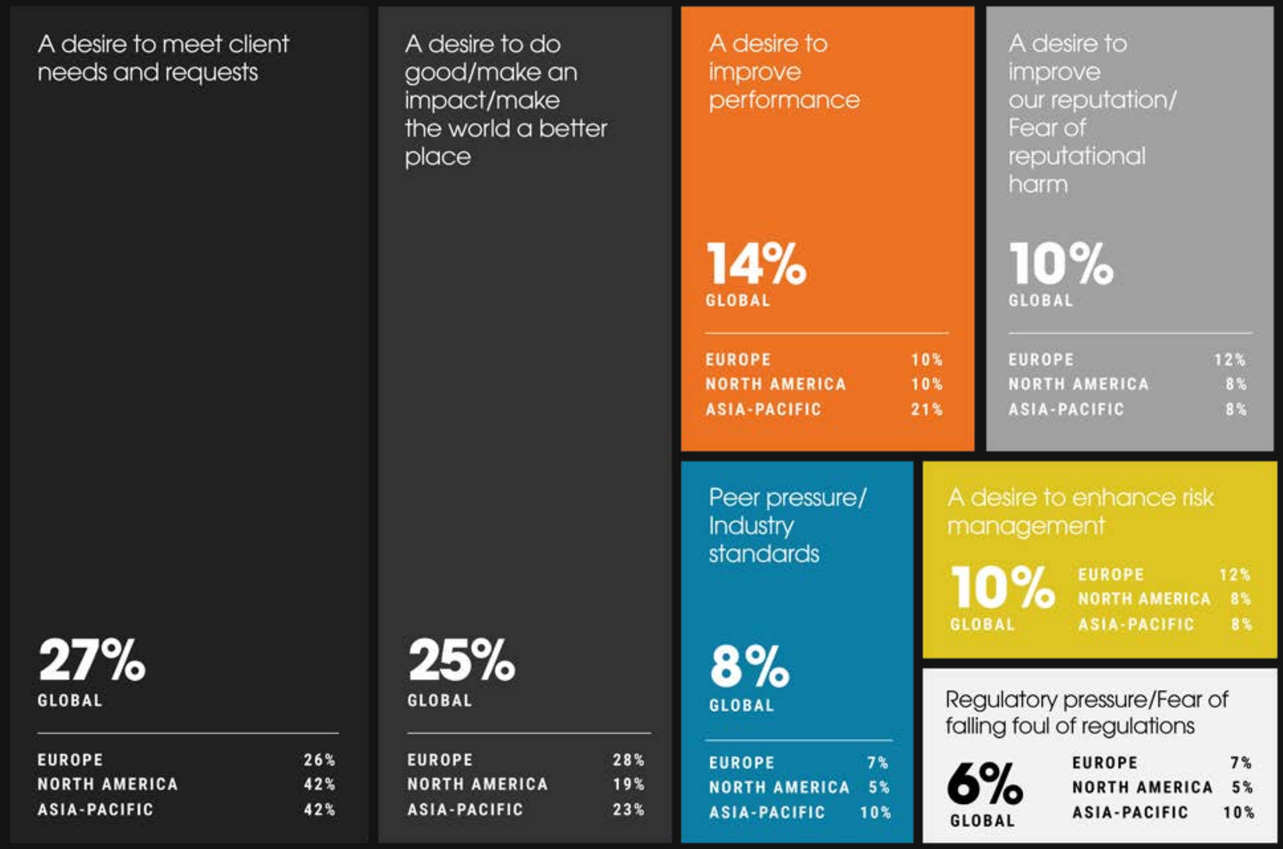
IT'S MORE THAN GREEN PRACTICES

While ESG is strongly associated with sustainability and carbon footprint, it is a broad umbrella. Sometimes climate change and ESG are used interchangeably, but this is incorrect. Climate is a subset of the entire ESG world. Environment includes air, climate, water, and waste; it's about broader environmental impact. ESG ratings also consider social criteria; how companies treat their people. It examines labor practices, diversity, cultural ethics, and data security practices. The governance component gives thought to what policies, procedures, controls, and incentives are in place within a corporation to ensure appropriate ESG compliance.

URGENCY

The increased urgency around ESG is coming from new regulations, shareholder interest, and public declarations of corporate or organizational goals, and regulations will likely increase. For example, the U.S. Securities and Exchange Commission recently proposed a regulation for climate-related disclosures for all public companies.

