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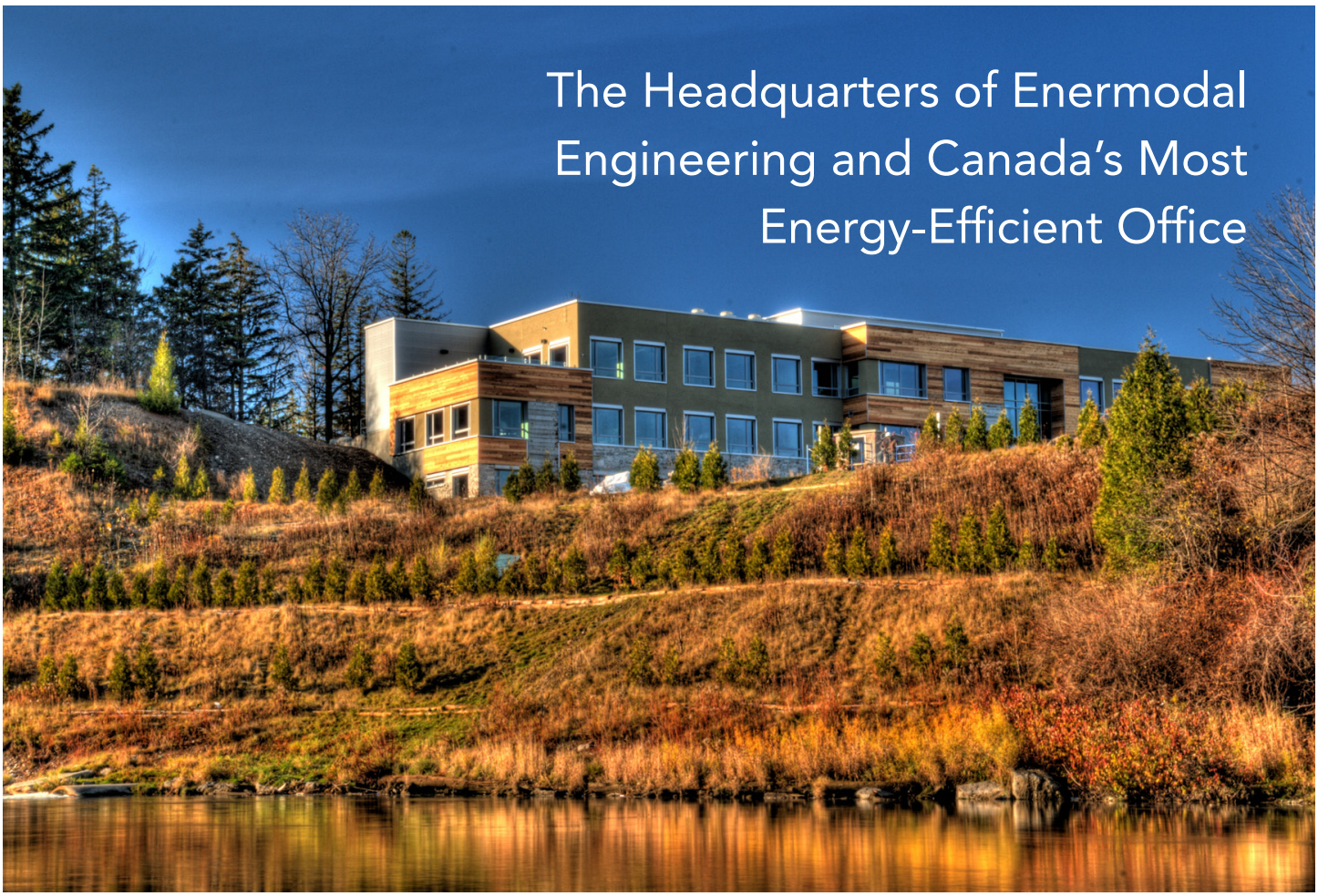
A **Grander** View



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ENERMODAL ENGINEERING

Creating energy and resource efficient buildings

A member of MMM GROUP

A **Grander** View

Project Highlights

Enermodal Engineering is Canada's largest green building consulting firm and Canada's premier LEED consultant, responsible for 40% of all LEED Canada NC certified buildings. In 2009, construction was completed on *A Grander View* – Enermodal's new Kitchener headquarters. Enermodal performed LEED certification, energy efficiency engineering, commissioning, building performance monitoring, green education program development, and mechanical/electrical engineering.

Currently, there are approximately 15 buildings LEED Canada NC (New Construction) Platinum certified. Enermodal not only wanted *A Grander View* to join this group, but aimed to design the first Canadian building to earn a triple Platinum rating: LEED-NC, LEED-CI (Commercial Interiors), and LEED-EBOM (Existing Buildings: Operations & Maintenance). More specifically, because a building's energy use is its most significant impact on the environment, *A Grander View* was designed to use 65 kWh/m^2 compared with the Canadian average of 380 kWh/m^2, and take the title of Canada's most energy-efficient office.

