

NGA GLASS CONFERENCE™ CARLSBAD

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Update: Natural Disasters, Building Resiliency, Building Codes & GLASS



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Recent Disasters in the United States



Recent Disasters in the United States

1. June 24, 2021 - Collapse of 55 out of 135 units in a 12-story high rise condominium in Surfside, Florida.

Ninety-eight people die, including three children.



The site of the Champlain Towers South partial collapse in Surfside, Florida.

[Credit: NIST](#)

A satellite image showing a large hurricane with a well-defined eye and spiral cloud bands. The hurricane is positioned over the Gulf of Mexico, with its outer edge reaching the Florida peninsula. The landmasses of the United States and parts of Central America are visible in the background, with some areas highlighted in brown, possibly indicating vegetation or urban areas. The ocean is dark, and the clouds are bright white and grey.

Recent Disasters in the United States

2. Hurricanes 2024

- August 5: Cat. 1 Hurricane Debby hits Florida
- September 26: Cat. 5 Hurricane Helene hits Florida, North Carolina and Georgia
- October 9: Cat. 3 Hurricane Milton hits Florida

Total estimated damage - \$113 billion dollars

Recent Disasters in the United States

3. California Wildfires - As of Jan. 27, 2025 - 17,000 buildings burned and 27 people killed.

Total estimated damage to date: a quarter of a trillion dollars.



Building Resiliency of Aging Buildings

- Building code jurisdiction generally ends when an occupancy permit is issued.
- This means that post-occupancy inspections to determine building code compliance as buildings age are generally not required.

Building Resiliency of Aging Buildings

Following the Surfside collapse –

Florida enacted laws mandating post-occupancy inspections of buildings at structural risk. Additionally, it requires many owners to fund reserves necessary to alter or repair their structures to meet current code.



Under this law, the owners in one complex in northeastern Miami-Dade County are reportedly facing assessments as high as \$400,000 each to alter and repair existing structures to current code.

Building Resiliency of Aging Buildings

Outside the Surfside legislation enacted in Florida:

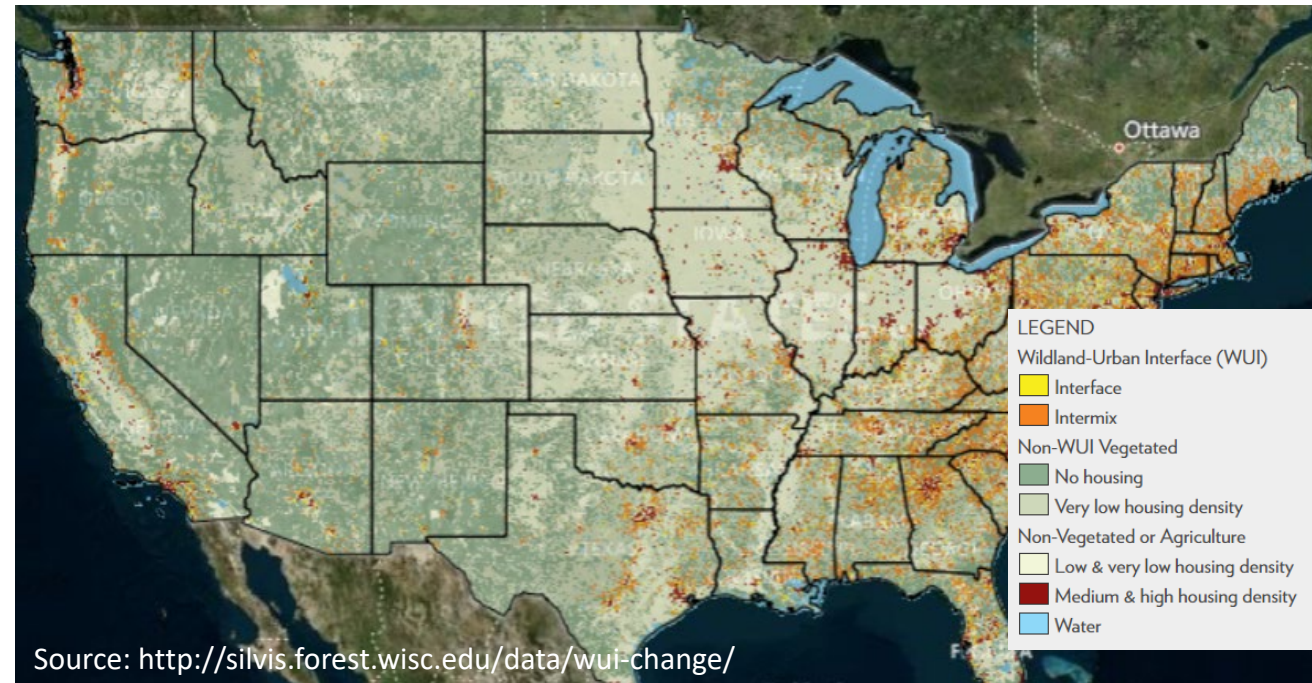
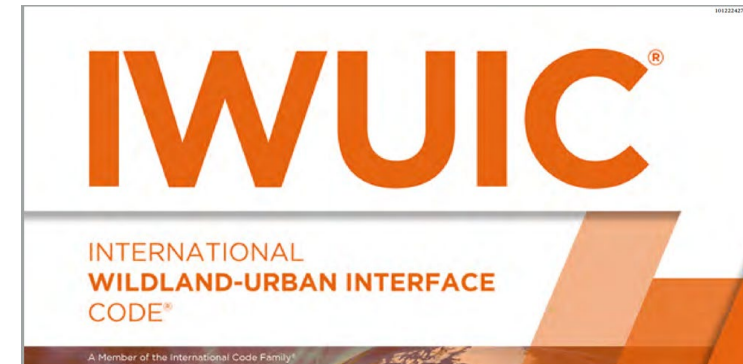
More than 32 million homes in the U.S. are at risk of damage or destruction by hurricanes.