WHAT IS THE PRIMARY REASON YOUR ORGANIZATION HAS ADOPTED, OR WOULD ADOPT, ESG?



Source: *THE CAPITAL GROUP ESG GLOBAL STUDY 2022*

Governments, global financiers, and development institutions like the World Bank Group are embedding sustainability goals as a criterion for funding access.

Shareholders want an ESG report to understand risk, and many companies have already made public declarations of their 2030 or 2050 goals.

ESG HAS A DOMINO EFFECT

We are hearing from companies that their customers, often other large firms, are driving ESG. That major retailer that they sell to, for example, wants to know what their emissions are for its reporting. The big players are looking at supply chain emissions and their vendors' emissions. As a result, those companies in the supply chain are approaching us with questions about what they can do to reduce and track their emissions. It has a domino effect.

AS ESG GROWS, THE QUESTIONS MULTIPLY

Up until recently, our technical expertise was more specific to climate change related factors or United Nations Sustainable Development Goals. We saw ESG growing in recognition and importance and decided to launch an ESG-focused practice as a new area of technical expertise. Now we're getting more questions from different companies who are looking for options to reduce their emissions and calculate their greenhouse gas inventories. They want to know, "How do I track and report this?"

High Sheldon Wind Farm
Sheldon, NY

Climate risk assessments

BY NORMAN SHIPPEE

Governments in Canada are taking climate risk seriously. They are anticipating the effect climate change will have on the built environment and they are demanding new processes to ensure they are funding projects that will stay resilient for decades. In response, our teams have increasingly been providing services, including climate change risk assessments, to help businesses and organizations plan for and adapt to the disruptive effects of climate change.

These challenges are significant for buildings. A McKinsey & Company report from 2020 on climate risk notes that "physical assets like buildings could be damaged or destroyed by extreme precipitation, tidal flooding, forest fires, and other hazards" and that companies and communities are unprepared for the effects of climate change.
"The pace and scale of adaptation are likely to need to significantly increase to manage rising levels of physical climate risk."

GOVERNMENT MANDATES

New federal building projects in Canada (or any building receiving more than $10 million in federal funding) require a climate risk and resiliency assessment, and sometimes greenhouse gas emissions assessments as well. Defense contractors, government agencies and various entities interacting with the government must adhere to guidelines stipulating that climate resiliency is addressed on building projects.

These new rules are still proliferating and are not always well understood. As experts on climate risk assessments, we often need to educate the client's project managers on how we can align efforts to satisfy risk assessments requirements.

PROVINCIAL GUIDELINES

Alongside federal mandates, provincial authorities such as the province of British Columbia are taking action. For instance, as part of its Climate Preparedness and Adaptation Strategy, British Columbia has put new guidelines (Climate Resilience Guidelines for B.C. Health Facility Planning and Design) in place for healthcare buildings. These guidelines expect a climate risk assessment process at the master planning stage. B.C. Housing also funds Mobilizing Building Adaptation and Resilience (MBAR), a program that helps people protect their homes and buildings from the destructive effects of climate change.

CLIMATE RISK AND DESIGN

In this way, climate risk influences design. Our work on climate risk helps inform architecture and design teams about climate change risk to existing assets for retrofitting projects or how potential design strategies and features they are considering on new buildings will be influenced by climate change. And our team considers detailed design criteria and ensures that projects going out to bid contain the most up-to-date code requirements and standard information relative to climate change risk. We perform climate risk and resilience analysis at various stages of projects, from concept design all the way up to retrofitting existing buildings or examining existing buildings for any resilience exposure.

Our work in risk assessments helps clients start to identify which assets are vulnerable and which potential adaptation and resiliency measures they should pursue. This can include hardening an asset to make it more resilient or looking for a sustainable solution in building design and systems to mitigate the climate risks they will face in the future. Designing for resilience in light of changing climate is simply the right thing to do.

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SUSTAINABILITY AND BUILDING PERFORMANCE

ESG SERVICES

From Stantec's New York City office, engineer Katie Formoso is Stantec's market leader for workplace repositioning who focuses on blending engineering solutions with architectural vision to deliver transformational results. A climate scientist based in Ottawa, Norman Shippee tailors solutions to help communities manage risks related to extreme weather conditions and climate uncertainty. Based in Sacramento, Yasmeen Sultana is the Technical Leader for Stantec's ESG practice in North America. She advises clients on ESG strategy and implementation.

