Cat tales

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The writing is on the wall for future wildfire risk in Canada

ICLR launched its wildfire research program more than a decade ago. At that time the largest wildfire loss for our industry was less than $10 million in claims paid, nevertheless the Institute warned that it was inevitable that our industry would experience a $1 billion loss event. In 2003, the fire on the edge of Kelowna had the potential to grow into a billion-dollar loss, but was put out shortly after it came into the city. Last May a fire near Slave Lake grew into a $700 million loss when it destroyed one-third of the town. We remain convinced that our industry will experience a $1 billion wildfire loss event. Indeed such losses may become regular events.

Our surprise last year was that a large loss was experienced in such a small community. The major wildfire losses for insurance companies in the United States and Australia typically involve fire burning into larger communities. But Slave Lake had a population of 7,000. Indeed there are hundreds of communities like Slave Lake located near forests across Canada. Many of these communities have valuable commercial facilities for mining, forestry, oil production or tourism. For example, several large fires were burning last year near Fort McMurray where significant oil production facilities are located. ►

Inside this issue:

Russia, Brazil and Canada have the largest forests in the world, and considerable experience with wildfire. Each year thousands of Canadians are evacuated because they are at risk from wildfire. Moreover, the research evidence is overwhelming that the forest area burned in Canada will increase significantly over the next few decades.

During Canada's early history it was common that uncontrolled fire in the forest would destroy urban centres. Urban fires also spread into forests. Indeed some of the world's largest fires on record were in Canada, including the Miramichi Fire in 1825. Over the past eight or nine decades, however, we have aggressively been working to suppress fires. Indeed, 90% of fires in Canada are now put out soon after they start, and many of the uncontrolled fires are in remote areas where a decision is made to allow them to burn.

Canada's success in suppressing wildfires at risk of burning into cities comes at considerable expense. Some years governments across Canada spend more than one billion dollars on wildland fire suppression. The expectation of more forest area burned will require a doubling of spending on fire suppression over the next few decades to maintain the current record of loss prevention. And this concern is growing at a time when governments seek to restore their fiscal health by constraining spending. There is a risk that the required funds will not be provided to maintain current levels of protection.

In these changing times it remains a challenge to get the Canadian insurance industry's attention on wildfire risk. The losses our industry experienced in Kelowna and Slave Lake should be viewed as a warning that we will soon need to manage this risk as actively as insurers in the United States and Australia, and should not be dismissed as one-off events.

ICLR concentrates its hazard research on four areas: water, wind, earthquake and wildfire, and this is reflected in the organization's five year strategic plan, which was written and released prior to the Slave Lake fire (see www.iclr.org).

Of wildfire, the plan notes: "ICLR will…actively work to assess the growing risk of a wildfire destroying an urban area in Canada. Billion-dollar loss events have increased in frequency and severity in the United States, Australia and Europe, and could strike in Canada. The Institute will continue to work with the wildfire research community, the Canadian Forest Service, provincial governments and municipal leaders. In particular we will seek to increase the awareness of the insurance industry about the increasing risk of loss and make established tools, like *FireSmart*, available to champion loss prevention.

"Notwithstanding the 2003 wildfire season in British Columbia, the Institute is of the opinion that the Canadian insurance industry may be too complacent about the potential for a major wildfire loss in the not-too-distant future. Hence, whenever possible, ICLR works to get messaging out that insurers need to consider the eventuality, first by becoming aware of the risk and of vulnerable areas of the country and, second, by including wildfire in pricing relevant risks…The Institute is also working to spread awareness within the insurance industry of the Canadian Wildland Fire Strategy (CWFS) and the important need to get funding for the plan as soon as possible, as well as awareness with regard to the availability of and need for better tools (including maps) to monitor and assess wildland fire risk."

The Canadian insurance industry has the rare opportunity to approach the peril of wildfire much differently than it has approached the hazards of water and wind, i.e. it has the chance to essentially start 'from the beginning.'

The industry can't turn the clocks back and start again on the underwriting of wind-related risk. And while it may wish it could do so with water losses, which have proven to become a problem, too much of that has flowed under the bridge.

However with just two major wildfire losses on the books in recent times and warnings of a future with more and larger wildfires in this country, now is the time to really consider the hazard, and endeavour to understand wildfire and the broader issues that inform wildfire risk, such as land/ forest management, the role of and interplay between governments of all levels, increasing development into the wildland/urban interface, and climate change, among them.

If the industry fails to do so now, it could very well find itself in position ten or twenty years out where stakeholders are sitting around a table talking about the wildfire insurance crisis in Canada and what to do about it.

Wildfires and their growing potential to devastate urban centres is an area of growing concern. It is a risk that has spread closer and closer to the urban interface in recent years.

These are some of the ideas that can be taken from the recent ICLR workshop on wildfire. The Institute remains committed to work with our member insurers and other partners to better understand and manage this threat.