Enermodal is on track to achieve these goals with its LEED NC and CI Platinum certifications in early June 2011. Metered water and energy data demonstrates that *A Grander View* uses 82% less energy and 89% less water than a conventional building. Additionally, an occupant survey independently conducted a year after move-in found a very high level of employee satisfaction with the building and its systems.

This building has won several awards including the Waterloo Region Healthy Workplace Gold Award and the Grand Valley Construction Association Environmental Award. *A Grander View* is one of two buildings representing Canada at the iiSBE Sustainable Building Challenge in Helsinki in the fall of 2011.

Beyond the building itself, *A Grander View* is special. The site is landscaped with only native species landscaping and employee garden plots with no permanent irrigation system and no pesticides or power tools used for maintenance; the building is located on an urban infill site; a beautiful view for employees of the Grand River; and full-cut-off exterior lighting fixtures for night sky-friendly lighting.

To reduce raw material use, *A Grander View* makes use of recycled and salvaged materials. The stone façade for most of the first floor was salvaged from the demolition of Calvary Pentecostal Church in Woodstock, Ontario. The beech flooring in the lobby was from a demolished Toronto building. The retaining wall on the north side of the property was from the demolished St. Clair River Tunnel in Sarnia, Ontario. And 70% of the furniture from the previous Enermodal office was re-used.

In terms of the building design, *A Grander View* is only 12 m across to ensure all employees have access to at least one view to the outdoors while minimizing the need for artificial light. The lighting power density is approximately 65% below ASHRAE standards through the use of ballast-integrated daylighting sensors, occupancy sensors, and high efficiency ballasts. The building has a low window-to-wall ratio of under 30% while still allowing large (3 m^2) windows approximately every four feet along the long north-south exposures. These windows are triple-glazed with fibreglass frames and the walls themselves are made from insulated concrete forms to ensure high insulation values. The well-conceived building shell means that there is no perimeter heating necessary and the entire building can be viewed as one engineering zone (rather than interior and perimeter spaces).

Project Highlights

To cope with low sun angles, solar heat gain and glare is eliminated through the use of innovative automated external shades. These shades, which are activated by a programmed level of incident solar radiation, are in more common use in Europe but have not been used very frequently in Canada.

A Grander View uses a metered 89% less potable indoor water than a conventional office through low-flow fixtures and an innovative rainwater cistern system. A significant energy use in most cistern systems is a series of filters to remove sediment from the water before it is delivered to its end use. To eliminate these filters, the cistern system at *A Grander View* includes a vortex filter, reduced rate water entry, and a floating suction intake line. The resulting water is cleaner, and the overall system more energy-efficient, than a conventional cistern. This cistern design has never been used before and is another Enermodal "first" that is likely to be replicated in other building designs in coming years.

Although most water used in the building comes from the cistern, Enermodal receives additional potable water from recapturing and using heat pump condensate created during the building cooling process. At peak cooling season (when rainwater would also be scarcest), the cooling process will produce 20 L per hour – that is enough to flush a toilet five times.

The most unique and energy saving aspect of *A Grander View* is its separate heating/cooling system (with variable refrigerant flow technology) and ventilation system. An innovative feature of the ventilation system was that both mechanical room intakes were connected to "earth tubes" consisting of a 2 ft. diameter concrete pipe run for 15 ft. below grade to a manhole capped with a louvered doghouse. This was an inexpensive installation since the building was built into the side of a hill and both mechanical rooms were technically below grade. The earth tubes temper the outdoor air by about 2°C using the heat of the ground in the winter and the reverse in the summer.

A Grander View is heated and cooled by three air-source heat pumps located on the roof – one pump assigned to each floor. The heat pumps are connected to 60 small fan coil units located throughout the building that distribute the heating or cooling from the heat pumps. This innovative use of many small fan coil units is called a "multi-split" system and allows for occupants to control the temperature and humidity in small workspace areas.

A Grander View's mechanical system not only changes the way the different technologies interact, but also increases the degree to which occupant needs determine mechanical system operation. In this building, occupancy sensors ensure that the heating/cooling system brings a room to the ideal indoor temperature only when someone is in that area. Therefore, there is no automation system that dictates pre-determined occupied and set-back times.

A Grander View makes use of high performance systems in a well-conceived design, achieves remarkable energy and water savings, and showcases what can be accomplished at virtually no incremental cost.

A **Grander** View

1. Introduction

Enermodal Engineering is Canada's largest green building consulting firm, with offices in Kitchener, Calgary, Edmonton, Winnipeg, Halifax, Thornhill, Vancouver, and Toronto. Enermodal is the only firm in Canada to offer the full range of green building services, including LEED consulting, energy efficiency consulting, building commissioning, building performance monitoring, and mechanical/electrical design. Enermodal is responsible for 40% of all LEED Canada NC certified buildings.

