



TEXAS TECH UNIVERSITY
National Wind Institute

Debris Impact Facility™

Guidance for Wind Resistant Residential Design, Construction & Mitigation

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It should be understood that constructing a home to be tornado resistant is expensive and impractical. Homes can be constructed more wind resistant for better survivability in severe windstorms and low scale EF tornadoes. Life safety can be achieved by installing basements and below ground shelters or above ground shelters constructed to ICC-500 and FEMA Standards with tested doors and assemblies. Tested pre-fabricated shelters are also available from many manufacturers and are listed on the NWI DIF website.

Most tornados are in the EF-1 to EF-2 range, 86-135 mph range. Homes are required by International Residential Building Code (IRC) to be built to a design wind speed of 90 mph, using Allowable Stress Design; or 115 mph, using Load Resistant Factor Design. Both of these wind speeds are based upon 3-second wind gusts. Straight line design wind speeds differ from cyclonic debris laden winds. But, with good construction, good connectors, and maintaining the load path connected from the ridge of the roof to the foundation, a home can be constructed to be more wind resistant.

The Following Suggestions Will Improve Home Resistance To High Winds:

1. Hip roofs have better wind resistance than gable roofs.
2. Gabled roofs should be reinforced to prevent hinging of the gable at the wall line.
3. High wind rated shingles that are installed with the correct nailing pattern and doubled eave edges sealed are recommended.
4. Installation of asphalt and fiberglass shingles in freezing temperatures can prevent proper adhesion of shingle sealing strips.
5. Pay close attention to roof decking installation. Storm damage investigations have revealed that only about 50% of pneumatic nails properly engage the intended rafters or truss top chords.
6. Roofs framed with rafters should have straps that connect both rafters at the ridge line.
7. Rafters and trusses should be aligned with studs to allow strapping of the rafters/trusses to the studs.
8. When using metal plate connectors, all holes should be filled with the proper connector nail.



9. Do not shoot down or powder nail wall sill plates. Use anchor bolts as recommended by the IRC or commercially available mechanical or epoxy systems.
10. Fully sheath all outside walls using the recommended size and spacing of fasteners, per IRC.
11. In lieu of traditional stick framing, other wall systems such as structural insulating panels (SIP) or insulated concrete forms (ICF) can be very wind resistant. Follow manufacturer's recommendations when making connections to these systems.
12. Use adjustable brick ties that slip up and down and make sure they are installed per code. The old corrugated ties are seldom installed properly and do not provide wind resistance.
13. Select siding materials that have high wind and impact resistance rating. These systems must be installed per the manufacture's high wind nailing schedule.
14. Garage doors should be high wind/hurricane rated (130+ mph) and should be only single vehicle width.
15. Windows and glass doors should be double glazed and hurricane rated.
16. Masonry chimneys with flue tiles should be filled with mortared rubble or concrete and steel reinforcement. Chimney failure of veneered or sided chimneys is a frequent issue in high winds. Attention should be paid to installing them structurally connected, not just set on top of the roof sheathing.

How to Wind Mitigate an Existing Home

Mitigating an existing home can be challenging and more expensive than incorporating the mitigations into a new home. However, there are certain things that can be done when it is time to reroof the home or there is a desire to upgrade windows and doors. The items below reference the above list for new construction.

1. With the roof deck exposed or with an accessible attic, gabled roof ends can be reinforced, as indicated in No. 2.
2. Inspection of the underside of decking will reveal deck nails that have missed the rafters/trusses, as indicated in No. 5. This connection is easily accomplished prior to the installation of the new roofing underlayment.
3. Before reroofing, ridge rafter/truss ties can be installed, as indicated in No. 7.
4. Addressing comment No. 7, while the roof deck is still exposed, a portion of decking can be cut out along the roof eave, thereby exposing the rafter/joist or truss connection to the walls. This will allow the installation of clip angles equal to Simpson HL/HLG. These should be screwed in place, rather than nailed.

5. Before the installation of the new roof, check the installation of veneered or sided chimneys. Should the connections be poor or non-existent, the veneer and siding will have to be removed for installation of a structure that connects to the rafters/joists or truss system, per comment No. 15. Care should be taken in the proper installation of roof flashing around the chimney to prevent leaks.
6. After all the mitigations around the roof lines are completed, per comment No. 3, install high wind rated shingles that are installed with the correct nailing pattern and double eave edges sealed.
7. Regarding comment No.14, overhead garage doors are easily replaced at any time. Such a replacement should be a Hurricane Rated door (130+ mph).
8. Aging homes frequently need window and door replacement to improve thermal and weather intrusion. Per comment No. 15, double-pane insulated windows and doors hurricane rated windows are an easy install and will enhance overall building opening wind and impact resistance.

Other Sources Of Information And References Include The Following:

Shelters

- ICC-500-2014 - *ICC/NSSA Standard for the Design and Construction of Storm Shelters*
- FEMA P-320-2014 – *Taking Shelter from the Storm, Building a Safe Room for Your Home or Small Business*
- FEMA P-361-2015 – *Safe Rooms for Tornadoes and Hurricanes, Guidance for Community and Residential Safe Rooms*
- National Storm Shelter Association (NSSA)

Companies and Organizations

- Federal Alliance for Safe Homes (FLASH) <http://www.flash.org/>
- Fortified for Safer Living, <http://www.flash.org/>
- Insurance Institute for Business and Home Safety (IBHS), <https://disastersafety.org/>
- Resilience STAR, https://disastersafety.org/wp-content/uploads/RSTAR-Program_V7.pdf
- Simpson Strong-Tie, <https://www.strongtie.com/resources/literature/wood-construction-connectors-catalog>
- South Carolina Safe Home, <http://carolinahomesandinteriors.com/b/resources-for-the-home/sc-home-resources/sc-home-services/helping-carolinians-weather-the-storm-south-carolina/>