Reducing damage to houses in storms

An evaluation of the performance of roof sheathing

By Gregory A. Kopp, Boundary Layer Wind Tunnel Laboratory, Faculty of Engineering, Western University

Our post-storm damage investigations have found that roof systems are vulnerable to

Roof damage as the result of a tornado in Saskatchewan.

extreme winds. Residential, wood-framed houses appear to be particularly vulnerable. Once a component fails, it can become wind-borne and impact a downwind structure, which, if it impacts a window or door, will cause it to fail. This leads to internal pressurization, which can cause further failures, particularly to the roof components and structure. Failures of the building envelope increase losses by allowing wind and rain into the building. It has been observed that the loss of a single sheet of plywood, can allow so much water into the house that the structure becomes an insurance write-off. Thus, keeping all building components intact, even those which may not be critical structurally, is important to mitigating overall losses.

One of the challenges is that sheathing is often observed to fail at wind speeds below those they are to be designed for. Several factors can contribute to this under-performance, such as (i) improper selection of materials, (ii) improper installation, (iii) degradation of materials due to aging or lack of

Sheathing failure caused by inadequate hold-down strength, likely missing nails or deteriorated materials, in Vaughan, Ontario.

durability within the intended life span, and (iv) potentially inappropriate prescriptive design standards which may over-estimate the capacity or under-estimate the load.

The team of researchers at the University of Western Ontario's Insurance Research Lab for Better Homes (IRLBH) recently conducted a detailed study to determine roof sheathing performance under wind loads experienced in severe wind storms. In order to assess the wind loads on roof sheathing, wind tunnel studies of more than 40 different houses were conducted at the Boundary Layer Wind Tunnel Laboratory (BLWTL). The key parameters effecting wind loads on houses

Photograph of the different nails used in the roof sheathing study. From left to right: twist-shank nail, HurriQuake® nail, adhesive coated ring-shank nail, another ring-shank nail, and a staple.

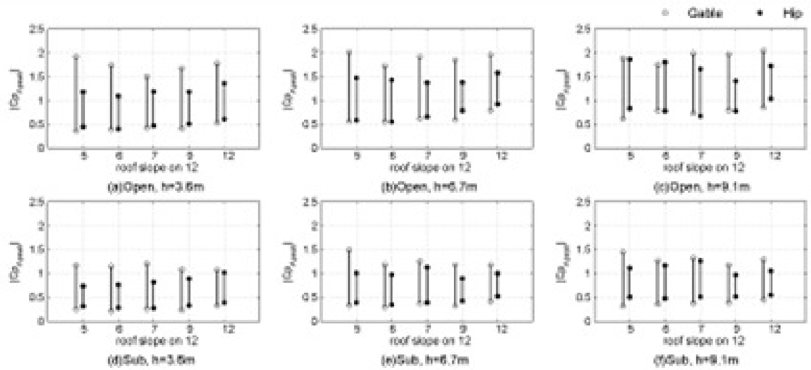
are the terrain and surroundings, number of storeys, roof shape, roof slope, and whether or not there is a large opening on the walls (caused by failure of a window or door). So, in our study we considered four different suburban neighbourhood housing patterns, houses with 1, 2 and 3 storeys, and the effects of gable and hip roofs with slopes varying from 4:12 to 12:12. To determine how well sheathing could withstand such loads, more than 200 full-scale tests of sheathing were conducted on a wide range of sheathing configurations. These included examining the effects of different types of nails, nailing patterns, missing ►

nails, and the use of plywood versus OSB. What follows gives a "flavour" of the results and a listing of the main conclusions; to obtain copies of the detailed studies, please contact the author.

Wind loads on sheathing

The main conclusions from our wind tunnel study are as follows:

1) Hip roofs generally tend to have less severe loads on roof sheathing than gable roofs. The reason for this is because the highest sheathing loads occur for winds parallel to the ridge near the gable ends. Hip roofs mitigate this to some extent, and their worst loads tend to occur on panels adjacent to the hips instead.
2) For hip roofs, the higher the house, the larger the wind loads on the sheathing. For gable roofs, the eave height does not matter as much.
3) Roof slope is not the critical parameter for wind loads on residential roof sheathing.
4) Surrounding houses in a suburban neighbourhood tend to reduce the wind loads substantially compared to the building code's "design case" for engineered structures, which is based on a single, isolated building in a flat, open terrain. There are two reasons for this: (i) reduced wind speeds caused by the rougher terrain (suburban terrain versus open terrain), and (ii) direct shielding effects. Thus, farm houses have greater vulnerability than houses backing onto large school yards with few trees in a suburban neighbourhood; but the houses adjacent to the school yard also have measurably greater vulnerability than do the houses embedded in typical suburban neighbourhoods.
5) The wind load provisions in building codes are generally adequate, though not perfect (particularly for gable roofs), for houses embedded within suburban neighbourhoods. However, they are not adequate for the case of isolated houses in flat, open terrain.

