Institute for Business & Home Safety's

Building Code Resources

Where building safety research leads to real-world solutions.

What is a building code?

A building code is the minimum acceptable standard used to regulate the design, construction and maintenance of buildings.

Why are building codes needed?

Building homes and businesses according to modern code requirements such as the International Building Code (IBC) and the International Residential Code (IRC) provides consistency and triggers processes such as inspections that help ensure buyers are getting a quality product. Codes offer a sound investment. Research shows that every $1 spent saves a property owner $4 in future losses associated with a wide variety of dangers, including fire and water damage and natural hazards, according to the Multi-hazard Mitigation Council of the National Institute of Building Sciences.

Cost increases to bring structures up to code, or beyond, can depend on both the existing level of construction quality and current building code requirements. What are the major benefits of strong code adoption and enforcement?

» over

- Safe buildings are achieved through proper design and construction practices and a code administration program that ensures compliance. The substantial investments made by home and business owners are protected through complete code enforcement.
- Codes provide uniformity in the construction industry. This uniformity permits building and materials manufacturers to do business on a larger scale, passing any related cost savings on to the consumer.
- Building codes promote a level, predictable playing field for everyone involved in the development process – from designers, builders and suppliers to buyers, who are entitled to rely on construction of a safe, sound building.
- Inspection during construction provides peace of mind and third-party verification that code compliance has been achieved. On average, 10 inspections are conducted to homes, businesses, offices or factories to verify conformity to minimum standards.
- A study done for the Institute for Business & Home Safety (IBHS) found that losses from Hurricane Andrew, which struck south Florida in 1992 and caused more than $20 billion (in today's dollars) in insured damage, would have been reduced by 50 percent for residential property and by 40 percent for commercial property if they were built in accordance with Florida's 2004 statewide building code.
- Another IBHS study following Hurricane Charley in 2004 found that modern building codes reduced the severity of property losses by 42 percent and the frequency of losses by 60 percent.

Who Sets the Modern Building Code Standards?

- Modern codes are consensus documents based on established scientific and engineering principles, drafted through input from leading technical experts, construction professionals, enforcement personnel and the products industries.
- The International Code Council (ICC) has developed the most widely adopted set of codes to unify the U.S. building regulatory system.
- The ICC was formed when the three model code organizations in the United States merged. This created a unified national code that could be used by architects and engineers.

Why Doesn't Every State Have a Code?

- Legislative approval is required for a state to adopt and enforce a building code.
- State laws are typically passed to create a Building Code Council that writes, interprets and updates the code, and requires enforcement. Systems are enacted to regulate the licensing of building inspectors, contractors and subcontractors. These regulations help protect consumers from fraud and poor workmanship.
- IBHS provides assistance to states in developing and implementing regulatory processes. IBHS also has an online training tool to assist with establishment of local building departments and instruction regarding code inspections for quality assurance.

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The Benefits of Statewide Building Codes

Definition of a Building Code

A building code is the minimum acceptable standard used to regulate the design, construction, and maintenance of buildings for the purpose of protecting the health, safety and general welfare of the building's users.

A Short History of Building Codes

Building codes have been around in some form for thousands of years. In 2000 B.C., the code of Hammurabi dictated that if a dwelling collapsed and caused the death of the owner, the builder would be put to death.

The Roman Empire instituted building codes after fatal building collapses, and a great fire that destroyed 15,000 buildings in 1666 led to the development of London's early building codes.

In the United States, the great Chicago fire killed 250 people, destroyed 17,000 structures and left nearly 100,000 people homeless in 1871. Four years later, that city enacted a new building code and fire-prevention ordinance.

As is often the case, building codes were the afterthought of tragedy rather than forethought for prevention. As cities grew and experienced their own disasters, building codes were developed based on individual experiences more than scientific knowledge.

In 1905, the first nationally recognized U.S. building code was established. Much of this code regulated the type of building components that could be used in construction and did not allow for newly developed materials.

Modern building codes are steeped in established scientific and engineering principles that have been thoroughly tested. This allows for the reliance on measurable performance rather than the rigid specification of materials and methods. Over the centuries, building codes have evolved from regulations stemming from tragic experiences to standards designed to prevent them.

Benefits of State Building Codes

The purpose of building codes is to construct safe buildings, thereby reducing deaths, injuries and property damage. The codes regulate the design, construction and maintenance of buildings. Statewide adoption and enforcement of such codes result in consistent design and construction of safer buildings.

