FEDERAL EFFORTS TO REDUCE THE IMPACTS OF WINDSTORMS

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH &
SUBCOMMITTEE ON TECHNOLOGY

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

FIRST SESSION

WEDNESDAY, JUNE 5, 2013

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FEDERAL EFFORTS TO REDUCE THE IMPACTS OF WINDSTORMS

WEDNESDAY, JUNE 5, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH &
SUBCOMMITTEE ON TECHNOLOGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittees met, pursuant to call, at 10:03 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Larry Bucshon [Chairman of the Subcommittee on Research] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

Congress of the United States
House of Representatives

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Subcommittees on Research and Technology Hearing

Federal Efforts to Reduce the Impacts of Windstorms

Wednesday, June 5, 2013
10:00am-12:00pm
2318 Rayburn House Office Building

Witnesses

Dr. Ernst Kiesling, Research Faculty, National Wind Institute, Texas Tech University

Ms. Debra Ballen, General Counsel and Senior Vice President, Public Policy, Insurance Institute for Business & Home Safety

Dr. David Prevatt, Assistant Professor, Department of Civil and Coastal Engineering, University of Florida

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
SUBCOMMITTEES ON RESEARCH AND TECHNOLOGY

Federal Efforts to Reduce the Impacts of Windstorms

Wednesday, June 5, 2013
10:00am-12:00pm
2318 Rayburn House Office Building

Purpose

On Wednesday, June 5, 2013, the Subcommittees on Research and Technology will examine the current role of research and development in mitigating the damaging effects of windstorms across the Nation and the methods of transferring the results of research into practice for stakeholders including building code developers, builders, and property owners. The hearing will review the activities of the National Windstorm Impact Reduction Program (NWIRP), a multi-agency program between the National Institute of Standards and Technology (NIST), the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the National Science Foundation (NSF). The hearing will also review a bill to re-authorize this program--H.R. 1786, The National Windstorm Impact Reduction Act Reauthorization of 2013, sponsored by Rep. Randy Neugebauer.

Witnesses

- **Dr. Ernst Kiesling,** Research Faculty, National Wind Institute, Texas Tech University
- **Ms. Debra Ballen,** General Counsel and Senior Vice President, Public Policy, Insurance Institute for Business & Home Safety
- **Dr. David Prevatt,** Assistant Professor, Department of Civil and Coastal Engineering, University of Florida

Background

Wind hazards—which include tornados, hurricanes, and derechos—are threats to all fifty states and cause injuries, deaths, economic disruptions, and property damage. In a statistical summary for 2012 released last month, the National Weather Service (part of NOAA) reported that 641 Americans die annually (10-year average) from weather-related injuries with wind hazards representing, by far, the largest cause.[1] Hurricanes also dominate property estimates.[2] Although the number of wind hazard-related deaths has decreased, the costs of these disasters continue to rise.[3] In 2005, the National Science and Technology Council found that, "[d]ue to changes in population demographics and more complex weather-sensitive infrastructure, Americans today are more vulnerable than ever to severe weather events."[4]

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[1] National Weather Service, "Summary of Natural Hazard Statistics for 2012 in the United States," (May 2013) http://www.nws.noaa.gov/om/hazstats/sum12.pdf
[2] *Id.*
[3] National Science and Technology Council, Committee on Environment and Natural Resources, Subcommittee on Disaster Reduction, "Grand Challenges for Disaster Reduction" (June 2005), pg. 1, *available at* http://www.sdr.gov/docs/GrandChallengesSecondPrinting.pdf
[4] *Id.* at 4.

The National Windstorm Impact Reduction Program (NWIRP)

The NWIRP was originally established in 2004 by the National Windstorm Impact Reduction Act of 2004 (P.L. 108-360), authored by Rep. Randy Neugebauer. NWIRP's objective is to achieve measurable reductions in losses of life and property from windstorms through coordinated Federal multi-agency research efforts, in cooperation with other levels of government, academia, and the private sector. It emphasized the improved understanding of windstorms and their impact, and the development and implementation of cost-effective mitigation measures to reduce those impacts while promoting community resilience.[5]

The program authorized the National Institute of Standards and Technology (NIST), the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the National Science Foundation (NSF) to support activities that improve the understanding of windstorms and their impacts. The program was authorized for three years—through FY 2008.

NIST's role in NWIRP is to support research and development to improve building codes, standards, and practices for buildings, structures, and lifelines. To fulfill this role, NIST has engaged in the development of: software and procedures to facilitate the use of automated wind impact sensors on buildings; computational tools for determining realistic wind loads on buildings; and methodologies for predicting ultimate structural capacities.

FEMA's role in NWIRP is to support the development of risk assessment tools and effective mitigation techniques; data collection and analysis after windstorm events; and outreach to facilitate mitigation measures. Activities identified by FEMA that meet these goals include: update and development of HAZUS, a modeling tool for communities to estimate damage, economic loss, and social impacts of storms; Mitigation Assessment Team (MAT) studies of building performance after major storms; construction guidance for building in vulnerable coastal areas and storm shelters; and cooperation with NOAA to improve evacuation planning for hurricanes.

NOAA's role in NWIRP is to support atmospheric sciences research to improve the understanding of windstorms and their impacts. Aligned with NWIRP's goals, NOAA performs education and outreach related to hazards through Sea Grant institutions and other means; supports research and operations at the National Weather Center for improved prediction and monitoring of severe storms and hazardous winds; gathers field data on hurricane dynamics; develops probes and other monitoring equipment for data collection in extreme weather; develops decision support tools that map wind-speeds; provides information and planning assistance to increase community storm resiliency; and participates on the U.S.-Japan Panel on Wind and Seismic Effects.

NSF's role in NWIRP is to support basic research on engineering and the atmospheric sciences to improve the understanding of windstorms and their impacts on the built environment

[5] National Science and Technology Council, "Windstorm Impact Reduction Implementation Plan" (2006), pg. 3, *available at* http://www.whitehouse.gov/sites/default/files/microsites/ostp/windstorm_impact_reduction_implementation_plan_final.pdf

and lifelines. To that end, NSF has funded research in the atmospheric dynamics that form storms and hazardous winds; document and preserve engineering data on buildings following wind hazard events; and perform social science research about how people respond to wind hazard warnings to gain a better understanding of evacuations.

H.R. 1786, introduced by Rep Neugebauer (R-TX) in the 113th Congress, re-authorizes the NWIRP program; assigns responsibilities to the agencies that make up the program; requires a strategic plan; sunsets the NWIRP advisory committee at the end of the authorization period; authorizes funding for the programs through FY 2016; and transfers the leadership of the NWIRP program from the Office of Science and Technology Policy (OSTP) to NIST.

Issues of Concern

The costs associated with windstorms are increasing, but limited Federal research funding is focused on understanding windstorms and their impacts and developing mitigation measures. OSTP's 2006 NWIRP Implementation Plan strongly recommended a coordinated effort for research and development to reduce hazards from windstorms. The limited research that NSF, NIST, NOAA, and FEMA have supported in wind hazards requires a greater level of coordination.

Long-term research on hazard reduction may achieve a reduction in the massive economic losses from windstorms; however, researchers in the wind engineering community point to a consistent lack of funding as a cause in the decline in the number of graduate students and professors in the wind engineering profession and as a hindrance to advancing knowledge that would have useful applications in reducing losses from windstorms.[6]

Research and development on improving the resilience of structures to windstorms may be available, but model building codes are not always adopted by states. For example, in 2012, the Insurance Institute for Business & Home Safety (IBHS) analyzed the residential building codes in 18 hurricane-prone coastal states along the Gulf of Mexico and the Atlantic Coast and found that while some states have implemented well-developed systems for all aspects of code adoption and enforcement, others have virtually no regulatory process in place for building codes.[7]

Summary

The hearing will examine ways to improve the existing federal wind research and development portfolio, advance an understanding of the gaps in wind research and development, and explore how to reduce the loss of life and economic losses the United States currently experiences from windstorms.

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[6] *See* RAND, "Assessing Federal Research and Development for Hazard Loss Reduction" (2003), *available at* http://www.prgs.edu/content/dam/rand/pubs/monograph_reports/2005/MR1734.pdf.
[7] *See* Insurance Institute for Business and Home Safety, "Rating the States" (2011), *available at* http://www.disastersafety.org/building_codes/rating-the-states_ibhs/.

Chairman BUCSHON. Good morning, everyone. This joint hearing of the Subcommittee on Research and the Subcommittee on Technology will come to order.

Good morning, and welcome to today's joint hearing entitled "Federal Efforts to Reduce the Impacts of Windstorms." In front of you are packets containing the written testimony, biographies and Truth in Testimony disclosures for today's witnesses.

Before we get started, since this is a joint hearing involving two Subcommittees, I want to explain how we will operate procedurally so all Members understand how the question-and-answer session period will be handled. The Chairmen and Ranking Members of the Research and Technology Subcommittees will be recognized first. Then we will recognize Members of the two Subcommittees present at the gavel in order of seniority on the full Committee, and those coming in after the gavel will be recognized in order of their arrival. I now recognize myself for five minutes for an opening statement.

Today's hearing will focus on how we can reduce the impacts of debilitating storms on our communities across the country. Even with improved forecasting capabilities and awareness, these storms can be unexpected and leave a trail of destruction in their paths. In addition to literally destroying lives, these windstorms shut down entire economies of a region during the time it takes to rebuild. Structures, while more resilient that they used to be, are still often not built to sustain high winds or storm damage that may follow these storms. Building codes, practices and performance standards can help, but oftentimes retrofitting an existing building is simply too costly given the relatively small risk of a direct hit of a windstorm.

Federal agencies currently conduct research and development to help inform the resilience of buildings and communities, but it is not clear how each agency is conducting unique work that is not duplicated by another agency. I believe that a coordinated mechanism would help shed light into what is going on at the Federal level, and how it can be strengthened to ensure better coordination.

Every year the Federal Government funds not only disaster relief but also billions of dollars in emergency supplemental appropriations when states are hit particularly hard by unexpected disasters. I believe that we need to be more responsible about planning how to deal with natural disasters. I am curious to hear from our witnesses if they believe better research could cut down on the dollar figure.

Since the time that my colleague, Representative Neugebauer, introduced his windstorm research bill in late April, several Midwestern states have endured significant damage and loss of lives from powerful tornadoes. I would now like to yield to Representative Neugebauer for him to share some background on that legislation.

[The prepared statement of Mr. Bucshon follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON RESEARCH CHAIRMAN LARRY BUCSHON

Good morning, I would like to welcome everyone to our hearing.

Today's hearing will focus on how we can reduce the impacts of debilitating storms on our communities across the country. Even with improved forecasting ca-

pabilities and awareness, these storms can be unexpected and leave a trail of destruction in their paths.

In addition to literally destroying lives, these windstorms shut down entire economies of a region during the time it takes to rebuild. Structures, while more resilient that they used to be, are still often not build to sustain high winds or the storm surge that may follow these storms. Building codes, practices, and performance standards can help, but oftentimes retrofitting an existing building is simply too costly given the relatively small risk of a direct hit of a windstorm.

Federal agencies currently conduct research and development to help inform the resilience of buildings and communities, but it is not clear how each agency is conducting unique work that is not duplicated by another agency. I believe that a coordination mechanism would help shed light into what is going on at the federal level, and how it can be strengthened to ensure better coordination.

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We have a panel of witnesses before us who can articulate what it will take to cut down on the economic impacts and lives lost from these storms. I would like to extend my appreciation to each of our witnesses for taking the time and effort to appear before us today. We look forward to your testimony.

Mr. NEUGEBAUER. Thank you, Mr. Chairman, and I appreciate you holding this important hearing today, and you know, one of the things that we know about wind, particularly in West Texas, where I am from, wind can be your friend or it can be your foe, and out in West Texas right now, my congressional district, for example, probably has the largest concentration of wind production for electricity really in the world, and so that is the time when it is our friend, but where it can be our foe is obviously when we have seen these deadly tornados that have occurred in Texas and Oklahoma and other states recently. And over the history we have seen where hurricanes and windstorms and tornados have caused a tremendous amount of property damage, but more importantly, it has caused the loss of lives. I think it is estimated that every year there is about 80 deaths and 1,500 injuries. I think in 2011, there were 551 fatalities. It was not particularly a good year, and unfortunately, we are kind of off to a rough start this year.

And so what makes sense is to take research and technology and figure out ways to incorporate into our construction techniques a way to protect both the people that habitate those facilities but also to protect and mitigate the damage. As the Chairman mentioned, you know, it causes billions of dollars worth of damage, and if we can mitigate that, it obviously saves that money for not only the taxpayers but for the people that own those properties.

I am particularly delighted with the esteemed, great panel that we have today, and particularly my good friend for a long time, from Texas Tech, Dr. Kiesling, and for his pioneering work on, you know, the mitigation of wind.

So with that, the reason that I introduced in 2004 the National Windstorm Impact Reduction Act basically to try to coordinate all of the research that is going on and make sure that—one of the things that I feel very strongly about is that it is one thing to do the research but then we have to commercialize and use that re-

search, and I think one of the things that we have seen is a lot of the research that had been done across the country has been able to be commercialized, and I am hopeful to hear more about that today.

But NWIRP basically does another thing too that I think is important, and that is to make sure that we are efficiently using the taxpayers' money and coordinating this. So many times we have seen in all agencies everybody kind of has their turf, and since the wind issue has a lot of different parts to it, it makes sense to make sure that there is coordination going on among the various participants that are involved in that. So this bill, I think, is going to help protect lives, I think it is going to reduce property losses but, more importantly, it also makes sure that there is good coordination so that when we do come up with good ideas, that we can make sure that we commercialize them and that we can utilize that information in the future.

So Mr. Chairman, thank you so much for having this important hearing, and I look forward to hearing from these witnesses.

[The prepared statement of Mr. Neugebauer follows:]

PREPARED STATEMENT OF REPRESENTATIVE RANDY NEUGEBAUER

Thank you, Mr. Chairman, for holding this hearing today on federal efforts to reduce the impacts of windstorms. This is an extremely important topic, particularly in light of the devastating tornado that tore through Moore, Oklahoma. According to the National Weather Service, that tornado was the widest ever recorded and one of the strongest. I'm looking forward to hearing testimony from today's witnesses about federal research and development priorities in relation to tornadoes and other windstorms.

In particular, I'd like to welcome Dr. Ernst Kiesling from the National Wind Institute at Texas Tech University. As a fellow Red Raider myself, I have seen firsthand the tremendous research that Dr. Kiesling and his colleagues are pursuing that will continue to help saves lives and reduce property damage from windstorms.

Windstorms can be devastating: every year, there are about 80 deaths and 1,500 injuries from tornadoes. Two Thousand Eleven was an especially bad year, with 551 fatalities caused by tornadoes alone. The property destruction is also devastating. When a family loses their home in a windstorm, they don't just have to rebuild their house—they have to rebuild their lives.

That's why the research like that being done at the Texas Tech National Wind Institute and elsewhere is so critical. It is helping us better understand the mechanics of windstorms, and teaching us how to build stronger, safer shelters.

The National Science and Technology Council has stated that America's primary focus on disaster response is "an impractical and inefficient strategy for dealing with these ongoing threats. Instead, communities must break the cycle of destruction and recovery by enhancing their disaster resilience." This bill would help ensure that the federal government is adequately addressing disaster resilience and mitigation, which is critical to reducing the costs of disasters to taxpayers.

I first authored the bill that created NWIRP back in 2004. NWIRP helps to improve building codes, voluntary standards, and construction practices for buildings and homes. It also supports basic research to better understand windstorms, atmospheric science research and data collection, and the development of risk assessment tools and mitigation techniques. Since 2008 when the original authorization expired, NIST, NSF, NOAA, and FEMA have been conducting related activities, but have had no direction from Congress on the actual NWIRP program or what specific research it should be conducting.

My bill, H.R. 1786, is first and foremost a bill that ensures smart and efficient use of taxpayer dollars. It reauthorizes and improves NWIRP by clarifying research priorities, enhancing coordination between these agencies, and establishing stronger reporting criteria. The bill makes NIST the lead agency. This will lead to a clearer mission for the program and ensure proper accountability to taxpayers. It will also prevent duplicative research across the agencies. It also creates a National Advisory Committee on windstorm impact reduction, made up of unpaid, non-federal em-

ployee experts to offer recommendations on the program and its priorities. This ensures that industry and scientific recommendations are taken into account when guiding the direction of NWIRP, leading to a leaner and more effective program. Lastly, it creates an Interagency Coordination Committee, chaired by the Director of NIST, to develop a strategic plan, coordinate budgets, and report on the progress of the program. This will help Congress keep better track of NWIRP and guarantee transparency and wise use of taxpayer dollars.

I'm looking forward to the testimony today and hope that the Committee will take up and pass H.R. 1786 as soon as possible. Thank you Mr. Chairman.

Chairman BUCSHON. Thank you. We have a panel of witnesses before us who can articulate what it will take to cut down on the economic impact and lives lost from these storms. I would like to extend my appreciation to each of the witnesses for taking the time and effort to appear before us today. We look forward to your testimony.

I now recognize Ms. Wilson for her opening statement.

Ms. WILSON. Thank you, Chairman Bucshon and Chairman Massie, for holding today's hearing on the National Windstorm Impact Reduction Program-or NWIRP. I would also like to recognize our Ranking Member from the entire Committee, Ms. Johnson, to our Committee meeting today.

NWIRP directs four Federal agencies—FEMA, NOAA, NSF and NIST—to conduct coordinated research and development on the nature of windstorms, their effects, and on ways to mitigate their impact. The program also calls on these agencies to make sure this research is translated into practice. This work has led to advances in monitoring the design and construction of buildings, and increased awareness and preparation by the public. But there is still much more to be done.

Regrettably, consideration of this program is timely as our thoughts and prayers go out to the people of Moore, Oklahoma, who are putting the pieces back together after a massive tornado ripped through their community just two weeks ago. As a Floridian and a survivor of Hurricane Andrew, I know firsthand that natural hazards are a leading threat to America's economy and Americans' lives.

In recent years, Americans have seen flooded subway stations in New York City, earthquake damage in the Nation's Capital, the great American city of New Orleans submerged under water, unimaginable devastation in Joplin, Missouri, and now entire neighborhoods in Oklahoma flattened to the ground.

There has, in fact, been a record number of declared Federal disasters in the United States over the last two years, and 2011 was the deadliest year on record for tornadoes with over 550 fatalities.

While we cannot stop a hurricane or tornado from happening, we should do all that we can to make sure our communities have the tools they need to respond and recover from such an event. We as a Nation must invest in preparedness and resilience. Studies of FEMA's pre-disaster mitigation program have shown that for every dollar we invest in mitigation activities, we save $3 to $4 in recovery costs.

NWIRP has the potential to dramatically bolster the resiliency of our communities and reduce the costs associated with disaster recovery. Unfortunately, experts have expressed concern that insufficient funding has negatively impacted the implementation of the

program and we are missing out on low-cost mitigation opportunities.

Because of this, I do have some concerns with the legislation we are considering today. First, the bill cuts the authorization level for the program by 14 percent. Second, it locks in this lower funding level for the duration of the bill. We don't have any reason to believe the agencies need any less money to carry out the responsibilities we assigned them the last time we authorized this program.

And when we consider the devastating losses that have plagued the United States recently, this course of action seems irresponsible. That is why I reintroduced the bipartisan version of the Natural Hazards Risk Reduction Act, which will provide the program with an authorization level more appropriate to the task. This legislation passed the House by an overwhelming margin in the 111th Congress, and it also reauthorizes the National Earthquake Hazards Reduction Program. While they are differences between hazards, there are also commonalities and occasions where we should leverage resources.