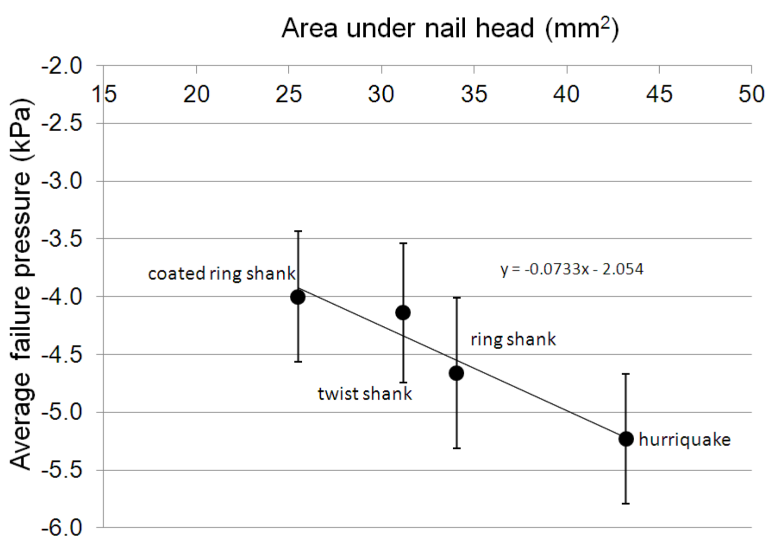


Range of peak pressure coefficients for all sheathing panels on a roof as a function of roof slope, upstream terrain and eaves height for single, isolated houses.

Response of sheathing to extreme wind loads

The main conclusions of our full-scale sheathing capacity study are as follows:

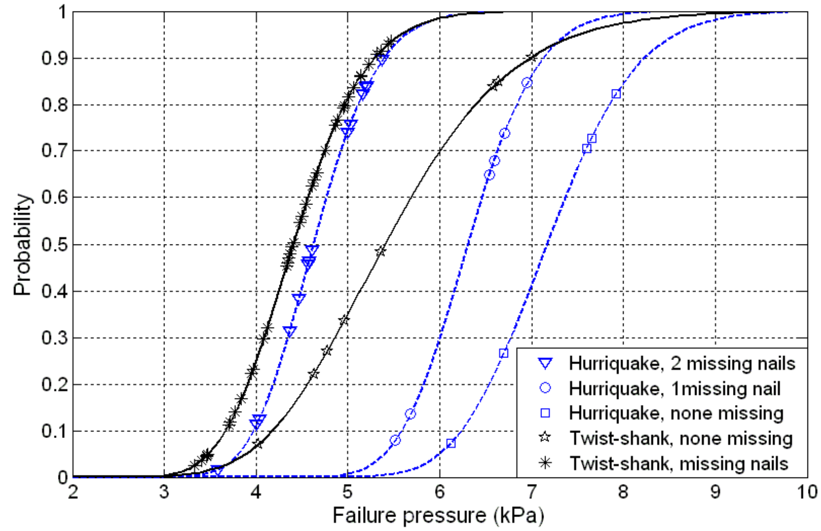
1) The nail head size (area of the head less the area of the shank) is a critical parameter for determining the capacity of the sheathing panel. Some gun-nails have clipped heads, like the "coated ring shank" nail in the current study. This reduces the capacity of such nails dramatically (see figure below). Increased nail head size leads directly to increased capacity suggesting that the capacity of some fasteners may be limited by the panel material strength without further increases in head size.
2) Plywood is observed to increase the capacities by 30 – 40% compared to OSB panels for both twisted shank nails (which fail predominantly by pull-out, i.e., the nail is the ►



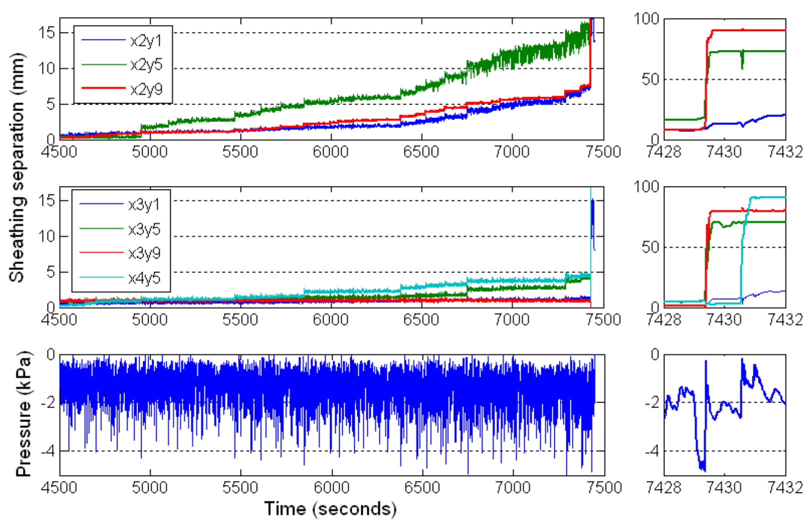
Average failure load for nailed OSB panels as a function of nail head area.

weak link) and the high capacity ring shank nails (which fail by pulling through the sheathing material, i.e., the panel material is the weak link).

