INSURANCE INSTITUTE FOR BUSINESS & HOME SAFETY'S

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MUCH MORE THAN A GRAND OPENING

WIND TEST DEMO REVEALS NEW FAILURE MODE - PAGE 4

Insurance Institute for Business & Home Safety

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Disaster Safety Review is published by the Insurance Institute for Business & Home Safety (IBHS) to further its mission to conduct objective, scientific research to identify and promote effective actions that strengthen homes, businesses, and communities against natural disasters and other causes of loss. Statements of fact and opinion contained in articles written by authors outside IBHS are their responsibility and do not necessarily reflect the opinion of IBHS or IBHS membership.

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President's Letter

By Julie Rochman
IBHS President and Chief Executive Officer

This issue of Disaster Safety Review (DSR) stands apart from all of its predecessors in two important ways. One is that, for the first time, DSR comprises a collection of articles entirely devoted to ongoing building science being conducted at IBHS' new Research Center in Chester County, S.C. More on the second "first" toward the bottom of this letter…

Research Center laboratory commissioning is nearly complete, with flow validation and pressure validation studies well underway. IBHS scientists Drs. Zhuzhao Liu and Tanya Brown are at the center of this work, which will be fully described in two scientific journal articles to be published shortly. These papers are part of IBHS work to establish Research Center bona fides among the world-wide wind research community. An excerpt of the articles is included in this issue.

It is critical that built environment stakeholders recognize our ability to meticulously recreate a variety of natural weather events and environments in our massive, unique laboratory. Broad acceptance of IBHS lab methods and protocols is critical to our success, as we seek to influence the behavior of third parties, virtually all of whom have significant financial investments on the line, and some of whom have conflicting agendas. IBHS must be seen as a highly credible, independent, objective evaluator of products and systems. And we will be just that. That is because, at IBHS, we never answer a research question before we ask it. We will carefully design and record our experiments, conduct accurate, thorough analyses of test data, and provide clear, complete reports of our findings to key audiences.

Another essential attribute of solid science is transparency. To that end, this edition of DSR contains an article by IBHS Director of Research Dr. Anne Cope that addresses our approach to wildfire testing (which is now operational, thanks to a cooperative agreement with the Savannah River National Laboratory, U.S. Department of Homeland Security, and the U.S. Forest Service); and another by Dr. Brown explaining our approach to hail testing – something that, as someone who grew up in the Midwest, I'm particularly interested in and fascinated by.

Lest DSR readers think that the lab is all merely potential at this point, a second article by IBHS Chief Engineer and Senior Vice President for Research Dr. Tim Reinhold in this edition spotlights a very important finding that arose out of the wind demonstration tests we ran during the Research Center dedication and public opening this past October.

As scientific findings are generated by the IBHS Research Center, we will aggressively promote the findings to consumers, public policymakers and the business community. We will do this to spark action among those who design, finance, regulate, build, and maintain/rebuild structures, so that they do more to incorporate effective methods of property loss mitigation into their own work, and so that they can be made aware of products and systems that either are ineffective with respect to property loss prevention, or actually may increase losses. Debra Ballen, IBHS General Counsel and Senior Vice President for Public Policy authored a piece for this DSR in which she focuses on the specifics of translating lab data into sound public policy.

…and now for the second "first" that this DSR represents: it is being published under our new name.

Long-time members and others who have followed IBHS over past decades may note that the organization's name has changed a few times since our founding over 35 years ago. Originally, the organization was called the National Committee for Property Insurance. Several years later, we became the Insurance Institute for Property Loss Reduction. And about a decade ago, we transitioned to the Institute for Business & Home Safety. Each of these name changes occurred for good reasons that made perfect sense at the time. Now, it makes perfect sense to change the organizational name once more.

In part to meet our desire for full transparency, and in part to give proper credit to the insurance industry for their spectacular efforts to bring the Research Center to life, going forward, we will be known as the Insurance Institute for Business & Home Safety. For the sake of continuity, ease, and so that we do not squander the brand equity previously attached to our name, the Institute will continue to use and be known more casually by the acronym IBHS. The "I" will just have that much more meaning and importance.

The Insurance Institute for Business & Home Safety remains dedicated to making the built environment a much safer, stronger place for people and communities everywhere. In this and future issues of DSR, you will be able to join us on an incredible journey down a scientific path that will add significantly to what is already known about how best to build and retrofit residential and commercial structures.

All of us at IBHS are immensely proud of our insurance industry affiliation, and very pleased that "Insurance" is now at the front of our name. We will work hard every day to ensure that our members and partner organizations are equally proud of their affiliation with us in 2011 and beyond.

Much More than a Grand Opening

By Timothy A. Reinhold, Ph.D., P.E.,
IBHS Senior Vice President for Research
and Chief Engineer

In the months and years leading up to its construction and opening, supporters of the IBHS Research Center spent countless hours discussing the potential. Visually compelling videos to support stronger building practices, unmatched real-world demonstrations of full-scale structural performance, and unlimited potential for creating cutting-edge building science research were some of the main themes of those discussions. Yet, it's safe to say few people, if anyone, expected that a meaningful scientific finding would emerge from five simple "demonstration" events of the wind capabilities for supporters of the lab and the national media in the fall of 2010.

Even more unexpected, but clearly in keeping with the IBHS message that safe construction can be affordable, was the solution to this newly discovered structural failure mode: $20 and a little manual labor. To understand how IBHS engineers arrived at the low-cost solution that will make a big difference in how houses perform against windstorms, it is important to walk through each of the high-wind demonstrations and the types of structural performance issues encountered in the two houses studied: one built to conventional Midwestern construction standards and the other to the IBHS FORTIFIED for Safer Living® Midwest standard.

TEST HOUSES

The IBHS Research Center's specimen construction manager spent two days in the Bloomington, Ill., area before the fall events visiting construction sites and documenting typical wood frame construction practices. IBHS previously worked with partners in Bloomington to develop plans for several affordable FORTIFIED for Safer Living® houses built there. Those plans followed the typical high wind design guidance available in prescriptive design documents.

These affordable houses had a small enough footprint (20 ft. by 30 ft.) to allow two replicas of the two-story main building (the actual houses included a side garage and basement) to be installed side by side on the IBHS Research Center's turntable. Close attention was paid to the structural framing in an effort to ensure both houses used platform framing, similar to what was observed in the Bloomington area. Straps were added to the FORTIFIED house to provide a continuous load path, using metal strapping from the roof to the second floor, between the second and first floors, and from the first floor to the foundation.

Additional differences between the conventional and FORTIFIED houses included:

- use of ring-shank nails to attach the roof and wall sheathing on the FORTIFIED house, instead of the staples typically used in conventional Midwestern construction;

- installation of a sealed roof deck (4 inch-wide ice and water shield self-adhesive strips) over the seams between the roof sheathing;

- installation of high-wind rated shingles on the FORTIFIED house, versus an unrated three-tab shingle on the conventional house;

- installation of a high-wind rated vinyl siding product on the FORTIFIED house versus a typical unrated vinyl siding product on the conventional house; and,

- changing the entry doors from in-swing on the conventional house to out-swing on the FORTIFIED house.

Both houses had windows with a design pressure rating in excess of 35 pounds per square foot, the same soffit and flashing materials, and wood frame first floor and second floor systems. The only interior finishing completed was the installation of gypsum wall-board to provide a ceiling below the roof trusses. IBHS engineering calculations suggested the connection of the roof structure to the walls was weak enough on the conventional house that the entire roof structure might lift off the walls, if a large window or door failed by breaking or being forced open by the winds and internal pressurization occurred. Consequently, the ceiling material was added to provide a more realistic surface for the internal pressure to act on.

Both houses were built on top of steel beams, which provided connection points for the anchor bolts typically used to attach the sole plate to the top of the foundation or basement wall, and a rigid base, which could be used to lift and move the houses with the IBHS custom-built moving system. From the sole plate up, the buildings were replicas of conventional and FORTIFIED residential wood frame houses being built in the middle of the United States.

Table 1: Estimated and Actual Repair Costs

Source of Repair	Conventional House	FORTIFIED House	Difference	Ratio
Company 1	$6,915	$2,975	$3,940	> 2:1
Company 2	$5,690	$745	$4,945	8:1
Company 3	$5,660	$1,736	$3,924	> 3:1

CONSTRUCTION MATERIALS AND COSTS

IBHS is material agnostic, as long as the material or product performs well; also, the organization does not yet have its own test protocols for evaluating specific types of products. In order to avoid competition between materials or manufacturers, IBHS chose to use unrated and high wind-rated vinyl siding from the same manufacturer on both test houses. Similarly, IBHS obtained unrated and high wind-rated composition asphalt shingles from the same manufacturer. The intended point was to illustrate, if the data supported it, that paying a little bit more for a wind-rated product could make a difference in the performance of siding and roof cover in high wind conditions.

