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## Wind Resistance of Wood Frame Walls

Well designed and well built wood frame homes, built to the latest building code provisions performed very well structurally in the highest hurricane winds to strike the US since hurricane Andrew. That was Hurricane Charley in 2004 and it clearly demonstrated that both wood frame and masonry homes built to the latest codes did well, at least structurally. The key is to develop a continuous load path that transmits loads on the roof and walls down to the foundation. Key elements of this are keeping the roof structure intact and connected to the walls and the walls connected together and to the foundations.



**Despite losing some windows and suffering roof damage, this wood frame home stood up well to Hurricane Charley**

[\(click image for larger version\)](#)

**Roof to wall connections and what you can do to strengthen them:** The first thing you need to do is determine how your roof structure is attached to the walls. In older wood frame construction, the connection of roof trusses or rafters to walls is 2 or 3 sixteen penny (16d) nails driven at angles (toe nailed) through the rafter or truss into the top plate of the wall. In newer construction metal straps are added that anchor the trusses or rafters to the top plate and sometimes to the studs in the walls below. In early applications of straps, it was considered sufficient to use straps on every other truss or rafter. Today, every truss or rafter is anchored with a strap if the builder is following high wind construction guidelines. Click on [Wood Frame Roof-to-Wall Connection](#) for suggestions on ways to inspect assess and upgrade your roof to wall connections.

**Wood Frame Exterior Walls and what you can do to strengthen them:** To complete the development of an effective load path that connects the roof to the foundations, you need to make sure that the exterior walls are strong enough to withstand the wind forces and are well anchored to the foundation. Inadequate wall strength and poor connections between the wall and foundation can weaken your entire home. These vulnerabilities tend to show up when the highest winds of a major hurricane (Category 3 or higher) strikes your home. This is especially true if you live in a one-story

home with large roof truss or rafter spans and a low-sloped roof or a two story home. The walls that are most important to helping to hold the roof on are the exterior walls that the ends of rafters rest on. These walls can have a lot of uplift applied to them. The dead weight of these walls is only 5 to 10 pounds per square foot. So if a wall is 8' high its dead weight can only restrain 40 to 80 pounds of the hundreds of pounds of uplift that may be applied in a strong hurricane. This points to the necessity of tying the bottoms of wood frame walls to the floor below and ultimately to the foundation. Click on [Wood Frame Wall Checklist](#) for assistance in evaluating the condition of your wood frame walls and their anchorage.

In addition to transmitting (connecting) uplift loads on the roof down to the foundations, wall sheathing also is a major contributor in helping keep your house from being blown over or collapsing in a major hurricane. The important factors that affect the performance of the wall sheathing are the type of sheathing, how much of the wall is covered by wood sheathing, how well it is connected to the top plate, bottom plate and the wall studs, and whether joints between the sheets (if any) are blocked (covered by a 2x4 with the sheathing nailed to the 2x4). Another important factor is how well the wall is anchored to the foundation.

Anchoring of the bottom of the wall to the foundations requires the uplift 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 have to be used to transfer loads from the wall to the band joists around the floor system and from them 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 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.

### **More than one story?**

Two story houses have more wind stress applied to them than one story houses because they block the wind more and they stick up in the air to catch winds that are stronger than those on the ground. Further, the winds are stronger higher up because there is less around the upper floors to shield the wind. The following questions were developed with a one story house in mind. If you have a two or three story house you can still use the questions listed below, just check the roof to wall connections from the attic and the wall to foundation connections on the first floor. Generally, you will not have any way to assess the floor to floor connections unless you are re-siding your house. If you are re-siding your house or have it opened up because of some sort of repairs, you should find that either straps or continuous wood sheathing have been used to connect between wall studs on the floor above and below. If you don't find either of these to be true and really in any case if you have a two story house, you should get a design professional to help you decide how best to connect the floors before you install the new siding. Generally, if your roof structure is poorly connected to the walls of the top floor and the first floor walls are poorly connected to the foundations, you can be reasonably certain that the connections across the floors are also weak and that your home is more vulnerable than a comparable one story house to hurricane damage. If you don't have a lot of confidence in the strength of your multi-story house, do what you can for your roof, protect the window and doors, try to limit water intrusion and plan to evacuate early.

Click on [Wood Frame Wall Structure](#) to find out more details about inspecting your wood frame walls and what you can do to strengthen them. Click on [Wood Frame Wall Anchorage to Foundations](#) to find out more details about assessing your wall to foundation connection and what can be done to strengthen that connection.

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