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Engineering the Future: Embracing Sustainable Building Practices and Technological Advancements to Combat Climate Change

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In the face of the pressing need to combat climate change and reduce carbon emissions, the adoption of sustainable building practices has become paramount within the construction industry.

Engineers assume a pivotal role in spearheading this movement towards a greener future. An integral aspect of implementing these practices lies in embracing technological advancements.

Wendy Macdonald, a Sustainability Consultant at RJC Engineers (RJC), brings in-depth expertise and 23 years of invaluable experience as a pioneer in sustainable design. With a strong background in energy conservation, sustainability, and mechanical design, Wendy

effectively channels her passion for environmentally-friendly design principles to deliver sustainable projects and services in this field.

What role do engineers play in sustainable building practices? Why is RJC a leader in this space?

WM: Building design and construction takes a team, and engineers are key players in that team. We hold up the building, we keep it bright and warm, we keep the outside out and inside in. By virtue of what we specialize in, RJC has the ability to be a powerful carbon reduction firm. Between embodied carbon in the structure and energy efficiency born of great enclosure designs, our structures, envelope and building performance teams combine to affect much of the carbon emissions associated with building. We acknowledge the weight of that responsibility and employ our "creative thinking, practical results" motto to find elegant solutions to minimize the environmental footprint of the buildings we design.

How can RJC help Canada meet its 2050 net-zero emissions goals through sustainable building practices? Can you share some examples?

WM: RJC is a signatory to the SE 2050- the Structural Engineers 2050 Commitment Program. As a signatory of SE2050, RJC is part of a growing list of companies that have pledged to understand, reduce and ultimately achieve net-zero embodied carbon by 2050. We'll be driving down emissions in our own designs, sharing data and learning together about how to reach goals of net-zero emissions by 2050. We are committed to developing and providing access to tools that will allow us to benchmark embodied carbon metrics, set targets, track progress, and validate the design approach of projects for embodied carbon savings against industry trends.

Much of the work we do is in building retrofits. Keeping buildings standing, particularly if they can be retrofitted to operate in a low-carbon way, minimizes embodied carbon emissions. These projects mitigate the need for new construction, conserve resources, and reduce the environmental impact associated with demolishing and replacing older structures.

Canada's construction industry accounts for 17% of national carbon emissions. How can engineers use technology to integrate more sustainable building practices into new construction?

WM: Thankfully, technology is evolving to help engineers integrate more sustainable building practices into new construction. The availability of data and computing ability allows us to perform predictive modelling: better analyze and understand how buildings are likely to behave in various hypothetical situations, whether it be various energy efficiency strategies being considered, projected

climate conditions the building will be subjected to, or considerations of how clean electrical grids will be through time. For existing buildings, the ability to create digital twins gives us a powerful tool to help us figure out how best to keep existing buildings, but in a lower emission way.

Predictive modelling will continue to evolve as other tools, like AI, evolve and become more widely used in the industry. We can include decades of observed performance to forecast and hone the information we use to design our buildings.

Modelling as applied to structural design is theuse of tools to model structures for the purposes of minimizing the material usage where the material is not needed for function. Minimizing the materials can/typically results in reduced embodied carbon.

Can you give me some examples of cutting-edge technologies and/or methods that RJC has used to improve building sustainability? How does RJC improve energy efficiency, resource conservation, and overall environmental sustainability within its projects? What projects were these technologies and/or methods utilized at?

WM: With such a critical housing shortage paired with quickly increasing stringency of energy and carbon requirements in building codes, we noted developers' need to have a tool that provided fast building performance metric feedback for early concept designs. Drawing on this vast resource we have created a tool, which uses parametric analysis and outputs similar to what industry might be familiar with from Passive House's PHPP engine, to produce immediate and easily-understandable outcomes to feasibility stage inputs, giving quick feedback on a given design's likely ability to meet project operational energy and carbon goals (e.g. TEDI, TEUI, GHGI). We created the tool to help inspire confidence in the design at an early stage and to assess, at a high level, a design's ability to meet targeted energy and carbon metrics inherent in the BC Energy Step Code and Zero Carbon Step Code. We've used this tool for a number of housing-type projects.

