Well Blow Me Down: Developing Windstorm Hazard Technologies

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2000 Washington Internships for Students of Engineering

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About the Author

Justin Watkins is entering his fourth year of undergraduate civil engineering study at Oregon State University. This document is the product of research conducted while participating in the Washington Internships for Students of Engineering (WISE) program during the summer of 2000. His participation in the WISE program was sponsored by a grant from the National Science Foundation (NSF). The American Association of Engineering Societies (AAES) mentored his involvement in policy and engineering study.

WISE Program

The Washington Internships for Students of Engineering is a ten-week program for outstanding engineering students that are interested in public policy, and entering their final year of undergraduate study. Through frequent meetings and discussions with government officials, policy makers, lobbyists, and other non-government individuals, the students receive a better understanding of how government works and how engineers can contribute to policy-making decisions. The students are responsible for completing an engineering public policy paper that is of interest to their sponsoring society. For more information on the WISE program, contact WISE, Attn: Anne Hickox, 400 Commonwealth Drive, Warrendale, PA 15096-0001, or visit there website at www.wise-intern.org

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Executive Summary

Hundreds of people die, and billions of dollars are lost every year due to wind related natural disasters. Is there something that can be done to save these lives and retain this money? Is there legislation that can spearhead solutions to this growing problem in the United States?

The American Society of Civil Engineers (ASCE) is doing something to convince the federal government to fund research efforts focused on mitigating both the human and property loses. The House Science Committee, with help from ASCE and Wind Hazard Coalition, has been drafting a bill aimed at mitigating these damages. The bill's purpose is to research and develop new technologies for mitigating windstorm hazards, and disseminate the knowledge to the public and private sectors. Passage of the *Windstorm Hazard Reduction Research and Technology Transfer Act* will direct government funds to an organization called the National Windstorm Hazard Reduction Program (NWHRP).

The support of this bill in the engineering field is wide spread. Atmospheric scientists have completed studies on the damages of wind related natural disasters, and engineers have evaluated the feasibility of the private sector funding the wind engineering research. These experts feel the formation of NWHRP can effectively implement improved technologies that can save lives and money.

The political analysis of the bill is more difficult than the engineering investigation. A coalition and a Congressional caucus have been formed to support passage of the bill. Meetings have been held to discuss the detailed wording of the draft bill, and to focus efforts on advocating its passage in Congress. However, once the bill is introduced, detractors are expected to surface. Some segments of the building industry believe that if this bill is enacted more stringent and costly regulations will ensue. These organizations will likely lobby against the bill.

There are many legislative steps that must be taken before the bill can pass both the House and the Senate, and be signed by the President. The lawmakers must discuss alternatives and amendments to the bill that will ensure the protection of life and property.

After working closely with ASCE, attending all meetings with the Wind Hazard Coalition, and conducting independent research, the author strongly supports the enactment of *The Windstorm Hazard Reduction Research and Technology Transfer Act*. Recommendations of the author are discussed in the final section

Issue Definition

The Windstorm Hazard Reduction Research and Technology Transfer Act is legislation currently being drafted by the House Science Committee with help from the American Society of Civil Engineers (ASCE). This bill would form a federal government program called the National Windstorm Hazard Reduction Program (NWHRP).

Objectives

The objective of NWHRP is to significantly reduce the loss of life and property due to windstorms in an efficient manner.[1] An advisory board comprised of residential constructors, commercial constructors, and material experts, will decide the detailed numerical goals to be achieved by this program. In order to achieve the objective set forth, the bill will create a national program aimed at reducing the hazards of windstorms, which will involve the cooperation of the government, and the private and public sectors. There are several purposes for creating NWHRP, which include:

1. Develop regional practices
2. Asses building types
3. Improve weather service technologies
4. Disseminate knowledge
5. Study effects of implementation
6. Support better land use decisions
7. Prepare public for windstorm disasters

Measures Taken by NWHRP

NWHRP will take several steps to achieve its goals.[2] The approaches taken to obtain the goals are identified in *The Windstorm Hazard Reduction Research and Technology Transfer Act.*

[1] "The Windstorm Hazard Reduction Research and Technology Transfer Act" draft of July 5, 2000
[2] "The Windstorm Hazard Reduction Research and Technology Transfer Act" draft of July 5, 2000

Improve Engineering Methods and Practices

Research and development of improved design and construction methods and practices is an important part of NWHRP and will lead to increased safety for people and property. This national program will develop new practices that pertain to each regions particular windstorm hazards. The diversity of climates throughout the United States mandates a difference in engineering approaches. Through government funding to academia and the private sector, wind engineers are expected to develop new cost-effective techniques for mitigating wind damage in the design and construction industries. The majority of the funding for NWHRP will be allocated to research and development programs.

