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Disaster Safety Review

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.

Photovoltaic Arrays: High Wind Research

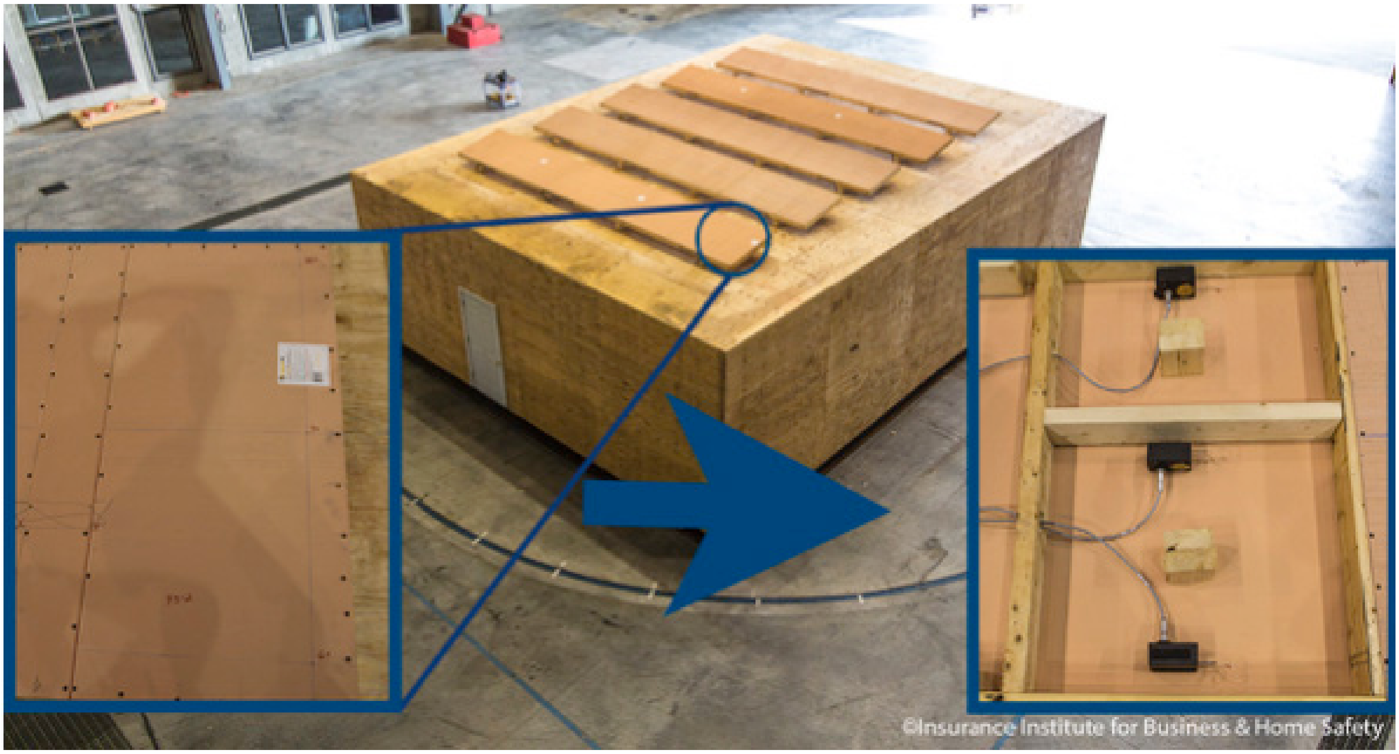

Figure 1. Photograph of solar panels on the roof of a building in the IBHS test chamber.

As the use of solar energy installations continues to grow rapidly around the country, the Insurance Institute for Business & Home Safety (IBHS) is examining the effects of wind on roof-mounted photovoltaic (PV) solar panel arrays. This has been identified as an area of high priority, especially for commercial insurers and reinsurers. The focus of the research will be to determine whether panels are being attached properly to structures so they are able to withstand high winds. Detached solar panels and arrays can cause extensive damage to roofs, weakening a building's protection against severe weather; they also can become flying debris, which becomes a hazard to anything in the vicinity.

Currently there is no nationwide guidance on the attachment requirements of solar panel arrays in order to resist wind loads. In 2012, the Structural Engineers Association of California (SEAOC) published guidelines on appropriate wind design loads on low-profile solar photovoltaic arrays on flat roofs. Work has begun to produce nationwide guidelines by adapting the SEAOC guidelines into the 2016 edition of the American Society of Civil Engineers (ASCE) 7 Standards for Minimum Design Loads for Buildings and Other Structures. The current codification effort provides a timely opportunity for IBHS to conduct this research to help validate or improve the submissions to ASCE. Currently the code change proposals under consideration by the ASCE Wind Loads Subcommittee are based on scale model wind tunnel experiments at scales ranging from 1:20 to 1:100. Due to the scales in which these experiments are conducted, they have both geometric (small size) and flow simulation (correctly matching the turbulence characteristics of the real wind) constraints. Full-scale experiments at IBHS will allow the examination of the effect, if any, of these constraints, particularly the effect of small gaps in sizes on the wind loads on photovoltaic arrays. In addition, IBHS' research will provide preliminary information to inspectors and underwriters of these systems as it relates to best practices for array attachments.

RESEARCH DESCRIPTION

Experiments conducted at IBHS in 2014, examined photovoltaic panel arrays on the roof of a building under realistic wind loading in the large test chamber. In total, 13 different array configurations were examined resulting in more than 170 tests and 60 hours of data being collected. The experiments examined the effect of: wind angle; panel size; height of the panel above the roof; distance of the solar panels from the edge of the roof; distance between solar panel rows; and inclination angle of the solar panels.

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Figure 1 (page 3) shows the test building with one solar panel array configuration in the IBHS test chamber. Rather than use real photovoltaic panels, mock panels were constructed out of wood to match the geometry of real panels as closely as possible. The use of mock panels was necessary to allow the installation of instrumentation that would otherwise not have been possible with real panels. The two insets in Figure 1 (page 3) show three pressure sensors (black boxes) installed inside the mock panels, which are used to measure the wind forces on the panel. Pressure sensors also were installed to measure the pressures on the roof surface under the panels and are used to examine how the wind loads on the roof of the building underneath are affected by the presence of the solar panels. As discussed above, these small gaps (i.e., between the panels and the roof surface) are often difficult and sometimes impossible to correctly model in scale model wind tunnel experiments. In total, 304 pressure sensors were used in these experiments.

Figure 2 shows a comparison of wind pressures on the roof surface of a building to the net wind loads on solar panel arrays from a cornering wind direction of 30 degrees as shown. The solar panels shown are elevated 5.5" above the roof surface and have a panel inclination relative to the roof of 10 degrees. For the roof surface, the highest wind loads (dark blue) are near the edges of the buildings. In contrast, solar panels have higher wind loads near the center of the building. This demonstrates the distribution of wind loads on the roof of the building can be substantially different from the distribution of wind loads on solar arrays.

With the results from the current study and other studies found in the published literature, the wind loads on solar arrays are relatively well-defined. However, the response of the panels to these wind loads is much less understood. Arrays of photovoltaic panels are attached together in rows and are often ballasted with no solid physical connection to the roof. As a result, photovoltaic assemblies (i.e., rows) are a dynamic system and may be able to move in high winds. Following Post-Tropical Storm Sandy, small movement of the photovoltaic panels was observed, which did not appear to damage or affect the functionality of the photovoltaic array system. However, even small displacements of solar panel arrays have the potential to damage other infrastructure on the roof or the roof cover itself.

