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GEOHERMAL AND SOLAR ENERGY POWER NEW NET-ZERO FIRE STATION

This impressive project is the City of Edmonton's first net-zero energy facility

The City of Edmonton is continuously working towards becoming an energy sustainable and climate resilient city and has set a target to be a carbon-neutral corporation by 2040. One project on the journey to meeting that commitment is the new Windermere Fire Station 31, which was built with sustainability and climate resilience top of mind.

Windermere Fire Station 31, which has been operational since July 2023, sets a strong precedent for new construction in the age of climate change. This net-zero energy building was initiated as a pilot

project under the City of Edmonton's prior policy (C532 Sustainable Building Policy).

"As a net-zero energy building, the total amount of energy used annually is equal to the amount of renewable energy created on site," says Devin Richards, project manager with the City of Edmonton. "This involves features such as solar panels, which generate on-site energy, and a geothermal system, which efficiently heats and cools the facility."

At 1,520 square metres (16,400

square feet), Fire Station 31 serves Edmontonians in the fast-growing southwest area of the city, bringing with it, in addition to its environmental credentials, the promise of greater safety and security for people in the event of an emergency.

The project team included S2 Architecture and gh3* as the architectural team and PCL Construction as the general contractor. The building design received the Canadian Architect 2018 Award of Excellence and is projected to achieve LEED Silver

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certification. PCL Construction's in-house experts engaged with the City, architects, and consultants early on to enhance design solutions and reduce costs.

OPTIMIZING DESIGN FOR SOLAR CAPTURE

Building for a sustainable and resilient future demands innovative approaches to building and systems integration.

The building shape is designed to maximize the generation of solar energy and minimize heat gain. The striking south-facing roof, featuring 382 panels with a rated capacity of 143 kilowatts, is gently sloped to capture the sun's rays most effectively.

"The subtle swoop of the roof is designed around the sun's movement," says Linus Murphy, an architect and

principal with S2 Architecture. "It is designed for the Edmonton area — you couldn't take this design and put it in Calgary or any other location with the same effectiveness."

CAPTURING BURIED ENERGY

Just under half of the sun's energy passes through the atmosphere and is absorbed by the Earth's surface.



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Accessing that energy to heat and cool Fire Station 31 became a shared sustainability goal for this landmark project. A team that included architectural, civil, construction, and geothermal experts came together to design and build a geothermal field that would meet the project's goals.

"We had a lot of back and forth in terms of the environmental numbers that are produced from this building, from the solar installation and from the geothermal," says Andrew Brennan, a superintendent with PCL's specialized

contractor team — Special Projects — which delivered the project. "This had to be closely coordinated and verified with the experts to get us to net-zero."

The geothermal field was designed in an L-shape outside the perimeter of the building itself, with the header pipes feeding into the station. It features 35 75-metre-deep boreholes which provide energy for heating and cooling.

IT'S ALL IN THE ENVELOPE

The importance of a well-designed and well-built building envelope in the quest to reach net-zero can hardly be

overstated. Any failure of the envelope can lead to moisture damage, air leakage, poor indoor air quality, and costly repairs.

"The challenges start if any of a building's four control layers — the air, moisture, vapour, and thermal barriers — are not properly designed or built," says Lori O'Malley, PCL's building envelope engineering specialist. "That's when the potential for issues to arise increases."

The R-value, measuring how well building insulation can prevent the flow of heat into and out of a building, was a key aspect of this project. PCL built an envelope featuring walls with an R-value of 35 (compared with a typical house wall of R-20). The roof insulation, consisting of a combination of semi-rigid mineral wool insulation on the metal roof and rigid polyisocyanurate insulation on the flat roof, has an R-value of 50. The underslab insulation consists of high-compression rigid insulation for an R-value of 20.

"We have virtually no thermal bridging, which is when metal goes from the warm side into the cold side," says Murphy. "We've reduced the glazing down to about 14 per cent of the building, which is really phenomenal."

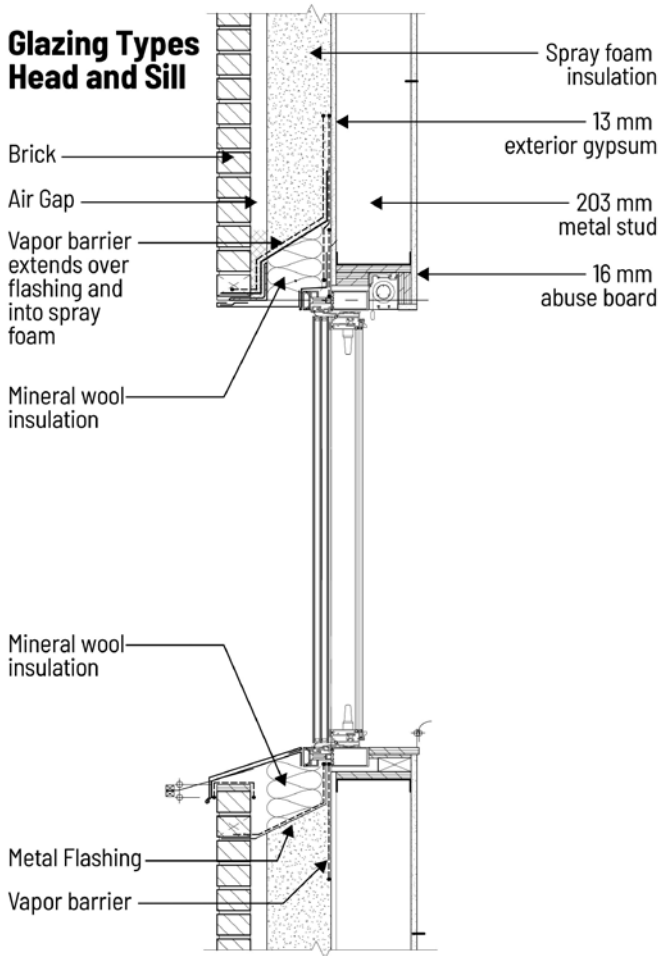
One of the building's key sustainability features is the bi-folding doors that allow the trucks in and out.

