

JOURNAL OF greenbuilding

VOLUME 2 NUMBER 2 **SPRING 2007**

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ENERGY EFFICIENT SUSTAINABLE SCHOOLS IN CANADA SOUTH

Joseph Passa, Architect, OAA, MRAIC ¹ and David Rompf, Dip. Arch.²

Introduction

"Canadians consume too much and most of it is wasted. Less than 10 percent of the energy we generate is actually used in the purpose for which it was intended. Most of it goes up in smoke. Our economy is fully one-third less energy efficient than the United States and only half as efficient as most European countries."

**Originally published as a foreword to Sustainability within a Generation: A new vision for Canada by Dr. David Suzuki*

The last few years have seen a massive swing in the architectural design industry toward green and sustainable concepts and practices. The industry is geared towards improving and evolving building products, processes, and design techniques in order to constantly improve the environmental aspects in the new and renovated structures being built today.

Passa Associates Architect decided a number of years ago to pursue the sustainable route at a time when it was difficult to convince owners and contractors to break with the norm and institute sustainable principles in the buildings they were erecting. This article highlights some of the significant projects that they undertook and attempts to explain how the use of new technologies, constantly evolving sustainable design practices, and ground breaking 'green' building materials with every new project can be reflected in the energy efficiency results which constantly improved with each new project. It is this desire to improve upon what's been done previously that is paving the way to a greener future. The calculations evolved through energy simulation software created a quantifiable system identifying how high performance energy efficient building can be achieved. This resulted in buildings with reduced green house gas emissions with the goal to grow into 'living buildings' giving back energy when able.



Our Lady of Mount Carmel Catholic Elementary School, Windsor, Ontario

Two of the first energy efficient green projects by Passa Associates Architect (PAA) were elementary school projects for the Windsor-Essex Catholic District School Board (WECDSD). Our Lady of Mount Carmel Catholic Elementary School was completed in April 2004 and was determined to be 39.5% more efficient than the Canadian Model National Energy Code for Buildings (MNECB) while St. Christopher Catholic Elementary School was completed in August 2005 at 59.5% more efficient than the MNECB making it the most energy efficient elementary or high school in the Province of Ontario and fourth most efficient in Canada.



St. Christopher Catholic Elementary School, Windsor, Ontario

These projects were followed by a Fitness Centre Addition to the University of Windsor in which the firm dealt with further complicated building encapsulation details utilizing techniques for daylight harvesting. The last project mentioned in detail is the renovation of an existing 'brownfield' industrial hospital linen building for use as the Glengarda New Facility, a school for Glengarda Child & Family Services of Windsor, Ontario. This project has been determined to be 65.2% more efficient than the MNECB.

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Our Lady of Mount Carmel Catholic Elementary School: Introduction

Our Lady of Mount Carmel School was typical of many elementary schools found around the Windsor-Essex County region. It was originally built in 1948 with several additions put on over time. The WECD SB approached PAA to prepare a conceptual design for a new addition at the school who suggested a sustainable design approach be taken. When questioned, the school board expressed concern about reducing their excessive energy costs in their current building stock and agreed to use the school as a test case for an energy efficient model that PAA suggested be designed as long as it maintained their standard budget. The conceptual design stage began in the spring of 2002.

The difficulty in convincing clients to take the sustainable route with new construction is a continual concern due to the common misconception that incorporating green and sustainable design features into a project automatically raises costs above typical construction. PAA's stated goal prior to conceptual design of the project was to provide an energy efficient building within the client's budget

while providing an imaginative and functional design with the belief that all building owners should endeavour to save energy and give back to the environment as much as possible. The WECD SB project budgets were fixed and they insisted that regardless of what design direction was taken the project had to meet the same square footage new construction cost allowance of their projects by other designers. It was therefore decided that the provided design would be "cost neutral" in fashion with sustainable concepts being introduced which would not cause the project budget to exceed the client's allowance. Another decision by PAA was to utilize the Commercial Building Incentive Program (CBIP) initiated by Natural Resources Canada as a way of off setting extra design costs associated with sustainable and energy efficient projects. A one time financial incentive equal to twice the difference between the estimated annual energy costs if the building were built to the MNECB standard up to a maximum of \$60,000 or the total design costs. As this development was a test project the intention was that the design process would be a model for all future projects by the WECD SB. Following the success of Our Lady of Mount Carmel Catholic School, the WECD SB mandated that all new construction projects by all their architects would be CBIP compliant, being the first school board in the



Our Lady of Mount Carmel Catholic School floorplan showing the existing remaining school building and all new additions

Province of Ontario to do so.

As part of the Integrated Design Process (IDP) used for this project, Enermodal Engineering, an energy consultant who also provided mechanical and electrical engineering design, was included as part of the design team to provide their specialized services with EE4 software which aided in making design decisions incorporating sustainable elements such as:

- providing an initial list of energy efficiency suggestions within the new design concept
- energy simulations of the new design
- provided associated M & E costs and payback analysis for IDP proposed energy efficient designs
- determined initial benchmarks required to apply for CBIP

The IDP design process was an invaluable tool in allowing PAA to coordinate the efforts of the design team while ensuring that all members of the team provided valued design input and that clear communication could occur between the owner, designers, maintenance aspects, and users.

Our Lady of Mount Carmel: Scope of Work

Construction commenced for the new additions to Our Lady of Mount Carmel in the spring of 2003. The design consisted of a South Addition of 16,000 square feet which consisted of six Classrooms, a Resource Room, Washrooms and a new Service Room, a Front Addition of 9,000 sf with four more Classrooms and a new Administration Area, and a Gymnasium expansion addition as well as various interior renovations made to an existing 28,000 sf structure consisting of previous additions with one section dating back to 1948. This original 10,000 sf portion of the existing building was demolished to make room for the new 9,200 sf Front Addition.