3) Failure is always observed to originate at the weakest nail in the central portion of the panel where the tributary area is largest for each nail. For nails with the typical pattern, the spacing is six inches on the edge trusses and 12 inches for the interior trusses on the panel. Thus, for trusses on the normal spacing of two feet on centre, there are only nine nails in the interior of the panel, and it is these nails which are responsible for holding the panel in place for high wind uplift. However, there is a sharing of load from one nail to the adjacent ones as it slips so that the capacity of the panel is above that of the weakest nail (even when the weakest nail is a "missing" nail). Changing the nail pattern to "6/6" will double the capacity of the sheathing, adding a very minimal cost to the installation.
4) Missing nails obviously reduce the capacity of panels. However, the weakest panels fastened with twist shank nails have only a slightly higher capacity than panels with two missing twist shank nails. Missing HurriQuake® ring-shank nails have a larger effect on panel capacity, such that if two of these nails are missing, the capacity becomes very similar to panels fastened with twist shank nails that also have two missing. Thus, quality control is particularly important to enforce in order to gain the benefit offered by engineered ring shank nails.
5) Under fluctuating wind loads, the failure progression is due to the short duration (typically less than 0.5 seconds) peak pressures. For twist-shank nails, the failure progression is incremental, with nail displacements accumulating in slips of 1-2 mm at some fasteners for the damaging peaks. Once there is sufficient damage accumulation so that there is a failure at one fastener, failure of the entire panel follows relatively quickly. For nails with ring shanks, the failure mechanism is more sudden, although there is some damage accumulation at the weakest fasteners so that the largest peak pressures do not always lead to failure. Thus, storm duration plays a significant role in both types of failure progression, which is not accounted for in existing loss/risk models. ►



Cumulative distribution functions for plywood panels fastened with twist-shank and HurriQuake® nails under ramp loads, including nailing patterns with "missing" nails.



Incremental damage of sheathing fastened with twisted nails during a dynamic wind load test.

Heat wave

Vulnerability and risk reduction in a changing climate

By Dan Sandink, Manager, Resilient Communities and Research, ICLR

Extreme temperatures have been shown to result in increased incidences of mortality and morbidity, and cities across the world have been subject to extreme heat events that have resulted in perhaps 100s of thousands of deaths in the 21st century. Estimates of the number of deaths caused during the western European heat-wave of 2003 range from 25,000 to 70,000, with an estimated 15,000 deaths in France. A heat-wave in the U.S. in 1980 resulted in 5,000 to 10,000 deaths and a 1988 event in the U.S. resulted in 10,000 excess deaths. The Canadian Disaster Database reported six heat-event disasters in the country since 1900, all of which resulted in a number of deaths. The most severe of these events occurred in 1936, when 1,180 deaths occurred across the country. A 2009 heat event in Vancouver and the Fraser area resulted in 134 deaths. Some researchers have argued that heat-waves are the leading cause of death from natural hazards worldwide.

Under changing climate conditions, an increase in occurrence of death during the summer and a decrease in the winter are expected, with an overall net increase in deaths from temperature extremes. Even slight increases in temperatures can have significant impacts on heat-wave risk. In Europe, it has been estimated that for every 1°C increase in apparent temperature[1] above normal thresholds, cities in northern regions could experience a 3% increase in mortality, and cities in southern regions could experience a 2% increase in mortality. In Québec, there has been an estimate of an increase in mortality by 2% for every 1°C increase in apparent temperature.[2] Extreme temperature thresholds, above which mortality increases more dramatically, have also been identified. A temperature threshold of 36.5°C in Madrid, Spain has been reported; for every 1°C rise in temperature above this threshold, there is a rise in mortality of 28.4%.[3] To counteract these hazards and vulnerabilities, there have been attempts to mitigate the impacts of heat-wave impacts on vulnerable populations, through both "active" and "passive" risk reduction options.

Factors affecting vulnerability

Internal vulnerability factors

Generally, morbidity and mortality risk associated with heat-waves is dependent on age, race, sex, class, home characteristics, access to air conditioning, general health and living in an urban area. Vulnerability can be high for children, pregnant women, people of low socioeconomic status, those with chronic health conditions, including diabetes, mobility and cognitive constraints. However, older adults, for example those over the age of 65 or 75 years, are considered particularly vulnerable to the impacts of heat-waves. Indeed, individuals over the age of 65 comprised 72% of the deaths that resulted from the 1995 Chicago heat-wave. Factors that affect the vulnerability of older adults include a higher likelihood of pre-existing medical conditions (e.g., cardiovascular and respiratory illnesses) and limited mobility. Diabetes, heart failure and alcoholism have also been identified as risk factors for increased morbidity and mortality during heat-waves. Further vulnerability factors for the elderly include diminished perception, impairment of the thermoregulatory capacity, and reduced ability to detect changes in temperature. Social isolation is often identified as a significant risk factor, and is related to living alone, being single, widowed or divorced and not leaving home on a daily basis.