St. Paul's Hospital
Vancouver, BC
Architect: HDR + Stantec
PCL Construction

Healthcare resiliency

Seven ways we can design more resilient healthcare projects today

BY SHANE O'HANLON

St. Paul's Hospital
Vancouver, BC
Architect: HDR + Stantec
PCL Construction
Stantec completed a complex and detailed climate hazard and vulnerability assessment, as required by the City of Vancouver for the St. Paul's Hospital project site.

Hospitals are essential buildings. During an extreme weather event or natural disaster, health care institutions must remain operational, providing emergency services to the populations they serve.
When we are designing new or updated healthcare projects, we must adhere to the applicable building codes for health and safety. But we also ask ourselves, can we do more?

In light of the changing climate and increased frequency of extreme weather events, it is critical for designers to build in resilience to projects so that they can safely provide for their communities decades from now. With our deep expertise in the health sector, we've developed several approaches to designing for healthcare resiliency that go beyond currently prescribed approaches and address resiliency more broadly.

1. Think regionally, engage with utility providers
Healthcare projects differ from the typical commercial design project in their large scale and complexity. Rather than focus solely on the building scale as one might with a commercial project, we look at the healthcare facility's role in its municipality and region. One of the first things we do on healthcare projects is to engage with our utility providers—gas, electricity, water—so we have a strong understanding of what's happening in the region and how our project fits into it. We promote robust stakeholder engagement with utility providers, transportation authorities, regional authorities, and entities around healthcare project resiliency.

We recognize that the hospital, unlike an office building or residential tower, will see a surge in use during an emergency, natural disaster, or extreme weather event. We examine regional vulnerabilities and connections to networks offsite. We must consider how the transportation network and the supply chain are essential to the continued operations of healthcare facilities.

How resilient is the facility to the threat of regional hazards? For example, how could the risk of wildfire beyond your site affect air quality issues at your facility? How vulnerable is the facility to offsite hazards such as flooding or downed trees that can disrupt access to the site during an emergency?

2. Facilitate engagement between disciplines
We facilitate communication regarding resiliency between the various design disciplines to find the right solutions. For example, we see extreme heat in many areas. One response to that is upsizing the building's cooling systems. But that approach will likely lead to increased energy use to provide that cooling. Instead, we engage early in the project and look for alternatives. Can we address part of that need for cooling

South Niagara Hospital *Niagara Falls, ON*

through the building facade design? Can we reduce our window-to-wall ratio and reduce solar gain on that building? Is there another discipline that can support, perhaps civil engineering or landscape architecture? Can we plant more trees on site to provide more ground level cooling and reduce the heat island effect, for example?

By involving as many disciplines as possible as early as possible we can facilitate holistic approaches to achieve resiliency, eliciting ideas from a multi-disciplinary team. Another example is how we might address changing precipitation patterns and more intense rainfall that accompanies climate change. Instead of simply oversizing the stormwater network to cope with increased demand and thus prevent flooding, we could incorporate landscape architecture elements to increase the infiltration on site or adjust the grading to lessen the impact in such an event.

3. Future proofing for climate change

In Canada, we have new guidelines for large capital healthcare projects that require designers to carry out hazard exposure screening and climate risk assessments on projects.

Climate risk assessments generally indicate that peak and average temperatures will be higher in decades to come. We can anticipate that healthcare buildings will require increased cooling ability as the climate warms. Rather than design to our current climate, we want to size and select systems according to climate change prediction data thereby building resilience from day one. But we want to be smart about it. Once we have considered how each discipline may support strategies to reduce cooling, e.g. the above-mentioned changes to window-to-wall ratio, or site orientation and solar gains, we can then look to the mechanical engineers to consider the HVAC systems. We may not want to put in an oversized cooling unit today, just the appropriate one for the next 15-20 years.

By involving as many disciplines as possible as early as possible we can facilitate holistic approaches to achieve resiliency, eliciting ideas from a multi-disciplinary team.