Initially, IBHS had a local builder construct one FORTIFIED house and two conventional houses. The bid to construct the FORTIFIED house was $3,000 more than that to build one of the conventional houses. When the first demonstration test resulted in complete destruction of the conventional house, IBHS commissioned construction of two additional conventional houses and one additional FORTIFIED house. This time, the bid price for the FORTIFIED house was about $5,000 higher than the cost of one conventional house. Assuming a per square foot cost of $100, the incremental cost to build the FORTIFIED house was between 2.3 percent and 3.8 percent of the total cost of the house.

TEST DEMONSTRATION SCENARIOS

In the first four demonstrations, the two test houses were installed side by side in the lab's large test chamber on a 55-foot turntable, and were simultaneously exposed to the same wind conditions. During the course of multiple tests, several different failure modes were observed for the conventional building and a structural system-related weakness was discovered in the standard high wind design and construction guidance.

The plan for each demonstration called for initially exposing both houses to winds typical of severe thunderstorms and nor'easters. Damage would be observed, and then wind speeds would be increased in an attempt to induce structural failures and explore whether there were significant safety margins in the construction.

Maximum frontal system winds typically do not exceed 80+ mph gusts at a height of 33 feet, and maximum gust wind speeds in severe thunderstorms typically will not exceed 100 mph, unless a microburst or tornado is spawned. Consequently, these initial wind simulations were based on actual field records; however, top wind speeds were scaled up towards these maximum expected speeds. Following the thunderstorm and frontal wind scenarios, wind records gathered during Hurricane Ike in Texas in 2008 were used to create a scenario to keep increasing the top gusts towards the maximum capacity of the facility.

> **"The entire structure was reduced to a pile of rubble in less than four seconds."**

FIRST DEMONSTRATION

During the thunderstorm and frontal wind scenarios, both buildings experienced some damage to flashing and soffit materials, and the conventionally constructed house experienced damage to siding and shingles. As wind speeds were increased using the Hurricane Ike records, the front door of the conventional house suddenly blew open (with wind speeds at about 100 mph) allowing wind pressure to build up inside the house. The entire structure was reduced to a pile of rubble in less than four seconds. Because the FORTIFIED house had an outward opening door, it did not blow open, and consequently, was never exposed to the same buildup of internal pressure experienced by the conventional house.

During review of video captured during the collapse of the conventional house, IBHS staff noted that when the front entry door blew in, the front wall broke loose at it base and the side walls appeared to balloon out. This raised questions about how well the side walls were attached to the second floor system. However, IBHS engineers decided against making a modification to the FORTIFIED house at that time in order to keep its strapping consistent with typical high wind prescriptive solutions. The original FORTIFIED house was repaired and a second FORTIFIED house was built along with a new conventionally constructed house.

SECOND DEMONSTRATION

For the second demonstration, a newly constructed conventional house was used alongside the repaired FORTIFIED house. The event proceeded very much like the first one, with the thunderstorm and frontal winds causing damage to flashing and soffit materials on both houses and extensive roof cover and siding damage to the conventional house. A few shingles also were lost from the FORTIFIED house during this event.

The difference in this demonstration occurred during the scenario where increased wind gusts were applied to the houses. The door on the front of the conventional house blew open and the side door blew out. This relieved the buildup of internal pressures in the conventional house. An inspection of the side door installation showed that the builder had tacked the frame in place using finishing nails on the fascia, but had never come back and properly blocked and anchored the door frame to the wall framing. Testing was stopped, due in part to time constraints and the fact that IBHS could not apply high internal pressures until the door was replaced.

Both houses were then evaluated for damage by claims adjusters trained in post-catastrophe loss estimation from two different IBHS member insurance companies. One was from a single–state insurer, and the other from a national carrier. The adjusters provided estimates of repair costs using their respective systems.

The repair estimates from the two insurance companies, along with repair costs supplied by the contractor, are listed in **Table 1** on **page 5**. The estimates and actual repair costs show the additional damage to the siding, fascia, soffits and roofing experienced by the conventional house from this single event were about equal to the cost of the upgrades for the FORTIFIED house.

Note: The houses were not finished on the interior and rain was not simulated during the high-wind tests. Had they been finished, the amount of interior damage to the conventional house would have added substantially to repair costs, while damage and repairs to the FORTIFIED house likely would have been only slightly higher.

THIRD DEMONSTRATION

The third demonstration took place in front of a national media audience. It involved the same FORTIFIED house used in the two previous demonstrations and a new conventional house commissioned after the first demonstration test that had not been exposed to a previous wind event.

As part of event preparations, IBHS brought in a building official from the Midwest to verify that construction of the conventional house was in keeping with real-world standards witnessed at construction sites in his area of expertise.

When the houses were subjected to the thunderstorm and frontal system winds, similar levels of damage were again observed to flashing and soffits on both buildings, and siding was lost from the conventional house. This time, the doors were so tightly blocked around their frames that the front door of the conventional house did not blow open. Consequently, the test with increasing wind speeds was completed without causing structural damage.

In a change from the two prior demonstrations, IBHS staff elected to block open the front doors to both houses and the test with increasing gust wind speeds was repeated. When the first gust wind speed of 96 mph was generated, the conventional house came apart following essentially the identical failure mode observed in the first demonstration (i.e., failure of the first floor at the base).

NEW FAILURE MODE IDENTIFIED

The FORTIFIED house remained standing after the third demonstration. However, a close examination of the FORTIFIED house did indicate the initiation of structural damage as the side and back walls began to pull away from the second floor framing. Along the sides, the walls pulled away from the floor beams by about ¾ inch. Had the test continued longer and the wind speed been a bit higher, the floor system would have disengaged from the walls and the second floor would have fallen towards the first floor.

This was, in fact, a manifestation of one of the failure modes suggested from close scrutiny of the video from the first demonstration event. Fortunately, the solution proved both relatively easy and inexpensive. IBHS staff used about $20 worth of standard twist straps and coil strapping available at a local home improvement store to tie the walls back into the floor system.

In addition to the $20 in supplies, fixing the damaged FORTIFIED house required jacking up the second floor framing system in order to push the walls back into alignment and removal of the vinyl siding around the joint between the first floor wall and the second floor framing.

The actual addition of the straps was relatively easy, as the contractor used a reciprocating saw to create a slot where the strap was slipped between the top of the first floor wall and the second floor rim joist. The end of the twist strap was pushed through the slot so that it protruded about 5 inches beyond the wall sheathing. The end was then bent down over the sheathing and it was face nailed through the sheathing into the double top plate at the top of the first floor wall.

These straps were installed about every four feet along the side walls, and the end inside the house was nailed to the side of an adjacent floor joist. Along the side walls, the floor joists run perpendicular to the wall. Along the back wall, the floor joists run parallel to the wall. Consequently, it was necessary to add blocking along the back wall

"The Research Center clearly has the potential to be a game changer, because it provides a tool that has never existed. It allows the insurance industry to help drive changes that will effectively strengthen homes and businesses to improve resilience against a variety of natural hazards."

$20 worth of standard twist straps and coil strapping from a local hardware store were used to correct a new failure mode identified during the wind test demonstrations.

between the rim joist and the next floor joist. A long straight strap or a piece of coil strapping was then inserted through a slot between the top of the first floor wall and the rim joist, so that it extended about 5 inches and the inside portion of the strap was long enough to run along the bottom of the blocking and wrap up the side of the second floor joist.

The short portion of the strap extending through the wall was bent down and face nailed through the sheathing into the double top plate. The inside portion of the strap was face nailed to the bottom of the blocking and the end was bent up and nailed to the side of the second floor joist. These blocks and straps were installed every 4 feet along the back wall of the FORTIFIED house. Siding had not yet been installed on the second FORTIFIED house, which had not yet been tested, and this made it easier to repeat this installation of blocking and strapping on that house.

FOURTH DEMONSTRATION

The fourth demonstration involved the repaired conventionally constructed house from the second demonstration and the original FORTIFIED house, which had been used in all of the previous demonstrations. The only change to the FORTIFIED house was the addition of the strapping described above.

In this demonstration, the front door of the conventional house blew open fairly early in the test sequence. Then, at a gust wind speed of about 95 mph, the entire roof structure began to lift off of the top of the second story walls. As it lifted up, the wind caught the roof even more and accelerated it up and back from the house. The second story walls began oscillating back and forth as the wind continued to blow and within a few minutes the entire structure came apart and ended up as a pile of debris. While it is possible the roof-to-wall connection was weakened during the second demonstration event, this performance demonstrates that, for a house of this size with its relatively short roof span, there are a number of connections that are weak and any one of them could lead to significant structural damage and possible collapse.