Assess Building Types

The assessment of new and existing structures is another purpose of NWHRP. The program would like to give priority to the class of structures, infrastructures, utilities, and other critical lifelines that are especially needed during times of disaster. Through research, NWHRP will assess and group the different building types together for a more effective retrofitting and construction process. By devising a system of grouping structures together, designer and constructors can quickly and effectively decide which measures must be taken to produce a safe and stable structure.

Improve Technology Transfer

Perhaps the most important purpose of NWHRP is keeping the engineering, public, and governmental communities well informed on the new wind resistant technologies that are available. Because building codes are decided at the state and local government levels, NWHRP will provide those lawmakers with the most current information to assist their decision making process. NWHRP will also inform designers and constructors about the new methods and practices being devised. The goal of this bill is not to develop a nation-wide standard wind prevention building code. NWHRP is trying, however, to research and develop new techniques

and practices to supply to state and local officials.[3] Through the dissemination of knowledge, the engineering techniques that are adopted in each community by state and local officials will be up-to-date and safe.

Advocate Land-Use Decisions

Additionally, NWHRP will advocate for better land-use decisions. The program will provide information to local officials to make land-use decisions.[4] Coastal areas are becoming increasingly more populated, despite their dangerous location. NWHRP will develop new design and construction methods that will mitigate some of the damages seen in these windstorm regions.

Improve Weather System Technologies

Improved technology for predictions, storm warnings, advanced planning, and disaster response is another goal of NWHRP. These technologies will enable weather system analysts to inform the public on current weather hazards. With improved prediction and warning technologies, communities can be ready to prepare and evacuate their homes before a serious windstorm strikes. NWHRP may fund organizations specializing in prediction techniques and early-warning systems. By helping to fund these organizations, NWHRP can improve and enhance wind related prediction techniques. Some of NWHRP funding can possibly be shared with supercomputer developers. Supercomputers are necessary to increase our prediction capabilities.[5] With funding set aside for similar measures, NWHRP can improve and supply new early warning technologies.

Coordinate Emergency Management Plans

The program seeks to coordinate emergency preparedness plans for wind related storms. Several measures will be devised to prepare communities for windstorm emergencies. Once

[3] Wind Hazard Coalition meeting, Washington, D.C, July 12, 2000
[4] Taken from discussions with ASCE advocates
[5] Discussion with NSF

windstorms are understood in finer detail, it will be easier to coordinate an emergency preparation plan that will create a safer community in which to live.

Improve Public Education

Another measure taken to ensure the achievement of the desired objectives is to create and improve public education and involvement programs. If NWHRP is formed, the public will have access to more information and have the opportunity to be more involved. If the public chooses to participate in such activities, the loss of life is likely to decrease. Similar to the public information supplied by the National Earthquake Hazards Reduction Program (NEHRP), NWHRP will better prepare the population of windstorm hazard areas for future disasters.

Study Effects of Implementation

NWHRP seems to understand the effects of implementing windstorm hazard reduction methods. The goal will be to analyze whether or not implementing a certain new technology is better for all parties involved. If the new technologies that are developed by this program aren't cost-effective, then the bill fails to help the communities for which it is designed. Low-income and non-engineered facilities are often the first buildings to sustain damage in windstorms. If the new technologies are not cost-effective, then construction costs will rise, and the homeowners end up shouldering the extra expenses. That is a mistake that NWHRP is designed to avoid.

Research and Development

The Windstorm Hazards Reduction Research and Technology Transfer Act specifies the kinds of research it plans to conduct. This research intends to aid NWHRP in the achievement of its goals.

Basic Wind and Microclimates

The first and most obvious research to conducted is basic wind characteristic and microclimate research. There is a great need in the engineering field to understand wind on a

more detailed level. Microclimates are those highly variable actions of weather that are seen in many local communities throughout the world.[6] Studying the many microclimates that exist in the United States will help NWHRP understand windstorms more completely, thus leading toward a multitude of solutions. Each particular microclimate may pose many different problems, and it is expected to have several solutions.