Building homes and businesses to the requirements of modern codes such as the International Building Code (IBC) and the International Residential Code (IRC) can result in safety from a wide variety of dangers including fire damage, water damage, electrocution, and natural hazards (windstorms, wildfire, flooding, freezing weather and earthquakes).

Cost-benefit studies have been conducted for wind and seismic code provisions, both individually and as a group. Every $1 spent saves society (individuals, states and communities) an average of $4 in future reduced losses, according to the Multi-hazard Mitigation Council (MHMC) of the National Institute of Building Sciences. The savings will increase up to $16 when these hazards are addressed through groups of code requirements.

Current Model Building Codes

In 1994, three code organizations merged to form the International Code Council (ICC). It released its first set of codes in 2000. As a result of new code development and the merger many states are in the process of examining or updating their existing codes. The Institute for Business & Home Safety (IBHS) provides technical expertise and input through its staff engineers and has produced resource material summarizing the status of code adoption across the country at www.DisasterSafety.org.

The National Fire Protection Association (NFPA) also is a major player in the development of codes and their fire and electrical building codes are widely used throughout the United States.

The Problem with Variations in Building Codes

State standards for construction and code-related inspection and enforcement vary widely across the country. Some statewide building codes are applicable to virtually every type of structure (residential, commercial, industrial, public, schools, hospitals, and farm buildings), while others employ lesser degrees of regulation and code applicability – or none at all.

Where statewide codes exist, it is not uncommon to allow individual jurisdictions (e.g., cities of a particular class or counties) to deviate from the state standard, often resulting in a weakening of the model minimum code. IBHS works through research and partnership to alert local and state officials to the dangers of watering down the code.

Another disturbing practice is the tendency to broadly adopt commercial building codes while excluding one-and two-family homes. This is another practice discouraged by IBHS.

In areas where no statewide code exists, such as Missouri, cities often choose to adopt and enforce building codes to govern both commercial and residential construction.

This trend may be less likely in outlying suburban or rural areas with smaller budgets. It is, however, important to note that these areas also have seen the bulk of new residential development in recent years. The combination of concentrated residential construction and lack of codes (or code enforcement) opens the door to a lack of quality control. This could have a broad impact on how these buildings will perform especially in natural disasters.

Why is it Important to Adopt a Code without Weakening Amendments?

Statewide building codes -- and adequate enforcement of those codes -- play a vital role in public safety and loss prevention. In addition to saving lives and reducing property loss, codes based on nationally recognized models can:

- reduce the need for public disaster aid;
- promote consistent guidelines for design professionals, suppliers and builders;
- create a minimum standard upon which consumers can rely; and
- contribute to the durability of structures.

Model building codes may require amendments to meet the particular administrative needs and requirements of the governing community. However, substantive content addressing design, construction or performance standards within these codes should remain untouched to ensure that minimum safety and performance are met. Leading experts in the fields of science, engineering and building construction have developed the minimum standards to ensure safe and predictable building performance.

When technical content in local codes deviates from

the standard, it should be allowed only to strengthen, rather than relax, code provisions. While local governments and the building industry may voice objections to codes (often on the asserted basis of cost), consumers, communities and builders clearly enjoy long-term benefits from effective building codes. Studies show that the costs of code enforcement may be offset by approaches such as sharing building departments between several smaller municipalities or between a city and county. This concept is similar to environmental and energy benefits a consumer sees when purchasing a more efficient air-conditioning system or more thermally efficient windows.

Federal Government

The Federal Emergency Management Agency (FEMA) supports the adoption and enforcement, without amendments, of disaster-resistant building codes, which they regard as a cornerstone of effective mitigation. FEMA realizes it is an inefficient expenditure of taxpayer dollars to respond to disasters that could have been avoided with the adoption of the International Building and Residential Codes (I-Codes).

The government support of these codes means that their provisions:

- meet the minimum requirements of the National Flood Insurance Program (NFIP);
- are substantially equivalent for seismic design to the 2000 or 2003 editions of the National Earthquake Hazard Reduction Program (NEHRP) Recommended Provisions for New Buildings and Other Structures published by FEMA;
- and reflect the current state-of-the-art engineering requirements for wind, such as those found in the 2005 edition of the ASCE 7 standard.