FIFTH DEMONSTRATION

With the four grand opening events completed and two FORTIFIED houses still standing, IBHS decided to push the performance limits of the retrofitted FORTIFIED house and expose it to a variety of wind conditions. For these tests, the FORTIFIED house was moved to the center of the turntable to allow it to be easily rotated to expose the house to winds from different directions.With a single house on the turntable, it was possible to increase the maximum test speed by about 10 percent (which would increase the wind loads by about 20 percent). The first test was conducted with the house in the same orientation used when the two houses were tested together: with the front door facing the fan array. However, the front door was blocked open while all other doors and windows were closed, and the wind speed was increased so that gusts as strong as 115 mph were applied to the house. Despite the pressurization, there was no movement of the exterior walls where they attached to the second floor framing.

The house was then rotated so that its wide face was oriented perpendicular to the wind. The door on that side was opened and all of the other doors and windows were closed. Again, no structural damage occurred.
In the final scenario, the house was rotated so that the back faced into the wind. The back door was opened and all other doors and windows were closed, pressurizing the house for a third time that day. At the top speed, the large window on the front of the house (now oriented downstream) and its frame dislodged from the wood frame house. Close inspection showed that fasteners anchoring the window frame flange to the wall were either missing or hit a joint between the framing and blocking added to align the window in the rough opening. No other structural damage was observed.

LEARNING FROM THE EXPERIENCE

There has been much discussion about the structural performance and features of the test houses since the demonstration. This is only the start of what IBHS expects to be long and productive conversations about incremental changes that can lead to increased resilience of houses and businesses.

For example, IBHS has long recommended that, wherever possible, entry doors should be designed to open outward in high wind areas as a means of reducing water intrusion. Why? Wind-driven rain leaks in around doors when they face into the wind. Under these conditions, an outward opening door is pushed against its door jamb and any weather stripping. Consequently, it tends to seal better as the wind blows harder. In contrast, an inward opening door is pushed away from the weather stripping and will become even more susceptible to leaks as wind speed increases.

In the case of the test houses, however, it's important to emphasize that simply switching the direction the door opens does not solve all possible pressure build-up problems. The failure could just as easily have been a large broken window on the windward face that allowed wind pressure to enter the building.

It is also important to avoid allowing any outcomes of the demonstrations to reinforce myths that are associated with natural disasters. The lack of structural failure in the second demonstration, when the side door immediately blew open, revived talk about the myth that houseowners should open windows on the leeward side of the house as a means of trying to save a house in a tornado. This is not recommended by IBHS or the National Weather Service. Why? Primarily because it is difficult to know where the leeward side will be as wind directions change rapidly. Equally important is the fact that people are at greater risk as they move around opening and closing windows while the storm passes by, because they would be directly next to glass that may break and cause serious injuries. Finally, an open window allows wind and water to enter the structure and cause damage to the interior finishes, furniture and personal property. In a severe wind storm (including a tornado), people should find the safest place in the building where they can take shelter and do as much as possible to protect themselves in that area.

APPLYING WHAT IS LEARNED

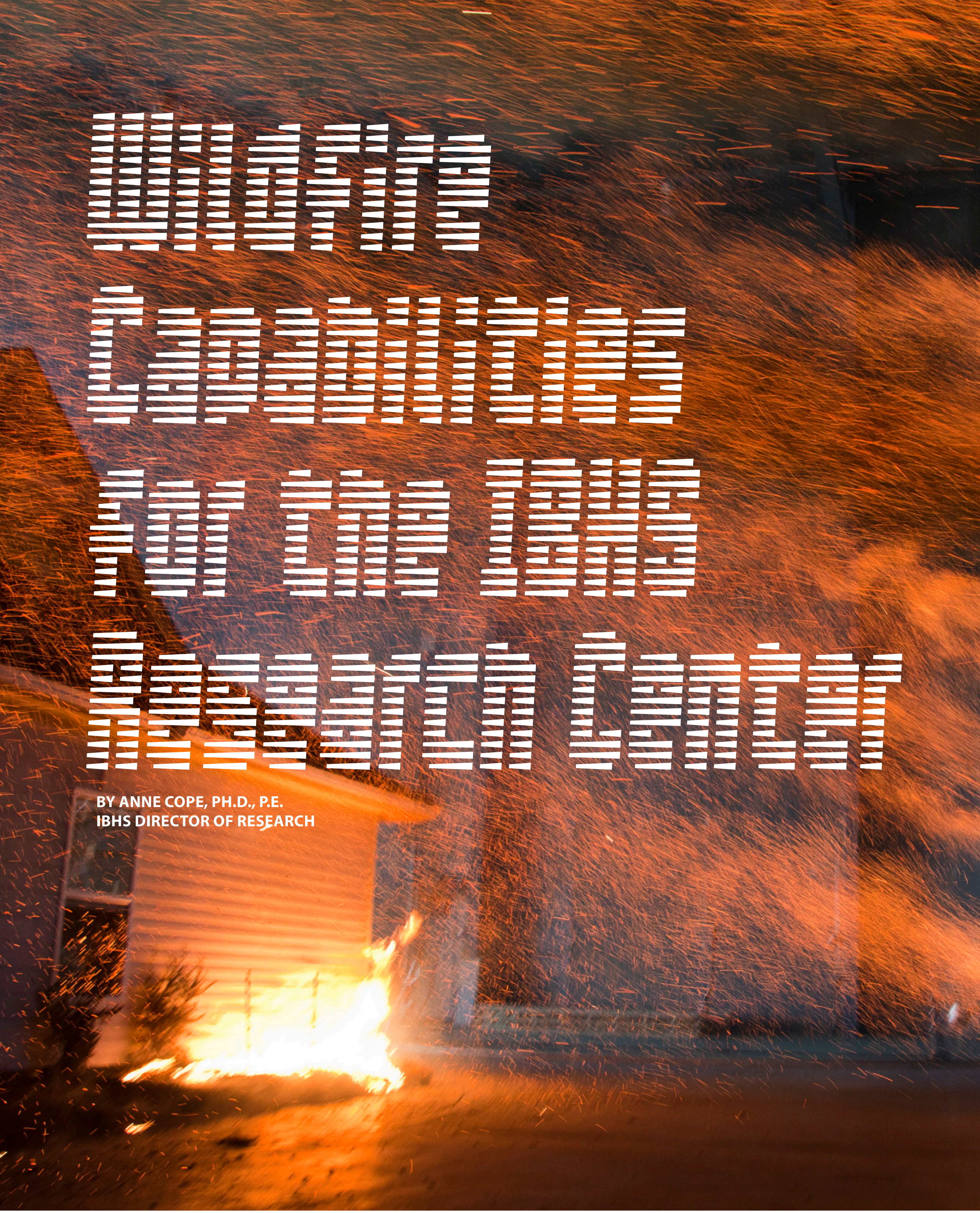
The Research Center opening demonstrations clearly reinforced the fact that conventionally built structures, even relatively small structures, such as the houses used in the tests, do not have much of a safety margin against structural damage. The rapid demise of the conventionally built houses, when wind pressures built up inside, shows once again the brittleness of conventional connections. Wood framing members used in these houses had a lot more strength than the connections between them. Widespread use of effective strapping, which might add up to 2 percent to the cost of a wood frame house, would create houses that are significantly more resistant to all kinds of severe wind events, as well as improve performance in an earthquake.

This is just one example of the initial payoff of the IBHS Research Center and its ability to realize the potential envisioned by the people and insurance industry representatives that made it possible.

These demonstration tests illustrated how prescriptive high-wind design guides may not adequately address all potential failure modes and clearly showed how missing one of them could significantly reduce the benefits and protection actually achieved. The events also highlighted the fact that a solution was both easy and inexpensive.

