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Features and Equipment

Features of your home including porch roofs, carports, screen enclosures that are attached to the house, awnings and canopies can be damaged by strong winds and frequently lead to damage to the main part of your house. Outdoor equipment such as air conditioner compressors, satellite dishes, solar water heater elements and other roof-top equipment can be blown off their pads or supports. Also remember that mobile homes, outbuildings, barns, fences, and storage sheds can fail. Both the parts of these structures and their contents can produce wind-borne debris that can break windows and sometimes tear openings into your house; letting in damaging rain and wind.

Porch Roofs:

Most porches and overhangs are poorly anchored and can get torn off the house, causing damage that extends well into the house. In many cases this has resulted in catastrophic damage to the house. The uplift forces on these wing-like roofs can be tremendous compared to the ability of their supporting posts, and especially the connections to the posts, to hold them down. Don't be deceived by seeing straps or other connectors. They are frequently undersized and should be checked for adequacy.

This porch on an older Florida house was closed in to make an extra room. Note that the roof was just resting on the brick column with no anchor to hold the roof down.
(click image for larger version)

Inspecting your Porch Roof Connection: The connections between the roof structure and the top of the columns and between the bottoms of the columns and the floor and/or foundation are the areas where you need to focus your attention. To keep the porch roof from being lifted off, the forces trying to lift

the roof off have to be resisted by the weight of the roof and forces developed in the columns that pull down on the roof. The weight of the roof is usually 10 pounds per square foot or less while the uplift forces may be 32 to 59 pounds per square foot. Toe-nails through the roof structure into the tops of the columns won't come close to providing enough restraint. A pin or small bracket designed to keep the bottom of the column from being knocked loose will not do much to hold down the bottom of the column either. In some cases, you may find a hurricane clip connecting the roof structure to the top of the column and another small strap at the bottom. In a few cases you may find a heavier metal strap or even a threaded rod that runs through the middle of the column. These heavier anchors are closer to being what you really need to hold down the porch roof in a strong wind.

The roof over this porch lifted off and opened up the main roof and the house to the fury of the storm
(click image for larger version)

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- [ ] There is no visible connection or only nails attaching the roof structure to the columns.
- [ ] There is no visible connection or only nails attaching the columns to the floor system or foundation.
- [ ] Thin metal straps with 4 to 5 nails on each side are used to connect the roof structure to the column.
- [ ] Thin metal straps with 4 to 5 nails on each side are used to connect the column to the floor system or foundation.
- [ ] There is a heavy metal strap at least 1" wide and 1/8" thick connecting the roof structure to the column with at least 4 nails or screws.
- [ ] There is a heavy metal strap at least 1" wide and 1/8" thick connecting the column to the floor system or foundation. The strap is either embedded in the foundation or floor slab or connects to a wood floor system with at least 4 nails or screws.
- [ ] There is a threaded rod going up through the column with a steel plate and large nut that is holding down the roof structure and the rod is anchored into the foundation or floor slab.

Rough Estimates of Uplift Forces: You can estimate the uplift forces on the support columns by using the Column Uplift Worksheet.

Anchoring the Roof: If you do find metal straps or rods connecting the roof to the columns and the columns to the foundations you can look them up at the Simpson StrongTie website or the USP website. The small straps are generally able to carry about 400 pounds each, the larger straps 800 to 900 pounds and the threaded rods several thousand pounds if they are adequately anchored.

This column is held down by two rusty tech screws
(click image for larger version)

Retrofit Options: If you need to strengthen the connection, you will need to check the size of the slab or foundation where the column can be anchored. In most cases you can find hardware that can be used fairly easily but in some cases you may have to be creative.

Carports:

Carports are usually designed for 23% lower loads than your house because the building code does not consider them critical from a life safety point of view. In other words, no one expects people to try to ride out a hurricane in a carport. Furthermore, connections and anchorage of the roof panels as well as the supporting columns is frequently poor and bracing may be non-existent. Post storm damage investigations do suggest that there are a couple of retrofits that may make a difference in keeping a typical carport intact; at least up to a point. To be really wind resistant, you would probably have to rebuild most of the carport.

Metal panels on carport roofs frequently break loose in strong winds
(click image for larger version)

Design and Construction: Some carports are anchored to the fascia board at the eave of the house. Unless this board has been well connected to the roof structure, it will probably pull loose if the carport roof applies much in the way of forces to the fascia board. If the carport is free standing and some distance from the house, the wind will tend to blow through it and the uplift loads on the roof will be lower than if one side is blocked by a wall or the house. Ironically, connecting the carport to the house can significantly increase the uplift forces on the roof of the carport for winds blowing towards the side of the house where the carport is attached. For these wind directions, pressure tends to builds up on the wall of the house and on the bottom side of the carport roof. Most carports maintain a very

open look with relatively slender columns and almost no bracing to keep the columns from bending over as the wind pushes on the edge of the roof. If the carport has a low profile, these forces will usually be relatively small and lateral forces on the roof are not a big design factor. However, all of that can change dramatically if the roof deck begins to lift up and catch the wind.