Research to be conducted at the IBHS Research Center in 2015, will for the first time ever, examine the response of actual solar panel arrays to real wind loads, examining both the initial movement of the panel and how failures of the panels or arrays propagate. The distribution of ballast also will be examined to develop guidelines on both the quantity and appropriate distribution to prevent movement of the panels. DSR

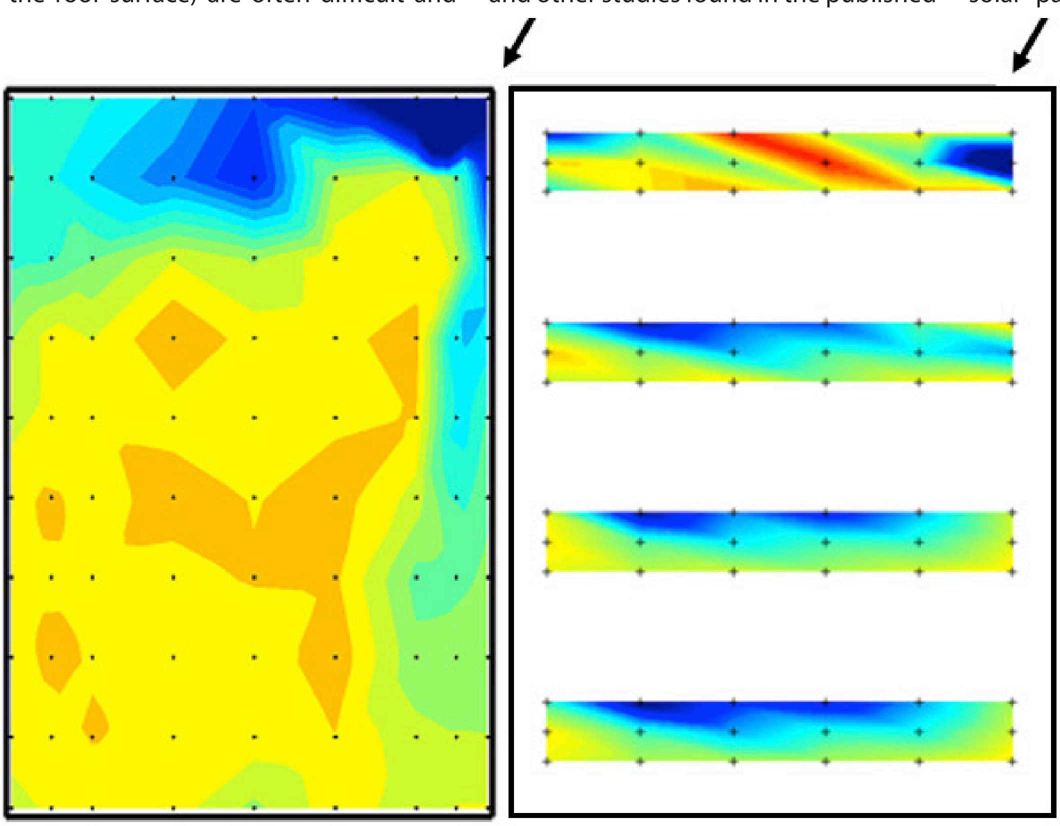


Figure 2. Wind pressures on the roof of a building (left), and net loads on solar panels on the roof (right).

Relative Impact Resistance of Asphalt Shingles

Part of IBHS' multi-faceted hail research program includes relative performance comparisons of impact resistance of roofing products using standardized impact tests. The focus of testing for 2013-2014 is on asphalt shingles where Underwriters Laboratory Test Standard 2218 (UL 2218) is recognized as the current test standard. Although these standardized tests do not exactly replicate natural hailstone impacts, they provide a way to compare relative product performances in controlled and repeatable laboratory tests. This report describes results from UL 2218 impact tests on 22 different asphalt shingle products produced by five different manufacturers.

The UL 2218 impact test standard is a steel ball drop test to evaluate the impact resistance of prepared roof coverings. The Class 1 projectile is 1.25″ in diameter, Class 2 is 1.50″, Class 3 is 1.75″, and Class 4 is 2.00″ in diameter. These steel balls are dropped from the height necessary to achieve the same kinetic energy a hailstone of the same size would have in a thunderstorm (UL 2012). IBHS designed and built a custom testing device that meets the specifications of UL 2218 and makes testing efficient for use by a single operator. The device uses compressed air to lift the steel balls to the dropping height, where their position is held in place until triggered for the drop. The device is described further in the Appendix (available in the [full report on DisasterSafety.org](DisasterSafety.org)).

The results summarized in this report provide an assessment of the relative performance of different roof shingle products when subjected to this standardized test and evaluated using the performance criteria adopted in the test standard. Performance criteria used in this assessment do not necessarily reflect the performance criteria used by insurance companies in determining whether to repair or replace an asphalt shingle roof cover following a hail event. Any evidence of opening—tearing, fracturing, cracking, or rupturing—on the back of the shingle is recorded as a test failure. The absence of an opening visible on the back of the shingle denotes a test pass. . Crushed or dislodged granules, dents, or openings visible only on the top of the shingle, are not considered failures in UL 2218 performance criteria.

It should be noted that the products tested by IBHS were obtained from local vendors and thus reflect the condition of products after they have been subjected to the supply chain which may involve multiple pallet stacking and exposure to a variety of storage conditions. All products tested were purchased in 2013. The shingle weights, thicknesses, bundle weights, and all identifying packaging information have been recorded in a shingle library database.

Continued on page 6

Test Methodology and Materials

Test panels (3 ft. x 3 ft.) were constructed with shingles installed according to the manufacturer's guidelines for the specific product. The panels were constructed, conditioned, stored, and tested according to UL 2218 requirements. Each product was impacted with two strikes of the appropriate size steel ball at a number of locations representing different features of the product assembly. Resultant impact marks were observed under a microscope.

Basic 3-tab and architectural shingles from each manufacturer were tested, along with basic Class 4-rated impact resistant (IR) 3-tab (if available) and architectural shingles. Manufacturers typically use a mesh or scrim on the back surface of an IR shingle to increase the impact resistance, as shown in Figure 1, while others use polymer modifiers in the asphalt, which has no visible difference when compared to a traditional shingle. Both types were tested and compared. Premium architectural products from three manufacturers also were tested, to evaluate the performance of thicker, heavier products. Table 1 describes the shingle selections.

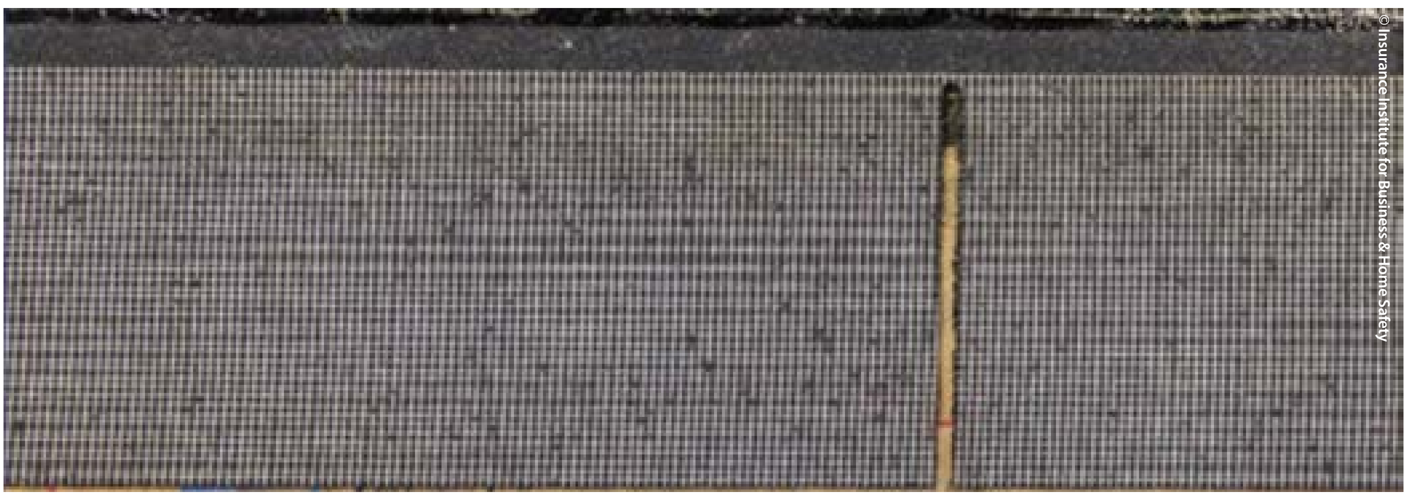


Figure 1: Example of mesh on the back of an IR 3-tab shingle.

