CHANGING THE WAY WE BUILD

Architects and Engineers Get Together to Consider the Whole Life of a Building

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Dunlop Architects Inc. and Halsall Associates Limited are developing innovative sustainable design solutions that put their clients on the competitive edge. They are proving that architects, engineers and their clients can collaborate in the early planning stages of major construction projects to design buildings that improve environmental performance, minimize operating costs and deliver a cutting edge aesthetic.

Halsall Associates and Dunlop Architects recently collaborated on the design development for a groundbreaking new Student Centre at the University of Toronto. In this case, the students were the client. Like many of their generation, they felt personal responsibility for protecting the environment. They couldn't understand why you would construct a building that wasn't sustainable. They worked actively with the design team to ensure that their new facility would leave a positive legacy. They encouraged the team to take bold new steps in eco efficiency and to consider the performance of the building over time.

Disconnect

"We are committed to changing the way our industry creates buildings," says Peter Halsall, president of Halsall Associates Ltd., a national engineering consultancy based in Toronto. "All too often, buildings become a burden to future generations. We want to work to make them an asset."

Halsall Associates provides structural and cladding engineering services for new construction and renovations in major public sector projects including hospitals, commercial buildings and cultural facilities.

Douglas Webber, a Halsall project manager and stakeholder in the firm, has developed unique capability in sustainable process. He explains that their clients' interest in sustainability typically began with a demand for energy efficiency and improved indoor air quality. However, Halsall Associates has decided to take a more proactive stance and to develop broader in-house competencies. With more expertise, they can encourage clients to take bolder steps that will reduce the ecological footprint of their buildings, save them more money in operating costs and enhance the social benefits of the facilities.

"We were motivated by our desire to do the right thing, " says Webber, "and our belief that these efforts would differentiate us in the marketplace."

Peter Halsall is also personally concerned about environmental degradation and recognizes that "the planet is not going to make it unless things change. We have to do something more than just recycling or driving bikes," he says.

One major challenge in taking a long term view of sustainability is the disconnect between the management of capital and operating budgets on a typical building project. "The capital and operating teams function independently," says Webber, "and often fail to develop a coherent vision." In some cases the developer, owner and users of a facility are all separate stakeholders with their own sets of priorities. For example, a condominium developer builds units to be sold off as quickly as possible with little consideration of long term cost issues like energy efficiency and durability that will be important to future stakeholders in the facility.

But, when a client is interested in developing a high performance sustainable building, Halsall's integrated design approach and holistic vision can bridge the gap between the developmental and operating phases in the building life cycle. An integrated team of architects, designers, engineers, clients and end users can interact at the design stage to optimize performance on many levels. The Halsall team has found that such a collaborative process can lead to agreement on more rational budgets for operations and building maintenance. For example, the cross disciplinary team can decide to shift capital away from mechanical equipment to pay for a more efficient building envelope. The result can have significant impact: lowering operating costs without increasing initial capital costs.

Efficient Envelopes

The sustainable design process at Halsall embraces holistic thinking by all collaborators on the design team. This enables the team to integrate such technologies as: super efficient envelopes, reclamation and re-use of demolished concrete, wood products from managed forests, thermal mass systems for storing energy, green roofs, life cycle analysis of building materials, supplementary cementing materials and reuse of structural steel (see Harvesting Steel p. 9).

The design engineers at Halsall use ATHENA, a Canadian-developed computer modeling tool, to compare alternative designs based on their respective environmental impacts.

Halsall wants to move along the path of sustainability through educating clients and the business community about the negative impacts of buildings on the environment.

Office Task Force

The Halsall staff are knowledgeable and keen to put the principles into practice whenever clients are open to new strategies that can both save them money and improve environmental performance.

Peter Halsall has established a corporate culture that reflects these values. Doug Webber chairs an internal sustainability office task force which is charged with finding new opportunities for the company to improve its own practices. So far, they have significantly reduced the use of paper in the office, started a carpool and issued employees with transit passes in lieu of parking privileges. The task force has also introduced staff seminars, newsletters and monthly presentations on sustainability for both internal and external groups.

Partners in Integrated Design

Dunlop Architects Inc. is also building a strong values-driven internal culture. Dunlop is an architectural consulting firm consisting of 14 principals and more than 100 employees. The company is acknowledged as a leader in the design of health care, institutional, entertainment and high tech communication facilities in North America. It operates with annual net gross revenue of $10 million. The affiliate Interior Design Collaborative Incorporated allows Dunlop to offer an integrated package of architectural and interior design services. But, what also sets Dunlop Architects apart, is its lead position on sustainability.