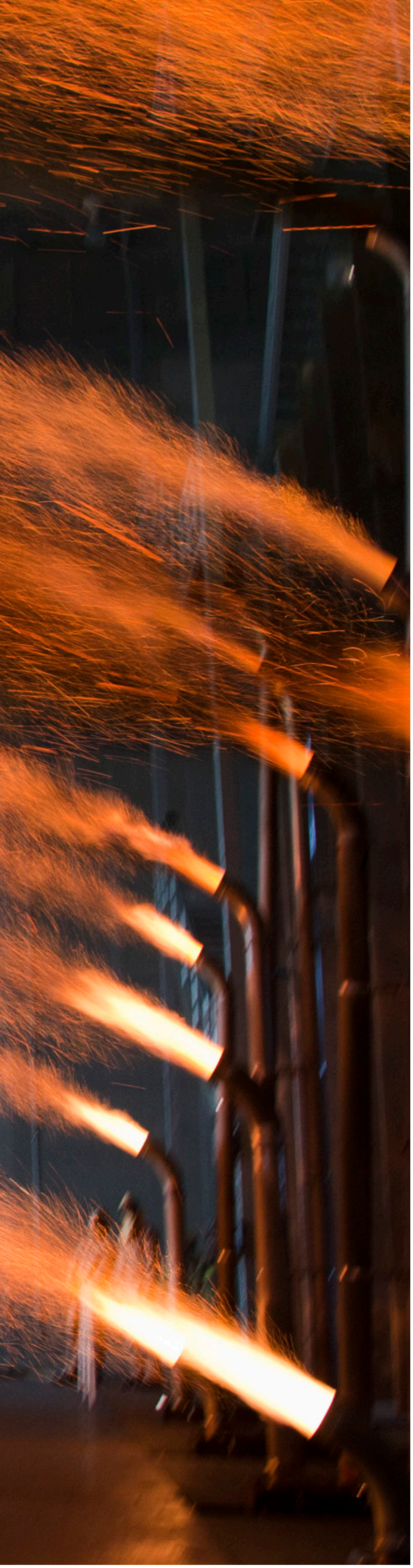
What was learned during the initial wind demonstrations has already made its way into the IBHS FORTIFIED program. The Research Center clearly has the potential to be a game changer because it provides a tool that has never existed. While the grand opening events focused on wind-related risks, that is only a small sampling of the capabilities of this remarkable facility. The next steps are to explore structural ignition issues relating to wildfire exposures beginning in spring 2011, followed by hail storms and wind-driven water in the months and years ahead.

While there remain countless expectations surrounding the lab, IBHS is committed to allowing the research to lead the way and to sharing the results in a transparent fashion. This approach fosters a tremendous opportunity to affect change through both small and large accomplishments. Both have a place in building science and will result in more resilient communities, where safe construction can be accomplished at almost any price point.



Wildfire Capabilities for the IBHS Research Center

BY ANNE COPE, PH.D., P.E.
IBHS DIRECTOR OF RESEARCH



Uncontrollable wildfires are becoming more prevalent and the average number of acres burned each year by fire is steadily rising. The average number of acres burned between 1990 and 1994 – 3.4 million – increased to 4.1 million acres in 1995 and 1996, and grew again to 6 million acres between 2000 and 2004[1]. In 2007 alone, 9.3 million acres were burned as a result of 85,000 wildfires[1]. As the number of homes and businesses in the Wildland Urban interface (WUI) increases, the threat of destructive wildfires affects a larger population in the United States. The WUI wildfire problem has historically fallen between the traditional studies of forest fires and building fires. However, with more buildings being built in the WUI and the increased number of catastrophic, wind-driven wildfires that exceed the fire services ability to contain the fire, WUI wildfire studies have become an important area of inquiry for IBHS.

CURRENT RESEARCH AND CODE DEVELOPMENT EFFORTS

"STAY AND DEFEND" APPROACH TO WUI RISK REDUCTION

The "Stay and Defend" approach to protection of property against wildfire developed in Australia has received significant attention in the United States[2, 3]. However, the devastating Black Saturday fire in Australia in 2009, in which dozens of lives were lost, presented a significant barrier for efforts to establish such a program in this country. The fundamental basis of "Stay and Defend" is the theory that wildfire typically moves very quickly through a community and that satisfactorily prepared buildings can provide both protection from radiant heat and sufficient oxygen to protect occupants until the wildfire has passed. At that point, people can exit buildings and put out spot fires from embers that typically cause buildings to ignite and burn. Key elements of the Australian program are: 1) structure preparedness, which focuses on near-home fuel modification and use of fire-resistive construction materials, and 2) personal preparedness and training, which serves to truly alert individuals to the frightening risks they may face, and to provide instruction on how best to mop up spot fires once the wildfire has passed.

WILDFIRE ADAPTIVE COMMUNITIES

Fire officials in the U.S. have taken several approaches over the years to encourage wildfire preparedness by residents living in and near WUI areas. These programs include Firewise, which is a product of the National Fire Protection Assocation (NFPA), along with others, such as Fire Safe Councils and Living with Fire. The newest approach is called Ready, Set, Go! and is a product of the International Association of Fire Chiefs (IAFC)[4]. In contrast to the Australian approach, this program encourages residents to "Ready" their homes through mitigation, getting families "Set" to evacuate by making an emergency plan, and being prepared to "Go" when fire officials warn a wildfire is threatening. IBHS and NFPA have joined with IAFC in support of Ready, Set, Go! pilot programs in several states. The program launched nationally in spring 2011.

Another program, which has taken hold in San Diego County, Calif., more closely resembles the Australian approach, but it does not require any training or carry any expectations that homeowners defend their property in a wildfire. This program is known as Shelter in Place, and it was used to construct several communities within the Rancho Santa Fe Fire Protection District. The developer worked with Rancho Santa Fe fire officials to create communities that were built with wildfire in mind[5]. The Shelter in Place approach requires several mitigation techniques above and beyond local building codes.

These additional measures include:

- use of residential sprinklers;
- well-maintained, fire-resistive landscaping, with a minimum 100-foot defensible space surrounding all structures;
- road and driveway widths designed to accommodate two-way traffic and large firefighting apparatus;

- adequate water supply and water flow for firefighting efforts; and,
- vegetation modification zones surrounding the entire community

Beyond these requirements, community covenants provide the fire department the ability to inspect buildings and landscaping and to issue citations to homeowners if deficiencies are present. While the program is intended to keep wildfire away from the homes, firefighters still encouraged homeowners to evacuate early when the Witch Creek Wildfire threatened several of these communities in October 2007.

Communities in the U.S. that adopt Shelter in Place for new construction or fire-adaptive requirements for existing buildings are categorized by IBHS as "Wildfire Resistant Communities" because we do not want residents to get a false sense of security. Neither IBHS nor our members are prepared to recommend that people stay and defend their homes during a wildfire event. It should be noted that proper training is a critical component for homeowners who might want to stay; as noted above, the Shelter in Place program did not include any such training. Nevertheless, a significant point of interest is that not a single home within three studied Shelter in Place communities was destroyed by wildfire during the Witch Creek Wildfire, during which these communities were exposed to fire conditions that resulted in the destruction of homes of similar vintage in other nearby, conventionally constructed communities[1].

U.S. FOREST SERVICE IGNITION POTENTIAL RESEARCH AND MODELING

Research Physical Scientist Jack Cohen, with the U.S. Forest Service's Rocky Mountain Research Station, has been a leader in studying wildfire events. His work is credited with helping to shift the primary focus from fuel modification alone to a more balanced approach of reviewing the structure and its immediate surroundings to identify potential ignition points and mitigate these risks. Much of his early work towards quantifying the ignition potential for specific buildings started with the building and moved outward[6]. Some of the rules of thumb developed and promulgated as guidance for new structures and for retrofitting existing structures can be traced to his field observations and experiments.

NIST RESEARCH PROGRAM

The National Institute of Standards and Technology's Building and Fire Research Laboratory has been actively studying wildfire events and structural ignition for several years. This research is carried out through the Reduced Risk of Fire Spread program. Initial efforts have been aimed at characterizing conditions generated by WUI fires, developing models for predicting their spread, and identifying mechanisms for structural ignition caused by burning vegetation.

Major projects to date include a study of a community exposed to the Witch Creek Fire, where timelines, intervention measures, and building and vegetation characteristics were assessed in detail. Another major initiative involved creating an ember generator for use in ember attack research; most of which has been carried out in a wind tunnel facility in Japan under a cooperative agreement with the Japanese government. Published results from this effort have focused on ignition as the result of embers entering a structure through vents and/or collecting on tile roofs. The development of rapidly

deployable instrumentation for use in the WUI has also been undertaken, with proof of concept tests conducted[7].