	Shingle Types Tested				
Manufacturer	Basic 3-tab	3-tab IR	Basic architectural	Architectural IR	Premium architectural
A	1	0	1	1	0
B	1	1	1	1	3
C	1	0	1	1	1
D	1	0	1	1	1
E	1	1	1	1	0
Total Count	5	2	5	5	5

Table 1: Shingles selected for UL 2218 testing.

Performance Observations

Common Impact Marks

Crushed granules—the severity of which ranged from barely discernable to pulverized—were observed on every panel tested, as seen circled in red in Figure 2. These generally were visible both to the naked eye and under magnification. Although this kind of mark was observed on every panel tested, this damage mode is not seen in the field. Hailstones often will dislodge granules but are not hard enough to crush them. Additional marks included varying severities of dents and flattening of the shingle material, also shown in Figure 2 (rounded shingle edge traced in yellow). Flattening was evident particularly at joints, corners, and edges. The most severe dents occurred for impacts along the 2x4 brace in the center of the panel, where the deck was stiffened and there was not much flexibility to respond to the impact. This area simulates where roof trusses or rafters would be located.

Figure 2: Common marks observed during UL 2218 tests included crushed granules (red circle) and flattening of the shingle edge (yellow trace). Image is magnified at 7.5x.

Common UL 2218 Performance Criteria Failures

Although not always visible to the naked eye like crushed granules, when inspected using a microscope, typical damage that met the failure criteria of UL 2218 included tears at shingle edges or corners, on the back of shingles as shown in Figure 3a, as well as cracks in the center of shingles and at joints, visible on the back, as shown in Figure 3b. Three-tab shingles were impacted at six locations including the edge, joint, corner, eave edge, and two center locations (one in an area between 2x4 framing members supporting the roof sheathing and one on top of a 2x4 framing member) with double impacts. Architectural shingles were impacted at similar locations on both the single- and double-ply portions of the shingle, for a total of 12 impact locations with double impacts. To be considered an impact failure, a crack or tear must have been visible on the back surface of the shingle. The number of passing double impact locations, along with the number of failing double impact locations and photographs of the top and bottom of each location were recorded for each tested shingle panel.

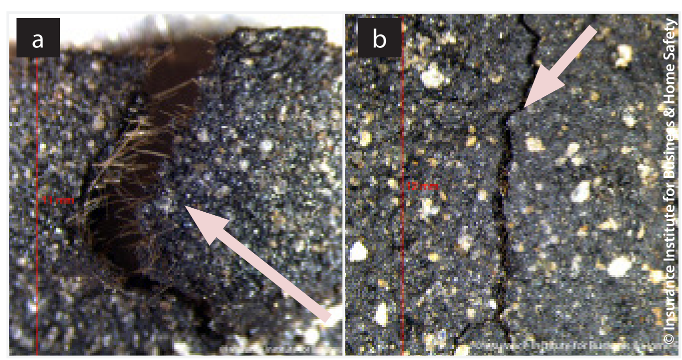


Figure 3a: Example of a tear visible at the edge of a shingle from the underside. Figure 3b: Crack visible in the underside of a shingle. Both images magnified at 7.5x.

Performance Comparisons

To present relative performance comparisons, percentages of double impacts that resulted in test pass ratings were compiled for the various shingles tested. These results are shown in Figures 4 through 8 (pages 8-12). It should be noted that a failure at any one impact location on a specimen is defined as a test failure according to UL 2218, but the data presented here are the percentage of passing impact locations which allows for relative performance comparisons. The following summarizes the comparisons among the classes of asphalt shingle products. Products in the IR groups have Class 4 impact ratings, and thus should withstand testing without cracking or tearing on the shingle back for all four projectile sizes. However, none of the products tested—basic or impact rated—passed more than Class 2 impacts without at least one double impact location failing the UL 2218 performance criteria.

1. *Basic 3-Tab Shingles versus Basic Architectural Shingles:*

(FIGURE 4)

a. Class 1 UL 2218 impacts resulted in passing ratings for about 45 percent of the impact locations for 3-tab and about 55 percent of the impact locations for architectural shingles.

b. Class 2 UL 2218 impacts resulted in passing ratings for about 25 percent of impact locations for the 3-tab and about 40 percent of the impact locations for the architectural shingles.

c. Class 3 UL 2218 impacts resulted in passing ratings for about 25 percent of impact locations for the 3-tab and about 35 percent of the impact locations for the architectural shingles.

d. Class 4 UL 2218 impacts resulted in passing ratings for about 25 percent of impact locations for the 3-tab and about 30 percent of the impact locations for the architectural shingles.

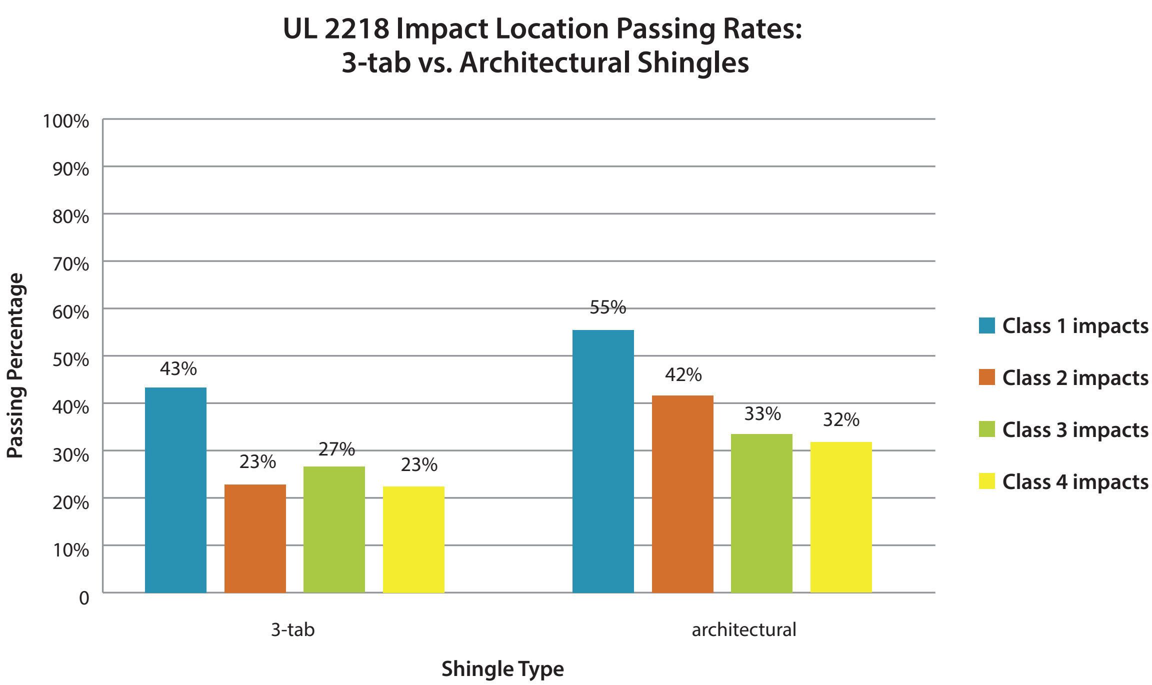


Figure 4. Comparison of basic 3-tab and basic architectural shingle performance to Class 1-4 impacts.

