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Testimony of

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The National Windstorm Impact Reduction Program: Strengthening Windstorm Hazard Mitigation

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Chairman Wu and members of the Subcommittee, my name is Dr. Tim Reinhold. I am the Senior Vice President of Research and Chief Engineer for the Institute for Business & Home Safety (IBHS), which is a nonprofit initiative of the U.S. property-casualty insurance industry dedicated to reducing property losses of all types. Our members write 87 percent of the property-casualty business in the country. Our research and mitigation messages are focused on earthquakes, wildfire, high-winds, hurricanes, freezing weather, and flooding. We are specifically involved in windstorm impact reduction through:

- research and testing;
- communications;
- outreach and education;
- building code development and adoption;
- data collection and analysis; and
- promotion of incentives for mitigation and disaster resistant construction.

Our members have clearly recognized the need for, and potential benefits of, significant new investments that target hazard-related research and focus on physical mitigation of buildings and structures. In response to that need, the IBHS Board of Directors this spring authorized construction of a major new independent research laboratory for which we are currently involved in a $40 million capital fundraising campaign. A central element of the laboratory will be a windstorm simulation facility capable of reproducing a variety of conditions ranging from hurricane winds and wind-driven rain, wind-blown hail, and wind-driven wildfire effects.

In addition, our members have voted to significantly increase our operating budget over the next few years. Beyond this direct investment in our own efforts, IBHS members clearly recognize the need for additional federal investments in basic and particularly applied research related to natural hazards and mitigation efforts. Specifically, IBHS as well as a number of our member companies have supported the "National Windstorm Impact Reduction Program" and IBHS provided testimony during the hearings that led to its initial authorization. It is unfortunate that no funds were ever appropriated for that program.

Risks and Vulnerability

Over the past decades, with the exception of Hurricane Katrina, we have seen dramatic drops in the loss of life during hurricanes due to better warning and evacuation systems. Warning times for tornadoes have improved in many parts of the country through the extended use of Doppler radar, and we are seeing increasing numbers of people being evacuated in areas threatened by wildfire. In contrast to the reductions in loss of life, we have seen dramatic increases in property losses as our nation concentrates more and more of its population and wealth along our vulnerable coastlines and in areas with greater risks for wildfires. It has been estimated that some 60 percent of the new homes built in the 1990s (about 8.4 million houses) were located in the Wildland Urban Interface (WUI), and are at increased risk of damage from wildfires. Furthermore, fully 50 percent of the U.S. population now lives within 50 miles of the coast, and one-third of housing units within the contiguous U.S. are currently located within the WUI.

As a result of this increased population density in vulnerable areas, we are certainly not immune to a large loss of life in a future hurricane event. Many experts are concerned that a fast developing and fast moving hurricane could produce a large loss of life among people trapped in traffic jams associated with attempts to evacuate too many people in too short a time. Ultimately, we are not likely to be able to provide enough evacuation capacity and warning time to handle the demands if population growth continues unabated. Many emergency managers would argue that we have already passed the point where mass evacuation is viable in many of the more vulnerable areas. We are also seeing large numbers of people being evacuated in front of fast-moving wildfires and have already reached the point where more people die on the roads trying to evacuate before wildfires strike than die in buildings that burn during the wildfires.

To counter the evacuation risks and the dramatic increases in property losses from hurricanes, we desperately need to build stronger and safer homes and businesses resistant to windstorm effects, including water intrusion. Stronger, storm-resistant buildings will mean that coastal inhabitants, who are not in vulnerable structures or in inundation areas where evacuation is mandatory, will not need to evacuate. In addition, property losses will be reduced and the resiliency of our communities will dramatically improve. Post-storm analysis of building performance following the 2004 and 2005 hurricane seasons has clearly demonstrated that modern engineering-based design of buildings is reducing structural damage and economic losses.

However, water intrusion and interior damage is still causing many people to be displaced from their structurally sound buildings. Unfortunately, the large inventory of properties built without any building code requirements, or using earlier inadequate codes, continues to dominate the losses whenever a storm strikes. Improved analytical tools and test methods are needed that will allow more cost-effective design for new buildings and that address water intrusion issues. Significant research is needed to address risks for existing buildings, which should include development of analytical tools and test methods to support both development and evaluation cost-effective mitigation measures.

Similarly, we need a better understanding of wildfire risks and better methods for predicting wildfire spread and community performance. There are clear indications from community assessments following recent wildfires that it is possible to design and maintain fire resistant communities. However, the assessment of risk factors still needs significant improvement. Current modeling efforts within NOAA, NIST, the U.S. Fire Service and academia need additional support. Again, the research should target the assessment of risks to existing buildings and the development of analytical tools and test methods that will support both the development and evaluation of cost-effective mitigation measures for individual properties and for community approaches to reducing risks.