This Committee has an important role to play in helping Americans prepare for and recover from all natural hazards. By reauthorizing both of these programs, we can minimize the number of Americans who are harmed or killed by natural disasters or who have to face the challenge of putting their homes, businesses and communities back together.

I look forward to working with my colleagues to make our communities more disaster resilient.

Thank you again, Mr. Chairman, for holding this hearing, and thank you to the witnesses for being here today. I yield back the balance of my time.

[The prepared statement of Ms. Wilson follows:]

PREPARED STATEMENT OF SUBCOMMITTEE ON TECHNOLOGY
RANKING MEMBER FREDERICA WILSON

Thank you, Chairman Bucshon and Chairman Massie for holding today's hearing on the National Windstorm Impact Reduction Program—or N-WIRP [*N- werp*].

N-WIRP directs four federal agencies—FEMA, NOAA, NSF, and NIST—to conduct coordinated research and development on the nature of windstorms, their effects, and on ways to mitigate their impact. The program also calls on these agencies to make sure this research is translated into practice. This work has led to advances in monitoring, the design and construction of buildings, and increased awareness and preparation by the public. But there is still much more to be done.Regrettably, consideration of this program is timely as our thoughts and prayers go out to the people of Moore, Oklahoma, who are putting the pieces back together after a massive tornado ripped through their community just two weeks ago.

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There has, in fact, been a record number of declared federal disasters in the United States over the last two years, and 2011 was the deadliest year on record for tornadoes with over 550 fatalities.

While we cannot stop a hurricane or tornado from happening, we should do all that we can to make sure our communities have the tools they need to respond and recover from such an event.

We as a nation must invest in preparedness and resilience. Studies of FEMA's pre-disaster mitigation program have shown that for every dollar we invest in mitigation activities, we save $3 to $4 dollars in recovery costs.

N-WIRP has the potential to dramatically bolster the resiliency of our communities and reduce the costs associated with disaster recovery.Unfortunately, experts have expressed concern that insufficient funding has negatively impacted the implementation of the program and we are missing out on low-cost mitigation opportunities.

Because of this I do have some concerns with the legislation we are considering today. First, the bill cuts the authorization level for the program by 14 percent. Second, it "locks in" this lower funding level for the duration of the bill. We don't have any reason to believe the agencies need any less money to carry out the responsibilities we assigned them the last time we reauthorized this program. And when we consider the devastating losses that have plagued the United States recently, this course of action seems irresponsible.

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This Committee has an important role to play in helping Americans prepare for and recover from all natural hazards. By reauthorizing both of these programs, we can minimize the number of Americans who are harmed or killed by natural disasters or who have to face the challenge of putting their homes, businesses, and communities back together.

I look forward to working with my colleagues to make our communities more disaster resilient.

Thank you again, Mr. Chairman, for holding this hearing. And thank you to the witnesses for being here. I yield back the balance of my time.

Chairman BUCSHON. Thank you, Ms. Wilson. The Chair now recognizes the Ranking Member of the Full Committee, Ms. Johnson, for an opening statement.

Ms. JOHNSON. Thank you very much, Chairman Bucshon, for holding today's hearing to examine the National Windstorm Impact Reduction Program.

The last few years have been devastating years for natural disasters in this country. We experienced the deadliest and most destructive tornado season in U.S. history in 2011. Unfortunately, the trend continues this year with massive tornadoes in Oklahoma and in my home State of Texas. We have also had earthquakes in areas that don't usually experience earthquakes, including Virginia and Oklahoma. And Hurricanes Sandy and Irene caused widespread destruction and death along the Eastern seaboard.

This Committee has an important role to play in minimizing the number of Americans who are harmed or killed by natural disasters or who have to face the challenge of rebuilding their homes, businesses and communities.

By reauthorizing the National Windstorm Impact Reduction Program, we can reduce the vulnerability of our communities to disasters. Therefore, I am glad my fellow Texan, Congressman Neugebauer, been a champion for NWIRP and that he introduced legislation to reauthorize this important program.

However, I want to express my support for the legislation recently introduced by Congresswoman Wilson, of which I am a cosponsor. The *National Hazards Risk Reduction Act of 2013* would reauthorize both the wind-related program and the National Earthquake Hazards Reduction Program. I believe we need to take a multi-hazards approach to disaster mitigation, and Ms. Wilson's

legislation would link these two critical programs through the establishment of a single interagency coordinating committee, creating opportunities for synergy among the various research activities.

I also don't believe we should prioritize one hazard program over another as they are all important to producing communities that are resilient to any and all disasters. As a result, I hope that as we move forward with legislation we consider all of the hazard programs within the Committee's jurisdiction.

And finally, it is clear that NWIRP agencies have not gotten the resources they need to carry out all of the responsibilities assigned to them by Congress. Thus, I am concerned by the cuts proposed in the legislation that is the topic of today's hearing. We simply can't afford to have these agencies miss opportunities to implement low-cost mitigation measures. In the end, strong and effective hazard reduction programs will not only save lives and property, but also provide us with meaningful cost savings.

Thank you, Chairman Bucshon, and I yield back the balance of my time.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
RANKING MEMBER EDDIE BERNICE JOHNSON

Thank you, Chairman Buschon for holding today's hearing to examine the National Windstorm Impact Reduction Program—or NWIRP.

The last few years have been devastating years for natural disasters in this country. We experienced the deadliest and most destructive tornado season in U.S. history in 2011. Unfortunately, the trend is continuing this year with massive tornadoes in Oklahoma and in my state of Texas. We've also had earthquakes in areas that don't usually experience earthquakes, including Virginia and Oklahoma. And, Hurricanes Sandy and Irene caused widespread destruction and death along the Eastern seaboard.

This Committee has an important role to play in minimizing the number of Americans who are harmed or killed by natural disasters or who have to face the challenge of rebuilding their homes, businesses, and communities.

By reauthorizing the National Windstorm Impact Reduction Program, we can reduce the vulnerability of our communities to disasters. Therefore, I am glad my fellow Texan, Congressman Neugebaurer, has been a champion for NWIRP and that he introduced legislation to reauthorize this important program.

However, I want to express my support for the legislation recently introduced by Congresswoman Wilson, of which I am a co-sponsor. The *National Hazards Risk Reduction Act of 2013* would reauthorize both the wind-related program and the National Earthquake Hazards Reduction Program.

I believe we need to take a multi-hazards approach to disaster mitigation, and Ms. Wilson's legislation would link these two critical programs through the establishment of a single interagency coordinating committee—creating opportunities for synergy among the various research activities.

I also don't believe we should prioritize one hazard program over another as they are all important to producing communities that are resilient to any and all disasters. As a result, I hope that as we move forward with legislation we consider all of the hazard programs within the Committee's jurisdiction.

And finally, it is clear that the NWIRP agencies have not gotten the resources they need to carry out all of the responsibilities assigned to them by Congress. Thus, I am concerned by the cuts proposed in the legislation that is the topic of today's hearing. We simply can't afford to have these agencies miss opportunities to implement low-cost mitigation measures. In the end, strong and effective hazard reduction programs will not only save lives and property, but also provide us with meaningful cost savings.

Chairman BUCSHON. Thank you, Ms. Johnson.

If there are Members who wish to submit additional opening statements, your statements will be added to the record at this point.

Chairman BUCSHON. Now I would like to introduce the witnesses. Our first witness is Dr. Ernst Kiesling, a Professor of Civil Engineering at Texas Tech University and Executive Director of the National Storm Shelter Association. He has had a long career with Texas Tech University, serving as Chairman of the Civil Engineering Department and as an Associate Dean of Engineering for Research. He leads the storm shelter research effort within the Wind, Science and Engineering Research Center at Texas Tech. Dr. Kiesling received his M.S. in mechanical engineering from Texas Technological College and an M.S. and Ph.D. in applied mathematics from Michigan State University. Welcome.

Our second witness is Debra Ballen—did I pronounce that right?

Ms. BALLEN. Ballen.

Chairman BUCSHON. Ballen, the General Counsel and Senior Vice President for Public Policy for the Insurance Institute for Business and Home Safety. Ms. Ballen has also worked with the American Insurance Association and the University of Colorado's Advisory Committee for the Hazards Center. She graduated with a J.D. from Harvard Law and an A.B. degree from Princeton University. Thank you.

Our final witness is Dr. David Prevatt, an Assistant Professor at the University of Florida. He has been with the University of Florida's Department of Civil and Coastal Engineering since 2007. His research focuses on the mitigation of extreme wind damage to low-rise construction. Dr. Prevatt is a member of the American Society of Civil Engineers, on the board of the American Association for Wind Engineering, and a member of the U.K. Wind Engineering Society. Dr. Prevatt received his Ph.D. from Clemson University. Welcome.

As our witnesses should know, spoken testimony is limited to five minutes each after which Members of the Committee have five minutes each to ask questions. Your written testimony will be included in the record of the hearing.

I now recognize our first witness, Dr. Kiesling, for five minutes.

TESTIMONY OF DR. ERNST KIESLING, RESEARCH FACULTY, NATIONAL WIND INSTITUTE, TEXAS TECH UNIVERSITY

Dr. KIESLING. Thank you. Mr. Bucshon, Mr. Neugebauer and distinguished Committee Members, I thank you for the opportunity to be here. You have done a good job of outlining both the problem and potential solutions, and pointed to one of the major problems that we face in not only lack of funding but lack of continuity in funding to do the research we need to do.

One other thing I would point out is not just the loss of lives and the human suffering, but the anxiety that comes with severe events like tornados and hurricanes. And I will speak primarily on storm shelters or safe rooms, because that is where I spent most of my career working, and secondly, I think it addresses this last problem of anxiety and human suffering effectively.

I have been part of the wind engineering program at Texas Tech since 1970 when an EF–5 tornado impacted Lubbock. I was Chairman of the Civil Engineering Department at that time. You can help make my day by telling me I don't look old enough to have done that, but I don't want you to lie.

With your support, we have developed a world-class program at Texas Tech, unparalleled facilities—I have included a picture of some of in the report, a unique doctoral program in wind, science and engineering, and we have turned out about 20 doctoral students or graduates there, and they are taking prominent places in the professional community.

Today we have very good weather forecasting that gives information on locations and paths of tornados and hurricanes but we still have to deal with the effects of severe winds, and even the advice given the public we have found in the last two weeks in Oklahoma leaves much to be desired. In fact, it is inaccurate and dangerous, some of the advice that is being given. So not only do we need to do the good work such as forecasting has done but need to convey a consistent message to the public as to how do you react, how do you respond to disasters. A focused approach to research and development and implementation is needed to reduce impact of windstorms on urban society. Many specific areas could be mentioned—testing facilities, a repository for windstorm damage documentation, and that is in process, development of computational wind engineering tools, implementation of known research into standards and codes, and others will speak to that, development of manpower to pursue meaningful research and professional practice, and then educational programs that convey sound, consistent guidance to the people as to how they react and respond to extreme events—extreme wind events.

Property damage can surely be abated by improved building codes and by their enforcement. We have a tremendous problem in the lack of enforcement because that is done largely at the local level, and there are many disconnects that occur between the agencies and the researchers that generate good research and what happens in the field, and education, I think, is the best way to address that.

We have particularly in the storm shelter area available standards and guidelines. We have an industry association, the National Storm Shelter Association, and we have a program that recognizes those storm shelters that comply with the standards. We have all types of shelters available today that meet these standards and guidelines and provide near-absolute occupant protection from extreme winds, yes, even an EF–5, despite some of the information that has been given, particularly in the last couple of weeks in Oklahoma. Some of the advice given has been deadly and wrong. There are many characteristics of the Hazard Mitigation Grant program, and Ms. Johnson, you mentioned that. It is an excellent program that does a lot of good things. The downside of it is that funding that is generated is post disaster so it is sometimes four or five years. We are just now finishing some projects that were funded with the Hazard Mitigation program with funding growing out of Hurricane Ike that occurred five years ago. So it takes time, and I think it is important that we have, say, pre-disaster mitiga-

tion grants of some type and sizable ones that can do preparation for disasters, not respond to them. I don't understand why the Pre-Disaster Mitigation Grant program was discontinued, and I am not saying that we need that but we need something like that that allows us to prepare in advance.

There has been a lot of talk about shelters being mandatory. I believe that the states, such as Alabama, have set a good example, and that storm shelters for schools should be made mandatory by states that have serious problems in new buildings, and much can be done to improve existing buildings in that regard. I believe that mandatory shelters should also be for multi-family residential housing units, vulnerable populations such as daycare centers, retirement villages and so forth, nursing homes, mobile home parks and apartments. I think it should not be mandatory for privately owned single-family and multi-family residences—though incentives of some type would certainly be appropriate.

So my recommended action would simply be that you have identified the agencies—NIST, FEMA, NOAA, NSF. All are experienced in administering large-scale programs and they work well together, I think. We have capable professional personnel that conduct research if they have adequate funding to do so, and I think if you look particularly at the programs that have been funded, the earthquake program and the prediction program in the weather area, you will see that we have unprecedented return on investment in those programs, and I would encourage Congress to make funding available to make similar investments in the area of mitigating the wind disaster. Thank you.

[The prepared statement of Dr. Kiesling follows:]

TESTIMONY
of
Ernst W. Kiesling, P.E., Ph.D.
Research Faculty, Texas Tech University
Executive Director, National Storm Shelter Association
to the
Subcommittee on Technology
Committee on Science, Space, and Technology
House of Representatives
June 5, 2013

I have been part of the wind program at Texas Tech University since 1970 when the Lubbock Tornado occurred. I was chairman of the Civil Engineering Department at that time. With your support we have developed a world class program to mitigate the wind hazard. Capabilities include:

- Unparalleled facilities (Attachment 1)
- Unique doctoral program in Wind Science and Engineering, initially funded with an NSF IGERT grant.

A lot is known about windstorms, especially forecasting. Awesome things are being done in warnings, tracking and using modern technology to make information available and useful. Forecasting helps us prepare for extreme winds such as tornadoes and hurricanes but we still have to deal with the effects of extreme winds. Investments in weather forecasting have produced good return on investment and saved many lives. Similar investments need to be made in other program areas.

NEEDED RESEARCH

Much more research is needed for us to understand the nature and characteristics of extreme winds. Knowing more would help designers and planners increase safety and reduce damage. Forecasting is giving us more accurate information on storm locations, paths and lead times. But if we don't know what to do or where to go for safety the warnings lead to anxiety. The cost of anxiety and uncertainty is enormous. Based on a study we did about 30 years ago, I would estimate that over 6 billion person hours are spent annually under severe weather watches or warnings. Storm shelters can save lives, but I believe more importantly they relieve anxiety.

A focused approach to research, development, and implementation has potential of significantly reducing impact of windstorms on urban society. Specific focus areas include:

- Testing facilities for simulating winds in hurricanes, tornadoes and thunderstorms, enabling us to test structural components and systems.
- Repository for documented windstorm damage that is organized and made available to researchers, code writing bodies and practicing professionals.
- Development of computational wind engineering for wind/structure interaction, wind/urban infrastructure interaction, and simulating structural mechanics for fluctuating loads.

- Implementation of known research results in to standards and codes through economic, social behavior studies.
- Development of manpower who can pursue meaningful research and professional practice in aspects of mitigation, response and recovery.
- Education/outreach programs that convey sound, consistent guidance that leads to intelligent responses to potentially disastrous perils.

Some programs are in place but most need a reliable, sustained source of funding for maturation and expansion.

ROLE OF BUILDING CODES

Property damage can be abated by improved building codes including informed design, higher design wind speeds, and stricter code enforcement. States or local jurisdictions may adopt provisions of building codes. Model codes such as the International Building Code (IBC), the International Residential Code (IRC) and many others are available for consideration by jurisdictional code bodies. Building codes are adopted at state or local levels and are implemented at the local level. It is appropriate to require states and local jurisdictions to be required to develop and periodically update hazard mitigation plans as prerequisite to federal or state grants. They may be required more broadly, forcing locals to identify the most relevant hazards and mitigation strategies.

States, local jurisdictions, governmental agencies, education institutions and profession societies should be incentivized to offer educational programs to architects, engineers, and building inspectors on design, construction and inspection of new and retrofitted buildings. A wealth of information is available but implementation is lacking, even in new construction. Some sound, inexpensive improvements such as connections along the load path are not implemented in some cases. This should not surprise us but should motivate us to action. After all, people still die in rollover auto accidents who are sitting on their seat belts!

STORM SHELTERS AND SAFE ROOMS

In the early 1970's we developed the concept of the above ground storm shelter. I have spent my career supporting development, deployment and quality in storm shelters/safe rooms. Elements of the well-established technology include:

- Available Standards and Guidelines
  - ICC 500, ICC/NSSA Standard For The Design And Construction Of Storm Shelters
  - FEMA P-320, Taking Shelter From The Storm: Building a Safe Room For Your Home or Small Business
  - FEMA P-361, Design and Construction Guidance for Community Safe Rooms
- Industry Association, The National Storm Shelter Association (NSSA), an IRS 501-c-6
- NSSA Standards-Compliance Verification Program (Attachment 2)

- NSSA Seal Program of NSSA Producer Members who have demonstrated standards compliance

Available now is a wide variety of storm shelters:

- Residential, Community
- Aboveground, Underground
- Concrete, Steel, Timber, Fiberglass

For every situation and circumstance a storm shelter solution can be found to meet needs.

I will make unequivocal statement that…

Above-ground storm shelters that meet these standards and guidelines provide near-absolute protection with a margin of safety from a worst-case tornado--yes an EF-5 Tornado. To say or imply that the only safe place is underground is false and misleading. Studies in Moore, OK following their EF 5 tornado of May 20, 2013 confirm this statement.

Widespread deployment of storm shelters (safe rooms), residential and community, can produce significant societal benefits. Several programs are available to augment the cost of shelters. The FEMA Hazard Mitigation Grant Program (HMGP), with funding driven by Stafford Act had funded approximately 22,000 residential and 1,200 community shelters. There are many positive characteristic of the HMGP program--stimulates mitigation activities, leverages private capital, ... A major downside is that HMGP benefits a few qualified recipients after an event. With funding generated by Hurricane Ike (2008), storm shelter education programs are nearing completion in 2013 and community storm shelter construction is commencing along the Texas coast.

Sustained funding bases are needed to assist in preparing for unforeseen events. Some state-funded programs provide continuity. State/Federal partnerships to provide continuous funding are encouraged more vigorously.

ON MANDATING SHELTERS

A much debated question is: "Should storm shelters be mandated by law?"

There is considerable impetus and positive sentiment, mine included, for states or local jurisdictions to make storm shelters or safe places mandatory in new public buildings such as K-12 schools, colleges, day care centers located in high-risk areas. Alabama has had good results with such a law as have isolated jurisdictions such as the city of Omaha, NE. Mandatory shelter laws are also appropriate for new multi-family residential units housing vulnerable populations who are tenants, not owners. This includes but is not limited to nursing homes, mobile home parks, and apartments. Tenants should expect to pay a major portion of the cost of providing protection rental or leasing agreements. Public funding might provide subsidies for low-income families.

Shelters should not be made mandatory for privately owned single or multifamily residences. Rather, incentives such as property tax credits, financing or competitive grants will suffice. We do have an obligation to present reliable information on what is technology is available and concomitant costs. Educational programs are needed for design professionals, architects and engineers, building officials including inspectors, school boards, public officials, builders, and the public. Passage of the proposed NWIRP bill will be helpful in this regard.