The existing site was minimally affected with the new construction due to the condensed addition designs which aimed to minimize site impact by utilizing an un-used portion of the site adjacent a drainage right of way. The new additions were actually designed and located to impact existing trees as little as possible while improving the external site and building interior circulation patterns. Existing trees which were affected by the location of the new additions were carefully removed and relocated on the site. Courtyards were created within the confines of the school which offered calming and pleasing views for

students and staff from most vantage points instead of asphalt play yards and parking lots. All new classrooms are off single sided corridors which created the outdoor courtyards adjacent the existing structure. The overall design is focused on providing a relaxing environment conducive to teaching and learning while creating a general feeling of safety and security. The classrooms themselves are intended to be passive 'Laboratories for Learning' evolving questions from students regarding the use of materials, exposed piping, ductwork & sprinklers, and the shape and design of the room which extends upwards to 18 feet high at the north ends and slopes to 11 feet to the south with large overhangs. The existing parking lot was also modified to allow for an organized division of the four modes of traffic inherent to peak loading for schools; teacher parking, volunteer parking, parent pick-up, and school buses.



View of link corridor showing courtyards each side and the extensive use of glazing to maximize daylighting
Our Lady of Mount Carmel Catholic School



Existing exterior windows were removed and new enlarged windows with exterior sun shades were installed - Our Lady of Mount Carmel Catholic School

Our Lady of Mount Carmel: Sustainable Features

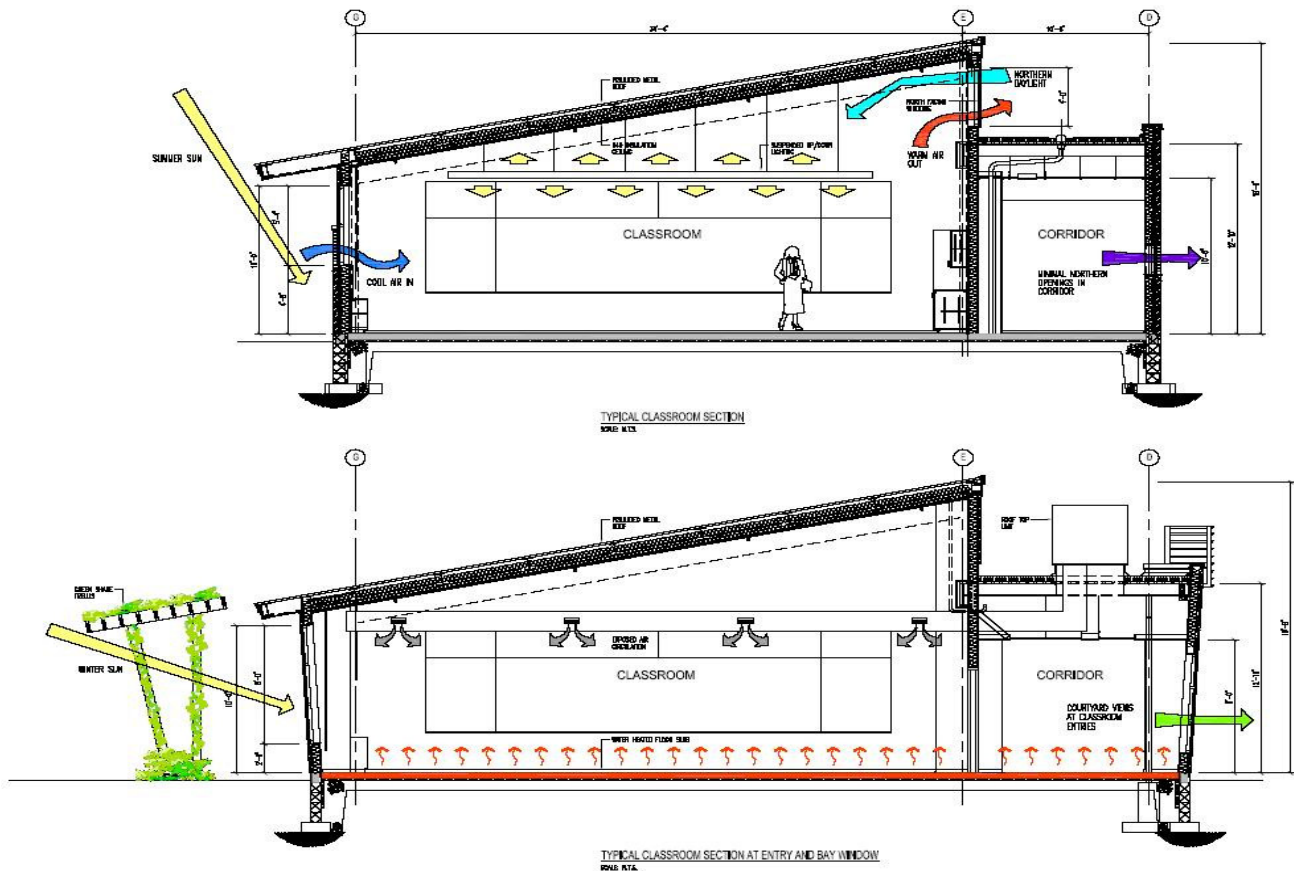
The existing school building had steel framed windows with single pane glazing which were entirely replaced with new fibreglass window frames complete with double glazed units with low-e coating and argon gas filled. The fibreglass frames offer a higher insulation value over the aluminium frames typically used. All windows on the project were designed with sliding operable windows with heights previously tested with the teachers to give occupants control for fresh air. In order to better utilize the existing solar orientation of the building, existing south facing window openings were enlarged to offer greater day lighting opportunities and had sun shading devices attached to the exterior of the building to aid in reducing solar heating gains and reduce the glare of direct sunlight.

The new south facing addition was designed to take full advantage of day lighting by having extensive amounts of south facing windows above computer screen locations along with high clerestory north facing windows. The large south facing windows in the classrooms are shaded by a continuous four foot sloping roof overhang. The classrooms have been

designed with sloped white painted ceilings to better allow daylight reflective penetration deep into the rooms.

For lighting efficiency in the new additions daylight sensors will shut off the lights when there is sufficient daylight outside. The lights are wired so that the ones closest to the north facing high windows will shut off first and then the suspended banks will systematically shut down as daylight levels deepen into the room and are registered as being adequate enough for electric lights not be required. Occupancy sensors throughout the new additions provide additional energy savings especially during after school hours. Not only is electrical demand lowered because of these energy saving devices but the cooling load on the building is reduced because of the reduction in heat generated by the lights.

