



 **GREAT GULF**

Active House Centennial Park

The first certified Active House in the world





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The first certified

Active House in the world

Great Gulf's Centennial Park Residence is designed to improve human comfort and well-being. Its clean modernist architectural aesthetic comes with energy-saving and environmentally conscious features such as interior and exterior LED lighting systems, low-flow water fixtures and finishes that are easy to maintain. But what ultimately makes this home so appealing is an approach to design that maximize opportunities for natural daylight and ventilation.



activehouse

The Active House label is a worldwide quality stamp for comfortable and sustainable buildings. It advises on elements that are important to humans life and living in their homes.

Buildings that have received the Active House label have been designed and evaluated with a combined focus on comfort, smart use of energy and minimum impact on the environment.

The label is a sign to homeowners that this building is designed with focus on human needs and a home fit for the future.



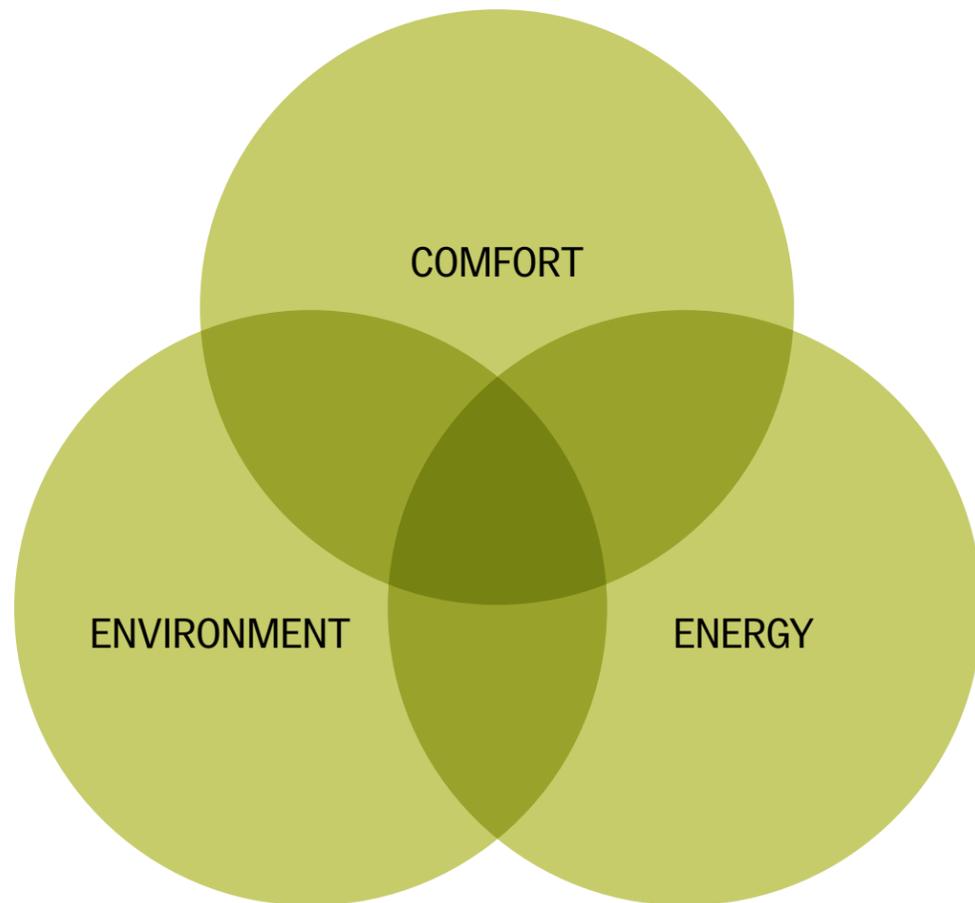
Buildings that give more than they take

Active House is a vision for buildings that create healthier and more comfortable lives for their occupants without impacting negatively on the climate – moving us towards a cleaner, healthier and safer world.

The Active House vision defines highly ambitious long-term goals for the future of buildings. The purpose of the vision is to unite interested parties based on a balanced and holistic approach to building design and performance, and to facilitate cooperation on such activities as building projects, product

development, research initiatives and performance targets that can move us further towards the vision.

The Active House principles propose a target framework for how to design and renovate buildings that positively contribute to human health and well-being by focusing on the indoor and outdoor environment and the use of renewable energy. An Active House is evaluated on the basis of the interaction between energy consumption, indoor climate conditions and impact on the environment.



The Active House key principles are as follows:



Comfort

- A building that provides an indoor climate that promotes health, comfort and sense of well-being
- A building that ensures good indoor air quality, satisfactory thermal climate and appropriate visual and acoustical comfort
- A building that provides an indoor climate that is easy for occupants to control and at the same time encourages responsible environmental behaviour



Energy

- A building that is energy efficient and easy to operate
- A building that substantially exceeds the statutory minimum in terms of energy efficiency
- A building that exploits a variety of energy sources integrated into the overall design



Environment

- A building that exerts the minimum impact on environmental and cultural resources
- A building that avoids ecological damage
- A building that is constructed of materials that can be recycled

Active House is an initiative supported by the VELUX Group





Active House – Centennial Park Radar

The Active House was born from the efforts of a European consortium comprised of various partners from academia, professional practice, and building material manufacturers to develop a methodology that promotes energy efficiency and human comfort. Adopting Active House specifications depends upon factors that include site location, climate, life-cycle costs, thermal comfort, indoor air quality and energy sources. Essential factors like thermal comfort can affect sleep and work patterns while proper indoor air quality promotes a healthier indoor climate — a relief to those who suffer from asthma and allergies. An Active House design prefers renewable energy sources such as wind, geothermal and solar energy produced on or off-site, to reduce its dependency on fossil fuels. Synthesizing these and other factors into a single home represents an important challenge, given that we spend such a large percentage of our lives indoors.