Physiological factors add to the vulnerability of elderly individuals. Adaptation to heat depends on the body's ability to cool itself through sweat production, increased cardiac output and redirection of blood flow to the skin. When environmental temperature exceeds core body temperature, sweat production is the primary means of losing heat. However, these responses can be inhibited in elderly people due to chronic illnesses or the impacts of diuretic and anti-cholinergic drugs. Further, limited heat tolerance in the elderly can be exacerbated by poor aerobic fitness and chronic health conditions. The side-effects of prescription and over-the-counter drugs may increase risk by affecting hydration status, electrolyte balance, haemodynamics, thermo-regulatory set point and alertness. Some drugs, such as anti-cholinergic drugs, can affect sweat production. Replenishment of fluids lost through perspiration and exhalation of breath is highly important for thermoregulatory compensation for high ambient temperatures. However, elderly individuals tend to have lower fluid intakes as they often exhibit a decreased sense of thirst.

External vulnerability factors

Acclimatization to higher temperatures due to the geography of a city externally affects the vulnerability of populations to high temperatures. Physiological adaptations may occur for populations living in warmer climates, and acclimatization in these ►

areas results in a requirement of higher temperatures to cause heat-related mortality. Timing of heat-waves can also affect risk. Populations are more vulnerable to heat-health impacts when heat-waves occur earlier in the warm season, such as in April or May, because they have not had the chance to acclimatize to hot weather over a summer season. Further, lower mortality during winter due to milder winter temperatures can increase the size of the at-risk population that will be prone to summer heat-waves, and the occurrence of a heat-wave after absence of heat-waves over several years can increase mortality considerably.

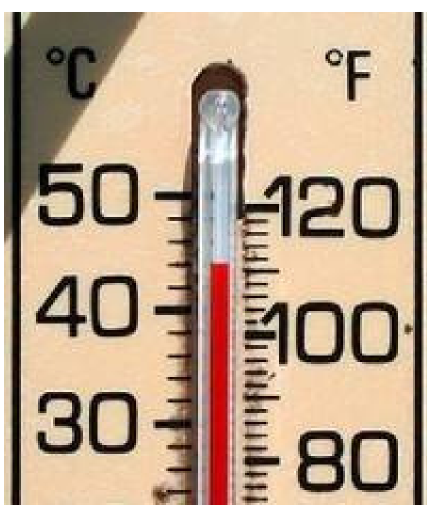
Individuals living in cities are at greater risk compared to rural residents, largely due to urban heat-island (UHI) effects. In highly urbanized areas, buildings and paved areas with low albedos absorb a greater amount of the sun's energy during the day and continue to emit long-wave radiation at night, increasing minimum temperatures. High night-time minimum temperatures can significantly exacerbate health effects during heat-waves as there is no relief for individuals suffering from heat-health impacts during the evening and following days will start with higher temperatures.

A further external vulnerability factor for extreme heat impacts is community experience with historical heat-wave events. It has frequently been discussed in hazard management literature that it is only through a prior experience with an extreme event that communities and people learn to adapt to the impacts of the events. In the case of heat-wave preparation, this phenomenon was observed by the proliferation of heat-wave risk reduction programs following the European heat-wave of 2003. A lack of experience can also affect adaptive behaviour in individuals, as personal experience can reduce "apathy, indifference, wishful thinking and denial," which can affect perceptions and behaviours related to personal hazard mitigation, and can socially reinforce concern related to hazards through friends, neighbours and community networks.[4]

Active and passive options for heat wave risk reduction

Active options

Mortality from heat events is largely preventable through relatively simple measures, including increasing fluid intake and accessing air conditioning. Active programs encourage these types of behaviours, and activate immediately before or during heat-wave events. Active options often take the form of heat-health warning systems, which are based on monitoring of weather systems to predict extreme heat and warning residents of upcoming periods of hot weather. These systems have been applied in many cities around the world, including Shanghai, Chicago, Philadelphia and Dayton, Ohio, among other cities. In Canada the Clean Air Partnership has reported that Toronto, Halton Region, the Town of Oakville, Peel Region, the Town of Markham, Hamilton, Kingston, London and Montréal



have implemented these types of programs. Interventions associated with these systems may include mass-media announcements, opening of cooling centres, home visits and other communication with vulnerable populations including home visits, and website issued bulletins. Common actions that are advised through active programs during heat-health alerts include avoiding the outdoors or sun, keeping hydrated, staying in or seeking out air conditioned environments, proper use of fans, avoiding overexertion, dressing appropriately, and checking on elderly or vulnerable neighbours.