- States generally do NOT require post-occupancy permit inspections to determine whether homes in hurricane zones comply with current code.
- For example, glass in windows and doors in existing structures in hurricane zones are not required to be hurricane rated unless the glass is voluntarily replaced.

Building Resiliency of Aging Buildings

California generally requires property owners in wildfire-urban interface zones to create and maintain 100-ft defensible spaces around buildings – post occupancy permits – however,

- Approximately 16 million homes have been built in high fire risk areas in the U.S. - approximately 5 million homes in California alone have been built in high fire risk areas.
- California does NOT require post-occupancy inspections in high fire risk areas to determine whether existing buildings have glass in exterior windows or doors that is ember resistant or fire-protection rated glass – and,
- California does NOT require post-occupancy inspections in high fire risk areas to determine whether the roofs or exterior walls of buildings are ignition or fire resistant.



Building Resiliency of Aging Buildings

What changes can make buildings more resilient as they age to address the risk of natural disasters?

- In hurricanes, homes are often damaged or destroyed because flying debris breaks the glass in exterior windows or doors which allows high winds and driving rain to enter and destroy the home.
- In wildfires, homes often burn when the glass in their exterior windows or doors is broken when flying ember strike them. Broken glass allows the burning embers to ignite curtains, furniture and flammables in the home, burning it from the inside.

Building Resiliency of Aging Buildings

- If existing homes at risk for hurricanes or wildfires were inspected and upgraded to change the glass in exterior windows and doors to hurricane rated or fire-protection rated glass, many would likely be spared significant damage or destruction.
- If existing homes built in hurricane or wildfire areas were required to upgrade roofs and exterior walls, windows and doors to meet most or all current code requirements, the toll that natural disasters take on America would likely be significantly reduced.

