ARCH 684: Advanced Studies in Canadian Sustainable Design
Winter 2002

Kim Cooper

Mountain Equipment Coop, Toronto, Ontario

Mountain Equipment Coop, Toronto, Ontario

Table of Contents

Mountain Equipment Coop, Toronto, Ontario:

Quick-Facts:	
Building Name	Mountain Equipment Coop
City	Toronto, Ontario
Country	Canada
Year of Construction	Completed March 1998
Architect	Stone, Kohn, McGuire, Vogt Architects, Toronto: Dan Cowling, Project Architect
Consultants	
Program	Retail Store: vending outdoor and recreational equipment, members only sales
Gross Area	
Owner/User Group	Mountain Equipment Coop, members.
Climate	Temperate, cold-humid
Special Site Conditions	Built on an infill site previously used for industrial use. Site was contaminated so soil needed remediation.
Aesthetics	Use of brick and stone on exterior in keeping with commercial/industrial district of neighbourhood.
Structural System	Combination of concrete frame (using a coal slag by-product) and steel for first and second floors, heavy timber for clerestory section. Timbers reclaimed from Marconi Building in Montreal and salvaged wood from bottom of Ottawa and Lachine Rivers.
Mechanical System	The whole building system is run by a Building Management System (BMS).
Special Construction	Green roof over large percentage of flat roof over second floor.
Daylighting	Provided by high level clerestory that serves to daylight a high percentage of the interior space.
Shading	Roof overhangs at clerestory. No devices at second floor.
Acoustics	Not noted.
Ventilation	Sensors on operable clerestory windows open automatically to vent as required.
Adaptability	Part of the ground floor area not presently required by MEC is leased out to other tenants. This will be reclaimed in the eventual need of expansion.
User Controls	Not known.
Estimated LEED rating	Not yet available.
Budget	10 to 15% less than actual cost of construction
Cost of Constructions	$5.3 million dollars
Annual Maintenance Cost	Not available
Special Circumstances	Decision made to use underground parking to reduce the footprint of the building. Revenue from parking is put back into the coop and its sustainable initiatives. The MEC Toronto Store began to participate in the Open Doors Toronto weekend, May 2003. Over 400 people toured the facility and green roof.

Mountain Equipment Co-operative, Retail Store
Toronto, Ontario

Covered bike area at entrance to building on King Street.

Introduction: Environmental by Design

To MEC, the "green" building is one that meets the needs of its users, and is built and sustained by resources available within its immediate area.

A "green" building is also one that addresses and enhances its environment - at a minimum, it should not detract from it. The design and construction of a building affects many environments, not only the ecological environment.

At the micro level, "green" design must address home and work environments, and in MEC's case - the retail environment. At the community level, choices made must address the social, cultural, ecological and urban suburban environments. At the widest level, these choices must address the social, economic, and ecological environments on a global scale. In order for these choices to be adopted widely, they must also meet the pervasive western economic imperative - in other words, greening has to pay for itself.

The "Rs" of Construction
The initiatives adopted in the construction of our new facilities can be broadly expressed in 4 categories:

1. *Reduce* - Avoid using unnecessary materials.
2. *Reuse* - Incorporate existing materials.
3. *Recycle* - Incorporate existing materials in new ways.
4. *Rethink* - Look for new and better building solutions.

Key Questions
MEC's environmental design process is fairly simple: we look at each building element (from floor finishes to roofing materials) and ask ourselves the following questions:

- Can we do without it?
- Does it have less embodied energy (the energy required to manufacture and transport a product)?
- Does it have less embodied pollution (the quantity of pollutants created in the manufacture and transportation)?
- Is it more energy efficient?
- Is it locally manufactured (contributes to the local economy, and reduces embodied energy and pollution)?
- Does it have a longer ~lifecycle (longer lasting products reduce consumption)?
- Can it be recycled, and does it contain recycled content?
- Does it reduce the amount of waste destined for a landfill?
- Is the product a naturally occurring, renewable, and sustainable resource?
- Does it raise awareness of environmental issues?

(text taken from the MEC building website)

"Mountain Equipment Co-op is a member owned and directed retail consumer co-operative, which provides products and services for self-propelled, wilderness oriented, recreational activities, such as hiking and mountaineering, at the lowest reasonable price in an informative, helpful and environmentally responsible manner.'
MEC mission statement

Building Analysis

"The challenge was to design a retail environment in an urban location that evoked the rugged nature of the member's pursuits and actively made materials and system 'choices' which, while fulfilling the need for consumption of goods, sustained and preserved the resources on which the members rely for their adventures. The ultimate benefit of these and other choices' made by MEC for their new home is to demonstrate to their membership and, indeed other retailers the sustainable development features which may be incorporated into building design."

