

Hurricane Retrofit Guide



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Roofs

Roof-to-Wall Connections for Masonry Houses

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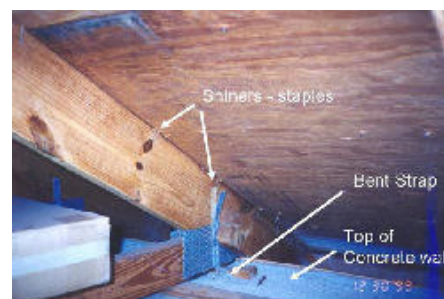
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Roof to Wall Connections: In houses with masonry walls, it is common to find a flat wise 2x8 lumber plate that is bolted or strapped to the top of the masonry wall. The trusses or rafters are then connected to this plate using toe nails and, in wind resistant construction, metal straps. In newer wind resistant masonry construction, the plate may be missing and the straps may be embedded directly into the top of the concrete wall (in a bond or tie beam) and the trusses and rafters will be set directly on the walls with a metal plate or some other sort of moisture barrier between the top of the wall and the wood. 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.



Despite the fact that the photo indicates every truss is strapped, this strap between the top of a masonry wall and the truss is a demonstration of a poor installation. Straps should never be bent sideways before attaching to the truss or rafter. This roof can be lifted up a couple of inches before the strap really becomes effective in holding the roof down. Loose connections allow movement that makes it easier for varying wind loads to tear apart the connection. Also note that the shiners indicate that the sheathing was stapled on.

(click image for larger version)

Strengthening the Roof-to-Wall Connections for Masonry Wall Houses:

There are several ways to gain access to the roof-to-wall connections in masonry houses. First, it may be possible to gain access through the eave area (which may be exposed or through the soffit which is the flat surface at the eaves that forms a sort of ceiling where the roof overhangs the exterior wall). Second, there is an opportunity to gain access to this connection when the house is being re-roofed. Finally, access can be gained by removing wall and ceiling material along the outside walls.

Wind uplift forces on your roof tend to be highest at the ends and corners of your roof and are higher for gable ends than for hip roof ends. Consequently, the most important areas for retrofitting roof-to-wall connections are the 6- to 8-feet of the outside walls, measured back from

an exterior corner of the house, where the trusses or rafters actually connect with the exterior wall. Similarly, retrofitting roof-to-wall connections at gable ends are more important than retrofitting roof-to-wall connections where you have a hip roof end.

Access from the soffit areas: It may be possible to gain access to the roof-to-wall connection by removing the soffit panels. The rafters or trusses can then be strapped either to the wood plate on the top of the wall (if there is one and it is well anchored to the wall with anchor bolts) or directly to the top of the wall if there is a bond/tie beam along the top of the wall. If you have rafters, select a strap that will wrap over the top of the rafter or extend high enough so that the top nail is within one inch of the top of the rafter. If you connect directly to the bond/tie beam at the top of the wall, use a strap that has larger holes in the part that goes over the wall and use masonry screws (Tapcon® or another masonry screw) to make the connection. Use ¼" diameter masonry screws because they provide much more strength than the 3/16" ones. Also be sure to use the masonry bit that comes with the screws or is purchased separately. The hole size is essential to the effectiveness of these screws. A hammer drill will make drilling the holes easier, but really is not a necessary tool for drilling holes in concrete blocks. Install the screws so that they are screwed into the side of the wall and so that most of the screws are a couple of inches below the top edge of the block wall. A way to make the masonry screw installation easier is to use a battery powered drill to drive the screws into the pre-drilled holes. If you are using a hammer drill, switch off the hammer drill option. The battery powered drill will give you a better feel for how hard it is to drive the screw than a corded drill. This may help you avoid stripping the threads or twisting off the head of the screw.

Other approaches that can be used when rafter tails are exposed and there are no soffits, are to leave connectors exposed, but somewhat hidden by paint or to hide straps behind a frieze board on the outside wall. In some circumstance one might get away with using pre-finished boards like synthetic trim boards. Alternatively one could paint frieze boards a trim color (i.e. a contrasting color to the walls) in order to minimize painting the rest of the wall.

Access from the roof: When your house is being re-roofed, there is a great opportunity to retrofit the roof-to-wall connection with minimal additional cost. The approach is to remove roof sheathing at the eaves in areas where you want to reinforce the connections. Then from the top, right angle gusset brackets (such as Simpson or USP HGAM) can be installed that are screwed into the truss or rafter and anchored to the wall below using masonry screws that are long enough to extend a couple of inches into the bond beam at the top of the wall. If there is a wood top plate, the rafters or trusses can be strapped to the top plate and the top plate to wall connection can be reinforced using masonry screws with washers. The following specific guidelines were developed for the Florida Building Commission to support a mandate by the State Legislature that requires houses valued at more than \$300,000 to include some roof-to-wall retrofits as part of a re-roofing project.

Prescriptive method for gable roofs on a masonry wall: *Unless it is possible*

to verify through non-destructive inspection or from plans prepared by a design professional that the roof structure is anchored at least as well as outlined below, access shall be provided to a minimum of 6-feet of framing members, measured from the corner, along the exterior wall on each side of each gable end. Wherever a strap is missing or an existing strap has fewer than four fasteners on each end, approved straps, ties or right angle brackets with a minimum uplift capacity of 500 lbs shall be installed that connect each rafter or truss to the top plate below or directly to the masonry wall using approved masonry screws that will provide at least a 2-1/2 inch embedment into the concrete or masonry. When the straps or right angle brackets are attached to a wood sill plate, the sill plate shall be anchored to the concrete masonry wall below. This anchorage shall be accomplished by installing 1/4-inch diameter masonry screws (each with a supplementary 1/4-inch washer) having sufficient length to develop a 2-1/2 inch embedment into the concrete and masonry. These screws shall be installed within 4-inches of the truss or rafter on both sides of each interior rafter or truss and on the accessible wall side of the gable end truss or rafter.

Prescriptive method for hip roofs on a masonry wall: Unless it is possible to verify through non-destructive inspection or from plans prepared by a design professional that the roof structure is anchored at least as well as outlined below, access shall be provided at a minimum to the hip rafter, to the hip girder and to one rafter/truss on each side of the hip girder at each corner of the hip roof. The hip rafter, the hip girder and the rafters/trusses adjacent to the hip girder that are not anchored with a strap having at least four fasteners on each end, shall be connected to the concrete masonry wall below using approved straps or right angle gusset brackets with a minimum uplift capacity of 500 lbs. Adding fasteners to existing straps shall be allowed in lieu of adding a new strap provided the strap is manufactured to accommodate at least 4 fasteners at each end. The straps or right angle gusset brackets shall be installed such that they connect each rafter or truss to the top plate below or directly to the masonry wall using approved masonry screws that will provide at least a 2-1/2 inch embedment into the concrete or masonry. When the straps or right angle gusset brackets are attached to a wood sill plate, the sill plate shall be anchored to the concrete masonry wall below. This anchorage shall be accomplished by installing 1/4-inch diameter masonry screws (each with supplementary 1/4-inch washer) with sufficient length to develop a 2-1/2 inch embedment into the concrete and masonry. These screws shall be installed within 4-inches of the truss or rafter on both sides of each interior rafter or truss and on the accessible wall side of the gable end truss or rafter.

From inside your house: You can also gain access to the roof to wall connection from the inside of your home if you are willing to remove wallboard and ceiling material along the outside walls. The picture shown below is from a retrofit project where the roof to wall connections were retrofitted from the inside of the house.



Example of a roof-to-wall connection on a masonry home performed from the inside of the house.

(click image for larger version)

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