Université de Montréal

BIODIVERSITY CENTER

CANADIAN CONSULTING ENGINEERING
AWARDS 2012

Category: Building

bouthillette parizeau

advanced building solutions

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The joint venture between the City of Montréal and the Université de Montréal had a set objective for the new Biodiversity pavilion at the Botanical Garden; instate innovative high performing technology measures, obtain LEED® Gold certification, maintain project within the allocated budgetary limits, and timeframe.

Bouthillette Parizeau has prompted meetings with occupants of the pavilion, researchers at the Institute of Plant Biology Research, to obtain a functionality of space and services according to their expectations. The purpose of these meetings was to ensure that they understand and express their specific needs, which are defined by the type of services, the amount of outputs, their position and the required quality of equipment, so that the latter does not interfere with the results of their research. View the massive amount of needs; we have maintained communication with researchers in the design phase, to minimize surprises during construction. Throughout the process, the various meetings helped raise everyone's role and make sure to tie up the project so that nothing is left to chance.

Bouthillette Parizeau also put forward an efficient resources team of professional expertise in each discipline. The owner was not satisfied with the ordinary. He had its own construction experts and constantly questioned and pushed to new heights the design.

Heat balance analysis of the building in order to determine and customize the strategies to be implemented was the ultimate deciding factor combined with an energy simulation.

The representatives of the Université de Montréal along with Bouthillette Parizeau were keen to innovate and take bold measures on the electrical and mechanical side, such as choosing a geothermal system as the building main source of heating and cooling.

The project incorporated several other elements, such as: sophisticate control building management system (BMS) for geothermal balance between the heating period and the cooling period; solar wall to preheat the total outdoor air required for the building; energy recovery of the exhaust air of the laboratories; energy recovery of a chiller; energy recovery of special rooms (electrical, elevator, telecom, freezer and refrigerators for botanical research and servers); frequency inverters of motor fans and pumps; temperature control for the occupants; CO_2 sensors to modulate outdoor air; motion sensors; daylight sensors; reduction in lighting density without compromising research (overall reduction of 15%); indoor lighting systems were designed to minimize light pollution; fluorescent T8 and electronic ballast with DEL lighting; outdoor lighting fixtures are of the full cutoff type; high efficiency transformer; water, electricity and energy metering for analysis of usage energy consumption.

In a hydraulic perspective, some of the measures that withstood a rigorous energy analysis and implementation was a closed loop geothermal system designed to meet 100% of heating requirements when the energy recovery measures are operational.

In summer, the space conditioning is provided by two chillers that use R410a refrigerant in accordance with the Kyoto Protocol. Thus the geothermal well field is solicited to its maximum at all times to answer load demands (18 wells equilibrium meets 100% of the heating load for 48% of cooling loads at peak conditions), as well as avoiding ground thermal unbalancing.

From an aerodynamics point of view, the installation of a Dedicated Outdoor Air System (DOAS) was favored to supply three air handling systems; the offices and laboratories, the exhibition hall, and the storage of botanical artifact. The DOAS with variable volume includes a solar wall installed on two facades, for which its usage is preferred in winter; in summer, air is introduced by conventional louvers.

The air is then treated by transferring the energy from the exhaust air of the laboratory system ("run-around" type).

The exhaust system of laboratories in itself had to be treated as a process, as it must ensure a rate of 10 air change per hour in occupied period and 6 in unoccupied period, where rates were a set requirement by the owner.

The main exhaust, centralized in one system, allows for improve heat recovery. Although the energy recovered efficiency is less as compared to other options in the market, the strategy employed completely avoids air cross contamination by reintroducing contaminants from the exhaust air from laboratories in the outdoor air supply. This run-around type coils has an efficiency of 45%.

Certified by a third party, Natural Resources Canada, the result of the simulation demonstrated 51% less energy consumption compared to the MNECB baseline case.

The integrated design demonstrated to the owner and the other professionals that mechanical and electrical design has evolve and have become more complex. It is not anymore a single recipe of design for the heating and cooling season peak. The owners wanted a capacity optimization of their installation in order to reduce the energy bills, the maintenance and operation fees.

Several efforts were made to reduce water consumption and sewer discharge, not only by specifically selecting low flow plumbing fixture, but as well as implementing a rain water harvesting system from a section of the pavilion roof and redistributing it to the non potable water consuming fixtures such as water closet and urinals.

The LEED® project, with Gold level anticipated, has raises an issue of current methods of design and allowed the youth to introduce measures on the cutting edge technology that represent their dynamism. This success highlights the expertise and creativity of our profession whose profits will spring on us all to showcase the exceptional quality engineering. Our sole concern is to protect the interests of the client to obtain a building up to its expectations and superior quality, our pride lies in a job well done and a satisfied customer.

Sustainability is an awareness of resource use. Our scope is focused on the following resources: water, air and energy. Bouthillette Parizeau has demonstrated efforts by introducing measures to minimize the consumption of potable water, energy consumption and their uses. Bouthillette Parizeau offered an environment with indoor air quality for occupants, using finishes with low VOC (Volatile Organic Compound) and the installation of CO_2 sensors. Finally, the optimal energy consumption of the building is the result of measures available on the market. This is a collection of coherent and adapted strategies according to the climatic zone. Each measure is sought at a precise moment to benefit from its maximum efficiency for a minimal investment.

This equilibrium is unique because it is a reflection of a unique building.

NEW APPLICATION OF EXISTING TECHNIQUES/ORIGINALITY/INNOVATION

The process

Université de Montréal wanted a new building for their plant biology researchers (IRBV). Because of their close-knit relation with the Botanical garden of the City of Montréal, they were renting spaces in their administrative pavilion. The installation was not meeting their growing staff and the laboratories were not at the cutting edge technology.

An idea germinated between both parties, to build a new pavilion for the researchers on the Botanical garden grounds. The new building would be almost entirely paid and operated by the University at the exception of an exhibition hall. A requirement of the City of Montréal was that the exhibition hall was to follow along the path of the tropical greenhouses.