Construction Materials and Building Systems

NWHRP plans to research the abilities of different construction materials and building systems to resist windstorm loads. The research of building systems will lead toward developing stronger construction components, such as windows, doors, and roofs. Specific material research will make, test, and improve the basic materials we use to construct buildings, such as wood, steel, and concrete. If these structural components increase in strength, the damage from winds and subsequent floods that normally follow wind will greatly decrease. This program will conduct research on existing building types to develop new windstorm resistant methods of retrofitting. The research and development of construction equipment may also be included in the funding of NWHRP. The future technologies that will be used to mitigate windstorm damage might require new construction equipment. The desired result of all the building research is to construct a safer building at nearly the same or lower cost.[7] The initial benefactors from this research will be the buildings needed during disaster times. These building types include critical and lifeline structures such as hospitals, schools, and public utilities.[8]

Socioeconomic Impact

NWHRP will include a rather unusual element to its research and development. This program will study the effects of wind hazards on a socioeconomic level. They want to know the effects of implementing new technologies for the public. Creating structurally sound buildings is

[6] Definition taken from Wind Hazard Coalition meeting, and Merriam Webster's Collegiate Dictionary
[7] Wind Hazard Coalition meeting, Washington, D.C., July 12, 2000
[8] "Windstorm Hazard Reduction Research and Technology Transfer Act" draft of July 5, 2000

a goal for all structures, regardless of their monetary worth. The most susceptible buildings to windstorm damage will be the focus of this bill.[9]

Weather System Technologies

Gathering of knowledge for predictions and early-warning systems for windstorm hazards is the final type of research to be conducted by NWHRP. The product of this research intends to identify, evaluate, and accurately characterize windstorms. NWHRP will improve emergency services, reconstruction, and redevelopment after windstorms. With these techniques, NWHRP will map storms in finer detail. These technological updates will greatly improve the disaster relief and predictions of windstorms.

Technology Transfer

The current draft of the bill that will form NWHRP has specified methods of technology transfer.[10] NWHRP will include the collection, classification, presentation, and dissemination of research results to state and local officials, community leaders, builders, homeowners, and the general public. Part of the technology transfer strategies include the coordination of government and the private sector to facilitate the training of employees in the design and construction industry, local officials, and any other interested persons. Finally, NWHRP will increase public awareness and information related to windstorm hazard mitigation

Implementation

Not later than 30 days after the enactment of the bill, the Director of the Office of Science and Technology Policy (OSTP) will establish an Interagency Group. The co-chairs of this group will be the OSTP Director and the Director of the Federal Emergency Management Agency (FEMA). The group shall consist of representatives from appropriate federal agencies, including, National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the National Institute of Standards and Technology (NIST), the

[9] "The Windstorm Hazard Reduction Research and Technology Transfer Act" draft July 5, 2000
[10] "The Windstorm Hazard Reduction Research and Technology Transfer Act" draft July 5, 2000

Department of Energy (DOE), and other agencies in the jurisdiction over housing, construction, and natural disaster mitigation and relief.[11] This group will be responsible for forming and implementing NWHRP. This format is very similar to the one installed at the beginning of NEHRP.

Engineering and Technological Support

Need for a national program that reduces the hazards of windstorms is shown by analysis of specific issues in the engineering field and the private sector. Public safety is the primary concern of the design and construction industries. The duty to protect the public from severe wind damages has been promoted by the wind engineering field. Several recommendations of wind engineering studies have suggested development of the National Windstorm Hazard Reduction Program. These researchers have found that there is a serious lack of research done in the wind engineering field. These experts strongly believe that with governmental aid, wind engineers will develop new design and construction methods and practices that will create safer structures. A wide variety of windstorms are causing billions of dollars of damage and killing many people yearly. Frequent wind related natural disasters prove that NWHRP is needed.