Performance Comparisons

2. *Basic 3-Tab Shingles* versus *IR 3-tab Shingles:*

(FIGURE 5)

a. Class 1 UL 2218 impacts resulted in passing ratings for about 65 percent of the impact locations on the IR 3-tab shingles versus about 45 percent for the basic 3-tab shingles.

b. Class 2 UL 2218 impacts resulted in passing ratings for about 75 percent of the impact locations on the IR 3-tab shingles versus about 25 percent for the basic 3-tab shingles.

c. Class 3 UL 2218 impacts resulted in passing ratings for about 60 percent of the impact locations on the IR 3-tab shingles versus about 25 percent for the basic 3-tab shingles.

d. Class 4 UL 2218 impacts resulted in passing ratings for about 60 percent of the impact locations on the IR 3-tab shingles versus about 25 percent for the basic 3-tab shingles.

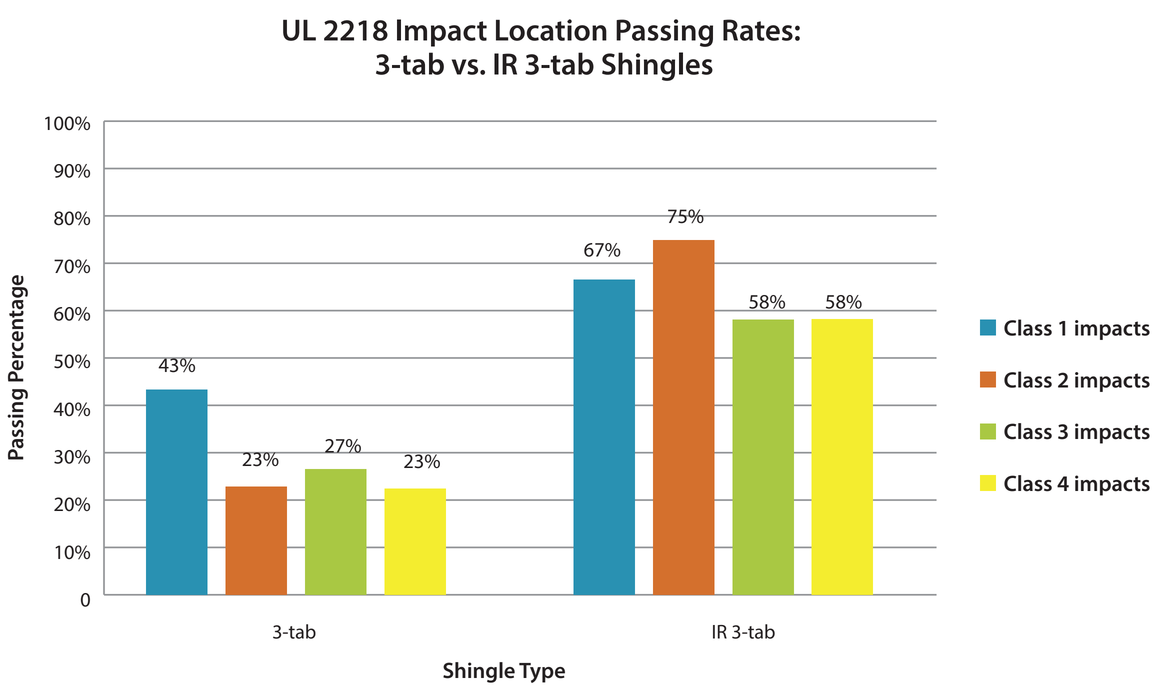


Figure 5. Comparison of basic and IR 3-tab shingle performance to Class 1-4 impacts. It should be noted that the IR products are rated to withstand Class 4 impacts.

Performance Comparisons

3. *Basic Architectural Shingles versus IR Architectural Shingles:*

(FIGURE 6)

a. Class 1 UL 2218 impacts resulted in passing ratings for about 75 percent of the impact locations on the IR architectural shingles versus about 55 percent for the basic architectural shingles.

b. Class 2 UL 2218 impacts resulted in passing ratings for about 70 percent of the impact locations on the IR architectural shingles versus about 40 percent for the basic architectural shingles.

c. Class 3 UL 2218 impacts resulted in passing ratings for about 60 percent of the impact locations on the IR architectural shingles versus about 35 percent for the basic architectural shingles.

d. Class 4 UL 2218 impacts resulted in passing ratings for about 40 percent of the impact locations on the IR architectural shingles versus about 30 percent for the basic architectural shingles.

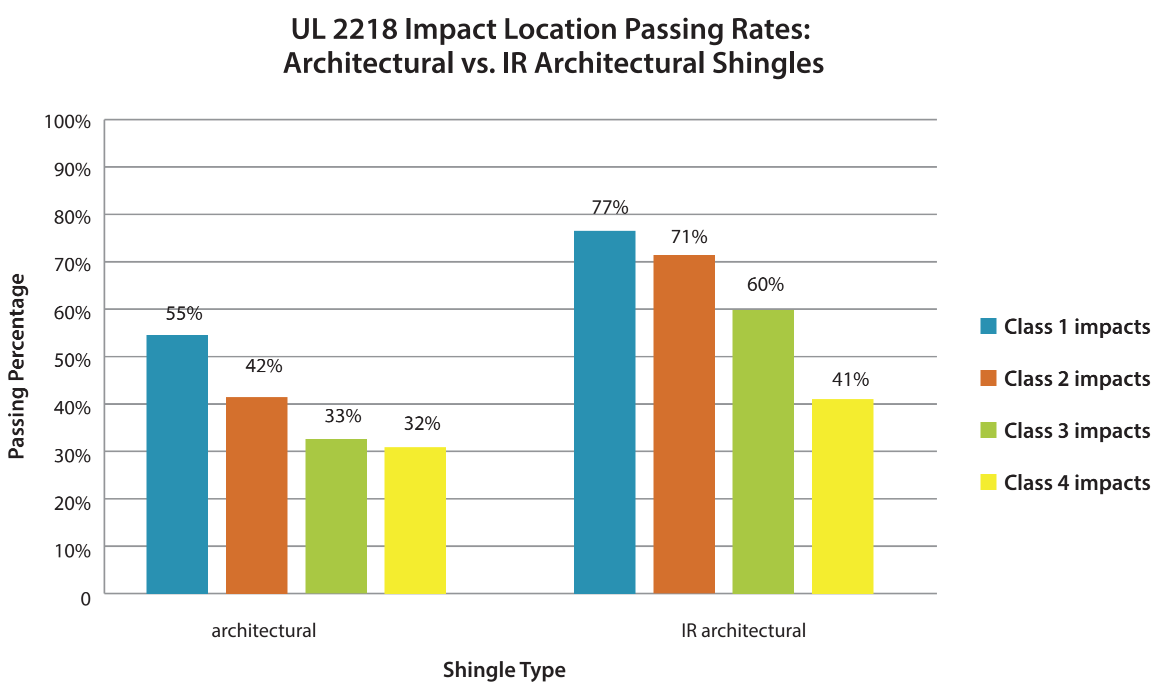


Figure 6. Comparison of basic and IR architectural shingle performance to Class 1-4 impacts. It should be noted that the IR products are rated to withstand Class 4 impacts.