3.3 Sustainable Construction

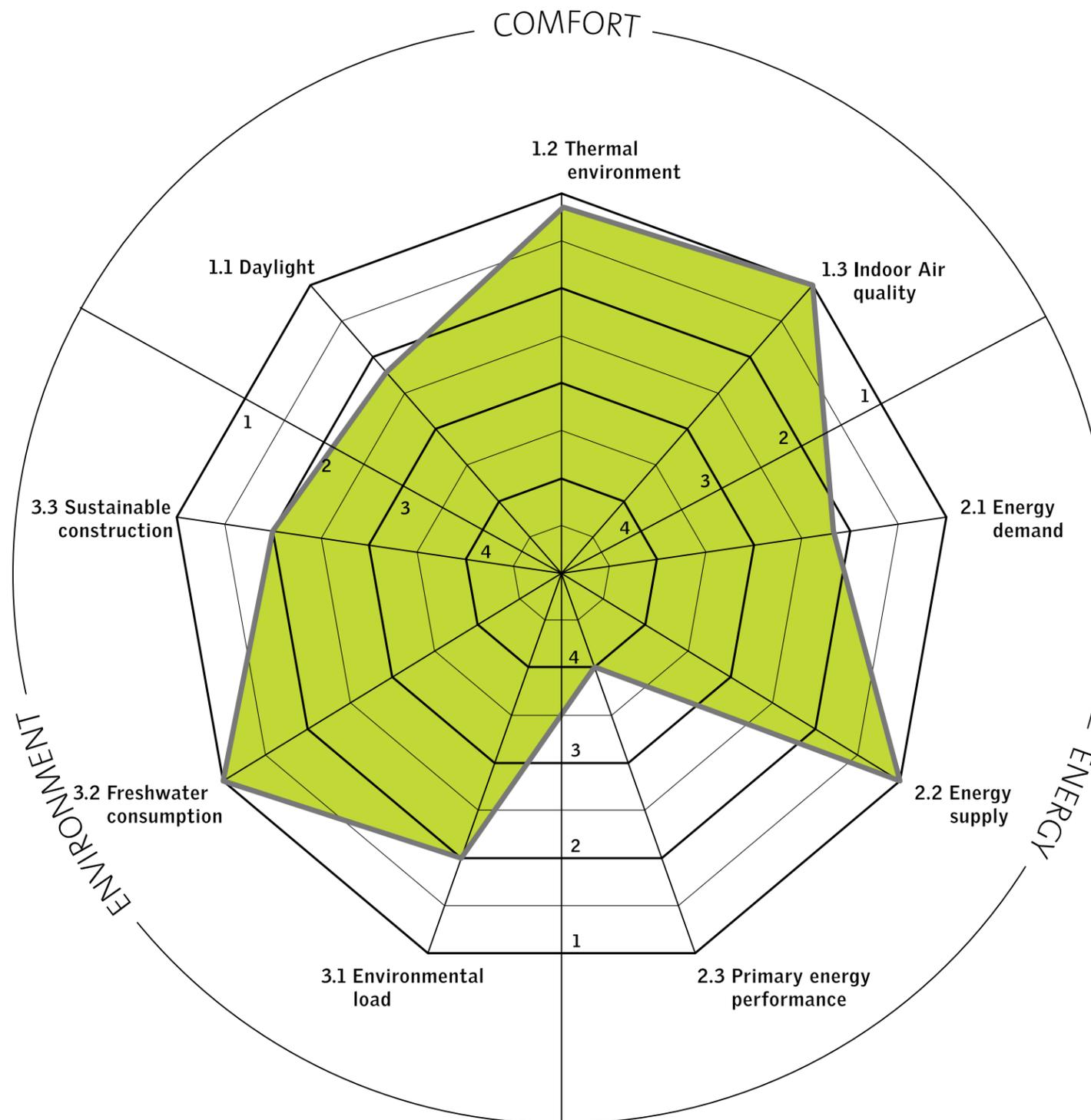
The result of category "2" is a combination of 3 scores. One for recyclable content - it has been calculated that more than 89.5% of the materials in the house will have a recycling potential. The second score is an assessment of percentage of wood with FSC certification. Since FSC, PEFC certificates are not very common in Canada, replacement by SFI certification was approved. Based on documentation from Great Gulf regarding sustainable wooden products, it has been identified, that approximately 80% of the wooden products (by weight) used are SFI certified. The third score is a result of building materials and products percentage with EPD (Environmental Product Declaration). To evaluate the EPD criteria the percentage (by weight) of the building material with an EPD must be calculated (weight of materials with EPD/total weight of the building, 80% of the weight must be accounted for).

3.2 Fresh Water Consumption

The freshwater consumption and savings compared to standard values have been evaluated and a score of 1 was achieved. A saving potential of 57% has been achieved due to use of water savings faucets, toilet flushes, washing machine and dishwasher that meet requirements of GreenHouse. According to the calculation the family living in the house will be using 107.6 L/day (reference value for Ontario is 251 L/day).

3.1 Environmental Loads

A Life Cycle Analysis calculation is carried out with the score 2.0 which is a good result and above average compared to other houses evaluated internationally. The high score is achieved due to use of renewable energy sources, so that the environmental load of energy demand in the use-phase is diminished and only an environmental impact from the production and End-of-life phase of the building materials is considered.



1.1 Daylight

The daylight factor has been calculated at 2.27 using the VELUX Daylight Visualizer software. The kitchen, living/dining room and bedrooms were evaluated resulting in the total score of 2.2% DF. In some of the rooms with large glazing surface and additional skylights the daylight factor is very high. In Bedroom 2 the daylight levels achieve category 3 due to the proximity of neighbouring building, the kitchen achieves a category 3 due to the placement further away from the windows. The average score is high and shows that daylight levels are high and well balanced in the evaluated rooms.

1.2 Thermal Environment

The score of the thermal environment is 1.1. An HRV unit supplies fresh air with the heating set-point at 21°C and cooling system is preset to 25°C.

1.3 Indoor Air Quality

The score for the indoor air quality is evaluated in VELUX EIC software and achieves category 1. The air is supplied directly through the ducts of the HRV system and through the ducts of the furnace heating system. It is assumed that the average air exchange rate through mechanical ventilation is 1.5 ACH (which has been accounted for house volume with many other parameters) and skylights are used for additional natural ventilation and night cooling in warm periods. Therefore rooms with skylights achieve better indoor air quality. The combination of large volumes and continuous fresh-air supply results in a very good score on the IAQ indicator.

2.1 Energy Demand

The score of the energy demand is 2.2. The score is the result of a well-insulated and air tight building envelope and fenestration with a low U-values. The compactness achieved by building in two storeys with a usable basement also has a good effect on the energy performance.

2.2 Energy Supply

The scores on energy supply and primary energy performance depends on the degree of renewables in the supply system. The energy supply is a combination of heat produced by a heat pump and gas furnace. Gas and electricity is provided by Bullfrogpower. Bullfrogpower delivers energy from renewable sources and imposes the energy to the grid at the same level as the customers' demands. Bullfrogpower states that the energy imposed to the grid is 100% renewable.

2.3 Primary Energy Performance

The score for PE Performance is "4". The off-site renewable energy sources do not help this category. The house also has 10' ceilings and a higher than average window to wall ratio. Although the PR metric is very stringent, the house performs exceptionally well in comparison to Canadian standards.





A home that gives more than it takes

Centennial Park Residence is a distillation of Great Gulf's recognition of the modern homebuyer's needs which are becoming increasingly savvy about incorporating health and well-being into their daily lives. Located in the suburban West End of Toronto, Ontario, this demonstration home is the result of highly process-driven approach to building an affordable energy-efficient product achieved through the combined expertise of a team of Danish and Canadian Building Science professionals, the award-winning Toronto architecture firm superkül, and Great Gulf, the builder committed to evolving the Active House concept in Canada. The Active House was first developed in Europe and is defined by its use of natural daylighting and ventilation, energy-efficient strategies, and an overarching concern for human comfort and health. Because it takes less energy to operate than a typical home, while providing

exceptional levels of thermal comfort and natural daylight, the Active House is a concept that "gives more than it takes."

