

CASE STUDY

The first 3D printed multi-family dwelling built in Canada

Windsor, Ontario

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SPRAY FOAM INSULATION HELPS FIRST OF ITS KIND 3D PRINTED MULTI-FAMILY DWELLING IN CANADA ACHIEVE AN OPTIMAL BUILDING ENVELOPE

Huntsman Building Solutions (HBS) spray foam insulation for 3D printed homes in Windsor.

In Windsor, ON, Habitat for Humanity Windsor-Essex has recently completed the first 3D printed homes in Canada, with plans for more to come in the following year. This breakthrough project will provide affordable housing to those at risk of homelessness and elevate members of the community through The Bridge Youth Resource Centre. Four units have been built and certified, with designs focused on accessibility and net-zero emissions. The four-plex housing offers a kitchen and living space, a bathroom with mechanicals, and a bedroom that suits one to two individuals.

The project began in 2021, when Habitat for Humanity Windsor-Essex partnered with the University of Windsor, Great Northern Insulation (GNI), and Huntsman Building Solutions (HBS),

among others, to research and develop the first 3D printed homes for residential use in Canada.

This unique venture was funded by a generous commitment from Canada Mortgage and Housing Corporation's Innovation Fund, a fund intended to support ideas that improve access to affordable housing in Canada.

The teams involved with this project faced several challenges throughout its development, as they worked through new and unique problems due to the nature of the construction. Patience was needed as lab samples were printed, tested, and analysed to understand the best methodology for constructing 3D printed homes.

"This was a new idea which required creativity, flexibility, and patience as we worked through the design and testing process to deliver a high-quality,

net neutral final product which could comfortably house those in need of assistance. Working with Great Northern Insulation, Huntsman Building Solutions, and University of Windsor allowed us to break new ground in the field of 3D printing and create something amazing," said Fiona Coughlin, CFRE, Executive Director & CEO, Habitat for Humanity Windsor-Essex.

The unique construction of the dwelling's 3D printed walls required insulation to be installed between the walls into a 5 1/4" cavity. Spray foam insulation represented the only way to achieve a high-quality solution in such a unique space, while simultaneously offering a high level of comfort for residents and assisting the dwelling in reaching a state of net-zero emissions.



CHALLENGE	SOLUTION	RESULTS
<p>Habitat for Humanity needed to find project partners who could think and work creatively and were also scientifically minded, to tackle this one-of-a-kind project.</p> <p>They also needed insulation that could function well and be applied to the unique construction of the dwellings, while adhering to building codes and achieving net-zero emissions.</p>	<p>Huntsman Building Solutions worked closely with Great Northern Insulation (GNI) to address the physical and creative needs of this project. To create a high-quality building envelope, GNI used HBS PIP Foam 250 throughout the project to ensure the unique construction was properly insulated.</p>	<p>Great Northern Insulation and Huntsman Building Solutions pulled out all the stops when it came to offering their expertise throughout the project's timeline. They brought their combined years of experience and creativity to the table to create a complete building envelope for a first-of-its-kind project in Canada, setting the standard high for future 3D printed dwellings. Residents of these 3D printed dwellings will enjoy lower energy bills and more comfortable conditions, far into the future thanks to 'PIP Foam 250' pour-in-place insulation.</p>

Products / Solution

For this unique and ground-breaking project, Huntsman Building Solutions closed-cell pour-in-place foam 'PIP Foam 250' was the best choice. When incorporated into any building envelope, traditionally constructed or otherwise, it provides several benefits, with its greatest assets for this project being its versatility and multi-functional properties. An insulation product that can be more than just insulation, and provide an air and vapour barrier, as well as weather resistance, means less products are required for the construction process. This translates to lowered costs, construction times, as well as lowered environmental impact.

Spray foam insulation uniquely grants architects freedom to design and build more complex structures due to its ability to fit virtually any space. Certain design choices, such as the use of 3D printed walls with a cavity, can only be completely insulated using spray foam. For the eventual residents of projects insulated with spray foam, they will enjoy a more comfortable living environment as

PIP Foam 250 insulation systems enables less air leakage and lower condensation.

The solution to the challenges faced by Habitat for Humanity Windsor-Essex was not just high-quality, versatile spray foam insulation, but also a capable team of experts ready to install the product and creatively solve testing problems onsite. Great Northern Insulation sent a team of seasoned industry experts with decades of experience to work around the complex installation requirements of the project.

Process

Habitat for Humanity Windsor-Essex, the contractor, brought in Great Northern Insulation (GNI) to conduct the pour-in-place foam installation. Founded in 1980, GNI have been a close business partner of Huntsman Building Solutions for several years and are well-regarded for their expansive operation with 9 locations across Ontario. They have over 350 employees ready to accelerate insulation projects, and decades of experience affording them unmatched expertise and creativity.



Before the construction of the 3D printed dwelling even began, there was a large amount of research and testing needed to determine what was needed for the first 3D printed dwelling in Canada.

The project was unique, and the first of its kind, so GNI needed to creatively address the needs of the construction, while providing the same high-quality building envelope. Due to the complexity of the architecture and its unique design, including suspended levels, the project was a welcomed challenge. The crew from Great Northern Insulation applied Huntsman Building Solutions' PIP Foam 250 polyurethane insulation inside the full width of this unique 3D printed 5.25" cavity in 10" lifts to ensure that there were no voids in the cavity disrupting the building envelope.

"Choosing pour-in-place foam insulation for this project just made sense. This was such an exciting and unique project, and for such a good cause, that we wanted to make sure we could offer the most comfortable and efficient final product possible. PIP foam insulation allowed us to work in most weather conditions over the 45-day printing period, and the result is a complete building envelope that will last an incredibly long time," said Rick Bartel, General Manager from Great Northern Insulation.

Results

The project was a fantastic success, due to the hard work put in by all parties, the incredible versatility of PIP Foam 250, and the willingness of Huntsman Building Solutions and Great Northern Insulation to adapt to the unique requirements of the construction process. With the building envelope insulated with pour-in-place foam in a unique manner, Huntsman Building Solutions worked closely with Great Northern Insulation to ensure comfortable conditions for

residents and net-zero emissions were achieved. The use of PIP Foam 250 will keep the dwellings cool in the summer, and warm in the winter, reducing energy consumption year-round.

"What's great about using PIP Foam 250 in these homes is that no maintenance of the insulation will be required. The product will remain durable and airtight for the home's lifetime. Habitat for Humanity Windsor-Essex and the University of Windsor worked incredibly hard to research and design materials which would stand the test of time, so we wanted to match that commitment with a product that maintains prime condition far into the future" said Rob Serino, Territory Manager in Ontario from Huntsman Building Solutions.

The use of PIP Foam 250 has helped this project achieve net-zero emissions, but it will also help reduce the long-term environmental impact of these 3D printed dwellings. Utilizing pour-in-place foam to insulate the uniquely 3D printed concrete structure mean that small imperfections were fully sealed, preventing all presence of potential air gaps and heat loss. This enabled the perfect building envelope to be achieved despite the unique and new construction technique.