Cat tales

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All about the nails

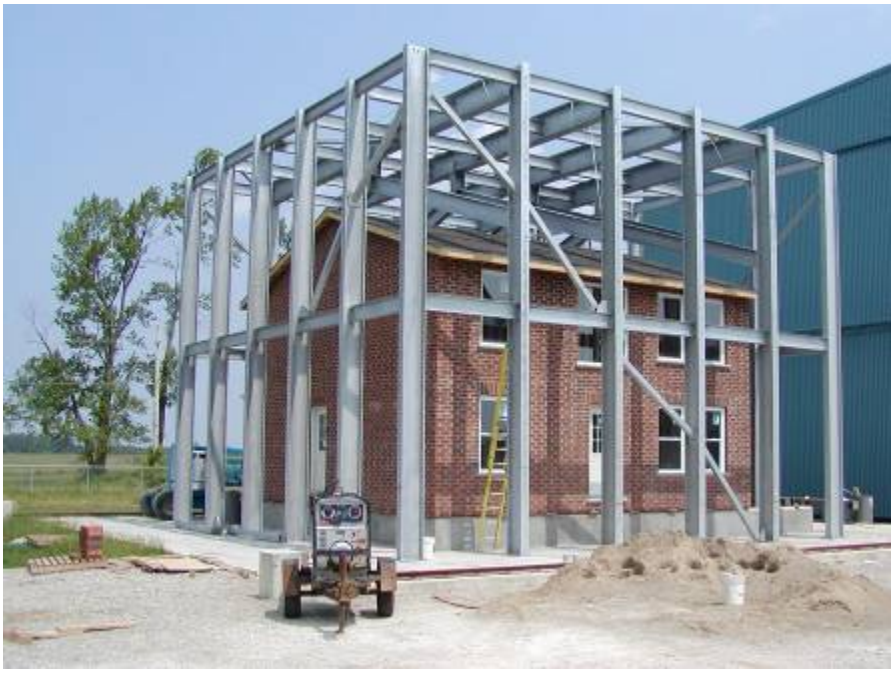
Results of preliminary testing at the Insurance Research Lab for Better Homes

By Glenn McGillivray

After years of dreaming, planning, fundraising, and building, the first tests conducted on the full-scale house built inside the Insurance Research Lab for Better Homes (IRLBH) are complete and the results are in. The house, built to Ontario building code standards and not unlike any new home one would find in most any new subdivision in the province (or across the country, for that matter), was constructed by Fanshawe College building program students. The IRLBH itself is located on the northern edge of the London International Airport in London, Ontario.

Professor Greg Kopp of the University of Western Ontario's engineering department and Boundary Layer Wind Tunnel Laboratory, conducted an ICLR Friday Forum seminar on Friday, September 19 to go over some of the preliminary findings made by the IRLBH team. Many attendees were already quite familiar with the facility – the Three Pigs Laboratory, as it was known before receiving its official moniker after a sizeable donation by the Insurance Bureau of Canada – as over the course of several Friday Forums over the years, many had seen the lab grow from the germination of an idea, to become the only laboratory ►

Figure 1: Full-scale house test specimen inside galvanized steel reaction frame.



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of its kind anywhere in the world.

Though some early testing (on panes of glass) had been performed in the lab some months ago, these were done on rigs separate from the house. The testing related by Dr. Kopp was the first in which parts of the home itself were placed under stress in order to determine, in this case, how hurricane-force winds may impact roof connections.

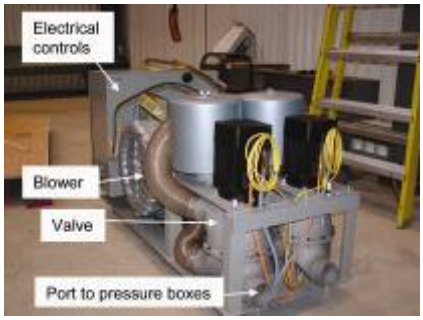


Figure 2: Pressure Load Actuator—The unit is about 600 mm wide and 1,200 long.

The idea behind the IRLBH is to replicate hurricane force and other damaging winds on low-rise buildings and houses by using specially designed actuators and vinyl pressure bags to apply both positive (i.e. push) and negative (i.e. pull) pressure on a specimen structure. As hurricane-force winds can switch from positive to negative and back again in less than a second, the actuator/airbag concept was devised, as simply blowing wind using a large wind tunnel or other such device would not replicate the full effects of hurricane-force winds (and would also be prohibitively expensive to build and operate).