Today, at Dunlop Architects, principals are helping their clients to understand the business and environmental benefits of sustainable design in a number of ways. They conduct in-house research, and give presentations and seminars to demonstrate the positive outcomes.

SCARBOROUGH STUDENT CENTRE

Why Wouldn't You Design This Way?

Recently, Halsall Associates and Dunlop Architects had a unique opportunity to push the boundaries of sustainable design when they collaborated to develop the new Student Centre for the University of Toronto's Scarborough Campus (UTSC). (The consultant team also included Keen and Carinci Burt Rogers for mechanical and electrical engineering disciplines). This was one of the few Canadian university campuses not to have a dedicated facility for student activities. The students played a key role in partnering with the university to raise the money to build the $10 million three storey building. They were keen to participate in every phase of the design process – and to ensure that their new facility incorporated state-of-the-art thinking on sustainable construction.

The new Student Centre will house offices of student organizations, plus the university's office of student affairs, the health centre, equity office, a multi-faith chapel, a games room, study areas and retail stores.

Campus Gateway

This prominent gateway building was initiated with the objective of enriching student life on campus by providing a supportive, learning environment in an environmentally responsible manner. From the start, the design team along with the student stakeholders in the project, explored innovative design techniques to minimize the environmental consequences through efficient use of energy and resources. According to Stephen Phillips, a principal at Dunlop Architects and the design principal for the Centre, "This project reflects the unique spirit, dedication and values of the student body at UTSC. It has been really exciting to work so closely with such committed students through every aspect of the design."

The strong visual impact from the campus entrance and clear pedestrian circulation position the Student Centre as the primary entrance into the existing university corridor. The president of the University of Toronto, Robert Birgeneau, feels that the extra facilities "will make this building the hub of campus life and contribute further to the sense of community that has always been integral to the student experience at Scarborough". Student union president, Dan Bandurka recognizes this landmark project as the "culmination of a lot of hard work from many individuals and a direct result of the determination of past student leaders to make sure that future generations will have what they did not".

Architects' design image for the UTSC Students Centre. Photo: Dunlop Architects Inc.

Open to All Opinions
The project team took an integrated design approach with effective stakeholder engagement in all aspects of project planning, design and implementation. The Dunlop-Halsall team was open to every opinion and suggestion received and was ready to address all concerns. Regular meetings and workshops with students in the presence of designers and architects helped to establish the goals and a cohesive understanding of the priorities of all stakeholders. The commitment of the students involved encouraged the engineers and architects to do things that have never been tried before. In one instance, a suggestion made by the design team was to use Titanium cladding, rather than more traditional metal cladding materials on the west face of the building to more effectively capture and reflect the changing sunlight The students supported this proposal – and even raised the additional funds for the installation.

Reclaimed Materials
Early on, the design team struggled to locate an abandoned site for retrieving concrete and steel with known properties since demolition companies do not stockpile salvaged material for subsequent uses. Apart from the steel framing reclaimed from the ROM demolition (see sidebar), the Student Centre is also making use of other recycled content materials such as windows and curtain wall frames, and ceramic tiles. These recycled materials will account for 20% of the total material content of the building. To minimize the cement content in the concrete, the design team is using supplementary cementing materials such as fly ash and slag without compromising the aesthetic polish of the facility. The project has also managed to eliminate adhesives to fix carpets, use formaldehyde-free mill work and solvent-free finishes to eliminate air pollutants and improve air quality. A comprehensive waste management strategy has been specified for the construction and operation of the building.

Optimizing the Building
The Student Centre at UTSC is one success story in sustainable design – a landmark project demonstrating what can be achieved when architects, engineers and other members of the design team work collaboratively with a committed client.

"Designers have become adept at optimizing individual systems within a building," observes Halsall's Doug Webber, "but few have experience in working through an integrated process to optimize the whole building as a system."

Peter Halsall adds: "There are many opportunities for the construction industry to curb the human impact on the earth, without significantly changing the way we do business." ●

Harvesting Steel from the ROM

Five percent of the total steel content for the building frame of the Student Centre has been reclaimed from the recent demolition at the Royal Ontario Museum (ROM).

Halsall are the structural engineers for the transforming new addition to the ROM designed by architect, Daniel Libeskind. (Libeskind conceived the glass crystal that has become the iconic symbol for the renovation. But it is the Halsall team that will decide how to erect the glass and steel crystal to withstand the snow and ice of the Canadian winter.)