Active mitigation options are applied at the local level. Indeed, it has been argued that these types of options should be tailored to suit specific local demographic, socioeconomic, political and economic circumstances. The need for local solutions is compounded by the difference between cities and the impact of these differences on health, including geography, climate, wealth and various other factors.

The importance of localized development of heat-risk reduction programs is augmented due to the fact that the temperature at which risk reduction plans must be activated vary depending on the geographical and climatological characteristics of individual cities, which can affect acclimatization. Further, threshold temperatures may also change over time due to demographic and socioeconomic shifts in communities. Thus, risk reduction plans should be adjusted regularly to ensure that they reflect the nature of the population within the city.

Passive options

There are many passive options that are available to mitigate the impacts of extreme heat. These measures are ►

especially valuable in dense urban areas to mitigate UHI impacts, and can also serve to increase health through access to nutritious food, increase physical activity and increase social engagement. Several passive measures are presented in table 1.

Table 1: Example of passive mitigation options[5]

Mitigation strategy	Measure	Outcomes
Building materials and design	Green roofs	Reduce heat-related illness, increase thermal comfort
	Increased albedo	Reduce heat-related illnesses and respiratory illnesses, increase thermal comfort
	LEED building compliance	Reduced heat-related illnesses
	Shade trees around buildings	Improve thermal comfort, reduce reliance on A/C
	Improved home insulation	Increase thermal comfort, reduce heat-related illnesses and respiratory disease
Land use change	Urban forestry	Outdoor cooling, thermal comfort, reduce heat-related illnesses, increase green spaces
	Pervious surfaces	Outdoor cooling through evaporation, improved thermal comfort, reduced heat-related illness, increased green space, Low Impact Development
	Community gardens	Improve nutrition, increase exercise, reduce 'lifestyle' diseases, increase community engagement
Transportation systems	Improve public transit	Increase exercise, reduce heat-related illness and respiratory illnesses, increase community engagement
	Pedestrian, bike friendly transit	Increase exercise, reduce heat-related illness and respiratory illnesses, increase community engagement
Other approaches	Reduce waste heat	Cooler ambient temperatures, reduced heat-wave events
	Community design to promote social interaction	Reduce isolation for vulnerable elderly, reduce mortality risk during heat events

Green roofs are a measure that can be applied to reduce ambient temperatures in urban areas. When used throughout an urban area, green roofs can reduce localized air temperatures and can provide cooling capacity within buildings. Increasing albedo, or the reflective properties of surfaces, can help reduce UHI effects and cool buildings. Man-made materials have a much higher heat-capacity than natural surface covers, including earth and plants, and are more able to absorb, store and re-emit heat throughout the day. Use of highly reflective building materials is an option to increase albedo of urban surfaces, and can reduce ambient air temperature by 1-3.5°C. Reflective materials can also be integrated relatively inexpensively over time, through their incorporation in routine maintenance of buildings and other urban surfaces. The impact of the use of highly reflective materials has been explored in Los Angeles, California, where use of such materials can reduce average temperatures by 1.5°C and by as much as 3°C when combined with other strategies, such as urban forestry.

A further straight-forward means of reducing heat impacts is improving insulation in homes, which can both help to keep buildings cool in the summer and warmer in the winter. Leadership in Energy and Environmental Design (LEED) building practices provide opportunities for mitigating the UHI. LEED design includes various factors, including high-albedo and green roofs that can serve to mitigate UHI impacts.

Urban forestry, which includes preservation and restoration of trees, is a further option that can reduce the UHI. Trees can shade urban surfaces and through evapotranspiration can dissipate energy that would otherwise be absorbed into surfaces and increased canopy cover can reduce air temperatures by 1-3°C. Further, increasing vegetation through urban forestry and green roofs can also reduce ground-level ozone, reduce reliance on air conditioning and provide a range of additional social and ecological benefits. Pervious surfaces, which serve to absorb stormwater rather than shed it into stormwater management facilities like storm sewer systems, serve multiple purposes including lowering air temperature levels through evaporation of water. Pervious surfaces, which often take the form of vegetated ground cover, can also increase urban surface albedo.

Reduction of waste heat from industrial processes, automotive sources, buildings and air conditioning has also been identified as a means of mitigating UHI. For example, a study by Ohashi *et al*. (2007) in Tokyo, Japan found that waste heat generation by air conditioners increased local temperatures by 1-2ºC. Efficient building design and improved public transportation systems can assist in reducing waste heat in urban areas. The placing of shade trees around buildings can significantly reduce reliance on air conditioning, and can offset cooling costs by 25-80% in some circumstances.

Improved public transportation systems have been cited as long-term means of reducing the impact of heat-wave events. Aside from reducing waste heat by decreasing vehicle use, public transit that supports pedestrianism can increase physical activity which may contribute to reduction of chronic diseases like diabetes. Improved public transit also reduces pollutants, including particulate matter. Similar outcomes can result from promoting pedestrian and bike-friendly transit; however this approach may also increase social contact. Similarly, community gardens provide opportunities to increase long-term health through increased nutrition and exercise, which may decrease rates of lifestyle diseases like diabetes and can also increase social contact. ►

Active vs. passive measures: Which is more effective in reducing vulnerability?