CODE DEVELOPMENT AND IMPLEMENTATION

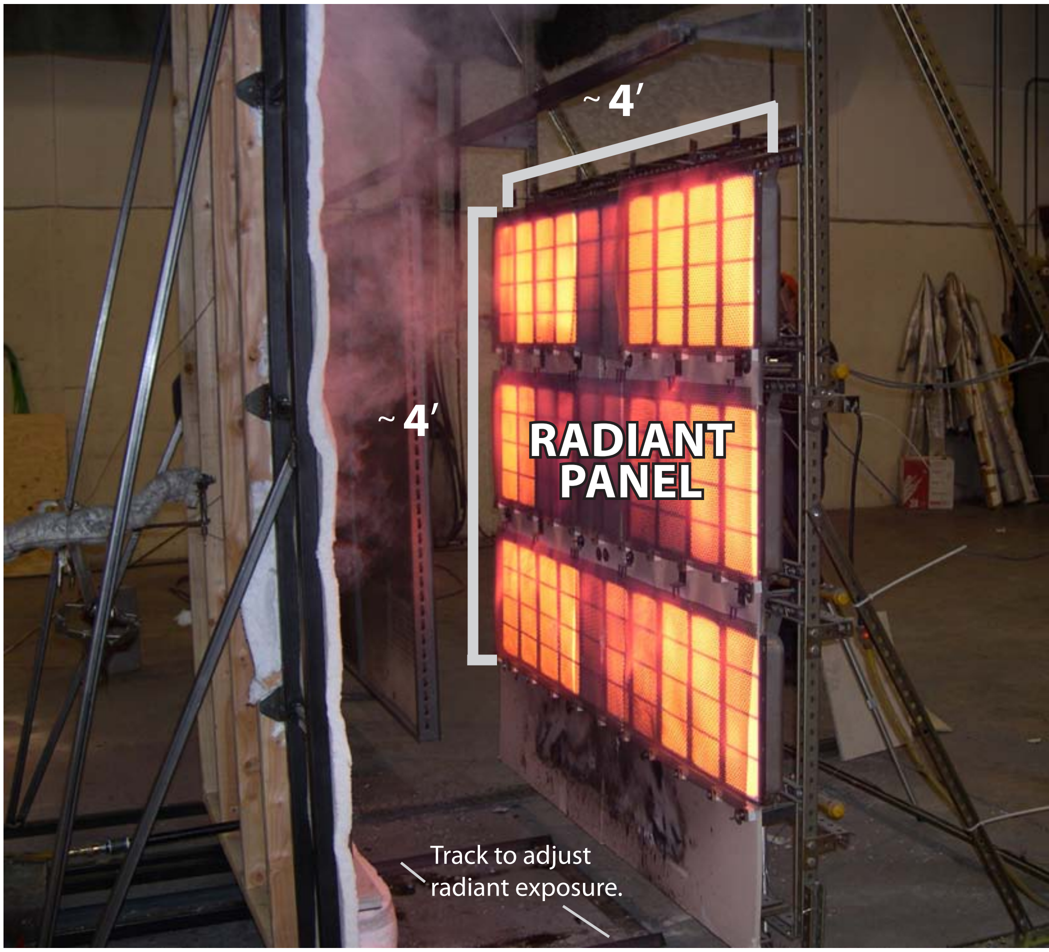
There have been significant recent improvements in building code requirements related to WUI areas. California, for example, has developed maps identifying wildfire hazard zones and requires fuel modification areas around buildings constructed within these zones. While there is evidence that newer building codes are making a difference, code adoption and enforcement remain key issues in the continued efforts to enhance the resilience of structures and communities to disastrous fires. Many current mitigation recommendations are based on prescriptive guidance and anecdotal evidence. There is a clear need to develop more objective, science-based guidance, building code provisions, and standards that truly reproduce the physics of the problem being addressed.

DEVELOPMENT OF WILDFIRE TESTING CAPABILITIES

The primary objective of IBHS' wildfire research program is to reduce the risk of fire spread to buildings in WUI communities and enhance the resilience of structures and communities to disastrous fires. This goal will be achieved through: systematic development of methodologies to simulate full-scale, wind-driven ember attacks and flame induced radiant heat at the IBHS Research Center; assessment of post-event field studies; laboratory testing and analysis; and, development and dissemination of proposed code and regulatory changes as well as retrofit guidance.

WHERE WE STAND NOW

IBHS has partnered with the U.S. Forest Service (USFS) and the Savannah River National Laboratory (SRNL) to work on wildfire research activities. Through the Wildfire Ignition Resistant Home Design (WIRHD) project sponsored by the Department of Homeland Security, IBHS scientists and engineers have been working together with USFS experts and SRNL scientists and engineers to develop ember generation and radiant panel capabilities at the IBHS Research Center.



Photograph taken at Western Fire Center, Kelso, Wash.

Equipment capable of injecting burning embers into the wind stream in the large testing chamber has been developed for the IBHS Research Center. Equipment similar to the prototype pictured on page 12 is placed in the 5-foot wide pit that spans across the inlet side of the test chamber. Ductwork allows burning embers to be injected into the wind stream at 10-foot intervals across the inlet area.

With this system, the IBHS Research Center is capable of reproducing ember storms typical of wildfire events, replicating the along-wind and across-wind turbulence characteristics of natural winds occurring in wildfire conditions as well as the embers carried in those winds.

Major differences between the IBHS facility and ember generation capabilities currently used in Japan include the size of the building that can be tested, the detailed simulation of flow characteristics possible in the IBHS laboratory, and the duration of the ember attack. These factors allow IBHS researchers to produce much more accurate simulations of ember attacks on building components, including attic vents and complex roof shapes, and the gusty nature of the wind environment associated with an ember attack during a wind-driven wildfire event.

A large radiant panel similar to the type of panel prescribed by ASTM E1623, but on a larger scale, is currently being developed for use in the IBHS Research Center. This panel will subject test building components to the radiant heat characteristics of a wildfire and will be used in conjunction with the ember generation equipment for the WIRHD program testing at the IBHS Research Center. The radiant panel being developed for the IBHS Research Center will be 5 feet by 5 feet, and similar in concept to the 4 feet by 4 feet panel shown in a photograph from the Western Fire Center (previous page). It is designed to allow easy expansion to a 10 foot by 10 foot panel at a later date.

UPCOMING TESTS AND MEDIA EVENTS

The ember generation equipment was used throughout March 2011 in the large test chamber during a series of tests designed to demonstrate differences in ignition potential between various construction techniques, building materials, and landscaping materials.

All tests were filmed to create demonstration videos that will become part of a tool that will allow construction of a virtual representation of specific buildings, including the surrounding landscape and neighborhood characteristics. This tool will allow evaluation of the current ignition potential of properties and analyses after various proposed steps are taken to reduce the risk of ignition from a wildfire.

A media day to showcase the wildfire capabilities at the IBHS Research Center and the progress on the WIRHD was held on March 24. This enabled IBHS to share its research progress with the public and attendees at the IAFC Wildland Urban Interface Conference, which was held the following week in Reno, Nev.

FUTURE EFFORTS

Future research capabilities for the IBHS Research Center include the development of full-scale, wind-driven flames to simulate the effects of a tree, shrub, or out building that becomes a “torch” near a building at risk in a wildfire. IBHS scientist and engineers also hope to partner with other research organizations to develop and implement rapid deployment instrumentation in advance of wind-driven wildfire.

Information gathered in post-event field studies and in laboratory testing and analysis will be used to continually evaluate and update the regional wildfire retrofit guidance documents published by IBHS. This information will also be used to develop proposed code and regulatory changes as needed.

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Hail Capabilities for the IBHS Research Center

By Tanya M. Brown, Ph.D.
IBHS Research Engineer

Hailstorms are a common threat to communities in the United States during the spring and summer months, especially to Midwestern and Great Plains states. Research indicates that more than 75 percent of cities in the continental U.S. experience at least one hailstorm each year[1]. Hailstorms were responsible for approximately $1.2 billion per year in damages to structures and crops during the 1990s[2] – and the damage caused by a few individual hailstorms alone has approached that value.

A hailstorm in the Dallas-Fort Worth metroplex in May 1995 caused $1.1 billion in damages[2], while a large, long-lived thunderstorm in April 2001 caused hail damage of over $1.5 billion along a path of more than 360 miles through Kansas, Missouri and Illinois,[3] with hailstones of up to 2 ¾ inches reported in some areas. The majority of hailstorms are short-lived and contain only small hailstones, causing little to no damage. However, some thunderstorms are capable of producing severe hail which can cause damage to crops, vehicles, and structures, and can cause injuries or even death.

The National Weather Service defines severe hail as 1 inch in diameter or larger, a new criterion adopted nationwide on Jan. 5, 2010[4]. Research has shown that severe hail damage to shingles and other roofing materials begins with hail of 1 inch diameter, [4, 5] which is why the criterion was increased from its previous value of ¾ inch. Aircraft damage begins with hail of ¾ to 1 inch. Crop damage begins with hail diameters of about 1.6 inches[6]. Some efforts have been made to seed potential thunderstorm clouds in hopes of reducing the size of hail and its impact on crops; however this mitigation effort is controversial and does not seem economically viable for protecting structures in large communities. Efforts would be better spent on developing or enhancing building materials, testing methods, and repair methods to make components more resistant to severe hailstone impacts.

