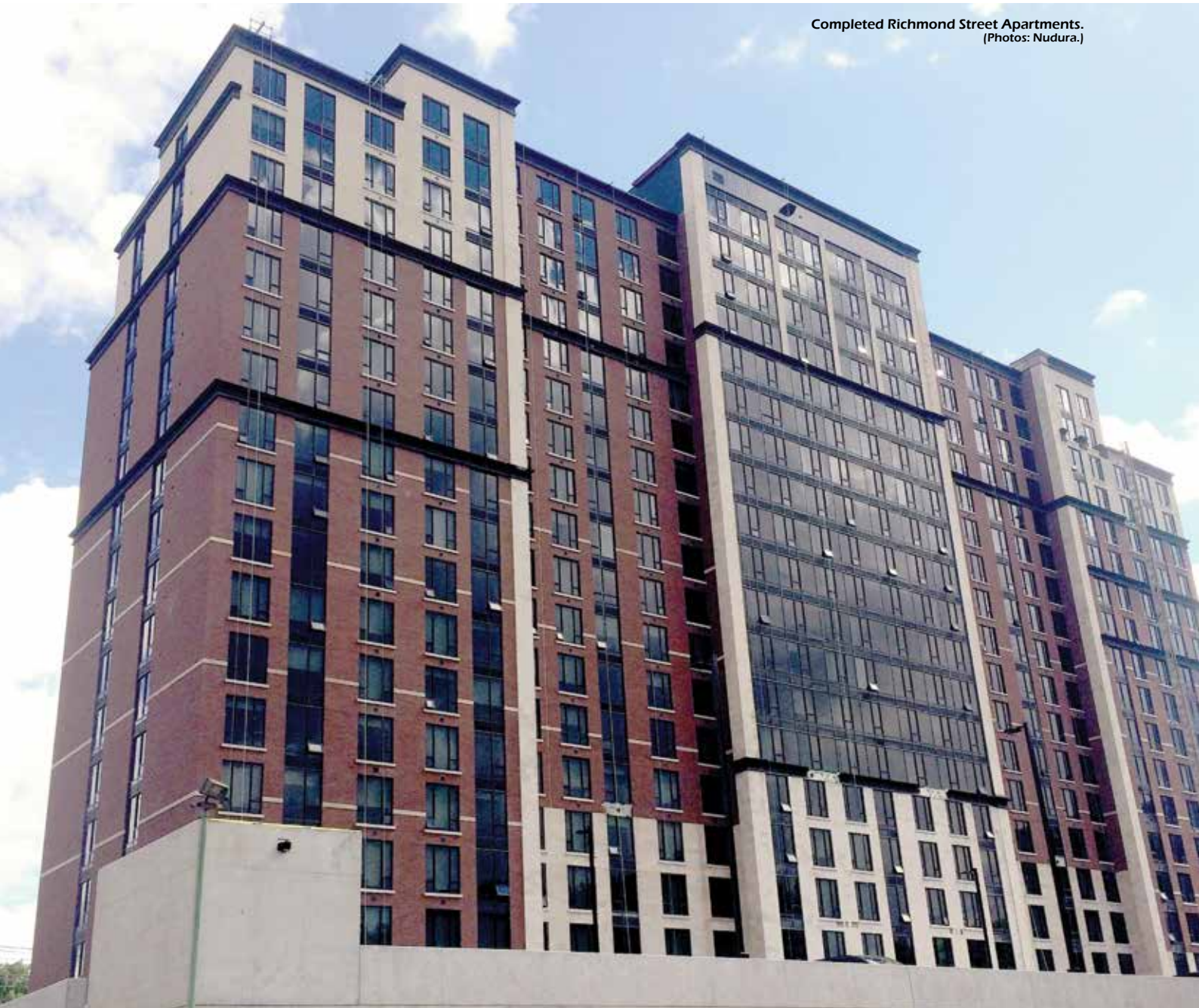
Richmond Street high-rise apartments, London, Ontario

At a cost of C$40m, the *ICF Builder* award-winning Richmond Street Apartment block in London, Ontario provides student housing adjacent to the University of Western Ontario. One of the tallest projects ever specified in Nudura insulated concrete formwork (ICF) and the first in London, Ontario, it comprises 19 above-ground storeys for multi-residential use and occupies an area of 336,802ft² (31,290m²). There are several more ICF buildings of comparable size currently under construction in the area where ICF has gained recognition as a proven system.

Jean-Marc Bouvier, Nudura, Sussex, UK



Completed Richmond Street Apartments.
(Photos: Nudura.)

Concrete pour.

Constructing ICF elements.

As 85% of the walls (150,000ft^2 or 13,935m^2) were built with ICF over an eight-month period, this method of building envelope construction saved five months of construction time, compared to using traditional methods. Innovatively, ICF was used in stairways and other non-traditional areas.

The project has substantial glazed features and a mix of building fabric finishes, which achieve an aesthetically attractive exterior. There are several canopies that help delineate the use of mixed materials. This was accomplished by introducing spandrel bypass window features in front of the ICF wall. The use of glass contributed to aesthetic appeal, while keeping the openings reduced and high-performing ICF walls (insulation) present.

The wall system has since proved to have a very high energy performance, reducing the heating and cooling requirements of the building. There is very little air leakage in this wall system and having exterior insulation on the walls reduces cold bridging challenges.

Internal view of the new apartment block.