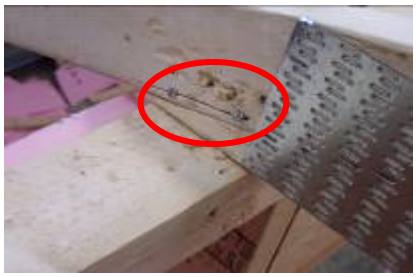


Figure 3: Problems with connections are the major issue for response to wind.

The actuators are first attached to a steel exo-skeleton which surrounds the house. These, in turn, are used to apply pressure on the house via inflation of the vinyl bags. When the steel frame around the house holds all 100 actuators and accompanying airbags, the surface of the home would scarcely be visible. Indeed, when this takes place, members of the research team would have to enter the house by crawling under it and using a trap door located in the floor. For the test reported herein, however, only one portion of the home was rigged up with actuators and vinyl bags.

According to Dr. Kopp, the results “Were a big surprise.”

The roof was first subjected to pressures consistent with a Category 1 hurricane. “We assumed the roof connections would fail at this level. However, after subjecting the roof to a Cat 1 storm for 15 minutes, all we got was a crack in the drywall.” The surprise, he noted, was to learn that the roof failed in increments.

After stopping and restarting the actuators, each time ramping up the pressure, it was discovered that the nails in the roof began to pull out a bit at a time. “By the time we reached a Cat 3 event, we had total failure. Toenails holding the trusses to the joists pulled out, and there was a significant gap between them.” Once this happens, he noted, the only thing holding down a roof is its own weight. “The failure was an important one, particularly given that we applied only vertical loads. It was assumed that the envelope of the building would remain intact, but if we had simulated a breeched window or door, as often occurs in hurricanes, we would have had a catastrophic failure much earlier. Also, no water ingress, as also occurs in a hurricane, was factored in.” Additionally, he noted, the team was surprised to

Figure 4: Example of a toenail roof to wall connection in the house where the nail has split the wood and offers very little hold down force.

learn that the leeward side of the roof (i.e. the side upon which no force was applied) lifted prior to the windward side.

As a result of the test, it became evident that it is possible for a roof to become completely disconnected from the walls, yet settle back down with little visible evidence of such a catastrophic failure having taken place. Thus a roof can be sitting on the walls, appearing to be fine when, in reality, it has become completely disconnected from the structure. Such a failure may only be detected if someone were to enter the attic and conduct an inspection, or if the home was hit with another wind event, days, weeks or even years later, causing the roof to fly off, even at much lower speeds than would otherwise be the case. Similarly, as toenail connections pull part of the way out, there could ► Pg 5

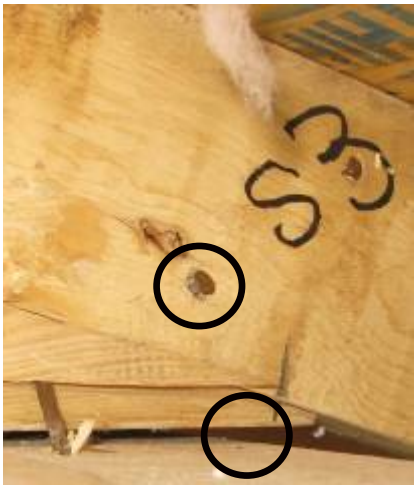


Figure 5: Roof connection after Dynamic Test #3. The nails moved considerably, and a large gap appeared between the joists and trusses.

Downtown Guelph businesses better prepared for disasters

ICLR, The Co-operators and the Downtown Guelph Business Association launch free emergency planning pilot project for small businesses in Guelph

A pilot program conducted this summer in Guelph, Ontario, has provided 350 small and mid-sized businesses in the city's downtown core with tools to help them become more resilient to the impact of natural catastrophes, fires, power outages and other potentially devastating events. The first-of-its kind pilot, part of ICLR's Open for Business™ program, employed a university student from May to August to provide support, distribute kits, and act as a resource to local businesses.

McMaster University student John McIntyre, spent the summer marketing the program, contacting individual businesses to set up meetings and helping downtown Guelph businesses start their continuity plans. With a 97 percent distribution rate (the remaining 3 percent declined to take part for various reasons) downtown Guelph now has the resources to be prepared if an unexpected disaster were to strike.

"The business community in downtown Guelph consists mainly of small, independent operations. These types of business don't always have the resources needed to develop robust business continuity plans," said Kathy Bardswick, president and CEO of The Co-operators. "Through this pilot project, these businesses received invaluable planning tools and advice that could one day mean the difference between getting through a disaster and being driven out of business."