Currently, the 2006 edition of the I-Codes and the 2003 NFPA 5000 Building Construction and Safety Code meet these criteria.

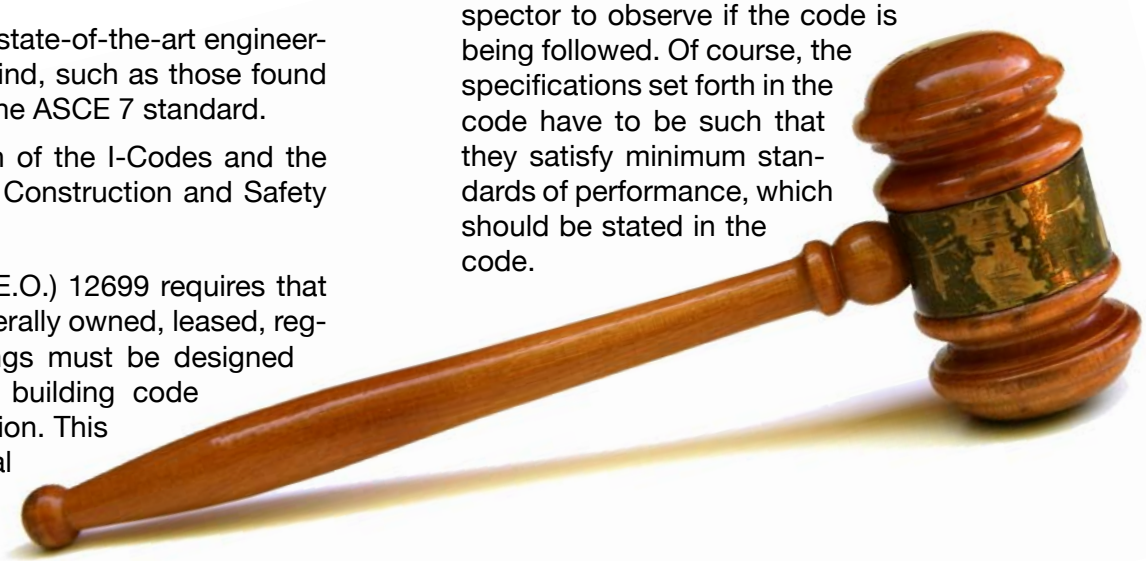
NEHRP, Executive Order (E.O.) 12699 requires that all new construction of federally owned, leased, regulated, or assisted buildings must be designed and constructed using a building code that meets a specific criterion. This criterion states that federal agencies are permitted to use only those model building codes that have been determined to be substantially equivalent to a recognized seismic standard. At this time, the 2003 and 2006 I-Codes and the 2003 NFPA 5000 meet that criterion.

Federal guidelines that govern building, funding and other types of support surrounding construction require compliance with the intent of the codes without amendment. Communities that choose to use weakened amended versions of modern building codes may be subject to less federal funding for pre- and post-disaster mitigation.

Performance vs. Prescriptive Codes

Typically two classes of codes are employed:

- Codes are classified as “performance codes” if they require the completed construction to satisfy specified standards (such as 120 mph winds) without describing in detail how to accomplish the task. “Prescriptive codes” require that certain materials be used and describe how to build in some detail (e.g., use 8d nails). There are also variations that combine elements of performance and prescriptive codes.
- Performance codes allow the designer and builder to use any combination of materials and methods that will satisfy the requirements for the code. Such codes allow wide latitude, and some say this makes them more difficult to enforce. A plan reviewer or inspector may require additional information to determine how the combinations of materials and methods in a set of specifications will perform. Prescriptive codes by their nature enable the plan reviewer and inspector to observe if the code is being followed. Of course, the specifications set forth in the code have to be such that they satisfy minimum standards of performance, which should be stated in the code.



Enforcement is Critical

Good building codes have little value if they are not enforced. Independent studies of damage following Hurricane Andrew and the Northridge Earthquake revealed that lax code enforcement needlessly increased total damage.

Building codes are generally enforced at the local level. These departments are often funded by permit fees, which average less than one percent of construction costs. Plan reviewers and building inspectors are vital to the success of building codes. Unless these functions are adequately funded and staffed with qualified, trained, tested and certified personnel, the full value of building codes will not be realized.