Further energy savings were obtained by installing an in-floor radiant heating throughout the new additions. This heating system was selected due to its efficient method of providing a higher comfort level. The higher capital cost was offset by reductions in the amount of and size of required



Our Lady of Mount Carmel School classroom design schematic illustrating the sustainable features such as radiant in-floor heating, cool / displacement air ducted from single sided corridor roof top unit with heat recovery, and daylight harvesting.

ductwork for the project. The decision to incorporate the radiant in-floor heating was determined early on in the design process due to the many implications its decision had on mechanical, floor and structural designs. A standard thickness 4" concrete floor slab on grade was used throughout the project but with the added features. The design of the slab and its surrounding materials required careful consideration in order to prevent heat loss through the slab, possible cracking of the slab, and how the finish materials adhered on top would react. The slab was designed to be installed over 2" of continuous lapped rigid insulation to prevent loss of heat through the base material beneath. Around the perimeter of the slab a continuous insert of rigid insulation was placed to prevent thermal bridging through the foundation wall. It was also determined that the vapour barrier commonly installed beneath the slab would not be required.

Prior to pouring the slab, wire reinforcing mesh was first laid out on top of the rigid insulation. This mesh was needed to fasten the water piping in order to install it at the depth required within the slab. The slab was further reinforced with additional fibre mesh reinforcing throughout the concrete. The PEX piping was laid out in a looping pattern with the spacing between the loops being closer together when located along the building perimeter and further apart when located in the centre of the building. Occupant control was maintained by having the piping laid out so that zones were created within the layout which each having its own thermostat and manifold locations.

This heating system provided a reduction of the existing boilers for the school by one third. With the demolition of the front 10,000 sf of the building and its replacement of 9,200 sf and with the addition of 18,000 square feet of other additions one of three existing boilers was no longer needed and was decommissioned. The school, previously smaller, working with three boilers, is now much larger and runs on only two boilers.

Roof top air handling units provided conditioned air to the new spaces. High level air conditioning ducts provided low velocity fresh air and displacement circulation while the air handling unit fan speeds increased for A/C requirements. The variable speed fans on the rooftop units along with heat recovery wheels, equipped on all rooftop units, allowed for additional energy savings.

The building envelope was carefully designed with both batt insulation and rigid insulation in order to avoid all thermal bridging providing an extremely efficient building envelope. Building a better box is the key to energy efficiency reducing energy



Installation of the radiant in-floor heating piping loops prior to pouring of the concrete floor
Our Lady of Mount Carmel Catholic School

demands and allowing smaller ducts, motors & fans for all mechanical devices. The result is an interior environment extremely comfortable for its occupants with a high performance building envelope maintaining interior temperatures with maximum efficiency. The comfort level is increased with the provision of the occupant control operable windows provided throughout. Interior ventilation air is maintained fresh by the variable speed rooftop unit fans. Sound levels are controlled by sound absorbing material integrated into the high volume wall surfaces. Occupant comfort is a key consideration in sustainable design principles as well as the current and future use flexibility of the structure. The new additions were erected using post & beam steel construction which will allow for ease of modifications with high impact gypsum board partition walls.



Typical classroom north wall elevation showing high clerestory windows and white sloped ceiling
Our Lady of Mount Carmel Catholic School

The roofs of the new additions are low sloped metal roofs. These roofs offer long life spans and are made from recyclable materials. The existing flat roofs were upgraded from minimal insulation to extremely well insulated white coloured roofs. While construction was occurring it was suggested by PAA to install a small test green roof on one of the linking corridors of the new additions and was agreed by the board. This test roof was to be the first green roof in the Canada South area. The green roof was relatively small in nature but was intended to be a stepping stone in the process of the WECDSB having future projects with much larger green roof installations.

Our Lady of Mount Carmel: Summary

With positive media coverage and encouraging endorsements from the community Our Lady of Mount Carmel was completed in the spring of 2004 well in time for the new school year start later in September. The successful project had met all programming needs of the client while incorporating several regionally ground breaking sustainable concepts. The project had come in under budget proving that sustainable design can be incorporated without extra cost. In fact, the cost per square foot of the new green school was marginally lower than other similar non-sustainable WECDSB projects. With several additional sustainable features the tender cost the four million dollar project came in \$65,000.00 under the budget cost at \$122.00 per sf. The project was completed on schedule with its green design not being the cause of any delays.

In addition the project received high praise and recognition. During its re-dedication ceremony the school was presented with a plaque from the Canadian federal government's CBIP program acknowledging its successful approval for an NRC (Natural Resources Canada) grant. It received a CBIP incentive of \$31,000 since the project was 40% more energy efficient than the Model National Energy Code for Buildings. The MNECB itself is approximately 10% more energy efficient than the Ontario Building Code which are the minimal requirements for construction in the Province of Ontario. It was approximated that the annual energy savings would be \$17,000.00 over a standard design similar structure. This would have amounted to approximately \$ 425,000.00 over the 25 year life of the mortgage at current energy rates which are assumed to increase. Our Lady of Mount Carmel was the first project to receive a CBIP grant in the Canada South Region and was noted as being in the top 10% of energy efficiency in Canada at the time of receiving the grant.

Throughout the entire design and construction phases of the project, the WECDSB was educated in sustainable design and with its new found knowledge confidently mandated CBIP compliance for future energy efficiency.

In early 2006, the WECDSB asked PAA to design two new additions for Our Lady of Mount Carmel. The resulting additions included a 1,440 sf Child Care Facility and a 5,500 sf Four Classroom Addition. These additions were incorporated into the existing design scheme and blended seamlessly with the additions built in 2004. CBIP applications were taken out for both additions and were approved with the energy modelling of energy efficiency at 36% over the MNECB with an estimated annual cost savings of \$4,100.00 over a standard design similar structure or \$102,500.00 over 25 years. The CBIP incentive grant of \$8,800.00 was paid to the project team. Of note is the fact that with the further added area the previously reduced two boiler system was still capable of handling the required energy demand with the additional total 25,000 sf of space above the previous three boiler system prior to the combined renovations.

St. Christopher Catholic Elementary School: Introduction

The second sustainable project completed for the WECDSB was the St. Christopher Catholic Elementary School additions. Conceptual design commenced in the spring of 2003. The project included 13 new Classrooms, a Resource Centre, a Gymnasium expansion, Change Rooms for the gymnasium and an extensive renovation of the existing school building including renovating an existing classroom into a Child Care Centre.



