Rafter Framing
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Roof systems constructed with trusses seem to be the standard in today’s construction practices. However there are instances where rafter framing is the better, and sometimes easier, method to use for roof framing. There are some building contractors who prefer rafter framing to truss framing. Rafter framing gives the builder control of the material that goes into the roof framing system. The material and the rafter system must meet the requirements of the building code to be approved though. Knowing the code sections addressing roof framing, and knowing how to properly frame with rafters can provide a code compliant, strong and safe roof frame system.

The code requirements for rafter framing can be found in Chapter 8 of the 2003 Michigan Residential Code (MRC), in section R802. Section 802.1 requires the load-bearing dimensional lumber being used as rafter, truss or ceiling framing to be grade stamped. Material that has been grade stamped has been inspected and approved, by qualified inspectors, to meet certain standards for the quality of the material. This is not to say that rough-sawn material can not be used for load-bearing material. If rough-sawn material is to be used, it is the responsibility of the owner or contractor to arrange for the inspection and grading of the material before it will be approved for use. In lieu of a grade stamp, a certificate of inspection from a qualified lumber grading or inspection agency can be accepted.

Section 802.2 of the 2003 MRC requires that all roof/ceiling framing be designed and constructed to meet the requirements of Chapter 8 and the figures shown in R606.10(1) - (3) or in accordance with the American Forest and Paper Association (AFPA) National Design Standard. All materials used in roof framing must be secured using at the very least, the fastener schedule provided in table R602.3(1) of the 2003 MRC. Roof framing not meeting the design, construction and fastening requirements may not provide a structurally sound roof framing system, and could be subject to structural failure.

Section R802.3 of the 2003 MRC gets into the framing details that are required by the Building Code. This section tells us that the rafter framing must be framed to either a ridge board or to an opposing rafter using a gusset plate as a tie. Ridge boards are required to be at least a nominal 1 inch thickness and not less in height than the height of the rafter cut. Using the proper height ridge provides full bearing for the rafter against the ridge board. The same holds true for hip and valley rafters except that the hip or valley rafter must have a minimum thickness of a nominal 2 inches. Proper bearing at the ridge, hip and valley connections is a must. If not properly supported, the rafter may become stressed, and splitting of the material can occur. The picture on the right is a perfect example of a poorly supported rafter. This rafter was found in an attic area, where a new addition roof is being supported off the existing roof framing. The dark line on the rafter is actually a split in the material. 2/3 of the rafters found in this roof addition were split, due to poor support at the upper cut of the rafter. Most of the splits extended 6 - 8 feet down the rafter. With the addition of a heavy snow load, it is just a matter of time before this roof system suffers a structural failure. Hip and valley rafters are to be supported at the ridge connection with either a brace down to a bearing partition, or be designed to carry and distribute the roof loads of the hip or valley to the ridge at the point of connection. In other words, the ridge has to be designed to carry the load from a hip or valley, and support that load at the hip or valley connection to the ridge, or be supported by bracing down to a load-bearing wall or framing below.

Section R802.3.1 addresses the code requirements for ceiling joist to rafter connections. This section refers to tables R602.3(1) and R802.5.1(9). These tables contain the fastener requirements for securing materials together to meet code compliance. Table R602.3(1) requires a minimum of 2 - 16D framing nails to attach the rafter to the wall plate. This same table requires a minimum of 3 - 10D framing nails to attach a ceiling joist to a rafter. However table R802.5.1(9) requires additional nails at the rafter/ceiling joist connection. The number of nails required in table R802.5.1(9) varies depending on the slope of the roof, the rafter spacing and the roof span. The table shows that a lower slope roof actually requires more fasteners at the rafter/ceiling joist connection than a steeper slope. By referring to these tables in the 2003 MRC a code compliant connection between the rafters and ceiling joists can be made.

Rafter span, the distance that a rafter can run between supports, is noted in Section R802.5. Rafter span is considered the distance horizontally from support to support. This section points to tables R802.5.1(1) through R802.5.1(8). These tables provide the maximum spans for common lumber species such as Douglas Fir, Hem-Fir, Southern Pine and Spruce-Pine-Fir. Factors such as rafter spacing, species of lumber, snow load and size of the material are all considered when the maximum span is calculated. The maximum spans allowed in these tables are calculated assuming that a ceiling joist or rafter tie is being used near the wall connection, or that the rafters are installed to resist any outward push on the exterior walls. When ceiling joists or rafter ties are located in a higher area of the attic space the rafter span must be adjusted using the rafter span adjustment factor at the end of each table.

Per Section R802.6, rafters must bear on a minimum of 1 ½” on wood or steel, or a minimum of 3” on masonry or concrete. When the minimum bearing can not be provided, the use of a ledger or hanger will be required. When hangers are used, the hangers must be sized accordingly for the loads being placed on them.

Engineered wood products, such as I joists and LVL beams, may also be used for roof framing. However, engineered wood product rafters require a slightly different installation than nominal wood rafter framing. Correct bearing for I joists is critical for the system to work properly. Additional mechanical connections and straps may be required. When engineered wood products are used, the rafter system must be designed and installed in accordance with the engineered wood product manufacturer’s specifications.

Failure to follow the requirements of the Building Code for rafter framing can result in structural failure, costly repairs, and even serious or fatal injuries to a building’s occupants. By following at least the minimum requirements of the code sections listed, a rafter system can be provided that will be structurally stable, and be approved at the time of inspection. Should you have questions regarding rafter framing, or any other code requirements, contact your local Building Inspection Department. Your local Building Department can and should be your best source of code information.

Code information from the 2003 MRC