The joint venture between the City of Montréal and the Université de Montréal had a set objective for the new Biodiversity pavilion at the Botanical Garden; instate innovative high performing technology measures, obtain LEED® Gold certification, maintain project within the allocated budgetary limits, and timeframe.

The Université de Montréal called for tender of their professionals. The selection was not only based on the fees, but was based on a strict evaluation list that included several criteria, such as: notoriety, expertise in laboratories, sustainability as well as experience of the individuals. The architectural Firm was Provencher Roy + associés Architectes, SDK in civil and structure engineering and Bouthillette Parizeau in mechanical, electrical, commissioning and site supervision.

From the start, the team of professionals, together with representatives from the Université de Montréal and representatives of the City of Montréal, has identified the main guidelines to identify the needs, objectives, responsibilities and constraints that the project had to comply with. This first step was to state the fundamental principles:

- Integrated Design;
- Compliance with the principles of sustainable development and LEED®;
- Compliance with occupant requirements, design guides, program, budget and schedule.

Bouthillette Parizeau proactive team has demonstrated its skills and its ability to handle the basic principles established by its experience for such projects and its ability to innovate. No pre-feasibility study has been undertaken, whereas the guidelines put forward by our team met the standards of the owner.

Based on our convictions and our expertise in sustainable development, Bouthillette Parizeau has identified energy efficiency measures to implement and associate the budget required to achieve so. This initiative has raised awareness among other professionals to do the same and realize that a transfer of cost to our field leads to lower operating costs for the owner for subsequent years. In addition, a review of the first LEED® scoring system was used to increase awareness of the stakeholders about the direction of the project and the efforts required to obtain the LEED® Gold level desired by the owner. Our expertise in the field was noticed through our involvement in the Sustainable Building Council of Canada and the U.S. Green Building Council, which began in 2003, and the various LEED® projects to our credit.

The new 4 180 m² pavilion at the Botanical Garden will serve as an exhibition center, classrooms, laboratories, art collection storage, and office space.

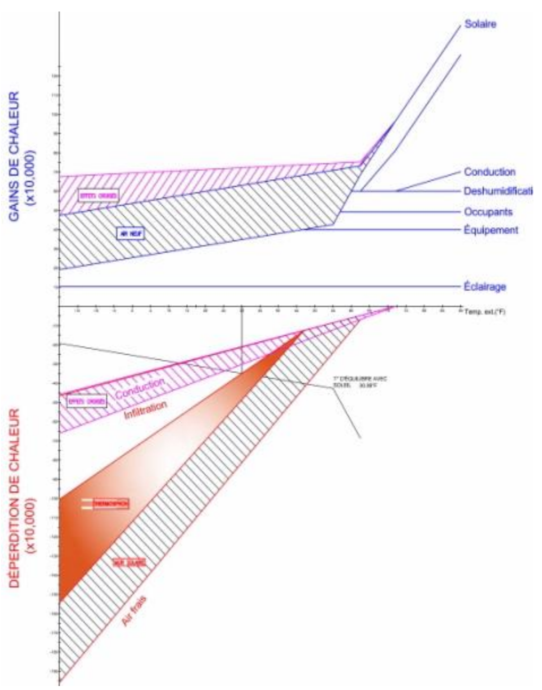
Upon several meetings and studies involving every professionals and clients, the building was optimized to meet several criteria: daylight, views, comfort, access, security and functionality. The building evolved during the preliminary phases in order to obtain a perfect volume containing 48% of windows and higher thermal value of the envelop. Space distribution is as follows: 23% Art collection storage, 18% Laboratories, 15% Exhibition hall, 12% Classes, 7% Offices, 10% Mechanical and electrical spaces and 15% others spaces.

Back to basic

Bouthillette Parizeau has prompted meetings with occupants of the pavilion, researchers at the Institute of Plant Biology Research, to obtain a functionality of space and services according to their expectations. The purpose of these meetings was to ensure that they understand and express their specific needs, which are defined by the type of services, the amount of outputs, their position and the required quality of equipment, so that the latter does not interfere with the results of their research. View the massive amount of needs; we have maintained communication with researchers in the design phase, to minimize surprises during construction. Throughout the process, the various meetings helped raise everyone's role and make sure to tie up the project so that nothing is left to chance. The team of operation and maintenance of the Université de Montréal has also been involved and appreciated the HVAC systems functionality. All equipment is located inside, mostly in the basement and thus protected from the weather, which facilitates access for maintenance and prolongs equipment life.

Considering the complexity of the work and the large amount of information to gather, the team established a structured procedure to distribute effectively the requirements. Bouthillette Parizeau also put forward an efficient resources team of professional expertise in each discipline. The owner was not satisfied with the ordinary. He had its own construction experts and constantly questioned and pushed to new heights the design.

For LEED® certification, we also benefited from the involvement of our site supervisor during the design, acting as a commissioning authority. This familiarization of the project was beneficial to the site supervisor and allowed him to respond immediately to questions generated by the site and reduce the response time. Bouthillette Parizeau has also followed up tightly change notices cost, which were reduced by 34%, a saving highly appreciated by the owner.



Based on several meetings with the users in order to define their needs and the building envelop, a heat load calculation was first executed to determine the heating and cooling load, as well as the air requirements for the new pavilion. Heat balance analysis of the building in order to determine and customize the strategies to be implemented was the ultimate deciding factor combined with an energy simulation. This comparison subjected several measures to the building loads related to outdoor air treatment (i.e. solar wall, energy recovered from laboratory hoods), building's equilibrium temperature, and internal cross effect.