Enermodal outgrew its Kitchener headquarters in 2007 and began planning for the construction of a new office. Enermodal performed LEED certification, energy efficiency engineering, commissioning, building performance monitoring, green education program development, and mechanical/electrical engineering, while local firms Melloul-Blamey Construction, MTE Consulting, and Robertson Simmons architects inc. performed contractor, structural/civil engineering, and architecture consulting respectively to round out the design team. Construction began in October 2008 and finished one year later.

Currently, there are approximately 15 buildings LEED Canada NC (New Construction) Platinum certified. Enermodal not only wanted *A Grander View* to join this group, but aimed to design the first Canadian building to earn a triple Platinum rating: LEED-NC, LEED-CI (Commercial Interiors), and LEED-EBOM (Existing Buildings: Operations & Maintenance). More specifically, because a building's energy use is its most significant impact on the environment, *A Grander View* was designed to use 65 kWh/m^2 compared with the Canadian average of 400 kWh/m^2, and take the title of Canada's most energy-efficient office.

Enermodal also wanted to demonstrate what is possible when technical expertise and ingenuity are fueled by strong commitment to innovative mechanical/electrical design. This goal is clearly demonstrated in the many first-in-Canada technologies and design strategies included in the building.

A Grander View showcases never-before-used materials, an innovative mechanical system, and an unconventional approach to interior fit-up. A primary design influence was the desire to create a beautiful and comfortable work environment for employees. A narrow building footprint (only 12 m across for the three-storey, 2,150 m^2 building) allows every occupant to have an outside view and access to abundant natural light.

Enermodal is on track to achieve these goals with its LEED NC and CI Platinum certifications in early June 2011. Metered water and energy data demonstrates that *A Grander View* uses 82% less energy and 89% less water than a conventional building.

This building has won several awards including the Waterloo Region Healthy Workplace Gold Award and the Grand Valley Construction Association Environmental Award. *A Grander View* is one of two buildings representing Canada at the iiSBE Sustainable Building Challenge in Helsinki in the fall of 2011.

2.
An **Environmentally Responsible** Site and **Community Benefits**

2. An Environmentally Responsible Site and Community Benefits

Enermodal chose the location of *A Grander View* to be easily accessible by car and bus, to have a close connection with natural landscapes, to minimize disruption to the local environment, and to be in a mixed-use industrial and commercial urban neighbourhood in need to redevelopment.

The ultimate site chosen for *A Grander View* was a derelict, unused gravel parking lot at the time of purchase, but Enermodal immediately saw the potential of this large property overlooking the Grand River.

Early on, Enermodal engaged the City of Kitchener and the surrounding community in the design process. Several meetings with adjacent neighbours and the City were held prior to the start of construction. The City of Kitchener was pleased Enermodal was interested in locating in the Bridgeport community which was undergoing a revitalization. Enermodal contributed to the development of the City's plan for revitalization of this area. At the advice of local community groups and the City, Enermodal offered to extend the Walter Bean Grand River Trail along its property and maintain this portion of the trail.

Many businesses and institutions unintentionally pollute the night sky and neighbouring properties through light pollution—exterior lighting that sends light upwards or onto adjacent sites. This lighting wastes energy and can draw migratory birds off course. To prevent light pollution, Enermodal utilized several types of energy-efficient, downward-facing exterior lights:

- 42 W compact fluorescent wall pack, building-mounted lights over doorways
- 20 W ceramic metal halide, canopy lighting over the main entryway
- 175 W full cutoff pole lights over the parking lot

In terms of landscaping, the hope at *A Grander View* was to inspire other property developers to follow Enermodal's lead and manage stormwater, promote biodiversity, utilize native species plants, create wildlife habitats, and achieve a pesticide- and irrigation-free landscape.

The land in front of *A Grander View* includes space for employee garden plots as well as native species landscaping, including aspen, sumac, dogwood, and carolina rose. Behind the building, a hill has been reclaimed for beautiful plants such as flowering raspberry and wild rose.

The Grand River valley slopes are a natural corridor for wildlife, both daily and during seasonal migrations. The landscaping approach at *A Grander View* will provide protective cover and food for wildlife. Animal species that will be attracted to *A Grander View*'s site include butterflies, bees, songbirds, hawks, deer, rabbits, and foxes.

Best of all, this landscaping plan requires no pesticides, fertilizers, or irrigation, as native species are genetically adapted to cope with local climate conditions and pests. This is a great environmental benefit, as pesticides and fertilizer create a variety of environmental and human hazards, such as polluted groundwater and harm to those applying these chemicals.