Other types of windstorms, including strong thunderstorms and tornadoes, routinely represent a large portion of annual losses across our nation. While there are no clear indications that the total number of tornadoes or the strength of tornadoes is increasing, the expansion of urban and suburban areas means that the chances of a major storm affecting homes and businesses continues to increase. Building codes have tended to stay away from prescribing strengthening of buildings to resist tornadoes because the chance that a particular building will be struck are below the risk threshold usually used by building codes to prescribe minimum design requirements. Key goals for personal protection can be expressed as creating a safe place and providing time to get there before a tornado strikes. Nevertheless, some high-value properties are being specifically designed with these events in mind, and the International Code Council recently developed a shelter design standard that addresses design of both tornado and hurricane resistant shelters. The potential for large tornadoes to affect large portions of communities or a whole community have been driven home in recent years by the Oklahoma City tornado and the Greenburg, Kansas, tornado.

When it comes to the general population of buildings, there are clear indications that modest strengthening of connections could reduce structural damage in the more frequent weaker tornadoes. About 87 percent of the land area affected by tornadoes or other thunderstorm-related wind events experience nominal wind speeds below those associated with a moderate hurricane. Even the most intense EF-4 or EF-5 tornados produce large variations in wind speeds, with significant areas around the periphery of the storm being affected by lower wind speeds. There are clearly differences in the wind structure of these storms. NOAA and NOAA/NSF funded academic research to investigate the structure of these storms is needed. NIST and NSF funded research is also needed to investigate the corresponding wind-structure interaction. This research is needed to assess the implications for design of building components, connections and systems when additional protection is desired.

Experience over the past several decades and projections for the future all indicate that damage and losses from hurricanes, tornadoes and wildfires are all expected to increase. Most of that growth is related to increased concentration of population and property values in risky areas. Improvements in the design and construction of new homes and communities, and the implementation of mitigation measures for existing buildings and communities, are the most effective means for actually decreasing the losses and impacts on communities. Improved predictive tools for communicating risk and for providing advance warning so that last-minute preparations can be taken and safe evacuation accomplished also play an important role.

Mitigation Research

As indicated above, a major emphasis of future research should be on developing improved predictive tools and test methods that address the specific characteristics and risks of each of the hazards. Progress has clearly been made in defining general problems and vulnerabilities; but, as we move to the level of a specific community and then to a specific structure, predictive tools lose their ability to address specific vulnerabilities, to assign loss estimates to those vulnerabilities and to establish clear cost-benefit estimates for mitigation measures.

In order to better assess various mitigation measures and to establish priorities, significant research is needed that will enhance existing or develop new test methods, analytical tools and system approaches to integrating the vulnerability assessments. Given the state of the art, I would suggest an almost equal investment of resources in short-term and long-term efforts. There will have to be a coupling between knowledge gained from research into the nature of the risks with analytical tools and test methods to assure that the salient physical factors are adequately included.

Parallel efforts can be effective. We need to revisit and carefully review current test methods and analytical tools in light of recent observations from post-event assessments. This will assure that any limitations and possible relationships between laboratory or computer simulations and field experience are clearly defined. At the same time, additional research is clearly needed on the nature of the threats posed by the different hazards and of the physical characteristics that are potentially important to performance of buildings when they are exposed to the hazards.

A major emphasis of the research should be directed towards system effects and system performance so that the roles of various vulnerabilities can be properly assessed within an overall performance-based analysis. The research should focus on more complete definition of the phenomenon involved in the basic hazards and on the interaction of those hazards with the built environment. Initial high-level assessment and tools can help in the short-term, but ultimately, the assessments and tools must be built upon a very granular foundation that properly accounts for individual elements within the context of the system performance.

Case studies and demonstration projects, similar to those employed in building energy research, should be a part of the program. Durability and performance in extreme events after years of exposure to the elements must be factored into assessment of products and systems. We must move beyond assessments that are limited to new unused products and account for the effects of aging.

Much of the private industry research and development as it applies to wind hazards has focused on meeting existing test standards so that products can obtain product approvals necessary to allow their use in building construction. There are some ongoing efforts to look at new test methods and performance issues within government laboratories and academic institutions and to some extent by industry associations.

Implementation of the National Wind Impact Reduction Program

In a real sense, the National Wind Impact Reduction Program (NWIRP) has never been implemented in any meaningful way because no funds were ever appropriated for the program. Nevertheless, there has been some progress in windstorm-related research through activities of individual agencies using existing authority and budgets and through several earmarks that have directed budgeted resources to academic organizations at the expense of agency activities and priorities. Significant advances include the measurement of meteorological parameters in hurricanes, around the periphery of tornadoes, and in wildfire regions and in improving the understanding of wind loads and wind effects. However, these efforts have been fragmented and of limited scale due to lack of resources. Consequently, they have generally not provided the level of detailed information needed to significantly improve our understanding of all of the important parameters or significantly improve assessment tools or modeling of the events.