EXISTING TEST METHODS AND CODES

Researchers long have been interested in studying the effects of hailstones on buildings. Ice impact testing began as early as the 1950s, when researchers began launching ice stones at roofing products to determine their damaging effects. The major disadvantage of these ice impact tests is the inability to accurately recreate natural hailstones. The stones utilized in these tests are simply balls of frozen tap water or distilled water, and are harder and denser than natural hailstones. Many studies of the structure and density of natural hailstones have revealed that natural stones are composed of layers of different kinds of ice (clear and rime) and air bubbles, which causes a decreased density compared to frozen ice balls. However, there is an advantage to using these harder, denser, artificial stones for testing—they inflict the worst possible damage that could reasonably be expected from a stone of a particular size[6]; however, this kind of testing has been met with some resistance from

building component manufacturing groups in particular, because they are not realistic in terms of mimicking Mother Nature. FM Global testing (FM 4473) utilizes freezer ice balls of distilled water[7], and testing programs at Haag Engineering[6] and J.D. Koontz & Associates[8] also use freezer ice balls of tap water for testing of roofing materials.

Because it is difficult to create artificial hailstones with repeatable characteristics, many studies have utilized spheres of other similarly dense materials. Steel balls of density 0.9 g/cm3 have primarily been used for impact testing, although other materials and densities have also been used. In this method of testing, balls of varying diameters are dropped from a height necessary to duplicate the energy of hailstones of identical diameter. Several assumptions are inherent to this method: each hailstone is spherical; hailstones do not deform on impact; and some recovery of the impacted material is allowed[9]. Depending on the individual storm and the produced hailstones, the first two assumptions may not or may not be accurate of naturally occurring hailstones. Field investigations in 1953 showed that only 58% of hailstones were spherical[10], while another study in 1960 showed that only 75% of hailstones were spherical[9]; the remainder were either conical or irregular in shape. The irregular hailstones are especially concerning, because they are often the largest hailstones. The Underwriters Laboratories testing standard (UL 2218) utilizes steel balls, while ASTM 3746 uses a rounded steel missile for testing of roofing materials. There has been some resistance to these test methods by manufacturers in particular, because of the significant difference in properties of steel balls versus frozen ice balls or hailstones; they do not respond the same upon impact. While ice balls and natural hailstones somewhat crush or deform upon impact, steel balls or missiles do not, thus the response of the impacted material is different.

Figure 3a: A real hailstone collected by Texas Tech severe storm researchers during VORTEX 2 2009. Figure 3b: An artificial hailstone created by IBHS researchers.

While there are numerous methods and standards for impact testing of roofing products, there are no set guidelines for impact testing of other materials, such as windows and siding, which can be severely damaged during hailstorms (particularly those storms with high winds). While current test methods outline testing procedures for new materials, they do not account for materials which may have been exposed to the elements for some time.

At the IBHS Research Center, engineers have the capability to push beyond the limits of current testing programs, by conducting impact testing of additional materials and aged materials.

DEVELOPMENT OF HAIL TESTING CAPABILITIES

WHERE WE STAND NOW

While construction, demonstration events, and commissioning have been underway at the Research Center, engineers have been working hard in the background to begin the development of hail impact testing methods and systems. An extensive library of over 220 articles on the meteorological properties of hailstones, artificial production of hailstones, field research programs, and engineering studies of hailstorms and impact testing has been gathered to identify current and best-practice methods of recreating realistic hailstones and hailstorms in the laboratory.

A large, commercial-grade, low-temperature freezer has been purchased to allow engineers to create large batches of hailstones for use in impact testing, while finely controlling freezing conditions. Numerous experiments have been designed to test various methods of altering the density of freezer ice balls to make them more natural and realistic. Experiments have also been designed to investigate irregularly shaped hailstones. While these experimental methods initially focus on just one size of hailstone, once the methods are perfected, manufacturing of hailstones can be extended to various sizes, and will

Hail Capabilites - continued on page 22

Comparison of Field and Full-Scale Laboratory Pressure Data at the IBHS Research Center

Tanya M. Brown [a]
Zhuzhao Liu [a]
Murray J. Morrison [a,b]
Anne D. Cope [a]
Douglas A. Smith [c]

Figure 1: Aerial photograph of the newly constructed IBHS Research Center in Richburg, S.C.

INTRODUCTION

IBHS has constructed a unique, state-of-the-art, multi-peril applied research and training facility in Richburg, S.C. (Figure 1). The central element of this facility is a specially designed laboratory which is large enough to subject full-scale, one- or two-story residential structures and commercial buildings with flat or pitched roofs to a variety of wind conditions or the reproduction of specific storm events that involve wind.

Critical steps in facility commissioning include demonstrating the ability to simulate various types of wind events and the ability to accurately reproduce local pressures and pressure distributions on the surface of a test building.

This article describes the cooperative effort between researchers from IBHS, Texas Tech University (TTU) and the University of Western Ontario (UWO) to investigate the facility's ability to reproduce local wind pressures and overall pressure distributions on the Texas Tech University Wind Engineering Research Field Laboratory (TTUWERFL) experimental building. The first part of this research involved having TTU researchers review more than 20 years of full-scale data from TTUWERFL to identify records where a large number of pressure taps were monitored and wind speed data were available either upwind of, or directly above, the test building. Data records were sorted according to whether they corresponded to stationary records or to thunderstorm events.

Drawings of the WERFL building were acquired from TTU and a replica of the WERFL building was constructed at the IBHS Research Center. The replica IBHS WERFL building is the small blue metal building shown in the lower left foreground in Figure 1. Examples of the pressure taps used on the WERFL building were obtained from TTU, duplicated at the IBHS Research Center, and installed in the replica building at the same locations used to collect pressure data on the original WERFL building. The same model of Setra pressure transducers used on the TTU WERFL building is being used on the replica building.

The goal of this research is to determine how closely the IBHS Research Center can reproduce local pressures measured on the WERFL building, including mean, root-mean-square, peak positive and peak negative pressures, as well as overall pressure distributions. Testing includes simulation of generic open country flow conditions and reproduction of the actual time histories measured at the anemometer located upstream of or above the WERFL building.

IBHS RESEARCH CENTER TEST CHAMBER

The core facility of the IBHS Research Center is a large lab within which one- and two-story residential and commercial buildings can be subjected to high winds, along with wind-driven rain, hail and fire. The facility was designed to generate wind gusts greater than 58 m/s (130 mph), which adequately represent full-scale wind effects from Category 3 hurricanes, thunderstorm frontal winds, and horizontal flow from microbursts. The lab is equipped with 105 fans of 1.68 m (5.5 ft.) diameter. The fans are grouped into a cell array of five towers and three rows. Each of the fifteen cells is individually controllable, and all fans contained in a particular cell run at the same motor frequency. Each of the cells in the lower row of the array contain nine fans, in a three row-by-three column grid, while each of the cells in the middle and upper

[a] Insurance Institute for Business & Home Safety Research Center, Richburg, SC; [b] Boundary Layer Wind Tunnel, University of Western Ontario, London, ON, Canada
[c] Wind Science & Engineering Research Center, Texas Tech University, Lubbock, TX