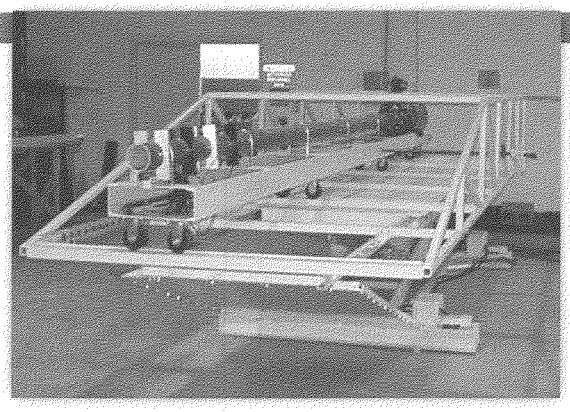
RECOMMENDED ACTION

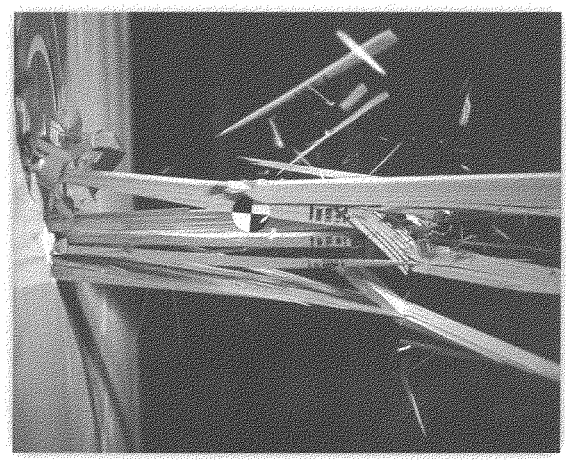
I believe passage of the proposed NWIRP bill will facilitate mitigating the effects of the wind hazard in the United States. The agencies identified to administer the NWIRP --NIST, FEMA, NOAA, and NSF--are all experienced and coordinated to effectively manage large-scale programs. Many capable professional personnel are available to conduct research and education to mitigate the wind hazard. **I therefore urge Congress to pass the bill that contains the NWIRP program and that escalating property values at risk and the expected large return on investment (ROI) be recognized in establishing funding levels. An unprecedented return on investment may be expected.**

ATTACHMENT 1

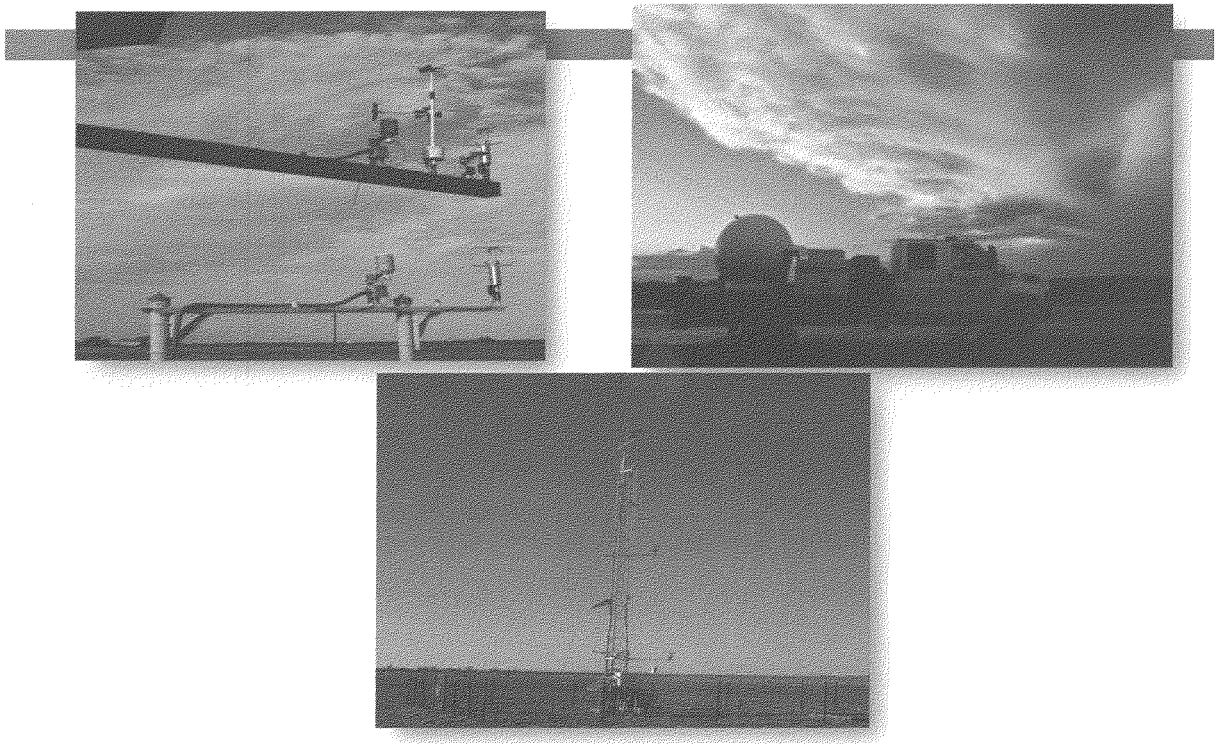
Facilities at Texas Tech University

Facilities at Texas Tech University





Facilities at Texas Tech University



ATTACHMENT 2

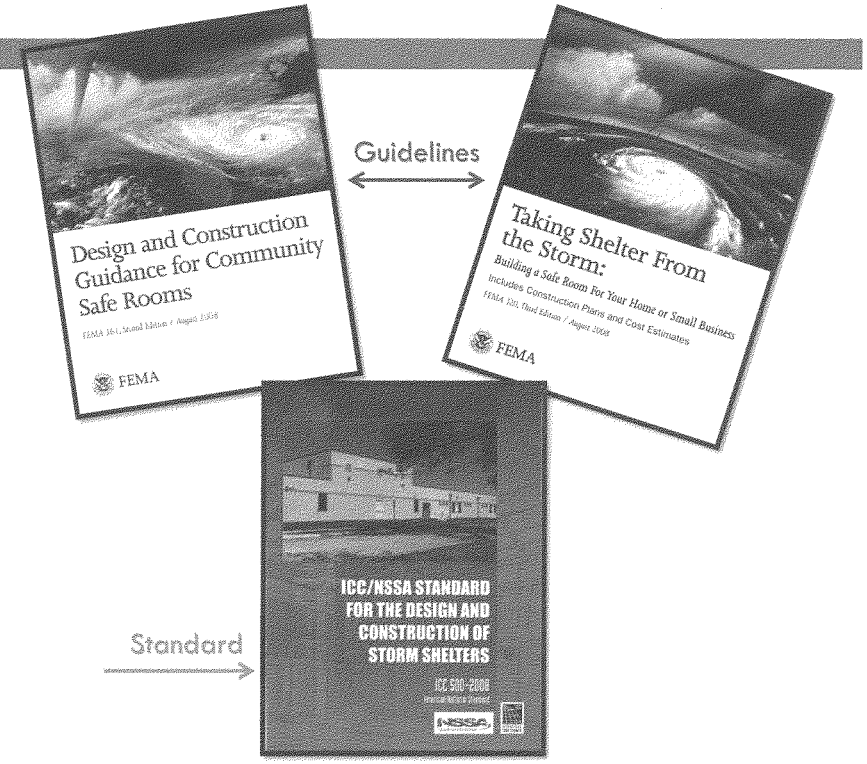
Applicable Standard & FEMA Guidelines

6

- FEMA 361
- FEMA 320
- NSSA/ICC-500

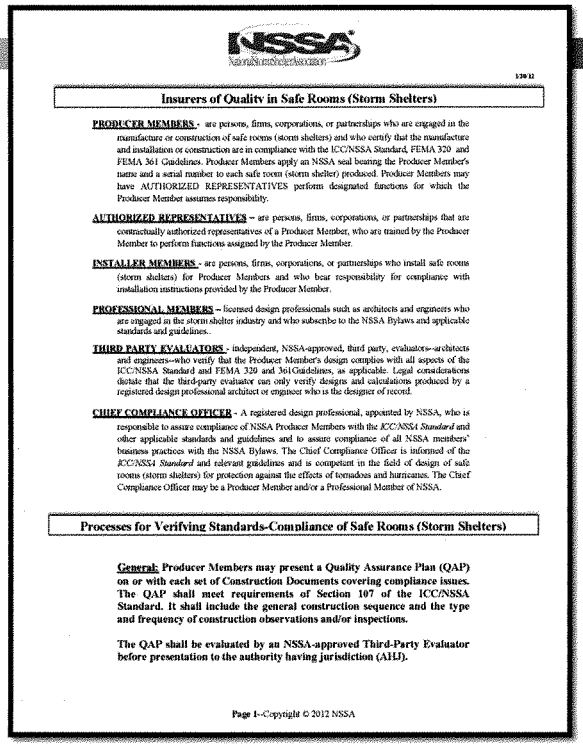
Additionally

- ASCE 7-05
- I-Codes



ATTACHMENT 3

Quality Assurance Verification



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Insurers of Quality in Safe Rooms (Storm Shelters)

PRODUCER MEMBERS - are persons, firms, corporations, or partnerships who are engaged in the manufacture or construction of safe rooms (storm shelters) and who certify that the manufacture and installation or construction are in compliance with the ICC/NSSA Standard, FEMA 320 and FEMA 361 Guidelines. Producer Members apply an NSSA seal bearing the Producer Member's name and a serial number to each safe room (storm shelter) produced. Producer Members may have AUTHORIZED REPRESENTATIVES perform designated functions for which the Producer Member assumes responsibility.

AUTHORIZED REPRESENTATIVES – are persons, firms, corporations, or partnerships that are contractually authorized representatives of a Producer Member, who are trained by the Producer Member to perform functions assigned by the Producer Member.

INSTALLER MEMBERS - are persons, firms, corporations, or partnerships who install safe rooms (storm shelters) for Producer Members and who bear responsibility for compliance with installation instructions provided by the Producer Member.

PROFESSIONAL MEMBERS – licensed design professionals such as architects and engineers who are engaged in the storm shelter industry and who subscribe to the NSSA Bylaws and applicable standards and guidelines.

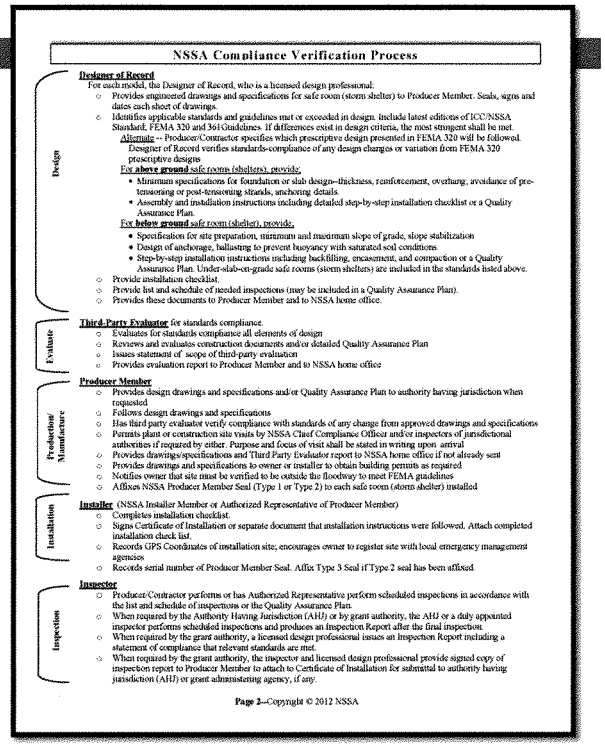
THIRD PARTY EVALUATORS - independent, NSSA-approved, third party, evaluators--architects and engineers--who verify that the Producer Member's design complies with all aspects of the ICC/NSSA Standard and FEMA 320 and 361Guidelines, as applicable. Legal considerations dictate that the third-party evaluator can only verify designs and calculations produced by a registered design professional architect or engineer who is the designer of record.

CHIEF COMPLIANCE OFFICER - A registered design professional, appointed by NSSA, who is responsible to assure compliance of NSSA Producer Members with the *ICC/NSSA Standard* and other applicable standards and guidelines and to assure compliance of all NSSA members' business practices with the NSSA Bylaws. The Chief Compliance Officer is informed of the *ICC/NSSA Standard* and relevant guidelines and is competent in the field of design of safe rooms (storm shelters) for protection against the effects of tornadoes and hurricanes. The Chief Compliance Officer may be a Producer Member and/or a Professional Member of NSSA.

Processes for Verifying Standards-Compliance of Safe Rooms (Storm Shelters)

General: Producer Members may present a Quality Assurance Plan (QAP) on or with each set of Construction Documents covering compliance issues. The QAP shall meet requirements of Section 107 of the ICC/NSSA Standard. It shall include the general construction sequence and the type and frequency of construction observations and/or inspections.

The QAP shall be evaluated by an NSSA-approved Third-Party Evaluator before presentation to the authority having jurisdiction (AHJ).



NSSA Compliance Verification Process

Design

Designer of Record
For each model, the Designer of Record, who is a licensed design professional:
- Provides engineered drawings and specifications for safe room (storm shelter) to Producer Member. Seals, signs and dates each sheet of drawings.
- Identifies applicable standards and guidelines met or exceeded in design. Include latest editions of ICC/NSSA Standard, FEMA 320 and 361Guidelines. If differences exist in design criteria, the most stringent shall be met.
  Alternate -- Producer/Contractor specifies which prescriptive design presented in FEMA 320 will be followed. Designer of Record verifies standards-compliance of any design changes or variation from FEMA 320 prescriptive designs
  For **above ground** safe rooms (shelters), provide:
  - Minimum specifications for foundation or slab design--thickness, reinforcement, overhang, avoidance of pre-tensioning or post-tensioning strands, anchoring details.
  - Assembly and installation instructions including detailed step-by-step installation checklist or a Quality Assurance Plan.

  For **below ground** safe room (shelter), provide:
  - Specification for site preparation, minimum and maximum slope of grade, slope stabilization
  - Design of anchorage, ballasting to prevent buoyancy with saturated soil conditions
  - Step-by-step installation instructions including backfilling, encasement, and compaction or a Quality Assurance Plan. Under-slab-or-grade safe rooms (storm shelters) are included in the standards listed above.
- Provide installation checklist.
- Provide list and schedule of needed inspections (may be included in a Quality Assurance Plan).
- Provides these documents to Producer Member and to NSSA home office.

Evaluate

Third-Party Evaluator for standards compliance.
- Evaluates for standards compliance all elements of design
- Reviews and evaluates construction documents and/or detailed Quality Assurance Plan
- Issues statement of scope of third-party evaluation
- Provides evaluation report to Producer Member and to NSSA home office

Production/ Manufacture

Producer Member
- Provides design drawings and specifications and/or Quality Assurance Plan to authority having jurisdiction when requested
- Follows design drawings and specifications
- Has third party evaluator verify compliance with standards of any change from approved drawings and specifications
- Permits plant or construction site visits by NSSA Chief Compliance Officer and/or inspectors of jurisdictional authorities if required by either. Purpose and focus of visit shall be stated in writing upon arrival
- Provides drawings/specifications and Third Party Evaluator report to NSSA home office if not already sent
- Provides drawings and specifications to owner or installer to obtain building permits as required
- Notifies owner that site must be verified to be outside the floodway to meet FEMA guidelines
- Affixes NSSA Producer Member Seal (Type 1 or Type 2) to each safe room (storm shelter) installed

Installation

Installer (NSSA Installer Member or Authorized Representative of Producer Member)
- Completes installation checklist.
- Signs Certificate of Installation or separate document that installation instructions were followed. Attach completed installation check list.
- Records GPS Coordinates of installation site; encourages owner to register site with local emergency management agencies
- Records serial number of Producer Member Seal. Affix Type 3 Seal if Type 2 seal has been affixed.

Inspection

Inspector
- Producer/Contractor performs or has Authorized Representative perform scheduled inspections in accordance with the list and schedule of inspections or the Quality Assurance Plan.
- When required by the Authority Having Jurisdiction (AHJ) or by grant authority, the AHJ or a duly appointed inspector performs scheduled inspections and produces an Inspection Report after the final inspection.
- When required by the grant authority, a licensed design professional issues an Inspection Report including a statement of compliance that relevant standards are met.
- When required by the grant authority, the inspector and licensed design professional provide signed copy of inspection report to Producer Member to attach to Certificate of Installation for submittal to authority having jurisdiction (AHJ) or grant administering agency, if any.

Biographical Sketch

ERNST W. KIESLING, P.E., Ph.D. (Pronounced Key-sling)
Research Faculty, National Wind Institute Texas Tech University
Executive Director, National Storm Shelter Association (NSSA)

Dr. Kiesling has spent most of his career at Texas Tech University in teaching, research, administration and public service. He served as Chairman of the Civil Engineering Department for 20 years and as an Associate Dean for 7 years. He leads the storm shelter research effort within the National Wind Institute at Texas Tech.

Dr. Kiesling and his colleagues developed the above-ground storm shelter capable of providing a very high degree of protection from extreme winds. Texas Tech provided shelter designs and other input to FEMA publications on storm shelters. He serves on the International Code Council (ICC) Committee that developed the NSSA/ICC 500 storm shelter standard.

He was instrumental in founding the National Storm Shelter Association (NSSA) a non-profit trade association dedicated to fostering quality in the shelter industry. He has served as Executive Director of the Association since its inception in 2000.

He will testify today on what he feels will be the most effective governmental actions in mitigating the extreme wind hazard

Chairman BUCSHON. Thank you.

I now recognize our second witness, Ms. Ballen, for five minutes.

**TESTIMONY OF MS. DEBRA BALLEN,
GENERAL COUNSEL AND SENIOR VICE PRESIDENT,
PUBLIC POLICY, INSURANCE INSTITUTE
FOR BUSINESS & HOME SAFETY**

Ms. BALLEN. Thank you for the opportunity to testify today. My name is Debra Ballen. I am with the Insurance Institute for Business and Home Safety, a 501(c)(3) organization wholly supported by the property insurance and reinsurance industries and dedicated to mitigation, research and communications.

As a research organization focusing on mitigation, IBHS has long been supportive of the NWIRP. We provided testimony during hearings that led to its initial authorization as well as the effort to reauthorize the program in 2008, and we have worked in partnership on a number of projects with all of the NWIRP agencies. We are pleased to be here today, and we thank you for your interest in this important matter.

Given the broad geographic threat of windstorms, the percentage of our population at risk, the frequency of events and the tremendous toll taken, the Federal investment in wind-related research is much less than it should be. That said, we are not negative on a multi-hazard approach. A coordinated, well-funded research program as embodied in NWIRP is needed to pull together scientific information about wind hazards, wind engineering expertise that defines the connection between storm characteristics and loads imposed on buildings, structural engineering expertise that develops efficient systems to handle these loads in new and existing buildings, and national coordinated efforts to promote mitigation.

We believe that IBHS can play an important role in these initiatives. The centerpiece of our research program is our unique world-class research center. Using a 105-fan array to simulate wind as well as full-size residential and commercial test specimens and other specialized equipment, IBHS can recreate a variety of highly realistic natural disasters involving wind alone, wind plus rain, wind plus fire, and wind plus hail.

I would like to take a moment to show you how research and related communications contribute to our understanding of the destructive power of wind and the benefits of mitigation. You will see the power of wind in a video from the first public demonstration that we conducted at the research center in the fall of 2010. We subjected two wood-frame houses to a highly realistic storm that has occurred in North Texas and the Midwest. Although they look the same from the outside, the home on the left was built using a code as it exists in Central Illinois while the home on the right was built to a higher IBHS standard. I should add that the winds you are going to see were not tornadic. So here is a very short video of that test.