Windstorm Disaster Damages

The main objective of NWHRP is to significantly and effectively reduce life and property losses. Although the annual impacts of natural disasters are highly variable, the National Oceanic and Atmospheric Administration (NOAA) estimates the average annual deaths from tornadoes and hurricanes are 58 and 14, respectively. NOAA additionally estimated the average annual costs for damages due to hurricanes and tornadoes. Tornadoes average nearly $900 million of damage yearly, while hurricanes average damages just under $5 billion per year.[12]

Windstorm damage data is formed from the disaster figures of several different types of storms. Through this wide spectrum of storms, wind is found to be a very destructive and costly contributor. There are four basic types of storms that can be categorized as windstorms.

[11] "The Windstorm Hazard Reduction Research and Technology Transfer Act" draft July 5, 2000
[12] National Oceanic and Atmospheric Administration, "A Nation at Risk", 2000

Windstorms include, but are not limited to, tornadoes, tropical cyclones, destructive wind, and thunderstorms.[13]

Tornadoes

Tornadoes are the most obvious type of windstorm. All the damages that are attributed to tornadoes can also be credited to wind. There have been several destructive tornadoes in the last decade that have demonstrated the power of wind. According to the Federal Emergency Management Agency (FEMA), the United States averages 10 violent tornadoes per year.[14] Violent tornadoes are defined as F4 or F5 tornadoes on the Fujita scale. The Fujita scale is based on the amount of damage a tornado causes, and has been associated with average wind speeds.[15] Wind speeds range from 50 mph to over 250 mph in F5 tornadoes. FEMA published a study of the tornadoes of May 3, 1999, which produced the likelihood of tornadoes hitting different areas of the United States. It shows that all states east of the Rocky Mountains are in danger of roughly one day with a tornado per year. Areas in coastal Florida and "tornado alley" in the Midwest are twice as likely to be hit with a tornado.

The understanding of tornadoes is fairly limited. We have the technology to see hurricanes forming off the coast days in advance, while our tornado warnings are restricted to hours before touchdown.[16] Researching early detection systems that locate thunderstorm rotations will allow life-saving warnings to be issued.[17] With government funded research we can enhance prediction systems and engineering methods and practices. While tornadoes can cause sever damage, tropical cyclones cause more than five times the damage of tornadoes yearly.

Tropical Cyclones

Tropical cyclone is a term given to storms that form in coastal areas, and are assigned three classifications. Tropical cyclones with maximum sustained surface winds of less than 17

[13] "The Windstorm Hazard Reduction Research and Technology Transfer Act" draft July 5, 2000
[14] FEMA, "Midwest Tornadoes of May 3, 1999", Building Performance Assessment Report
[15] FEMA, "Midwest Tornadoes of May 3, 1999", Building Performance Assessment Report
[16] http://www.noaa.gov

m/s (39 mph) are considered “tropical depressions”. When the winds reach speeds between 17m/s and 33m/s (74 mph) they are dubbed “tropical storms”. Any tropical cyclone with wind speed over 74 mph is considered a hurricane. Hurricanes are the most damaging tropical cyclone, and will be the main focus of NWHRP. Unlike tornadoes, not all hurricane damages are caused by wind. Although hurricane damage is highly variable, wind damage can comprise up to 75% of the overall damage. $4 billion of Hurricane Hugo’s $6 billion of damage was credited to wind.[18] Hurricanes are the second most damaging natural disaster yearly.[19] The average yearly damage of hurricanes in the United States is $4.97 billion. While most of a hurricane’s damaged is insured as flood damage, some of the flooding is caused by wind. Some structural flooding is preceded by strong winds that penetrate the building.

During a hurricane, wind has the ability to penetrate the barrier between the outside atmosphere and the calm infrastructure. First, wind can create airborne missiles, or flying debris, that can crash through windows or doors. Once the barrier has been penetrated, rain is able to flood the infrastructure. Second, a building can be forced completely off its foundation from the strong wind forces. In this case the water has easy access to the interior of the structure. Finally, strong winds can tear the roof off a building. When high velocity winds pass over the top of the roof, and the interior of the building is calm, a pressure difference is formed. This difference in pressure creates an uplift force on the roof. Once this force becomes great enough, the roof can rip off. This process is very similar to the wing of an airplane. See Figure 1 for an illustration of the similarities between an airplane wing and a rooftop.