Performance Comparisons

4. Premium Architectural Shingles versus *Basic and IR Architectural Shingles:*

(FIGURE 7)

a. Class 1 UL 2218 impacts resulted in passing rates for about 60 percent of the impact locations on the premium architectural shingle products.

b. Class 2 UL 2218 impacts resulted in passing ratings for about 45 percent of the impact locations on the premium architectural products.

c. Class 3 UL 2218 impacts resulted in passing ratings for about 40 percent of the impact locations on the premium architectural products.

d. Class 4 UL 2218 impacts resulted in passing ratings for about 35 percent of the impact locations on the premium architectural products.

e. In all four classes of testing, the passing rate of the premium architectural products was higher than the basic products, but lower than the passing rate of the IR products.

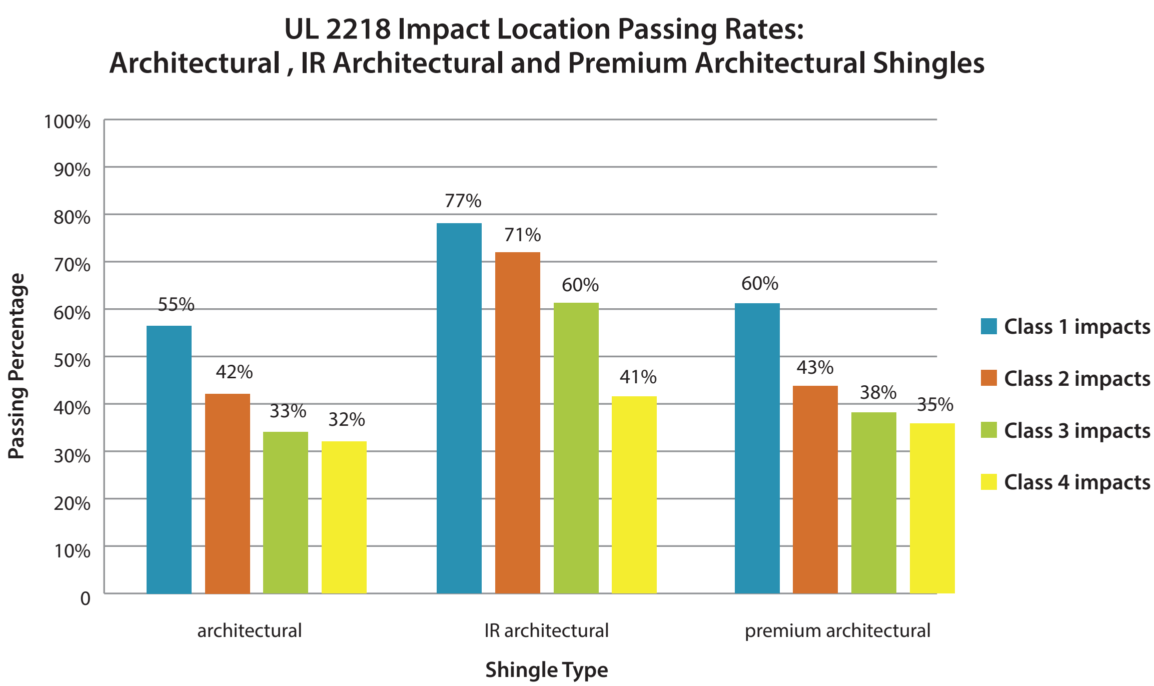


Figure 7. Comparison of basic and IR architectural shingle performance to Class 1-4 impacts. It should be noted that the IR products are rated to withstand Class 4 impacts.

Performance Comparisons

5. Polymer Modified IR Shingles versus Traditional IR Shingles:

(FIGURE 8)

a. Class 1 UL 2218 impacts resulted in passing ratings for about 85 percent of the impact locations on the polymer modified IR products compared to about 70 percent for the traditional IR shingles.

b. Class 2 UL 2218 impacts resulted in passing ratings for about 90 percent of the impact locations on the polymer modified IR products compared to about 60 percent for the traditional IR shingles.

c. Class 3 UL 2218 impacts resulted in passing ratings for about 75 percent of the impact locations on the polymer modified IR products compared to about 50 percent for the traditional IR shingles.

d. Class 4 UL 2218 impacts resulted in passing ratings for about 55 percent of the impact locations on the polymer modified IR products compared to about 35 percent for the traditional IR shingles.

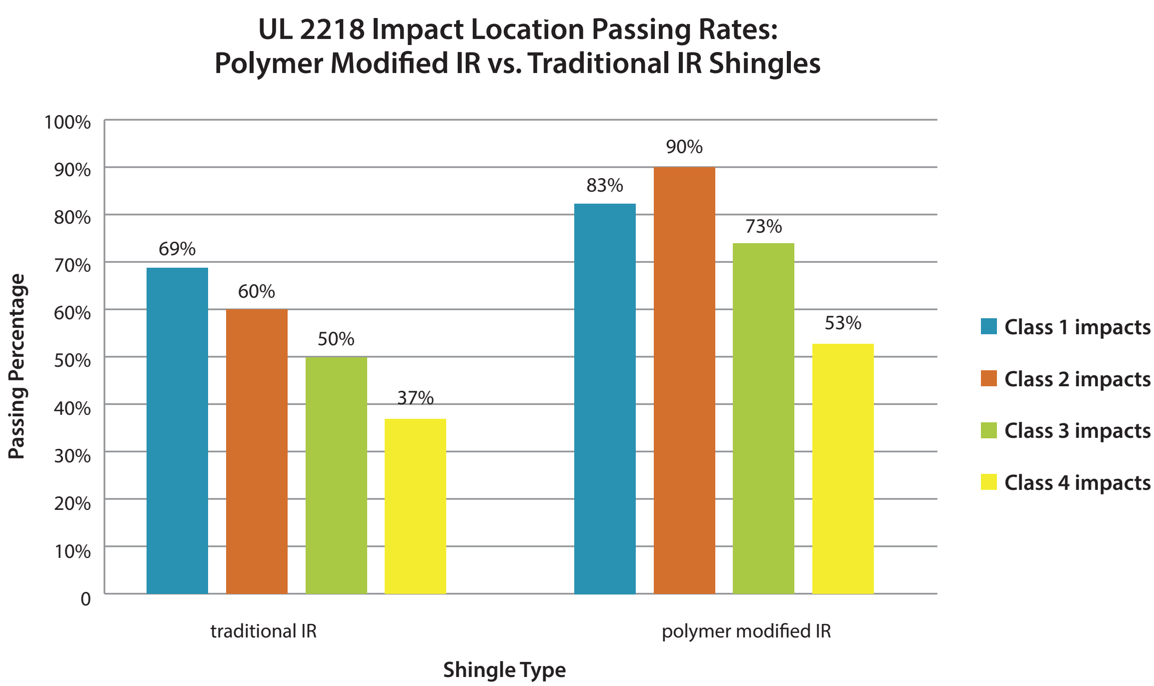


Figure 8. Comparison of traditional IR and polymer modified IR shingle performance to Class 1-4 impacts. It should be noted that these IR products are rated to withstand Class 4 impacts.

Performance Comparisons

More detailed analyses of the passing and failure modes were conducted, as it is currently unclear if some modes are more detrimental to product performance than others. Also, claims adjusters will rarely be able to view the back of shingles after a hail event without causing more damage. These passing and failure modes were defined as follows:

PASS

no tears or cracks visible on top or bottom of shingle surfaces.

PASS-TEAR TOP ONLY

tear visible on the top only at shingle edges or corners.