[Video shown.]

You can see just how quickly and how completely the home on the left was destroyed, and as you think about the loss of life and property had this been a real event with people inside the home that was destroyed, you can also understand the importance of re-

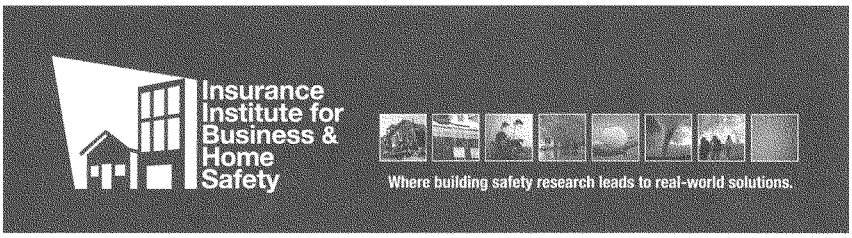
search as a complement to communications in order to get people to pay attention, change their attitudes, and ultimately demand safer and stronger buildings. It is much better to learn this lesson in the IBHS's test chamber than from places like Moore, Oklahoma, and Miami, Florida.

Along with stronger, safer building, we believe that mitigation leads to a stronger, safer insurance system. Among the insurance-related benefits of mitigation are a reduction in the frequency and severity of weather-related claims, a downward shift in the loss exceedance curve, better management of losses in rare but severe events, more efficient capital deployment, healthier private insurance markets, and less stress on residual markets.

The property insurance industry's research priorities for wind mitigation are directly in line with policyholder interests: less physical destruction, less economic loss, less societal displacement, fewer injuries and deaths. Breaking the cycle of destruction so that residential and commercial structures do not have to be put together again and again will benefit building owners, occupants, communities and also insurers.

In closing, I thank you for the opportunity to offer our comments on the critical role of mitigation research and the importance of NWIRP reauthorization. We urge you to move forward on this important legislation that will help to harness advancements in windstorm science and engineering in order to improve our Nation's safety, sustainability and resilience.

[The prepared statement of Ms. Ballen follows:]



Testimony of Debra T. Ballen
General Counsel and Senior Vice President for Public Policy
Insurance Institute for Business & Home Safety (IBHS)

Before the U.S. House of Representatives
Subcommittees on Research and on Technology

RE: H.R. 1786, Reauthorization of the National Windstorm Impact Reduction Program
June 5, 2013

Members of the Subcommittees on Research and on Technology, thank you for the opportunity to speak with you today in support of reauthorizing the National Windstorm Impact Reduction Program (NWIRP).

The Insurance Institute for Business & Home Safety (IBHS) is a 501(c)(3) organization, wholly supported by the property (re)insurance industry. IBHS conducts objective, scientific research to identify and promote effective actions that strengthen homes, businesses, and communities against natural disasters and other causes of loss. IBHS does this by identifying and advocating improved property design, construction, strengthening, maintenance, repair, and preparation practices.

The centerpiece of our research program is the IBHS Research Center in Chester County, South Carolina. It is the only laboratory of its kind in the world. Using a 105-fan array and other specialized equipment, IBHS engineers can recreate a variety of highly realistic wind, rain, fire and hail events. Other test facilities use scaled-down models or pieces of buildings. Only IBHS can look at entire structures as a system. The ability to mimic Mother Nature in a controlled, repeatable way allows IBHS to demonstrate the effectiveness, affordability and financial value of stronger building codes and better-built structures; identify effective solutions to building vulnerabilities; strengthen the relationship between theoretical and real building performance; and validate/improve current scientific bases for designing and installing building products and systems. Our goal is to translate the results of this research into better public policy and market-based approaches to mitigation, in order to provide the most cost-effective protection possible across America.

The IBHS Research Center represents a tangible $40 million initial investment, and a continuing multi-million annual commitment, by insurers to facilitate the research and outreach outlined above. Our members have done this in part because wind hazard research as it applies to building performance has been underfunded for decades. While various federal agencies are able to allocate significant resources to research about weather hazards, very little has been specifically directed toward understanding how the characteristics of different types of windstorms affect the real-world performance of building components, connections, and systems.

Ultimately, if we are to reduce wind losses across the nation, it is not sufficient to limit our efforts to better forecasting—although that has certainly been and continues to be tremendously effective in reducing deaths and injuries. Rather, we must reduce the vulnerability of homes and businesses to wind-related hazards, whether it is wind-driven wildfire and embers, hail damage, wind-driven water, or simply the forces of the wind that work to rip buildings apart. Existing buildings and structures must be strengthened and designers must be able to create new buildings and structures that can achieve specific performance goals. Federal funding of research enabling performance-based design for seismic risks is helping to make that a reality with respect to earthquakes. Similar investments are needed to support development of performance-based design tools for wind risks.

A recent study by the Center for American Progress estimates that, from 2011 to 2013, the federal government spent $136 billion total on disaster recovery and relief (much of it attributable to wind events), which adds up to nearly $400 per American household per year. While every year brings unique weather and other disaster scenarios, the number of extreme weather events causing a billion dollars or more in damage, and the total cost of those events, has been steadily increasing for the past three decades. This is attributable not only to patterns of extreme weather, but also demographic trends that put people and property closer together, and too often in harm's way. IBHS strongly agrees with the FEMA Mitigation Framework, which emphasizes that it is critical to identify new ways to "stop increasing the trajectory of our risk and start taking steps to reduce it." H.R 1786 is one such initiative.

IBHS and the NWIRP

As a research organization dedicated to mitigation, IBHS has long been supportive of the NWIRP. We recognize that our research and guidance must be corroborated and expanded on by others in order to gain broader acceptance in the marketplace. A coordinated, well-funded federal research program is needed to pull together meteorological information about the hazards; wind engineering expertise that defines the connection between the wind storm characteristics and loads imposed on buildings and structures; structural engineering expertise that develops efficient systems to handle these loads and load effects in new buildings and to strengthen existing buildings; and national coordinated efforts to promote mitigation. The NWIRP is a key initiative addressing this critical need, and it should be both strengthened as outlined below and funded with appropriations. We provided testimony during hearings that led to its initial authorization as well as the effort to reauthorize the program in 2008, and we appreciate the opportunity to be here today.

IBHS' mission is closely aligned with the goals set forth in H.R. 1786:

- improving the understanding of windstorms and their impacts;
- developing and encouraging the implementation of cost-effective mitigation measures to reduce those impacts;
- implementation of windstorm risk reduction measures by federal, state, and local governments, as well as national standards and model building code organizations, architects, and engineers;
- development of performance-based engineering tools, along with wind-related model building codes, voluntary standards, and construction best practices;
- coordination of federal post-windstorm investigations; and
- ultimately achieving measurable reductions in the loss of life and property from windstorms.

We are particularly pleased to see the focus on windstorm research this morning. Given the broad geographic threat of windstorms and the percentage of our population at risk, the frequency of events, and the tremendous toll taken by windstorms, the federal focus on wind-related research is much less than it should be. As of last week, there have been 370 preliminary tornado reports, and 3305 preliminary severe wind reports in 2013. In the past five years, there were over 7500 tornadoes reported, and over 75,000

high wind reports, along with 17 tropical cyclones making landfall in the U.S. Andrew, Katrina, and Sandy—as well as Tuscaloosa, Joplin, and Moore—are among the more salient reminders of the destructive power of wind, but less infamous wind disasters also have wreaked havoc on families and communities throughout the U.S.

In order to provide better coordination of federal windstorm research efforts, we believe that the reauthorizing legislation should designate a lead agency for the NWIRP. We are supportive of designating the National Institute of Standards and Technology (NIST) as the lead agency because the heart of the program, if it is to be successful, is pre-event mitigation including retrofitting existing buildings and structures or improving the hazard resistance of new buildings and structures through stronger building codes and standards; adequate enforcement, training and education; improved methods for evaluating the hazard resistance of materials, components and systems; and improved methods for assessing the costs and benefits of all these activities. We also support funding and research roles for the Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the National Science Foundation (NSF). Additionally, consideration might be given to a role for the Department of Housing and Urban Development (HUD), because of its role in promoting affordable housing and in the establishment of standards for manufactured housing.

IBHS has worked in partnership with all of the proposed NWIRP agencies. We have worked on wildfire issues of common interest and on development and adoption of building code provisions with NIST. We have partnered with FEMA and DHS on developing mitigation guidance, launching mitigation initiatives, and conducting post-disaster assessments to understand the benefits of mitigation. We have worked with university partners to help deploy instruments that have provided NOAA with high-fidelity near-surface wind data and support the idea of a university consortium that brings many instrument platforms together to provide the most complete description possible of hurricane winds near the earth's surface where they affect buildings and structures (Digital Hurricane Consortium). We have provided in-kind support for a number of NSF funded university research programs and also performed critical wind validation activities at our Research Center with high-quality, full-scale data available from NSF and NIST funded research programs at Texas Tech University.

Mitigation Matters

Given its important societal benefits, mitigation is a public health objective, economic imperative and humanitarian obligation. Every region of our country is vulnerable to one or more potentially devastating natural hazards; this is why improving disaster mitigation, preparedness, response, and recovery must be a national priority.

- Mitigation encourages personal responsibility by providing the tools that people need to protect themselves and their families from harm. In this regard, there are well-documented physical and property protection measures that homeowners and businesses should take to reduce damage and dislocation from almost every type of natural disaster. In addition, all Americans should have a disaster essentials kit, as well as an emergency evacuation plan that includes food, water, communications tools, and other supplies in sufficient quantity to last for at least three days.

- Mitigation is a sound fiscal strategy for private property owners and all levels of government, almost always resulting in significant long-term savings, including reduced public sector response and recovery costs. According to a study conducted by the National Institute for Building Sciences' Multi-hazard Mitigation Council, every dollar spent by FEMA on hazard mitigation grants reduced post-disaster relief costs by $3.65—a savings for all taxpayers, regardless of where they live.

- Mitigation trades off an investment today against future losses. This creates a greater sense of inter-generational equity and a way to avoid the need for future Americans to pay for damage that could have been reduced or avoided entirely through cost-effective property protection measures taken now.

- Mitigation is a sound business strategy that protects the physical plant of commercial facilities and the bottom line of the employers who occupy them, as well as their employees, suppliers, and customers.

- Mitigation is particularly important for vulnerable populations, including the elderly, people with disabilities, those living in poverty, and those with limited English language skills. Such individuals often live in housing that is less able to withstand natural forces, and they may lack necessary resources for quickly evacuating in the face of imminent harm.

- Mitigation protects the environment by reducing the massive amounts of post-disaster debris that can overwhelm landfills and lessening the release of carbon dioxide and other greenhouse gases generated when buildings burn in wildfires.

- Mitigation enhances community resiliency by protecting property, improving disaster planning and response, and creating a culture that is focused on long-term economic health and social welfare. While everyone wants their home to escape damage, few would want to live in the last house standing in a community destroyed by natural disaster. That is why comprehensive, community-wide property mitigation efforts are critical to maintaining community vitality.

Insurance and Mitigation

Along with stronger, safer building, we believe that mitigation leads to a stronger, safer insurance system. Among the insurance-related benefits of mitigation are: a reduction in the frequency and severity of weather-related claims; a downward shift in the loss exceedance curve; better management of losses in rare but severe events; more efficient capital deployment; healthier private insurance markets; and less stress on residual markets.

IBHS is proud of the role that the property insurers and reinsurers play in advancing risk mitigation through their membership in the Institute and their financial support for the construction of our Research Center. As a building science institute, and due to antitrust concerns, IBHS does not have access to, and cannot compile, a list of market-based discounts offered by specific insurers. The quickest way for individual property owners to find out if their residential or commercial building qualifies for an incentive (for example, by meeting the designation requirements of IBHS' hazard-specific FORTIFIED Home retrofit program) is to ask their insurance agent or company. Not all companies offer discounts, and some may offer larger or different incentives than others, so it also pays to shop around.

A few states (Alabama, Louisiana, Mississippi, North Carolina, and South Carolina) have developed legislative or regulatory discount frameworks for homes built or retrofitted to the aforementioned FORTFIED standards. In these states, IBHS has worked with insurance regulators and insurance companies to make sure that the discount programs work as they were intended upon enactment, and actually facilitate risk-based pricing, which can serve both to encourage effective mitigation and discourage unsound development in disaster-prone areas.

In addition to discounts, insurance incentives related to mitigation may include a positive decision by an underwriter to provide coverage in the voluntary, rather than through the residual, market, lower deductibles, or more favorable coverage terms relating to post-disaster claims payments. Again, these are business decisions made by individual insurers, and IBHS neither influences such decisions nor

specifically tracks them. That said, IBHS research helps our member companies to better understand structural vulnerability and the role that mitigation plays in reducing it, as well as what mitigation features to look for when inspecting a residential or commercial building.

In a truly resilient society, mitigation incentives would extend beyond the insurance industry to others who benefit from reduced loss costs at the individual property owner or community level—e.g., mortgage lenders, landlords, community developers, and municipal bond underwriters. Although IBHS promotes this concept when speaking to these external audiences, we are not aware of any non-insurer, private sector mitigation incentives that are being offered at this time.

Mitigation Research Priorities

The property insurance industry's research priorities for wind mitigation are directly in line with policyholders' interests—less physical destruction, less economic loss, less societal displacement, fewer injuries and deaths. Breaking the cycle of destruction so that residential and commercial structures do not have to be put back together again and again will benefit building owners, occupants, communities, and insurers.

The coordinated focus and resources provided by the NWIRP can accelerate the progress of the research and focus it in ways that are of particular value to researchers, practitioners, and the public. As Congress looks towards reauthorization of the NWIRP, we would suggest that it concentrate efforts in four areas.

- The first is enhanced understanding of events, including better definition of parameters that are important to the design and performance of the built environment. Because hurricanes develop more slowly than tornadoes or straight-line windstorms, scientists have had more opportunity to study when/how/why they form and change, and to take actual measurements during the storm itself. The NWIRP could allocate additional resources to improve the ability to forecast tracks and intensities of hurricanes, as well as to study and describe storm characteristics such as wind turbulence, gust structure, and wind-driven rain. In addition, there is some promising new technology that is allowing the research community to gain more insights into tornadoes and thunderstorms, which is critical to monitoring storms likely to produce damaging winds and improving warnings. These efforts should continue, along with 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. We currently rely on aerial and satellite photography, as well as on-the-ground post-disaster investigations and statistical studies to assess damage. These types of assessments miss the progression of damage and the cause and effect relationships between initial failures and subsequent damage. The IBHS Research Center and other new facilities that are capable of full-scale testing of building components or sections of buildings are beginning to shed some light on cause and effects, but more research is urgently needed in this area. Additional research also could include the influence of hurricane wind characteristics and water droplet size distributions on wind loads and water intrusion, respectively. 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 research aimed at improving building codes, developing effective mitigation measures and analysis tools to improve design efficiency, and assessing the benefits of mitigation measures or design requirements on both component and system performance. This research also should target the resilience of transportation and lifeline systems as they are essential to the quick recovery of individuals and communities.

- Finally, we suggest a focus on reviewing current test methods, standards, and analytical tools for rating wind resistance in light of recent observations from post-event assessments. Much private industry research and development related 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. The goal should be to make sure that high wind-rated products perform as expected and do not simply meet arbitrary thresholds that bear little relation to actual events.

Thank you for the opportunity to offer our comments on the critical role of mitigation research and the importance of NWIRP reauthorization. We urge you to move forward on this important legislation that will help to harness advancements in windstorm science to improve our nation's safety, sustainability, and resilience.

Biography of Debra T. Ballen
Insurance Institute for Business & Home Safety (IBHS)

Debra Ballen joined IBHS in 2008 as the general counsel and senior vice president of public policy. In this capacity, she is responsible for managing all of the organization's legal matters and overseeing IBHS' public policy efforts and commercial mitigation strategies. In addition, she also serves as the organization's corporate secretary.

Prior to her work with IBHS, Ms. Ballen was the executive vice president of public policy management for the American Insurance Association (AIA) in Washington, D.C. She developed and implemented policy for AIA's priority federal and state public policy issues. She also has served on the Advisory Committee for the Hazards Center at the University of Colorado, and on the Organization for Economic Cooperation and Development (OECD) High Level Advisory Board on Financial Management of Large Scale Catastrophes, which includes a heavy emphasis on mitigation measures.

Ms. Ballen graduated with a juris doctorate degree from Harvard Law School and an A.B. degree from Princeton University. She also has received the CPCU designation.

Chairman BUCSHON. Thank you very much for your testimony. I now recognize our final witness, Dr. Prevatt, for five minutes.

TESTIMONY OF DR. DAVID PREVATT, ASSISTANT PROFESSOR, DEPARTMENT OF CIVIL AND COASTAL ENGINEERING, UNIVERSITY OF FLORIDA

Dr. PREVATT. Chairman Bucshon, Chairman Massie and honorable Subcommittee Members, my name is David Prevatt. I am here to advocate on behalf of the American people for the creation of wind hazard-resilient communities within the next ten years. I believe the reason we don't have this already is that no one has been bold enough or committed enough to demand it. I wish to add the support of the American Society of Civil Engineers and the American Association for Wind Engineering and my own support for H.R. 1786. These organizations have been working for the past ten years since Congressman Randy Neugebauer of Texas first proposed this legislation. We also support the transfer of leadership to the National Institute of Standards and Technology.

Since Professor Fujita first published his Fujita Scale in 1971 and his report on the Lubbock tornado, our populations in the Tornado Alley has grown 50 percent. What does that mean? We have more schools, we have more hospitals, commercial spaces and certainly a lot more houses. It is not complicated. There are today more objects in harm's way than there were before. Also, since the 1970s as well, NOAA and the National Severe Storms Laboratory has invested heavily in weather infrastructure, over $167 million over the last ten years, in better research to predict unstable weather, in providing warnings of tornados, in more equipment, forecasting products. The public is aware of this and confident in its use, and private sector has stepped up to mine it. We can get forecasting information on our smartphones.

It is not complicated: longer lead times before tornado strikes reduce loss of life. In parallel, the 1970 Texas Tech University's wind engineering faculty, they initiated the first building damage studies after the Lubbock tornado, documented problems with houses, how they are made. Modern houses still have those problems. Houses have smaller nails, fewer nails than they once were in the 1940s. Connections are inadequate. They cannot resist tornado loads. Houses are insufficiently anchored to the foundations and they rock very easily. There are no vertical load paths in the houses built in Tornado Alley, and I can attest. I was there in Moore, Oklahoma, two weeks ago.

It is not complicated. The result is more houses, more poorly built houses, and more property loss and disruption of our communities. Tornados now, damage has increased two and a half times since the 1970 Lubbock tornado.

So my message today is not complicated. It is simply to tell our representatives that the people of the United States want to live in tornado-resilient communities. They also deserve to live there without fear. A tornado-resilient community is one where all schools have shelters or at least safer spaces that afford some protection to our children; that our hospitals and emergency buildings are all hardened against tornados, wind hazards and earthquakes;

that our houses are built so that fewer will be completely destroyed, destroying the lives and some will be repairable after a tornado, civil infrastructure are designed for tornados and that the private sector has the research backing to work to economically develop affordable and weather-resilient houses. Really, it is not complicated.

The wind engineering and structural engineering communities stand ready to begin this work. We have been ready for ten years. And with your support, we can begin this task to provide for our people. To get there, please support H.R. 1786, authorize its funding and sustain support for the wind engineering and structural engineering communities for our houses.