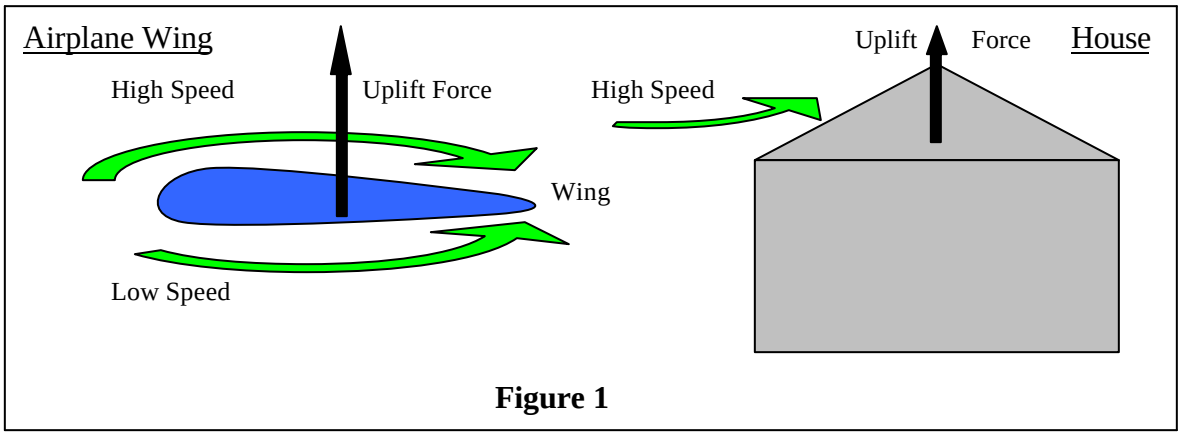

Figure 1

[17] “Tornadoes…Nature’s Most Violent Storms”, National Weather Service, www.nssl.noaa.gov/NWSTornado
[18] American Society of Civil Engineers, “Hurricane Hugo One Year Later”, 1991
[19] National Oceanic and Atmospheric Administration, “A Nation at Risk”, 2000

The perception is that hurricane rain creates the flooding alone. However, it is a combination of rain and wind that creates the enormous hurricane damages. Hurricane Andrew is an excellent example of severe the wind damages that can be sustained during a hurricane, and is credited as the starting point of developing windstorm damage mitigation techniques. Hurricane Andrew struck Florida and Louisiana with severe winds and heavy rainfall. The hurricane damage was estimated to be $30 billion, and studies showed wind as a significant contributor.[20] It is seen that wind allows rain to do damage, by comparing hurricane damages to those of tropical storms. The difference between a hurricane and a tropical storm is the magnitude of the wind involved. Hurricane winds are commonly twice the speed of a tropical storm. When analyzing the billion-dollar disaster from 1980 to 1999, it is seen that there is 1 tropical storm, and 13 hurricanes.[21] Although tropical storms have less significant wind, they still sited in the bill. Any storm with wind related damage is considered a windstorm, and will be included in NWHRP.

Another tropical cyclones concern is their creation of tornadoes. After a tropical cyclone hits land and diffuses, a tornado is normally started. There is a danger of a tornado starting within three days of a tropical cyclone. Hurricane Andrew spawned 62 minor tornadoes, which performed notable damage.[22]

Destructive Wind and Thunderstorms

Destructive wind is another type of natural disaster that is included in this bill. Every region of the United States is susceptible to damaging wind. Often destructive wind accompanies severe thunderstorms. For this reason, thunderstorms have also been sited in the bill. Thunderstorm and high winds cause tremendous damages and loss of life. From 1995 to 1998 thunderstorm winds and high winds combined to average 66 fatalities and nearly $1 billion of damage yearly.[23]

[20] National Climate Data Center, "Billion Dollar U.S. Weather Disasters 1980-1999", 2000
[21] National Climate Data Center, "Billion Dollar U.S. Weather Disasters 1980-1999", 2000
[22] Landsea, Christopher W., "FAQ: Hurricanes, Typhoons, and Tropical Cyclones"
[23] National Weather Service, "Summary of Natural Disaster in the United States", 1995-1998

Professional Recommendations

Researchers in the engineering field, while studying wind related topics, have recommended formation of NWHRP. A discipline of civil and mechanical engineering has arisen in the past few decades for the study of wind. This fairly new area of study has become known as wind engineering. Some universities have adopted wind engineering as an undergraduate and graduate study. Two universities have become the leaders in the field. Colorado State University (CSU) and Texas Tech University (TTU) have become the main sources of information for the wind engineering community.