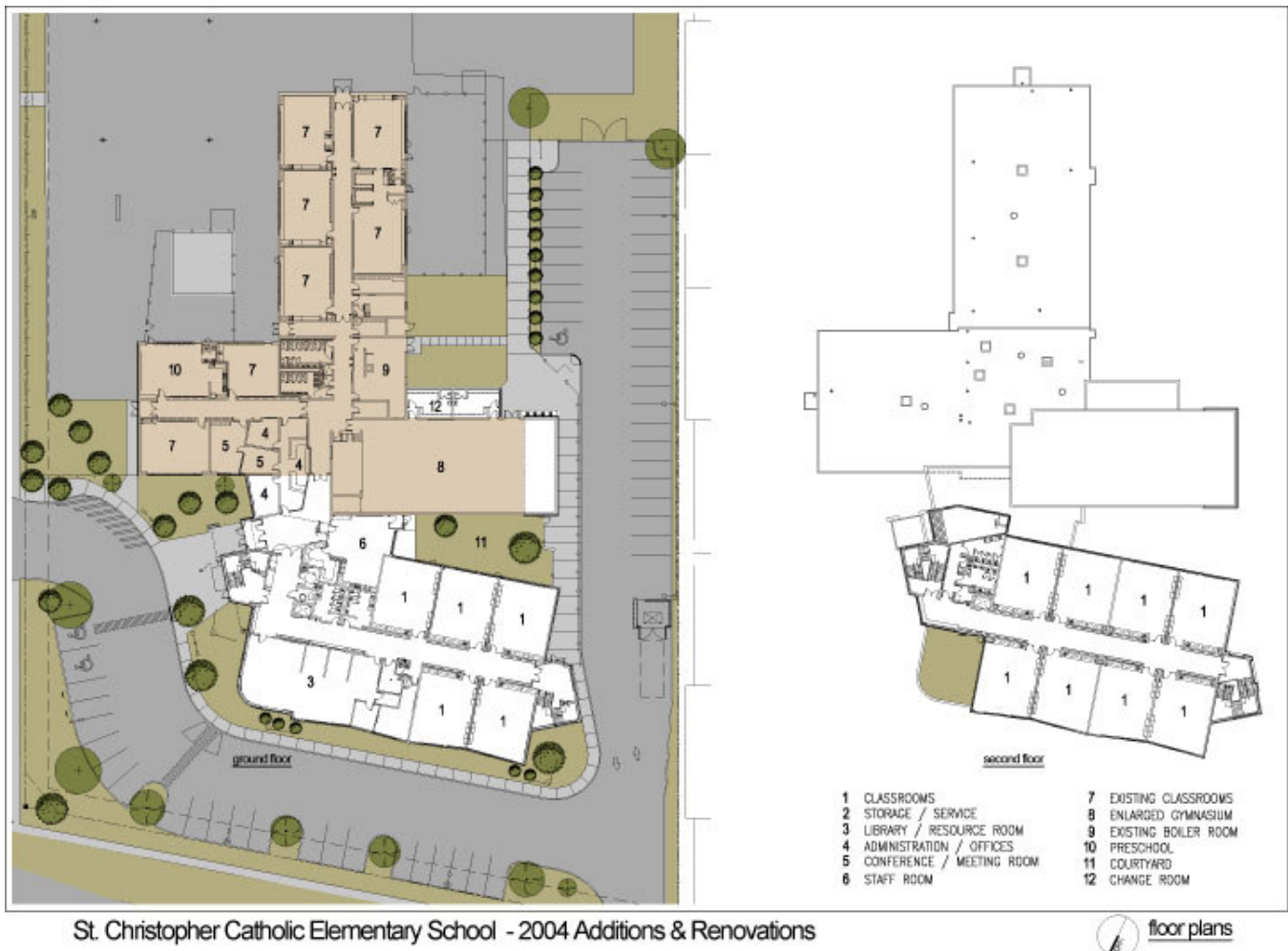
View of new main entry to two-storey addition
St. Christopher Catholic School

PAA was determined to provide a design which would provide similar energy saving features appreciated in the Our Lady of Mount Carmel design but was also requested to utilize over 400 recessed ceiling T8 light fixtures that the WECDSB had in stock and wished to use. The intention was to have a noticeable improvement in the energy efficiency above Our Lady of Mount Carmel while the lighting requirement dictated that flat ceilings must be included in the design.

Once again the IDP design process was used on this project to allow all building participants to voice opinions and suggestions to contribute to an energy efficient design. All opinions were documented and later used to assist the decision making process in order to evolve the developed design. The conceptual design was completed with energy simulation figures showing various benefits and construction costs. All simulations were discussed thoroughly with the architect, engineers and owner all expressing views and ideas in reference to the project budget. Cost estimates of upgrades and even CBIP grant predictions helped the owner decide what investments were prudent to make in the project.

St. Christopher Catholic Elementary School: Scope of Work

St. Christopher Catholic Elementary School is located in Windsor, Ontario, Canada in a residential neighbourhood which is located adjacent a major expressway within the city. The existing 19,000 sf school building contained 8 Classrooms, a Resource Room and a Gymnasium with a large front yard facing the expressway. Rather than build the expansion in the rear school yard losing valuable play space it was decided to locate the major addition in the front yard providing a new image for the school while using the only under utilized portion of the site. This created the opportunity to evolve the four required individual traffic patterns for the users with a new roadway and parking. The façade of the new two storey 25,000 sf addition facing the expressway was designed as an undulating wall to aid in the dispersal of traffic noise. The two-storey addition was again designed to minimally impact the site with all affected existing trees relocated on the site. As well, the existing school building was extensively updated with new ceilings, flooring, efficient lighting, and a new insulated flat roof.



St. Christopher Catholic Elementary School: Sustainable Features

The new two-storey addition for St. Christopher Catholic Elementary School was designed using highly durable and yet recyclable materials. Steel structural members, exterior metal cladding and concrete block constitute the majority of the construction. Composite concrete and structural metal deck floors were used on the second floor. The use of the structural metal decking allowed for a reduction in overall steel used on the project. Day lighting was once again considered extensively in the design with large expanses of north and south facing glazing in the Classrooms. Fibreglass framed windows with warm edge spacers and argon gas filled double glazed sealed units were used exclusively on the project. This was combined with a high performance insulated 6" metal stud building envelope which was designed to avoid instances of thermal bridging with additional perimeter rigid insulation. Sliding operable windows were provided throughout the new addition to allow for additional occupant comfort control and exterior mounted aluminium sun shades were installed in the high Atrium area at the entry to control direct solar glare and reduce solar heat gains in the building. Water usage in the new addition was reduced over a standard designed structure by installing waterless urinals and low flow fixtures.