3. **Sustainable** Materials

At *A Grander View*, the following materials came from salvaged sources:

- The stone façade for most of the first floor was salvaged from the demolition of Calvary Pentecostal Church in Woodstock, Ontario.
- The beech flooring in the lobby was from a demolished Toronto building.
- The retaining wall on the north side of the property was from the demolished St. Clair River Tunnel in Sarnia, Ontario.
- 70% of the furniture from the previous Enermodal office was re-used.

Enermodal's new office includes a variety of materials with high recycled content: exterior steel (27%), structural steel (74%), rebar (100%), paint (100%), paper-based countertop (100%), porcelain tile (40%), carpet tile (80%), ceiling tile (80%), gypsum board (95%), concrete (30%), metal studs (62%), and mineral (40%), batt (35%), and spray foam insulation (17%).

Half the building materials used at *A Grander View* are from local sources, including concrete, structural metals, sandstone on exterior of building, rebar, interior gypsum board, and metal studs.

4.
A **Healthy** Indoor Environment

Prior to beginning design, Enermodal surveyed its employees to find out what they wanted in an office building and work space. The priorities from employees were natural daylight and views, open concept offices, good indoor air quality, and plentiful meeting rooms.

The desire for maximum daylight determined three key building features. One feature is the building's unusually narrow footprint—it is only 12 m wide. This allows every workspace to receive light from two directions. The second feature is the use of interior glass walls wherever possible, including in meeting rooms and enclosed offices.

These walls allow light to penetrate deep into the building core. The third feature is a large skylight that provides natural light to the central atrium, stairs, and corridors. The result of these three design features is a naturally-lit work space for every employee and every task.

While large windows allow maximum daylighting, the size and type of the windows were also determined by the need to minimize energy loss (heat in winter and cooling in summer). The windows are triple-glazed, low-emissivity, and argon-filled with insulated spacers. The fibreglass frames are better insulators than traditional aluminum frames. Although the window selection resulted in a higher window cost, this cost is offset by the elimination of perimeter heating and by decreased utility costs that result from decreased heat/cooling loads.

Even when energy-saving windows are used, conventional office buildings suffer from unwanted glare and high solar heat gains during the summer. To address this problem, *A Grander View* is oriented along an east-west axis, minimizing problematic east and west exposures. Recessing the windows deep into the walls provides window shading when the sun is high in the sky.

Innovation:

To cope with low sun angles, solar heat gain and glare is eliminated through the use of automated external shades. These shades, which are activated by a programmed level of incident solar radiation, are in more common use in Europe but have not been used very frequently in Canada. The roller shades not only prevent glare but also keep any absorbed radiant heat outside; this helps to prevent unnecessary cooling costs. When glare conditions change, the blinds automatically re-open to permit views and daylight.

A common cause of poor indoor air quality is office equipment. At *A Grander View*, office equipment that emits pollutants, such as photocopiers, is located in a separate room with a separate ventilation system that sends toner and generated ozone directly outdoors, rather than recirculating pollutants throughout the office.

All corner offices and meeting rooms have dedicated fan coil units with local set point override for occupant control. With 60 small zones throughout the building, there is excellent thermal comfort and air control. Every four employees in the open concept areas have two ventilation nozzles located in the central bulkhead that can be adjusted to change the direction of the air. These nozzles are directed down to ensure air reaches occupants. Effective local environment control: Room temperature sensors located in office areas control dedicated fan coil air conditioning units. Full modulation of fan coils output allows for longer fan coil run times in cooling mode for better dehumidification and prevents supply air operating at a high enough temperature to cause stratification in heating mode.

There are alternatives to VOC-laden materials and furnishings for those design teams willing to make careful selections. At *A Grander View*, low-emitting products were used throughout the building. All sealants, adhesives, paints, and coatings are water-based products with extremely low VOC levels. Millwork, laminates, and office furniture are formaldehyde free. All carpet is Green Label Plus certified, and all furniture is GREENGUARD certified.

After moving into the space, Enermodal continues to survey occupants every six months about the office to make sure the occupant needs are met. The results of the anonymous, online occupancy surveys of all employees are compared to an American database of hundreds of LEED and non-LEED office building occupancy survey results.

Diffusers

A Grander View received the following results as percentage of satisfied employees and the percentile compared with the database of buildings:

	% EMPLOYEES SATISFIED	PERCENTILE
General Building Satisfaction	100	100
Lighting	96	99
Cleanliness & Maintenance	95	95
Office Furnishings	95	99
Air Quality	95	99
Office Layout	89	96
Thermal Comfort	81	98
Acoustic Quality	49	70

Acoustic quality was an issue for about half of the respondents as a result of the open concept offices and the exceptionally quiet HVAC system. To address the open concewpt office acoustic quality, the lowest performing area of the building from an occupant perspective, Enermodal installed sound masking equipment that simulates the louder air movement sound of most mechanical systems in the fall of 2010. Another occupancy survey will be conducted in the fall of 2011 to ensure the perceived acoustic quality improves.