Is there one project that best showcases RJC as a leader in sustainable building practices?

WM: For a moment, let's talk about sustainability in the broader sense. We are particularly pleased to have the opportunity to work with and learn from First Nations communities.

We are currently working with a Nation who, like so many others, has been subject to displacement from their traditional lands, resulting in their homes being located in a flood zone. That, combined with local industry practices, climate change and previous poor building practices has resulted in their homes flooding and now being in need of replacement. For this project, and through listening, we've learned about

how to rebuild homes in a way that meets the needs of the people living in them (as well as in a way that is energy efficient and low carbon). We've learned about how industry practices have increased the risk of local flooding, and have had the chance to connect with industry to explore how these practices can be changed. This project has also enabled training in the construction industry for some community members. Building well-loved, low-carbon homes while increasing training for how to maintain them and improving local economic and climate resiliency? That's a sustainable building practice.

We are also working on a deep energy retrofit project for a building belonging to a West Coast First Nation. This project uses predictive modelling tools and circular economy to target net-zero carbon.

Can you share some examples of RJC's recent partnerships or collaborations that ensured sustainable building practices were well-utilized within its projects? Why is this important?

WM: The wonderful thing about working in the sustainability space is that we're all ultimately aiming for a common goal. RJC frequently collaborates with other design firms, who may also be our competition. Take energy modelling and carbon retrofits as an example. Some retrofits are opportunities for (or triggered by the need for) enclosure upgrades, and that's one of our specialties. Others are heavily dependent on a mechanical system change, and the need for careful eye to electrical service. We share the energy modelling role with other team members as best fits the project, in part to make sure the owner gets the best bang for their buck (which translates into a greater likelihood for a successful, carbon-reducing outcome).

What is RJC's long-term vision for more sustainable built environments?

WM: As has been said by others: moving beyond "sustainable" and "less bad" towards "more good." The built environment is a means to undo the damage that has been wrought on the life-giving planet we've been lucky to experience. Our goal is to collaborate with architects, developers, and communities to foster a built environment that harmonizes with the natural world, promoting healthier and more ecologically balanced communities.

How do you think RJC will shape the future of sustainable building practices in Canada?

WM: RJC will shape the future of sustainable building practices in Canada by being a trusted partner to our clients, a leader in low carbon resiliency, and a mentor and ally to our peers through collaborative efforts, studies, and initiatives like SE 2050. Through our "Creative thinking, practical results" motto, we've learned to be light on our feet yet grounded in reality. Both are needed in these changing and critical times.

Are there technologies that engineers should be utilizing more of in order to improve building sustainability?

WM: A great building enclosure remains an unsung hero in much of the industry. Though they are gaining traction, reasonably simple concepts like minimizing infiltration (and confirming that through blower-door testing) remain uncommon practices in much of Canada. Another piece that can be missed is careful detailing, resulting in unnecessary thermal bridging and more money spent on insulation that may not have been required. Who you hire matters – if you hire a firm adept in both energy modelling and enclosure design, we can really help a building design team focus their efforts so time and money can be freed up for other things.

Is there anything else you would like to add about RJC's involvement in sustainable building practices?

WM: Our team has recently developed RJC Revit Quantities Tools, allowing us to quickly and accurately obtain high-quality quantities data for our projects. Quantities of structural materials are integral to embodied carbon calculations, an ever-increasing necessity due to buildings' contributions to climate change. With RJC Revit Quantities Tools, we have the ability to compute structural material quantities to assist clients and contractors with accurate and timely determination of construction costs and embodied carbon measures.

RJC teamed with industry peers to author "Embodied Carbon in Residential Structures – A Toronto based case study". The case study looks at four current projects in the Greater Toronto Area. The structural and architectural teams for each project calculated the embodied carbon of the structure and substructure.

The focus was on the structure and substructure as together they account for 40 – 70% of the overall embodied carbon of a building. The purpose of the study is to inform policymakers, industry professionals, citizens, and any other relevant or interested stakeholders, of the issues that need to be addressed and the background information to make educated decisions to impact meaningful change.

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