Two factors ensure the success of an energy-efficient home in a competitive residential market: affordability and quality of workmanship. Home Technology's manufacturing facility was the key driver in responding to these two challenges, enabling the construction of pre-assembled components that fit together with greater precision and less material waste than what can ever be achieved on site. The end-product is one where walls, windows and entrances don't easily allow heat to escape, or cold air to cause uncomfortable drafts. Extensive visualization studies and mock-ups coordinated by Great Gulf with input from its partners translated into greater affordability—and value—for the consumer.



Centennial Park Residence is about bringing an easily maintained, environmentally friendly home to the consumer and improving the quality of life for homeowners who lead busy lives.

FACTS

Builder
Great Gulf

Design Team
superkül, HomeCAD, Home Technology, Quail Engineering, HVAC Design, Building Knowledge, Velux Building Science Team in Denmark and Toronto

Total Areas
Gross Floor Area: 3,221 sf / 299.24 sm
Net Floor Area: 2,846 / 266.07 sm

Breakdown
Ground Floor
Gross Floor Area: 1,230 sf / 114.27 sm
Net Floor Area: 1,060 sf / 98.48 sm

Second Floor
Gross Floor Area: 1,991 sf / 184.97 sm
Net Floor Area: 1,786 sf / 165.92 sm

Separate Areas
Garage (Not included in total calculation)
Gross Floor Area: 441 sf / 40.97 sm
Net Floor Area: 391 sf / 36.32 sm

Basement (Not included in total calculation)
Gross Floor Area: 1991 sf / 184.97 sm
Net Floor Area: 1786 sf / 165.92 sm

Location
West Toronto, Ontario, Canada



Architectural Features

- C-shaped courtyard with double-height enclosure space brings daylight into the central stair and core area
- Floor-to-ceiling windows provide a strong connection to the outdoors while providing the feeling of greater spaciousness
- Triple-pane windows allow for exceptional thermal comfort. Glass type based on building orientation.
- Double-height spaces maximize cross-ventilation and stack effect, thereby reducing demands on air conditioning
- See-through fireplace system separates the living and dining rooms without compromising daylight penetration
- High-quality building products ensure a low-maintenance lifestyle over time

Product Features

- VELUX skylights and Sun Tunnels bring natural daylight into every living space
- Three-zone furnace and heat pump HVAC system
- Huber Zip Wall System allows for easy to install tight-fitting exterior wall system
- Underslab insulation to maintain thermal comfort in basement and improve energy efficiency
- Rogers Smart Home Monitoring System
- Equipped with Tesla's Powerwall rechargeable lithium-ion battery system for home use
- Low-flow plumbing fixtures throughout for water conservation



A generous double-height space wraps around a small courtyard design to create a light-filled airiness and a connection to the outdoors.



Architecture – Guided by the light

Great Gulf's Centennial Park Residence is immersed in natural daylight. Visitors immediately notice the light-filled double-height C-shaped courtyard which forms an architectural "anchor" for the entire home. When the windows are open, the home's overall design facilitates cross-breezes and natural ventilation, therefore minimizing a reliance on air conditioning. The ground-floor living room, dining area, and kitchen are laid out in an open plan with no barriers to obstruct daylight, other than a see-through fireplace system dividing the dining and living room areas. Triple-glazed windows enhance thermal comfort while select surfaces and colours reflect light throughout. Double-height spaces vertically connect upstairs spaces, such as the family room on the second floor. This strategy of maintaining strong visual connections also guarantees clear exterior views from almost every room in the house, without sacrificing privacy. Removing visual barriers between living spaces—both horizontally and vertically—makes the home feel far more spacious than its approximately 2,900 square feet.

A Light Study: Heavy Research in Natural Daylight & Energy-Use

To better understand what it means to live in Centennial Park Residence, Russell Ibbotson, Technical Manager for Building Industry at VELUX Canada, will be moving into the home with his wife Bethany and their three children for six months. As Russell Ibbotson explains, "people know how to build a house like this, but after living in it and being able to experience it, we'll have a much better understanding of how it functions that will resonate with a wider audience." With his family, Ibbotson will document the home's many energy-efficient features and how indoor climates affect us physically and mentally. His experience will be captured through a blog, short videos, and social media channels. To further his messaging, some of his approaches to storytelling will be directed at younger audiences. With the help of a third-party research group comprised of specialists dedicated to daylight, energy and indoor climate, Russell's evolving narrative will include a number of scientific experiments that will form the basis

of a quantitative analysis to help guide the monitoring and surveying process of the home. The data assembled over the six months will be able to fully explain the qualitative aspects of Centennial Park. The types of experiments that Russell will be using include sensors that measure inputs such as daylight, reflectance, temperature, moisture, and carbon dioxide. By monitoring and logging all of this data, he will be instrumental in helping the supporting research team refine a design process for making healthy spaces. Bethany is a conservation biologist who is currently looking after their three children who are 18 months, three and six years old. Their six-year-old is developmentally delayed with an autism related disorder. Familiar with approaches to scientific research Bethany will be sharing her observations from living in the new home with Russell as they work together on developing a narrative that promotes a bigger conversation about a broader public's expectations of daylight and healthy indoor climates. She is excited to work with Russell and their children to explore the benefits of Centennial Park Residence and its effect on their ability to learn, play, and grow. Seeing the world through their

children will provide an invaluable method of observation often missed by engineers, building science specialists, and architects involved in developing Centennial Park Residence.

Another important dialogue to explore is the conservative homebuyer. Purchasing a home using Active House guidelines signifies a strong value proposition that may only be appreciated after experiencing the merits of its design. Understanding the motivations of homebuyers and aligning their interests with the benefits contained within the Centennial Park Residence is what the Ibbotsons intend to achieve through discussions with their friends and new neighbours who they hope will visit the house in West Toronto. To follow the Ibbotson family experience please visit – activehouse.ca.

Bring light in, Turn the lights off!

Natural daylight has a huge positive benefit to our well-being which includes boosting concentration, efficiency and mood. So much natural daylight comes into Centennial Park Residence that little to no artificial lighting is required during the day.