Dan Cowling, Project Architect

View of interior of daylit store.

Close up of heavy timber roof connected to steel and concrete structure for ground and second floors.

Program:

OBC Major Occupancy Classification: Type E (mercantile occupancies)

Commercial (Retail) Design:
- high ceilings - 13 to 15'
- free floor plan - articulated by column supports
- abundant lighting - natural and electrical
- easy access to upper level - central stair
- administrative/staff areas - no public access

MEC Toronto, implements a much greater concern for environmental impact than the average retail establishment as a reflection of the Co-op's naturalist values. The careful selection and treatment of materials and building systems provides a healthy indoor environment, while maintaining a high quality retail space.

Site:

Located on the northeast corner of King Street West and Charlotte Street in Toronto's downtown area, the MEC store is built upon an infill site previously used for industrial purposes. The site was excavated to remove contaminated soils in adherence to local laws, this was under taken through the process of soil remediation - harmful chemicals were removed from the soil before it was relocated - the treated soil was reused for offsite landscaping.

To provide the parking required by zoning by-law, the decision was made to include underground public parking from which the financial benefits are reinvested into the operating cost of the Co-op. This sub-level for parking use allows the footprint of the building to occupy the entire site and also augments the rationale behind the costly excavation required by the municipality. OBC classification of the underground parking is F3 (low hazard industrial).

Charlotte Street Façade, with entrance to the underground parking garage at left, King Street Façade at right.

Surplus space at the southwest corner of the building is portioned off and leased to other businesses; this economical use of the site to gain extra income reflects the Co-op's mission. However, this space will be reclaimed in the event of needed expansion.

Structure:

The building is made up of two structural techniques, flat slab construction at the ground floor and basement levels, and post and beam construction on the second storey to support the floor and central skylight structure - the structural supports are arranged according to a grid. The flat slab construction allows for greater spans with the use of capitals and drop panels.

The vertical structural elements consist of six cylindrical columns of poured, reinforced concrete that surround a central area and reach the full, two-storey height; these central columns are tied to the upper floor slab by reinforced concrete beams. The use of these double height columns allows for a large open atrium space that brings daylight from the skylights into the lower levels. On the ground floor, surrounding these central columns are freestanding columns poured, reinforced concrete crowned with concrete capitals and drop panels (flat-slab construction) On the second floor these intermediate supports are made up of structural steel columns that support the roof. Along the exterior wall, square reinforced concrete piers are integrated into the full two-storey structural wall assembly. Poured, reinforced concrete columns and shear walls in a flat-slab assembly support the ground floor slab at the basement level.

The horizontal structural elements for the first and second floor are made up of poured, reinforced concrete floor slabs. The ground floor is coated on the underside with a sprayed on fire resistant material to provide the required 2hr. rating between type E and F3 occupancies stipulated by the building code (OBC table 3.1.3.A). The second floor slab does not require any fire rating due to the size of the central atrium, (OBC 3.2.8). The structural members of the roof consist of structural steel decking on open-web steel joists that are carried by the steel I-beams, which are in turn supported by the intermediate steel columns on the second floor. All of the structural steel elements of the roof, including its vertical supports are fully exposed as allowed by the building code (OBC Table 9.10.8.A). The use of steel for the second floor, which has a higher embodied energy than concrete, was governed by time constraints as steel allows for a faster rate of construction.

The large skylight structure is supported on a steel ring beam that is held up by the central columns surrounding the atrium, and extends upward, beyond the main roof plane. This element is made up of reused structural timber frame and timber decking salvaged from the Marconi (radio) building in Montreal that was being demolished. This central feature allows natural light into the store and creates a unified element for the store, between the interior and exterior. As an extension of the roof structure the timber members need not be fire resistant and are left exposed, which helps to achieve the natural ruggedness of the interior aesthetic.

The canopy along the front of the building is also constructed of reclaimed structural timber members and decking from waterlogged wood that had sunk to the bottom of the Ottawa River. They were reclaimed, air-dried and cut to their specifications. This façade, with the use of reclaimed lumber reiterates the natural posture of the building in an urban form within the context of King Street West.