Building Resiliency of Aging Buildings

Homes ignite in one of three ways:

1. Flying embers from as far as a mile away
2. Radiant heat
3. Direct flame contact from nearby fires.

Building Resiliency of Aging Buildings

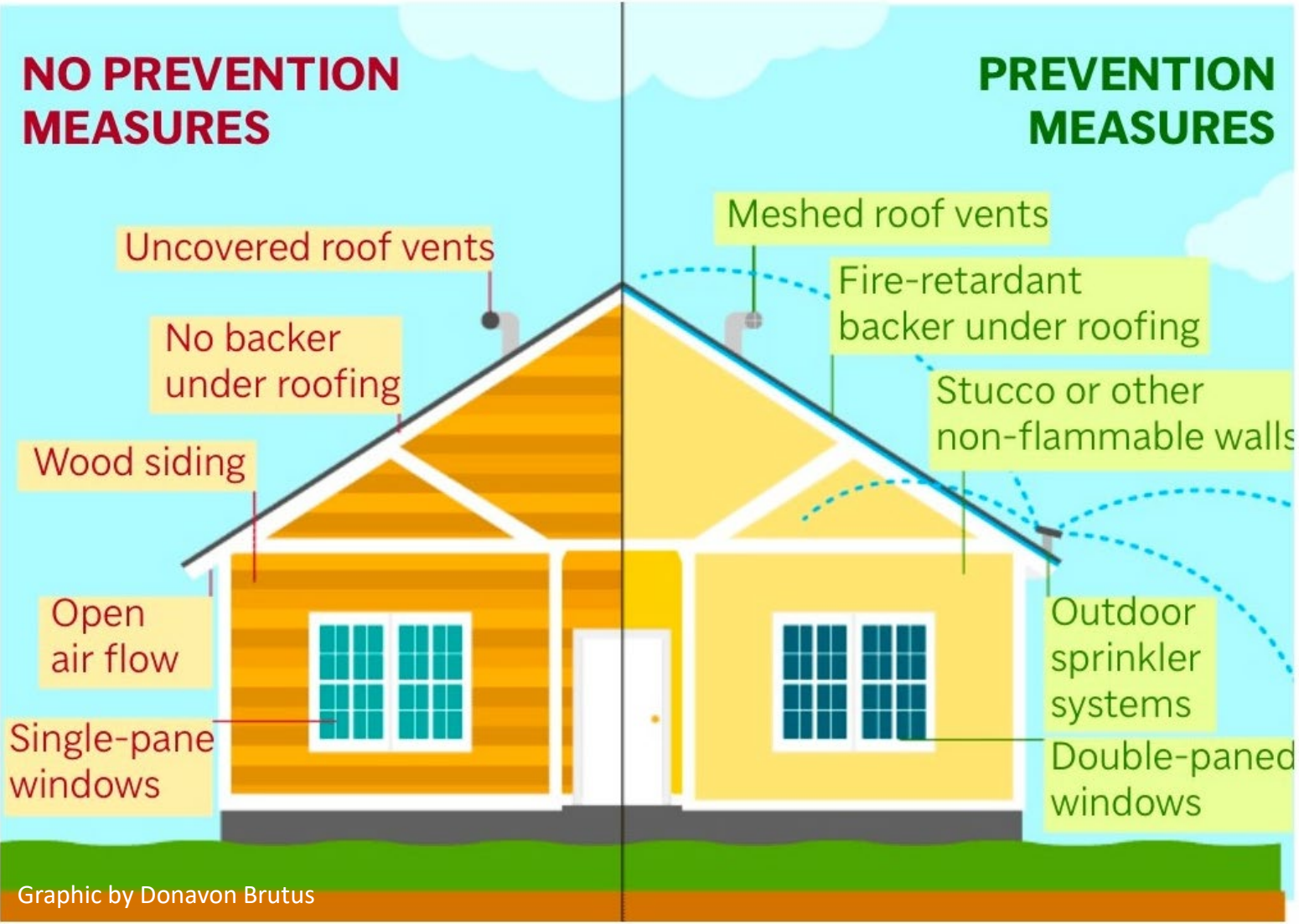
What would a home designed to survive a wildfire look like?

- It would have exterior glass that is tempered which is ember resistant – or even BETTER - fire-protection rated glass that won't fail from ember strikes, extreme radiant heat of even direct flame.
- No eaves with nooks that can catch and trap flying embers.



Building Resiliency of Aging Buildings

Building materials can help protect homes from wildfires.