Research indicates that one in four small businesses forced to close because of an unanticipated event never reopens, in large part because they tend to have fewer resources to devote to business continuity planning. To support them, businesses in downtown Guelph were visited and provided with disaster planning kits free of charge. The Open for Business™ information and planning tools are presented in three main components:

- The Open for Business™ Disaster Plan Folder provides advice and is designed to hold important papers such as leases, insurance policies and contact lists.
- The Open for Business™ Getting Back to Business Guide provides step-by-step instructions to help business owners assess damage, file insurance claims, and get back to business.
- The Open for Business™ Toolkit contains helpful information, checklists and forms to help business owners reduce the potential for loss and reopen quickly.

Along with the paper resources noted above, a USB key containing soft copies of all Open for Business™ forms was given to each participating enterprise to allow business owners to electronically fill out key forms.

The pilot project was a partnership between the Institute for Catastrophic Loss Reduction, The Co-operators, and the Downtown Guelph Business Association (DGBA).

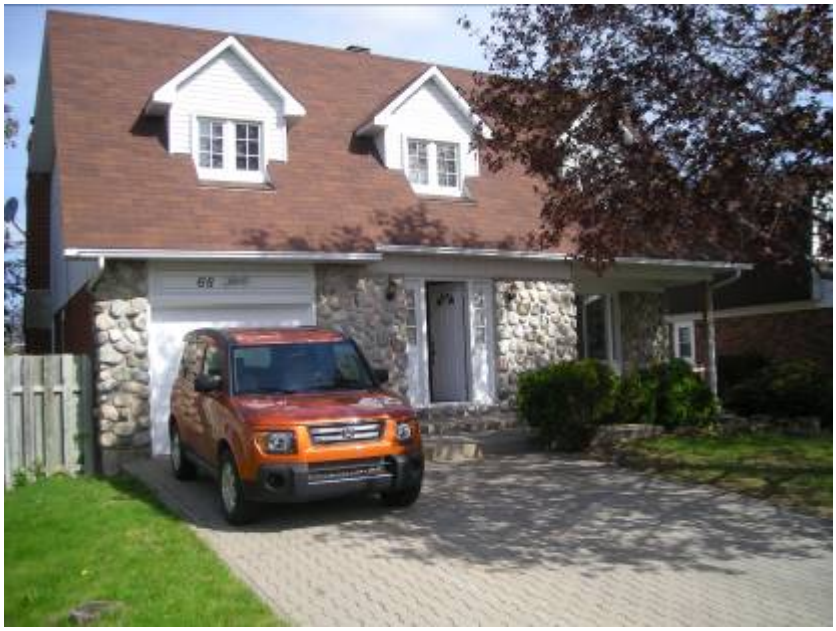
On February 4 of this year, ICLR was invited to host a workshop in Guelph to help businesses plan and prepare for emergency situations. The free event, sponsored by The Co-operators and hosted by the Downtown Guelph Business Association, raised awareness about the need for business continuity planning. The three organizations later decided that rolling out Open for Business™ was an important next step that made good sense for small business in Guelph.

With a devastating fire in downtown Guelph's recent history (the Gummer Building fire on Good Friday 2004), a tornado in 2000, and multiple weather warnings being issued across the country each year, the three organizations delivered the Open for Business™ program in an effort to make businesses in Guelph more resilient.

With strong positive feedback from these businesses, ICLR is looking to offer this program on a much larger scale. The Institute is currently working with a major Canadian p&c group to deliver 50,000 kits to the carrier's small business insureds, and ICLR will be looking for more ways to make the toolkit available to small businesses across Canada.

The Open for Business™ program was created by ICLR's sister organization, the Tampa, Florida-based Institute for Business and Home Safety. It has been brought to Canada under a licensing agreement between ICLR and IBHS.

ICLR retrofits a Montreal home to make it more resilient to winter storm and earthquake



The Institute for Catastrophic Loss Reduction unveiled its latest home retrofit project on May 9. As part of the insurance industry's ongoing commitment to educate Canadian homeowners about disaster safety, ICLR once again chose Emergency Preparedness Week (May 4-11) to unveil its latest home retrofit project, this time in Montreal, Quebec. Montreal was chosen in order to mark the 10th anniversary year of the Great Ice Storm of January 1998, an event that remains far and away the most expensive natural catastrophe in Canadian history.

Paul Kovacs, Executive Director of ICLR, conducted a media tour of the home. Says Kovacs: "Actions taken to make a home more resilient to natural catastrophes should reflect local hazard risk. All of Quebec represents an active zone for winter storm, and the Montreal corridor contains an active seismic zone. Homeowners living in these areas, and in other places in Canada that are subject to different extremes, can prepare now for hazards that will inevitably strike in the future."