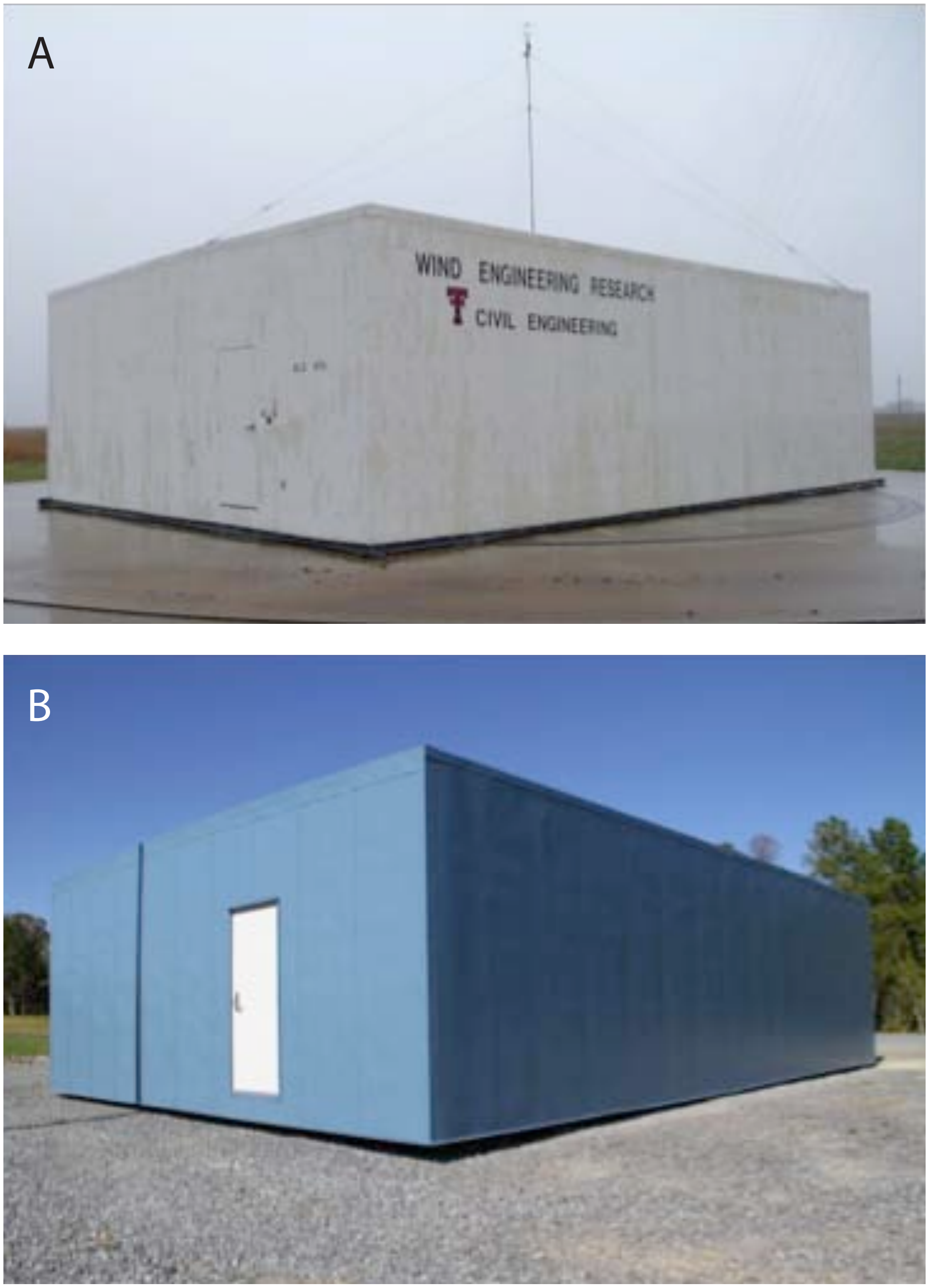

Figure 2: The a) original WERFL building in Lubbock, Texas and the b) replica building for use in testing at the IBHS Research Center in Richburg, SC.

rows of the array contain six fans in a two row-by-three column grid.

As wind is generated by the fans, it is forced through a contraction at the inlet to speed up the flow before entering the test chamber and impacting upon test specimens. The inlet to the test chamber is 9.1 m (30 ft.) tall by 19.2 m (65 ft) wide. Directional vanes are located at the end of the inlet to allow for altering lateral wind flow by moving the vanes up to 15° in either direction. The four vanes on each of the five towers are grouped together and controlled by one hydraulic motor. This allows separate control of the vanes for each column of cells. The test chamber has a clear interior height of 18.3 m (60 ft.), is 44.2 m (145 ft.) wide by 44.2 m (145 ft.) long. The flow exits the chamber through an outlet that is 10.7 m (35 ft.) tall by 21.3 m (70 ft.) wide and disperses in the natural environment. A 16.8 m (55 ft.) diameter custom-built turntable is employed so that complete rotation of structural specimens can occur during testing without human intervention. Testing at the IBHS Research Center will include changing the orientation of the test specimens relative to the wind direction, varying the speed of the fans to create low frequency gusts, moving the directional vanes to generate lateral turbulence, introduction of raindrops with prescribed distributions of droplet sizes and rainfall rates, injection of burning embers of various sizes, and injection of simulated hailstones.

PRESSURE VALIDATION

IBHS has constructed an exact replica of the TTU WERFL building to use in pressure validation testing. WERFL is a full-scale test building instrumented with 204 pressure taps which have been used to collect wind-induced pressure data in a natural, open exposure environment in Lubbock, Texas, since 1989 (Levitan and Mehta, 1992a, 1992b). The buildings are 9.14m (30 ft.) x 13.72 m (45 ft.) and 3.96 m (13 ft.) high. The WERFL building in Lubbock and the replica building at the IBHS Research Center are pictured in Figures 2a and 2b respectively. A house-moving system is used to place the IBHS WERFL replica building inside the laboratory test chamber. The building can be rotated on the turntable to vary the angle of attack of the wind flow.

Data collected from TTU WERFL have been used to validate previous wind tunnel tests (Okada and Ha, 1992; Xu, 1995; Tieleman et al., 2003; Bienkiewicz and Ham, 2003) and CFD results (Qasim et al., 1992; Chang, 2001; Bekele and Hangan, 2002). A meteorological tower adjacent to the original TTU WERFL building has collected time histories of wind data that correspond to the pressure data collected by the structure. With more than 20 years of field data collected, numerous cases were identified by TTU researchers in which the wind acted from a direction (wind azimuth angle of 275°-285°) such that it flowed through the meteorological tower and then impacted the WERFL building. Several of the cases also met the criteria of being stationary in both wind speed and direction, and the wind speed at roof height (3.96 m, 13 ft.) was greater than 6.71 m/s (15 mph) to ensure that turbulence present in the flow was mechanically generated. In each of these cases, both the wind time histories from the meteorological tower and the pressure coefficient time histories from WERFL were extracted. The data were sampled at a frequency of 30 Hz, and each of the records was 15 minutes in duration. In addition, the mean wind speed was calculated from the wind speed time histories, and the mean and standard deviation of the pressure coefficients at each of the pressure tap locations were determined. Six of these records were identified for use in the initial testing at the IBHS Research Center.

These cases represent the best simulation of generic open country flow where the velocity time history upstream of the building is known. These data cases are being used by IBHS researchers in validating the ability of the full-scale test facility to reproduce wind-induced pressures on the WERFL building in the laboratory test chamber. Pressure time histories on the TTU replica building are being generated both by reproducing the gross flow characteristics (low frequency gust structure and directional variations) and by generating typical open country flow simulations having higher mean wind speeds, but similar turbulence characteristics, including turbulence intensity and length scales.

The selected datasets correspond to cases where one of the building faces is roughly perpendicular to the mean flow direction. Additional data cases from the TTU WERFL site have been identified in which the wind approached the WERFL building with varying angles of attack. The emphasis is placed on obtaining records where the building was subjected to winds blowing towards a corner of the building (quartering winds). For these cases, meteorological data are available from an anemometer located on top of the building at 10 m height. These cases will be utilized for comparing results from the IBHS WERFL replica building for the wind directions that tend to produce corner vortices and some of the highest magnitude negative pressures on the building roof.

In addition to the stationary flow cases, records of thunderstorm events were also identified and extracted from the TTU database. These have also been simulated and results are being compared with the original WERFL results. Repeated tests with the same simulation time history are being compared to investigate result variability when lower frequency flow characteristics are controlled and repeated while high-frequency turbulence for each simulation is random. This will provide insights into the relative importance of low-frequency gusts and high-frequency turbulence as it affects peak pressures and pressure distributions on buildings.

For each of the datasets, the original TTU wind speed time histories were resampled to a frequency of 2 Hz to match the response period of the fans in the test chamber, and these data have been converted to fan capacities to serve as input data for the IBHS fan control system. The flow generated by these input time histories are then applied the IBHS WERFL replica building, which is outfitted with pressure taps identical to those in the original TTU WERFL building. From these tests, the mean, standard deviation, peak positive and peak negative of the pressure coefficients obtained at the IBHS Research Center are being directly compared with those obtained in the field at the TTU WERFL site in Lubbock, for each of the 204 pressure taps.

Preliminary test results are currently being analyzed and while the comparison of results is promising, IBHS researchers believe it can be further improved by tweaking the flow simulation to better match full-scale. These tweaks involve: adding high frequency turbulence into the flow regime; creating greater variation in mean wind speed within the lower cells to better simulate real-world boundary layer winds; and, varying the low-frequency gust structure across the inlet by varying control algorithms for wind speed and direction for adjacent cells to better reflect the lat-eral variations in wind characteristics.

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PUBLIC POLICY IMPLICATIONS:

IBHS Research Center

By Debra T. Ballen, IBHS General Counsel and Senior Vice President of Public Policy

While IBHS is justly proud of the technical capabilities of our new state-of-the-art Research Center, we recognize that our mission is not only to conduct laboratory research, but also to use the knowledge we gain to reduce the social and economic effects of natural disasters and other causes of property loss. One way that this is accomplished is through enactment and enforcement of laws and regulations that help Americans build and maintain stronger homes, businesses, and communities.[1]

We know from experience that the building performance chain has many links, several of which are heavily influenced by public policy actions.

- Land use plans - which should consider natural hazards and site conditions to help communities and individuals understand the real risks/ costs associated with development and redevelopment in sensitive areas.
- Building codes – which are minimum acceptable standards for protecting people and property with respect to the design, construction and maintenance of buildings.
- Incentives that motivate home and business owners to invest in "code-plus" construction, as well as proper maintenance and retrofitting, reduce losses and improve community resilience.
- Effective community-wide disaster planning, preparation and response are essential to survival and rapid recovery.