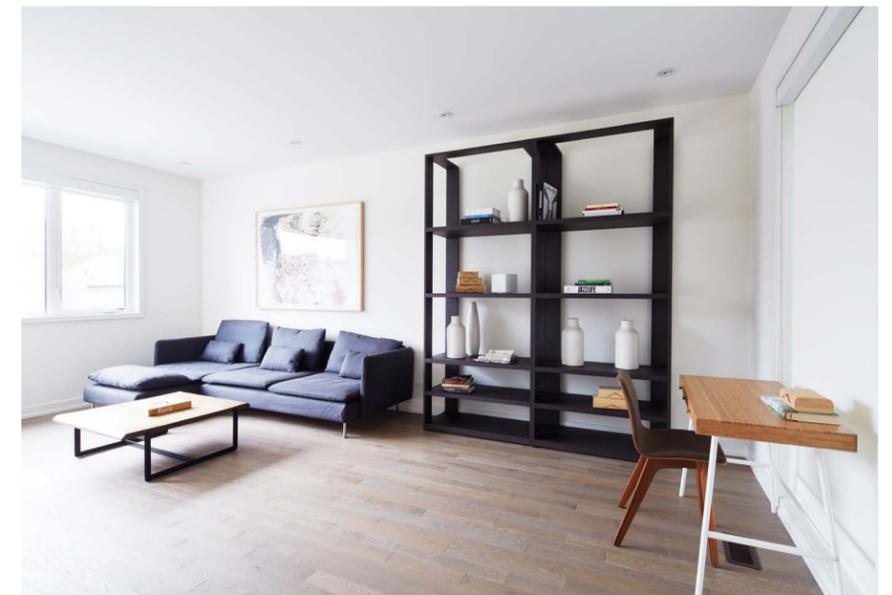
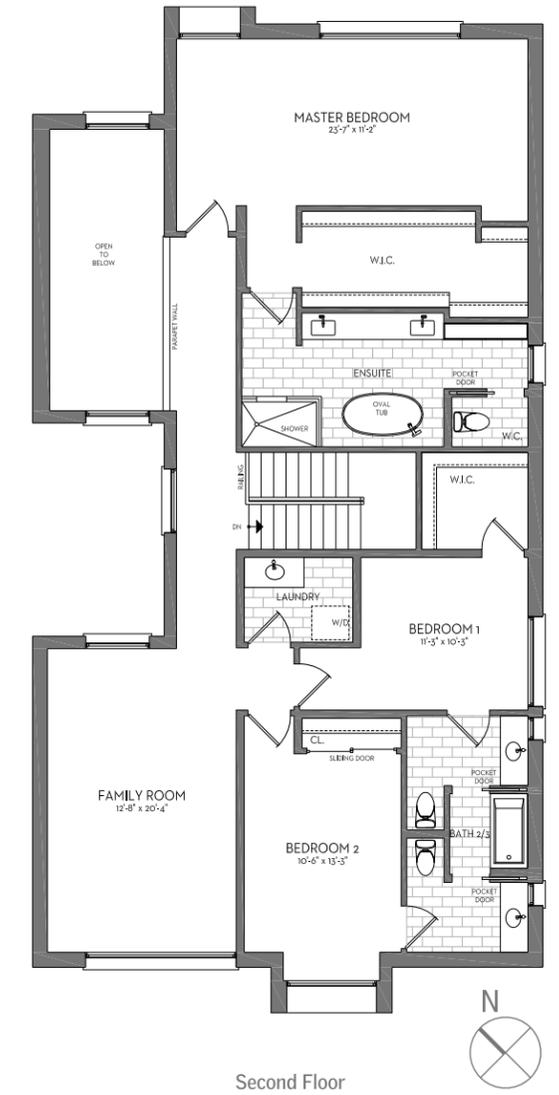
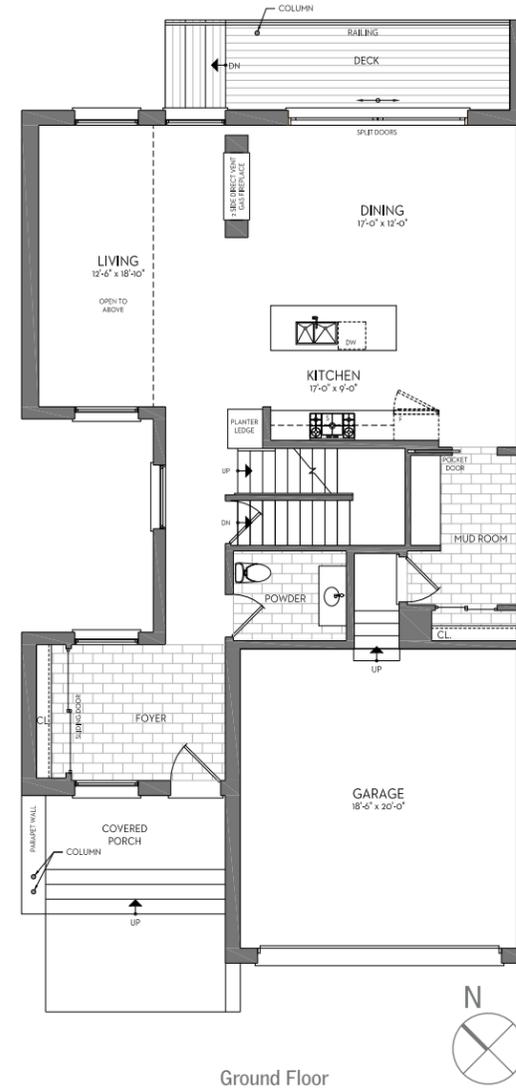
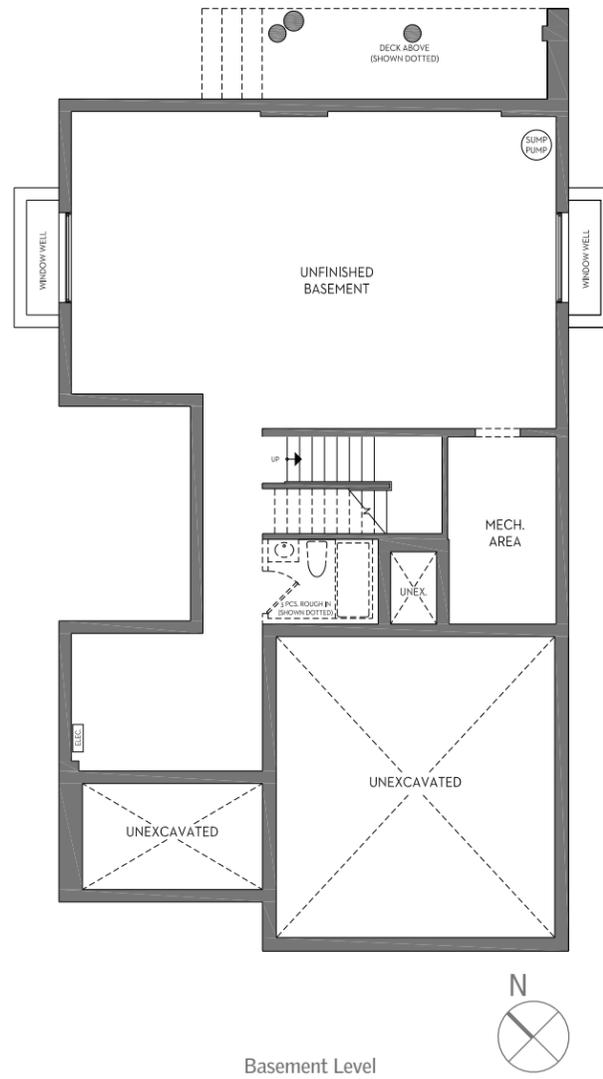




This occurs even in the secondary living spaces where ten strategically positioned skylights and four Sun Tunnels bring daylight into darker spaces such as washrooms, the master bedroom's walk-in closet, and the laundry room. Massive oversized windows ensure a constant connection to the outdoors. Natural daylight reaches nearly every space of the home because computer models help visualize and then determine the optimal placement of windows, skylights, and Sun Tunnels. The results are dramatic Direct and indirect light are both maximized and reflected off of walls, ceilings and even the engineered strip flooring to help increase the effects of daylight throughout.