5. Combining **Best Practice** M/E Design with Smart Use of New Technology

5. Combining Best Practice M/E Design with Smart Use of New Technology

If the remarkable energy efficiency of *A Grander View* could be attributed to a single element, it would be the mechanical system. The design team's approach was to use on-the-market equipment in a well-conceived design—good basic mechanical engineering that examined how different mechanical elements should interact and how to carefully control system operation.

Energy Simulations and Actual Energy Use: After the creation of the desired building design for *A Grander View*, the Enermodal Energy Division conducted an EE4 energy analysis to confirm that the proposed design was optimal from an energy standpoint. The computer model predicted savings of over 82% compared with a conventional building. This model was verified by Canadian government agency NRCan and was verified as providing the lowest energy use per square metre of any office.

The building's metered energy use is 68 kWh/m^2. Ongoing commissioning will likely bring this number down to the predicted 65 kWh/m^2 predicted in the design energy models. The energy use of the building means *A Grander View* will receive all 10 LEED Canada v1.0 Energy Optimization points.

Airtight Envelope: A major contribution to achieving an energy-efficient and comfortable building was to create an air-tight and heavily insulated building envelope, made possible, in part, by insulated concrete form (ICF) walls. To avoid thermal bridging (heat loss between two poor insulators) between the thick, concrete walls and the window openings, the construction team lined the window opening with insulation. The ICF joints were sealed to prevent moisture from penetrating the building shell.

- wall construction (R-22 assembly)
- insulated room (R-26)
- triple-glazed, low-e, solar control windows with argon fill, fibreglass frames with insulating spacers to achieve USI of 1.6 W/K-m^2 and Solar Heat Gain Coefficient (SHGC) of 0.29


Ceiling Mounted Occupancy Sensor

With the use of Carrier Hourly Analysis Program (HAP) to model building loads with the above building envelope, the overall heating and cooling loads were limited to 228.2 MBH (including 10% safety factor) and 20.2 Tons Cooling (TC) respectively.

Well-Conceived, Easily Controlled M/E Design: In order to minimize first time and maintenance lifetime costs while providing an energy-efficient system, the design philosophy was to keep the system as simple as possible and to minimize the amount of equipment. The system selected was a decoupled system consisting of a series of Energy Recovery Ventilators (ERVs) providing ventilation and washroom exhaust for the building and three variable refrigerant flow (VRF) multi-split air source heat pumps serving the heating and cooling requirements for the building.

Earth Tubes: A feature of the ventilation intake was that both mechanical room intakes were connected to "earth tubes" consisting of a 2 ft. diameter concrete pipe run for 15 ft. below grade to a manhole capped with a louvered doghouse. This was an inexpensive installation since the building was built into the side of a hill and both mechanical rooms were technically below grade. The earth tubes temper the outdoor air by about 2°C using the heat of the ground in the winter and the reverse in the summer.

Energy Recovery Ventilators: Due to the architecture of the building, it was found that the building could be divided into 9 occupancy zones, consisting of east and west office areas for each of the three floors and one meeting room per floor. The decision was made to go with 9 smaller ERV units as opposed to a single, large variable air volume unit for the following reasons:

1. Code-enforced constant volume requirements of the washroom exhaust, which were closely in balance with respect to the ASHRAE-62 ventilation requirements of the respective spaces.

2. Intent of using occupancy sensors to turn off equipment in spaces not in use. It is generally more energy-efficient to turn off equipment than to turn down equipment.

3. Smaller, "off-the-shelf" ventilation equipment is at least cost comparable larger custom ERVs.

4. Smaller equipment suspended in ceiling spaces allowed for more efficient use of mechanical room space.

5. Ease of control: turning equipment on and off saves more energy, is simpler and more cost-effective than supplying, installing, commissioning, and controlling with variable frequency drives (VFD's) and variable air volume boxes.

The ERVs themselves consist of a ducted supply and return fan and a paper-based media air exchanger designed for transfer of latent and sensible energy. The advantage over more typical, wheel-based energy recovery ventilators were as follows:

1. Relatively compact size; units could be mounted in ceiling spaces, as they were in the meeting rooms, or high in mechanical bulkheads leaving floor space for other use.

2. No power or control required to enable energy recovery as with a wheel

3. Comparable latent and sensible effectiveness to energy recovery wheels. Heating energy recovery is specified to 70%, cooling total energy recovery specified to 50%.

Variant Refrigerant Flow Fan Cassette Unit

4. Units did not require condensate drainage and could be mounted in various orientations, including upside down, to increase flexibility of installation

5. Comparable, low leakage rates compared to standard, wheel-type units

An additional advantage of providing energy recovery ventilation air exchangers, as opposed to sensible-only recovery (known as heat recovery ventilation), was that no active humidification was required to maintain comfortable levels of relative humidity during the winter months.