Building Code Effectiveness Grading Schedule (BCEGS)

IBHS worked with the Insurance Services Office (ISO) in the development of a program where the enforcement capacity of a jurisdiction could be evaluated. ISO collects information related to personnel qualification and continuing education as well as number of inspections performed per day. This type of information, combined with local building codes, is used to determine a grade for that jurisdiction at the time of the evaluation. The grades range from 0 to 9 with the lower grade being more ideal. Information about the factors that contributed to the overall score can also be obtained through ISO. Insurers can use BCEGS for policyholder credits, based on the performance of a jurisdiction and the building code being enforced.

Summary

Building codes are the minimal standards to which buildings are constructed throughout the country, and they are instituted to ensure the safety and health of building occupants. Stronger codes are more cost-effective in the long run, and to be effective they must be enforced by qualified personnel, who are properly trained, to ensure that the approved standard is met for the minimal safety and performance of a building.

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Model Legislation

This document is intended to serve as a model for drafting legislation in the creation of a statewide building code. Included here are the relevant language and outlines to establish uniform standards and amendment procedures, to form a State Building Code Council and set up supporting departments at the local level, and to designate enforcement authority.

SAMPLE BILL

Relative to state building codes; to provide for scope of building codes; to provide for public policy; to provide for the creation and authority of the (name of state) Building Code Council; to provide for enforcement; to provide for appointment of building officials; to provide for council's code adoption authority; to provide for adoption of a state building code; to provide for applicable codes for inspections; to provide for revocation authority and injunctive relief; to provide for continuing education; to provide authority for the state fire marshal; and to provide for related matters.

State Building Code Council

The (name of state) Building Code Council, hereinafter referred to as the "Council," is hereby created and shall consist of (enter number) members. Each member of the Council shall be appointed by the Governor, for a term of three years and until a successor is appointed. No member of the Council shall receive per diem or other compensation for their duties on the Council.

Of the members initially appointed by the Governor, ** shall serve for terms of one year each, **** shall serve for terms of two years each, and *** shall serve for terms of three years each. Thereafter, all appointments shall be for terms of three years. The Governor may remove appointive members at any time.

The Building Code Council shall be composed of *** members appointed by the Governor consisting of one registered architect, one licensed engineer practicing structural engineering, one licensed general contractor, one licensed engineer practicing electrical engineering, one licensed engineer practicing mechanical engineering, one building code official, one representative of the insurance industry, one representative of the gas industry, one representative of the disabled community, and one representative of the State Fire Marshal.

Any member who shall, during his term, cease to meet the qualifications for original appointment (through ceasing to be a practicing member of the profession indicated or otherwise) or fail to attend three consecutive Council meetings shall thereby forfeit their membership on the Council.

The Governor may make appointments to fill the unexpired portions of any terms vacated by reason of forfeiture, death, resignation, or removal from office. In making such appointment, he shall preserve the composition of the Council required in this Act.

The Building Code Council shall prepare and adopt, in accordance with the provisions of this Article, a Statewide Building Code to govern the construction, installation, reconstruction, alteration and repair of buildings and other structures, and the installation of mechanical devices and equipment therein.

The council shall be responsible for clarifying the intent of the General Assembly and address questions which might arise with respect to provisions of the State Building Code required by this chapter and are binding upon a state or local governmental entity or agency enforcing the State Building Code.

Within 30 days after its appointment, the Building Code Council shall meet on call of the Governor. The Council shall elect from its members a chairperson and vice chair and such other officers as it may choose, for such terms as it may designate in its rules. The council shall adopt regulations under the Administrative Procedure Act in order to implement the provisions of this Part.

The Council shall meet regularly, at least once every three months, at dates and places determined by the Council. Special meetings may be called by the chairmperson on their own initiative and must be called at the request of three or more members of the Council within fourteen days of such request. Each member must be notified by the chairperson in writing of the time and place of regular and special meetings at least seven days before the meeting. Each meeting shall be open to the public and any official decision of the Council may be made only by a vote of at least two-thirds of those members in attendance at the meeting provided that a quorum is established prior to a vote. A majority of members of the Council shall constitute a quorum.

State Building Code

The state building code shall establish uniform performance standards within the state and provide reasonable safeguards for health, safety and welfare, and will provide for the use of modern methods, devices, materials and techniques.