Waterless urinals were installed in existing and new student washrooms

Energy efficiency was achieved in several ways with this project. Firstly, the entire new addition is served by one make-up air unit mounted on the roof with a heat recovery wheel. Following the success of the in-floor radiant heated floor at Our Lady of Mount Carmel the floors of the St. Christopher School addition are both radiantly heated and now cooled as well. A total of 25,000 sf of flooring had the in-floor piping installed which provided efficiencies in both heating and cooling systems with less required ductwork and a relatively low energy usage compared to typical heating and cooling systems.

An added natural gas fully modulating condensing boiler with the two existing boilers used as slaves supply heat to radiant vestibule heaters and floors throughout the addition (94% thermal efficiency) while a new fully modulating rooftop chiller serves the radiant cooling system. There was a concern in the design stage of not being able to fully control the room temperatures of the vestibules in the building during the summer months when the in-floor radiant cooling was operating. The constant opening and closing of the exterior doors during hot and humid conditions might cause the accumulation of condensation on the cooled floors. This was overcome by simply removing the radiant floors from the vestibules and providing wall mounted water heaters in the vestibules with fans. The entire new addition has cooling provided by the radiant in-floor system while in the existing school water cooled fan units were installed in each of the existing school Classroom ceilings as well as the revised Administration areas.



Rooftop mounted make-up air unit complete with heat recovery wheel
St. Christopher Catholic School

Efficient lighting was predominantly used by installing the T8 florescent fixtures the board had in storage throughout the new addition and in the existing building where existing light fixtures were all removed. Occupancy sensors and daylight sensors were again used extensively throughout the new addition and existing renovated building to provide additional energy efficiency. Sensors were also installed in all Classrooms to determine occupancy use and control motorized dampers that allow fresh air displacement ventilation being delivered to each Classroom as required. If a room is unoccupied the dampers close automatically and the fan providing the ventilated air to the room automatically reduces speed based on the reduced ventilation air demands. This allows for energy savings by reducing fan use in spaces not occupied.

Amongst all the sustainable design features at St. Christopher the most visible aspect of a green building leaving the greatest impact on those who visit is the 5,000 sf green roof, which was the largest of its kind in the region when it was built. The extensive green roof plantings cover half of the second floor roof of the new addition at the school and also cover a portion of the roof over the ground floor Resource Centre viewed from the second floor. The lower roof garden roof is visible through large windows located in the second floor corridor and is on display and enjoyed by students, staff and visitors. The 'passive living laboratory' concept used at Our Lady of Mount Carmel is carried through this project as well hoping to stimulate and educate students in sustainability in their environment with the intention to instil green principles in the minds of young children.



Lower green roof located off a corridor to be visible as an education tool for children (shown here in winter)
St. Christopher Catholic School

The extensive planting green roof consists of sedum, grasses, wild flowers and leafy perennials which were selected due to their hardiness, relatively shallow roof systems and their drought and frost resistance. The design of the green roof allows for water retention within the roofing system which prevents drying out of the soil and plant material in dry weather situations. In extreme dry weather or drought conditions, a water system installed on the roof can be used to water the plants. Green roofs are relatively maintenance free with watering only required during the initial planting period to establish root growth and during extreme dry conditions. As with any roofing system, it is recommended that an inspection occur annually to check flashings and drains. The system is designed with granular roof ballast or river rock installed in areas of potential problems around the perimeter of the roof (in order to repair or check flashings) and around any roof penetration in order for ease of access should any be required. The growing medium used is a mix of organic and mineral soil. At St. Christopher's 6" of

soil was installed. The soil is specially designed with a binder so it will not blow off of the roof. The green roof acts as a bio-filter for air pollution and it helps reduce noise transmission into the building which is important considering the building's location next to an expressway. It is expected that the green roof will



View showing healthy growth of high green roof area
St. Christopher Catholic School



View showing upper portion of 5,000 sf green roof
St. Christopher Catholic School



View from above of lower green roof area which can be seen from windows in second floor corridor
St. Christopher Catholic School

increase the life expectancy of the roof at St. Christopher to about 50 years on average.

Additional sustainable benefits of the green roof are:

- Low maintenance requirements and reduced building cooling through evaporation
- Environmental benefits due to reduction of urban heat island effect
- Better storm water management on site with less roof run-off
- Additional processing of airborne toxins and re-oxygenates the air

The green roof at St. Christopher School is composed of the following materials which add approximately 25 psf in weight to the roof:

- Substrate soil complete with plant material
- Filter layer (to ensure soil is not washed away by water drainage)
- Drainage / Water Retention Layer (designed as water troughs to contain water so as to evaporate and maintain moist soil conditions)
- Rigid Insulation (Extruded Polystyrene)
- Root Prevention Layer (to protect from damage caused by root growth)
- Membrane Protection Sheet (additional protection for roofing membrane)
- Roofing Membrane – Tremco's Tremlar-TRA-LRM System (Polyester Reinforced EPDM/SBR Sheet fully adhered with a cold process adhesive to the roof decking surface)

St. Christopher Catholic Elementary School: Summary

Following the opening of St. Christopher Catholic Elementary School the WECDsB once again was inundated with praise and community news events regarding their efforts to modify their school design practices with the integration of green and sustainable principles in their organization. The WECDsB was awarded the 2005 Essex-Region Conservation Authority Conservation Award for Education for St. Christopher School. The award recognized organizations which have made outstanding contributions towards improving the local natural environment. The school has been the

focus of several news articles including being mentioned on the Canada Green Building Council website as a notable sustainable project in Canada. The recognition that Passa Associates Architect, the WECDsB and St. Christopher's itself has received has helped forge and reinforce a green image that has been beneficial in the region for other environmental projects.

A CBIP application was filed for St. Christopher School and was approved with a technical review in February 2005 indicating that the project was 59.5% more energy efficient than the MNECB equivalent. This made the project roughly 70% more energy efficient than the local Ontario Building Code requirements. The CBIP incentive grant was calculated to be \$ 50,076.00 and paid to the project design team. St. Christopher's was also recognized by the CBIP program as the most energy efficient elementary or secondary school in the Province of Ontario and the fourth most energy efficient in Canada at the time of completion in August of 2005.