Let us mobilize community leaders to upgrade their building codes and include vertical load path provisions in all buildings, in all buildings. Support our research community to work with innovative private-sector companies to design buildings and build resilient and sustainable 21st-century houses. It can be done. Advance the wind and structural engineering research program, support your faculty that would provide these solutions to these existing problems.

Honorable Members, it really isn't complicated. Thank you.

[The prepared statement of Dr. Prevatt follows:]

Testimony of

David O. Prevatt, Ph.D., PE

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at the

Joint Hearing of Research & Technology Subcommittees
Committee on Science, Space and Technology
U.S. House of Representatives

Room 2318 Rayburn House Office Building

Federal Efforts to Reduce the Impacts of Windstorms

June 5, 2013

INTRODUCTION

Chairman Bucshon and Chairman Massie and Honorable Subcommittee Members, my name is David Prevatt, and I am a professional engineer and Assistant Professor of Civil and Coastal Engineering at the University of Florida. The faculty of the Department of Civil and Coastal Engineering (CCE) is very active in multiple aspects of wind hazards research and the design of hazard resistant infrastructure. Our wind hazards research focuses on understanding the effects of extreme wind events (hurricanes and tornadoes) and other elements (rain, storm surge) on buildings and infrastructure in areas affected by severe winds in order to increase their resilience. Our combined expertise includes in-field measurement and characterization of hurricane winds and wind loads, evaluation of structural capacity to resist wind loads and the efficacy of retrofits.

I am also a Director of the American Association for Wind Engineering (AAWE), and a member of the American Society of Civil Engineers (ASCE). I am appearing today on behalf of the University of Florida, AAWE, and ASCE.

The American Association for Wind Engineering (AAWE) was originally established as the Wind Engineering Research Council in 1966 to promote and disseminate technical information in the research community. In 1983 the name was changed to American Association for Wind Engineering and incorporated as a nonprofit professional organization. The multi-disciplinary field of wind engineering considers problems related to wind and associated water loads and penetrations for buildings and structures, societal impact of winds, hurricane and tornado risk assessment, cost-benefit analysis, codes and standards, dispersion of urban and industrial pollution, wind energy and urban aerodynamics.

The American Society of Civil Engineers (ASCE), was founded in 1852, and is the country's oldest national civil engineering organization. It represents 140,000 civil engineers individually in private practice, government, industry, and academia who are dedicated to the advancement of the science and profession of civil engineering. ASCE is a non-profit educational and professional society organized under Part 1.501(c) (3) of the Internal Revenue Code. ASCE is an American National Standards Institute (ANSI) -approved standards developer and publisher of the Minimum Design Loads for Buildings and other Structures (ASCE-7), which is referenced in the nation's major model building codes. As part of the ASCE-7 document, engineers are provided guidance in estimating the loads resulting from wind effects on structures. Thus, ASCE is at the forefront in the development of new information for engineers regarding wind and is in a unique position to comment on the status quo and our needs for the future.

I wish to add ASCE's, AAWE's and my support for H.R. 1786 "The National Windstorm Impact Reduction Act of 2013. ASCE has a long history with the National Windstorm Impact Reduction Program (NWIRP) and worked with Congressman Randy Neugebauer on the original authorizing legislation in 2004. Since that time our members have testified on several occasions before Congressional Subcommittees in support of NWIRP. My 2008 testimony is part of my written package. While we believe it is very important to move forward to reauthorize the NWIRP, we also believe that it is important to consider the broader area of hazards mitigation and would urge the Science Committee to not only move to reauthorization of NWIRP, but to include the reauthorization of the National Earthquake Hazards Reduction Program (NEHRP) and other programs as part of boarder hazards legislation.

Individually and collectively, wind storms are among the most devastating of all natural hazards. While NWIRP was created in 2004 Public Law 108-360, absent funding, the program's potential to develop ways to mitigate the effects of extreme wind has not been realized. As the sole, unified national program designed to address efficient wind-resistant design and construction, early warning and detection, improved emergency response, and public education and awareness, a fully funded NWIRP would result in a significant reduction in losses, both human and economic.

II THE US IS LOSING ITS LEADERSHIP IN WIND ENGINEERING

The lack of coordinated and sustained support for wind engineering over four decades has severely hurt the discipline. The lack of funding has meant that research is done in piecemeal fashion on shoestring budgets, in contrast to research for the earthquake engineering community that has had the generous support of federal funds. As a result, wind engineering research tends to be locally focused and somewhat limited in scope. We are losing our competitive edge both at home and abroad. There has been attrition of wind engineering faculty, and many engineering schools do not teach wind engineering. Without funding, it has become difficult to attract the best students to the field, as fewer and fewer university faculty positions are available.

While Federally-funded research to wind engineers has averaged less than $1M/year (counting TTU, ISU, UF, Notre Dame) over the last decade, still it has helped improve our understanding of the tornado, and downburst phenomena and their damaging effects on structures. This level of support is less than 5% of the desirable level that we think is needed to address this problem. A proposed level of support of say $20M/yr over 10 years is justifiable compared to the $2 billion in losses that occurred last week in Moore, OK. The benefits of research are immense and they have long-term societal benefits.

In contrast, starting in 2002, the Network for Earthquake Engineering Simulation (NEES) has had over $70 million Federal funds invested in new experimental facilities at fifteen universities and was slated to receive an additional $40-50 million per year from 2004-2014 for research funding. Internationally, the US is also losing its stride in wind engineering. Wind tunnel testing of long-span bridges and super skyscrapers are being done overseas. China has commissioned the most sophisticated and special purpose wind tunnels and their wind research program has been heavily funded. At this rate, we may face the future possibility of having to outsource US wind engineering research.

Funding of this proposal is critical as our "state-of-the-art" research is outdated, over 40-years old, and this is reflected in our building codes and structural design of buildings that do not address tornadoes at all. Since 2000, tornadoes have caused over $19 billion in economic losses and resulted in nearly 1,200 fatalities in the U.S. I have witnessed the aftermath of the two deadliest tornadoes of 2011 (Tuscaloosa, AL and Joplin, MO) and, last week I was in Moore, OK to conduct my damage surveys following the 20 May 2013 tornado. An important observation from that damage survey (sponsored by ASCE, AAWE and the National Science Foundation), was that despite recent experiences in Moore with powerful tornadoes, (in 1999, and again in 2003), newer homes and larger homes are constructed just as inadequately as any that were built before 1999, and they fail just as catastrophically.

We visited several elementary schools that were destroyed by the 20 May tornado, and others outside the tornado's path to examine how safe rooms or protected spaces can be included. Such details are necessary in public spaces and our schools. We were told during our visit to the Moore Medical Center, that they accommodated over 300 persons in their safe room, although there were only 30 patients and staff in the building, the majority of occupants came from the surrounding mall and neighborhoods seeking shelter just before the tornado hit.

III THREAT OF PROPERTY LOSS FROM WINDSTORMS

Property loss caused by severe wind storms is a national problem and it is increasing in magnitude. In 2011, there were 533 deaths caused by tornadoes. Lately, we have seen more frequent EF4 and EF5 tornadoes (historically less than 3% of all tornadoes historically) hitting a population center every 2-3 years (e.g. Parkersburg, IA 2008; Tuscaloosa, AL 2011; Joplin, MO 2011; Moore, OK 2013; add to this list). It is just a matter of time before a major metropolitan center will be hit. Oklahoma City barely escaped from a direct hit this time. In such a scenario the loss of life could be in thousands and property loss unimaginable. Our important cities with populations greater than 500,000, like Chicago, St. Louis, Kansas City, Dallas-Ft. Worth, Minneapolis, Des Moines, Atlanta, Washington DC are all at risk.

Our buildings and other infrastructural lifelines, such as bridges, tall buildings, airports, cell-phone towers, defense-related structures such as radars, are simply not designed to resist tornadoes of even lower intensities (EF1 to EF2: 86-135 mph), which are more common (90%). There are other types of intense winds, which are capable of causing similar destruction as most commonly occurring tornadoes.

Through considerable and sustained Federal investment, atmospheric/weather scientists and equipment have helped to increase the warning time for tornadoes and often saved lives in doing so. The bottom line is that buildings where people seek shelter and which are supposed to protect them from extreme winds often fail to do so. Whole communities are wiped out in major events, and it is no wonder that some people are afraid to shelter in their own homes when tornadoes threaten.

Many (including some engineers) hold the belief that a tornado-resilient community is an economic impossibility - our research suggests that this is not the case. However crucial information is first needed to develop an engineering model of the tornado loads and of the building's structural resistance. That said, if buildings in Moore, OK had used the latest wind-resistant construction knowledge available today, the structures would be more robust and the damage could have been reduced. We estimate the buildings destroyed by the 2013 Moore, OK tornado were designed for one-third of the loads likely imposed by that tornado. Therefore is not surprising that such extensive failures occurred. Those Moore buildings did not have common and inexpensive details, such as hurricane ties, continuous vertical load paths, continuous structural sheathing, reinforced garage doors, window protection and adequate number of anchor bolts, large washers and nuts. Buildings with these components have performed well in Florida's high-wind zones and they have suffered less economic loss in recent hurricanes as a result.

The National Science Foundation has funded research at UF to develop tornado-resiliency for residential communities and my research group is tackling the task in stages. Firstly, we are adapting technologies already deployed in coastal, hurricane-prone construction zones to upgrade construction in tornado alley buildings. Secondly, we are researching the impact of high-tech composite construction, using newer materials, adhesives and connections. The limitation to this research has been our incomplete knowledge of the magnitudes and/or how tornado forces interact with buildings. Recent research at Iowa State University and Texas Tech University is changing that, and patterns are also emerging from damage observations after tornadoes highlighting distinct differences between the tornado load patterns, and hurricane loads.

Unfortunately, reducing vulnerability to wind hazards is not just a question of developing the appropriate technical solution. Wind hazards are created by a variety of events with large uncertainties in the magnitudes and characteristics of the winds. Solving wind vulnerability problems will require coordinated work in scientific research, technology development, education, technology transfer and public outreach. Specific research needs are listed below:

- A need for a new robustness in the supporting academic infrastructure to generate improved basic supporting science and technology, to improve the availability of trained new university faculty/researchers, and trained engineers to implement improved practices and planning.
- A need to improve the techniques for assessing the economic impacts of different design decisions for both new and retrofit applications. This is an urgent need since 90% of our existing houses are over 20 years old and were built in accordance with building codes lacking engineered wind resistant provisions. If building codes are not upgraded and older structures retrofitted, the damage caused today will only increase in the future.
- A need to better understand the engineering micrometeorology of tornadoes, thunderstorm winds and downbursts and hurricanes. We need better understanding of the effects of these winds and suctions in the vortex core on structures due to their distinctly different features. Our knowledge base is to design for a boundary layer flow, while these storms have different profiles and dynamics.
- A need to better understand the potential loadings on structures through a comprehensive program of boundary layer wind tunnel testing, tornado simulation tests and validation using field observations. Pre-deployed in-field instrumentation is needed to capture the actual building loads during a tornado.
- A better understanding of how and at what level of loading existing structures fail and the application of this knowledge to new construction.
- An intense program to study various ways of identifying weaknesses in existing infrastructure and practical retrofit techniques to ameliorate these problems.
- Comprehensive testing of full scale structures to learn how to economically improve wind and hazard resistant construction and associated water penetration and damage.
- A need to quantitatively understand the surge and wave loading on coastal structures and how the coastal structures respond to loading.
- A need for technology transfer from the research to the practice and the general public, through dissemination activity, by upgrading archaic building code provisions, and by education of the building professionals.
- A need for full-scale monitoring of our taller and more flexible structures, which have been designed on the basis of scale models, but none have been tested in extreme event of a hurricane or tornado. This knowledge will help to predict the outcomes should a large urban area be impacted.

III WORKING WITH NWIRP AGENCIES

For the past 10 years, I have worked with and benefited from the support of NWIRP Agencies, including FEMA, NSF, NIST and NOAA. The support of these agencies is vital if we are to break the cycle of tornado impact, catastrophic damage and rebuilding. For example, through the NOAA Sea Grant Program, we have tested structural retrofit techniques for residential roof structures that utilize spray-on foam adhesives and insulation that simultaneously increase wind resistance, improves thermal insulation and acts as a secondary water barrier.

In 2011, the NSF supported my research team to collect perishable data after the Tuscaloosa, AL tornado. Several faculty members from different universities and their students were involved. The ASCE and the International Associations of Wind Engineering supported our damage survey of the Joplin, MO event, one month later. The reports, book and peer-reviewed papers produced from those efforts have provided new knowledge and they have facilitated the first attempt at developing a design philosophy for tornado loads. That impetus has led to ASCE Wind Load Task Subcommittee to undertake recommendations for tornado wind loads as part of the Commentary, to be included in the 2016 revision of wind loading standard.

NSF and the National Oceanic and Atmospheric Administration (NOAA) organized the "Weather-Ready Nation" series of workshops in 2012 to plan the future of our response to severe weather. Their final report included the following recommendation pertaining to the built environment:

In the area of hazard mitigation/disaster recovery, workshop participants identified the need to develop a better understanding of surface level wind and how it affects buildings. This knowledge could be used to develop more cost-effective methods of retrofitting existing structures that would enhance their wind resistance and to identify more cost-effective methods of constructing safe rooms and shelters. {There is} a need to identify ways to use regulations (e.g., building codes) and incentives (e.g., tax credits) to promote implementation of tornado-resistant retrofits, incorporation of tornado-resistant construction into new structures, and construction of safe rooms and shelters. In addition, there is a need to define community resilience, identify specific indicators for measuring it, and incorporate these indicators into the criteria for designation as Storm-Ready communities. {The workshop} also identified some activities that would achieve multiple purposes, such as establishing post-storm assessment teams."

IV. VULNERABLE BY DESIGN

Ultimately the reason we pursue this research is to be able to create protections of life and the way of life for our fellow citizens. I have seen thousands of homes damaged affecting thousands of lives, where some improvement could have mitigated their losses. Our schools

remain vulnerable to damage, and safe areas must be provided. Without this research, pursued as a national priority, the engineering knowledge needed will not be produced that can change these outcomes. Our homes are vulnerable by design. By following current building codes, they have little chance of surviving a violent tornado. Over half of economic losses from tornadoes are caused by EF-3 or lower tornadoes. Further, we know that even in EF-4 or EF-5 tornadoes, the most violent forces occur only within a narrow central band of the damage swath and the majority of buildings are damaged by lower intensities (EF3 or lower).

The repeated destruction of large communities of homes by tornadoes highlights the need for acceptance of more resilient residential construction practices as the basis for viable housing in the 21st century. The engineering research community must work hand-in-hand with innovators in building construction to develop more resilient structures at an economic cost. Clearly, rebuilding after the 1999 and 2003 tornadoes to the same building codes have not served the people of Moore, Oklahoma well. Wide swaths of homes built in 2005 had the same weaknesses present as the homes destroyed in the earlier tornadoes, and they failed in similar manners. Unless we change these practices and develop structural retrofits of existing buildings, the level of damage occurring in Moore will increase and affect another community. While there are still many unknowns in windstorm designs, what is concerning is that we have not yet incorporated what we do know into our building codes.

Our communities are now calling for national leadership on the issue of wind damage to buildings. I contend that a-10-year goal of creating a tornado-resilient community is an achievable one. The research community is ready, willing and capable to undertake the challenge of producing better houses and other buildings for this nation.

There is much still to be learned regarding windstorms and in particular tornadoes, where even the wind speeds at ground level are merely estimates. We do not know what design loads should be used for tornadoes, and what is an appropriate level of performance that should be expected of our buildings during violent tornadoes. We do not completely understand how and at what level of loading existing structures fail. We do not yet know how to balance the costs and benefits of tornado-resistant designs and retrofits on a home-by-home basis. But we know that tornadoes and hurricanes are very different, and present different design challenges. We know that even at the same wind speed, building loads in a tornado are much higher than in a hurricane due to the strong vertical suction within the vortex.

VI MODEL BUILDING CODES

Responsible building is essential to improve the quality of life, assure safety and durability, and to reduce vulnerability to future hazards. Traditionally, design practice and building codes have been the responsibility of the local communities. Recent natural disasters have demonstrated a high level of interdependence between the viability of local cities and the national economy. The traditional assumption that local jurisdictions could determine the level of safety and quality to which they would build has yielded to the recognition that uniform national standards are needed to assure that the economic impact to the nation is controlled. These national standards are best delivered in a national model code that local jurisdictions should be encouraged to adopt.

The purpose of a building code is to establish minimum requirements necessary to protect and improve public health, safety and welfare in the built environment. Model building codes provide for protection from fire, structural collapse, general deterioration, as well as extreme loads related to man-made and natural hazards. They are also created to protect natural resources, owner costs and the environment through improved minimum building standards. Building codes are "living" documents, that are changed over time as more knowledge about particular loads and materials become available. The wind engineering knowledge in our building codes has not kept pace with the growth of communities in regions at risk of tornadoes. Safe and sustainable buildings are achieved through performance-based code-based design and construction practices in concert with a code administration program that ensures compliance. National model codes serve to keep construction costs down by establishing uniformity in the construction industry as well as minimizing disaster recovery costs. This uniformity permits building and materials manufacturers to do business on a larger scale - statewide, regionally, nationally, or internationally. This larger scale, in turn, creates cost savings for the end consumer. Codes also help protect real estate investments, commercial and personal, by providing a minimum level of construction quality.

Experienced volunteer professionals work together and develop model codes under a multi-step process. Most professional engineering organizations maintain code development committees that initiate code provisions based on the practice in their technical areas and these are often augmented by university-based research. Topics for code provisions are often introduced in case study reports or research papers. In time, many of these provisions are gathered together and published as design guidelines. Eventually the guidelines are transformed into standards and incorporated into the model code. ASCE, as a premiere American National Standards Institute (ANSI)-approved standards organization, develops and maintains many of the standards referenced or incorporated in the model codes. Through a

thoughtful and extensive process, ASCE assures that each standard represents a broad consensus of the related professional community.

State and local legislative bodies are not obligated to adopt model building codes, and may write their own code or portions of a code. A model code does not have legal standing until it is adopted as law by a legislative body (state legislature, county board, city council, etc.). When adopted as law, owners of property within the boundaries of the adopting jurisdiction are required to comply with the referred codes. Because codes are updated regularly, existing structures are traditionally only required to meet the code that was enforced when the property was built unless the building undergoes reconstruction, rehabilitation, or alteration, or if the occupancy of the existing building changes. In that case, provisions are included in the code to require partial to full compliance depending on the extent of construction.

VII H.R. 1786 "The National Windstorm Impact Reduction Program Act of 2013"

We support reauthorization and full funding for the National Wind Storm Impact Reduction Program. We also support the transfer of leadership to the National Institute of Standards and Technology (NIST). If the program is funded and utilized to its full potential, we would see the development and transfer of new technology that will reduce losses experienced each year as a result of wind storms.

The funding should be targeted to achieve the following goals:

- Reduce economic losses from windstorms and increase the resilience and sustainability of communities.
- Develop affordable designs to provide enhanced windstorm protection.
- Improve emergency management planning.
- Develop cost-effective retrofit schemes with existing construction to improve individual and community resilience.
- Develop improved severe weather warnings with longer lead-time, fewer false alarms, and more accurate prediction of affected areas.
- Implement innovative codes and standards that provide for wind-resistant construction and programs for assuring increased compliance.
- Develop new materials and innovative design concepts and emergency response approaches to minimize electrical power loss as a result of windstorms.
- Conduct public education on wind hazards and methods for hazard reduction.
- Collect and archive wind and national infrastructure data.
- Train the next generation of technical experts and enhance the knowledge of design and construction professionals.