The council shall adopt and amend only the latest editions of the following as the state uniform construction code:

(1) International Building Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(2) International Residential Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(3) International Plumbing Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(4) International Mechanical Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(5) International Fire Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(6) National Electrical Code, NFPA 70. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(7) International Energy Conservation Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(8) International Fuel Gas Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(9) International Existing Building Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(10) International Wildland-Urban Code. The applicable standards referenced in that code are included for regulation of construction within this state. The appendices of that code may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption.

(11) Any other codes published by the International Code Council which the Building Code Council deems necessary to fulfill (?) the requirements of this Act.

Enforcement of the Code

All municipalities and counties in this State shall enforce the State Building Code as provided in this Act. Municipalities and counties may establish agreements with other governmental entities of the State to issue permits and enforce building codes in order to provide the services required by this chapter.

The Building Code Council may assist in arranging for municipalities, counties or consultants to provide the services required by this Act to other municipalities or counties if a written request from the governing body of the municipality or county is submitted to the council. Notwithstanding any other provision of law, the governing body of a county or a municipality shall be authorized to set fees for inspections, re-inspections, plans reviews and other activities necessary for the enforcement of the State Building Code. The Building Code Council shall certify a person performing building codes enforcement including building officials, plans reviewers, and inspectors. The council shall establish the requirements and process for the certification and continuing education of code enforcement officers, code enforcement inspectors, and building officials. The Building Code Council may impose fees necessary implement and continue the programs required by this chapter and as set forth by the rules of the Council. The monies collected by the fees shall be retained by the Building Code Council and used to implement and continue the programs required by this chapter.

Each county shall appoint a building official or contract with other political subdivisions so that the unincorporated area of the county is under the jurisdiction of a building official. Each municipality shall appoint a building official or contract for a building official within the municipal limits. Based on the needs established by each municipality or county, the building official or appointing authority may appoint and employ other personnel and assistants necessary to perform the required inspections and duties and may prescribe fees for construction permits and inspections.

Notwithstanding any other provision of law, the governing body of a county or municipality may impose fees necessary to implement and continue the programs required by this chapter upon a vote of a simple majority of the governing body unless a super majority vote is required by local ordinance.

To secure these purposes, the Building Code Council shall certify a person performing building codes enforcement including building officials, plans reviewers, and inspectors. The council shall establish the requirements and process for the certification and continuing education of code enforcement officers, code enforcement inspectors and building officials.

For a violation of the building codes or regulations adopted pursuant to this Part, the local building official may enjoin further construction of the project as provided by local ordinance. The municipal, district, or county attorney, attorney general, or other appropriate authorities of a political subdivision, in addition to other remedies, may apply for injunctive relief, mandamus, or other appropriate proceeding in the district court of the jurisdiction where the violation occurred.

Amending the Code

The Building Code Council may revise and amend the State Building code, either on its own motion or upon application from any citizen, state agency, or political subdivision of the state. The Council shall comply with the same procedural requirements and the same standards set forth in this Act for adoption of the code when amending the code. Amendments to code shall provide more stringent requirements than those specified in the model codes. The state uniform construction code shall be updated every three years.

Local governments and state agencies with building construction regulation responsibilities may provide for more stringent requirements than those specified in the State Building Codes if determined to be more stringent than the State Building Code and approved by the Building Code Council.

Institute for Business & Home Safety's

Building Code Resources

The Benefits of Modern Wind Resistant Building Codes on Hurricane Claim Frequency and Severity
- A Summary Report -

Hurricane Charley
Charlotte County, Florida
August 13, 2004

Introduction

The devastation left behind by Hurricane Andrew when it struck the State of Florida in 1992 fueled the beginning of a process to reevaluate the building code standards in place and the enforcement of these standards. In 1995, coastal areas of the State of Florida, including Charlotte County, began to use and enforce high wind design provisions for residential housing. A key element in that process was the adoption of the SBCCI's Standard for Hurricane Resistant Construction SSTD-10 as a prescriptive alternative to engineered design of housing. A major emphasis of SSTD-10 and engineering based design was the development of continuous load paths to ensure that all loads were directed to the foundations. The move to formal consideration of high wind design and the use of SSTD-10 as an alternative was accompanied by significant training and education of builders and building officials. The first full year where high wind standards were in place and used in Charlotte County was 1996.