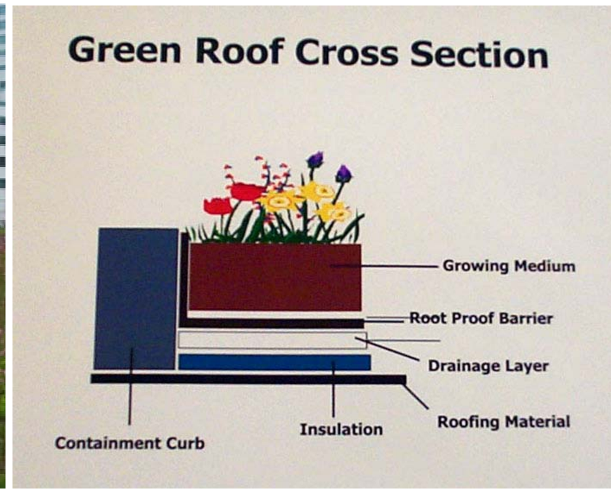
Within the interior of the building through the use of fire resistant concrete where required, steel and wood where fire resistance was not an issue. The Architect has employed a palate of structural materials that are left unfinished and exposed. This feature of the MEC store is economical, aesthetical and ecological; it reveals the importance of material selection to ecological design and the need to understand this from the beginning of the design process.

Envelope:

The typical exterior wall is masonry cavity wall made up of concrete block on the interior, a vapour barrier, semi-rigid insulation, an air space and masonry veneer on the outside. The R-value of the typical wall section (approximately R20) was developed using an oversized masonry tie and increasing the cavity space to 5" allowing 3.5" of insulation to be used. This section design exceeds the ASHRAE 90.1 minimum standards for insulation by 60%. The concrete block on the interior has been left exposed and painted as the finished interior wall surface.

The composition of the typical roof section consists of a torched on 2 ply bituminous waterproofing membrane, on a mechanically fastened underlayment, on semi-rigid roof insulation (R20), on protection board, on vapour barrier, on structural steel decking. The section of the sloped roof of the skylight structure is made up of pre-finished metal decking, on Z-bar framing, on semi-rigid roof insulation (R20), on vapour barrier, on protection board, on reclaimed wood decking. Approximately 50% of the flat roof is covered by a roof garden that also provides extra insulation and less heat transfer.

The double glazing, which is concentrated on the south façade and in the skylight, incorporates an oversized, Argon filled space between the glass lights, a low-E coating, this significantly lowers thermal light energy transfer, and provides abundant natural lighting. Some of the windows are operable and provide a means of natural cooling and or ventilating the store. The strategic placement of the glazing maximizes energy savings due to passive heating and lighting. The U-value of the glazing is 40% below the ASHRAE 90.1 standard and is extremely efficient in both thermal and sound insulation.



View of green roof, with drawing detail of roof composition.

Materials:

The concrete mix for the columns is composed of 35-50% ground granulated blast furnace slag, a waste product with enormous compressive strength, which allows a considerable reduction in the use of Portland cement, approximately 25-35%. The coal slag is a by-product of steel production and contains 75% less embodied energy than Portland cement, for which the mining process has a detrimental environmental impact. The use of this waste material, which was sourced in Sudbury, not only takes advantage of the by-products of another energy intensive process, it also diverts this solid waste from the landfills. However, the introduction of coal slag to the concrete mix does increase the curing time and forced a reduction of this material in later parts of the construction when time restrictions became an issue; traditional concrete has also be employed in some portions of the structure. The majority of the poured concrete within the building has been left unfinished and exposed to reduce material and chemical use and the energy required for their production.

The fabrication of steel is harmful to the environment, yet time and cost constraints resulted in the inclusion of the steel structure for the upper storey. However, the structural steel elements used contain a percentage of recycled content and the priming process for the structural steel elements was not required to reduce production energy and use of chemicals. Although the internal use of the steel minimizes corrosion, a surface patina has developed but the implications of this superficial oxidization does not compromise the structural integrity of the beams, columns, joists or decking. Other more finely crafted steel fixtures have been covered with a wax coating to avoid this surface corrosion. The recycled content of the steel stairs is approximately 50%.

