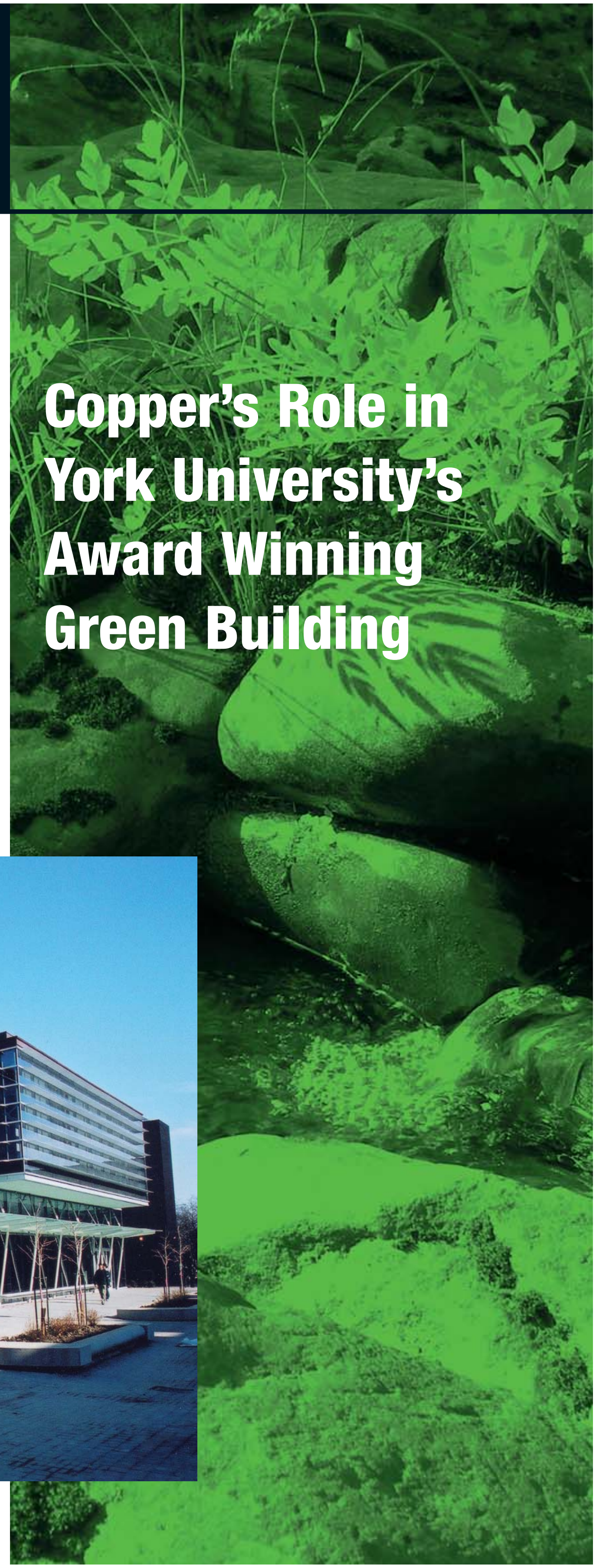
Green Building

A Case Study



Copper's Role in York University's Award Winning Green Building

The building's envelope provides a diverse engaging experience for passing students. Photo: www.coppercanada.ca

INTRODUCTION

Completed in 2001, the Computer Science & Engineering Building at York University exemplifies a number of the benefits associated with both green building design and the use of copper. The building, which occupies a central location on the campus, has been recognized with numerous international awards for its innovative design, as well as by its users. Its copper façade provides a visually stunning external skin to a building that has been exceptionally well planned throughout, minimizing its impact and leveraging the natural benefits of its location.

THE BUILDING

Overview - The four storey building brings together three main elements: a 950-seat lecture hall, a large atria, and office and lecture spaces. Located on York's main pedestrian thoroughfare, the building's extensive glazing and airy entry engage pedestrians, which was a key design consideration for the University. The façade consists of large copper pans that cover the upper two storeys with a minimum of transverse seams. The effect is visually stunning, but also integrates well with the nearby buildings which contain numerous copper accents. Glazing is used extensively both inside and out and helps to create an open and inviting building.

What Makes it Green - the Building's Features

Genesis Phase - A great deal of effort went into the design of the building to ensure that the functions of each building element not only did not overlap but were mutually supportive, making the building superior to its individual parts.[1] Early in the project, both the designers and York University committed to selecting materials and designs to meet the objectives of a green building.