Bouthillette Parizeau has secured the implementation of multiple measures of sustainability that form the portrait of a rigorous analysis of needs, the vocation of spaces, the profile of occupancy, the building geometry and climatic conditions in Montréal. Through various tools, such as heat balance, and energy simulation software, we optimized the energy consumption related to the external air supply.

bouthillette parizeau

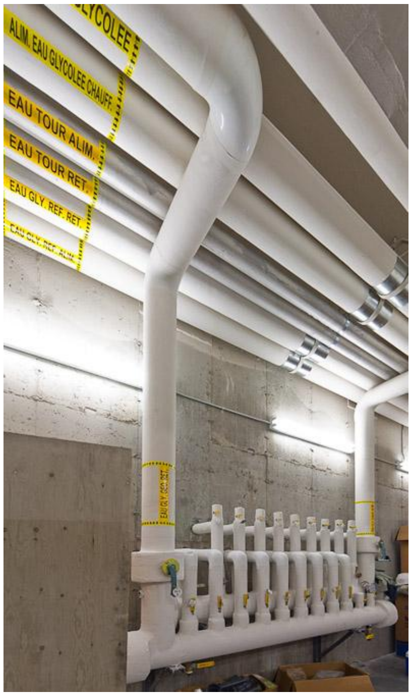
The representatives of the Université de Montréal along with Bouthillette Parizeau were keen to innovate and take bold measures on the electrical and mechanical side, such as choosing a geothermal system as the building main source of heating and cooling.

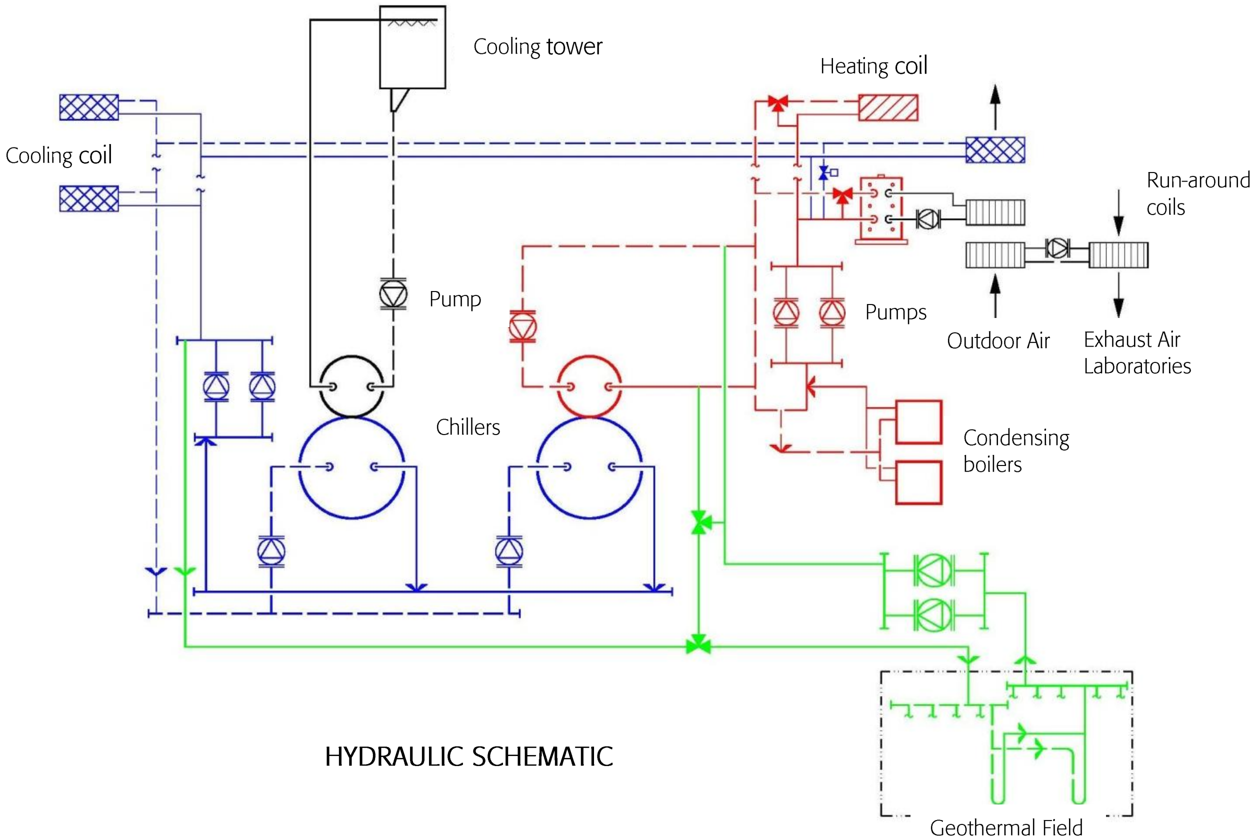
The project incorporated several other elements, such as:

- A sophisticate control building management system (BMS) for geothermal balance between the heating period and the cooling period;
- A solar wall to preheat the total outdoor air required for the building;
- Energy recovery of the exhaust air of the laboratories;
- Energy recovery of a chiller;
- Energy recovery of special rooms (electrical, elevator, telecom, freezer and refrigerators for botanical research and servers);
- Frequency inverters of motor fans and pumps;
- Temperature control for the occupants;
- CO_2 sensors to modulate outdoor air;
- Motion sensors;
- Daylight sensors;
- Reduction in lighting density without compromising research (overall reduction of 15%);
- Indoor lighting systems were designed to minimize light pollution;
- Fluorescent T8 and electronic ballast with DEL lighting;
- Outdoor lighting fixtures are of the full cutoff type;
- High efficiency transformer;
- Water, electricity and energy metering for analysis of usage energy consumption.

Hydraulic Network

In a hydraulic perspective, some of the measures that withstood a rigorous energy analysis and implementation was a closed loop geothermal system designed to meet 100% of heating requirements when the energy recovery measures are operational. In fact, the calculated total heating load is met by the sum of the contribution from the geothermal field, energy recovered from chillers as well as energy recovery from laboratories of exhaust air, and the heat gained by preheating outdoor air through the solar wall. Nevertheless, high efficiency natural gas condensing boilers (e = 95%) were considered within the distribution network to compensate for any failure of an energy recovery measure. These equipments are primarily used for redundancy or in extreme winter peak conditions, 1% of the time according to the ASHRAE fundamental handbook. This strategy was used to limit the installation of additional geothermal wells, without compromising the results in terms of energy consumption, while minimizing the initial costs of infrastructure.





HYDRAULIC SCHEMATIC

With soil composition of slit clay and limestone studies showed thermal conductivity of 2.93 W/m·°C, the well field consists of 18 geothermal wells with a depth of 122 meters. After several iterations on piping layout for the wells, analysis demonstrates a 2 pipe well off-centered to have a better outcome, and each two well are in a reverse return pattern.

