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Investigating the Roof-to-Wall Connection:

Inspection:

In your attic, use a flashlight to look at the connection between the trusses or rafters and the outside walls of the house. Try to determine whether you can see any indication of metal straps. Don't be confused by metal plates that rest on the top of the wall under trusses and rafters that were used in older construction to separate the wood from the concrete. If you see straps, check to see whether they are on every connection or every other connection. Look for the following:

Roof-to-Wall Connection Checklist

1. Is there any sign of a metal strap connecting the roof rafters or trusses to the wood plate or directly to the top of the wall?
 Yes
 No
2. If there are straps, are they installed at the end of every truss or rafter or to the end of every other truss or rafter?
 Yes - Every Truss/Rafter
 No - Every Other Truss/Rafter
3. Are nails installed in every hole in the strap?
 Yes
 No
4. Do the straps wrap over the top of the rafters?
 Yes - I have trusses or the straps wrap over rafters
 No - I have rafters and the straps do not wrap over the top of the rafters.

Assessment:

If you answered "No" to question 1, your home is a candidate for installing hurricane straps. The least expensive thing you can do (as a start) that will reduce your risk of loss of the roof is to protect all large windows and doors because this will reduce the chance that wind forces will also be pushing up and out from the inside of your house. You should make sure that your garage door is protected or replaced with an appropriate wind rated one if you don't already have one. Protecting your windows and doors could mean the difference between the home keeping its roof on or losing it when the winds climb above category 1 strength. You should definitely plan on evacuating if a category 2 or above storm is threatening your area, even if you protect the windows. You may want to consider adding straps as described below, if it can be done inexpensively and you have a bond beam at the top of the wall. A bond/ tie beam is a beam at the top of a wall made by having concrete and ideally steel reinforcing placed into the top row of concrete blocks. It may be that the tie beam was made by pouring concrete into forms at the top of the wall thus not using blocks for the beam.

If the answers to all of the questions are "Yes", your roof is reasonably well strapped to the walls and you should concentrate on other areas of vulnerability, including determining the amount of reinforcing in the walls as outlined below.

If the answer to question 1 is "Yes" but the answers to either the 2nd or 3rd question is "No", you may want to consider additional work on connecting the roof to the walls if it can be done inexpensively. Retrofitting the roof to wall connection is particularly important if your roof has a fairly low slope, the home is more than about 30 feet wide, you have open areas around your house, and you live in an area where the 3-second gust design wind speed is greater than or equal to 120 mph. Again, the least expensive thing you can do (as a start) that will reduce your risk of loss of the roof is to protect all large windows and doors because this will reduce the chance that wind forces will also be pushing up and out from the inside of your house. You should make sure that your garage door is protected or replaced with an appropriate wind rated one if you don't already have one. Protecting your windows and doors could mean the difference between the home keeping its roof on or losing it when the winds climb above category 2 strength. You should definitely plan on evacuating if a category 3 or above storm is threatening your area, even if you protect the windows. You may want to consider adding straps as described below, if it can be done inexpensively and you have a bond or tie beam at the top of the wall.

Investigating the Reinforcing of your Block Walls - Vertical Steel and Concrete Filled Cells:**Background and Suggestions:**

If you have a concrete masonry block home there are a couple of techniques for determining how well the exterior walls are reinforced and anchored to the foundation. If you have installed permanent anchors for shutter on your windows and found that the blocks on both sides of your windows are hollow, you probably have un-reinforced or at least under-reinforced walls and some additional checks would be a good idea. In addition, just because a few holes you made indicated solid concrete does not mean that the blocks are necessarily reinforced with steel and concrete. It is possible that you hit a concrete partition within the concrete

block. Some blocks have two cells so they have one interior partition of block that goes from front to back of the block while some blocks have three cells and have 2 partitions. Because concrete blocks are easier to drill into than solid concrete, you may be able to distinguish between the partitions of a block and solid concrete simply by how hard your drill has to work. Un- or under-reinforced means that the cells of blocks did not have steel placed in them and were not poured with concrete at corners and beside each door and window. If you have not installed permanent anchors for shutters, you can use a small masonry bit and drill holes in the wall on both sides of the window opening, in an inconspicuous location about 3-inches outside the line formed by the vertical edges of the window. In newer wind resistant construction, you should find solid concrete on one side or the other of the window. If you find hollow blocks on both sides, you probably have un-reinforced or at least under-reinforced walls and additional checks would be a good idea. You can patch your little exploratory holes using a little dab of exterior caulk after you have blown off the concrete dust.

