



Structural Seismic Retrofits For Hawaii Single Family Residences With Post and Pier Foundations

Volume I

Results of Study, Structural Analysis
and Retrofit Strategies

Prepared for



FEMA

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Final Report
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The following demonstration is based off the 2009 report by Dr. Ian Robertson and Gary Chock. You may be able to do most of the work yourself, but first, seek the advice of a licensed structural engineer. The work can reduce earthquake and hurricane damage.

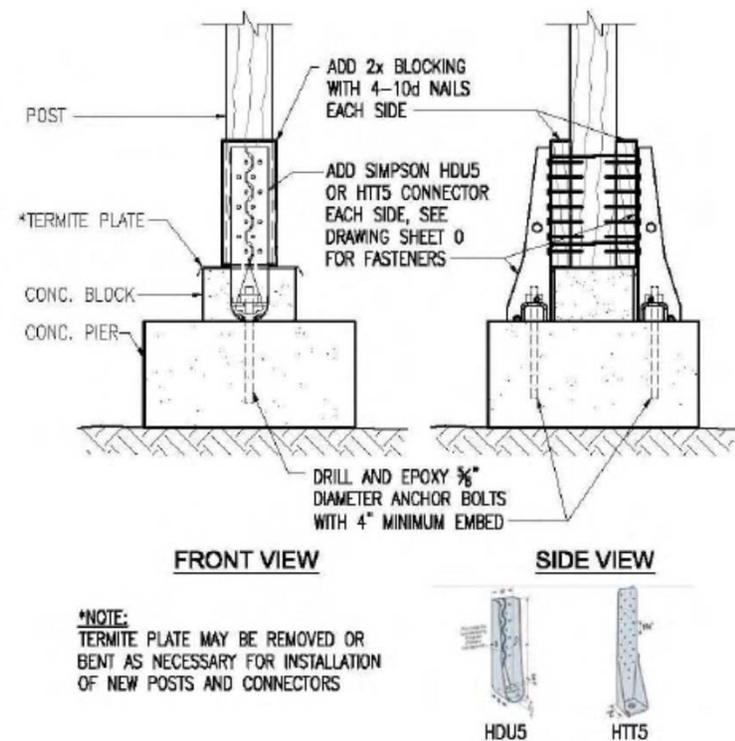
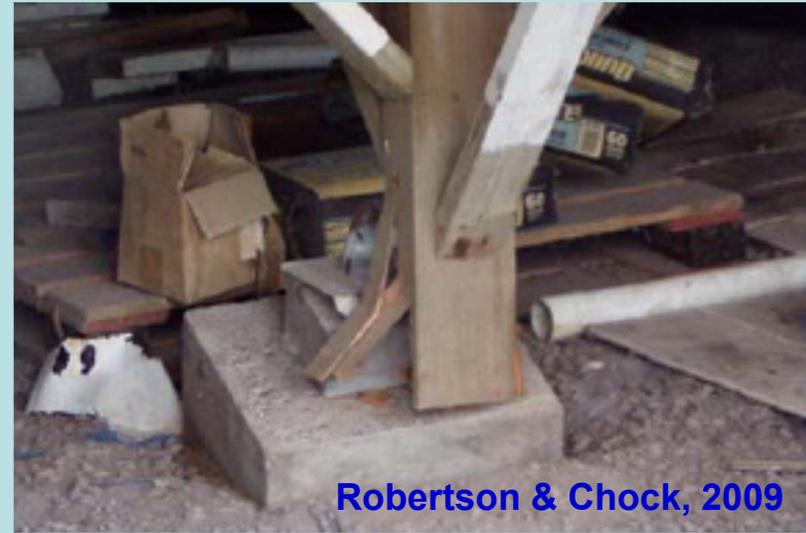


Figure 7: Simpson HDU Hold-down Connection

Single-wall houses on post and pier foundations are easily damaged from earthquakes and hurricanes. The posts sit on a termite pan, with no connections and are held by friction.



