

August 17, 2010

Structural Support
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Homeowners
Sun City Hilton Head
Bluffton SC 29910

Attached report describes engineering evaluation of the design of connections between so-called "valley" roof trusses and the underlying main roof trusses for houses in the Sun City Hilton Head development.

I am a professional engineer, licensed in South Carolina, with extensive experience in structural design and analysis for residential buildings.

This evaluation has been performed independently, without any request from any party.

Initial distribution of the report (hardcopy) is being made to several persons directly involved. The report will most likely be available from the Structural Support web site in the near future (www.structural101.com).

Evaluation is focused on design capacity of valley truss connections specified on available building design plans prepared by engineer for the builder.

For roof framing design at Sun City, it is reasonable to conclude that design capacity of valley truss connections made with two 12-penny (12d) nails is much less than required capacity for wind pressures specified by the governing building code.

Design capacity (also known as "allowable" capacity) is less than "failure" capacity. This key issue is addressed in the report.

Determination (via calculation) of connection design capacity and required uplift capacity (wind force) is subject to some "engineering judgment" due to actual conditions that do not conform with standard conditions forming the basis for standard code provisions. Conservative design is warranted considering uncertainties with non-standard conditions as well as risk of severe damage during a hurricane if valley truss connections fail. However, basic conclusions remain intact even when more liberal assumptions are used.

Problems with as-built construction are discussed briefly, and only in general. Details of as-installed truss connections have been provided by Tony Kunich of Professional Home Inspections (PHI). Of course design deficiencies plus construction defects equal high risk for severe structural damage in the future.

Connections made with one 10 gage x 3-1/2 inch wood screw may have adequate design capacity, but only if wood members are not already damaged by nails.

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Per Island Packet reports, much remedial work has been performed. However, as also reported by the Island Packet, PHI has apparently found many remaining defects with valley truss connections. Additional work may very well be required to ensure adequate protection against the very real risk of substantial damage during a hurricane where nail-only connections remain, and especially where nails were omitted or wood split.

Letter by Ryan Rasmussen (PulteGroup)

In his letter published in the Island Packet (4-28-10), Ryan Rasmussen (National Engineering Manager for PulteGroup) attempts to downplay the importance of, and even dismiss, additional truss defects reported by inspector Tony Kunich by contending that Mr. Kunich had not been using "*the exact plans for the house under inspection*". Mr. Rasmussen also claimed that an inspector must have "*an understanding of the engineering behind the plans*" to "*properly make an assessment of a home's truss system*".

The Island Packet has (apparently) not verified whether Mr. Kunich was using "exact" plans for the various houses inspected by Mr. Kunich. Such verification should be relatively easy by visiting the Beaufort County building department to compare plans (that should be) maintained on file for each house.

However, much more important is that, relative to valley trusses, all of the connection details are standard for every valley truss. Also, based on plan details reviewed for this evaluation (supplied by Mr. Kunich), all wind uplift connections for main roof trusses are based on a standard schedule (with only a few options) that applies to every house in Sun City.

The claim that "exact plans for the house" are required to inspect roof trusses is therefore misleading at best.

The claim that an inspector must understand "engineering behind the plans" is surprising. Essentially Mr. Rasmussen is implying that all building inspectors, including municipal building inspectors, must have an engineering background to perform valid inspections of roof trusses. If this incredible claim were true (which it certainly is not), then it would also apply to construction workers and supervisors, resulting in the bizarre situation that no one other than an engineer could possibly understand whether or not roof trusses have been properly installed.

Most importantly, Mr. Rasmussen discusses results of specific calculations, for what he implies is the governing valley truss condition, by claiming that the design uplift load for each valley truss connection is 87.8 pounds. (Tangentially, reporting design loads using decimals is one hallmark of inexperience. Whole numbers are much more than adequate "precision".)

Based on the lack of any PE identification, Mr. Rasmussen is (apparently) not a licensed professional engineer. Though calculation of wind uplift forces is not all that complicated, Mr. Rasmussen should have explained whether or not he performed his own calculations. He may have obtained (or derived) the 87.8 pound force from calculations submitted to Del Webb by the engineer Charles G Thom, Jr, PE, back in February 2007. Those calculations (see Appendix) are discussed in the attached report.

Available calculations prepared by Mr. Thom (for nails and screw) are grossly incorrect. The most important error is failure to properly calculate the tributary area of 8.0 square feet (for wind uplift pressure) applicable for each valley truss connection, for the governing position of the valley truss vertical web relative to the main roof truss. This key error was (apparently) caused by failure to properly evaluate how wind force is distributed (along the "load path") from each valley truss to the valley truss connections.

As highlighted in the report prepared for this evaluation, and based on a reasonably conservative application of standard building code provisions to roof geometry that does not conform entirely to those provisions, design wind uplift force for valley truss connections is 222 pounds or 322 pounds, depending on slope of the valley trusses.

Considering expected installation tolerances, and using correct calculation methods, design capacity of two 12-penny nails (if installed without splitting wood) is reasonably taken as 138 pounds, much less than required design capacity. Of course, where nails were omitted and where wood was split, the problem is much more severe, unless adequate remedial work has been performed.

Mr. Rasmussen claims that design capacity should be adequate even if numerous nails were not installed. Specifically, he contends that omission of 8 nails out of 20 should be acceptable. If believed, this claim, based on grossly flawed engineering, provides a false sense of "security" that could result in severe damage to houses even for windspeeds much less than the 130 mph specified by the building code.

Mr. Rasmussen also failed to acknowledge that there are two separate reasons for the valley truss connections; (1) Wind uplift resistance, and (2) Lateral bracing for top chords of the main roof truss. In his letter of July 2005 to Del Webb, Mr. Thom describes the genesis of this critical error, incredibly relying on an unidentified "vendor" to "interpret" the Truswall valley truss drawing.

Further Evaluation of Reported Defects

As repeatedly recommended in the various comments I have offered on the Island Packet web site (and in the "PE Retired" blog), homeowners should obtain evaluation of all truss defects reported by Professional Home Inspections (and any other inspection firm) by a qualified professional engineer licensed in South Carolina.