Dr. Jack E. Cermak, an emeritus professor at CSU, has emerged as one of the leaders in wind engineering. In a letter to the Engineering News Record (ENR), a weekly civil engineering magazine, Dr. Cermak and Richard G. Little of the National Research Council (NRC) suggest and support the idea of a national program that reduces the hazards of wind.[24] They believe to effectively reduce wind hazards a national government funded program should be created. Dr. Cermak makes many references to NWHRP in his publications. The NRC has also supported CSU and wind engineering, as seen in their cooperative letter to ENR.

The NRC formed a committee to review the need for a large-scale test facility to research the effects of extreme winds on structures. Dr. Cermak chaired the committee of 14 members in academia, government, and independent groups. Following a complete analysis, the committee formed two recommendations. First, it was not cost-effective for the U.S. Department of Energy to construct a large-scale wind test facility. Second, Congress should consider allocating sufficient funds to establish and maintain a National Wind Hazards Reduction Program.[25] The NRC is not the only group to find that a national program for the reduction of wind hazards would be beneficial to the public.

Texas Tech University has performed several wind engineering studies. TTU has worked with the Federal Emergency Management Agency (FEMA) several times in analyzing the effects of disasters on structures. TTU and FEMA have published analysis of the tornadoes of May 3, 1999. In these publications the need for a National Windstorm Hazard Reduction Program is

[24] Cermak, Little, Engineering News Record, "Letters", September 20, 1999
[25] National Research Council, National Academy Press, "Review of the Need for a Large-scale Test Facility for Research on the Effects of Extreme Winds on Structures", 1999

addressed. TTU and FEMA support the formation of such an organization, and feel they can contribute to its success.[26]

Research Funding for Wind Engineering

The wind engineering field has a very limited research budget, which results in a lack of research being conducted. Between $5-10 million of wind hazard research is funded each year by the government. Meanwhile, earthquake research receives nearly $100 million yearly from the government. Statistically, wind causes far more damage yearly than earthquakes in the United States. Engineering researchers are advocating for more funding to study the hazards of wind. Wind engineers will conduct more research with the increased funding of the new Act, and thus develop new methods and practices for engineering.

Political Analysis

While the technical support shows a strong case for the passing of the windstorm hazard bill, the political process is far more difficult. Several aspects complicate the proceedings of the bill. Some groups stand to lose money if the bill is passed. Some of these groups are affected directly, while others indirectly. Several questions must be addressed to decide if legislators should pass this bill. Is this the best way to spend $100 million dollars? Does this bill help the people for whom it is intended? Whose stands to lose from the passing of this bill?

While legislators ultimately make the decisions, many organizations prepare to their own answers to these questions and attempt to sway lawmakers in their decisions.

Drafting Process

Several organizations have formed the Wind Hazard Coalition in Washington, DC to help in the drafting and lobbying of The Windstorm Hazard Reduction Research and Technology Transfer Act. Some coalition members favor the bill, while others remain neutral. Neutral parties attempt to affect the wording of the bill in their favor. Financial issues ultimately decide

[26] FEMA, "Midwest Tornadoes of May 3, 1999", Building Performance Assessment Report

an organization's stance. The groups represented in the coalition are discussed in the following to further detail.

Engineering Societies

Engineering societies want Congress to pass this bill to provide funding for more research, more jobs, and safer communities. Engineers in academia and the industry will conduct research that will create more engineering jobs for the construction of better buildings. These universities and corporations want the government to aid in the funding of their multimillion-dollar research. With the help of government funding, these engineers can develop new engineering practices and methods that will save money and lives.

Private Corporations

Private non-engineering corporations are another set of organizations that favor the bill. These corporations stand to make a lot of money after the bill is enacted. For instance, Solutia Inc. favors the enactment of the wind program, and is currently helping draft the bill. Solutia Inc. advocates the bill's passing because they make hurricane resistant windows.[27] If the windstorm hazard bill is passed, the windows they manufacture may become the industry standard. The corporations that make the current materials in the industry could loose money, and are not likely to support the bill. However, they are not involved in the drafting process, and are not represented in the Wind Hazard Coalition. It is likely that they will advocate the bill's defeat when it is presented to the Congress.