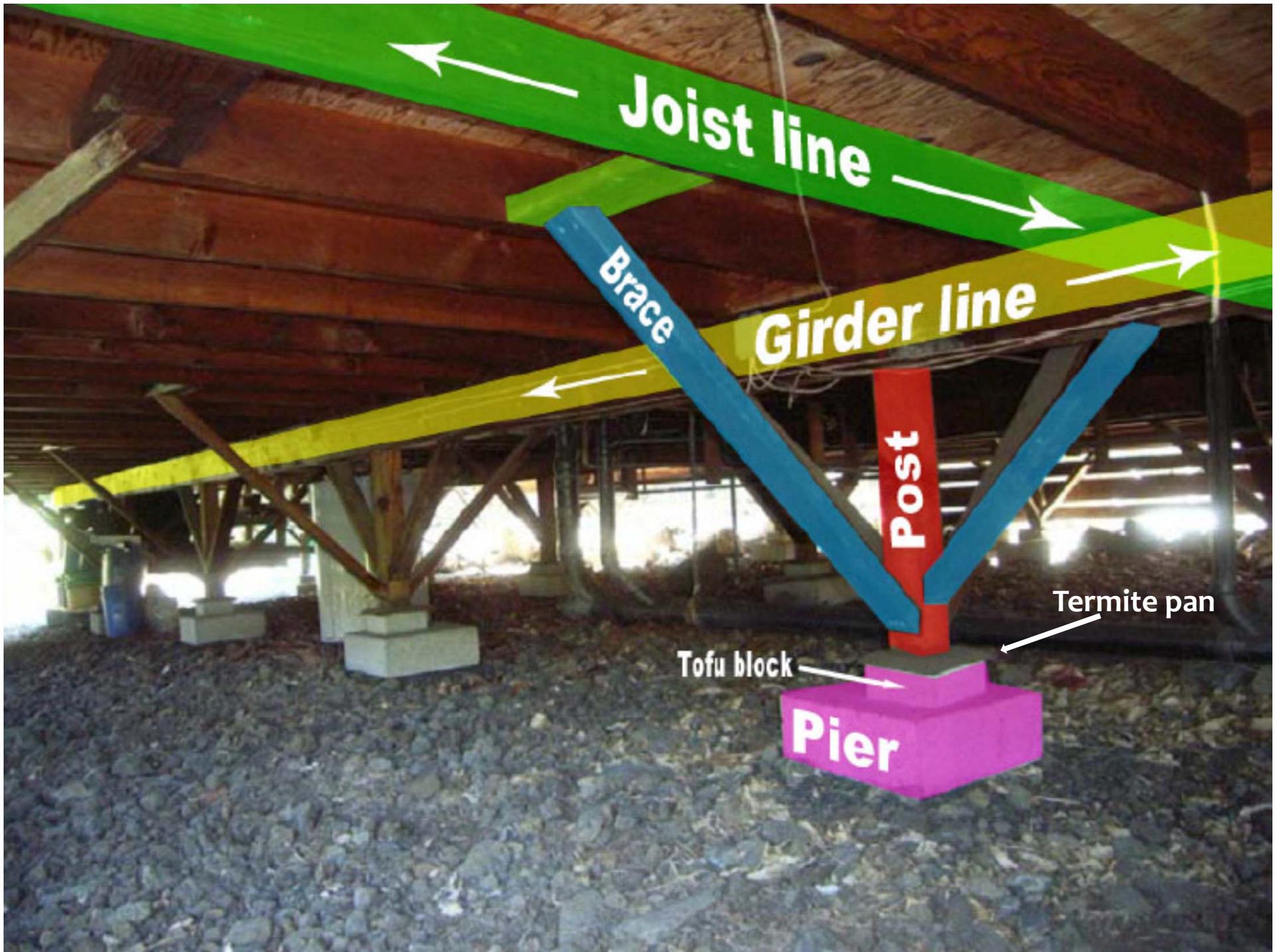
Robertson & Chock, 2009



Robertson & Chock, 2009



Robertson & Chock, 2009



Joist line

Brace

Girder line

Post

Termite pan

Tofu block

Pier

Which of these regions is the house located in (homes with the following zip codes are located in 4B: 96718,96737,96749,96760,96771,96772,96777,96778)? **NEXT** ▶

For increased accessibility [alternative HTML inputs](#).