PASS-CRACK TOP ONLY

crack visible on the top only at shingle joints and centers.

FAIL-TEAR

tear visible on the bottom at shingle edges or corners.
A tear may or may not have been visible on the top of the shingle.

FAIL-CRACK

crack visible on the bottom at shingle joints and centers.
A crack may or may not have been visible on the top of the shingle.

An example of this more detailed analysis is provided in Figure 9 (page 14), which shows that polymer modified IR shingles perform better in each impact test class than the traditional IR shingles. From this dataset, polymer modified products are less likely than traditional products to have a crack visible on the top without also being visible on the bottom. They also are less likely to exhibit tears at edges and corners and the dominant damage mode is cracking at joints and shingle centers.

Performance Comparisons

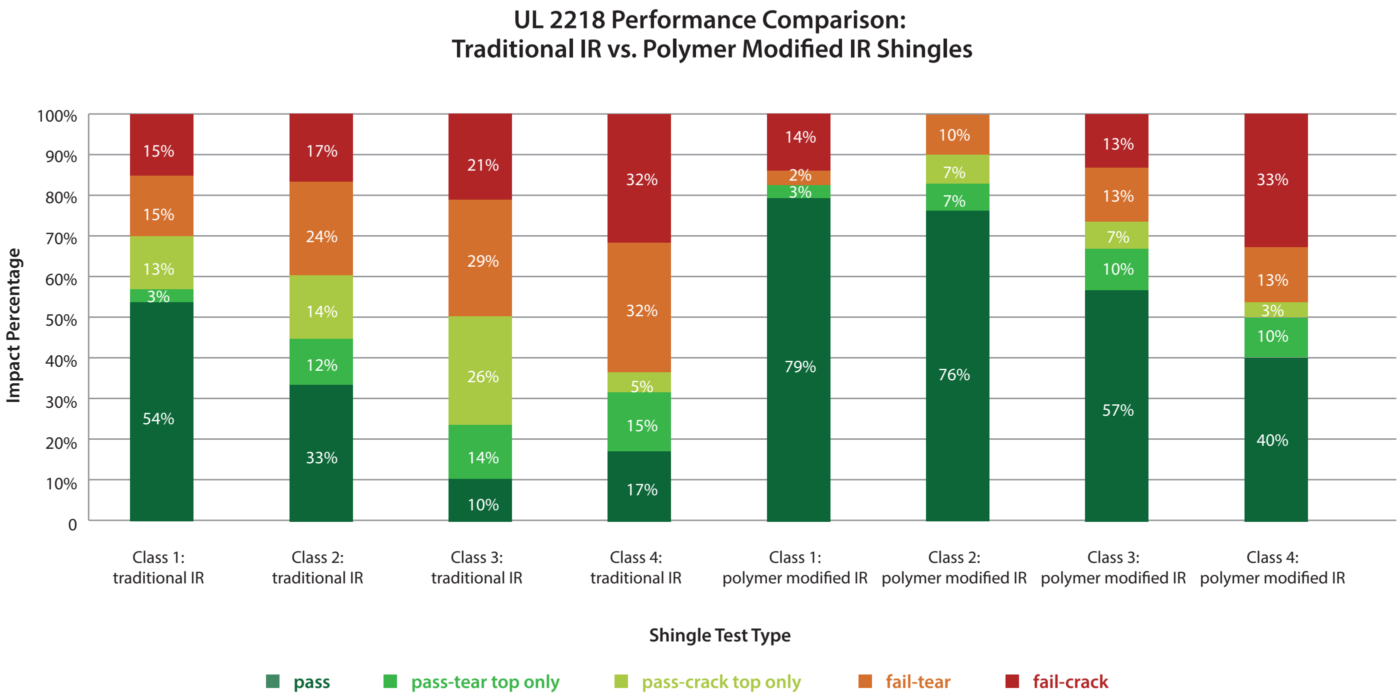


Figure 9: Detailed analysis of passing and failure modes for traditional IR and polymer modified IR shingles. It should be noted that the IR products are rated to withstand Class 4 impacts.

With the exception of two product groups, the data exhibit well-behaved declines in passing percentages with increasing steel ball sizes. The graphs suggest the basic 3-tab shingles performed better under Class 3 impacts than Class 2 impacts, and the IR 3-tab products performed better under Class 2 impacts than Class 1 impacts. However, this is likely a reflection of the variability in results given the relatively small sample sizes of six or 12 impact locations per product for each steel ball size, and two or five products in each product group. Additionally, in comparing impacts classified as "pass" as outlined above (no tears or cracks visible on top or bottom) in this testing series, with those classified in the same manner in a previous testing series, differences of about 3 percent to 30 percent were observed. It also is reasonable to expect some variation due to the subjective nature of rating the impacts. To examine these two factors, a test series is underway to evaluate the performance of multiple replicates of three shingle products (one basic architectural, one IR architectural, and one polymer modified IR architectural) when rated by multiple researchers. This test series should help to quantify expected variability in the results.

Summary and Results

Using the UL 2218 tests and performance criteria, the following results were found for the products tested:

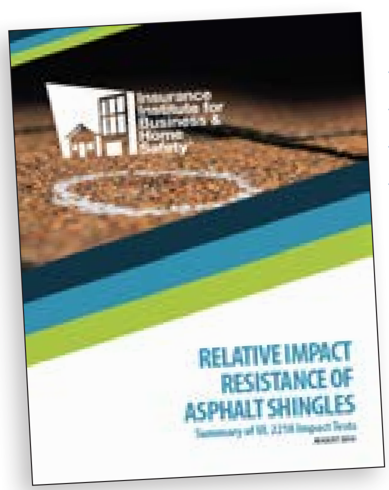
- Basic architectural shingles perform slightly better than basic 3-tab shingles (about 5 percent to 20 percent difference).
- IR 3-tab products performed better than the basic 3-tab products (about 55 percent to 225 percent better) for all steel ball impact classes. The basic products had relatively consistent passing rates for the Class 2 and larger steel ball impacts, while the IR products showed consistent passing rates for Class 3 and larger steel ball impacts.
- IR architectural products performed better than the basic architectural products (about 25 percent to 80 percent improvement) for all steel ball impact classes. The basic products showed consistent passing rates for Class 3 and 4 steel ball impacts, while the IR products showed a steady decline in performance but much higher passing rates.
- IR architectural shingles performed about the same as IR 3-tab shingles, except for Class 4 steel ball impacts, where the performance of IR 3-tab shingles was about 40 percent better than the IR architectural shingles.
- Premium architectural shingles performed slightly better than the basic architectural shingles (up to 15 percent better), but not as well as IR architectural shingles (about 15 percent to 40 percent worse) when subjected to all four steel ball impact classes. All three products showed a decline in passing rates with increasing steel ball size, but the decline began tapering off for the basic and premium products.
- Polymer modified IR shingles performed better than traditional IR shingles (about 20 percent to 50 percent improvement) for all four steel ball impact classes. This was most noticeable at the larger steel ball sizes (1.50" to 2.00") where the polymer modified shingles performed at least 40 percent better than the traditional IR shingles.

Next Steps

These results will be shared with shingle manufacturers and Underwriters Laboratory with the goal of improving shingle testing and performance. The test series to examine panel-to-panel and subjective rating variability for three sample products is ongoing. At the completion of those tests, selected asphalt shingles will be tested with pure ice spheres according to the FM 4473 test method and all 22 asphalt shingles will be tested using IBHS' own methods with more realistic laboratory hailstones. The effects of layering shingles, substrate type, aging, and the comparative performance of other roofing material types will be evaluated in the future. The effects of batch-to-batch variability in shingle performance and how the characteristics of the shingles (thickness, weight, etc.) affect impact performance are being explored. DSR

References

Underwriters Laboratory. (2012). UL 2218: Standard for impact resistance of prepared roof covering materials. UL: Northbrook, IL.