Insurance Agencies

Insurance agencies favor the passing of the bill. If this bill is passed, then stricter building codes may be adopted on the local level. Once stronger buildings are being constructed, insurance companies will likely pay fewer damage claims. The stronger buildings are made, the less likely they are to fail, and the less money insurer must pay to their customers.

[27] Interview with Greg Wilson, Vice President of Government Affairs, Solutia Inc.

Housing Organizations

There are some organizations that stand neutral on the formation of a national agency to reduce the hazards of windstorms. These groups represent the manufacturing housing industry. If this bill is enacted, the cost of construction may rise. The bill, in its current form, makes several references to cost-effective solutions to wind hazard mitigation. However, new construction methods will require builders to consult experts in the wind engineering field. During the beginning stages of the bill's enactment, field engineers will not know how to properly implement the new practices. Interacting with consulting groups increases the cost of the overall construction. The construction industry is concerned with the classification of buildings as well.[28] NWHRP may devise a building classification system that distinguishes the measures taken for retrofitting and new construction. Once the insurance industry realizes which types of buildings are susceptible to windstorm damages they are able to raise the premiums, or not insure those types of buildings at all.

Advocating Process

Both supporters and detractors of the bill have formed groups to persuade policy makers toward their conclusion. ASCE is perhaps the most dominant advocate for the development of NWHRP. Working closely with the House Science Committee, ASCE has developed several drafts to present to the Wind Hazard Reduction Coalition.

When the bill is presented to Congress, the detailed wording will decide which committee has jurisdiction. ASCE is working with the House Science Committee on the detailed wording of the bill. The House Science Committee knows which words will or will not insure their jurisdiction. Since ASCE has often worked with the House Science Committee, they feel the bill has the best chance of being passed in that committee. Once the committee reviews and revises the bill, it is presented to the entire House of Representatives with their recommendations. The committee has the power to kill the bill, by either not voting, or defeating the bill before it goes to Congress. Since ASCE often works with the Science Committee, the bill will probably make

[28] Interview with Ken Ford, National Association of Home Builders

it to the Congressional Floor. ASCE doesn't expect much support in the current Congress, but by presenting the bill now, they will form support in the next congressional session when the bill has a better chance of passing.

Avoidance of political enemies is another reason that ASCE is working with the House Science Committee. A staff member from the House Science Committee chairs the Wind Hazard Reduction Coalition meetings. This creates the political illusion of a House bill being drafted, with ASCE as an interested party. Since all organizations must work with the House Science Committee, they are reluctant to pose resistance to the bill's progress. The power of the Science Committee is driving the bill through Congress.

During the drafting stages of the bill, the primary concern of ASCE is to form political support in the community, and in Congress. This support is organized in the Wind Caucus. The caucus is a group of representatives, from mostly windstorm prone areas, such as "tornado alley" in the Midwest, that support the windstorm hazard bill. A caucus has no legislative function, but it does have a political one. A caucus is formed to educate interested representatives on the supporting arguments of a bill, thus expanding its support in Congress. The Wind Caucus currently has 26 members, and the caucus numbers will rise as ASCE informs more representatives of the bill and how it affects their districts. With the Wind Caucus growth, the probability of passing the bill is much greater.

Political Challenges

There are many political hurdles that supporters and detractors must overcome to prove their point to legislators. As one supporter, ASCE must demonstrate the bill's benefits to as many representatives as possible. This is especially difficult to prove to the representatives in the Western United States. If the representative doesn't live in a windstorm prone area, and therefore their constituents are not affected, then the strongest argument of ASCE is ineffective. However, the member's district may house a university with a very strong civil engineering program that would benefit from the bill's passing. Finding these political advantages is an art form in which lobbyist are experts.

While the supporters are advocating the bill's passing on Capitol Hill, the detractors are arguing just as hard for its failure. The opponents of the bill must use the same political tactics

as the supporters, but for the opposite conclusion. They must show the negative impact the bill would have in a representative's district. One tactic that helps in opposing the windstorm hazard reduction bill is corporate pressure. If a major corporation is housed in a representative's district that manufactures the current standard building materials, then pressure can be applied through that corporation's advocating. Legislators generally do not wish to upset their constituents. If hundreds of voters lose jobs, because a corporation is forced to downsize, then the representative will oppose the bill. With congressional elections being held every two years, representatives are forced to vote in support of the majority of their district.

