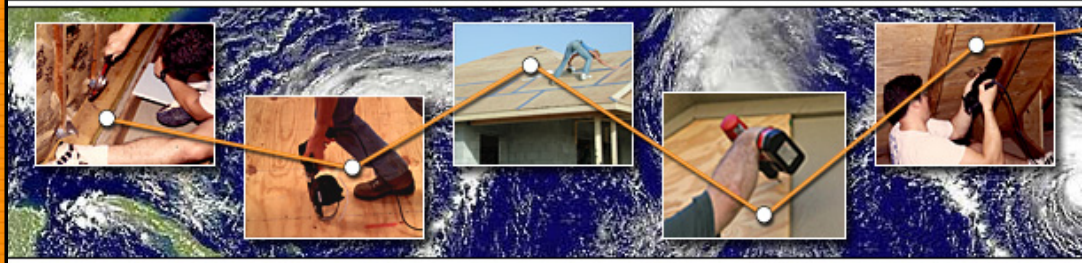


# Hurricane Retrofit Guide



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## Wood Frame Wall-to-Floor Connections

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### Important Characteristics of Well Anchored Wood Frame Walls:

Anchoring of the bottom of the wall to the foundations requires the uplift and lateral loads to be transferred into the bottom plate of the wall and from that plate into the foundation (slab on grade) or into the floor system and then into the foundation (elevated wood frame floor). The transfer of loads into the bottom plate can be accomplished either by the exterior sheathing if it is plywood or OSB or through straps between the studs and the bottom plate or a combination of the two methods. In areas where the 3-second gust design wind speed is greater than 120 mph, the latest high wind construction guides for slab on grade construction require straps embedded in the concrete and nailed to the bottom plate or the wall studs, or 5/8-inch diameter anchors bolts spaced at 18 inches or less. They also require 3-inch by 3-inch by 1/8-inch thick washers between the nuts and the bottom plate if anchor bolts are used. If you have a wood frame floor, anchor bolts don't work. Straps or other methods such as overlapping the sheathing have to be used to transfer loads from the wall to the band joists around the floor system and from the band joists into a sill plate which is anchored to the foundation. If you have framed floors, you will be well advised to seek professional help to come up with cost effective solutions.

Finally, laboratory testing and engineering analysis indicate that the ends of the walls should have large anchors called hold downs (sometimes threaded rods or cables are used that run the full height of the wall). Except for a few parts of the country, it is unlikely that you will find these if your house was built before 1995.

Homes built after the mid-1990's along the coasts of North Carolina and Florida, most of the coast of Texas, some parts of coastal South Carolina and a few coastal communities in Louisiana and Alabama should have well built and connected walls. This may be true for some older homes in these areas as well.

### Inspection of Wood Frame Wall Anchorage:

If you have a wood frame house with an un-finished garage or remove drywall from an exterior wall near one of the corners of the house or in the garage, you can get a pretty good idea about how well your walls are built and how well load paths are developed. Print out the [Wood Frame Wall Checklist](#) and use it to record observations about how your wood frame exterior walls are anchored to the floor or foundation. This checklist also includes some suggestions about the implications of what you find and what you might consider doing. The questions in the checklist assume slab on grade construction. For homes with wood frame elevated floors,

the exterior walls have to be connected by straps or sheathing to the rim joists (a band of wood members that frame around the edge of the wood frame floor system) and the rim joists have to be connected to the sill plate (pressure treated wood member lying flat on the top of the foundation wall and anchored to the foundation). You should be looking for anchor bolts that attach the sill plate to the foundation. Because the floor framing helps tie the system together, the anchor bolt spacing for the sill plate (below a wood frame floor) can be about twice the spacing indicated in the questions in the checklist.

Look at the connection of the wall studs to the bottom plate and the connection of the bottom plate to the foundation. The latest high wind anchorage uses 5/8" anchors with 3" by 3" washers that are at least 1/8" thick. Older installations used 1/2" anchors that were frequently shorter so that there was less embedment into the concrete and were frequently installed without a great attention to detail. The washers were frequently just regular round steel washers for 1/2" bolts. Recent tests have demonstrated the importance of the larger washers when winds approach design values.

### **Retrofit Suggestions for Wood Frame Wall Anchorage:**

If you decide to retrofit the wall to foundation connection, you will need access to the base of the wall studs and the bottom plate from either the inside or outside of the wall. If you have brick veneer, your only option is access from the inside of your home. The most cost effective time to do this retrofit is when you are undertaking a major renovation that calls for removing drywall, if you are replacing the siding on your home, or if you are rebuilding after flood or storm damage. The retrofit involves the following actions. Make sure the wall studs are adequately connected to the bottom plate of the wall framing and the bottom plate is anchored to the floor or foundation. If you have undamaged bottom plates and the wall sheathing is either replaced or is in good condition, you may be able to get much of the strength you need by improving the nailing of the sheathing. Metal clips are available at building supply stores that make it easy to strap the wall studs to the bottom plate. A palm nailer or a pneumatic nail gun that is designed to locate the nail holes in straps can be a good investment if you have a lot of straps to install. For slab on grade construction, install anchors by drilling holes through the existing bottom plate into the concrete slab or foundation. Place the holes as close to the center of the bottom plate as possible and space them every 16 to 18 inches along the exterior walls and within 12-inches of the ends of the walls. You can either use the new large anchor bolts with threads for screwing into concrete or you can install threaded rod anchors using epoxy grout. In either case, use 3-inch by 3-inch washers that are at least 1/8-inch thick. In many cases all these materials will be available at your local building supply store.



**Warning: If epoxy grout threaded rods are used, you will need to clean the holes after you drill them or the epoxy will not develop a good bond with the concrete. Carefully follow the epoxy manufacturer's instructions about how to clean the holes. It would be a shame to go to all of the effort to install rods only to have them perform at half of their potential.**

If you have an elevated wood frame floor, look at one of the high wind guides for wood frame construction to get ideas for properly attaching the walls to the floors and then the floor system to the foundation. If you have this condition you should seek the assistance of a design professional. High wind construction guides such as the Standard Building Code Congress guide SSTD 10, that was last published in 1999, or one of the series of High Wind Guides produced by the American Wood Council, that contain lots of good graphics, show proper construction methods for different wind speeds. SSTD 10 is available as a free download at [http://www.iccsafe.org/Store/Pages/Product.aspx?id=8744P99\\_PD-X-SS-P-1999-000001](http://www.iccsafe.org/Store/Pages/Product.aspx?id=8744P99_PD-X-SS-P-1999-000001). The wind speeds used in SSTD 10 are fastest-mile wind speeds, not the gust speeds used in this guide. You can add 20 mph to the speeds listed in SSTD 10 to convert to gust speeds. Consequently, the recommendations for 90 mph are for 110 mph gusts, 100 mph correlates to 120 mph and the highest wind speeds listed in the guide, 110 mph, convert to 130 mph gust speeds. The American Wood Council's high wind design guides are available for download at <http://www.awc.org/Standards/wfcm.html>.

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