Download the full report including the Appendix at DisasterSafety.org

As Wildfire Risks Grow, So Does Wildfire Research at the IBHS Research Center

It is becoming an all-too-common story to see residents fleeing their neighborhoods and hoping for the best for their homes and businesses in the paths of wildfire. Already this year wildfires have spread across California, Alaska, Arizona, Texas, and Washington. Unfortunately, this scene is happening more frequently, and is likely to continue as extreme weather conditions are not expected to improve in the West anytime soon. The increased number of wildfires are causing more damage. The good news is there are steps residents can take to better protect their homes and businesses from this deadly disaster. The Insurance Institute for Business & Home Safety (IBHS) is conducting groundbreaking research that will decrease the risk of property damage from more frequent fires.

"The recent fires show us there are still a lot of things we can teach communities to reduce their wildfire risks," said Julie Rochman, president and CEO of IBHS. "We want to break the cycle of increasing destruction we see every year across the country."

CAL FIRE has responded to nearly 5,000 wildfires, a 26 percent increase compared to an average year of about 3,900 wildfires. Meanwhile, wildfire risks in California continue to climb as the entire state experiences, according to the U.S. Drought Monitor.

In addition, annual economic losses from wildfires have averaged $1.3 billion since 2000, almost five times the annual average of $286 million that occurred in the 1980s, according to Headwaters Economics. Meanwhile, the U.S. Forest Service and the U.S. Department of the Interior are projected to spend more than $470 million than is budgeted to fight wildfires this season, a result of overloaded fire departments.

With the growing risk, the IBHS Research Center is again at the forefront of reshaping how communities face wildfire. Previous IBHS wildfire research conducted in 2011, analyzed the effect of wind-blown wildfire embers and radiant heat on homes and building components. Now IBHS engineers are examining wildfire looking at embers once more, this time how a home's vents make it vulnerable to damage or even destruction.

"We have been focusing on the importance of embers as it relates to the ignition of homes," said Dr. Steve Quarles, IBHS senior scientist and wildfire expert. "We're interested in what makes a home vulnerable to ember exposures and how we can reduce these vulnerabilities,

Firefighters assist with the ember research during a demonstration at the IBHS Research Center. (2014)

thereby reducing property damage. One way is isolating how embers enter the vents in the attic spaces of a home. Once in the attic, embers can ignite combustible materials there, and subsequently burn the house from the inside out."

In January, Dr. Quarles and others at the IBHS Research Center conducted tests that subjected a full-scale home to realistic ember storm simulations. The goal was to better understand what types of vents and vent locations might be more vulnerable and need more protection. While Dr. Quarles is still analyzing the data and plans to issue a full report by the end of 2014. The testing has revealed three significant findings already:

- Finer mesh screens at vent openings reduce the size of ember that can enter the attic or crawl space.

- Vents with openings that are perpendicular to the wind flow (vertical orientation) are more vulnerable to the entry of wind-blown embers than vents with openings that are parallel to the wind flow (horizontal orientation).

- Even in the worst cases of observed ember entry into the attic space, wood members (trusses and plywood) did not ignite. If embers were able to accumulate next to combustible items that are commonly stored in attics, such as old magazines, clothes and cardboard boxes, ignition would be more likely. Minimizing the amount of combustible items stored in the attic (or crawl space) would reduce the chance of an ember ignition.

"It was funding from a CSAA Community Safety Foundation Grant and a collaborative effort by everyone at the IBHS Research Center that led to the success of our recent research," Dr. Quarles said. "We were able to significantly improve the performance of our ember generators and the use of technology relative to the testing system we used in 2011. "

Although more attention is being given to the vulnerabilities of homes and buildings to wildfire, more research and education is needed. IBHS will continue to conduct research on the vulnerability of homes and communities to wildfire and work with local, regional and national organizations to educate residents.

"With our unique testing facility, we have the ability to conduct realistic exposure scenarios that enable us to develop mitigation strategies that can be used by home and business owners in wildfire-prone communities," Dr. Quarles said. DSR

Embers attack an IBHS test home igniting dry vegetation during a demonstration at the IBHS Research Center. (2014)

EMC Insurance Learns Value of Business Disaster Planning from First-Hand Experience

EMC Insurance Companies has always understood the importance of business continuity planning and being prepared for the unexpected. According to Lisa Hamilton, EMC's vice president of corporate communications, they have had a business continuity plan on the books since 1989, which is updated annually. They hold regular drills, and expect members of the company's core recovery team to have hard copies of the plan at work and at home.

EMC also has encouraged its clients to use IBHS' Open for Business and new OFB-EZ (Open for Business-EZ) continuity planning programs.

On Saturday, March 29, 2014, at 12:31 a.m., they had an opportunity to put their plan into action. An historic building under renovation across the street from their headquarters in Des Moines, Iowa, caught fire and caused residual damage to three buildings in their complex.

While there are rarely upsides to such an event, the fact the fire occurred at night and on a weekend meant few employees were on site, and EMC had two days before the 1,200 employees who normally work in those buildings were expected to return to work.

When the fire occurred, the employees who were on site were evacuated by the fire department, and the facilities and operations team was immediately called to the scene. Hamilton, along with other key staff, were called into the office by 3 a.m.

The facilities team quickly had the air handlers to the buildings turned off to reduce smoke being pulled into the building, used the smoke evacuation system in the buildings, and met with the fire department to discuss protecting their buildings.

The fire department determined a section of one of their buildings was safe for use in the hours after the fire, so the core recovery team was able to establish a command base to discuss next steps.

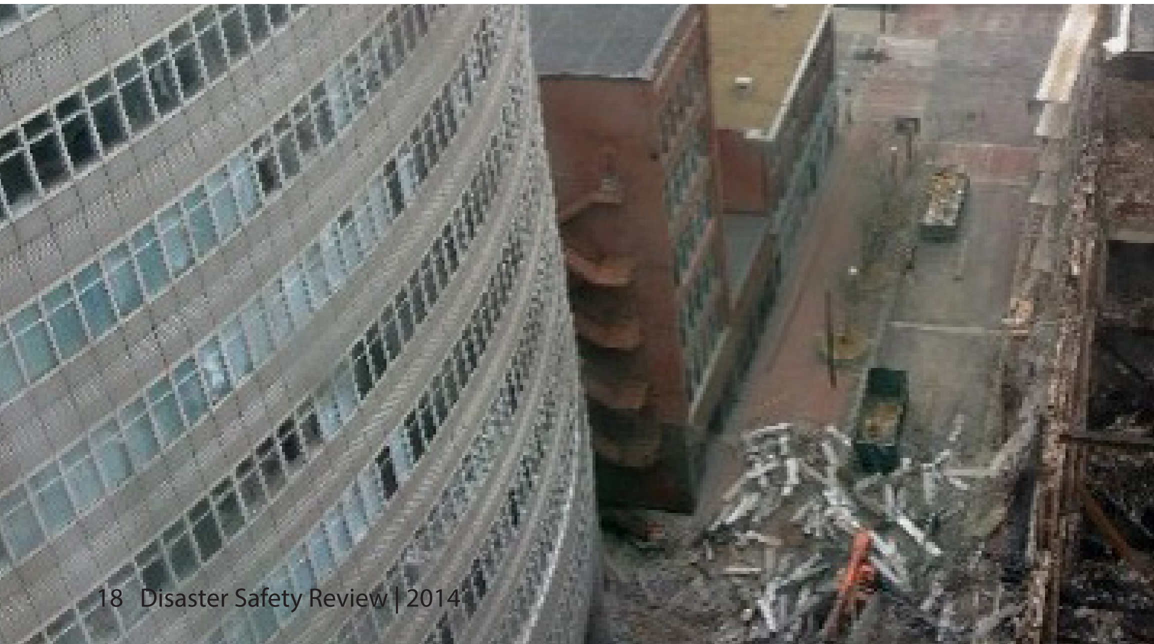
"'That morning, I remember our facilities person actually going through our disaster plan page by page, and saying here's what we do," said Hamilton.