- Improve regional risk assessments, especially involving multiple hazards, lifeline interdependencies, and ripple effects.

VIII CONCLUSION

Windstorms are possibly the only natural disaster whose impact on humans could be mostly resolved by proper research. There are wind-engineering experts in the country (20 or so left, like endangered species) who believe that this problem can be resolved, if properly addressed. The National Earthquake Hazards Reduction Program (NEHRP) is a good example of the strong correlation between spending on research dollars at a sustained level and its impact on reducing structural damage from earthquakes.
The NIWRP needs to follow suit. This should be a coordinated effort at the national level involving universities, government agencies (national labs), building officials and industry; expect to see positive results in 5-10 years. Grand challenge problems need grand solutions.

I sincerely urge the Members of these Subcommittees to work towards bi-partisan support of this urgently needed bill, which can shift our support for wind engineering research from low to high gear, as this is an urgent national priority.

To paraphrase the words of President John Kennedy's famous 1962 "To the Moon" speech:

"Let us choose to live in tornado-resilient communities. Let us choose to develop tornado-resilient homes within a decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win".

Thank you.

END OF TESTIMONY

David O. Prevatt, Ph.D., P.E. (MA)
Assistant Professor – University of Florida

After earning his Ph.D. degree from Clemson University in 1998, Dr. David O. Prevatt worked for seven years with the Boston-based ENR500 consulting engineering firm, Simpson Gumpertz & Heger Inc. in building envelope system design and remediation. He joined the faculty of Clemson University in 2004 as an Assistant Professor and directed the Wind Load Test Facility, conducting wind tunnel tests on low-rise building models and investigating of post-hurricane damage to residential buildings. In May 2007, Dr. Prevatt joined the University of Florida's Department of Civil and Coastal Engineering where his research focuses on the mitigation of extreme wind damage to low-rise construction. Dr. Prevatt recently led the damage assessment teams that documented damages caused by the 2011 Tuscaloosa, AL and Joplin, MO tornadoes. More recently, he was a member of the NSF RAPID team evaluating damage to residential buildings and the ASCE-sponsored survey team evaluating schools and commercial structures, following the 20 May 2013 tornado in Moore, OK.

Dr. Prevatt was recently awarded an NSF CAREER research grant to develop more tornado-resilient homes and communities. His current research continues to understand and predict the structural load paths in light-framed wood structural systems, and building envelope components using experimental and analytical modeling techniques. His research vision is to advance 21st century housing that will be the sustainable backbone of hazard-resilient communities. Dr. Prevatt is a professional engineer (registered in the Commonwealth of Massachusetts and in Trinidad and Tobago) with over 20 years consulting experience in structural engineering and building investigations. He is a member of the American Society of Civil Engineers, the on the Board of the American Association for Wind Engineering, and a member of the UK Wind Engineering Society.

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Chairman BUCSHON. Thank you very much. I want to thank all the witnesses for your testimony. It is a fascinating subject. I want to remind the Members that the Committee rules limit questioning to five minutes. The Chair will at this point open the round of questions. I recognize myself for five minutes.

Ms. Ballen and Dr. Prevatt, initially, what are the stepping stones that are preventing us from building better homes? I mean, what is the rate limiting steps? Why, even with all the information we have out there, why don't we do it?

Ms. BALLEN. Well, we have actually developed a strategic plan at IBHS that I think responds to your question, and that is, first we need to get people to pay attention. We have the research capabilities. These fine universities, work that groups like ours have done, provide the technical answers but we need people to understand them, and the video that you saw I think as an example of getting people to pay attention. That video has actually been on the Today show, it has been on the Weather Channel. People have seen that and begun to think about "gee, how do I make that not happen?" So the next step is getting them to change their minds and getting them to value that stronger roof instead of a granite countertop, and once individuals are making those choices, we as a society need to rise up and really demand, demand to be in a community with a better building code or demand, you know, that Congress, you know, enacts these types of legislation. I think a lot of people just don't—they haven't gotten that first step so they can't get to the second step and the third step, and that is at least, you know, perspective on that. Dr. Prevatt?

Dr. PREVATT. What I would add to that is, we still lack the knowledge of designing buildings for tornados. There has been a dearth of research in wind engineering that supported the faculty working on wind engineering matters. We had the zenith in the 1980s and since that time there just has not been the research there. Currently, we are trying to understand how the tornado loads interact on a particular building, how the load paths have to be improved in order to do that. So part of the problem is not only do people need to be initiated to want to change, we have to provide an opportunity and knowledge of how they can change.

Chairman BUCSHON. Thank you. I can tell you, I was in health care before, and there is a powerful motivating factor for people and it is called denial, and it is a very difficult thing to overcome when people see what is the statistical chance of their home being hit and convincing them that they need to have that home built with higher standards. It is very, very difficult thing to overcome as well as messaging why that is the case.

Dr. Kiesling, this is my own personal question. Has there been any—is there research out there on not only telling us where tornados are and where they are going but how to divert them away from urban centers?

Dr. KIESLING. I think the first part of that question, the answer is yes. Certainly, the people are doing an excellent job of predicting the path and where the tornados are. I don't see any hope of diverting, though we occasionally hear from people who have proposals for that. In the first place, we don't know where they are going to occur far enough in advance, and secondly, there is a tremendous

amount of energy there that has to be dealt with in trying to divert them, so I frankly, personally do not have much hope for that.

Chairman BUCSHON. Or dissipate them, for example, and dissipate the energy or anything like that?

Dr. KIESLING. Hopefully it can work. I have to depend on, I guess, the next generation to come up with solutions there because I simply do not see how we can dissipate or divert tornados.

Chairman BUCSHON. Okay. Is there a—describe the difference in research between straight-line winds and tornadic winds. Is there a big difference there?

Dr. KIESLING. Well, straight-line winds generally, we know what pressures they exert on buildings and they are pretty predictable, but in a tornado or hurricane, the variations are great and I think we need to know a lot more about not only the intensity but the variation and the characteristics of extreme winds so that we can better deal with them. We are making progress, but again, it is a long, slow process and requires manpower that is hard to come by.

Chairman BUCSHON. Do you have a comment, Doctor?

Dr. PREVATT. I would add that in tornados as well, we have something that we don't understand, which is vertical suction below the vortex, and that has never been, you know, understood in terms of how it reacts or interacts with the winds that are ensuing into the tornado.

Chairman BUCSHON. Thank you very much. My time is about to expire so I will now recognize Ms. Wilson for her line of questioning.

Ms. WILSON. Thank you. In her testimony, Ms. Ballen states that wind hazard research has been underfunded for decades. The other witnesses also express a similar sentiment in their testimonies. All of you indicate that NWIRP has never been implemented in any meaningful way because of lack of resources. What opportunities are we missing by not providing the program with, as Dr. Kiesling puts, a reliable, sustained source of funding for maturation and expansion?

Dr. PREVATT. I think we just have to look at the earthquake engineering program and see what benefits we have gained from that. We are talking about something that has been funded to the level of, you know, millions of dollars per year. Literally all other wind engineering research over the last ten years at the top wind engineering schools amounts to about $1 million per year. We are talking about, and I have seen it, Joplin, Missouri, Tuscaloosa and Moore, Oklahoma. We are talking about $2 billion, $3 billion and $5 billion. Those are the numbers, and we simply are not addressing them. What has happened over the time, unfortunately, is there has been attrition of wind engineering faculty. Structural engineering faculty no longer study how to make houses stronger, you know, commercial structures and so on, and these are the areas where we have the most damage, the most dollars lost and the most lives affected.

Ms. BALLEN. I agree certainly with everything that Dr. Prevatt just said. I think our feeling is that if there were more money that were in this program, or money in this program, since there really hasn't been money in this program. You know, we have identified in a broad way the areas where we think we could really lead to

progress, and the first is enhanced understanding of the events themselves, and different issues in terms of understanding tornados and understanding hurricanes but certainly it starts with the science and the meteorology of that.

The second is understanding the connections between those events and the built environment. We are doing some of that at the IBHS research center but certainly more could be done through enhanced funding through NWIRP of universities and others. We recreate the nature and then we see how nature reacts to the built environment, homes and small businesses.

The third area is identifying those mitigation measures that actually work, the tornado-proof home or even in the area of hurricanes where we know a lot more. There is still a lot more to be learned about how to make those structures better able to sustain nature. And the final thing would be making sure that the tests that our products and standards are based on really do accurately reflect the real world. What we saw in the auto safety arena was that everyone could build a car that withstood the first NHTSA tests because they knew exactly what they needed to build to, and that didn't necessarily mean it was safe in the real world. And so we need to develop testing standards that actually do reflect what we learned from the first side in terms of the real-world weather events.

As far as the funding levels are concerned, as you identified in your opening statement, you know, whatever the level is, and more is obviously better from the perspective, I think, of all of the panelists that are here but you also identified that the static funding is a problem. If the idea of the program is some of these are short-, some of these are medium- and some of these are long-term events, if you fund it sort of at the same level throughout the three-year period or whatever the period is, you get everything started and then you can't identify anything new in the second and third year. So we certainly would recommend at least modest upticks as you go forward so that, you know, we can make sure that we can start what we finish but also start other things that are identified in the early years of the program.

Ms. WILSON. Dr. Kiesling, do you have any response?

Dr. KIESLING. Sorry. What was the question? Did you ask me if I needed to add anything?

Ms. WILSON. Do you want to add anything about the lack of funding?

Dr. KIESLING. I think, again, not only the level of funding but the continuity is a problem because particularly with young faculty because young faculty are under tremendous pressure to produce research to generate funding, to publish, and if they have areas where that funding is more readily available and dependable, then they are going to go to those areas. So it is very difficult for us to recruit young faculty into wind engineering, for example, because of the lack of continuity of funding.

Ms. WILSON. Thank you.

Chairman BUCSHON. The Chair now recognizes Mr. Schweikert for his questioning.

Mr. SCHWEIKERT. Mr. Chairman, I would like to yield to the sponsor of the bill, Mr. Neugebauer.

Mr. NEUGEBAUER. And I appreciate the gentleman.

You know, I think one of the things that we want to happen here, and it has been alluded to by the witnesses, is getting people to build buildings that will mitigate some of the potential damage and loss of life. You know, I think one of the misnomers out there is that you have to build Fort Knox so that the cost of building that, you know, is not economic because of the probability that event happening versus the cost of doing it, and so one of the things I think I am very big on is using the carrot, you know, rather than the stick. And so I have a couple of questions. One of those, do you see within—for example, many of these losses of property were insured losses, and so obviously the insurance industry has a huge interest, you know, in this issue. Two things. Do you see them recognizing a difference in homes or buildings built to different standards so that there is incentive for homeowners or people building a building to, you know, spend the extra dollars to do that? So that would be my first question.

Ms. BALLEN. Let me take that one since I know a little bit about that issue. We look at property mitigation in two ways. One are building codes and one are efforts to go above building codes. Building codes, as much as we support them, are really intended for life safety as opposed to property protection, and so while obviously a code-built home is better in many ways, if the issue is property protection, I think that is not necessarily what an individual insurer is likely to consider the best possible. IBHS has developed a voluntary standard. It is called *Fortified Home* or *Fortified for Safer Living*, and does go above code. It is hazard-specific. So we try to identify the types of building construction techniques that will help for specific hazards. Again, every insurance company does make its own decisions but several states have recognized *Fortified* and requiring insurance companies to do that in their filings. So we do have a little bit of a track record in Mississippi, Alabama, Louisiana, South Carolina, and we are seeing that companies are in fact individually making decisions in terms of filing.

That said, I want to emphasize that the types of things that are in *Fortified* are not unaffordable. They are relatively low-cost improvements that a homeowner can make. I am talking about a couple of thousand dollars generally, particularly in an area that already has a code. One of our partners in terms of *Fortified for Safer Building* is Habitat for Humanity. They are actually the largest builder in this country at this point in time, and we have partnered with Habitat on a number of *Fortified* homes in hurricane-prone areas and in other areas and so if we can get those *Fortified* standards into a Habitat home, you know that those are not unaffordable standards. It is a question of sort of being there at the time when decisions are being made. You know, to say to someone that has a roof on a home, this is not a good roof, you need to take off this roof and put a whole other roof on is a very expensive proposition, but if you are at the point where a homeowner is replacing a roof or needs to replace a roof because the first roof has blown off, it doesn't cost that much more to build to a *Fortified* standard.

Mr. NEUGEBAUER. I think one of the things that—another theme of this particular legislation but I think a theme that we hear a number of the people up here talk about is, you know, dissemina-

tion of that information and coordination of that information, and so, for example, this research, for example, do you sit down with, say, industry participants, say, the national home builders, for example, and share, you know, this information and introduce a dialog with them to make sure that they are being made aware of this?

Ms. BALLEN. We certainly have started that. They started out rather negative and skeptical of IBHS and our capabilities and our mitigation messages but we have invited them all to our research center. They see that $40 million facility, they see that fan capability and they realize that we are very serious about doing the research and doing the communications and that has led to a much more constructive dialog. There are a number of organizations that we have had longstanding, very positive relationships with, and I should mention the ASCE is probably one of our strongest partners here in Washington and at the state level and certainly at the technical level as well. They have visited our research center. The architects are another group that we are trying to encourage young architects in architectural schools to incorporate stronger building into their curricula. So we are reaching out to a number of organizations. Our companies reach out to their policyholders. We try to leverage those relationships to try to get the word out into social media, which of course is huge in all areas and is huge after disasters. We are trying to make that part of the mitigation movement as well.

Mr. NEUGEBAUER. Okay. I thank the gentleman for yielding.

Chairman BUCSHON. I now recognize Ms. Johnson for her line of questioning, five minutes.

Ms. JOHNSON. Thank you very much.

Just as a follow-up to the course of questioning, I can't forget the image of seeing the one lone house that remained standing during Hurricane Ike in Galveston, only to think how did it survive out there alone, to find later that the entire neighborhood was devastated and that house survived, and it was because they had used the type of materials that would resist many winds. How do we—I just heard your comments from the standpoint of encouraging architects but it seems to me that local ordinances when permission is gotten for building has to be involved. How do we do that without making it seem that this is big government trying to boss everybody? But I should think that insurance companies should be very interested in having resilience in the building as well as governments. You know, with the ability of our satellite system to predict, we have gone a long way in saving lives but we haven't done nearly as well in saving property, and that is a major concern in an economy like today. How do you see that responsibility fitting where and what can we do?

Dr. KIESLING. Representative Johnson, one thing I would tell you about that is one building that you saw in Ike, I saw one building or one neighborhood in Moore, Oklahoma, that had hurricane ties, something that actually would hold the roof down to the wall, just one out of thousands and thousands that we looked at. Essentially, we have to do a better argument to convince individuals, as Ms. Ballen said, that this is something that they ought to think about instead of that granite countertop. Let us look back at ourselves

100 years ago, our large cities—Chicago, New York, San Francisco—we all faced fire considerations. Blocks and blocks were burning down. It was at that time that those city leaders, legislators, politicians and the public got together and said enough is enough; if Chicago is going to survive, we are going to have to, you know, all pull in one direction, and that is what we did. And we can do it again. We have the ability to do it again. I think right now the public is generally fearful of tornados, fearful of the wind hazard, and they believe we don't have the talent to do it. I think if we have put a man on the moon, we could pretty much keep a roof on a house.

Ms. BALLEN. I certainly agree with that statement. We are very strong supporters of building codes, and about a year ago, we did a little study. We called it "Rating the States," and we looked at the building-code regimes from Texas to Maine in the coastal states on a one to one—a zero to 100 scale. The scores ranged from four to 95. So there was quite a range. And I will tell you that as a public communications vehicle, a lot of people may not know what a building code is but they know that is good to have a high score and it is bad to have a low score, and that really has started a dialog, and the most positive responses that we have gotten from the media certainly have been in those states with the low scores about how they can do better. One state that was not at the bottom, was in the middle but actually passed a bill this year—Maryland, that specifically addressed an issue that we had identified in those states. So it is a way of making building codes understandable to people so again they begin to demand that they want to be—we would say ideally in a state, we support statewide mandatory building codes. It is much easier for enforcement. It is much more consistent. But there are some states where that hasn't happened, and Texas certainly is one of them. At a minimum at the local level there ought to be strong ordinances in effect.

Ms. JOHNSON. Any other witness comments? Thank you, Mr. Chairman. I yield back.

Chairman BUCSHON. Thank you. I now recognize Mr. Lipinski for five minutes.

Mr. LIPINSKI. Thank you, Mr. Chairman.

In his testimony, Dr. Kiesling calls for economic, social and behavioral studies to understand implementation of research results like stronger building codes. I think this is something very important that we have to use the lessons from social science to ensure that the other lessons that we are learning from research get implemented. Can Dr. Kiesling and other witnesses expand upon that and where exactly they see the importance?

Dr. KIESLING. I think implementation is a serious problem in many areas. I would back up a little bit and say that in terms of improved building codes, we can do a lot of good by simply meeting existing building codes that are not, say, effectively enforced or inspected, but if we increased the design wind load only a small amount, we would save a lot of property because even in a tornado, most of the damage is done at wind speeds, say, in the 100- to 125-mile-per-hour wind, and if we design for a little bit more than we do, 90- or 100-per-hour winds, that would save a lot of the structures that are currently being destroyed.

I don't know what the answers are to implementation but I see it as a serious, serious problem, not only in enforcing building codes but it haunts me that I hear reports of traffic deaths in our city, and in many instances people were killed in rollover accidents without wearing their seat belts so they are sitting on property they already own that can be very effective in saving lives, and so it should not surprise us, I think, that we have problems in enforcing building codes and motivating people to do a better job of construction. I don't know the answers but I think we need to involve maybe social sciences and disciplines that we have not effectively engaged before to see how do we implement what we already know, but there is much more to be learned. I don't say we have all the answers. We need to learn much more but we also need to do a better job of using what we already have.

Ms. BALLEN. We are hoping actually to gather social scientists at our research center this December so that we can really begin to explore that in more detail. To the extent we have sort of sketched out the way we think about this issue, we think it is first a question of getting the hearts and minds of people, getting them to really sort of want this, and we talked about that a little bit before in terms of one of the answers to the previous questions. The second is providing the adequate incentives. That is for both individuals and for states. An example of how that might work at the state level is the *Safe Building Code Incentive Act* that also has been introduced in this Congress. It provides additional funding for States that do the right thing in terms of enacting strong building codes. That is a financial incentive. There could be other incentives for individuals. And finally, understanding the politics of this. We talked about the builders. You know, we have to make this a win-win proposition and make the market really want this to happen for us to sort of address those social-science issues.

Dr. PREVATT. I might add that NOAA and the NSF, National Science Foundation, last year, they operated, or they organized a pretty comprehensive workshop called Weather Ready Nation in which they brought together the physical scientists and engineers with the social scientists to actually discuss the issues of weather, you know, acknowledging that yes, forecasting has got us so far, and yes, we are better at it but the property damage. So the move has been started. There is a report which if you would like I can provide that link to you in which we are now working with social scientists. I was on a rapid NSF project in Moore, Oklahoma, and we did involve Mississippi State social scientists and social scientists from the University of Alabama as well as ourselves, engineers in other universities.

Mr. LIPINSKI. Thank you. I would like to take a look at that. I think it is something that we oftentimes overlook I think in legislation here. We should make sure that in NWIRP we include social sciences because you can do all the research that you want to know how to mitigate damage to property, threats to human life if no one is implementing those and we don't know, as Ms. Ballen said, we are not sure about the incentives of how to get people to actually take that into account. Then we just have research sitting on a shelf that is not doing anyone any good, so I think that is some-

thing important that we have to make sure that we are considering here in providing at the Federal level.