Halsall had been the structural engineers for a previous renovation at the ROM, so they knew the properties and strength of the steel that was being demolished. That gave one of the Halsall team on the Student Centre project the bright idea to reclaim some of the steel from the ROM demolition and reuse it in the campus facility. The U of T students loved the plan. Halsall Associates asked permission and the ROM team agreed – they even offered to deliver the steel to Scarborough.

Doing Less Harm

Manufacturing cement produces approximately 8% of all carbon dioxide emissions created worldwide and accounts for about 0.6% of the total energy use in North America.

Using supplementary cementing material such as fly ash or slag can dramatically reduce these negative impacts on our environment. The environmental consequences can also be minimized by avoiding demolishing existing structures and adapting them for alternative use. For new buildings, designing larger bay sizes and allowing for higher live load capacities increases a building's adaptability with minimal increase in construction cost. Using wood as a building material instead of concrete and steel can reduce air emissions and energy use. Moreover, specifying forest-certified products ensures that environmental and social benefits of forests are retained. An efficient building envelope with carefully designed walls and glazing systems can optimize the mechanical system and interior light quality of the building.

Reclamation and recycling of demolished concrete diverts construction waste from landfill and has less embodied energy than quarrying new material. In addition to this, thermal mass of exposed concrete can substantially reduce a building's reliance on mechanical systems for heating and cooling. Installing a green roof is another sustainable design solution that can minimize the urban heat island effect by lowering the amount of solar radiation absorbed and re-radiated as heat. ●

Green Design Interventions

The green design features and construction procedures used in the UTSC Student Centre have addressed issues such as sustainable site strategies, energy efficiency, material and resource selection, and the quality of the indoor environment.

1. Sustainable Site Strategies
Alternative transportation, minimization of impervious surfaces and retention and enhancement of existing natural habitat of the project area were some of the key issues addressed by sustainable site design strategies. For alternative transportation, the design group has made provision for biking paths using the bicycle parking and showering facilities at the nearby gymnasium. To ensure efficient water usage, the facility includes the use of a rainwater harvesting system for irrigation, dual flush toilets and chemically treated urinals and ground water percolation. A four inch thick extensive roof top garden on the part of the building housing student offices reflects the students' commitment to their environmentally friendly and energy efficient building.

2. Energy Efficiency
The energy efficiency of the building will exceed the ASHRAE 90.1 standard by at least 30% due to miscellaneous energy conserving approaches such as passive heating and cooling, efficient lighting system, effective building form and natural ventilation. The orientation of the building together with glazing selection, window size, thermal mass, shading strategies, plantation and natural ventilation were applied to allow passive heating and cooling. The south side of the building has been positioned for maximum exposure to sunlight and on the other three sides, the numbers of windows are decreased while the size of each windows is optimized. These thoughtful design features allow the low-angled winter sun to enter the rooms. The addition of larger window shades will prevent the high-angled summer sun from entering. The thermal mass of the exposed concrete inside the building accommodates for systematic absorption and release of the heat radiation that allows the mechanical equipment to be downsized.

The energy efficiency of the building is optimized through efficient lighting system including occupancy and daylight sensors and the supplementation of minimum ambient light levels with task lighting. The cost of air conditioning and ducting is minimized by a natural ventilation and cooling system, narrow building plan, air to air heat exchangers and inclusion of operable windows for cross ventilation. The building form has been carefully chosen to maximize ventilation and access to sunlight.

The operable windows (a user-friendly design feature) accompanied by the fresh air vents will permit continuous flushing of fresh air inside each room.

3. Materials and Resources
The materials used in construction contain a substantial proportion of salvaged matter and recycled content that has reduced the embodied energy of the building.

Smarter Design
According to a new Worldwatch report:
an estimated 55% of the wood cut for non-fuel uses is for construction, 40% of the world's materials and energy is used by buildings and 30% of newly-built or renovated buildings suffer from "sick building syndrome," exposing occupants to stale or mould- and chemical-laden air" (Worldwatch Institute, 1995).[1] Leading edge building designers claim that most of the problems are caused by inherent design weakness. But buildings that co-opt natural forces for heating and cooling, install efficient appliances and climate control systems and use renewable, recyclable, nontoxic construction materials can provide healthier, more enjoyable and more productive environments in which to live and work.

Note

1. Roodman D., Lenssen N., (1995) *A Building Revolution: How Ecology and Health Concerns Are Transforming Construction*, Worldwatch Institute Report, 124.