Legislative Analysis

The legislative process is another primary aspect to be considered when advocating a bill. Legislators may alter the bill to fix any future problems. The bill may be compared to similar legislation to identify its benefits and faults.

Similar Legislation

NWHRP has adopted it design and goals from a program that was started in 1977. The National Earthquake Hazards Reduction Program (NEHRP) began after the Earthquake Hazards Reduction Act of 1977 became public law 95-124.[29] The Great Alaskan Earthquake of 1964 was the defining moment in earthquake mitigation, similar to the way Hurricane Andrew prompted windstorm hazard mitigation. From 1964 to 1977 there were many research documents that supported the development and enactment of NEHRP. Some of the same researchers, NRC, NAS, and NAE support the creation of NWHRP.

NEHRP has made great strides in improving structural performance during earthquakes. The dissemination of knowledge to the public has been quite effective. The earthquake prone areas of the Western United States have implemented new building codes and standards that have proven to be effective during earthquakes.[30]

[29] "NEHRP Background", http://quake.wr.usgs.gov/study/nehrp/nehrp.html , 2000
[30] ASCE dicussions

Earthquake prevention techniques have become a part of the civil engineering curriculum at universities across the nation.[31] By creating NWHRP, many, including ASCE hopes to see similar results.

Process

Passing a bill in the House of Representatives is very difficult. ASCE hopes to have the bill "dropped" late in the 2000 Congressional Session. "Dropping" is the action of presenting the bill to the House. A representative takes the bill and drops it in the parliamentarian's box for review. While anybody may draft a bill, only a House Representative may drop it. After the bill is dropped the parliamentarian numbers and it is assigned to the committee, or committees that have jurisdiction. To increase the chances of a bill passing, the drafters word the bill in a way that it will be assigned to as few committees as possible. ASCE wants the windstorm hazard bill to be assigned to only the House Science Committee. It is likely, however, to be sent to at least one more committee.

When a bill goes to a committee, they make the necessary changes to the bill. Each committee forms its own revised draft of the bill, and presents it to the House. If there are differences in the drafts, which are inevitable, the committees must go to "conference". In conference, the committees discuss the wording of the bill, and attempt to resolve their differences. If their differences cannot be resolved, the bill dies. For this reason, drafters, and supporters of bills, try to word the bill to go to one particular committee. As previously stated, ASCE would like the windstorm hazard bill to go to the House Science Committee, and maybe the House Transportation and Infrastructure Committee. These two committees have the most supporters of ASCE's ideas.

Modifications and Alternatives

There is no other piece of legislation that addresses the reduction of windstorm hazards, or the lack of funding in the wind engineering community. Therefore, once the bill is dropped, legislators will try to alter the bill to address all possible problems that may arise during the life

[31] Structural Engineering courses, Oregon State University, 1999-2000

of the program. Matching of funds between the government and private sector is one alteration that might be proposed. Since some corporations stand to make money with such a bill, government may want those corporations to help pay for the research.

Providing tax breaks to households that implement the program's new technologies is another amendment that is being considered. Drafters of this amendment hope to offset the construction costs of applying the new technologies by rewarding the participating households with tax refunds. This change tries to insure that the benefactors of this program are the groups identified by the bill: the low-income and highly vulnerable homes.

Conclusions and Recommendations

Several recommendations have been formed through extensive research and the participation in countless meetings in Washington, DC. First, engineers need to be an integral part of the legislative process. Engineers in academia, as well as in the field, should contact their representatives and suggest joining the Wind Caucus. Second, the drafters, advocates, and legislators of the bill should ensure that this program's success is achieved, by developing new technologies that are cost-effective for the general public. This bill is designed to help low-income families, and advocates need to insure that this goal is met. And finally, better communication between the wind engineering research community and the engineering societies' offices in Washington, DC is a must. Researchers can provide publications and technological support that will help NWHRP advocates.

Researching the engineering and public policy intersection for this bill was the purpose of my study. This connection is the pivotal issue. Engineering knowledge is an invaluable tool that must be used by advocates and lawmakers. Political knowledge of advocates is also a valued commodity to the engineering field. If the engineering fields can work closely with the governmental offices of the societies that represent them, the knowledge of the two communities could combine to form a greater political and societal power.