This cast aluminum insert once held a carport column in place - Imagine trying to hold down hundreds of pounds of uplift with the one tech screw on the left side

(click image for larger version)

Retrofit Options: Probably the most important thing is to try and keep the roof decking attached to the frame of the carport. This will minimize the lateral forces on the roof. Improving the anchorage of the roof deck can be as simple as adding additional fasteners to anchor the deck to the framing. This is easy to do if the roof deck is made up of metal panels or insulated metal panels; just install another set of the same fasteners in between the existing fasteners. If you have a wood roof deck, check out the options for strengthening the roof deck attachment when you re-roof in What To Do When Re-Roofing or if it will be some time before you re-roof, check out Enhancing Roof Sheathing Attachment Strength.

Second, check out the anchorage of the columns supporting the roof of the carport. This has frequently been a weak link in the system. You can use the porch column uplift worksheet to get an idea of how high the forces may be on the columns. You may be able to add angle brackets that will help anchor the columns to the concrete slab.

Aluminum Screen Enclosures:

This used to be a nice screen pool enclosure before the hurricane blew through

(click image for larger version)

Aluminum screen pool enclosures have become quite popular in Florida. Unfortunately, they are often poorly designed to resist wind loads, and inadequately anchored, braced and connected. They are often the first structures to be blown down and then blow into your house and possibly your neighbor's. While it would take almost rebuilding these structures to make them really wind resistant, there are some things that can be done at relatively low expense that will make a difference; up to a point. Unfortunately, when winds get high enough and the members have not been designed adequately, the long slender members will buckle and the structure will crumple.

Diagonal cable braces should be installed as close as possible to the columns to avoid buckling the members

(click image for larger version)

When the wind blows from right to left, this cable will be pulled tight trying to keep the screen enclosure from blowing over. It will pull down on the top member. At the same time, the wind forces on the screen face to the right will apply a lot of compressive forces to the top member and it will likely buckle from a combination of the compression and the bending caused by the pull of the cable. Some manufacturers make triangular brackets that are screwed onto the corner and allow the cable to be attached directly in line with the corner.

(click image for larger version)

Design: The building code tends to focus on life safety issues. Since no one is expected to try and ride out a hurricane in a screen enclosure, the code allows designers to design these structures for 23% lower forces than are required for your house. In addition, a number of the assumptions and procedures that have been widely used in the design of these structures have also contributed to create structures that will frequently blow down at relatively low wind speeds. These design assumptions and calculation procedures are changing and the industry is working to produce stronger structures. However, this is little consolation for owners of many of the existing structures.

Typical anchorage of corner column in older screen enclosures - this is a very weak connection for resisting either uplift or bending

(click image for larger version)

Retrofit Options: Reviews of enclosure failures suggest that the simplest retrofits that may do some good include improving the anchorage of the columns to the concrete deck and installing additional diagonal bracing. In a lot of cases, the screws begin to rust almost immediately and

loose considerable strength.
Replacing rusted screws with slightly larger stainless steel screws is another way to try and get the most out of the structure you have in your existing screen enclosure.

Storage Sheds:

Storage sheds pose a real threat by contributing wind borne debris to a neighborhood because, typically, they are not built to the same standards as regular buildings. Further they usually have a large doorway that consumes nearly all of the face of one of the walls. This means that one wall has almost no strength to resist wind and that same wall can allow air to flow into the building. In addition sheds are usually not well anchored to the ground or a foundation.

Storage shed blown apart by Hurricane Charley - note the tools still hanging on what is left of the wall
(click image for larger version)

Forces on a shed: The horizontal force applied by a 130 mph wind to a shed that is 8' wide by 8' high is about 2,100 pounds. That is the weight of a small sports car.

Inspecting your shed: Is it strong enough? The answer to the question is your shed strong enough is easy, because most likely the answer is a resounding `No!'. It would be an exception if it were strong enough.

- [ ] Can you push on any corner of the shed and make it wiggle? Try all four corners pushing in both directions.
- [ ] Can you lift a corner of the building up off the ground, even a little bit? Answer this question assuming the building has no contents to weight it down.
- [ ] Is the shed rated, designed and properly anchored for the wind zone where it is located?

The answers to these questions will most likely lead you to know that something has to be done. The question is what.