Option	Choice
Region	
Inland/Shoreline	
Stories	
Floor Area	
Shape	
Maximum Post Spacing	
Maximum Post Height	
Minimum Post Height	
Damaged Blocks	
Interior Posts	
Exterior Posts	
Thin Posts	
Detached Braces	
Number of joist LRS	
Number of girder LRS	

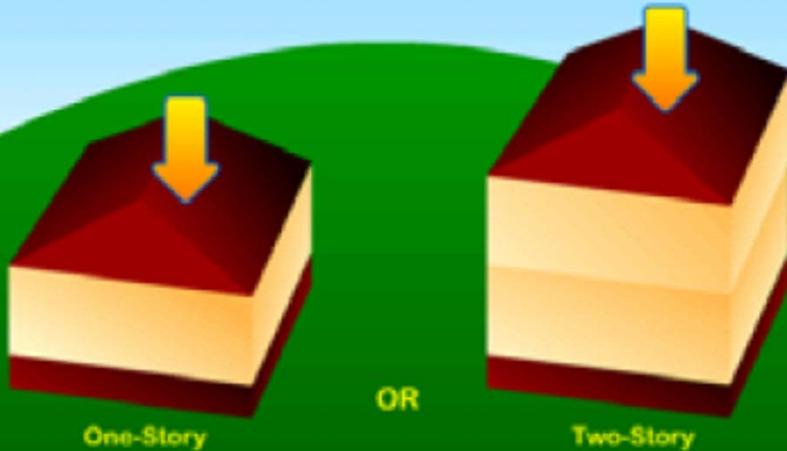
Start Over Get Recommendations

The retrofit options are dependent on what seismic zone the house is in. Even for the most seismically active area, the south portion of Hawai‘i, the retrofits can provide earthquake and hurricane protection. For these areas shear walls may be needed also.

Proximity to the coastline is also a factor.



Is your home one-story or two-story?



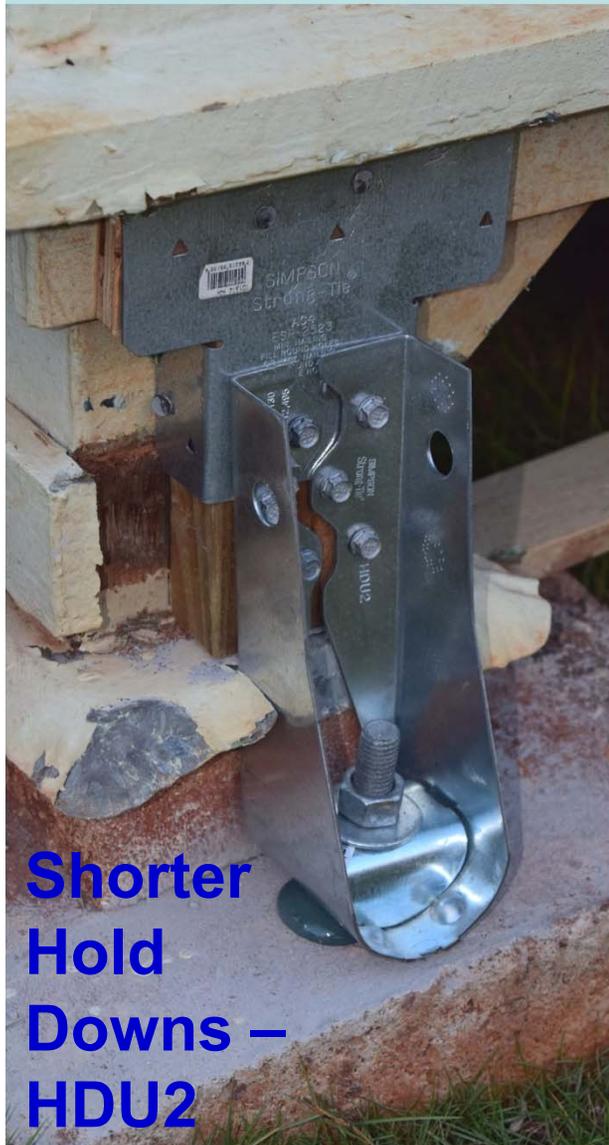
Maximum Post Height: feet and inches
For increased accessibility [alternative HTML inputs.](#)

Other factors to consider besides the seismic zone are number of stories, post spacing, post height, and the ratio of the tallest post with the shortest. Refer to the 2009 Report and 2018 Assessment for proper spacing to retrofit the post.