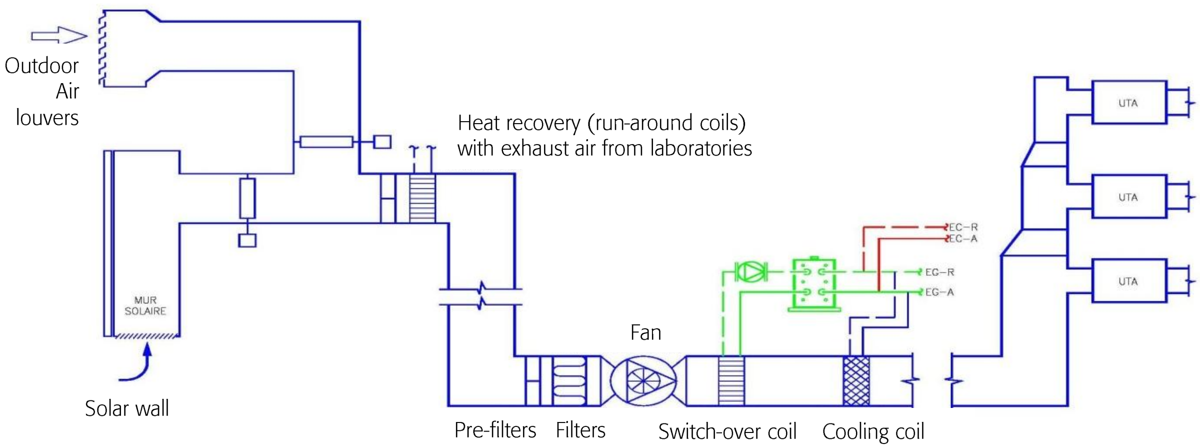
In summer, the space conditioning is provided by two chillers that use R410a refrigerant in accordance with the Kyoto Protocol. The first chiller is coupled with a water tower; a conventional arrangement for a capacity of 77 tons (EER of 15.8). The second chiller is a geothermal type and has the ability to respond to 48% cooling load, or 71 tons (EER of 16.2). Thus the geothermal well field is solicited to its maximum at all times to answer load demands (18 wells equilibrium meets 100% of the heating load for 48% of cooling loads at peak conditions), as well as avoiding ground thermal unbalancing.

This process is the product of multiple iterations to obtain the optimal scenario and maximize equipment capacities (temperature differentials and efficiency) while achieving the best cost-benefit ratio. Hydraulic networks of chilled water, heating water and geothermal, use 25% propylene glycol in order to maximize energy transfer between them, thus eliminating intermediate equipments which could affects the overall performance and would have increased project costs. A significant advantage for the maintenance and operation team since it eliminates the purchase and handling of chemical treatment products.

In addition, an independent 50% ethylene glycol network has been installed for heat recovery in laboratories exhaust air to preheat or pre-cool outdoor ventilation air, thus contributing to a free 90 kW for preheating outdoor air in the winter and 6 tons in the summer.

Air Handling Units

From an aerodynamics point of view, the installation of a Dedicated Outdoor Air System (DOAS) was favored to supply 5 950 L/s to three air handling systems; the offices and laboratories, the exhibition hall, and the storage of botanical artifact. The DOAS with variable volume includes a 193 m^2 solar wall installed on two facades, for which its usage is preferred in winter with a 95% efficiency and an annual saving of 11 tons of CO_2; in summer, air is introduced by conventional louvers.

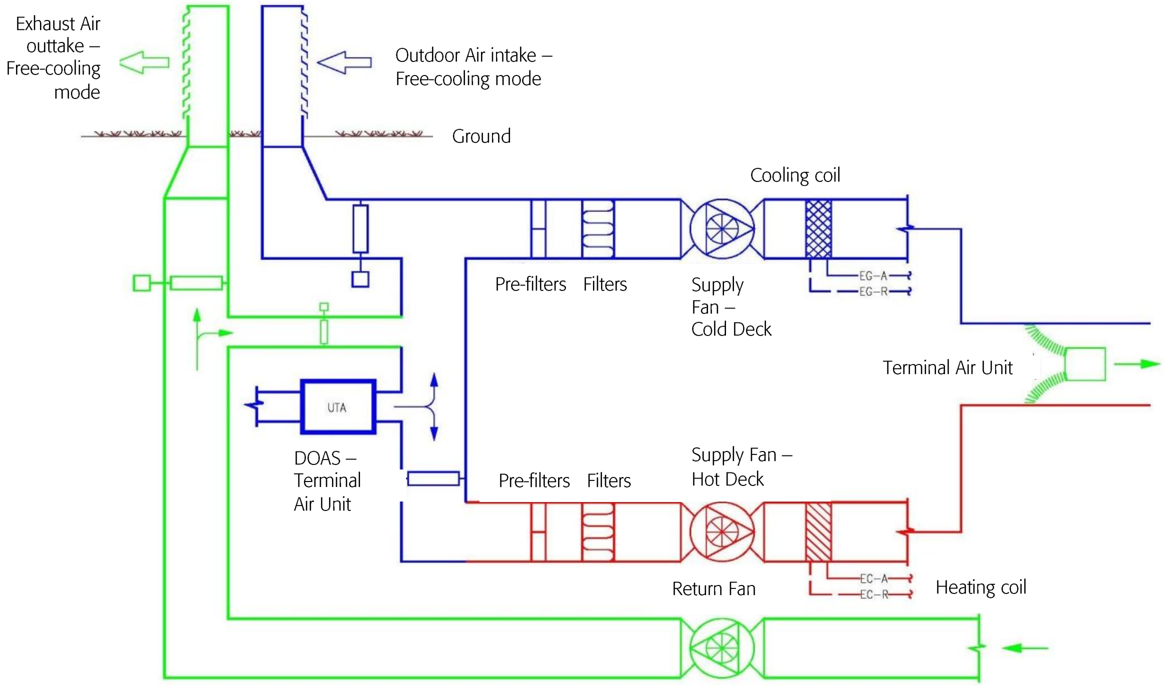


DEDICATED OUTDOOR AIR SYSTEM (DOAS)

The air is then treated by transferring the energy from the exhaust air of the laboratory system ("run-around" type). Furthermore, air then passes through a dual purpose coil, either heating or cooling depending on the season (switch-over coil). This additional strategy has served in reducing the static pressure of the system, and thus directly reducing the driving force of the fan and energy consumption.