The Montreal home retrofit included:

- Installing a generator as an alternative power source
- Putting in surge protection on bigger-ticket electronic items
- Fitting the meter with a natural gas seismic shut off valve
- Anchoring cabinets, office equipment, and bedroom furniture to walls
- Outfitting the washing machine with armoured water supply hoses
- Anchoring the hot water heater to the floor
- Securing pictures and mirrors to the walls
- Applying 3M Scotchshield safety UV film to windows
- Installing carbon monoxide and smoke detectors and providing a fire extinguisher
- Installing snow melt cables on roof edges and gutters to prevent the formation of ice dams
- Providing a disaster preparedness kit.

From late Sunday, January 4 to Saturday, January 10, 1998, freezing rain lashed eastern Ontario and southwestern Quebec before heading into Canada's Atlantic provinces. In Quebec, 100 millimeters of freezing rain ravaged Montreal and parts of the province's south shore. By January 18, 25 Canadians were dead.

Emergency crews worked around the clock responding to reports of trees pulling down hydro poles and ice toppling transmission pylons. In Quebec, 1.4 million customers lost electrical power – translating into roughly three million people or half the province's population. At the storm's height January 9, more than 10 per cent of Canadians were without electricity.

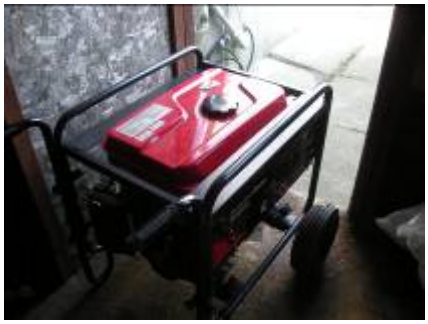
On Friday November 25, 1988, the largest earthquake in eastern North America in 53 years occurred just south of Chicoutimi, Québec. Referred to as the Saguenay earthquake, the temblor registered 5.9 on the Richter scale. Though there was no loss of life as a result of the event, some property damage was reported, particularly to older unreinforced masonry structures. In Montreal East, the former City Hall suffered serious damage to the masonry cladding. ►

The retrofit included the installation of a natural gas seismic shut off valve and a protective cage, to shield the meter in the event the chimney collapses or other debris falls on it during an earthquake.

ICLR retrofits a Montreal home to make it more resilient to winter storm and earthquake *cont*...

According to Kovacs: "We can prevent natural hazards from becoming disasters if people undertake simple, appropriate preventative measures beforehand. Such actions and measures are affordable and take little time to do. We showcased them in this home."

The Montreal home marked the sixth year that ICLR has retrofitted an existing home as part of Emergency Preparedness Week. In 2007, a home in Edmonton was retrofitted to protect against tornado and winter storms. In 2006, a home in Ottawa was made more resilient to earthquakes and winter storms. In 2005, a home in Vancouver was made more resilient to earthquakes, and in 2004, a Halifax home was protected against hurricanes. In 2003, a home in London was made more resilient to tornadoes. The Institute has also retrofitted several child care centres as part of its "Protecting our Kids from Disasters" program.



A generator was wired into the home's electrical service panel in order to provide power should a prolonged outage effect the area.

The home's water heater was fastened to the floor to prevent it from toppling over in the event of an earthquake or other disturbance. This prevents the gas line from severing, causing an explosion and fire, and also prevents water damage.

All about the nails *cont*...

conceivably be a loss of the roof at some later point as a result of a second, though much weaker, wind event.

With a good appreciation of the importance of such connections, the IRLBH team ensured that every nail used to secure roof sheathing, and every toenail connection in the house was recorded to aid in the interpretation of the experimental data and to aid computational modeling. These data will be used for the development of probabilistic failure (risk) models.

"If we had to boil this failure down to one thing, it's the nails – it's all about the nails," said Dr. Kopp. "Nails that are sunk but miss joists or trusses, or where the connections badly crack the wood, are as good as no nails at all. An improperly sunk nail can mean the difference between it holding zero or just a few pounds of force, to it being able to handle 80 pounds of force or more. The details are critical," he said.

As reflected in the vision statement of the IRLBH, the idea behind the facility is "To find optimal solutions which mitigate damage to homes, and other light frame structures, under extreme environmental conditions; conditions such as wind, wind-driven rain, snow, and the various factors that support mould growth." The initial tests conducted at the IRLBH during the month of August are important first steps to ensuring that the lab's vision statement is fully realized.

As Dr. Kopp put it: "No one should die from wind in Canada."

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Mission
To reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions that improve society's capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters.

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