For most metal sheds adding strength to the building itself would mean essentially starting over again. However anchoring the building to a concrete slab would help it act more like a structural box. If a slab is not an option, one could install screw anchors into the ground near the corners and use ratchet straps criss-crossed over the top and pulled tight to anchor the shed to the ground. Tying the straps off with a rope that is wrapped around the building at mid-height would help create a net-like system for restraining the shed and would help hold the door shut.

If you have a plastic shed, attaching it to a concrete slab or installing four

screw anchors in the ground and strapping the shed down as described above may be the only realistic options for trying to keep the shed from flying around in the storm.

If you have a pretty well made wood shed, then you can do two things to help it survive. Anchoring it to the ground would make a big difference especially it is anchored to a concrete slab. A good connection to a slab would help hold the building down and help it act more as structural box. You can strengthen the building itself much like one would a house by the use of metal straps. If a slab is not an option, using screw anchors and strapping it down may be the only other option.

Anchoring Outdoor Equipment:

A couple of angle brackets could have kept this compressor in place
(click image for larger version)

It would be nice to attach the equipment to the shelf
(click image for larger version)

Equipment outdoors or in a carport such as air conditioning compressors, water conditioners, water heaters, pool equipment, washing machines, and the like may well get blown around in a hurricane. While they may not get blown very far, it may be far enough to cause a lot of damage to the equipment. Damage, to electrical hookup and condenser lines, that can be hard to get repaired after a hurricane. People who have had their air conditioners damaged and had to wait first for restoration of electricity and then for a repairman in mid summer heat can testify you don't want this to happen to you. Luckily it is easy to anchor such equipment. Some manufacturers make kits for anchoring their equipment. If not, you may be able to make your own and use the manufacturers own cover screw attachment points to anchor the equipment. All it may take is a few right angle brackets to connect the equipment to a concrete slab, a wood porch, or a wall. There need to be enough brackets to resist wind forces from all directions.

If you plan it right, you may be able to use the screws from the cover to attach an angle bracket to the equipment.
(click image for larger version)

In some cases you can use a standard small bracket and anchor the bottom pan of the compressor
(click image for larger version)

Chimneys:

This owner was fortunate that the chimney just leaned over and did not crash down and penetrate the roof
(click image for larger version)

We tend to forget about how much chimneys expose our houses to damage. Because chimneys stick up in the air they are particularly vulnerable to wind. Adding to their vulnerability is the fact that they stick up above the roof where the wind can pickup speed as it whips around and over the house. Unfortunately, they frequently are simply not built well enough to resist hurricane winds. Chimney types include those that are factory made of galvanized or stainless steel sheet metal piping (frequently encased in a sheathed wood frame with vinyl siding and those made at the site using wood framing, masonry (concrete blocks), or stone. Chimneys are made for different purposes, some to exhaust combustion fumes from a gas water heater or gas fireplace, some conventional chimneys for wood burning fireplaces, and some are simply decorative. Sizes can range from 4" diameter galvanized pipe that may stick up beyond the roof 3' to much more massive and decorative chimneys. On frame houses fireplace chimneys tend to be about 2' by 4' wide and stick up at least 3', and some much more than that height. The two things you want to consider when evaluating your chimney are:

- Can it survive the wind forces?
- Will it let water into the house?

The wind forces acting on chimneys are much greater than one might think. A site built fireplace chimney 2' wide by 4' wide extending up 4' above the roof will present a face to the wind that can be subject to a force of over 700 pounds in a 150 mph wind. Imagine having three 230 lb men hanging from the tip of the chimney, with the chimney turned

sideways.

Inspecting your metal chimney: Is it strong enough?

[ ] By pushing on the chimney can you cause it to wiggle? This is somewhat subjective, but if you can cause it to wiggle (not simply just budge), then hurricane winds will beat on the chimney and loosen it. Push or pull from all four sides.

[ ] Are screws that hold sections of pipe missing or severely rusted?

[ ] If the chimney has guy wires or struts to help support it, are they in good condition? Are they rusted?

If you find any of the above conditions or others that cause you concern, then you probably need to call a professional to make repairs. If the metal chimney is for a gas appliance such as water heater, then call the gas company. If the metal chimney is for a metal fireplace, then call the local representative for the manufacturer of your fireplace. You can probably find a label that indicates the manufacturer of the fireplace on the face of the fireplace just behind the doors or behind the spark arresting screen. The reason for calling the local representative for the fireplace is to potentially save a service call because some fireplace manufacturers have their own specially sized chimney pipes.

Chimney cap
(click image for larger version)

Spark arrestor
(click image for larger version)

Inspecting your wood framed chimney: Is it strong enough?

[ ] By pushing on the chimney can you cause it to wiggle? This is somewhat subjective, but if you can cause it to wiggle (not just budge), then hurricane winds will beat on the chimney and loosen it. Push or pull from all four sides.