"These side-folding doors open two-and-three-quarter seconds faster than an overhead door goes up," says Murphy. "That may sound miniscule, but when those doors are opening 4,000 times per year, that adds up to time that the doors are closed rather than open, conserving energy and reducing response times."

Other sustainability and occupant-comfort measures include:

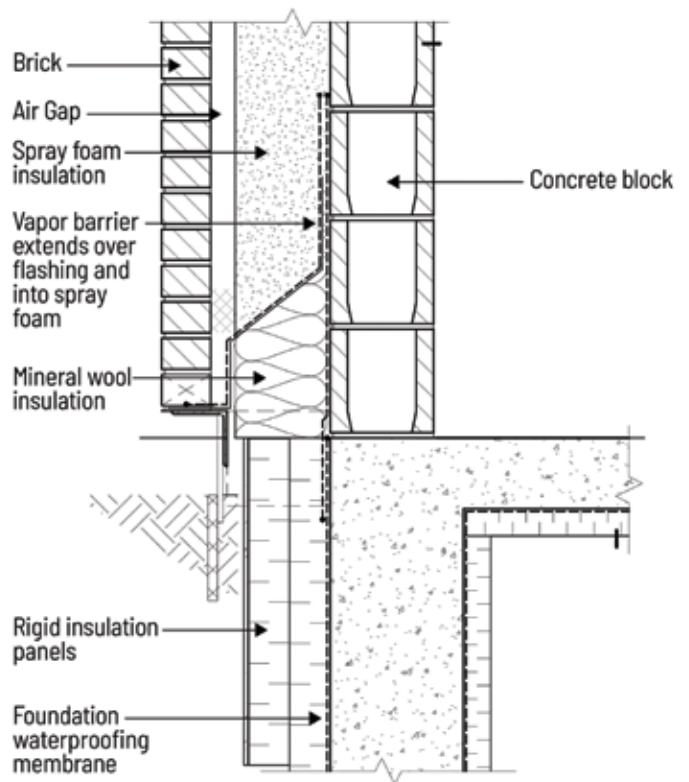
- LED lighting and occupancy sensors to help reduce lights being left on while not in use;
- Maximized natural light in the work

Glazing Types Head and Sill



The triple-glazed windows are set in walls made of 90mm brick veneer, a 45mm air space, 175mm of spray foam insulation and vapour barrier, 13mm exterior gypsum sheathing, 203mm metal stud framing and 16mm abuse board, giving an excellent solar heat-gain coefficient rating of 0.38.

Concrete Masonry Unit Wall Sill



A net-zero building requires a tight building envelope. In the case of Windermere Fire Station 31, the wall included a 90mm brick veneer, a 45mm air space, 175mm of spray foam insulation and vapour barrier and a 190mm concrete block wall. It provides an excellent U-Value of 0.167 W/m²K.

environment to reduce energy loads and improve occupant comfort;

- Site drainage to the perimeter where a bioswale aids in the removal of pollutants from storm water runoff;
- Enhanced health of the occupants in the engine bays through suction hoses that attach to the fire trucks' exhaust systems as soon as they enter the bay and do not release until they leave.

AN IMPORTANT COMMUNITY INVESTMENT

Along with improving the fire department's response time throughout Edmonton's southwest, Windermere Fire Station 31 will be a community centre in the event of an emergency. It is a post-

disaster, non-combustible, sprinklered building with a complete alerting system. It also has a dedicated room to receive donations for the many community drives Edmonton Fire Rescue Services supports.

WHAT'S NEXT FOR NET-ZERO AT THE CITY

"Edmonton is growing. We are preparing to be a city of two-million people. Building the necessary infrastructure to support that growth with climate-resilient features prepares us for the future and makes the station more efficient and durable," says Richards. "The City of Edmonton is continuously working towards becoming

an energy sustainable and climate-resilient city — this means reducing our greenhouse gas emissions, conserving energy, increasing energy efficiency, and shifting to renewable energy sources."

While this facility is the City's first net-zero energy facility, the City's updated Climate Resilience policy requires all new City-owned buildings to be emissions neutral — a step above net-zero energy.

"We're excited to take the lessons learned from this fire station and continue to innovate our sustainability practices as we build and rehabilitate other City of Edmonton facilities," says Richards. ♦