Designed for disaster resilience

A key challenge of the project's design was the control of certain seismic forces, which was achieved by building laterally for shear strength. The project was also complicated by the fact that the exterior walls were used for floor bearing, which placed constraints on the amount of possible window openings. From the exterior, the building appears to have more glazing than it actually does.

Nudura also offer four-hour fire protection for a minimum 6-inch (152mm) thickness concrete core. Tests show the system is no more toxic than burning wood and does not pose any risk of exposure to chemicals. Forms and the foam plastic insulation used in these systems have been tested for compliance with relevant international codes. All EPS foam used in Nudura ICFs contains a mandatory polymeric-based flame-inhibiting agent, which is designed to extinguish flame when the flame source is removed from contact with the foam.

Construction and site considerations

The primary challenge on the construction was the amount of reinforcement bars required in the ICF. This caused problems when pouring the concrete, to ensure even distribution throughout the concrete form was achieved. The solution was to redesign the lateral stiffness of the building by increasing the amount of reinforcement in the internal walls that did not have window openings.

This project is the first large-scale ICF building in London, Ontario. The construction and permit process attracted attention to the building department as city officials requested shop drawings for the ICF.

Project success

This student residence is providing the University of Western Ontario with first-rate accommodation and amenities at its London site. Amenities such as rooftop terraces (both private and public), gym, spa, saunas, tanning facility, movie theatre, video game centre, games room, study rooms, billiards room, yoga room, laundry facility and a restaurant all come together to create a compelling offer in the recruitment of students to the university.

This project has pushed the known boundaries of ICF in high-rise buildings – for example, techniques to use ICF in stairwells, elevator shafts and other areas that require modification or removal of the foam needed to satisfy relevant building codes. These efforts were made due to the high speed of installation and inherent cost savings over traditional builds. ■

Reference
1. MARCEAU, M.L. and VANGEEM, M.G. *Life cycle assessment of an insulating concrete form house compared to a wood frame house*. Portland Cement Association, PCA R&D Serial No. 2571, Skokie, Illinois, 2002.

Left: Completed ICF work on the high-rise building.

Sustainable assets
Quick to construct with high levels of performance and durability, insulated concrete formwork (ICF) has been gaining popularity in the UK for some time. ICF can provide a range of environmental benefits – not least Passivhaus levels of insulation and airtightness. The system is based on in-situ concrete walls cast into permanent, hollow expanded polystyrene (EPS) formwork. ICF delivers a sustainable building that will deliver other measurable benefits such as unbeatable insulation values, energy efficiency and four-hour fire resistance. It can be constructed whatever the temperature and virtually eliminates construction waste.

Thermal performance
Airtightness and thermal performance are central to the environmental performance of insulated concrete formwork. If you take the standard Nudura wall system, comprising a 102mm internal concrete core, EPS formwork (2 × 67mm) and applied interior and exterior finishes, this gives a calculated U-value of 0.24W/m^{2}K. U-values of 0.21, 0.18, 0.16, 0.14 and 0.11 can be achieved using the company's Plus Series product.

What's more, this form of construction can save building owners up to 70% in energy costs compared to traditional building methods. The total energy consumption for schools constructed with ICF can be as low as 40–50kWh/m^2/year. This kind of performance can be achieved with a U-value of only 0.24W/m^{2}K, as the system incorporates high levels of thermal mass and airtightness, while avoiding cold bridging.

Airtightness
Closely connected with thermal performance is airtightness. By eliminating gaps and draughts, ICF creates airtight structures that maximise the efficiency of mechanical heating, cooling and ventilation systems. This can result in healthier living and working environments for building occupants.

Materials and waste
A criticism that has been aimed at ICF is that its principal components – concrete and expanded polystyrene – are derived from fossil fuels. However, only 0.1% of a barrel of oil is used to make polystyrene. More importantly, for every litre of oil used to make EPS insulation, the product can save around 200 litres in reduced heating requirements. In addition, Nudura's EPS insulation does not contain, emit or use in its production any CFCs, HCFCs or VOCs, making it non-toxic and environmentally safe. It is also zero-rated for ozone depletion and global warming potential (ODP and GWP). For assembled walls, the ratings are zero ODP and <5GWP.

More than 50% of the product by weight comprises recycled material and is proven to reduce waste by 50% when compared to conventional cavity-block construction. It's also possible to reduce on-site waste to as little as 1%.

Life-cycle assessment
According to *ICF Builder,* life-cycle assessments comparing ICF to other building materials show it outperforms these in nearly every region and type of construction. LCA studies indicate that in-use operation, including heating and cooling, account for the majority of a building's environmental impact over its lifetime (up to 90%). ICF's ability to combine in-situ concrete walls with permanent EPS formwork maximises airtightness and thermal efficiency, resulting in significantly reduced energy/environmental costs and long-life expectancy.

Published in 2002, a PCA-funded report entitled 'Lifecycle assessment of an insulating concrete form house compared to a wood frame house'[1], evaluates two 220m^2 houses – identical, except for the exterior wall cladding and HVAC system (which was smaller in the ICF house) – modelled in five climatically diverse cities (Phoenix, Miami, Washington DC, Seattle and Chicago). According to the summary, "The results show that in almost all cases, for any given climate, the environmental impact in each category is greater (worse) for the wood house than for the ICF house.

"The largest impacts are in the form of depletion of fossil fuel reserves (categorised as damage to natural resources) and release to the air of respiratory inorganics (categorised as damage to human health). Among the construction products used in the house, wood products and copper tubing have the largest environmental load, followed by cement-based materials."

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