Toward the end of the 1990's the State of Florida began moving towards adoption and enforcement of a statewide building code. The first edition was the Florida Building Code 2001, which was adopted in mid year 2002. Once again, the adoption of this code was accompanied by extensive education and training, including a requirement that all licensed engineers, architects and contractors take a course on the new building code. This code had been in place for about two years when the 2004 hurricane season reached its peak.

In 2004, homes constructed to these new standards as well as older construction methods were put to the test as four major hurricanes attacked the State of Florida from both coastlines in a six week period between August 13th and September 28th, 2004. This study focuses on Hurricane Charley, the first of these storms, and assesses the relationships between building codes and damage. Specifically, the study seeks to determine whether and by how much the new building codes resulted in a lower claim rate per policy, less interior damage, and lower claim severity. One insurance member of the Institute for Business & Home Safety (IBHS) shared their claim experience in Charlotte County, FL with IBHS and has allowed IBHS to share the results of the data analysis through this report.

Claim Frequency

In this study, hurricane claim frequency is measured as the percentage of policies that resulted in a claim. The insurance company that contributed data to this study insured 5,636 policies in Charlotte County when Hurricane Charley made landfall in 2004. Of these policies, approximately 80% were written for homes that were constructed before the implementation of modern engineering based design in 1996. The remainder of the policies was written for homes constructed under the SBCCI high wind requirements or the 2001 Florida Building Code.

Hurricane Charley resulted in 2,102 reported claims in Charlotte County for this insurance company. On average, 37% of all insured policies resulted in a claim. But, when the claim frequency was calculated by year of construction, results in Figure 1 show that there was a significant reduction in claims when homes were constructed after 1996. Note that the analysis suggests that it took about a year before significant reductions in claims occurred. Claim frequency for homes built under these standards beginning in 1996 *(red)* are compared to those homes constructed before this standard were implemented *(blue)*. Figure 2 reveals that on average, claim frequency was reduced by 60% for homes constructed under the newer building codes.

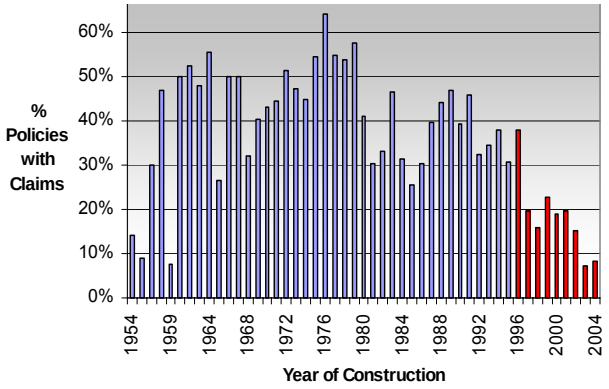

Figure 1: Claim Frequency by Year of Construction

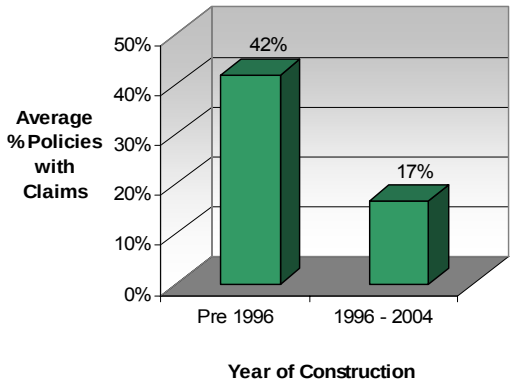

Figure 2: Average Claim Frequency by Building Code Category

Claim Severity

Hurricane claim severity is calculated in this study by dividing the total cost of damage, including the policy deductible, by the total square footage of the home to obtain an average cost of damage per square foot. This eliminates any claim severity variances that may result from homes of different sizes. Of the 2,102 claims incurred, 84% of these claims resulted in homes with a known square footage. These claims were used in the claim severity analyses.

Claims from Hurricane Charley for pre-1996 homes resulted in an average loss of $24/sf. For an average 2,000sf home, this equates to an average loss of $48,000. Policyholders were responsible for approximately $2,600 on average through their hurricane deductible.