Further proof that the implementation of sustainable design practices does not cost more than typical construction costs was gained with the fact the this project was tendered and came in \$350,000.00 under the project budget with the cost per square foot of the St. Christopher School 2004 Additions and Renovations lower than other non-sustainable WECDsB projects at \$118.00 psf for the \$4.4 million development.



Main Entry Hall showing ample natural daylight and exterior mounted sun shades
St. Christopher Catholic School

Human Kinetics Fitness Centre Addition / University of Windsor:



Curtain wall façade of Human Kinetics Fitness Centre Addition at the University of Windsor

A brief mention of this project highlights a development where careful examination of the building envelope was required while dealing with several existing conditions to provide high performance building encapsulation for this addition utilizing un-used 'found' space between buildings on the university campus. The 7,200 sf Fitness Centre Addition was designed to fit between two existing structures of different construction. Technically, only one new wall was introduced for the new addition which was designed as a striking, curved glass curtain wall. Existing walls all around the new space had to be carefully examined and a building envelope developed by dissecting the walls as required and installing a highly insulated continuous building encapsulation. The high ceiling space of the fitness centre is entirely painted in white and high clerestory windows have been installed in raised walls built above existing walls facing south to create an extremely well lit space. The clerestory windows have specially designed angled louver light shelves to provide deep penetration of the daylight which permeates the space. In fact, the natural daylight is so effective that during daylight hours 1/3 of the new T8 light fixture tubes in the facility are generally shut down.

The large two-storey east facing curtain wall allows for the harvesting of natural daylight but also greens the interior of the facility due to its relative scale and captured view to an adjacent park like setting on the University of Windsor campus. The exterior view is drawn completely into the building.

The interior of the space was intentionally left open and exposed which required careful thought and detail to lay out mechanical, electrical, structural and

architectural elements in an organized and coherent fashion. The entire ceiling; including the structural and mechanical features, have been coated in white to once again brighten the space with reflective light.



Light shelves installed inside the Human Kinetics Fitness Centre Addition the beneath clerestory windows allowing deep penetration of daylight

Glengarda New Facility / Linen Building Renovation: Introduction

Glengarda Child & Family Services is a multi-disciplined Children's Mental Health Centre situated in Windsor, Ontario and is located on the campus of the Windsor Regional Hospital in small old buildings partially due for demolition and redevelopment. They serve families with children who have mental health problems aged 5 to 12 years who are experiencing significant social, emotional, behavioural or cognitive difficulties. Glengarda was in need of more space and was considering building a new structure or possibly renovating an existing 32,000 sf industrial Linen Building on the Windsor Regional Hospital campus which had been vacant for over 8 years and used for hospital storage. After initial consultations with PAA, and through a space needs study which they provided, the decision was made to re-use the existing Linen Building for Glengarda's new school and offices. PAA, considering that the greenest buildings are the ones we already have in place, felt that this particular structure with its large 100 foot clear span trusses, had significant embodied energy within it that would have been lost if it was demolished. This direction proved to be highly beneficial to the hospital since they were able to re-cycle a portion of the campus which had been under utilized for a considerable duration creating a win-win situation for both organizations.



West Facade View of Hospital Linen Building Prior to Renovations, Windsor Regional Hospital



Proposed New West Façade – Glengarda Child & Family Services Building

The Glengarda New Facility in mid-2007 is currently in construction renovating the existing building originally built in 1968 for the Windsor Regional Hospital. The original structure was a two storey structure which housed offices and heavy industrial laundry building service areas and the laundry drying facilities. These areas were adjacent to wash floor space with a 22 foot high ceiling. Two ground floor lower shed roofed areas were added during the early 1980's for the storage and delivery operations with large loading bays. The building was constructed of typical brick and masonry walls with a steel column and truss structural system. The original portion of the building had no insulation in the exterior walls and minimal insulation (1/2") in the roof while the newer additions had 1" of rigid insulation in the exterior wall cavities and a 1 1/2" of rigid insulation on the roofs.

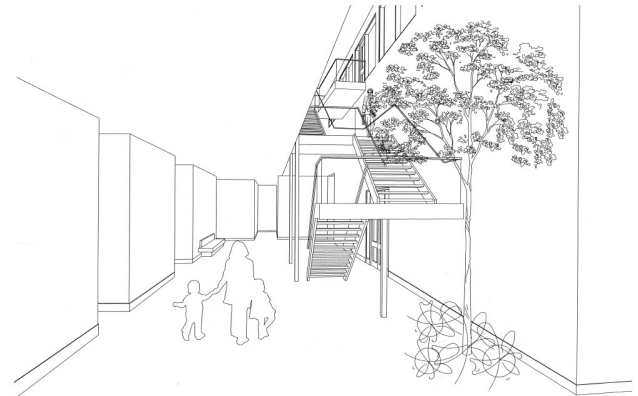
Glengarda New Facility / Linen Building Renovation: Scope of Work

The process of modifying an existing building into a high performance energy efficient renovated structure was a complicated process with the design

team determined to exceed it's energy savings targets set on it's previous projects and improve upon the nearly 60% energy efficiency over MNECB achieved with the St. Christopher School. In order to achieve this sort of resultant the building envelope had to be significantly upgraded including the roofing system.



Existing view of proposed Atrium area
Glengarda Child & Family Services Building



Perspective view of proposed Atrium
Glengarda Child & Family Services Building

All existing electrical and mechanical equipment in the building was removed and any metal that could be salvaged was removed for recycling. The large open space of the existing wash floor was designed for Classroom and student related activity areas. The existing Mechanical Room was able to be halved in size with the half remaining becoming the new Service Room in the new design. The second floor of the structure was used predominantly for administration areas and offices. The site was minimally affected with the existing asphalt parking areas to be resurfaced and some previously paved loading dock areas being rehabilitated with their surfaces and subsurface materials removed and

new soil and landscaping designed to create more green space. Existing plants and trees on the site were to be maintained or relocated carefully on the site. Following completion, the site will have more green space prior to construction.