The wood utilized in the MEC store does not originate from any virgin growth forest; which was a requirement prescribed by the client. Instead, the heavy timber structure and decking of the skylight were constructed using reclaimed timber from the old Marconi Radio building in Montreal. The structural members of the exterior canopy were also sourced from reclaimed lumber, in this case old log booms that had sunk to the bottom of the Ottawa and Lachine rivers. Both the heavy timber and decking were re-milled specifically for the MEC store by a company based in Montreal. These wooden members have been left untreated and exposed to avoid the use of toxic chemicals. The use and treatment of the reclaimed timber not only utilizes an already harvested resource, it incorporates a material with less embodies energy than steel to provide the crowning features of the building. These wooden elements are the most profound characteristics of the MEC store that visually tie it to the desired, natural image.
The semi-rigid Rockwool insulation used in the roof and wall assemblies is made up of 50% recycled content, providing both economical and environmental benefits. It also offers a better R-value and less embodies energy than traditional fiberglass batt insulation of the same thickness.

The friction-fit carpet tile employed as a flooring material in certain areas of the store has two ecological incentives, the first being its natural and recycled content. The second incentive, particularly more novel than the first, is the idea that if an occasion arises in which the carpet must be replaced due to damage, removal of single tiles as opposed to an entire roll of carpet, reduces the waste of a material resource. Moreover, the product features long wear capabilities and requires no toxic adhesives. This carpet, for all its positive benefits, is not quite the right product for the job as the store has realized. The long wear capabilities seem to collect and hold the fleece that comes off some of the merchandise. This makes the carpet look perpetually dirty and a bit older as well. They will be replacing the carpet with a slightly different type that has the same ecological qualities, that cleans better. They are giving the carpet away to be reused elsewhere.

Interior finished were kept to a minimum by leaving the majority of the structural materials exposed, the use of environmentally paints and sealers also reduces indoor air pollution. The application of a high reflectance paint on the exposed underside of the second floor slab increases the penetrating depth of natural lighting, reducing daytime energy demands.

The torched on 2 ply bituminous membrane on the roof reduces the material and chemical use of the more traditional built-up roofing system. Also, the membrane was chosen because it virtually eliminates the need for ballast and provides a reduction in the dead load of the roof, allowing the structural members to be reduced in size.

Exterior masonry facings of clay brick, concrete block and natural stone have all been sourced locally and are very durable, providing a long lasting finish that requires little or no maintenance. All of this adds up to a product with less embodied energy and less pollution. Crushed concrete granular fill, derived from the concrete surface of the former parking lot that was crushed on site, takes full advantage of a recycled material destined for the landfill and also reduces the requirement for other gravel to be dug up and transported to site.

Mechanical and Electrical Systems:

The whole building system is run by a Building Management System (BMS). This system places sensors throughout the store and monitors the temperature and adjusts accordingly.

Custom premium HVAC units with economizers increase the efficiency by up to 16% and utilize environmentally friendly refrigerants.

Energy efficient lighting fixtures are controlled by a computerized building management system (BMS). The staff areas have motion-controlled lighting so they turn off when no one is around.

There are six photovoltaic panels located over the natural stone wall on King Street West. Although not a significant power source, their installation is intended to demonstrate an emerging set of technologies that could further reduce energy requirements. The panels are estimated to supply enough power for the lights in the lobby. They are not directly connected to the lights, and do not have battery storage but are connected back to Ontario Hydro, and the energy produced is monitored through a converter.

The primary air movement within the building is controlled through mechanical ventilation, which is monitored and controlled by the BMS. The operable clerestory windows in the skylight structure are also mechanically controlled by the BMS that reduces the load on the mechanical ventilation system. Also manually operable windows are located in the staff areas to allow for natural ventilation of the interior space.

Costs:

The final cost of the MEC Toronto store was approximately $5.3 million dollars. This amount was roughly 10-15% above the original cost estimate. Initial capital cost concerns were for the most part set aside in favour of life cycle costing and environmentally responsible choices. Elements such as the skylight structure and the exterior canopy, due to their custom quality were more costly however these were aesthetically important to the Co-op's sensibilities. These elements are also directly related to reduced lighting and ventilating costs over the long run.

There was no real emphasis placed on a definite payback period for the initial extra expenditure but the Co-op has faith that the reduction in energy consumption brought on by their ecological choices, will eventually turn to profit.

MEC takes each of its new buildings and uses it as a test case. It takes all the lessons it has learned and tries to apply them to the next building. They are now starting to monitor building operational costs in their other new stores, to be able to get a better sense of actual cost analysis of initial versus long-term costs. They are also trying to incorporate the element of demountability of their stores. This would allow the materials to be more easily reused and recycled in the future if MEC moves out and the building is to be torn down.

References:

Information gained from the MEC website: http://www.mec.ca/Main and an extensive meeting with the staff at MEC and the project architect Dan Cowling.