In 25 years, the current unit will be inadequate, so we can then replace it with one that has a larger capacity. We need to anticipate that. Did we size the mechanical room in the building to be large enough to fit a larger unit,

North Island Hospitals *Comox Valley, BC*

VA Puget Sound – Mental Health & Research Building *Seattle, Washington*

or did we limit ourselves and undersize our room based on today's units that don't allow for future modifications. Can we access that room and replace that unit easily? Did we size the ducting in the building for that future load? Because we can't rip out all of the ductwork for airflow at a later date, not without huge expense and disruption to healthcare service delivery.

It's about recognizing where you can have flexibility with the space for the system, the ductwork, and the cooling unit itself. It's about allowing for the possibility of an auxiliary connection in 10 or 15 years to meet changing cooling needs.

Thus, we can anticipate what systems will be required in 2080 toward a facility's end of life. Where systems will not be accessible (above ceilings and in shafts) we should install 2080-sized equipment or ductwork now. Where systems are accessible (like in mechanical rooms or on the roof) we should simply allocate space for the future/replacement systems.

4. Flexible spaces for triage

The pandemic has demonstrated the need for flexible thinking around space use. It made us look at space on the healthcare campus differently. Can we reconfigure waiting areas, outdoor spaces like courtyards and plazas, even parking garages and other parts of the hospital in an emergency to deal with triaging patients? Can we convert those spaces quickly and make them useful? Flexibility and multi-use space informs a great deal of our thinking about design for healthcare campuses today.

← **VA Puget Sound – Mental Health & Research Building**
Seattle, WA
Upgrades at VA Puget Sound included seismic corrections to meet VA Seismic Standard H-18-8 for nursing tower, a community living center and replacement of 168 buckling restraint braces. Resilient features include water storage tanks which allow the hospital to stay operational for three days if service is disrupted.

5. Increased need for storage spaces

Another thing we see is the increased need for storage spaces inside buildings. During the pandemic, the need for PPE (personal protective equipment) in hospitals ramped up. And many hospitals realized that to be resilient they needed more reserve PPE on site rather than rely on just-in-time delivery. In light of supply chain disruptions and extreme weather events, healthcare institutions are looking for space where they can store materials and supplies so they're ready for anything.

6. Shading on site/ using outdoor spaces

Taking an architectural perspective, we see a different set of needs emerging with the recognition that an extreme event can cause a surge in demand for healthcare services. Seen through that lens, we obviously need more shading on site. But is there more we can do? During an extreme heat event, can we convert the plaza into a cooling center? Have we provided space to put up white shaded tents to shelter people outside who need shade and water before they can receive medical care?

Our architectural solutions are leaning into consideration for flexibility of spaces, particularly adjacent space outdoors.

→

Royal Columbian Hospital – Mental Health & Substance Abuse Wellness Centre
Vancouver, BC

7. Overland flooding and access routes

Ambulances and emergency vehicles must be able to reach the hospital during extreme weather events and extreme rainfall. So, on large healthcare projects, we must consider the possibility of overland flooding and the maximum allowable depth of standing water on the site that is safe for these vehicles to pass through.

We must explore opportunities to ensure that the site is graded to minimize overland flooding on essential routes and for ways to maintain access at the various entry and exit points, main entrances, roads, and parking areas. We configure these routes with consideration for the client's emergency access and operational needs. In other words, we must make sure that they know which routes are the safest to traverse if the site is flooded and they can't ascertain the water depth. Together, these approaches along with a mindset that anticipates the risk to resiliency posed by climate change helps us design more responsive healthcare complexes that support our communities in crisis.

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MORE CLIMATE CHANGE RISK ASSESSMENTS

Based in Vancouver, Shane O'Hanlon is a project manager, facilitator, and senior climate risk and resilience consultant.

Design for seismic activity

Engineering electric systems for healthcare in Southern California

BY JEFF HANKIN

The Earth is reshaping itself in California. Southern California is a high seismic zone and scientists predict a continued increase in seismic activity there in the future. Loma Linda University Medical Center sits at the intersection of two faults. The Loma Linda Fault meets the San Jacinto fault a few hundred feet west of the Loma Linda University Drayson Center. Researchers call the San Jacinto fault "a significant seismic hazard."

The design team for the expansion and renovation of Loma Linda University Health - Dennis and Carol Troesch Medical Campus was challenged to pay close attention to the seismic requirements in the international and California building codes as well as technical studies and predicted models for forces that a building would encounter during a seismic event in this area.

