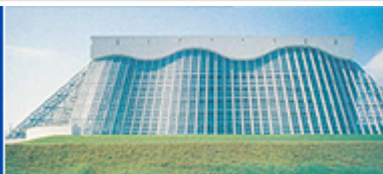


Saflex

About Laminated Glass

Benefits of Laminated Glass

Hurricane Protection

Advantages of Laminated Glass

Designing Impact-Resistant Systems

Comparing Performance and Cost

Building Codes and Standards

Hurricanes and Their Effects on Buildings

Designing with Saflex Interlayer

Designing with HP Saflex Interlayer

Laminated and Performance Data for Saflex Interlayer

Appendix

Project Profiles

Technical Information

Master Specifications

Manufacturers

Solutia Design Awards

Continuing Education

Press Room

Search

Contact Us

Hurricanes and Their Effects on Buildings

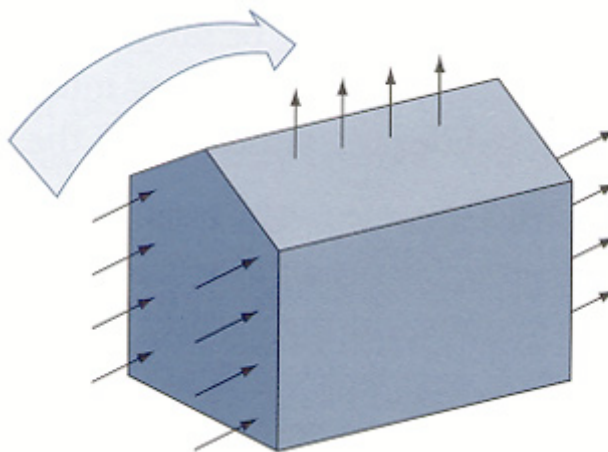
Hurricane Andrew

Hurricane Andrew struck South Florida in August 1992 and still ranks among the most destructive and costly natural disasters in U.S. history. A growing awareness and demand for new coastal area building products that address the concern of high winds, wind-borne debris and the damage they cause has emerged from a disaster that developed from an uncontrollable natural event.

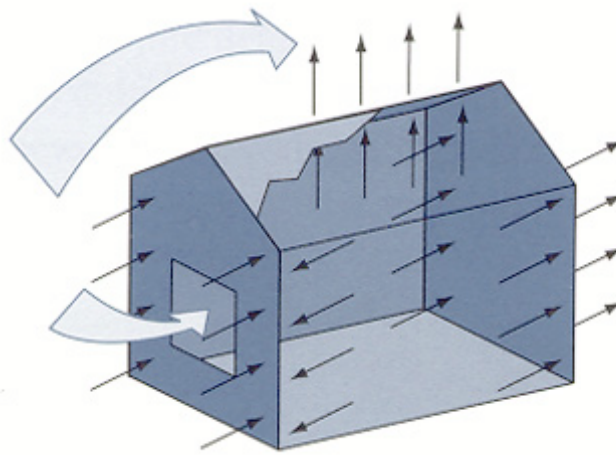
Preserving the Building

The severe and complex nature of hurricane-force winds presents special problems for protecting a building. Under normal circumstances, a building is designed to allow wind to flow over the structure. During a hurricane, a fully intact building envelope, or "outer skin," allows wind to flow at, over and past the structure without damage. Preserving the envelope of the building is one the most important steps in preserving the integrity of the structure and ensuring non-destructive windflow during hurricane-force winds.

Figure 2: Preserving the Building Envelope



Fully Enclosed Building



Building with Opening in Windward Wall

During a hurricane, intense positive pressure is created on a structure as the wind impacts the building (windward face). As the wind flows over or around a structure it can cause "lift" on the roof or "suction" on the opposite side (leeward face). This "suction" is normally referred to as negative pressure. Negative pressure is always higher than the positive pressure acting upon a building during hurricane conditions. If the building envelope is breached, wind also enters the building, thereby causing a dramatic increase in internal pressure. This internal pressure, summed with the external pressure, can effectively double the force acting to lift the roof and push the walls outward (see Figure 2). One of the most susceptible components of the building envelope is a glazed opening. Glazing that is designed to accept the impact from wind-borne debris without evacuating the opening and causing a breach in the building envelope is desirable.