[ ] Does there appear to be water damage to wood to such an extent that nails cannot do their job to hold the structure and siding together?

[ ] Has the plywood siding delaminated to such an extent that its ability to provide rigidity is compromised?

[ ] Have decorative boards deteriorated because of exposure to rain and sunlight to the point where they are not effective at holding the wood underneath them together?

[ ] Does the shroud have secure nails at least every 12" to hold it to the framing? By secure we mean; are the nails snug and not apt to fall out?

[ ] Are the nails that hold the shroud at least 2 1/2" long?

[ ] Are nails driven into good solid (undeteriorated) wood? If nails have pulled out replacing them with long screws of slightly larger diameter should solve that problem forever.

[ ] Is the wood that the shroud is nailed to well secured to the rest of chimney structure?

[ ] Is the shroud rusted to the point that it structural integrity should be questioned?

[ ] Can you tell what the chimney uses for sheathing? Is it plywood, OSB, or Thermoply type sheathing as a structural member?

How to make your framed chimney stronger: It is essential that a chimney be well anchored to a roof because if it gets blown off or over it can leave a huge hole in your roof to let wind and water enter your home.

This chimney box was only attached with a couple of toe-nails near the roof

(click image for larger version)

There are three possible ways to get at the framing to strengthen a framed chimney. One possible way is from the attic, but this will depend on where the chimney is located. If it is on the eave side of the house it is likely that the attic space is so limited that access is not practical. But if access is practical then straps can be run from the vertical framing members of the chimney down to the rafters or trusses. A strap should be run down from every corner of the chimney box and from each intermediate stud. There might not be rafter or truss members where these corners or studs are located. If that is the case, the way to provide anchorage for the chimney is to add framing members in the attic that will provide good tie down locations for the straps. To be effective straps should be tight so that the structure cannot start moving in response to the wind and begin to shake apart. In addition to strapping the framing there are likely nails that the original carpenters used to hold the framing to the roof sheathing. These nails could be clinched where they protrude through the bottom face of the sheathing. However, this will be only as strong as

the sheathing which in this application is not terribly strong.

To further strengthen the attachment of a plywood chimney box, one could add deadwood (e.g. 2x4's flat) between rafters or trusses that would be held in place by nails or screws through the sides of rafters or trusses. Then lag bolts could be screwed vertically up through the deadwood and into the bottom plates of the fireplace chimney box.

Another possible way to get at framing is to disassemble part of one face of the chimney by removing some trim boards and either all or part of a piece of plywood siding. Once the access is made you may be able to worm enough of your body in to attach straps as suggest above.

The third possible way is to remove the shroud. Removing the shroud should be easy to do, but still probably won't give you good bodily access. However, it will give you a way to feed coil strap material from above down into the attic where it can be fastened to framing members that may be some distance from the chimney (this may be needed because of limited attic access). Unless straps are very tight, they are not likely to be effective because any movement facilitates vibration that can pull nails and ultimately lead to failure. By feeding strap material from the top the strap will of necessity be long. A way to minimize this disadvantage is once the straps have been nailed at each end they can be tightened by adding blocking, more nails or similar methods to get the straps tight. At least one strap needs to be installed for each of the four faces of a chimney box.

If you are concerned about a chimney but simply can't get adequate access to make it stronger, then you need to have a remodeling contractor evaluate the situation. Another possibility is to add guy wires or struts to a chimney. Guy wires would have to be added so that support was provided in all directions. Struts tend to be unsightly, but they can be effective. However, both guy wires and struts could probably be made in such a way that they could be deployed just before a hurricane.

Inspecting your masonry chimney: Is it strong enough?

- [ ] Are there cracks between concrete block that are wide enough to cause concern that settling has taken place to such an extent that the mortar between blocks are so weakened that a strong vibrating wind might cause the chimney to come apart? Bear in mind the forces that are applied, 700 pounds to just a 4' by 4' section in a 150 mph wind. A masonry fireplace may have much more surface area exposed to wind depending on the design.
- [ ] Does the shroud have secure screws at least every 12" to hold it to the block or concrete? By secure we mean screws that are snug and not apt to fall out. Screws installed in concrete blocks can easily work their way loose.
- [ ] Is the shroud rusted to the point that it structural integrity should be questioned?

How to make your masonry chimney stronger: If your masonry chimney is falling apart, you should get a mason to evaluate it and help you decide what to do. If it has a single crack line or weak area, you may be able to brace it with a splint made from steel or aluminum angles at the corners that is fastened together with metal bands that wrap around the chimney. These angles could be used as attachment points for guy wires to brace the chimney from all directions.

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Questions