The ability of active and passive options to address various vulnerability factors is outlined in table 2. In comparison to passive options, active options may not be as effective in reducing underlying factors that result in vulnerability, especially when long time-frames and external vulnerability factors are considered.

Table 2: Vulnerability addressed by risk reduction measures

Vulnerability type		Mitigation type	
		Active	Passive
Internal	Drug effects	Addressed through warnings (+)	Not addressed (-)
	Social isolation	Visits to vulnerable populations (*)	Increased community engagement/contact (+)
	SES	Not addressed (-)	Housing conditions, community design addressed (*)
	Access to A/C, cooling	Short-term access to cooling centres (*)	Reduced ambient temperatures, reduced need for A/C (+)
	Housing	Not addressed (-)	Addressed (+)
	Access to transportation	Short-term access to cooling centres (*)	Improved public transit (+)
	Pre-existing conditions, chronic disease, fitness, dependency	Not addressed (-)	Addressed through improved public transit, community gardens (+)
External	Acclimatization	Not addressed (-)	Reduced ambient temperatures (*)
	UHI	Not addressed (-)	Addressed (+)
	Community design	Not addressed (-)	Addressed (+)

(-) indicates that factor is not addressed, (+) indicates that factor is addressed, (*) indicates that factor is partially addressed.

Some active programs provide information on the impacts of drugs in inhibiting physiological responses to heat events, a factor that is not addressed through passive programs. Further, active programs often include visits to or contact with vulnerable populations during or immediately before heat events. The experience of residents during the 1995 Chicago heat-wave, where those who were contacted by city social services staff and educated about heat-wave risks had lower risks of mortality, indicates that short-term social contact can reduce risk. Increased incidence of listening to the radio and reading newspapers to educate oneself about heat risks was also associated with reduced mortality risk in Chicago in 1995. However, social isolation is addressed through passive programs that include urban design that increases social interaction and community gardens. Developing social capital in this manner would not require active deployment of staff and volunteers during heat-wave events, and this approach is more in-line with proactive disaster mitigation, rather than emergency response.

Socioeconomics are also not addressed through response-oriented active options. While socioeconomics are not directly addressed through passive programs, factors associated with low socioeconomics, such as community design that increases the UHI and poor housing conditions, are addressed through passive programs. Though active programs are often designed to increase access to air conditioning, access is generally provided only over a short time period through cooling centres. Further, as discussed above, some aspects of air conditioning, including inhibiting physiological adaptations to heat and generating excess waste heat may exacerbate vulnerability. Passive programs can permanently reduce ambient temperatures and include building measures that reduce reliance on air conditioning. Further, while housing issues (e.g., insulation, passive cooling) are not addressed in response-oriented active options, a number of passive options address these issues, including LEED design, increased albedo and improved insulation.

Active programs generally include improved public transportation during heat-wave events (e.g., transportation directly to cooling centres), however passive programs may include permanent improvements in transit. Improving public transit has additional benefits, especially in the case of promotion of transit that includes pedestrianism and cycling, as these measures can increase physical activity and help reduce prevalence of health factors, such as chronic disease, that increase vulnerability to heat-wave events. In comparison, long-term health and chronic diseases are not addressed through active programs.

Conclusion

Heat-waves are a significant cause of death and morbidity across the world, and the impacts of heat-events are likely to increase due to changing frequency, severity and intensity of heat-waves caused by climate change. The importance of addressing vulnerability for summer-time high temperatures will be exacerbated by the fact that more vulnerable individuals are likely to survive milder winter temperatures and be exposed to high summer temperatures.

Passive programs, because they are long-term and have a strong proactive mitigation/prevention orientation, are designed to address the root causes of internal and external vulnerability. The effectiveness of passive programs is augmented by their multiple additional benefits—all of which will be required for both mitigation of climate change and adaptation to inevitable impacts of climate change. For these reasons, passive options are being applied throughout Canada and North America, often without ►

Swiss Re's sigma on natural catastrophes and man-made disasters in 2011 unveils USD 116 billion in insured losses and record economic losses of USD 370 billion

- Last year saw the highest economic losses in history, at USD 370 billion
- The insurance industry weathered 2011 soundly despite experiencing the second-largest insured losses ever, at USD 116 billion
- 2011 also brought the highest insured earthquake losses, at USD 49 billion
- Flooding in Thailand resulted in the highest insured losses ever for a single flood event, at USD 12 billion

Swiss Re's latest *sigma* study reveals unprecedented economic losses of USD 370 billion from natural catastrophes and man-made disasters in 2011. Despite immense insured losses of USD 116 billion (a 142% increase over the previous year) arising from record earthquake and flood losses, Swiss Re said in a release March 28 that "the insurance industry weathered the year well and played a key role in risk management and post-disaster recovery financing."