Some specific examples are described below. FEMA has produced a series of best practice documents following some of the major hurricanes and other windstorm events and has developed a powerful general risk assessment tool through HAZUS-MH. However, significant work is still needed before it will be particularly useful for evaluating individual properties. NIST has been working on a database assisted tool for improving the assessment of wind loads on structures that should be an important resource for improving load definitions in future editions of the model building codes. NIST also has been working on a detailed model of wildfires that includes the kind of detailed granular structure needed to create a useful predictive tool. Again, this tool may have its greatest use in improving future wildfire related building code requirements and in the assessment of mitigation measures.

NIST-related earmarks have funded research initiatives at Texas Tech University and for one year at a consortium of universities that included Clemson University, the University of Florida and Virginia Tech. The research conducted through these earmarks have contributed to improved understanding of wind loads and wind characteristics that are beginning to find their way into proposed building code changes. The NSF has funded a number of research initiatives, including one through PATH funding that has targeted water intrusion research. NOAA has been continuing its work on forecast enhancements and through earmarks has funded some of the land-based deployments of instruments to measure wind conditions in hurricanes. The National Sea Grant Program of NOAA also has funded a number of research efforts aimed at improving the resilience of coastal properties and the evaluation of mitigation options for existing buildings.

There has been some level of coordination of these various research activities between individual agencies and in particular between researchers at the various agencies. For example, NSF has funded the water intrusion research through funding associated with HUD's PATH program using jointly established priorities. NIST is working with NOAA and with the U.S. Fire Service on its modeling of wildfire risks. However, there has not been the level of coordination originally envisioned by a fully developed and fully funded NWIRP.

As Congress looks towards reauthorization of the NWIRP, we would suggest that it concentrate the efforts in three areas.

- The first is development of enhanced understanding of the events, including better definition of parameters that are important to the design and performance of the built environment. For hurricanes, this can include ability to forecast tracks and intensities of events, but it should go beyond that to include characterization of storm characteristics such as wind turbulence, gust structure, and wind-driven rain characteristics and quantity. For wildfires, it would include the influence of topography and terrain roughness on the local wind climate, turbulence associated with the flow, and influence of burning vegetation and houses on winds in a community. For tornadoes, it could include better definition of the wind field near the ground surface.

- The second area is research directed at better understanding and modeling of the interaction of the events with the built environment. For hurricanes, this would include the influence of wind characteristics and water droplet size distributions on wind loads and water intrusion, respectively. For wildfire, it would include the influence of wind on ignition points, fire intensity and heat transfer, as well as the ability of firefighters to influence the risks. For tornadoes, it would include the influence of the wind field characteristics on wind loads and a better understanding of the required strength of components and connections to resist these loads and effects.

- The third area is the research aimed at improving building codes, developing effective mitigation measures and analysis tools to improve design efficiency as well as assess the benefits of mitigation measures or design requirements on both component and system performance. This research also should target the resilience of transportation and lifelines systems as they are essential to the quick recovery of individuals and communities.

We would suggest that the legislation designate a lead agency and provide more balance in the suggested funding that will emphasize the mitigation-related research efforts. Ultimately, we need to reduce the losses and disruptions that accompany these events in order to protect our citizens and stabilize our communities and economy. The NWIRP should have as its core focus activities which support that mission. Consequently, from our perspective, NIST should be the lead agency but funding and coordination should extend at least to NOAA, NSF, FEMA, HUD and the FHWA.

Technology Transfer

The main obstacles to widespread implementation of windstorm mitigation techniques in new and existing structures relate directly to issues of complacency, education, research and demonstration of cost effectiveness of the measures. Throughout the country, homeowners are, in general, complacent about their exposure to extreme windstorms or they believe there is little that can be done to provide protection from the most intense storms where people frequently are killed or injured. People who live in central Florida have typically said that the real risk is in South Florida, or the Panhandle. Likewise, builders and legislators who live and work in the Florida Panhandle think that they are protected by a shelf of cooler water off their coast and that the real risk in the Keys or in the Carolinas. A major problem is that the typical return periods between major storms is such that people do not think it will happen to them.

Because of this low perception of threat from windstorms, consumers are less likely to spend the money required to make their homes more resistant to windstorms – especially when they can spend their money on upgrades they can enjoy everyday like granite counter tops and hardwood floors. The competition to spend extra money on home improvements rarely results in mitigation efforts winning out. There is a fundamental need to create reliable tools that will provide accurate estimates of the benefits of mitigation measures as well as the costs. There is also a critical need for social science research to help guide the mitigation programs so that solutions are also implemented.