I yield back. Thank you.

Chairman BUCSHON. Thank you. I now recognize Ms. Esty for five minutes.

Ms. ESTY. Thank you, Mr. Chairman.

As a quick follow-up to Mr. Lipinski's discussion for Ms. Ballen, in looking at incentives, is the insurance industry offering lower premiums to those who have retrofitted or, say, hurricane ties and what sort of incentives is the marketplace providing? Because we know, for example, the tax credits do not seem to be terribly effective right now, so I am wondering what is being done on the private side.

Ms. BALLEN. I always do stress that individual companies make their own decisions, but that said, IBHS developed a code plus standard called *Fortified*. We know that those technical standards work and the program includes an inspection and designation process so that we know that the homes that were built to those standards, supposedly built to those standards, really are built to those standards. Many individual companies are providing discounts for *Fortified* homes, and that has also been required in rate filings in some states, but it is not enough to say "oh, if a homeowner says or a builder says that they have built to that standard, it is."It has got to be inspected, it has got to be verified.

Ms. ESTY. Thank you, and a further follow-up. Living in Connecticut where we experienced a number of storms over the last few years, we have great concern about resilience about the life lines, utilities, infrastructure. So if any of the three of you can talk a little bit about what is being done on the research side, on these critical issues where you can't have rebuilding, you can't have—you can't even get access to people. You can't get them back on line, and what we ought to be looking at in that department.

Dr. PREVATT. I think that is the entire direction of the Engineering School of Sustainable Infrastructure and Environment at the University of Florida. That is our entire mission. It is in several universities, resilience and sustainability, the hallmarks of what we are doing in civil engineering. Before we get to a sustainable society, we first of all have to get a resilient one, one that is more robust, and the research sometimes is fundamental to this. We do need to better understand the loads. We do need to better understand the structural properties of the buildings, the infrastructure, the utilities, what have you, but, you know, I think we really just need to decide, we really do need just to decide that we want to live in a sustainable society, and we can do it. Yes, it will cost some money, it will cost some time, but I guarantee if you put engineers and scientists, social scientists as well, on this case, we can do this in ten years. It takes, you know, just that bold vision to go after it.

Ms. ESTY. Well, I know some of the work, say, that Frances Cairncross has done looking at multiple ways to address climate-change issues and particularly with our populations being increasingly concentrated on the coasts. We are seeing—whatever it is attributable to, we are certainly seeing an increase in more severe weather. So I think it is going to be extremely important that we

take this resilience line of research quite seriously and address it as an extremely high priority as we are extremely energy-dependent for everything that we do. If we do not harden our systems, we have been looking at cybersecurity but we also just need to look at natural weather ability to bring down whole cities, and I am quite concern that we not forget how critical that is. Just look what happened in Staten Island, look what happened in New York, and we do need to be emphasizing retrofitting, not just new standards, but what are we going to do with major cities that need to be retrofitted for the utilities.

Thanks very much. I yield back the balance of my time.

Chairman BUCSHON. Thank you. I now ask unanimous consent to recognize a member of the full Committee for questioning. If there is no objection then, the Chair now recognizes Mr. Neugebauer for five minutes.

Mr. NEUGEBAUER. Thank you, Mr. Chairman, and I would also like to return the favor and yield a little of my time to Mr. Schweikert from Arizona.

Mr. SCHWEIKERT. Thank you. I didn't know if I should object there and then I could yield. Thank you, Mr. Chairman.

It is Ms. Ballen?

Ms. BALLEN. Ballen.

Mr. SCHWEIKERT. Ballen. Actually, Elizabeth was hitting a point that I wanted to go to. We all live in a world where how many of us right now will go out and buy a Volvo over a, is it a Corvair? Any of us that are old enough to remember a Corvair, you know, unsafe at any speed. But the fact of the matter is, when you are buying a car today, aren't we also looking at the Consumer Reports and saying hey, this is safe, my insurance is cheaper. There is a price differential there driven by the insurance industry that actually changes our purchasing behavior. Why isn't that also the decision for those who are purchasing residential real estate is our price differential and our cost of insurance?

Ms. BALLEN. That is an excellent question and one we ask ourselves every single day. Our peer organization is the Insurance Institute for Highway Safety, and they showed the way, how research and communications lead to safer cars and people wanting them, and then you have enough people with these cars that you really begin to see the difference in the losses, and insurance companies respond to that.

Mr. SCHWEIKERT. But, you know, I understand for public buildings and schools and those things, particularly those with some Federal resources in them, we have a voice there. But if I am out buying a residential property or getting ready to refit or remodel and I—how many of us have bought a house and we will fixate on small margins on the interest rate between one lender and another? But if there is actual price differentials understood in the market between I did these types of tie-downs on my roof and this house doesn't have these sorts of tie-downs so I am going to pay this sort of premium, isn't that the ultimate solution here?

Ms. BALLEN. That is the ultimate solution. The market is the ultimate solution. It would be benefited by the kind of research that we are talking about but ultimately people need to want that. Now, I think the impediments are——

Mr. SCHWEIKERT. Well, the work is on incentives and disincentives, so they want it; they just need to understand there is a price difference.

Ms. BALLEN. They need to understand that, yes, and the building industry is much more complicated than the automobile industry. There are thousands of builders out there versus, you know, five or six or seven car companies. The guys that do it are every roofer, you know——

Mr. SCHWEIKERT. Well, and only because my undergrad is in real estate and my master's focus was in financing, the real estate world is the life I grew up in. It is not the builders, it is the consumer. And if you told me—if I came to you right now and said hey, you buy this house because of the attributes, you pay this interest rate, but if I bought this one I would pay this interest rate, we all scream and go running to this one. Why is it not the same in insurance? And Mr. Chairman, I would like to yield to Mr. Neugebauer because I know he had a little bit more on this.

Ms. BALLEN. Okay.

Mr. NEUGEBAUER. I thank the gentleman.

Dr. Kiesling, you know, one of the things that you mentioned a while ago is that the winds of a tornado are much different than a gust, vertical wind. So there are different categories of events, all the way from, I guess, an F–0 to F–5 so there is probably—at this particular point in time the F–5 is just, we don't have the technology, you know, on an economic basis to protect a home from an F–5 storm probably. So then if we go just to the mitigation of life over property saying the house doesn't make it, but there are things that you have done, worked on of various degrees that are fairly affordable inside that home of fortification. Could you just kind of cover a little bit of what are some practical things that could be done in the homes both retrofit and new construction?

Dr. KIESLING. Well, thank you for asking. I think from early on we more or less adopted the approach that it is very expensive to take a home of the type that we build today and design it to resist the worst-case tornado. You can certainly improve the performance and protect against severe damage from the vast majority of even tornados because, as I said before, the damage is caused by marginal wind speeds, but we adopted the idea or the philosophy of providing occupant protection in a small room, now called a safe room, because it is very affordable to harden and stiffen a small room of a house to provide near-absolute occupant protection. That might be a closet, a pantry, a bathroom, and that is practical for new construction, but the vast majority of safe rooms being installed today are manufactured. They are steel boxes, concrete boxes, timber boxes installed in a garage, on the slab of a garage, and they are very affordable. There even those shelters that are mounted under the slab. You can go in the garage, cut out a section of a piece of the garage floor, excavate, put a shelter under there and put a sliding door on it so you provide protection without even losing a parking space. There are many, many options available today, and I would say for almost every situation or circumstances, it is possible to design occupant protection from the worst-case tornado, and we have a real problem with that right now with public perception because there was so much bad publicity, misinforma-

tion in Oklahoma about having to be underground to survive an EF–5. That is simply a falsehood that should be squelched.

But in answer to your question, I think there is a way to protect life in a safe room very inexpensively, and I think we must do the best we can in reducing the damage by improving the buildings through building-code enforcement.

One other point that I would make that is different in the automobile industry and in the home-building industry, both are sensitive to initial cost but most of the houses are built speculative today, and as you well know, the marketability of housing is very, very sensitive to the initial cost, and not only builders but I think homeowners too look at that initial cost and resist any improvement that costs very much initially.

Chairman BUCSHON. Thank you very much. At this point, I would like to thank the witnesses for their testimony and the Members for their questions. The Members of the Committee may have additional questions for you, and we will ask that you respond to those in writing. The record will remain open for two weeks for additional comments and written questions from the Members.

At this point the witnesses are excused. The hearing is adjourned.

[Whereupon, at 11:17 a.m., the Subcommittees were adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Dr. Ernst Kiesling

QUESTIONS FOR THE RECORD
THE HONORABLE LARRY BUCSHON (R-IN)
U.S. House Committee on Science, Space, and Technology

Federal Efforts to Reduce the Impacts of Windstorms

Wednesday, June 5, 2013

1. How well does voluntary compliance work for the adoption of windstorm building code standards? How do homeowners become aware of the risks? What as policymakers can we be doing to promote wind hazard safety with our constituents?

Innovation--even significant improvement-- disturbs tradition and culture. Adoption of innovation or upgraded windstorm building codes challenges an industry that is steeped in tradition to accept new programs or strategies. Voluntary compliance acquiesces to innate resistance to upgrading building practices and thus tends to maintain the status quo.

Voluntary compliance with building codes and standards is not a particularly effective system to ensure that sound and safe building practices are used consistently. An effective system incorporates systematic adoption of modern model building codes, such as the International Residential Code (IRC), that are continuously updated and properly enforced by well-trained professionals. Responsibility for implementation rests largely at the local level where oftentimes some of the prequisites for effectiveness are missing. Many disconnects occur between federal guidelines and local implementation, between program designers' intent and field practices.
The current system allows for states to voluntarily select and adopt building codes and standards. At this time only 32 States and 3 U.S. territories have adopted an edition of the IRC effective statewide. Some states permit local governments to amend model codes to strengthen or weaken them.

Oftentimes voluntary compliance does not drive allocation of the resources necessary to support funding of building departments, code officials and continuous training. This is especially true in small jurisdictions.
Homeowners' perceptions of risks are sometimes formed by personal experience with a disaster event or by exposure to quality education programs, but more commonly they are formed by media reports or by advertising sound bites. Some quality messaging channels such as those offered by the Federal Alliance for Safe Homes (FLASH) are available. FLASH represents a diverse partnership of more than 100 academic, corporate, and nonprofit partners. The National Storm Shelter Association (NSSA) has strict membership requirements and administers unique quality assurance and seal programs to foster quality in the storm shelter industry.

Government can promote building improvements and wind hazard reduction in a number of ways.

- Sponsor a national summit to (a) identify mitigation programs that have begun or that are planned, highlighting especially those that are believed by instigators to be working effectively. Objectives include identifying available research results aimed at mitigating the wind hazard and

then exploring research needs. Social and behavioral scientists will be needed to work alongside engineers, architects, economists, homeowners, builders, and other participants and stakeholders in the built environment.

- Require code-plus building and infrastructure design as well as storm protection in projects in high risk areas where federal funding is involved.

- Create or restore large scale pre-disaster mitigation grants for programs such as code-plus housing and hazard-resistant schools. Require consistency with comprehensive state and local mitigation plans and owner share of construction costs.

- Establish retrofit mitigation programs to improve the huge inventory of buildings that lie outside the 2% of the built environment that is new (annual) construction impacted by building codes.

- Support quality education and awareness programs that emphasize benefits of upgraded building codes and improved construction practices. All communication channels must be utilized to reach all stakeholders with credible messages.

- Increase enforcement of existing building codes, especially on those projects where federal funding is involved. Work to discourage or prevent weakening amendments to building codes.

- Involve a new generation of researchers in disciplines not traditionally included in building and infrastructure research. They should be challenged and funded to create new concepts and paradigms in the design and construction industries.

- Fund design competitions for diversified, interdisciplinary teams involving academicians, students, practicing design professionals, builders, social scientists, and others.

2. What is your best estimate of how much damage wind alone causes every year? By your best estimate, how much can be mitigated by research into this area? What kind of return on investment do you foresee?

- The last ten-year average wind damage exclusive of hurricanes is $4.8 billion per year. The last five-year average is $7.2 billion per year. The trend is upward.
  - Two record-setting events occurred in past 5 years: 2008, $14.8 billion; 2011, $10.9 billion

- The last ten-year average wind damage including hurricanes is $19.2 billion per year. The last five-year average is $23.9 billion.
  - The two most costly weather events -- Hurricane Katrina and Superstorm/Hurricane Sandy--both occurred in the past 10 years.

Re: Return on Investment:

FEMA estimates return on mitigation investments to be 4 to 1. Return on research investments will be much higher though more long-term.

Examples of good investments in research include severe weather prediction/forecasting by NOAA/NWS and investments in earthquake engineering resulting in damage reduction over 3 to 4 decades. The automobile industry investment in safety research gives us another example where oftentimes the car does not survive an accident but the occupant does.

QUESTIONS FOR THE RECORD
THE HONORABLE RANDY NEUGEBAUER (R-TX)
U.S. House Committee on Science, Space, and Technology

Federal Efforts to Reduce the Impacts of Windstorms

Wednesday, June 5, 2013

1. I'm from West Texas, and my constituents are certainly concerned about and affected by tornadoes, but we're also extremely concerned about the deficit. So I tried to craft H.R. 1786 in a way that would spend taxpayer dollars wisely and reduce costs elsewhere. Do you have evidence that a small piece of investment from the federal government in this research is a smart investment and will reduce the costs of disaster relief in the future?

Improved weather forecasting and prediction exemplify the payoff of past research investments. Another example is the success of earthquake engineering research producing lower death tolls and relatively small damages experienced in the United States as compared with other countries.

A substantial investment in research will reduce the escalating costs of disaster relief. But we must shift our paradigms in building and infrastructure design as well as construction practices from initial cost alone to lifecycle costs, safety, and quality of life. We cannot expect to solve our problems with the same level of thinking we were at when we created them.

We have some sound technology that grew out of research conducted in the past, but much is still unknown, suggesting that additional research is needed. We must move forward boldly and expeditiously to employ a new generation of talent, technology, and media utilization to produce cultural change. The research focus in the foreseeable future for wind damage mediation is to bring these resources together to utilize the knowledge we already have and what we will develop in the near future.

2. Consumers and businesses can be the ultimate catalyst to demanding stronger homes and workplaces. What can be done to get more people to invest in this process, sustain their interest and make better choices in building homes and offices? Are there new ideas that maybe haven't been widely utilized in the private sector that can increase utilization of best practices?

To get more people to invest in the processes of disaster mitigation, they must be shown how they benefit from programs and investments and knowledge of how to participate in these programs. Possibilities include:

- Awareness and education programs that effectively use the full range of outreach channels to educate and inform about natural disasters, possible improvements, and relevant programs. Organizations such as the Federal Alliance for Safe Homes (FLASH) can be

engaged to provide accurate and timely information on how to make homes more disaster-resistant, either at the time of construction or with post-construction hardening or retrofitting techniques.

- Incentives and rewards to builders and owners for building to higher prescriptive and performance standards. Example incentives include grants, tax credits or reductions, insurance ratings, energy ratings, and fee waivers.

- Programs that increase builder responsibility for quality control to augment the inspection process and decrease dependence upon governmental control of housing or component quality. For example, the National Storm Shelter Association (NSSA) conducts a standards-compliance verification process and seal program to effect quality control and builder recognition. The program is believed applicable and worthy of adoption in other segments of the construction industry.

- Simple, clear and actionable "how to" information to inform consumers about specific, prescriptive and/or performance construction building practices at the time of building or rebuilding.

- State retrofit programs such as the My Safe Florida Home and/or South Carolina Safe Home Program which provides matching grants for home hardening and retrofitting activities.

A number of steps can be taken by government to invest in processes of disaster mitigation. Included are:

- Require code-plus building and infrastructure design as well as storm protection in projects in high risk areas where federal funding is involved.

- Create or restore large scale pre-disaster mitigation grants for programs such as code-plus housing and hazard-resistant schools. Require consistency with comprehensive state and local mitigation plans and owner share of construction costs.

- Establish retrofit mitigation programs to improve the huge inventory of buildings that lie outside the 2% of the built environment that is new construction impacted by building codes. Significant owner funding participation will leverage governmental funding.

- Support quality education and awareness programs that emphasize benefits of upgraded building codes and improved construction practices. All communication channels must be utilized to reach stakeholders with credible messages.

- Increase enforcement of existing building codes, especially on those projects where federal funding is involved. Work to discourage or prevent weakening amendments to building codes.

- Fund design competitions for diversified, interdisciplinary teams involving academicians, students, practicing design professionals, builders, social and behavioral scientists, and others. This will involve a new generation of researchers in disciplines not traditionally included in building and infrastructure research. They should be challenged to create new concepts and paradigms in the design and construction industries.

3. Funding aside, how can there be better research coordination among the entities involved in wind hazard research? Are you aware of or have witnessed any overlapping research being conducted as the result of agencies not communicating to one another?

One of the earliest events in a new research thrust in wind disaster mitigation should be a summit to (a) identify mitigation programs that have begun or that are planned, highlighting especially those that are believed by instigators to be working effectively, to (b) Identify available research results aimed at mitigating the wind hazard, and to (c) explore research needs to most effectively mitigate the wind hazard. A major focus will be on defining how we utilize what is already known and what will be our methodology for bringing it all together. Social and behavioral scientists will be needed to work alongside engineers, architects, economists, homeowners, builders, and other participants and stakeholders in the built environment.

Federal agency coordination and review of research and implementation is important to enhance focus and coordination of research among federal agencies and their constituents. This will help avoid overlap in federally funded research, not a major problem in the past.

Extensive participation in technical society and association meetings by researchers aids coordination and synergy. Project funding should provide for conduct of, and participation in, such meetings.

Responses by Ms. Debra Ballen

QUESTIONS FOR THE RECORD
THE HONORABLE LARRY BUCSHON (R-IN)
U.S. House Committee on Science, Space, and Technology

Federal Efforts to Reduce the Impacts of Windstorms

Wednesday, June 5, 2013

1. How well does voluntary compliance work for the adoption of windstorm building code standards? How do homeowners become aware of the risks? What as policymakers can we be doing to promote wind hazard safety with our constituents?

Building codes are sets of performance and prescriptive requirements enacted into law at the state or local level, based on "model" codes developed and updated by the International Code Council and other standard-setting organizations. The goal of this process is to reflect the latest scientific and engineering knowledge. To have the force of law, model codes must be adopted by individual jurisdictions. IBHS believes that the most effective and efficient way for this to occur is for states to apply the latest model code on a universal basis, and not to allow local "opt outs," especially in high-risk areas. Studies by IBHS and others have repeatedly found that construction in jurisdictions where building code compliance is not mandatory is much less disaster resilient. As a result, code compliance should be mandatory – including enforcement by qualified building code officials to assure that technical standards actually are properly followed. There is an old adage in the building industry that "you don't get what you expect, you get what you inspect."

Model building codes are designed to be *minimum life safety standards.* However, in general they tend to become maximum standards since most owners and builders see them as such. Away from the hurricane coastline where engineering based high-wind standards are more widely followed, conventional construction techniques dominate residential construction. This type of construction tends to be very vulnerable to damage in high wind events and voluntary code plus standards can provide significant improvements in resiliency by reducing the level of damage and breadth of damage paths in thunderstorms and tornadoes. IBHS' voluntary, science-based FORTIFIED building programs that bring engineering based construction techniques to these area offer one approach to improving building performance.