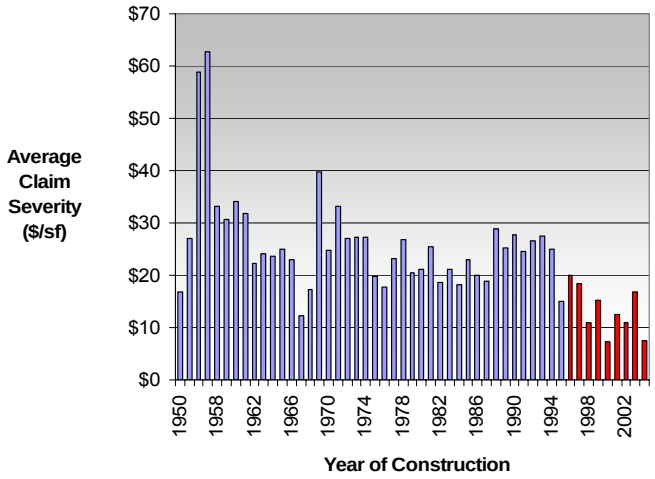

Figure 3: Average Claim Severity by Year of Construction

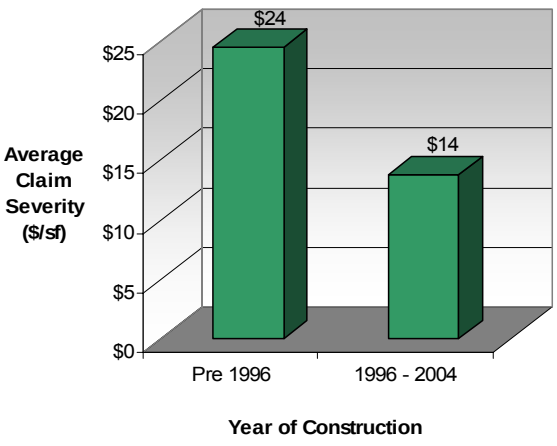

Figure 4: Average Claim Severity by Building Code Category

Figure 3 shows that when claim severity was analyzed by year of construction, there was a dramatic drop in the severity of a claim when homes were constructed after 1996 *(red)* as compared to those homes constructed before 1996 *(blue)*. The severity of a claim was reduced by 42% for homes built to the newer codes. This is displayed in Figure 4. Homes in this group resulted in an average loss of just $14/sf. For the average 2,000sf home, the loss was reduced to just $28,000 per claim.

Building Component Damage

A sample of 270 claims was reviewed through a manual process to determine which building components failed following Hurricane Charley. Results in Figure 5 show that roof damage was the most frequent source of damage, followed by damage to pool cages or screened porches, and soffits. Window and garage door damage occurred in approximately half of all claims.

In most cases, the frequency of component damage was reduced when claims occurred to homes constructed between 1996 and 2004. Garage doors were the most improved component, resulting in a 34% reduction in component damage frequency.

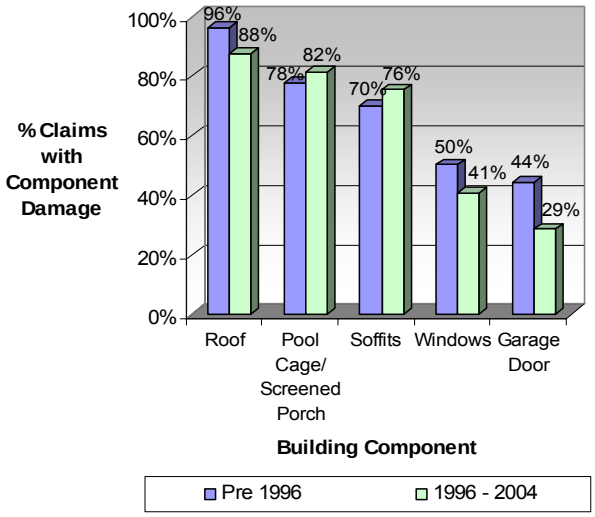

Figure 5: Frequency of Building Component Failure

Not only was there a reduction in damage frequency for these components, but there was a reduction in the severity of damage as well. Claims that resulted from homes built between 1996 and 2004 resulted in:

- 44% fewer total roof covering replacements compared to homes built before 1996. Instead, homes built between 1996 and 2004 most often required only partial roof covering replacements.

- 38% fewer homes had window glass and/or frame damage compared to homes built before 1996. Instead, homes built between 1996 and 2004 had a higher frequency of window screen damage only.

- 32% fewer total garage door replacements compared to homes built before 1996. Instead, the majority of homes built between 1996 and 2004 required only minor garage door repairs, such as track adjustments or dent repairs from debris impact.