Capitalizing on the dual purpose of the equipment, this reduces the size of the main cooling coil downstream and allowed for a reduction in the overall static pressure of the system. This strategy extends usage equipments over a longer period while reducing annual energy consumption. The DOAS injects the precise amount of outdoor air and to the required system via an air terminal unit, based on variable laboratory exhaust.

The ventilation and air conditioning for offices and laboratories are equipped with a series of measures to optimize its energy performance. The 12 400 L/s fans are equipped with frequency inverters that reduce the fan speed. When outdoor condition permits, the system can switch to the free cooling mode while increasing indoor air quality. This double deck system was deemed appropriate to respect the desired zonage comfort for the occupants and compensate for exhaust air rates. Several sensors are present to control in which mode to operate and maintain temperature and humidity range as established in ASHRAE standard 55-1999.

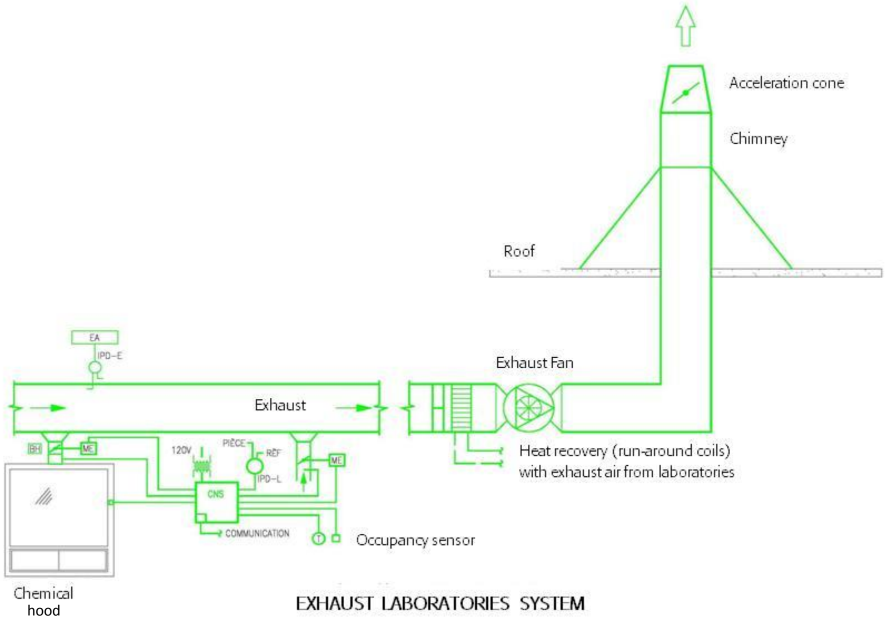


OFFICE AND LABORATORIES HVAC SYSTEM

The exhaust system of laboratories in itself had to be treated as a process, as it must ensure a rate of 10 air change per hour in occupied period and 6 in unoccupied period, where rates were a set requirement by the owner. Considering the volume to be handled, and the energy consumption related, 4 800 L/s, laboratories must therefore be equipped with a frequency inverter and occupancy sensor.

The main exhaust, centralized in one system, allows for improve heat recovery. Although the energy recovered efficiency is less as compared to other options in the market, the strategy employed completely avoids air cross contamination by reintroducing contaminants from the exhaust air from laboratories in the outdoor air supply. This run-around type coils has an efficiency of 45%.

Naturally, laboratories are maintained under negative pressure at all times, ensuring that harmful gases and odors do not migrate to the surrounding spaces, occupancy sensors are present to lower ventilation rates during unoccupied hours.



EXHAUST LABORATORIES SYSTEM

The air handling system for the exhibition hall supplies 6 000 L/s and also operates with a variable flow device. Although this system has a substantial air flow capacity, it supplies only one vast zone. Underfloor air distribution supply is an appropriate strategy for this case considering the space usage (constant changing art work display), the height of this space of 4 m with plenty of natural lighting. Air stratification elevates the temperature at the floor from 16.7°C and to nearly 29°C at ceiling level. This system can also operate in natural cooling mode: during mid-season 100% outdoor air is introduced into the space, thus saving energy consumption and equipment sizing.

The art collection storage area is also equipped by a unique ventilation system since the temperature of 16°C and 40% relative humidity must be controlled at all time in order to preserve the botanical value of the Marie-Victorin species. Considering the numerous windows, combined with the humidity present in the room, precautions were implemented to avoid the condensation and degradation of the windows. This environment was critical and limited energy recovery measures to be implemented without compromising the conditions to be maintained. In a high performance building, this factor came undermine efforts implemented in other systems of energy conservation measures. Bouthillette Parizeau had to incorporate more savings measures in order to be more energy efficient compared to the Model National Energy Code of Canada for Buildings (MNECB-1997).

Heating and air conditioning is provided by air handling units only. As such, no additional equipment at the perimeter zone provided the heating, freeing the perimeter for the installation of laboratory furniture or the movement of researchers.

As a research building, several other services have undergone a rigorous design, and are worth noting, such as: pure water type II, compressed air, vacuum, natural gas, drainage system with a neutralization cistern for laboratory acids for a sewer discharge in compliance with environmental standard.

COMPLEXITY

First LEED® building for the Université de Montréal, the representatives were eager to master the precepts and be more comfortable in sustainability for their eventual construction of the Outremont Campus or other subsequent pavilions. The Architects and M/E Engineers were more than willing to disclose their knowledge and use the Biodiversity pavilion as a flagship project for the owner, where the elements of sustainable development must be of high quality and performance while respecting the budget. This particularity translated in additional meetings and their length.