How will the building science produced at the IBHS Research Center transform the public policy process? It starts with sound engineering and building science. Working with IBHS members and other mitigation experts, IBHS staff has prioritized a research agenda that focuses on major types of loss caused by wind, water, fire and hail. Through meticulously designed research protocols, carefully calibrated testing, precise measurement, and careful data analysis, IBHS researchers will advance the collective state of knowledge about how natural disasters destroy buildings and what can be done to minimize these effects.

To change public policy, it is critical that research findings be effectively communicated in terms that can be understood by lawmakers and the people they serve. We know that a picture tells a thousand words, and video can make even the most arcane engineering concepts easy to grasp. That is why media outreach is such an important part of IBHS' strategy.

On the morning of the Research Center's Grand Opening, viewers who turned on the "Today Show" at 7 a.m. had a surprising wake-up: an up-close view of the complete, frighteningly quick destruction of a two-story house. Fortunately, this was not a natural disaster, but rather footage of the Research Center's inaugural testing, in which side-by-side houses – one built to conventional building code standards for Midwestern construction and one built to IBHS' FORTIFIED for Safer Living® criteria – were subjected to high winds simulating actual storms. In each of several similar tests, the conventional house was completely destroyed, while the FORTIFIED home suffered only minor cosmetic damage. These are the kinds of graphic images that policymakers need in order to understand the value of strengthening building codes and creating programs to incentivize homeowners to go beyond the regulatory requirements of building codes, and to retrofit existing homes for greater disaster resistance.

Partnerships are critical to leveraging IBHS' limited resources to integrate our work more fully into the public policy debate. During 2010, IBHS staff helped organized and participated in dozens of public policy forums, focusing on themes such as climate change, coastal insurance, community resilience, risk communication and wildfire. The research and communications outputs from the Research Center will underscore the importance of IBHS contributions to these important dialogues, as we are able to explain and graphically illustrate how various test results relate specifically to cost/benefit analyses and other challenges facing lawmakers. We also hope, over time, to bring key federal and state policymakers to the Research Center by serving as a venue for congressional field hearings, meetings of the National Association of Insurance Commissioners (NAIC) or other state policymaker groups, or hosting various technical forums of the International Code Council (ICC) or other standard-setting organizations.

BUILDING CODES

One area of particular concern to IBHS members is the code development process. Model building codes are developed by the ICC, but they are not self-executing—they must be adopted by each state and enforced at the local level. What's more, 13 states do not have a state-wide code; others apply the code only in some parts of the state; and too many states allow weakening amendments at the local level. All too often, the quality of local enforcement becomes known only after a disaster strikes.

This unique public policy structure means that codes tend to reflect technical, financial, environmental and political considerations. The process is very protracted [2], with occasional rapid-fire events.

All of this reinforces the importance of findings from the IBHS Research Center to improve the code development process at many levels.

- IBHS can design and implement tests that are specifically relevant to issues under consideration in a particular code cycle.
- IBHS will present research findings to ICC Code Action Committees as the codes are being developed.
- The graphic findings from the Research Center will help in our outreach to allies and adversaries in our efforts to strengthen building codes.
- These findings also will be powerful tools to encourage states to adopt the stronger building codes and require local implementation and enforcement.

FEDERAL LEGISLATION

Over the past several years, Congress has had before it a wide range of mitigation-related legislation, including bills to amend the Stafford Act [3]; financial incentives for states to take positive steps related to mitigation; tax incentives for homeowners or businesses to invest in mitigation; and environmental programs with mitigation provisions. While there has been broad, bipartisan support for most of these mitigation improvements, some of the broader bills to which they are attached have been caught up in partisan wrangling, while other mitigation measures simply failed to advance due to inattention as Congress debated more high profile matters.

Findings from the IBHS Research Center can help energize and refocus a robust mitigation discussion in Congress about how best to prepare our nation for inevitable disasters. As bills are introduced, IBHS may be asked to testify at legislative hearings before congressional committees, or to provide data or analysis about the mitigation benefits of various proposals. These activities are permitted by the Internal Revenue Code, IBHS by-laws, and our lobby tax guidelines.

STATE INITIATIVES

Beyond building code adoption, states may be engaged in a variety of mitigation-related activities. One particularly encouraging example is the South Carolina Safe Home Grant Program, which offers grants for South Carolinians to strengthen their homes against the damaging effects of high winds from hurricanes and severe storms. Several other coastal states have passed legislation providing incentives to homeowners to strengthen their homes beyond the minimums required by state or local codes; IBHS has been working with appropriate regulatory agencies on implementation, and to make sure that the resources are in place to meet increased consumer demand. As the visual images from the IBHS Research Center become even more widely distributed, we anticipate that the consumer demand for these kinds of programs will increase, and we are ready to provide technical assistance to states that wish to provide better protections to their citizens.

GAME CHANGER

The Research Center is a potential "game changer" that will lead to a more resilient nation. The starting point is impeccable and innovative engineering building science, but the end points are the individual, corporate, and regulatory actions necessary to reduce the human and economic toll of disasters.

NOTES

1 Because IBHS is a non-profit organization, the Institute's direct participation in lobbying activities is extremely limited and consistent with Internal Revenue Code rules; however, IBHS is a valuable technical resource in many public policy debates about all aspects of mitigation.

2 The ICC code development process generally involves a 36-month cycle.

3 The Robert T. Stafford Disaster Relief and Emergency Assistance Act (PL 100-707) constitutes the statutory authority for most federal disaster response activities.

Continued from Hail Capabilities article

allow for testing of sizes larger than what is currently tested in other programs.

UPCOMING CAPABILITIES

While the design of realistic hailstones is well underway, the delivery and hail impact system is still in the initial development stage. Several testing programs currently utilize a kind of hail gun, cannon, or dropping method to impact specific locations on a small test specimen. While IBHS will initially be using this method for small-scale testing in the small laboratory at the Research Center, engineers also face the unique challenge of bringing this testing to full-scale in the large test chamber. Engineers need to be able to impact not only the roof of a structure, but the walls, windows, and additional components, such as gutters, vents, and air conditioning units, taking a holistic approach by focusing on the building as a system, rather than individual pieces. Impact and delivery systems will be designed to allow for large quantities of hailstones to impact a full-scale test specimen within the test chamber. Engineers will also be able to study the effects of wind-blown hailstones, as the fan system can provide typical wind speeds time histories that might be seen during a hailstorm.

While current testing methods are limited to new, off-the-shelf materials, IBHS will have the capacity to study the effects of hailstone impacts on aged materials. And while current testing methods focus on roof materials, IBHS will focus on testing of many other components as well, and will include the effects of wind-blown hail. In addition, engineers will be studying roofing repair methods to determine how repairs might be made without completely reroofing structures following a hailstorm event, and will study how these repairs hold up as time passes.

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IBHS Research Center - A Photo Tour

The impetus and goals for the Insurance Institute for Business & Home Safety Research Center first emerged after Dr. Timothy Reinhold, now IBHS' senior vice president for research and chief engineer, surveyed damage following Hurricane Andrew in 1992.

IBHS staff and founding member companies met to establish priorities and the design team worked for more than a year to create the unique facility. The facility was made possible through a $40 million capital investment by more than 50 leading organizations in the property insurance industry.

The IBHS Board of Directors voted to break ground in July 2009 and the facility was completed a year later, with a Grand Opening held in fall 2010.

Below is the steel spine of the lab's 55-foot diameter turntable, which allows the anchoring of various-sized test specimens on the surface area of 2,375 square feet.

The lab's 105-fan array and other state-of-the-art equipment are capable of simulating fire, hail, wind storms, and wind-driven rain.

IBHS researchers conducted a wind test demonstration in fall 2010 that pitted a conventionally constructed house (below) against a house built to IBHS' FORTIFIED Midwest construction standards (right) in winds nearing 100 mph, only the FORTIFIED house survived.

Using a variety of outlets, IBHS test results are being aggressively promoted to the insurance industry, general public, policymakers and the media in an effort to significantly improve the way residential and commercial structures are designed, built, maintained and repaired.

IBHS researchers and partners conducted an ember storm test demonstration for the media in spring 2011 to demonstrate differences in ignition potential between various construction techniques, building materials, and landscaping materials.

The IBHS Research Center's 21,000-square-foot laboratory is uniquely capable of testing full-scale buildings, allowing researchers for the first time to study entire buildings and construction systems, as well as individual components.

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Glencoe Group
Grange Insurance (The Grange Mutual Casualty Group)
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The Insurance Institute for Business & Home Safety (IBHS) mission is to conduct objective, scientific research to identify and promote effective actions that strengthen homes, businesses, and communities against natural disasters and other causes of loss. Please visit our web site at www.DisasterSafety.org.

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