A Strategy - The University's commitment stemmed in part from a combination of factors. Originally the location was to house the department of Environmental Science, which introduced the concept of green building to the University's decision makers. This combined with other efforts to incorporate sustainability into decision-making at the University. Also there was an appreciation of the benefits of daylighting and lower operational costs in the design, which ensured the University's continued commitment to green design.

Climate Control - A major challenge for the designers was to apply strategies, learned and tested in moderate West Coast climates, to the highly variable climate of Southern Ontario where temperatures commonly vary between -15°C (5°F) and 30°C (85°F) throughout the year. Not surprisingly, one of the centre pieces of the building is the air circulation and temperature-moderating system.

The building is designed to adapt to fluctuating temperatures by operating as an exceptionally well insulated building in the winter months and as a "tropical" structure in the summer. The insulating properties arise from the very efficient envelope that has minimal thermal breaks and uses argon-filled insulated glazing units with spectrally selective solar coatings. The "tropical" properties arise from the large central atria which uses thermal stratification to create a negative pressure which draws fresh air in through the operable perimeter glazing. These features are controlled both automatically and manually by building operators specially trained in the building's operation. Controls for windows, air diffusers and lighting are visible and accessible within each space. Occupants repeatedly pointed to the ability to open their windows as a substantial improvement, and there has been a noticeable decrease in the number of complaints regarding air and environment quality. Throughout the year the temperature is moderated by a large subterranean plenum on the North side of the building through which air is drawn to take advantage of the ambient 17°C (63°F) ground temperature. Additional features such as daylighting and certain material choices all contributed to the moderation of temperatures. On a 32°C (90°F) day, users can expect to walk into public spaces conditioned to 26°C (79°F) and offices and labs in the 20-23°C (68-73°F) range.[2]

Copper was used throughout for detail such as parapets and flashings.

Lighting - Day light is an important feature of the building. Every space has access to natural light, either through direct external access or through one of the atria. Not only does this help to minimize the heat generated and energy used by lighting, but it improves an occupant's enjoyment of the building. Building electricity-use records show that on sunny days occupants chose not to turn their lights on, which emphasizes that individual controls in one's immediate environment pays dividends in terms of reduced energy consumption.

Material Selection - The designers did a great deal of research to select materials with low environmental life cycle impacts and to avoid excessive material use. Choices were often complicated. They found only a limited amount of environmental information available. Few builders understood how to use alternative materials and techniques. A limited number of products were available.

In some cases the builders conducted their own research and made decisions that pushed the limits of what had been done before and what could be done to improve the building's performance. This included using 50% fly ash

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[1] Lloyd, Nathaniel "York University Computer Science Building North York, Ontario" Paper for Advanced Studies in Canadian Sustainable Design pg.5
[2] Lloyd pg. 11

concrete to displace the high amounts of energy contained in traditional cement, as well as not installing a suspended ceiling which both reduced the total amount of building products and allowed the designers to reflect the lighting off of the polished concrete ceiling. By limiting the number of materials that went into the building, and minimizing products which created off-gassing, the building also lacks a "new" smell, a feature many users associated with a "clean" and "healthy" building. The focus on the environmental performance of materials also led to the use of copper in applications throughout the project.

COPPER'S ROLE

Copper is used extensively on the outside of the building with two-storey high pans that minimize the need for transverse seams all along the sawtooth features on the East and West sides of the building as well as the soffits. Copper was chosen for a number of reasons: its durability, low cost of maintenance, beautiful natural colour, low energy content, and recyclability. As it turns out, the copper cladding has also provided unexpected operational benefits as well.

Heat Capture - The ability of the copper cladding to capture the heat of the sun in winter came as a pleasant surprise to the building's operators. Based on what they learned, designers of the building have exploited this "solar wall strategy" in subsequent projects.

Cost Savings - The use of copper on the façade has contributed substantially to minimizing the expected maintenance requirements of the building. Copper's properties mean the cladding is essentially maintenance free, which reduces the operating costs of the building. This led the designers to select copper instead of their original material choice for the soffits as they expect the long term cost savings to more than offset the slightly higher initial cost. Beyond the financial rewards, environmental benefits include eliminating the need for chemical or artificial coatings or finishes.