Since the Biodiversity pavilion is erected outside of the Université de Montréal campus, the building had to be designed with two owners operating it simultaneously. Université de Montréal is in charge of the maintenance and operation of the building while the City of Montréal must control the HVAC system of the Exhibition hall for their purpose. Also, in case of any intrusion or fire-alarm, the city of Montréal is first responder. Therefore the BMS is linked to two different communication systems. Considering that the pavilion is a remote building, equipment maintenance must be kept to a minimum. Bouthillette Parizeau had these parameters in mind while designing the entire HVAC systems.

Here are a few example of the complexity of the building.

- The 18 vertical geothermal boreholes had to be placed in a limited space and taken into account the building footprint and strategic location of the cranes during construction while not disrupting the landscape of the Botanical garden and neither their activities through the seasons.
- Authorization from the Planning advisory committee of the City of Montréal. The laboratory exhaust chimney was located in such a way that the 3m height was minimized from street view.
- Université de Montréal requirements in terms of air change rate in the laboratory are higher than the rates established in the market, resulting in increased energy consumption for treated air. Since the building is ceiling free throughout the pavilion, Bouthillette Parizeau requested that the laboratories would be equipped with washable ceiling tiles. This simple installation reduces dust accumulation on the systems and reduces the room volume which reduces airflow exhaust and air compensation to be treated. This constraints required special attention in order to minimize energy consumption and, in a sustainable manner, to achieve a greater reduction of at least 25% compared to the Model National Energy Code for Building (MNECB).
- The entire HVAC systems are located in the basement to ease the maintenance especially during the winter months. This location was problematic during construction because a large opening to the ground floor slab and the curtain wall was left accessible in order to lower the mechanical equipment in their final position. Naturally a sequence of equipment delivery was also required to install the furthest equipment first.
- During installation, each mechanical opening in the ductwork, grilles, diffusers or systems was sealed in order to avoid dust accumulation. This procedure was daily maintained. The owner was not forced to instruct a ductwork cleaning at the end of the site work and avoided extra cost.
- Since the structure of the building is exposed to the occupants, the mechanical distribution was carefully design to follow the architectural layout. The distribution minimized the crossover of ductwork that would have otherwise been camouflaged in the ceiling. The spiral ductwork was constructed in such a way that the insulation is contained between two metal sheets. Sheet metal is more esthetically durable than canvas. The final paint coating contained little VOC's.

As engineers and consultants, the team's primary mission was to meet the standards and expectation of the owner, while maximizing intended results and providing the best possible quality in a decidedly complicated economic context. The multidisciplinary team had to convince the owner, to ensure the best possible strategy to implement from the start.

Bouthillette Parizeau engineering team was composed of experienced professionals who understand the fundamentals of geothermal heat exchange, energy efficiency and sustainable development as required by the Université de Montréal. They also made the best use of financial resources within a limited budget with no cost overruns while implementing innovative mechanical and electrical strategies.

Here are a few examples to limit the complexity of the project:

- The mechanical and electrical systems are exclusively installed in the basement, with the exception of the heat recovery of the air exhaust laboratories and fan. This eases the maintenance task for the crew while not disrupting the occupation of the building.
- The hydraulic diagram was translated to the simplest form, limiting the piping length, pressure drop and limiting possible leaks.
- Bouthillette Parizeau provided a constant support throughout the installation. They remained on site with the maintenance staff during the start-up, commissioning activities and performance validation of the systems.

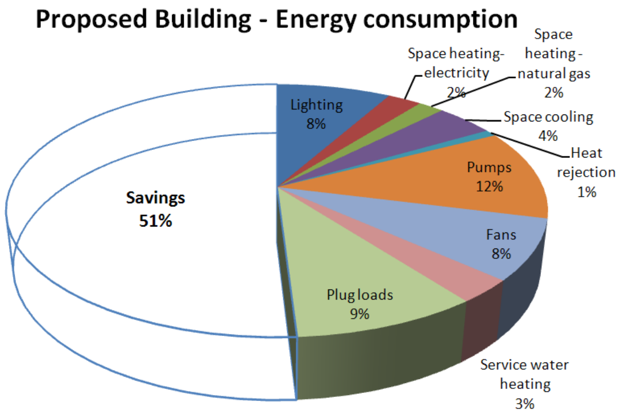
ENVIRONMENTAL IMPACT

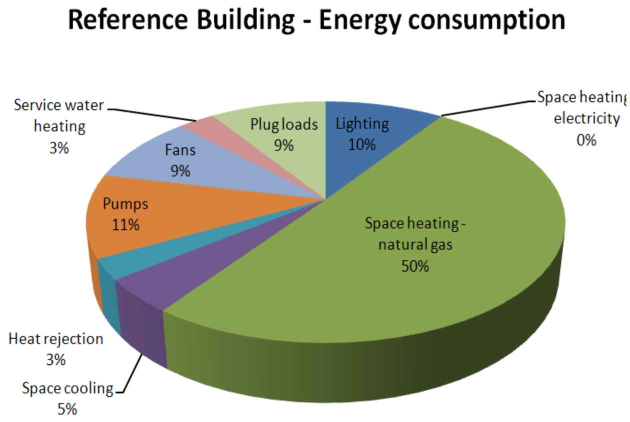
Innovation

Although applying any of these energy recovery measures separately can yield results in a standard construction, using these measures together in an integrated system under a centralized control system is air innovation. It is the key to maximize individual efficiency of the installed measures at the precise moment. In order to optimize the capacity of each equipment and effectively manage the operation of the building, it is crucial to understand the behavior of the pavilion as a whole building.

Note the usefulness of the thermal balance of the building early on in the project which assists to the elaboration of the sequence of operation. Without these studies, the sustainable measures would not operate at their full efficiency. Efficiency, capacity and behavior were subject to multiple iterations and manipulation process. To further understand the building, a computer generated energy simulation was performed using a software in accordance to local codes. Since the project aimed to obtain LEED® credits, the simulation had to effectively prove a significant energy savings in relation to the (Model National Energy Code for Buildings - MNECB) base building.

Certified by a third party, Natural Resources Canada, the result of the simulation demonstrated 51% less energy consumption compared to the MNECB baseline case.