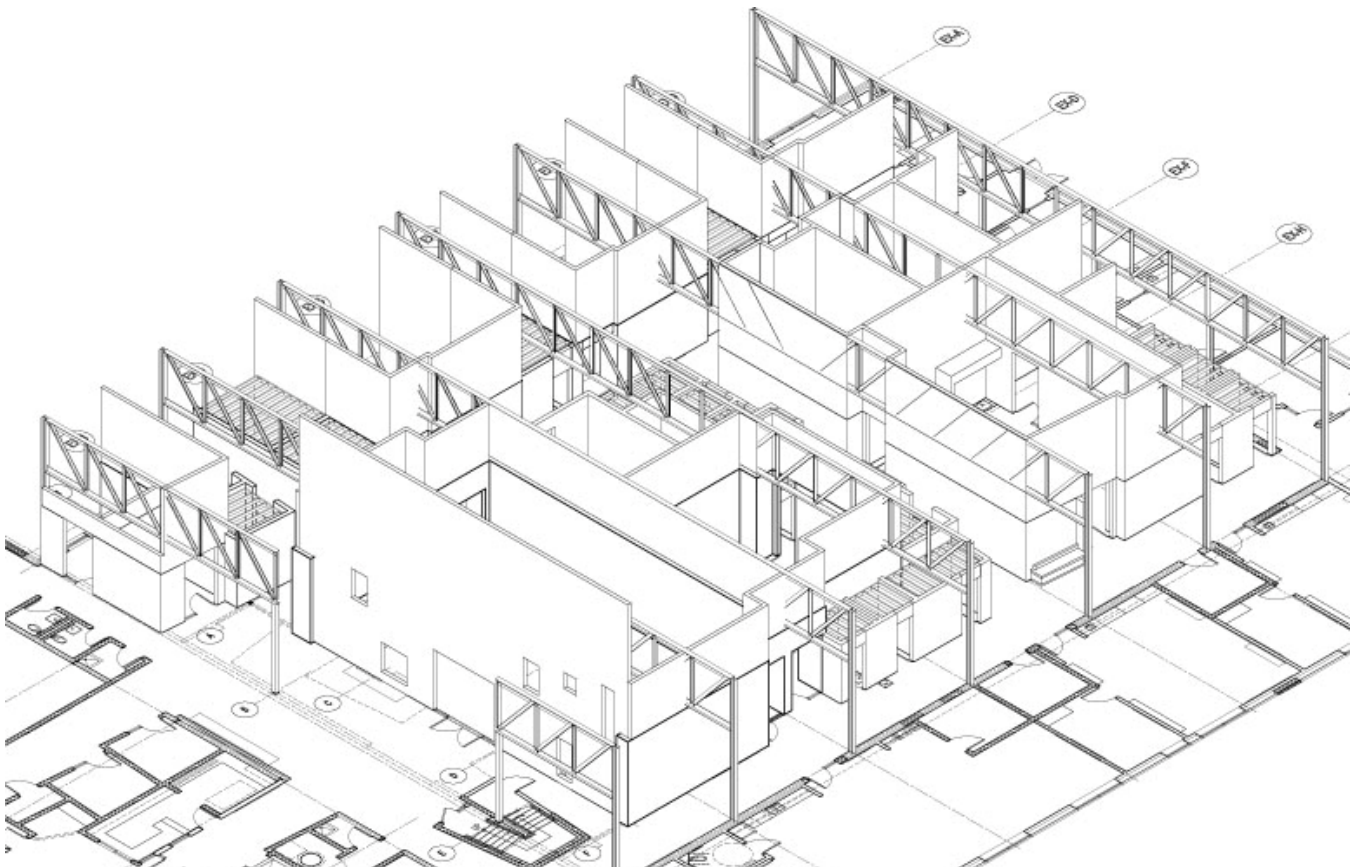
Glengarda New Facility / Linen Building Renovation: Sustainable Features

The most important of all the sustainable features for the Glengarda New Facility is the detailed and intricate building envelope which had to be evolved to deal with the lack of insulation in the majority of the exterior walls and roofs. The evolved design provided for a fully insulated and uninterrupted high performance building encapsulation which involved the use of spray applied, rigid and batt insulation in order to eliminate all thermal bridging concerns with insulation overlaps of 4 feet from the exterior and interior wall surfaces. This process was further complicated by the varying materials used in the construction of the existing exterior walls from cavity walls with insulation, cavity walls without insulation and pre-cast concrete wall panels. On the second floor the existing exterior brick façade was partially removed due to thermal bridging which existed with the second floor structural members being connected to the exterior wall. This brick was

recycled by being used to patch existing brick opening elsewhere on the project. The exterior walls of the second floor were finished with EIFS in order to better provide a high performance building envelope and eliminate the thermal bridging occurring at the second floor roof level. To maximize the building envelope fiberglass window frames with high performance glazing was once again implemented.



View of existing open high volume space prior to demolition with exposed trusses and wood roof deck
Glengarda Child & Family Services Building



Perspective showing existing 8'-0" deep trusses to remain and the proposed division of open high volume space allowing light penetration and acoustic separations. Glengarda Child & Family Services Building

To increase the energy efficiency for the project, all design strategies used on previous projects were used again including the radiant in-floor heating and cooling used at St. Christopher except this had to be achieved in an existing building. It was decided that the existing floor slab would remain and a new 3" thick concrete floor containing the radiant heating / cooling piping would be installed on top of high density rigid insulation over the existing floor. This solution allowed for the incorporation of the radiant system as well as dealt with the lack of insulation beneath the existing inaccessible floor slab. The reinforcing of the slab was a concern due to it only being 3" thick (due to height concerns in the lower existing additions) and having the in-floor radiant piping through it. However the fact that the slab and insulation is installed over an existing floor slab confidently remedied the floor slab cracking concern. Radiant heating / cooling was not installed on the second floor due to the existing thin floor construction and the weight factors involved for a new slab.

Further energy efficiency will be attained by the efforts to introduce daylight harvesting into the project. The existing windows of the building were not extremely well placed based on the solar

orientation of the building; however additional window openings were created to better allow day lighting of perimeter spaces of the design. Existing high ribbon window openings for the high ceiling space were maintained with the windows replaced. These windows will allow for day lighting bounce into the high ceiling space and due to the use of white paint on all high spaces and ceilings, as well as the strategic placement of several white painted drywall bulkheads, the daylight will penetrate deeper into the space.