There are some stud finders with metal detection that are capable of determining the location of reinforcing bars in masonry walls. Typically they have a "deep penetrating" metal detector option. Be sure to follow the manufacturer's instructions for calibration when you turn them on. These metal detectors can be used to conduct additional checks to determine how well your masonry walls are reinforced and anchored to the foundations. The checks outlined below are intended to help you make this determination. In older masonry homes, conventional practice was to grout "J" bolts into the top of the walls and anchor a wood plate to these "J" bolts. The trusses or rafters are then connected to this wood plate. In these walls, there may not be any reinforcing steel installed that runs from the top of the wall to the foundation. In some cases, the top blocks in the wall have a "U" shaped cutout and reinforcing steel is laid in that "U" shaped cradle and the top blocks are filled with concrete to form a bond beam at the top of the wall. In some cases, a header beam (also known as a lintel) installed above the window and door opening is the only part that is reinforced and no reinforcing is installed along the remainder of the top of the wall. To determine how well your wall is reinforced, use the deep penetrating metal detector setting on the stud finder / metal detector to search steel in your walls. Some of the better metal detectors will also indicate if both metal and electricity are detected. Consequently, be careful that you don't pick up a false positive from an electrical cable. Also don't be confused when using a metal detector near metal from window frames or downspouts. Make an effort to distinguish between steel in the wall and other indications by trying to track the indication.

Inspection:

Begin your search for reinforcing by checking for steel at the outside corners of the house. Go to an outside corner of your house and with the stud finder / metal detector in deep penetrate mode and placed against the wall about head high at the corner, move the stud finder sideways across the wall away from the corner. Repeat this on the other face of the corner. If you detect metal, move the stud finder vertically along a line that passes through the point where you detected the metal to make sure that the metal runs from the top of the wall to the bottom. Note the



Video: Checking for rebar
(click image to view video)

Note the

results on the checklist below. Then check along the top of the walls to determine if there is reinforcing steel running along the top of the wall. Note: if the block wall extends one or more block heights above the soffit panels, you will not be able to check for this from the outside of your house without removing the soffit where you want to make a test . If you do remove soffit do not be confused by the metal detector finding aluminum parts of the soffit system. Next, move the metal detector horizontally along the outside wall of the house, sliding it along over a long stretch of wall without openings to see if reinforcing bars are found. Determine the distance between the reinforcing, if any is detected, and note the results in the checklist below. Finally, check the location of anchor bolts or straps embedded in the masonry wall from the attic and estimate the distance of one of these from a corner of the house. Then go to that location on the outside of the wall and from a ladder determine how far down into the wall the metal is indicated. Most "J" hooks are about 16 -inches long and will engage the top couple of blocks when they are grouted into the top of the wall. If you get an indication of metal running all the way down through the wall, then it is likely that the cell below the "J" hook contains reinforcing steel and that these cells have hopefully been fully grouted throughout the height of the wall. Note the results on the checklist.

What you want to find is steel in the top row of blocks, steel coming down the wall at least at corners and openings for doors and windows over 5' wide, and steel going down to the foundation. Older homes may have very little or no vertical reinforcing. The evolution of vertical reinforcing in masonry walls is from no vertical steel; to the use of steel in the outside corners; to adding steel at one or both sides of wide openings such as sliding glass doors or garage doors; to steel at one side of even more openings and occasionally interspersed along long walls; to today's standards of steel at every opening and regular spacing on all exterior walls.

Masonry Wall Reinforcing Checklist - Vertical Steel and Concrete Filled Cells

1. Is there a solid grouted cell on either side of the window or door openings?

Yes

No

2. Were you able to detect reinforcing steel near the outside corners of the house?

Yes

No

3. Is there reinforcing steel indicated along the top of the wall (indications of a reinforced bond beam)?

Yes

No

4. Is there vertical reinforcing in the wall of the house? If so, what is the typical spacing between the reinforcing and does it run the full height of the wall?

Yes No Vertical Reinforcing

Yes No Spacing less than or equal to 8-feet

Yes No Full height reinforcing?



Assessment:

If you answered "no" to all of these questions, you have un-reinforced masonry walls and, if your home faces a large open area or the water or your house is 30' or wider, your home may be at risk of wall collapse or losing its roof in a Category 2 or stronger hurricane. The least expensive thing you can do to reduce your risk of wall damage or loss of the roof is to protect all large windows and doors. You should make sure that your garage door is protected or replaced with an appropriate wind rated one if you don't already have one. Protecting your windows and doors could mean the difference between the home keeping its roof on or losing it when the winds climb above category 1 strength. You should definitely plan on evacuating if a category 2 or above storm is threatening your area, even if you protect the windows. You may want to consider adding reinforcing as described in the following sub-section when you undertake a major re-modeling job. If you decide to try and reinforce your walls, you should get a design professional to help you find the best solution for your house.

If you answered "Yes" to all these questions, you have reinforced masonry walls and you do not need to worry about retrofitting your walls. Just to be clear that you found steel at the top of wall and down the full height of the walls at the corners and at wide openings.

If you answered "yes" to some but "no" to other questions, you probably have under-reinforced masonry walls. You should put a high priority on protecting all large windows and doors, including garage doors. You may also want to consider adding reinforcing as described in the following sub-section when you undertake a major re-modeling job. If you decide to try and reinforce your walls, you should get a design professional to help you find the best solution for your house.

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