Hurricanes, Typhoons and Tropical Cyclones

Storms producing high winds encircle the globe. The term "tropical cyclone" is a generic name for a lowpressure system that is non-frontal and occurs over tropical and sub-tropical waters. These storms are typically associated with thunderstorm activity and have a fairly cyclonic pattern of wind circulation. The terms "hurricane" and "typhoon" are the regional names given to tropical cyclones. When the winds reach 119 kph (74 mph), the storm is considered a hurricane in the North Atlantic and eastern parts of the north and south Pacific Oceans (a typhoon in the northwest Pacific Ocean). Because of our regional media interest, we are most aware of hurricanes in the Atlantic and Gulf coasts of the United States, as well as the Caribbean. Hurricanes are capable of producing sustained winds of 193 kph (120 mph) or more. When a hurricane passes a building, the winds become turbulent and change direction. During the often-long duration of a storm, loose objects and damaged buildings add to wind-borne debris, which can impact windows and doors. The Saffir-Simpson Hurricane Scale (see Figure 3) was developed to provide an estimate of potential damage during a hurricane due to flooding and destruction caused by the wind and wind-borne debris. The scale is based on ratings from one through five with five being the most severe. Windspeed is the determining factor for the Saffir-Simpson rating as it affects the amount of flooding and potential damage.

Table 3: Summary Chart of Saffir-Simpson Hurricane Scale

Category	Wind Speed	Storm Surge Height	Damage
1	119-153 kph (74-95 mph)	1.2-1.5 m (4-5 ft.)	Minimal (typically non-structural elements)
	154-177 kph	1.8-2.4 m	Moderate

2	134-177 kph (96-110 mph)	1.8-2.4 m (6-8 ft.)	(roofing materials, door and window damage, some trees toppled)
3	178-209 kph (111-130 mph)	2.7-3.7 m (9-12 ft.)	Extensive (Structural damage to small residences and utility buildings, minor amount of curtain wall failures)
4	210-249 kph (131-155 mph)	3.9-5.5 m (13-18 ft.)	Extreme (More extensive curtain wall failures, complete roof structure failures, extensive damage to doors and windows)
5	>249 kph (>155 mph)	>5.5 m (>18 ft.)	Catastrophic (Complete roof and building failures, complete destruction of mobile homes; severe window and door damage; massive evacuation of residential areas within 5-10 miles of shoreline may be required)

Wind and Debris

Sustained hurricane-force winds can last for several hours; gusting, turbulent winds repeatedly buffet a building; and, as a hurricane passes, winds slowly change direction, altering the direction of pressure being exerted on the building. During the sustained and high-speed winds of a hurricane, debris can be lifted from its at-rest position and become an airborne missile or wind-borne debris. Preservation of glazed openings and therefore the integrity of the building envelope is made difficult by the presence of wind-borne debris. In a hurricane, windborne debris can become a damaging missile. Large missiles, such as roof shingles and other construction materials, are common at heights up to 9 m (30 ft.) above grade; smaller missiles, such as roof gravel, are most prevalent at heights above 9 m (30 ft.). Following the impact from one of these missiles, building materials need to maintain the building envelope as they continue to be subjected to sustained and gusting winds until the hurricane passes.

Requirements for Protection

Hurricanes will occur; wind-borne debris will be present; and the result is an uncontrollable natural event. To prevent a hurricane from turning into a disaster, people and buildings need to be protected. To protect a building during a hurricane, the building envelope must be maintained. To prevent the building envelope from being compromised, windows and doors, typically the weakest link in a building's envelope, must be safeguarded from penetration by wind-borne debris, and they must also remain in place throughout the remainder of the storm. Laminated glass with *Saflex* interlayers can be designed to handle the damaging impact from wind-borne debris and remain in the opening during cyclical wind loading. In the past, temporary or permanently attached shutters were used to protect residential and commercial buildings in hurricane-prone areas. Not all shuttered systems are capable of enduring impact and continuing to provide protection to the opening. Laminated glass with *Saflex*, in properly designed windows and doors, eliminates the need for shuttered systems because the glass will stay intact even if cracked.

Brought to you by:



Solutia.com - Disclaimer - Privacy Statement

© 2006 Solutia Inc. All rights reserved. Trademarks may appear in italics.

* As used herein, ® denotes registered trademark status in the U.S. only; registration status in other geographies may be different.