The code defines Southern California as a specific seismic zone with specific design criteria and clear prescriptive requirements. The modeling data told the team that they needed to design a structure to absorb both ground force and then the energy that potentially transmits itself up the building.

←

Loma Linda University Health - Dennis and Carol Troesch Medical Campus
Loma Linda, CA
"Umbilical" and flexibile connections were designed for building movement

Base isolation
The structural engineer designed the building with base isolation—as a box that can move relative to the fixed earth around it. The building sits on 126 pendulum isolators that allow the structure to move 42 inches in any direction.

Three forces
The building and its systems needed to be designed for 3 ½ inches of interstory drift (how far one floor moves relative to another during a seismic event). The building would also be built to withstand deflection forces: the flexibility to absorb energy, bend to it, and dampen that energy as it returns to position. And the base isolated building needed the ability to move 42 inches relative to the earth around it.

Electrical and telecommunications
As the electrical engineer and information technology systems consultant Stantec had to find a way to deliver power and telecommunications to the building without creating permanent structures that would transmit seismic energy from the surrounding land to the building during an earthquake. We had to connect power (medium voltage, medium voltage utility power, essential power from a remote generator plant, and emergency power controls, plus telecommunications voice, and data systems). We had to design these robust systems to transmit power and data up the 17-story (one story below, 16 above) building to serve the needs of the adult and children's hospital towers and make them expandable, resilient, and flexible to accommodate growth over the next fifty-plus years.

"Umbilicals"
Anything that enters the building from outside needs to be able to be flexible enough to withstand that 42-inch movement in any direction. This incredible engineering challenge required a one-of-a-kind solution. We worked with our engineering team, our design assist trade partners, and equipment manufacturers to conceptualize and design a system that was flexible enough to move with the building during a seismic event, but also deliver power and telecommunication to any point in the building.

These customized flexible transitions or "umbilicals" allow the building to perform and maintain service continuity. They transition from the fixed conduit coming from the outside to a flexible cable transition system that we designed to withstand a building that can move, and then back to fixed elements that then rise or distribute horizontally in the building. Together, these features contribute to the Troesch Medical Campus' seismic resilience.

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MORE HEALTH

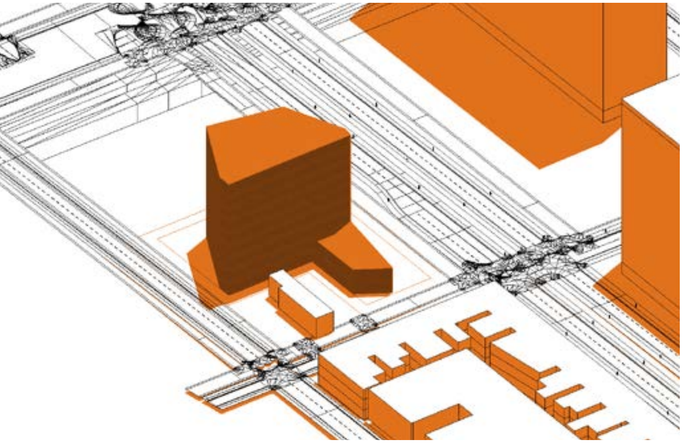
Jeff Hankin leads the healthcare engineering practice in California and is a member of Stantec's Global Health Sector leadership team. He leads and manages numerous healthcare projects from his location in Stantec's San Diego office.

CALCULATING THE POSSIBILITIES

Developing a new tool for carbon calculation and generative design to support sustainability

BY ESRA ABUMOUNSHAR

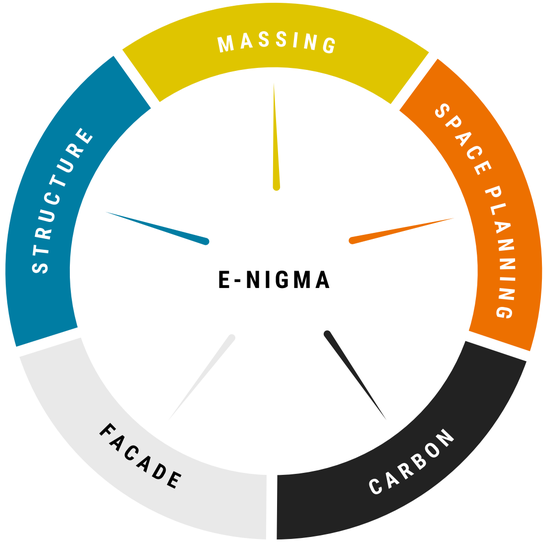
THE SOONER IN THE DESIGN PROCESS WE CAN EVALUATE OUR DESIGNS FOR THEIR CARBON IMPACT, THE GREATER THE OPPORTUNITY TO MAKE DESIGN DECISIONS THAT REDUCE THE CARBON FOOTPRINT OF BUILDINGS.