Natural Ventilation is a Breeze

To reduce the energy required for air conditioning and to help remove stale air, Centennial Park Residence contains features that boost air quality while mitigating fan energy. Natural ventilation is driven by either cross ventilation (wind) or the stack effect (a principle based on the fact that hot air rises, while cold air sinks). Large windows and operable skylights facilitate a natural air flow that moves throughout the home as the result of air pressure and temperature difference between the exterior and interior. These simple concepts work to help keep the house cool during warmer months while ensuring effective ventilation throughout the year. Natural daylight has a huge benefit to our well-being which includes boosting concentration, efficiency and mood. Moreover, the amount of natural daylight in Centennial Park will help improve sleeping patterns by regulating the circadian rhythms of its occupants—something particularly important during the winter months when daylight is already in short supply.

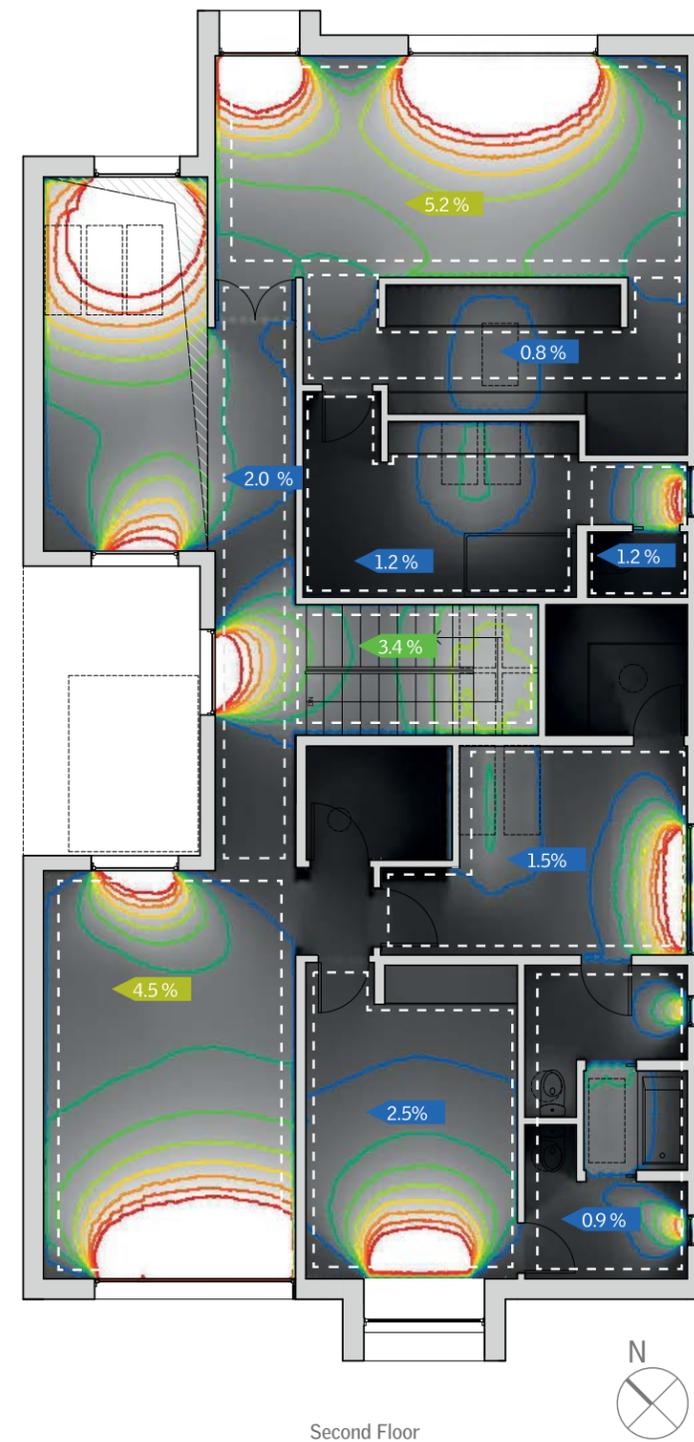
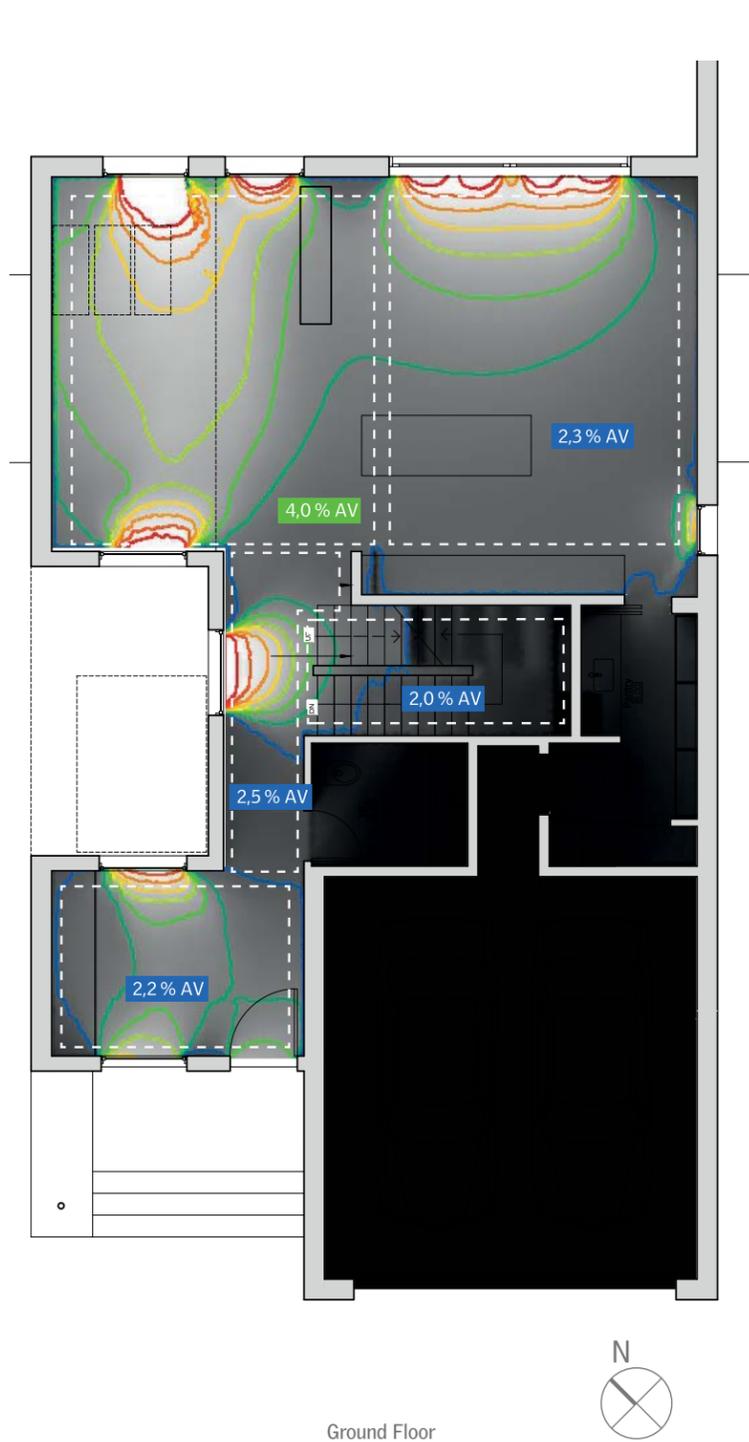