New Simpson Products Make the Retrofit Easier

Titen Heavy Duty Concrete Screw Anchor



**Long Hold Down
and Epoxy Anchor
Bolt**



**Short Hold Down
and Epoxy Anchor
Bolt**



**Short Hold Down
and Heavy Duty
Titen Concrete
Anchor Screw**

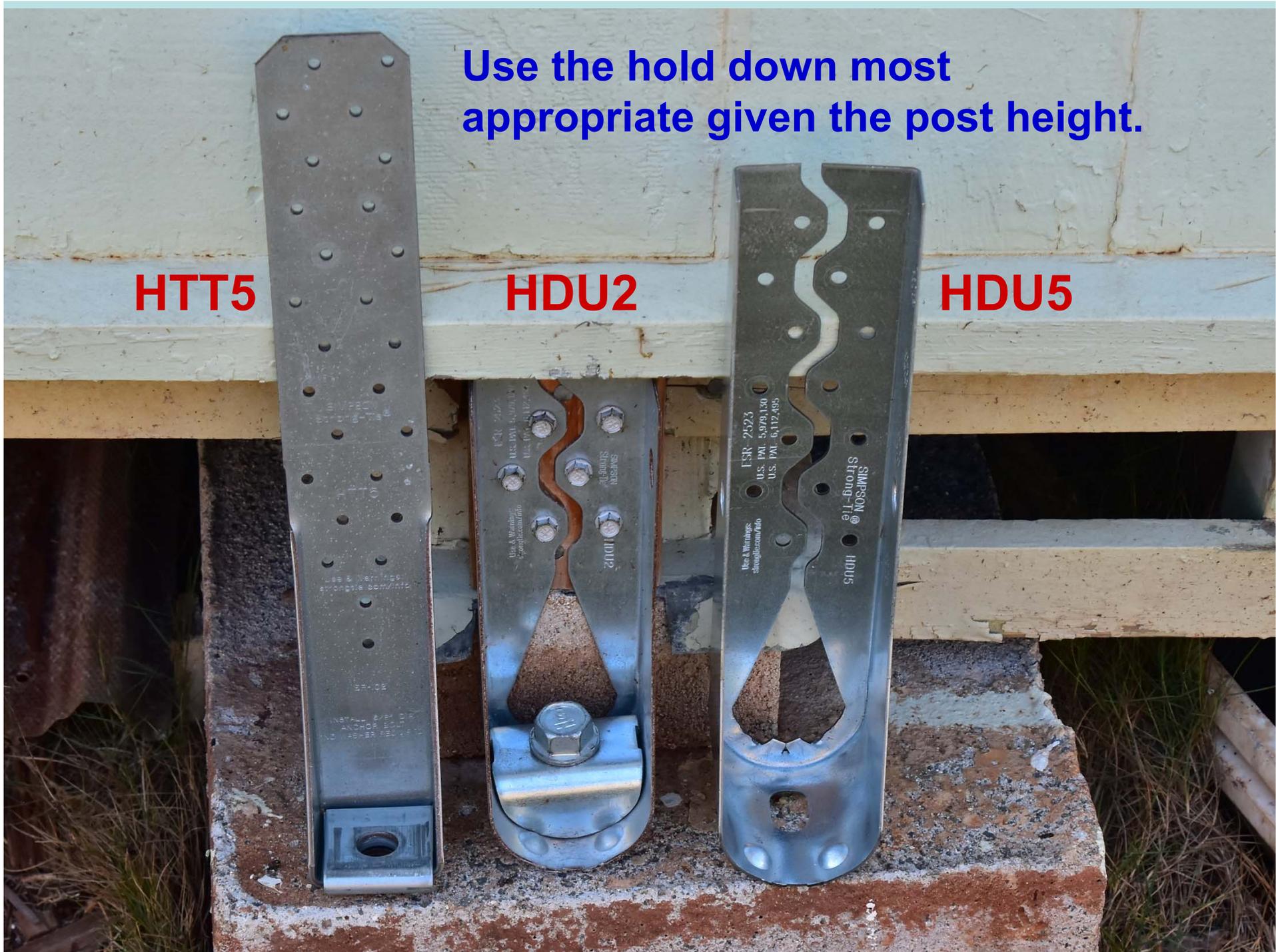


Use the hold down most appropriate given the post height.