From a design perspective, calculating a project's potential carbon impact in the early design phases can be costly and time-consuming, especially if these projections are not well integrated within the conventional design process. Because the design industry does not yet have a standard tool that can usefully and efficiently calculate carbon impact during the early design phases, the calculations currently require a significant, and sometimes costly, design effort.

What if we could generate multiple design options and quickly evaluate them for their carbon impact at the early stages of the design process? What would that mean for our designs and their carbon impact? These are some questions that led to the research and development of E-NIGMA, a new technology we're developing which combines carbon analysis with a customized generative design tool.

Nigma means "five" or "star," E-NIGMA is our working name for the digital tool we're developing with five primary functions: massing, space planning, structure, façade, and carbon calculator. Our current prototype supports rapid massing with carbon calculation and space planning analysis.



In phase two of E-NIGMA, we will devise a logic for space planning that can automatically inform the building's shape. Parallel to this effort, we're building out the structural materials aspect of E-NIGMA so that it can calculate embodied carbon, based on structural material choices. The final phase of our research will focus on integrating those existing capabilities with generative function for structure and façade and the ability to calculate carbon for the entire design.

When fully realized, E-NIGMA will combine the creative benefits of generative design with the data crunching power of a carbon calculator.

Carbon calculator
With as little as a site and a preliminary program, designers will use E-NIGMA to consider design options within the project parameters and calculate carbon emissions (including embodied carbon) based on size and shape and how much site can be preserved—for example, what's the carbon cost for using 70% of the site versus 100%?

Generative 3D design
When complete E-NIGMA will be more than a carbon tool, it will be a 3D modeling automation tool. With E-NIGMA, the designer never has to model multiple design options manually. Instead, the designer outlines the site, and E-NIGMA provides options, molding building siting possibilities. In five minutes, it can generate 400 different building options, so the designer's job is to then validate and prioritize those options, spending more focused time adding value to the design by assessing its carbon impact.

Without such a tool, there often isn't time and budget available to model, evaluate, and refine more than a few options, which leaves potentially game-changing options undiscovered. E-NIGMA will empower designers to focus on the human experience—wellness, community, and productivity—in the spaces they create.

Efficiency
We all know that design is an iterative process, often requiring re-work when project parameters, market conditions, or end use directive changes. Today, speed to market is critical. The true power of E-NIGMA will be its ability to automate 3D modeling and track any changes or refinements as the design evolves. As a result, there is no lost work, no rework, no remodeling, and better-informed decision making.

E-NIGMA WILL ALLOW DESIGNERS TO RAPIDLY EXPLORE WHAT'S POSSIBLE WITHIN PROJECT PARAMETERS AND EVALUATE OPTIONS FOR CARBON EMISSIONS.

Data overview
Alongside the 3D design options, E-NIGMA will display associated data such as the building's height, the total area, and carbon appetite. The designer can control parameters such as the floor-to-floor height within the tool. So, it's easy for the designer to flip back between the design platform and the assessment platform, giving designers and clients a sense of how program, design features, energy use, and carbon footprint are related.

University of Lethbridge
Lethbridge, AB
Architect: Stantec/KPMB

Giving clients the opportunity to make informed decisions early in the design process helps us achieve desired outcomes for design, flexibility, and most critically building performance.

OPTION 1 OPTION 2 OPTION 3 OPTION 4 OPTION 5

Five mass options generated by E-NIGMA. Option 5's larger dimensions have a dramatic impact on the building's carbon footprint, exceeding the targeted threshold. E-NIGMA enhances our ability to show clients how design choices relate to carbon impact.

Personalized to project, and client

E-NIGMA will transfer information related to either carbon or the building form into 3D, so the client has a visual representation of their project alongside its specific parameters. With this tool, designers can have focused conversations unique to the client's specific site, project location, and program requirements. E-NIGMA will also be able to incorporate some of the zoning aspects of the project such as setbacks and height restrictions so that the resulting options conform to site development requirements.