Daylight

It is the strategic use of natural daylighting that defines the true character of the Active House Centennial Park. So much illumination is provided that little to no artificial lighting is required during the day. This occurs even in the secondary living spaces where a skylight framed by a sculpted ceiling bisects the shared washroom between the two adjoining bedrooms, or in the master bathroom where two skylights grouped together and inserted into a long vertical "slice" in the ceiling.

The Danish design team modelled extensive computer visualizations to avoid insufficient levels of natural daylight in nearly every space of the home. Their work supported the architects' ability to select the most efficient sizes and the most effective locations for the skylights. The results are dramatic. The architects were able to maximize direct and indirect light which can be reflected off of walls, ceilings and even the engineered Pharoah White Oak hardwood strip flooring to help increase light reflectivity throughout.



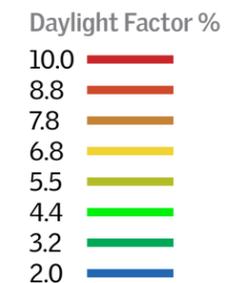
The daylighting performance of the Centennial Park has been measured using the daylight factor (DF) as the performance indicator.

The daylight factor is a common and easy to use measure for the available amount of daylight in a room.

It expresses the percentage of daylight available inside, on a work plane, compared to the amount of daylight available outside the building under known overcast sky conditions.

The higher the DF, the more daylight is available in the room. Rooms with an average DF of 2% or more are considered daylit. The daylight factor analysis has been performed using computer simulation software Daylight Visualizer.

The figures above are showing the daylight factor levels of each floor and the impact of the installed roof windows.