The integrated design demonstrated to the owner and the other professionals that mechanical and electrical design has evolve and have become more complex. It is not anymore a single recipe of design for the heating and cooling season peak. The owners wanted a capacity optimization of their installation in order to reduce the energy bills, the maintenance and operation fees.

The first step towards energy consumption reduction and environmental impact is to provide a high thermal value of the building envelope. Several efforts were undertaken between the Architect and the Engineers.

The HVAC strategies contributed in CO_2 reduction by 262 tons annually.

Canada's energy-efficiency codes and standards pushed the team into using renewable energy, such as: geothermal energy combined with a wide range of energy saving strategies. The Biodiversity pavilion falls within the green construction strategy encouraged by the federal government and by LEED®.

In the electrical division, the lighting choices were based on the design, choices to promote pleasant living without compromising the researchers and their studies.

Several efforts were made to reduce water consumption and sewer discharge, not only by specifically selecting low flow plumbing fixture, but as well as implementing a rain water harvesting system from a section of the pavilion roof and redistributing it to the non potable water consuming fixtures such as water closet and urinals.

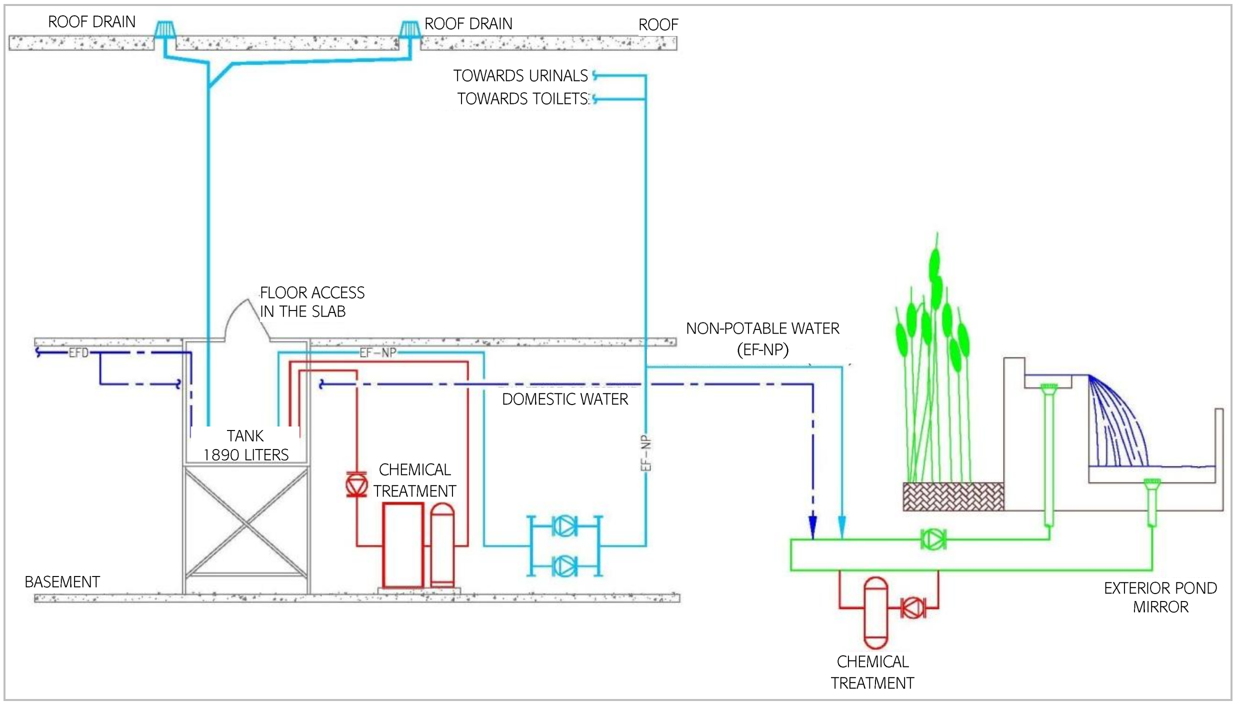
The volume of the cistern was calculated with the help of the tabulated rain fall data from Environment Canada, over 25 years of statistical data. An analysis was undertaken based on the days of the week, the applicable roof area and the consumption of the selected plumbing fixtures. The effective roof area is 1152 m², in which 982 m^2 is a white roof and 170 m^2 is a green roof assembly which drains into an 1895 Liters cistern.

An annual volume of 160,880 Liters is managed by an in house water treatment system that ensures its clarity and avoids it stagnation until it is either routed to the non-potable plumbing fixtures or it is substituting the evaporated water of the mirror pond in the inner courtyard. The reduction in potable water consumption amounts to 63% and the sewer discharge is reduced by 66%.

The rain water treatment include silica sand filter and 100 liters reservoir for peroxide injection purposes, the pond also goes through a filtration system with replaceable cartridge for easy maintenance. For sewer discharges which cannot be minimized due to laboratory procedure, they were deviated to a neutralization basin before joining the city's network.

In addition to these strategies listed, other green initiatives were included in the pavilion:

- Reduction in heat island with a green roof and high albedo membrane;
- Operable windows;
- Paints and adhesives with low volatile organic compounds (VOC);
- No additional parking space;
- LEED® site management plan for the erosion and sedimentation control;
- Alternative material usage with low maintenance surfaces.



RAIN WATER HARVESTING

Indoor air quality

Indoor air quality being partly related to outdoor air quality, Montréal has several outdoor air sampling stations around the city that can be viewed in all times on a government website www.rsqa.qc.ca. On a general bases the most elevated contaminants found in Montréal are PM2.5 and O3, however in the present case the values of these contaminants are below the EPA's established guidelines. In addition, there are no neighbors in proximity of the new pavilion which produce any contaminants which might alter the outdoor air data from the nearby sampling station.

Each ventilation system is equipped with filtration media with a minimum efficiency of MERV13, and is part of a regular maintenance program. It is worth noting that the run-around coil strategy completely avoids the cross contamination at the expense of improved overall efficiency for the well being of the occupants.