“Many experts say luck does play a part. After all, wind can shift 180 degrees in a split second, pushing fire away from your house and towards a neighbor’s. But they also say there are [many ways that homes can be made less vulnerable.](#)”

Building Resiliency of Aging Buildings

A home designed without eaves would look more like this!

- It would also have a roof made with a Class A rated roofing material, i.e., usually steel, asphalt fiberglass composition shingles, concrete or flat/barrel-shaped tiles.
- Its exterior walls would be made from ignition resistant and/or fire-resistant materials too. These can include concrete or steel, but one or more gypsum drywall layers is the most common fire-resistant interior finish.

It would also be surrounded by a “defensible space” free of plants, shrubs, and flammables and constructed using a lot of concrete.



West Hollywood Hills.
 Photo courtesy SweisKloss

Building Resiliency of Aging Buildings



It would look like this home that survived the Palisades fire in California!

- Please note that a number of the tempered glass windows did NOT survive the fire, making its exterior windows the weak link – they should have been fire-protection rated!

AN OVERVIEW OF THE U.S. BUILDING STOCK¹

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¹ Published as Chapter 2.1 in Spengler J.D. et al., 2001. *Indoor Air Quality Handbook*, New York: McGraw Hill.

Over 90% of the current U.S. housing stock was built before 1990; only 18% was built before 1940. The 1970s were the decade with the largest amount of housing built, with 19% of the current stock built during that period. The oldest housing stock is in the Northeast and Midwest and the newest is in the South.

The average existing single-family home has 3.0 bedrooms and 1.5 full bathrooms, for a total of 2,280 square feet of floor space, of which 1,950 square feet was heated space, the rest being unheated garage and basement areas. Air conditioning is installed in 70% of single-family households, with 47% having central units and 25% having wall or window units. Clothes washers are present in 93% of the units and 88% have clothes dryers.

The average existing multifamily dwelling has 1.6 bedrooms and 1.1 full bathrooms, for a total of 970 square feet, of which 920 square feet was fully conditioned space. Air conditioning is installed in 65% of apartment households, with 36% having central units and 30% having wall or window units. Clothes washers are less common than in single-family households, and are found in 31% of the units and 25% use clothes dryers.

Over 11 million apartment households—nearly half the sector (48%)—were eligible for Weatherization or for the Low-Income Home Energy Assistance Program, a federal subsidy for utility payments of low-income households. The average annual income of Federally eligible households in 1994 was \$11,245. Over 3 million rental units, nearly 10% of the rental stock (both single- and multifamily) are defined as “inadequate” which refers to the absence of heating and plumbing equipment as well as information on upkeep and maintenance (Harvard, 1997).

The average existing mobile home has 1.6 bedrooms and 1.1 full bathrooms, for a total of 980 square feet, of which 940 square feet was conditioned space. Air conditioning is installed in 70% of mobile homes; 43% have central units and 29% have wall or window units. Clothes washers are found in 84% of the units and 75% have clothes dryers. Forty percent of the households in mobile homes were eligible for the Low-Income Home Energy Assistance Program.

Basement and foundation type are important in studying migration of moisture, radon and soil gas into housing. In 1995 nearly half (45%) of all single-family housing had a full or partial basement. About one-quarter (26%) of the single-family houses were built over crawlspaces and 27% were built on concrete slabs (US DOC 1997a).

Energy Use Characteristics

In 1997, over half of all households (52%) used natural gas as their primary fuel for space heating, 30% used electricity, 9% used fuel oil, 4% used LPG, 2% used wood; and 2% used some other fuel (Figure 3). Of the 52 million households using natural gas for space heating, 71% had a central, warm-air furnace, 13% had a steam or hot-water system, and 8% had a wall or floor furnace. Of the 30 million households using electricity for space heating, 37% had a central, warm-air furnace, 32% had heat pumps, and 25% had built-in resistance units. Portable space heaters are used in 12% of all households, the majority (88%) of which are electric. The remainder of the portable heaters are kerosene or fuel oil—a potential source of indoor air pollution.

Conclusion

Homes at high risk for natural disaster should be inspected post-occupancy and brought to current code.

They can be saved!

All these were saved this year from wildfires here in California.











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