The heat wheels installed on the ventilation units allow recovering of latent and sensible energy which may have otherwise lost in exhaust air from the building. Moreover, earth tubes are used to pre-condition the fresh air before they enter the ERVs. The heat wheels combined with the earth tubes resulted in average heat recovery effectiveness between 75%~80% for all the ventilators.

Variable Refrigerant Flow Heat Pumps: *A Grander View* is heated and cooled by three air-source heat pumps located on the roof – one pump assigned to each floor. The heat pumps are connected to 60 small fan coil units located throughout the building that distribute the heating or cooling from the heat pumps. This innovative use of many small fan coil units is called a "multi-split" system and allows for occupants to control the temperature and humidity in small workspace areas.

Innovation:

All building heating and cooling is provided by three Mitsubishi Air Source Heat Pumps, one serving each floor. The configuration is typical of a standard multi-split system, where a single condenser/evaporator is mounted on the roof and provides hot gas or chilled liquid refrigerant to fan-coil units mounted throughout the space. This is one of the first buildings in Canada to use this type of system.

One of the major challenges designers face when working with air source heat pumps intended for service in Canadian climates is winter heating. Due to the difficulty in extracting heat from moist, cold air, typical designs require supplemental heat to provide primary heating during design conditions. These particular Mitsubishi unit specified and installed are equipped with a proprietary system that is able to operate at 80% of nominal heating capacity at design outdoor temperatures of -6°F and provide a coefficient of performance of 1.7. The system undergoes defrost cycles during the winter months; where the heat pump loop reverses for a short period (typically less than 10 minutes) to melt off frost on the outdoor unit's air exchanger. It should be noted that the system selected can only operate in heating or cooling. The option of providing simultaneous heating and cooling was not chosen because of system simplicity and the architectural design of the building permitted a non-diverse system. The building was intentionally designed to be very narrow, only 40 ft, for the primary intent of maximizing the penetration of day light into the core of the building. This also virtually eliminated any central core spaces, which typically require cooling year-round and limited the heating and cooling diversity of the building.

The main advantages of this system are as follows:

1. Modulating refrigerant flow provides superior energy performance to non-modulating refrigerant systems and similar performance to other forms of building energy transfer (water or air). System efficiency (COP) substantially improves when system is at part load.

2. Winter heating capabilities allowed for supplemental heat by electricity or natural gas to be eliminated from the design, providing substantial construction cost savings.

3. High design flexibility: Routing of liquid and suction lines require less mechanical space than hydronic pipe or ductwork, wide selection fan coil unit sizes and configurations provide flexibility for providing conditioning for a wide range of spaces.

4. Effective local environment control: Room temperature sensors located in office areas control dedicated fan coil air conditioning units. Full modulation of fan coils output allows for longer fan coil run times in cooling mode for better dehumidification and prevents supply air operating at a high enough temperature to cause stratification in heating mode.

Innovation:

A Grander View's mechanical system not only changes the way the different technologies interact, but also increases the degree to which occupant needs determine mechanical system operation. In this building, occupancy sensors ensure that the heating/cooling system brings a room to the ideal indoor temperature only when someone is in that area. Therefore, there is no automation system that dictates pre-determined occupied and set-back times.

Also, wall-mounted CO^2 sensors in the large, third-floor meeting room activate the ventilation system accordingly: if more people enter a room, more ventilation air is brought in.

Manual Free-Cooling System: In order to take advantage of favourable outdoor air temperatures during the shoulder season, the building was equipped with a 10,000 cfm modulating plenum fan located in a roof-top penthouse mechanical room that is connect to the top of the buildings central clearstory via an acoustic louver. The building operator will monitor outdoor air temperature and humidity and when conditions are deemed to be favourable (typically between 54 and 68°F), the fan will be enabled (while the mechanical conditioning will be automatically disabled), and occupants will be notified and will be able to open their respective operable windows as they choose.

Lighting: At *A Grander View* daylighting is the main source of light for the office. Daylighting sensors automatically dim lights when daylighting is sufficient to decrease the need for artificial lighting. Occupancy sensors are located throughout the building to turn off lights when a space is unoccupied. After decreasing lighting demand, Enermodal increased lighting efficiency by the use of lower wattage fixtures, such as premium efficiency T8 lamps and ballasts and compact fluorescent pendants. *A Grander View*'s lighting power density is a metered 65% lower than that of ASHRAE 90.1-1999 standard for office buildings.

Since the building has a narrow depth of 40 ft only, for an open-concept office, it can be assumed that the interior zone and perimeter zone would have similar heating/cooling load. The narrow interior zone would be dominated by the respective perimeter zone. Hence area of influence for perimeter and interior zone cannot be physically separated and there is no need to have separate HVAC system for perimeter and interior zones. This also enabled to use daylight to penetrate down to interior zones for all floors further reducing energy consumption for lighting and cooling.