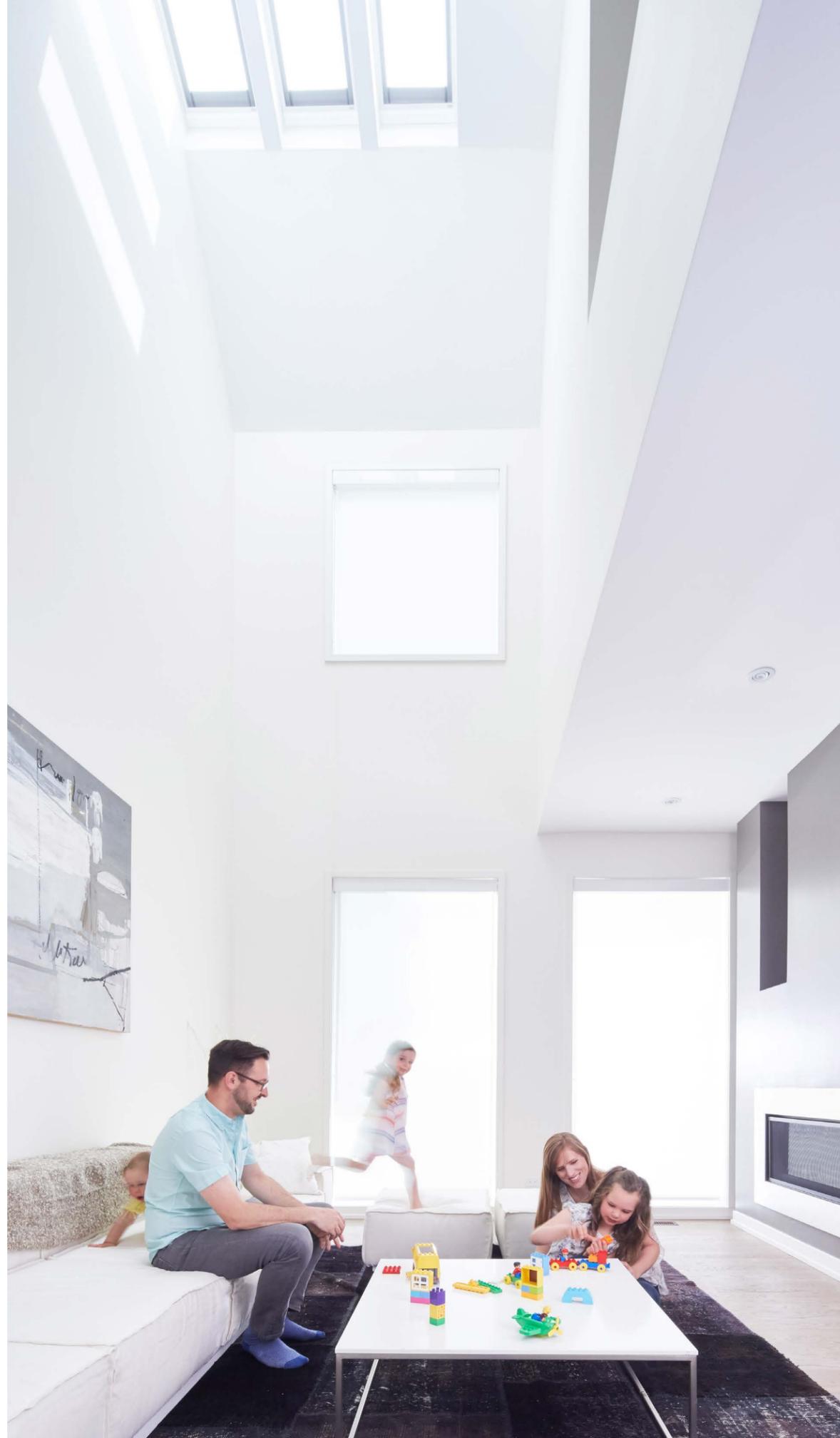


Staying in control

Centennial Park Residence is also an evolution in home automation with an emphasis on easy-to-use, hassle-free and reliable systems that can monitor aspects of the home not previously possible in Canada, even a few years ago. For example, the house is equipped with a Powerwall system developed and manufactured by Tesla. The Powerwall is a rechargeable lithium-ion battery controlled by a system which allows for energy management and reduction of electricity consumption during peak times. It can also be used as an emergency backup as well. Through Rogers Smart Home Monitoring, Centennial Park is equipped with WiFi thermostats, wireless lighting controls, various motion and alarm systems, and a sensor that can help limit costly water damage by triggering an alert when a leak is detected. And as for controlling natural daylight and fresh air, the fully programmable VELUX skylights are designed with an intelligent touchscreen remote control that can open and close the skylights as needed. In addition to maintaining their automatic and/or remote functioning for natural ventilation purposes, the skylights also have an insect screen, and equipped with an integrated rain sensors that automatically close them during inclement weather. For Centennial Park, VELUX is most interested in giving the user the ability maintain at least some control over the automatic technology. And as a result, they are very excited to study the data to emerge during its first few months of occupancy.



VELUX Solar Powered Venting Skylight
& Intelligent Touch Screen Remote



Tesla Powerwall



VELUX Sun Tunnel



Rogers Home Monitoring System



Home Technology's Prefabrication Facility

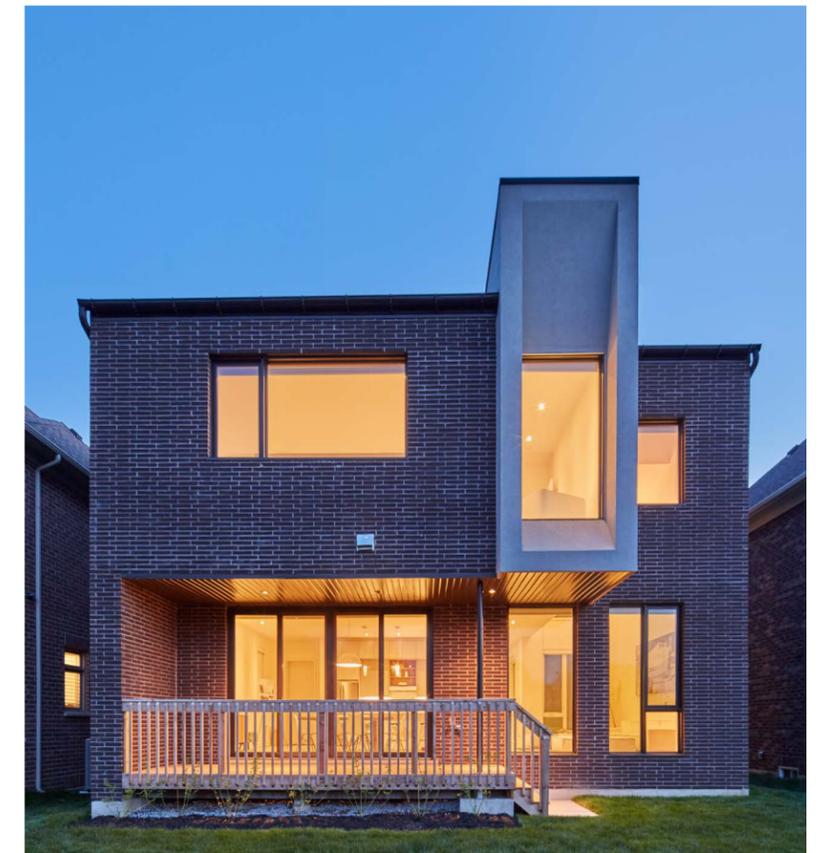




Sophisticated design kept simple



Centennial Park Residence optimizes comfort and energy efficiency through straightforward but intelligent design thinking that includes locating thermostats on interior walls that are not in direct sunlight for greater accuracy, the use of efficient low-flow toilets and faucets, or installing ducting that is insulated and sealed throughout the home to ensure that optimally conditioned fresh air reaches every room with an intended temperature distribution. The home has an on-demand hot water system instead of a larger and energy wasteful traditional hot water tank. Centennial Park Residence uses a three-zoned furnace and heat pump HVAC system that allows occupants to heat or cool their bedrooms at night while adjusting the temperature of unused living spaces. Containing fewer automated systems but the same level of craftsmanship and design, it is a simple to use Active House with exceptionally high performance.





Putting it together

Essential to the success of Centennial Park is Great Gulf's Home Technology system, an advanced indoor automated manufacturing plant that allows roof, wall and floor assemblies to be built as integrated panels in a controlled environment—even providing the opportunity to build full-scale mock-ups to verify the project's energy efficiency. The Home Technology facility is supported by myriad construction visualization, prototyping and fabricating technologies that reduce environmental waste and increase energy performance through the manufacture of tight-fitting building components. The evolving process is also a way to increase affordability to homeowners.

Tad Putyra, President and Chief Operating Officer of Great Gulf's low-rise division, recognizes the need to remain

competitive, especially in suburban markets where there is a greater challenge to deliver energy-efficient homes. Utilizing Great Gulf's Home Technology facility, they can work with consultants at the outset of the design process where, for example, the manufacture of larger spans can readily accommodate building products like VELUX skylights and Sun Tunnels. In other instances, by working with various partners such as ROXUL insulation, Huber Engineered Woods, Lennox HVAC systems, and Rogers Smart Home Monitoring, Great Gulf was able to coordinate with consultants through their Building Information Modelling (BIM) system, to deliver a better designed product with highly integrated systems that avoids unnecessary bulkheads or awkward spaces.



Rear exterior elevation stucco application being installed.



Installation of Home Technology's panels.



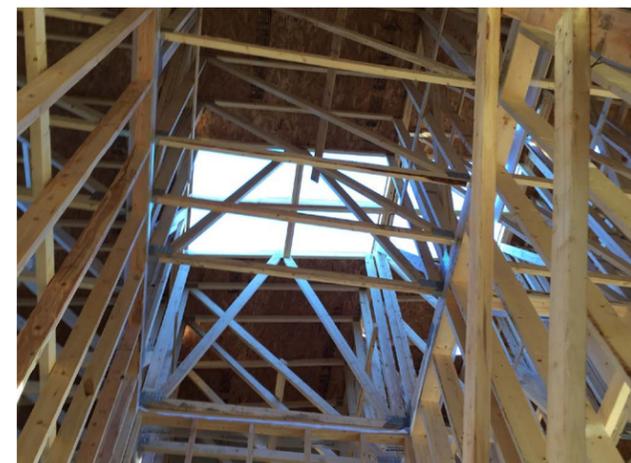
Crane lifting Home Technology's floor panel into place.



Installation of Home Technology's roof truss system.



Living room double height walls provides view through atrium with large windows.



