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THE MECHANICS OF HOME BUILDING

High winds

BY DEBRA JUDGE SILBER

What happens when a powerful windstorm slams into an average house? The devastation resulting from a tornado or strong hurricane might hint at a foregone conclusion: Goodbye, house. But by studying the precise effects of extreme winds on structures and the pattern of failures that result, researchers have made real progress in understanding how to make homes safer and more damage-resistant. (For more on protecting your home in the face of natural disasters, see "Surviving the Storm," pp. 74-79.)

High winds, whether from a hurricane or a tornado, affect structures in similar ways. Tornadoes can be stronger, but hurricane winds last longer and are accompanied by damaging rain. Both create significant uplift forces on roofs.

Although variables abound even when comparing wood-frame homes (the home's size and style, the type of storm and its strength, the storm's path and duration), research has revealed several common points of failure. It is in these areas that wind and flying debris combine to undermine a home's structure, turning a weather event into a catastrophe. It is also where adequate reinforcement can make a real difference in what remains after the clouds recede. Here's how it works.

Debra Judge Silber is managing editor.

HURRICANES

Saffir-Simpson wind scale	Wind speed**
Cat 1	74-95
Cat 2	96-110
Cat 3	111-129
Cat 4	130-156
Cat 5	157+

TORNADOES

EF scale	Wind speed (mph)*
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	200+

WINDOWS
Wind entering through broken windows creates interior pressure that can blow out roofs and walls.
Prevention: Protect openings from impact.

GABLES
Uplift forces lift roof sheathing, enabling wind to push the gable in on the windward side and pull it out on the leeward side. Similar failures occur between stories where top plates are not well secured.
Prevention: Attach roof sheathing firmly to framing at gable ends; tie gable-end walls back to structure. Reinforce wall-rim connections.

CORNERS
Suction resulting from variations in air pressure pulls corners apart.
Prevention: Reinforce with metal connectors.

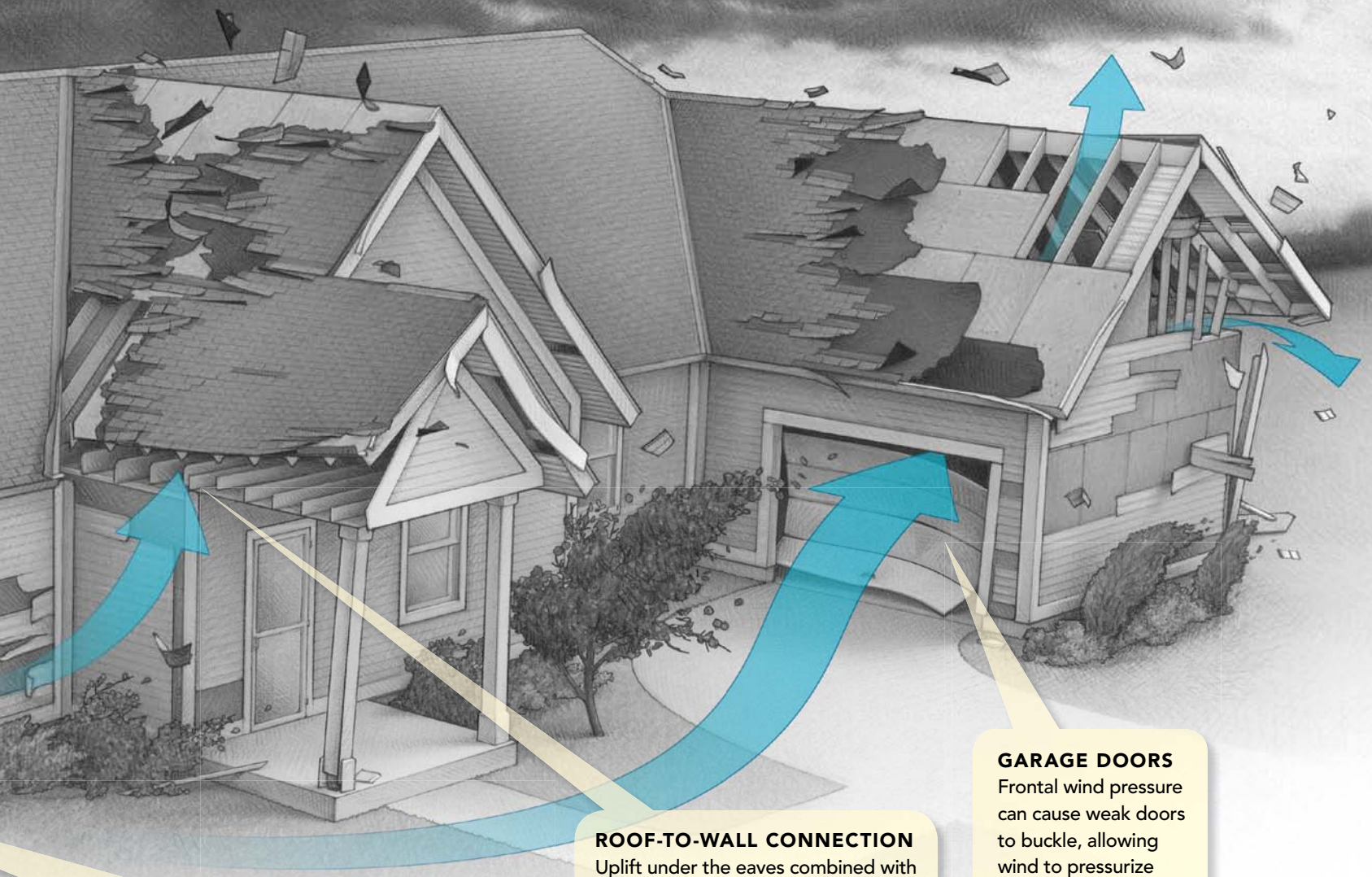
*Estimated speed of three-second gust. EF tornado scales are based on observed damage, not measured wind speeds. **Sustained measured wind speed

Drawing: Christopher Mills

vs. houses

DAMAGE CONTROL VS. SAFETY

A continuous load path in which all structural parts are tied together to resist wind loads is the best insurance against structural damage from hurricanes and weaker tornadoes (70% of tornadoes have wind speeds of 110 mph or less, the equivalent of a Cat 2 hurricane). To ensure personal safety in stronger tornadoes, however, experts agree that the only answer is a reinforced safe room or underground shelter.



WALL-TO-FOUNDATION CONNECTION

With inadequate anchoring, wind can force the sill plate off the foundation, resulting in collapse.

Prevention: Extend wood sheathing to sill plate; bolt sill plate to foundation.

ROOF-TO-WALL CONNECTION

Uplift under the eaves combined with negative pressure above the roof and internal pressure within (once the envelope is breached) undermines the roof-to-wall connection.

Prevention: Secure rafters/trusses to walls with metal connectors.

GARAGE DOORS

Frontal wind pressure can cause weak doors to buckle, allowing wind to pressurize the building envelope.

Prevention: Invest in wind-resistant doors with reinforced hardware.

Sources: Insurance Institute for Business & Home Safety; National Wind Institute, Texas Tech University