When comparing ventilation rate as established by ASHRAE standard 62.1 and the installed ventilation rate imposed by the owner's requirement and space vocation, it can be demonstrated that the installed ventilation exceed ASHRAE standard 62.1-2004 at normal occupancy density. For example in each laboratories and taking into account a ceiling height of 2.9 m, the average ventilation rate is at 0.066 $L/s/m^2$, as opposed to standard 62.1-2004 which represents a rate of 0.019 $L/s/m^2$, considering normal occupant density.

Variable ventilation rate for the laboratories for occupied (10 ACH) and unoccupied (6 ACH) are controlled by occupancy detectors. Carbon dioxide sensors are installed with respect to the calculated area density. With the exemption of laboratories were negative pressure is crucial, operable windows are present in offices to suit the occupants desires. With so many strategies implemented, Commissioning played a crucial role in the building construction, with the implication of the operation personnel to understand and operate their building for the years to come.

SOCIAL AND ECONOMIC BENEFITS

The conviction of the Université de Montréal in terms of sustainability in using consulting engineers demonstrates the awareness and confidence of our profession. The Biodiversity pavilion is an important reference illustrating oriented systems on sustainable development, both in terms of design, the realization and its operation.

Bouthillette Parizeau influences the market by promoting our profession through the many implications of its employees in several associations in the region. Including last December at the "Rendez-vous programme Bâtiment" organized by the Montréal Chapter of ASHRAE, Bouthillette Parizeau unveiled the project and its many attributes. Efforts are underway to publicize the project and others under our belt, in order to demonstrate the importance and place of consulting engineers in a more aggressive market.

Within the team Bouthillette Parizeau, the Biodiversity pavilion project allowed for research on different strategies to implement. Engineers and technicians were able to highlight some of the benefits and build a functional and coherent building. The results of extensive research and expertise will benefit future projects. Already, other project managers of the firm were able to profit from the findings and inform their customers about the advantages and disadvantages, and cost effectiveness of certain measures. The project has helped to implement sustainable development measures and to adapt our usual design methods. This contribution of innovation has solidified the trust between the team, the owner and other professionals. The strategy to blend experienced engineers with new graduates was used to facilitate knowledge transfer, as the younger, eager to perform and demonstrate their expertise, did not hesitate to seek advice from resources at the firm. The young team felt comfortable to ask people with experience, since the sustainable measures implemented were outside common practices. Site visits was organized and allowed the team to see the fruits of their labor and strengthen the sense of accomplishment.

The LEED® project, with Gold level anticipated, has raises an issue of current methods of design and allowed the youth to introduce measures on the cutting edge technology that represent their dynamism. This success highlights the expertise and creativity of our profession whose profits will spring on us all to showcase the exceptional quality engineering. Our sole concern is to protect the interests of the client to obtain a building up to its expectations and superior quality, our pride lies in a job well done and a satisfied customer.

MEETING AND EXCEEDING OWNER'S / CLIENT'S NEEDS

Budget

Bouthillette Parizeau has compiled a detailed and balanced assessment; and has continually updated to meet the construction budget. Two unforeseen site conditions were added to the final cost, therefore the presence of an abandoned tunnel and the collapse of the electrical transformer station on Sherbrooke Street that caused a delay in the construction.

Moreover, the small amount of additional demands expressed by the owner during construction of the pavilion shown that the original needs were well understood and identified. Regular meetings with the occupants have been successful. This is an excellent proof of a responsible investment.

Bouthillette Parizeau is renowned for the accuracy of its estimates, established with the help of specialized software constantly updated in light of market fluctuations, the economic context and related to other projects we realized.

While the project was underway, the team pursues a rigorous and structured methodology for budget follow-up. A detailed draft of the cost at each stages of design combined with an analysis value resulted in a definite and fair budget to be established. Project budgets were constantly monitored to ensure project did not run out of money before the end.

Mechanical and electrical budget (originally planned)	$4.97M
Final cost site conditions including mechanical and electrical change notice	$5.10M
Owner requests for additional mechanical and electrical	$0.25M

Total grants	**$295,731**
Hydro-Quebec	$151,957
Gaz Métro	$20,500
Energy Efficiency Fund	$122,774

Cost effectiveness

The final project cost was $15.4M, where mechanical and electrical division amounted to $5.4M, 35% of the total cost. The project profited from several government grants; Gaz Metro, Hydro-Quebec, Energy Efficiency Funds which amounts to $295,000. The simulation demonstrated that the annual cost savings results in a reduction of $58,000 annually of the operation and maintenance.

Schedule

The production schedule was postponed following numerous meetings with the occupants and requirements definition. The owner has consented to delay the tender bid in order to include the widest needs and generate fewer changes during construction of the pavilion.

The construction schedule of the pavilion was also postponed due to events beyond our control (due to contractual agreements between the City of Montréal and the Université de Montréal), and unforeseen site conditions specific (site decontamination, abandoned tunnel and the electrical transformer station collapse).

Issued for tender – original date	September 2008
Issued for tender – actual date	December 2008
Building delivery – original date	December 2010
Building delivery – actual date	April 2011

Fortunately, researchers were able to continue their studies in their existing premises at the IRBV.

Operation and maintenance

The operation and maintenance task are eased with the simplicity of the elements and through their implication with the M/E commissioning agent and Control commissioning agent. Several meetings were organized in order to explain the Building Management System (BMS) operation sequence and intensive formation were given to comprehend the delicate nature of each strategy.

The strategies implemented were customizing to the occupants needs, to the building orientation, building layout and the space type usage. *The outcome is unique for a unique building.*

CONCLUSION

Sustainability is an awareness of resource use. Our scope is focused on the following resources: water, air and energy. Bouthillette Parizeau has demonstrated efforts by introducing measures to minimize the consumption of potable water, energy consumption and their uses. Bouthillette Parizeau offered an environment with indoor air quality for occupants, using finishes with low VOC (Volatile Organic Compound) and the installation of CO_2 sensors. Finally, the optimal energy consumption of the building is the result of measures available on the market. This is a collection of coherent and adapted strategies according to the climatic zone. Each measure is sought at a precise moment to benefit from its maximum efficiency for a minimal investment.

This equilibrium is unique because it is a reflection of a unique building.