Two components that did not show a reduction in damage frequency as a result of the newer building code requirements are soffits and pool cages or screened porches.

The percentage of total soffit failures, as opposed to a partial soffit failure, was reduced in homes constructed between 1996 and 2004, but the fact that soffit failures were still so prominent was a cause for concern. This led to a modification in the Florida Building Code in December of 2006 that requires soffits be designed for the adjacent wall pressures and installed in accordance with the manufacturer's specifications. It is anticipated that these building code modifications will reduce soffit losses in future storms where homes are built to this standard.

Pool cages and screened porches were considered "exterior attachments" in this study and were the third most costly failure according to the results in Figure 6. The average cost to replace a pool cage was more than $7,000 and the average cost to replace a screened porch was more than $4,200 when a total replacement was required. It is estimated that 90% of the homes with pool cages in Charlotte County experienced some level of damage during Hurricane Charley.[1]

Interior Damage and Additional Living Expenses

The failure of many building components and particularly those that protect the building envelope, such as the roof, windows, and garage doors, can result in substantial damage to the interior of the home. In fact, interior damage was the second most severe loss source following roof damage. This can be viewed in Figure 6. The severity of interior damage can lead to subsequent additional living expenses (ALE) if the homeowner is required to evacuate their home during the damage repair process. This study revealed that homes constructed between 1996 and 2004 had 34% fewer claims with interior damage, and additional living expenses were only necessary for less than one month if they were required at all. By contrast, 20% of all claims resulting from homes constructed before 1996 required additional living expenses and 11% of these claims required additional living expenses for one month or more. This can be seen in Figure 7.

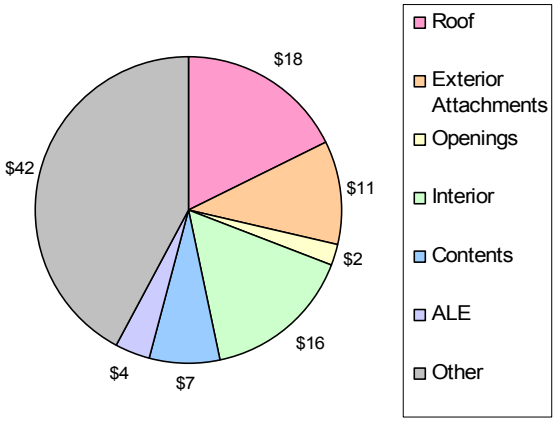

Figure 6: Loss Cost Distribution

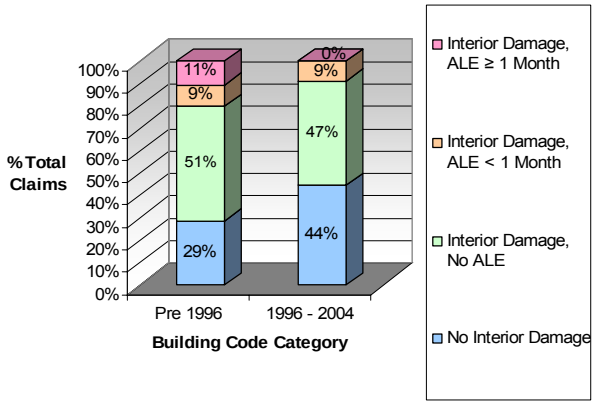

Figure 7: Frequency of Interior Damage and ALE by Building Code Category

Summary

Results from this study show that the enforcement of modern engineering design based building codes made a positive impact on the performance of residential homes during Hurricane Charley in 2004. The frequency of claims was reduced by 60% and the claim was 42% less severe when a loss did occur, for homes built after the adoption of the modern codes.

In most cases, homes built after the adoption of these new standards resulted in a decrease in the frequency and severity of damage to various building components. Furthermore, based on the analysis of additional living expense records, it is concluded that the new building code requirements allowed homeowners to return to their home more quickly and likely reduced the disruption of their day to day lives.

[1] *This estimate is based on data from the Charlotte County Tax Assessor Database. A 500 record sample revealed that nearly all homes with pools had pool cages. The tax assessor database was used to determine which homes with claims had pools.*

This study also showed that building codes are an evolving process and there is always room for improved construction practices. Even though there was significant improvement in residential construction performance overall, the performance of components such as pool cages or screened porches and soffits still need to be addressed. Identifying weaknesses in the codes can lead to better construction techniques and reduced losses for future events.