Aesthetics - Copper is easy to manipulate and install, allowing the designers to create the striking effect of the large pans. Copper was chosen for the prominent façades and with the development of the pans' patina, the building will have an evolving, natural finish. Also, the nearby Stacy Science Library had a number of copper elements including light fixtures and flashings. Using copper on the new building was an opportunity to create a dialogue between the new building and older campus structures.

Embodied Energy - An important criteria that led to the selection of copper was its low level of embodied energy. Copper is highly recyclable and durable and retains between 90-95% of its value relative to the cost of new copper.[3] As a result of this characteristic, the majority of copper extracted through history is still in circulation today, used over and over in a variety of applications. In this case, the fact that the copper could be sourced and formed locally was another benefit that reduced energy use over its life cycle and facilitated copper's use in the project. Finally, the designers were confident that when the building reached its end of life, the copper could easily be reused or recycled for other applications, further improving the building's long term environmental performance.

Expertise provided by Heather & Little Ltd. (fabricators), and French Bothers Roofing & Sheet Metal (installation), helped the designers to achieve their vision and ensure that the copper worked seamlessly with the other elements of the building.

The large pans provide a stunning feature to the West and East sides of the building. Photo www.coppercanada.ca

CONCLUSION

The consideration behind each element of this building, from the choice of materials that minimize its environmental footprint and operational costs through to its user-friendly design, are reflected in numerous awards, including the 2002 "Green Building of the Year" from World Architecture Magazine. One thing is clear when speaking with those involved with the project - they are most proud of the building's performance. The original design team established a target of beating the ASHRE 90.1 standard by 40%. The building's operation exceeded that target and beats the standard by 50%. Every year the building's operating costs have declined (from the typical $3/ft.[2] in Ontario), as it 'teaches' its users how to leverage its features to maximize its efficiency. Further, the building's features allowed the designers to spend only 15% of the building's budget on its mechanical systems rather than the conventional 30%. As a result of these types of savings, the designers met the University's budget requirements with a green building that is visually appealing. Finally, York University has incorporated sustainability criteria into a number of its new projects. This more than any other fact demonstrates the success of this 'experiment' in 'cold weather green building.'

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[3] CCBDA "Computer Science Building York University - Toronto" Canadian Copper Issue 147, 2001

COPPER CONTRIBUTING TO GREEN BUILDINGS

Used for centuries as a 'noble' and aesthetically pleasing building material, today copper's role is more important than ever because of its substantial contribution to any building's environmental performance. Across its life cycle, from extraction to recycling, copper can enhance energy efficiency, resource use and indoor air quality, as well as minimizing transportation costs and impacts. Copper can be used in any number of applications in a building improving its environmental performance from its envelope and elements including - cladding, roofs, sun shades, eaves, flashings and downspouts to finishing products such as bathroom fixtures, to plumbing, through to innovative new technologies such as high efficiency electrical systems, on-demand lighting systems and photovoltaic cells. Many building products benefit from copper's recycled content, often over 80%, and its durability, which tends to be measured in generations rather than years. Copper's attributes are clearly demonstrated by its role in achieving up to 13 LEED® credits across three performance categories - a number of which are demonstrated by the case studies in this series. Finally, its aesthetic qualities ensure designers can achieve their visual aspirations without sacrificing their environmental and cost performance objectives.

For more information on any of the case studies in this series, to learn how copper can be used in your next project, or find out how it can help you to achieve LEED certification, please contact the Canadian Copper & Brass Development Association through **www.coppercanada.ca** or the Copper Development Association through **www.copper.org**.

How Does Copper Make a Building Green?	Where is Copper Used?	Case Studies
Energy & Atmosphere (LEED) Optimize energy performance	Passive solar walls, high efficiency wiring and systems	York University
Material & Resources (LEED) Building reuse, Recycled content, Regional materials	Envelopes, roofs, plumbing, accents and fixtures	York University, Penn State SALA, E'Terra Inn
Innovation & Design Process (LEED) Innovation in design	Recycled content	Penn State SALA
Material & Resources (LEED)	Sunshades, plumbing, internal monitoring systems	Penn State SALA, York University, E'Terra Inn
Competitive Operations, Maintenance & Energy Costs	Passive solar heating, innovative and efficient technologies, low maintenance exteriors	York University, Penn State SALA, E'Terra Inn

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