Lack of data and research on the benefits of mitigation and strong building codes also poses a barrier to the implementation of mitigation measures. The data that insurers collect as a part of the claims process following a major wind event relates mainly to documenting the damage that the policyholder needs compensation for and making sure the insured is compensated according to the policy coverage in a timely manner. The role of the insurance adjustor in such a scenario is to document, estimate and pay or arrange for payment of covered expenses. Typically there are extreme time constraints placed on the adjustors and the companies they represent to review properties and act on claims in a short timeframe. Given these responsibilities, it becomes too onerous (particularly in a catastrophe when large amounts of disaster victims need to begin their recovery) to expect that the adjustor would be able to determine and document the actual causes of loss and identify mitigation measures that could have prevented or reduced the damage. Because of this, insurance data alone provides little insight into the impact that wind mitigation can have on total losses.

In order to produce meaningful data to assess the effect of windstorm mitigation activities, several things need to be known. First, the actual wind speed and the characteristics of the wind that the building was exposed to needs to be known. Then, details as to what parts of the building failed due to excessive wind force need to be documented and most probable causes of initiation of failure need to be identified. By comparing the wind speed with a careful study of the failures, researchers can begin to make credible quantifications of the potential benefits of windstorm mitigation.

Unfortunately, many of the NOAA Automatic Surface Observing Systems (ASOS) lose power and stop recording or reporting wind speed data during severe wind storms. There is a clear national need to harden these systems and provide backup power so that NOAA and all those affected by these storms have better data on surface winds in various areas impacted by the storms.

A number of barriers to constructing stronger and safer structures also relate to the adoption and enforcement of building codes and standards.

- First, a large number of local communities throughout the nation have not adopted any building codes and standards for residential construction.
- Second, a large majority of local communities have not adopted the latest model building codes without any local amendments that weaken the model provisions.
- Third, while there is more widespread adoption of model building codes and standards for commercial properties, there are again many local jurisdictions where code adoption is non-existent or woefully out of date.

Uniform and strong enforcement is another key issue, even in local communities that have adopted the latest standards. This lack of uniformity in the baseline for construction of homes and businesses means that the performance of buildings is less predictable and the levels of risk vary dramatically from jurisdiction to jurisdiction. We find that responsible builders have difficulties competing in areas where there are no building codes, which leads to building to the lowest denominator. Furthermore, we see national builders building differently in areas with identical design wind speeds, simply because the local building code adopted in a particular area does not require the same level of construction as the national model building code being enforced in the other area. All too often, the local building code is treated as the maximum rather than the minimum.

While issues of states' rights and local authority generally keep federal agencies from trying to mandate building codes, except for federal buildings, there are opportunities for the federal government to initiate a number of incentives that would encourage states to adopt and enforce statewide building codes without local amendments that weaken the minimum requirements. For example, FEMA could use the adoption and enforcement of statewide building codes as criteria for providing additional pre- and post-disaster mitigation funds to states. Federal mortgage agencies could provide lower interest rates or lower fees for mortgages on properties built to the latest building codes and standards.

Finally, many of the test and evaluation methods available for assessing the windstorm performance and durability of materials, components and systems fall short in reproducing the true nature of the loads and effects of severe windstorms and/or the effects of environmental factors on aging and associated degradation of windstorm resistance. Federal agencies can play an important role in funding research and developing facilities that will allow the more realistic simulation of windstorm loads and effects, and in the development of tools and facilities for assessing the effects of aging. Some efforts along these lines have been supported through the Partnership for Advancing Technology in Housing (PATH) through research and grants initiated by the National Institute for Standards and Technology and the National Science Foundation. Much more work is needed.

Conclusion

Windstorms and other natural disasters happen every year in the United States, and impact thousands of homeowners and businesses. Yet we do know how to build homes and commercial structures so that the losses and damage caused by natural disasters are significantly reduced. Ongoing research teaches us more every year, and ongoing communication and public education has the potential to reduce losses every year. All of the stakeholders can contribute to the creation of a climate where hazard resistant construction is valued and demanded and where a myriad of incentives are offered that will encourage local communities and states to build hazard resistant communities that become known for their resiliency in the face of severe windstorms or other natural and manmade hazards.

There are clear opportunities for the federal government to support research and the removal of barriers to the development of hazard resistant construction. We believe that the best road forward is through a coordinated multi-agency research initiative with significant new funds under the umbrella of the NWIRP.

Thank you very much. I would be happy to answer any questions you may have.