There are many ways for homeowners to become aware of the risks they face. Government agencies and the insurance industry are the primary carriers of messages to educate home and business owners about the risks they face from windstorms of various types – and how to mitigate those risks. (Like FEMA and local emergency managers, IBHS consider outreach and communications central to our loss reduction mission.) Each of these organizations conducts a wide range of public outreach efforts, broadly utilizing both traditional and digital/social media (http://www.disastersafety.org/blog/), as well as direct communications to property owners in at-risk communities. In addition, IBHS carefully organizes wind-related media demonstrations at our Research Center that showcase the potential harm windstorms can cause, along with appropriate mitigation guidance. IBHS also partners with the FEMA, insurance industry organizations and allied organizations on webinars and other

programs to help the public understand and reduce risk; FEMA's robust Web site (http://www.ready.gov/) focuses on risk awareness and disaster preparedness.

Policymakers can promote wind hazard safety with constituents via newsletters and traditional/digital/social media, town hall meetings, disaster preparation fairs, booths at community events, and other outreach opportunities. Ideally, this outreach and education would be done in advance of storms, in order to prevent damage, lessening post-disaster response and recovery resource expenditure.

2. What is your best estimate of how much damage wind alone causes every year? By your best estimate, how much can be mitigated by research into this area? What kind of return on investment do you foresee?

Every year brings a unique mix of windstorms, so the exact amount of annual losses varies widely; however, it is also true that the yearly property damage toll from windstorms typically is measured in multiple billions of dollars. For example, according Insurance Information Institute data, wind events are responsible for 8 out of the top 10 most costly U.S. disasters from a property loss perspective. These include Hurricane Katrina (2005), Sandy (2012), Hurricane Andrew (1992), Hurricane Ike (2008), Hurricane Wilma (2005), Hurricane Charley (2004), Hurricane Ivan (2004), and the devastating tornadoes and thunderstorms of April, 2011. Taken together, these events underscore the unpredictable nature of windstorms, their broad geographic reach, and the widespread damage they cause. For example, damage from Hurricane Ike, which made landfall near Galveston, Texas, caused significant damage to homes and commercial structures as far inland as Ohio, where it became the single largest insured loss event in state history (at $1.5 billion in losses).

IBHS estimates that, if we could just "get the roofs right" on residential and commercial structures in this country, annual property losses caused by windstorms could be reduced by about 50% – and research is the predicate to identifying and advocating effective property protection solutions for roofs and other building systems. From a societal perspective, translating research into effective action is a sound fiscal strategy for property owners and government agencies at all levels, because it results in significant long-term savings, such as reduced response and recovery costs. A study by Texas A&M researchers for the Texas Department of Insurance when they were evaluating the benefits of adopting new building code requirements for the hurricane prone coastline estimated that the benefit/cost ratio for certain building code provisions was as high as 16 and that the benefit cost ratio for adoption of the entire set of code changes was on the order of 4 to 6. Improvements in the technologies used to conduct benefit/cost ratios should be a focus of research funded by H.R. 1786.

QUESTIONS FOR THE RECORD
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1. I'm from West Texas, and my constituents are certainly concerned about and affected by tornadoes, but we're also extremely concerned about the deficit. So I tried to craft H.R. 1786 in a way that would spend taxpayer dollars wisely and reduce costs elsewhere. Do you have evidence that a small piece of investment from the federal government in this research is a smart investment and will reduce the costs of disaster relief in the future?

A recent study by the Center for American Progress estimates that, from 2011 to 2013, the federal government spent $136 billion total on disaster recovery and relief (much of it attributable to wind events); this equates to nearly $400 per American household annually. These are the kind of costs that research investments under H.R. 1786 could reduce. In addition, as pointed out in IBHS' testimony, a study conducted by the National Institute for Building Sciences' Multi-hazard Mitigation Council found that every dollar spent by FEMA on hazard mitigation grants reduced post-disaster relief costs by $3.65 – a significant return on investment for all taxpayers, regardless of where they live. Research of the type envisioned by H.R. 1786 has the potential to yield an even greater return, because results can be more widely applied and leveraged into "boots on the ground" projects in a variety of locations
that face similar wind risks.

In addition, mitigation can create a greater sense of inter-generational equity and a way to avoid burdening future Americans with paying for damage that could have been reduced or avoided through cost-effective property protection measures identified by research funded via H.R. 1786.

2. Consumers and businesses can be the ultimate catalyst to demanding stronger homes and workplaces. What can be done to get more people to invest in this process, sustain their interest and make better choices in building homes and offices? Are there new ideas that maybe haven't been widely utilized in the private sector that can increase utilization of best practices?

More research definitely is needed in order to identify factors that motivate consumers and businesses to demand stronger, safer homes and workplaces, and IBHS is working with the social science research community to help make that happen. One interesting study on this topic was supported by the U.S. Department of Homeland Security Science and Technology Directorate (Grant # N00140510629) and conducted by Professors Linda Bourque, Megumi Kano, Dennis Mileti, and Michele Wood, to answer the question "How do you get people to stop, listen, and get ready for disaster events they do not think will happen, and if they do,

will happen to other people?" After combing through over fifty years of communications research, the investigators in the DHS study concluded that two factors drive public preparedness. The first factor is *information received* if that information: 1) comes from multiple sources; 2) is sent over multiple communications channels; 3) is consistent; 4) identifies specific preparedness actions to take; and 5) explains how those actions reduce losses. The second factor is *information observed* – meaning that seeing others take actions consistent with the information received motivates people to take similar actions. In its communications activities, IBHS follows a number of these principles to fulfill our strategic goals of getting people to pay attention, take action, and transform our society's preparedness culture. Without a doubt, there are new techniques and (dis)incentives that could spur property owners to action – but vetting and making those techniques actionable will take further research.

Embracing new products, materials and technologies has frequently been quite slow in the building industry because of concerns about its performance and durability. There have been a few notable exceptions including a patented wall bracing system that solved wall bracing issues for walls with large openings for windows and doors. Key factors affecting the market penetration of new products include the ability to predict the performance of products in real-world events and confidence that the product will provide the desired or required performance over time spans associated with the useful life of buildings. Test standards that reflect the true physics of real world events and others that can accelerate the aging of products are critical needs of the research that would be funded by H.R. 1786. Once meaningful standards are in place, American ingenuity can be effectively turned loose to create products that meet those requirements. As builders, building officials and property owners gain more confidence in the ability of standards to produce effective products, the acceptance of new solutions will be accelerated.

3. Funding aside, how can there be better research coordination among the entities involved in wind hazard research? Are you aware of or have witnessed any overlapping research being conducted as the result of agencies not communicating to one another?

Because the original NWIRP program never received appropriations, only a de minimis amount of federal funding has been specifically directed toward understanding how the characteristics of different types of windstorms affect the real-world performance of building components, connections, and systems. As such, there has not been much overlapping wind-related research being conducted or supported by federal resources. The bigger problem has generally been that each agency is focused on its own needs and constituency. Consequently, opportunities for cooperation and leveraging of resources have been missed. We did see several groups conduct post Katrina damage investigations. While these assessments were largely complementary, a coordinated effort would have likely produced cost savings and a more comprehensive view of the storm impacts. NOAA supports an array of meteorological stations that are capable of providing significant insights into over-land storm wind characteristics. However, since they primarily support aviation needs, they have not been set up with high-speed data collection capabilities with power backup and these stations routinely fail to provide data needed by engineers during intense winds because they lose

power or don't capture the high fidelity data that would be most useful in characterizing the wind events for engineering purposes.

As far as IBHS' own research program is concerned, we endeavor to be a "gap filler" by utilizing the unique capabilities of our Research Center and focusing on projects that are not otherwise being undertaken by governmental, academic, or private sector entities. We have participated in several well-coordinated, multi-party federal grant requests, with our role clearly delineated and consistent with our expertise and experience. And, our work to date with the various NWIRP agencies has been project-specific and relates specifically to their individual mandates and missions with no redundancy.

On a going-forward basis, H.R. 1786 is well positioned to enhance coordination and reduce any overlaps in federal wind research efforts. This includes designation of a lead agency (we are supportive of NIST playing this role); assignment of specific roles for each participating agency; creation of an Interagency Coordinating Committee on Windstorm Impact Reduction to develop a strategic plan and oversee planning and coordination of the program; and, creation of a National Advisory Committee on Windstorm Impact Reduction that would specifically exclude federal employees as members.

Responses by Dr. David Prevatt

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1. *How well does voluntary compliance work for the adoption of windstorm building code standards? How do homeowners become aware of the risks? What as policymakers can we be doing to promote wind hazard safety with our constituents?*

How well does voluntary compliance work for the adoption of windstorm building code standards?
Collective action after a natural hazard is usually short-lived and not very widespread. The building code consensus process is by far the most efficient means for changing building codes and practices but it is a slow one – cycles can take as much as 10 to 20 years to be fully implemented.

Unfortunately, history indicates that voluntary compliance with windstorm building code standards is not effective, as communities have nearly always waited until after a major disaster to initiate improved structural design of buildings.

How do homeowners become aware of the risks?
For the most part homeowners remain nearly completely unaware of the risks they face from various natural disasters, or even the philosophy of the wind load code. Homeowners have near blind faith in the building professionals, contractors and code officials that see to our infrastructure – they believe that our houses can resist and are adequately built for all loads – this is not necessarily so.

Public Education, targeted from university researchers to specific groups has been successful on the small scale. The Institute for Business and Home Safety has been effective in promoting full-scale wind tunnel tests to disseminate knowledge about how buildings would perform in hurricanes.

Unfortunately the homeowners' knowledge of building performance comes mainly from viewing contemporary disaster footage in the media. NOAA, National Hurricane Centers and the Severe Storms Center provide the majority of knowledge. The structural engineering community can provide more realistic know-how, but this latter group is not trained to communicate with the general population and their advice largely is ignored.

What as policymakers can we be doing to promote wind hazard safety with our constituents?
The nature of the building industry is such that voluntary compliance is not a realistic option for most of your constituents. Homeowners are several steps removed from the design, construction process. By the time most homeowners buy a house it is completed

and the structural system is already hidden within the walls and above the ceiling. The process is not understood and the homeowners lack the education and involvement in the process to appreciate what is being done.

Examples include the state of Florida after Hurricane Andrew, Australia after Cyclone Tracy and a more recent example of the city of Joplin after the tornado in 2011. The reason for this is that communities and homeowners tend to not become aware of natural hazard risks until they are directly impacted by one. For example, after the 2011 tornado the city of Joplin adopted changes to the building code including mandatory use of hurricane clips and 4 ft spacing of anchor bolts rather than 6 ft spacing (http://www.joplinglobe.com/tornadomay2011/x2051368012/Council-endorses-building-code-changes).

However, there is no indication that any nearby municipalities not directly impacted responded in a similar manner. One of the best ways to promote wind hazard safety is to highlight examples of the improved performance of structurally fortified homes (IBHS video, IBHS fortified homes example, etc.) during natural disasters. In every disaster we should be looking for opportunities to document any proof we can find that stronger homes sustain less damage. Getting these images and stories in the news, on social media, along with continued efforts to make people aware of the risks they face every year, can be an effective way to enact changes.

2. *What is your best estimate of how much damage wind alone causes every year? By your best estimate, how much can be mitigated by research into this area? What kind of return on investment do you foresee?*

What is your best estimate of how much damage wind alone causes every year?

In 2006 dollars, annual wind damage is estimated at $6.8 billion (Changnon, 2009), with $4.24 billion of that from hurricanes, $1.63 billion from thunderstorms and $0.982 billion from tornadoes. More recent studies have indicated annual losses from tornadoes may be as high as $4.8 billion (Simmons et al, 2012).

By your best estimate, how much can be mitigated by research into this area?

The research shows that 85% of the area within the actual tornado path are affected by EF2 strength tornadoes or lower. This is the case even in the most destructive tornadoes (EF4 or EF5). Thus it is possible to address the majority of the building stock and mitigate damage from EF2 tornadoes. Congress members should understand the reason that damage appears so severe now is that

What kind of return on investment do you foresee?

A return on investment is mostly dependent upon implementation of the findings from research in this area. If implemented, it is estimated that every $1 spent on disaster resiliency yields $4 in future benefits. (NOAA, 2013).

The entity that stands to gain the greatest return on investment is the community affected by a natural disaster. It is the community that is set up to be in place for the very long-term, and it is the community moreso than any individual within that grouping that would likely experience multiple tornadic events. That these events affect current families is a hardship but they also greatly affect the ability of the communities to rebuild and recover afterwards. If buildings are designed to resist tornado loads that community will be able to get back on its feet and become productive again in much reduced time-frame than communities that did not implement structural resistance for their buildings.

Changnon, Stanley A., and Geoffrey JD Hewings. "Losses from weather extremes in the United States." Natural Hazards Review 2.3 (2001): 113-123.
Simmons, K.M., Sutter, D. and Pielke, R., 2012. Normalized tornado damage in the united states: 1950–2011. Environmental Hazards(ahead-of-print): 1-16
NOAA, Department budget reports (FY 2011-2014); appropriation bills (FY 2011-2013); NOAA Climate Disasters Database
(http://www.americanprogress.org/issues/green/news/2013/04/29/61697/infographic-disastrous-spending-federal-disaster-relief-expenditures-rise-amid-more-extreme-weather/)

QUESTIONS FOR THE RECORD
THE HONORABLE RANDY NEUGEBAUER (R-TX)
U.S. House Committee on Science, Space, and Technology

Federal Efforts to Reduce the Impacts of Windstorms

Wednesday, June 5, 2013

1. I'm from West Texas, and my constituents are certainly concerned about and affected by tornadoes, but we're also extremely concerned about the deficit. So I tried to craft H.R. 1786 in a way that would spend taxpayer dollars wisely and reduce costs elsewhere. Do you have evidence that a small piece of investment from the federal government in this research is a smart investment and will reduce the costs of disaster relief in the future?

   Do you have evidence that a small piece of investment from the federal government in this research is a smart investment and will reduce the costs of disaster relief in the future?
   The state of Florida has had tangible benefits from its mitigation efforts. It was shown in Hurricane Charlie in 2004 that houses built in accordance to newer building codes suffered far less damage than those homes built to meet older codes (Gurley and Masters, 2004). Other evidence of benefits of damage mitigation are in Australia –cyclone-resistant housing design.

   In Florida, an assessment study by the Florida's Dept. of Emergency Management after TS Debby estimated an 116% return on investment due to enhanced construction practices in Florida, with majority of this coming from investments since 2011.
   http://www.floridadisaster.org/Mitigation/SMF/documents/Report-TSDebby-LA.pdf

2. Consumers and businesses can be the ultimate catalyst to demanding stronger homes and workplaces. What can be done to get more people to invest in this process, sustain their interest and make better choices in building homes and offices? Are there new ideas that maybe haven't been widely utilized in the private sector that can increase utilization of best practices?

   What can be done to get more people to invest in this process, sustain their interest and make better choices in building homes and offices? Are there new ideas that maybe haven't been widely utilized in the private sector that can increase utilization of best practices?
   Leadership is necessary and sustained support of the research infrastructure. Engineered solutions do not come cheap and it is impossible to shortcut the process of scientific enquiry. Frankly for 40 years, we have known there is a problem with how we build houses and yet nothing has been done. In fact, we have accelerated the rate at which

these inadequately constructed homes are built in regions at risk of tornado strikes. The public's perception of the safety of their homes and offices is over-estimated. It is necessary to change the commonly held beliefs regarding these issues. Such a change in mind-set within a community will take ten or twenty years of sustained effort. We would need to put in the work to achieve this change.

3. Funding aside, how can there be better research coordination among the entities involved in wind hazard research? Are you aware of or have witnessed any overlapping research being conducted as the result of agencies not communicating to one another?

How can there be better research coordination among the entities involved in wind hazard research? Are you aware of or have witnessed any overlapping research being conducted as the result of agencies not communicating to each other?
With national leadership stemming from Congress through a federal division, support can be provided for widespread communication and collaboration of the social scientist and physical scientist in disseminating hazard resilient information. Practically support is needed that would enable scientist and engineers who are working on cutting-edge solutions to be able to bypass the closed world of peer-reviewed publications and scholarly conferences. Direct communication at science fairs, in science museums and such venues will have a much broader reach to persons who are more directly affected by the hazards and who may feel compelled to contribute to the change.

Better research coordination requires a sustained funding level that would enable the nurturing and education of engineers familiar with tornado design details, and that would support the research of wind engineering and structural engineering researchers over the long-term. As it stands research support is inconsistent that discourages young creative faculty and students from entering this field. Further the research funding is insufficient to support research infrastructure that can address the high-risk, high-reward type projects that could make a significant change in housing. Finally, there must be collaboration between the faculty researcher and the manufacturer/entrepreneur to develop new products for tornado-resilience at an economic and affordable to the consumer.

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--> NPR's Science Friday
--> Dr. Prevatt's Congressional Testimony on H.R. 1786

Appendix II

Additional Material for the Record

SUBMITTED STATEMENT BY REPRESENTATIVE DANIEL LIPINSKI,
RANKING MEMBER, SUBCOMMITTEE ON RESEARCH,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
U.S. HOUSE OF REPRESENTATIVES

Thank you, Chairman Bucshon and Chairman Massie for holding today's hearing to examine federal efforts to reduce the impacts of windstorms.

This is an incredibly important topic. Every year, severe winds from hurricanes, tornadoes, and thunderstorms damage or destroy thousands of homes and businesses, harm vital infrastructure, and, most importantly, threaten human life. An average of 74 Americans have died in tornadoes each year since 1983. My prayers go out to those in Moore, Oklahoma as well as those outside of Oklahoma City, who are currently dealing with this loss. We also cannot forget the more than 1,000 people who lost their lives in Hurricane Katrina.

The extent of property damage and economic losses from windstorms vary widely, but since 2010, economic costs are well over a $100 billion dollars.The National Windstorm Impact Reduction Program or N-WIRP has the potential to lessen the loss of life and economic damage by translating research and development on the understanding of windstorms and their impacts into improved building codes and emergency planning.

In order for these efforts to be effective they cannot leave out the most critical component—people. Understanding how people—such as state and local officials, business owners, and individuals—make decisions and respond to storm warnings is essential to designing effective strategies to prepare for, respond to, and recover from a disaster.

A recent survey by the National Center for Disaster Preparedness accurately highlights this need. The survey found that most Americans are unprepared for a major disaster and that they have a false sense of security about what will happen if a major disaster occurs.

Specifically, more than half of the families surveyed had no emergency plan in place for a hurricane or earthquake, and those who had a plan lacked essential items to implement their plan like flashlights and extra batteries. Even more unsettling is that one third of the individuals surveyed believed that calling 911 after a major disaster would bring them help within an hour. This is in stark contrast to reality which shows that emergency responders are overwhelmed after major disasters and communities often have to take care of themselves for several days before help is able to arrive.

I mention this because I think it is important to remember that we can perform all the engineering and natural science research we like, but in the grand scheme of things if we don't have a clear understanding of the human element in disaster mitigation, preparedness, and response then those efforts may be for not.

We only have to look to Moore, Oklahoma for an example. Moore had been hit by an EF5 tornado—the most powerful category—before, back in May 1999. One of the myths about tornadoes is that they will not hit the same city more than once. So when individuals are debating spending the $2,500 to $5,000 on a shelter or the $4,000 to $12,000 on a safe room, they are doing so thinking that another tornado will not hit and therefore, the extra expense is probably unnecessary. In fact, of the 40 new homes constructed since that May 1999 storm, only six of them contained a safe room.

Building disaster resilient communities will take an interdisciplinary approach and that approach must include social science research.