Stair opening in ceiling brings in an abundance of natural light.



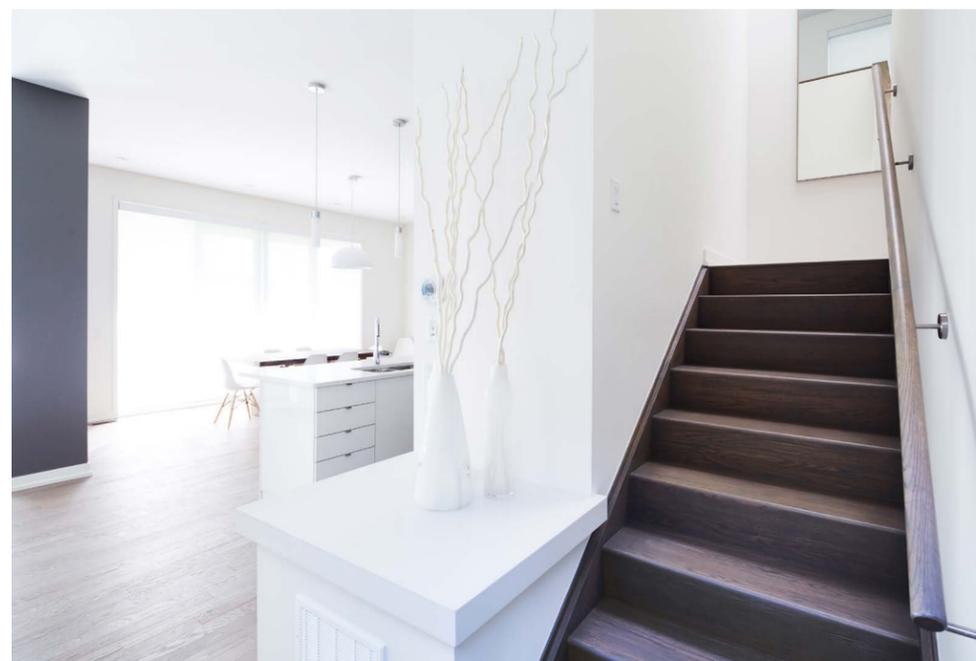
Living room walls and ceiling filled with ROXUL insulation.



Active House – Coordinated for Living

Simply put, Great Gulf Centennial Park Residence’s various technological applications and design concepts work together. For example, natural daylighting and ventilation strategies are supported by well-insulated basement floors and high-performance windows optimized for solar heat gain. Optimizing the placement of windows and walls are studied quantitatively and qualitatively: It is a coordinated strategy involving engineering

and design professionals. Such an integrated approach can be compared to advances made in electric vehicles in recent years. Just as the latest models of electric vehicles are appealing because the technology and design are highly integrated, innovation and design strategies that support Centennial Park Residence work holistically, triggering an emotional appreciation—and not just a scientific curiosity—for healthy and sustainable living.





Benchmark

As the first certified Active House in the world, it is still relatively early to accurately survey the full range of energy-consumption data associated with the Centennial Park Residence. Nevertheless, preliminary data has already revealed the home has surpassed current energy performance criteria in the Canadian marketplace. In time, all-encompassing metrics associated with Active House criteria established in Europe will have to be adjusted to factor into specific considerations such as Canadian climate conditions or the delivery of specific energy sources to residential customers. For example the pricing of natural gas and electricity in Canada is currently following a user-based consumption system that is quite

different from the European market. Already, Active House Centennial Park uses an energy-efficient heat pump system and is receiving electricity from Bullfrog Power—a green electricity provider that ensures the customer that energy comes from clean sources such as wind or low-impact hydroelectricity. The VELUX skylights and Sun Tunnels provide considerable natural daylight and ventilation benefits that help reduce electrical loads. As more Active Houses are completed, more data will be collected on this particular approach to residential design which will only serve to provide detailed and accurate long-term performance data relating to this new generation of healthy living.

Comparison of Centennial Park house and standard house built according to the Ontario Building Code 2012

| Indoor comfort | Active House Centennial Park | Standard House - Building code 2012 |
|------------------------------------|--|---|
| Daylight factor (average) | 3.3% | Below 2% |
| Windows | Triple glazed (0.97-1.19 W/m ² C) | Double glazed (<1.6 W/m ² C) |
| Skylights | Yes (2.29 W/m ² C) | No (<2.8 W/m ² C) |
| Openable windows & skylights | Yes | No |
| Energy | | |
| Windows | Triple glazed (0.97-1.19 W/m ² C) | Double glazed (<1.6 W/m ² C) |
| Low/high heat gain by orientation | Yes | No |
| Insulation | | |
| Walls | (R24 + R5 Exterior Board) | (R22) |
| Basement walls | (R24) | (R12) |
| Basement slab | (R10) | 0 |
| Attic Insulation | (R50) | (R50) |
| Mechanical | | |
| Space heating AFUE | 97% | >94% |
| Zoned heating | Yes | No |
| HVAC HRV | Fully ducted | Basic ducting |
| Heat pump | Yes | No |
| Other | | |
| Water saving faucets and equipment | Yes | No |
| Pre-fab panels | Yes | No |
| LED lighting | Yes | No |





Partners

Active House Alliance Canada: Value in Partnerships

The research and analysis that supports Centennial Park Residence is evident in the Scandinavian-inspired design. What is less apparent is the partnerships amongst manufacturers whose products are already widely available in Canada and well within the range of materials that Great Gulf already specifies for their more traditional homes. These partnerships are significant as they create a precedent to continue evolving innovative technologies and strategies so that the success of the Active House concept can reach more Canadians. For example, one recent addition to Great Gulf's Active House partnership includes Huber Engineered Woods who have developed an innovative structural roof and wall system with integrated air barrier that streamlines the weatherization process and transforms the assembly of exterior walls into a simpler installation process. Known as a ZIP System®, builders simply install the panels and tape the seams together using a proprietary system. Just as practice makes perfect, process makes partnerships.



Future thinking

One of Centennial Park Residence's most significant achievements is its ability to offer an energy-efficient home that blends manufacturing efficiency with affordability. Another important cost-related feature is the potential to successfully offer the Active House concept on smaller lot sizes, and in configurations such as a semi-detached or townhouse design.

It remains to be seen what kind of valuable qualitative and quantitative data will emerge from the initial six-month occupancy period of Centennial Park Residence. To be sure, through the observations of Russell Ibbotson and his family, along with the support of the scientific research team, new insights into the ways in which a homeowner experiences an Active House designed to this level of performance will be achieved.

Great Gulf's Centennial Park Residence incorporates streamlined technology with all the benefits of natural daylighting and ventilation that make for healthy and sustainable living. It is similar to the latest generation of electric vehicles in which consumers want reliability, performance, and style in one complete package—a hassle-free product that respects the environment while improving their quality of life.

To follow the Ibbotson family experience

please visit activehouse.ca.