Highest ever recorded economic losses

In 2011, total economic losses to society due to disasters (both insured and uninsured) reached an estimated USD 370 billion, compared to USD 226 billion in 2010. The earthquake in Japan, the largest known in terms of magnitude to have ever hit the country, accounted for 57% of 2011's economic losses. Altogether, natural catastrophe insured losses came to around USD 110 billion, while losses from man-made disasters were around USD 6 billion, making 2011 the second-highest catastrophe loss year ever for the insurance industry.

Kurt Karl, Swiss Re's Chief Economist, said: "Last year saw extraordinary and devastating catastrophic events. The earthquakes in Japan, New Zealand, and Turkey, as well as the floods in Australia and Thailand, were unprecedented and brought not only massive destruction but also the loss of thousands of people's lives. Yet two-thirds of the staggering USD 370 billion in economic damage will be shouldered by corporations, governments, relief organizations, and ultimately individuals, pointing to the still widespread lack of insurance protection worldwide."

Record-breaking earthquake insured claims

Due to the extreme magnitude of the event (Mw 9.0), the 2011 Japan earthquake cost the insurance industry an estimated USD 35 billion, making it the most expensive earthquake on record. "Because Japan's earthquake insurance protection is very low, particularly for commercial properties, the insurance industry will bear only 17% of the total losses. ►

Heat wave *cont*...

express purpose of mitigating heat-health risk, but for their multiple benefits. However, the main weaknesses of passive options are their costs and the long-time frame required for implementation. Thus, active programs have been implemented to fill that heat-health risk reduction gap. From an emergency management perspective, it is important that communities do not rely exclusively on heat-health warning systems and rather work to implement long-term passive systems in combination with active systems.

Notes

1) Apparent temperature measures relative discomfort due to combined temperature and humidity.
2) Doyon, B., Belanger, D., & Gosselin, P. (2008). The potential impact of climate change on annual and seasonal mortality for three cities in Quebec, Canada. *International Journal of Health Geographics, 7,* 23.
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Swiss Re's sigma on natural catastrophes *cont*...

Had Japan been more fully insured, 2011 would certainly have been the most expensive year ever also in terms of insured losses," says Lucia Bevere, Swiss Re Senior Catastrophe Data Analyst and co-author of the study. In New Zealand, where earthquake insurance penetration is high, particularly for residential properties, the February earthquake (Mw 6.3) – the third most expensive in history – triggered further insurance claims of USD 12 billion, covering 80% of economic losses.

Unprecedentedly high flood losses

The floods in Australia, the country's worst natural disaster ever in terms of losses, triggered insured claims of over USD 2 billion. However, at USD 12 billion, insured claims from the flood in Thailand are the highest ever recorded for a river water flood event. "Flood losses can be just as tremendous as earthquake and storm losses. The flooding in Thailand is a painful reminder that, given the high risk of flooding in many countries, other parts of the globe could be prone to similar or even bigger losses," says Jens Mehlhorn, Head of Flood Perils at Swiss Re and co-author of the study.

Mild hurricane season caps high U.S. insured losses

In addition to earthquakes and floods, an unparalleled tornado season in the U.S. caused insured catastrophe losses of over USD 25 billion. "Despite the exceptional tornadoes and Hurricane Irene, a relatively moderate hurricane season kept overall insured losses in the US lower than the record year of 2005, the year in which hurricanes Katrina, Wilma and Rita contributed the lion's share of that year's total global claims of USD 123 billion," adds Bevere.

The insurance industry weathered the events well

The insurance industry proved highly effective in weathering the extreme events of 2011. Despite historic losses and a challenging financial environment, the industry played a key role in post-disaster recovery financing, bringing much-needed funds to affected populations, businesses, and governments. The events, however, revealed increasing risk accumulation, particularly in emerging markets. "To support the industry going forward, Swiss Re will enhance its CatNet® information system by including more detailed river flood hazard zones. The update, to be released in spring 2012, will enable underwriters and risk managers to more accurately assess flood risks on a global level," adds Mehlhorn.

Reducing damage to houses in storms *cont*...

Final comments

To date, we have completed the wind tunnel tests to determine the wind loads on sheathing and the full-scale tests to determine capacities. We are currently working to merge these results in order to develop prescriptive recommendations which can be applied to all houses, considering the varying design wind speeds in the different regions of the country. In addition to this, we are developing recommendations for "above code" practices for regions with tornado risk, like in the prairie provinces and southern Ontario. Our preliminary calculations indicate that roof sheathing will be able to withstand tornadoes with a strength of EF-2 on the Enhanced Fujita Scale, such as those that occurred in Vaughan, Ontario in August 2009. The cost of this is only slightly heavier sheathing, ring shank nails (such as the HurriQuake® nails examined here) rather than common nails or twist-shank nails, and a slightly higher number of nails on each panel, going to the 6/6 spacing instead of the currently used 6/12 spacing.

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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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