Further daylight penetration will be achieved by the introduction of a high glazed atrium space into the existing structure where the existing roof will be removed and a raised glazed wall atop the atrium will allow for vast amounts of natural lighting into the centre of the building. This feature was evolved to also provide a convenience stair in the centre of the building for the one use occupancy. Day lighting will be further enhanced by three additional light monitors which will be cut into the existing main roof area and allow for further deep penetration of light. This day lighting design combined with the use of high efficiency light fixtures, occupancy sensors, and day lighting controls will allow for extremely high energy efficiency and lighting quality.

ENERGY SIMULATIONS FOR GLENGARDA NEW FACILITY

Scenario	Annual Energy Costs			CBIP Performance			LEED Canada & Environmental Performance		
	Electricity Cost	Natural Gas Cost	Total Energy Cost	% Energy Savings to MNECB	\$ Energy Savings to MNECB	CBIP Incentive * (max \$60,000)	Energy Cost Savings % (See Note 1)	LEED EAc1 Points (max 10)	GHG Savings tonnes CO ₂ /yr (See Note 2)
MNECB Reference Building	\$ 36,008	\$ 20,275	\$ 56,283	-	-	-	-	-	-
Proposed Design	\$ 16,748	\$ 5,417	\$ 22,165	65.2%	\$ 34,118	\$ 60,000	64.0%	9	115.5

* Subject to availability of funding.

Notes:

1. Excludes receptacle & fixed energy costs.

2. Greenhouse gas savings based on Ontario fuel mix.

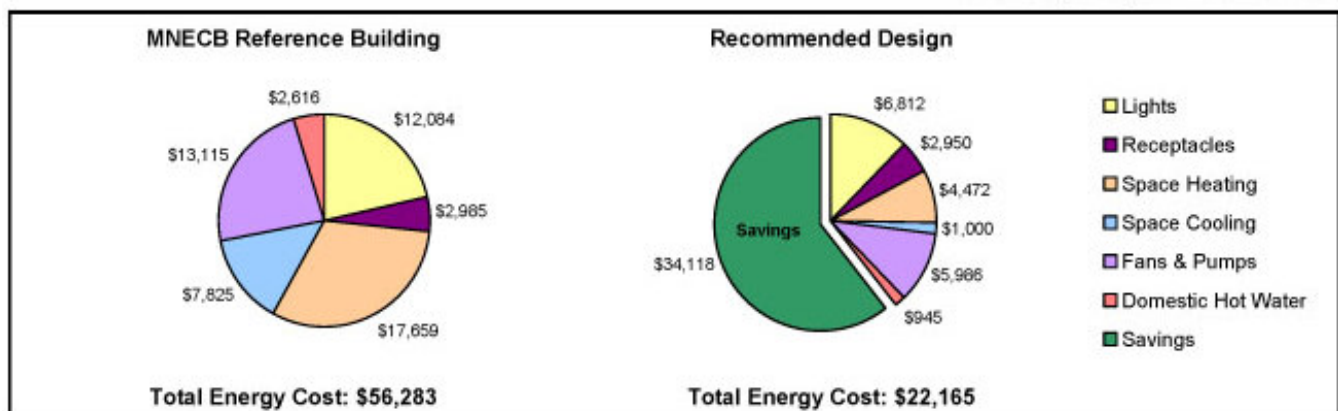


Figure 1. Schematic showing proposed energy efficiency values for renovations of the existing Linen Building on the Windsor Regional Hospital Western Campus for the Glengarda Child & Family Services (Image provided by Enermodal Engineering Limited)



Proposed aerial view showing atrium, roof monitors and green roof
Glengarda Child & Family Services



Proposed perspective view showing atrium, roof monitors and green roof
Glengarda Child & Family Services

The existing roofs of the building will be removed down to the decking and will be covered with a Tremco cold process roofing systems on R20 polyisocyanurate insulation over the low roof areas and second floor roof. The roof over the high ceiling space will be converted into an approximately 9000 sf green roof. In depth analysis of the existing structure was undertaken and determined that with some minor diaphragm modifications the existing roof structure could carry the additional 25 psf for the green roof. Additional project elements which are sustainable in nature were the extensive use of linseed oil linoleum flooring in the corridors and some public areas of the ground floor and the use of low VOC (volatile organic compounds) emitting paints and finishes throughout.

Glengarda New Facility / Linen Building Renovation: Summary

The Glengarda New Facility / Linen Building Renovation project is currently under construction

and is expected to be completed in November 2007. The exciting project is expected to draw attention as a showcase of energy efficiency and sustainable design in the renovation of existing brown field structures.

A CBIP application was submitted for this project and based on simulations is expected to be 65.2% more energy efficient than a building designed to the MNECB. The annual energy cost savings is anticipated to be \$34,000 at current energy cost rates. The anticipated incentive grant was \$60,000 which was the maximum allowable for a single submission under the CBIP guidelines. Unfortunately, following the submission of the application, it was revealed that the newly elected Canadian Federal Government cancelled the CBIP program. The application is still intended to be reviewed by Natural Resources Canada however to confirm the energy predictions to be similar as designed and effectively quantify the development.

Prior to tender it was determined that the Glengarda Facility / Linen Building Renovation would be submitted for LEED certification. In preliminary consultations it was determined that the project would likely achieve a LEED Gold certification. However, due to high cost for the application and commissioning procedures for the project the application was not approved by the owners.

Summary

Passa Associates Architect has been committed to constantly improving the sustainable design options they offer to their clients and have done this by constantly researching and monitoring changes in the industry and making the choices that best fit their client's needs. They also attempt to improve upon what they have done before with every new project. This trend has been shown with the projects that have been identified above and it will continue with future projects the firm is currently working on. PAA is currently part of a design team finalizing a 3-storey 168,500 sf New Engineering Building for the University of Windsor. The \$42 million dollar project is intended to start construction in the summer of 2007. The project will feature many sustainable features such as a cistern located on the green roof which will collect water for use in irrigation on the site and for use in a greywater system for flushing of toilets within the building. Additional features include an accessible green roof, extensive use of daylight harvesting, low VOC emitting products throughout and an extensive construction waste management program which will divert over 75% of scrap produced in construction away from landfills to be recycled or salvaged for reuse. The project will be

submitted for LEED certification with the intended target being LEED Gold.

As the opening statement of this article borrowed from Dr. David Suzuki indicates quite clearly we as a society have a long way to go in improving the environment we live in and together we must strive for sustainable efficiencies. As was noted at the recent GreenBuild Conference in Denver in 2006 by keynote speaker architect William McDonough, "If not us, then who? If not now, then when?"