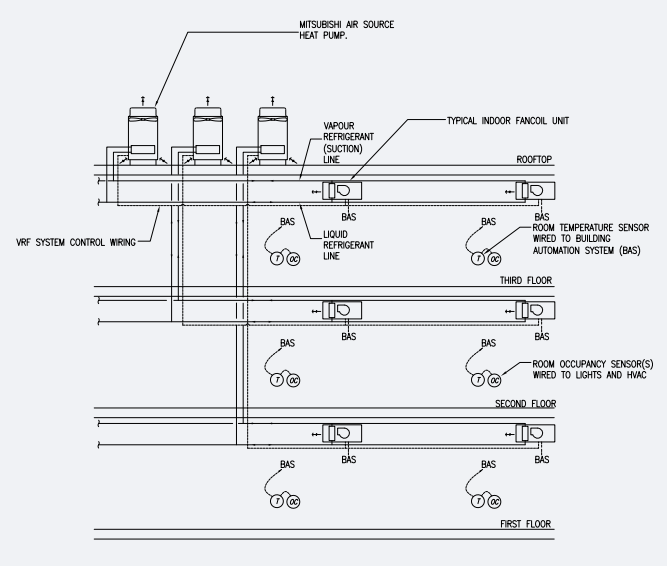

FIGURE: AIR SOURCE HEAT PUMP AND FAN COIL CONFIGURATION

The actual lighting power density is 65% lower than that of ASHRAE 90.1-1999 standard for office buildings.

Server Room Cooling / Domestic Hot Water Heating: The primary domestic hot water heating is performed by a 2 ton, air-source heat pump which converts heat from the building's network servers and heats a domestic hot water tank on demand. This tank is maintained at 120°F and small local electric tanks located closer to end appliances such as dishwashers boost water temperature as required.

When the domestic hot water tank temperature is satisfied, the heat pump is disabled. Therefore, there is a fresh air supply and exhaust fan connected to a reverse-acting electric thermostat to provide supplemental conditioning.

A Grander View features 24 rooftop photovoltaic panels that provide 5.5 kW peak electricity. To maintain the watertight roof membrane, the panels are not anchored to the roof but are mounted on concrete pads. These panels not only provide electricity, but also helped solve a problem for the design team. The City had required Enermodal to "hide" its rooftop mechanical equipment. As this was undesirable from an efficiency perspective, the design team proposed to the City that the solar panels could obstruct the view of the mechanical system, a proposal the City accepted.

To meet all of the remaining electricity demand at *A Grander View*, Enermodal has purchased green power from hydro, wind, and solar sources.

6. Water Efficiency and **Innovative** Rainwater Cistern

A key part of *A Grander View*'s water conservation is a rainwater cistern. Rainwater is directed from a rooftop drain into a 30 m^3 concrete storage tank located underground. This non-potable water is used to flush toilets.

Innovation:

A significant energy use in most cistern systems is a series of filters to remove sediment from the water before it is delivered to its end use. To eliminate these filters, the cistern system at A Grander View includes the following elements:

- Rainwater passes through a vortex filter to use the inertia of the falling water to spin out contaminates
- Water is delivered to the cistern at a reduced rate so as to not disturb the settled sediment at the bottom of the cistern.
- Cistern water is brought into the building through a floating suction line rather than a traditional intake line located near the bottom of the cistern where sediment collects.

The resulting water is cleaner, and the overall system more energy-efficient, than a conventional cistern. This cistern design has never been used before and is another Enermodal "first" that is likely to be replicated in other building designs in coming years.

Innovation:

Although most water used in the building comes from the cistern, Enermodal receives additional potable water from recapturing and using heat pump condensate created during the building cooling process. At peak cooling season (when rainwater would also be scarcest), the cooling process will produce 20 L per hour – that is enough to flush a toilet five times.

In most office buildings, the largest single use of water is irrigation. This unnecessary water waste was eliminated at *A Grander View* through landscaping that uses only native, drought-resistant plants.