HTT5

HDU2

HDU5



Procedures



Remove decorative fencing with multi-tool using flat wood blade, hammer and small nail-trim remover.



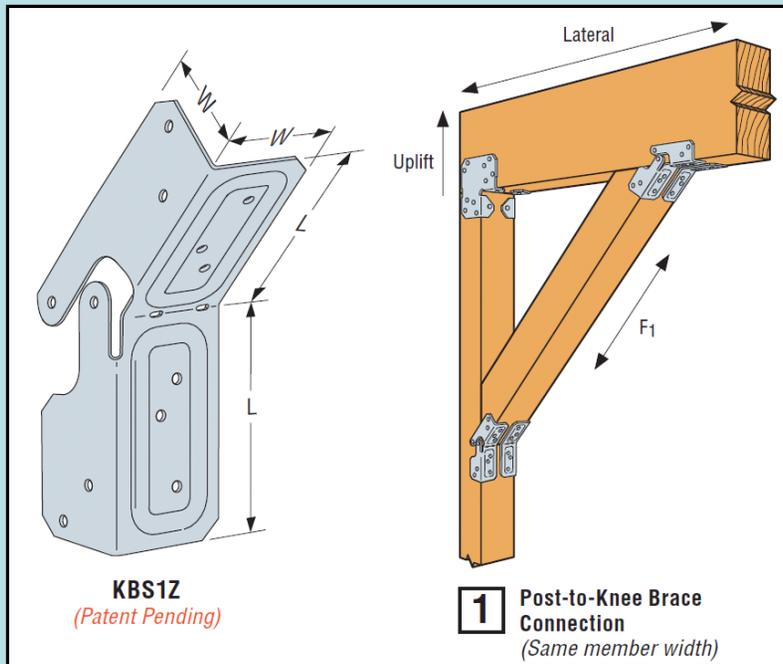


Install Simpson Strong Tie AC4 connector to inside post and beam. The AC4 is for 4" X 4" post. For larger post use AC6.

Use 3.5 inch 16d nails and a palm nailer. A hammer can be used but it is tiring and time consuming.



**Knee brace stabilizer
(Simpson
KBS1Z) installed
for all knee
braces.**





**Trace outline of hold
down on termite pan.**

**Cut termite pan with
snips.**



**Fold down or hammer
down termite pan
against tofu block. Do
for inside and outside.**





**Attach 2" X 4"
between post and
edge of tofu
block.**



**Attach Simpson HDU2 hold-down to
2" X 4" and concrete foundation.**



Repeat process for outside of post with 2" X 4."



Attach HTT5 hold-down to 2" X 4" and concrete foundation.

Drill hole with rotary hammer, clean hole of dust with air spray and brush. Then fill with epoxy. If epoxy used – drill hole is 1/8” larger than anchor screw. Set anchor screw and hold down.



The concrete anchor screw eliminates the need to epoxy. Drill hole with rotary hammer to same size as anchor screw (e.g., 5/8" hole for 5/8" anchor). Drill anchor screw with impact driver. Treat for corrosion with zinc rich galvanizing spray, primer for galvanized metal surfaces and enamel paint.



For short posts, complete for all exterior posts and double the corners. Refer to the 2009 report and 2018 assessment for post retrofit spacing.





HPT hurricane clip on each rafter. See Part 4 of the Homeowner's Handbook on procedures.



Each Exterior Post - Retrofitted



This single wall house on O'ahu now has a continuous load path.

Depending on the carrier, there are potential discounts on hurricane insurance for the different retrofits based on the stronger house and the reduced risk of property damage. This will vary with each company.

Hurricane Clips – 10%

Foundation Upgrades – 10-12%

Upgrades are cumulative, so total discount for this house is up to 22%.

One quote for this house went from \$1,184 to \$932 per year for hurricane insurance.