They began posting updates to their social media pages, website, and employee remote log-in site by 5:42 a.m. the morning after the fire.

They also sent emails to all employees and held a press conference on Saturday to share their message through traditional media. Interestingly, Hamilton noted most employees found out about the fire through social media.

EMC's executive team held its first status meeting by 8 a.m. the morning of the fire and met four more times that day. By 8 p.m. the fire department allowed them to go inside the rest of the affected buildings to assess damage.

Inspection of their buildings found exterior water damage from the firefighting operations, exterior window damage in two buildings, and some ember damage on the roof of their home office building. Because they had invested in Visionwall® high performance windows, no water or smoke damage occurred inside the office space. The windows, however, cracked on the outside, which resulted in glass falling on the streets around the buildings. Consequently, many windows in both buildings had to be replaced. While significant interior damage did not occur, EMC still brought in a recovery company to clean the office space and make sure they were ready for employees. DSR



Above: Fire in progress.
Left: Aftermath of the fire, taken from EMC Insurance's Hub Tower, overlooking their damaged East Building (left) and what's left of the historic Younkers Building (right).

Building Code Breakthroughs

As a result of two very different natural disasters, the state of Mississippi and the city of Moore, Oklahoma have acted to put stronger building codes in place to protect their communities. By requiring residents to build stronger, safer and smarter, these communities will now be better prepared for future natural disasters.

MOORE, OKLAHOMA

On May 20, 2013, a deadly EF5 tornado ripped through Moore, Oklahoma, making it the third most violent storm in less than 15 years to pummel the small city, which was struck by an EF5 tornado in 1999, and an EF4 in 2003. Since the last tornado, this community has taken significant steps to rebuild stronger, safer and smarter than ever before.

Last year, the people of Moore once again demonstrated their fortitude by coming together and committing to rebuild their community. While this is not an unusual response following a severe storm, the actions taken by Moore's city leaders were unusual. Beyond promising to rebuild the same way in the same place, the Moore City Council took the unprecedented step of amending its building code to specifically address the impact of tornadoes.

Moore is the first city in the country to adopt tornado-specific building code provisions, including the use of:

- *hurricane clips or framing anchors to tie the house together more effectively;*
- *continuous wood structural panel sheathing on all exterior walls to strengthen the home, which must be attached with ring shank nails that provide considerably stronger fastening than smooth nails or staples; and*
- *garage doors that are rated to withstand winds up to 135 mph.*

All of these requirements are part of the IBHS FORTIFIED Home™ program, which establishes superior construction and retrofit standards for new and existing homes. These requirements have been proven to strengthen homes during severe high wind weather events, especially along the coast, and IBHS engineers believe it is possible to apply many of the same requirements for hurricane resistance in tornado-prone regions to greatly reduce the damage caused by EF0, EF1 and EF2 tornadoes. While these requirements won't save a home in the direct path of an EF4 or EF5 tornado, the stronger standards will help narrow the path of damage caused by a tornado. Homes built to the new code that are located on the peripheral edges of a high level tornado or near the path of a low level tornado, should definitely experience less damage because they will be properly tied together and more resistant when high winds try to tear them apart.

MISSISSIPPI

On April 2, 2014, Mississippi Governor Phil Bryant made history by signing landmark legislation that created Mississippi's first state building code law. This came just weeks after the City Council in the city of Moore, Oklahoma, adopted amendments to its building code that specifically addressed the effect of tornadoes on homes.

In Mississippi, the adoption of a state building code law was the culmination of years of hard work among state officials, insurance and housing industry insiders, and lawmakers following Hurricane Katrina's catastrophic strike on the state's Gulf Coast on August 29, 2005. In its wake, the storm left six states, including Mississippi, in tatters and caused an estimated $108 billion in insured losses.

The new law requires counties and municipalities across the state to adopt one of the last three editions of the International Building Code. However, counties and municipalities are able to opt out of adopting the new law's provisions within 120 days of the effective date, which was August 1, 2014. While there is still work to be done, Mississippi lawmakers' efforts to push this legislation through will help tremendously to improve building safety for Mississippi residents.

While the proof will be when another natural disaster strikes Moore, or Mississippi, the evidence is clear that communities with strong, well-enforced building codes have a higher level of community resilience. This, in turn, means lower disaster recovery costs overall, reduced government post-disaster aid, less property damage, and most importantly fewer lives lost. DSR

@IBHSHAILSTUDY

IN THE FIELD

Since 2012, Dr. Ian Giammanco, IBHS lead research meteorologist, along with Dr. Tanya Brown – IBHS'lead research engineer and director of hail research – has led a team of staff members and scientists to the Central Plains region of the country to follow storms that are likely to produce hailstorms to better understand the characteristics of damaging hail.

Using sophisticated custom-made equipment, the hailstones are evaluated for hardness, size, shape, and mass. The data collected is used to accurately manufacture artificial hailstones at the IBHS Research Center and through research partnerships help improve radar detection of hail and weather forecast models

In this Q&A, Dr. Giammanco talks about the eight-day deployment he and members of the IBHS Hail Field Research Team recently completed to parts of Kansas, Oklahoma, and Texas.

DSR This is the team's third year conducting a field research study. What are some differences between this deployment and previous year's?

GIAMMANCO: This mission turned out to be a little easier. The target storms weren't long distance apart. Last year, we drove from Nebraska to Texas; this time, we visited Kansas, Oklahoma, and Texas. There weren't as many early mornings or late nights.

DSR Weather forecasting isn't an exact science. How do you ensure that a storm you've targeted will produce the results you're looking for?

GIAMMANCO: The typical approach is that you target the boundaries like cold or warm fronts that provide a trigger for thunderstorms. Often you'll start north and follow a front as it moves southward. The last thing you want to do is be behind storms to start the day. If a storm develops and you're behind it, you can never catch up.

I always have a fear that we make the best forecast, but storms may fire off elsewhere and we'll not get anything. When we get a target storm to operate on, we want to take advantage, because we could miss one the next day.

DSR Last year, your keen meteorological expertise kept the team out of harm's way when a devastating EF5 tornado touched down in Moore, Okla., just miles from where you were stationed. What's the most memorable event that took place on this trip?

GIAMMANCO: The day we collected all the extremely large hail (near Waurika, Okla.). That storm produced a large swath of hail. We collected data from 13 different locations. Two stones maxed out the hardness device. I was intrigued by how large the hail was. We've seen big stones before, but not in that volume.

DSR These field studies appear to go on without a hitch and yield great results for IBHS hail research. Were there any hiccups on this deployment?

GIAMMANCO: In some instances, we didn't have great spots on the ground that were flat enough to use the instrumentation properly. And we learned that strong winds can affect the scales we use to weigh the hailstones. So we made covers for the scales to lessen the effect of the wind. Even the transportation we used (an eight-passenger minivan) wasn't the best for this type of work because at times, with all of the people and equipment, it can get really cramped and uncomfortable.

You always want to do it better, faster, without sacrificing measurement quality. In your mind, you want it to be perfect. So we'll evaluate improvements or changes are needed for the next trip.