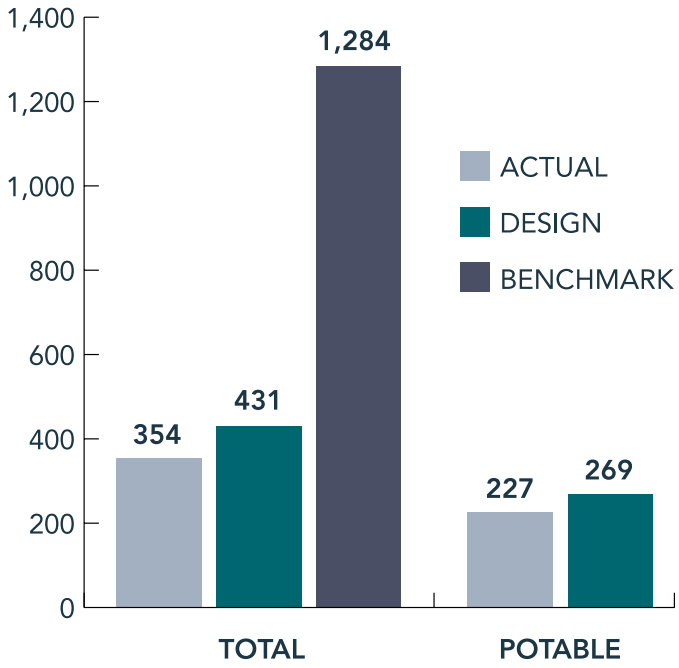

FIGURE: ANNUAL WATER CONSUMPTION

Inside the building, all plumbing fixtures are water conserving, as is the kitchen dishwasher. The men's restroom includes a waterless urinal. Together, the water conservation strategies result in a metered 89% reduction in potable water use.

One of Enermodal's water goals was to send water into the municipal stormwater system (and thus into local waterways) that is cleaner than the stormwater found on the site before development. To serve this goal, cistern overflow and stormwater runoff is directed to a grassy swale in the centre of the parking lot. The swale removes debris from the water as a first stage in treatment. The second stage takes place in a stormwater treatment unit located under the catch basin in the swale. The treatment unit removes finer dirt and grit, removing harmful phosphorus at the same time. The clean water is then sent to the municipal system with all oil removed and 40% less phosphorus and 80% fewer suspended solids than in typical urban stormwater.

7.
Leading Edge Operations and Maintenance

At Enermodal, a key part of monitoring corporate environmental impact is targeting LEED EB:O&M Platinum certification. LEED EB:O&M (Existing Buildings: Operations and Maintenance) is a new rating system that addresses the ongoing business processes and behaviours required to operate a sustainable facility. LEED EB:O&M describes the necessary operational policies and must be renewed every five years. Some of the aspects of building operation addressed by this rating system are housekeeping, purchasing policies, and waste management.

Many office cleaning products contain chemicals that are dangerous to janitorial staff and reduce indoor air quality for employees. Therefore, Enermodal implemented a green housekeeping program that specifies that all cleaning products are EcoLogo certified to be non-toxic.

Because Enermodal is a computer-heavy office, there are several policies to reduce energy use by computers. All office equipment and computers are Energy Star rated. Additionally, all computers are laptops and are programmed to go into "idle" mode after five minutes without use and to go into "sleep" mode after 30 minutes without use. Programming computers to go into sleep mode can save 7% to 15% of the computer's operating energy with no loss in performance.

Enermodal's goal is to be carbon neutral by 2014 as part of its Gold pledge to Sustainable Waterloo, a local non-profit. Carbon neutrality encompasses everything from building energy use to business travel to employee commuting.

A significant environmental impact of any business is the energy consumed by business travel. This is particularly true for Enermodal because LEED consultants and commissioning agents make frequent visits to construction sites. To minimize the carbon emissions from such travel, *A Grander View* includes a video conferencing system that will help Enermodal reduce the number of business trips for meetings. Additionally, Enermodal has commissioned a high-efficiency carshare vehicle to be at the office at all times for employees to use for site visits rather than their own (potentially more gas-intensive) vehicles.

To encourage green living away from the office, Enermodal developed some of the most progressive employee green incentive programs in North America to encourage employees to live green lives away from the office. These incentives were developed in collaboration with the Enermodal Employee Sustainability Committee. This committee meets once a month and proposes policies that contribute to improved business processes and employee satisfaction. Some of the employee incentives include complimentary bus passes, low-flow showerheads, compost bins, and rain barrels as well as $1,500-3,000 off the purchase of a hybrid vehicle.

8. **Lasting Impact** and Long Term **Savings**

A Grander View was constructed for $5.5 million (including fit-up, but excluding land purchase). This is quite comparable to other low-rise office buildings in the Region of Waterloo. The mechanical system was $42 sqft, while the electrical was $16 sqft. In terms of the high performance buildings Enermodal's M/E team has designed, this is one of the most cost-effective M/E systems. Enermodal will also save tens of thousands of dollars a year in utility, operating, and maintenance costs.

A Grander View will contribute to the public good at an individual, community, and national level. All design and construction team members (besides Enermodal) had never worked on a Platinum project previously. This was a great opportunity to learn about creating a high performing, sustainable building.

A Grander View, as Canada's most energy-efficient building, sets the bar high for other companies and design teams to emulate.

Already, over 2,000 BD+C professionals and members of the public have been given tours of this building – taking with them an increased knowledge of green buildings and what is possible.