Developer clients, for example, could see what kind of density and revenue is possible on a site before they've even purchased it, allowing them to make better informed acquisitions to meet their goals. From the start, the design is site and client specific.

A win-win

From the client perspective, E-NIGMA will drive project efficiency. From the designer perspective, it drives productivity. Because we're able to provide more options in a shorter span of time, we can help projects stay on track by accelerating the workflow during early design. In markets like healthcare where there are strict schedule requirements, this means we can evaluate preliminary design options quickly, homing in on the most viable option which we can then spend more time refining the details, without disrupting an often-rigid timeline.

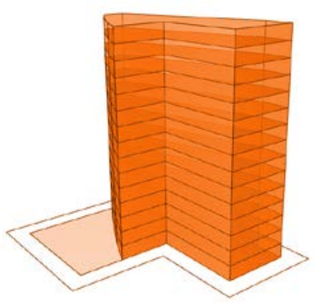
Real time collaboration, see the planning possibilities

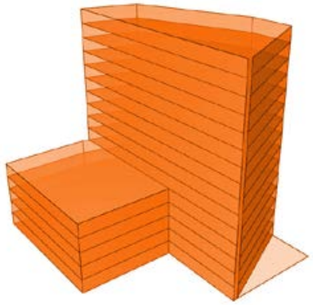
The beauty of a tool like E-NIGMA is that it empowers real-time collaboration. From our studio, we can run through distinct options that E-NIGMA generates, vet them, and get sign off from decisionmakers as we're modifying the options in real time. Clients can quickly see multiple relevant options and decide on a building form with us. It helps them see what's possible within the parameters of the project and site; for example, layout "Option 5" accommodates 24 exam rooms while layout "Option 2" only accommodates 16. By integrating the tool into our process, we will help align the full project team's efforts while cutting down on time-consuming back and forth reviews and lengthy decision making.

Anticipate new carbon legislation, restrictions

Many authorities are increasingly adopting incentives for carbon reduction in new construction and existing buildings. Likewise, clients,

OPTION 2 VS. OPTION 5





Outputs *(Option 2)*	
Building GSF	129609.898
% GSF	37.0
Preliminary Room Count	3410.787
Preliminary Cost Estimate	32402474.469
Facade Surface Area	82411.347
Embodied Carbon Footprint (Facade)	82411.347
Embodied Carbon Footprint (Structure)	82411.347

Outputs *(Option 5)*	
Building GSF	229591.197
% GSF	24.0
Preliminary Room Count	6041.874
Preliminary Cost Estimate	57397799.326
Facade Surface Area	118167.747
Embodied Carbon Footprint (Facade)	118167.747
Embodied Carbon Footprint (Structure)	118167.747

sometimes driven by their shareholders or ESG (Environmental, Social, and Governance) criteria, are making big moves toward responsible practices regarding their carbon appetites. Those anticipating or subscribing to the new standards must take carbon seriously and need guidance on how to meet emerging carbon goals. Technology applications like E-NIGMA provide a pathway for clients to meet new laws, regulations, or corporate and organizational targets by enabling them to see the carbon impact of their building or real estate choices before they commit. The tool provides the designer and client with clear insight into how a proposed building will impact an organization's carbon metrics.

Building a design library

E-NIGMA will enable us to extract carbon information from the digital 3D models we have generated and analyzed. We're building a library of approaches and elements that minimize carbon, and continually analyzing patterns and best practices to develop a robust toolkit of carbon reduction approaches for design.

Areas of application

We're still developing E-NIGMA and coordinating our efforts so that it fits alongside Stantec's *complementary efforts in carbon modeling for masterplans and generative design for multi-family housing.* We hope to apply E-NIGMA on healthcare and education projects, too.

We're excited for the future of E-NIGMA, and the opportunity it creates to share more options and identify new paths to a low carbon future for our client partners.

Trail Riverfront Centre
Trail, BC

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FIND OUT MORE ABOUT STANTEC.IO FOR BUILDINGS

Esra Abumounshar leads Stantec's generative and computational design research group from our Philadelphia studio.

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Executive Editor **Andrea Johnson** and **Summer Heck**
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Graphic Design **Miranda Esteve**