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MISCONCEPTIONS IN FRAMING COVED CEILINGS

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Designers frequently rely on framing manuals for the sizing of timber components in a house. The selection of rafters is one example.

The rafter span is commonly taken as the distance between the supporting wall to the ridge board (or to the underpurlin if present).

Although this approach is reasonable, there is an inherent assumption that is not well understood which can lead the unwary designer to specify an unsafe structure.

This can happen when the design involves a vaulted ceiling formed by a collar tie across opposite rafters. This profile is often also achieved with trusses, using what is commonly termed as overhang supported trusses or cove trusses. See Figures 1 & 2.

The question is often asked why the top chord size in the truss is so much bigger than the rafter size given in framing tables for the situation in Figure 1. The reason lies in understanding the structural systems involved.

Put simply, the timber framed structural system usually relies on internal load bearing walls to support the ceiling joists and underpurlins.

That is usually how spans are kept small resulting in smaller framing members. If internal wall supports were also available to the trussed system, the top chord size would also be considerably smaller.

However, the examples we have in Figures 1 & 2 do not use any internal walls for support. Hence, the roof structure has to span from wall to wall, whether it is raftered or trussed.

It is incorrect to size the rafter based on a span from wall to collar tie, or even to the ridge board.

In effect, the rafter spans from wall to wall even though the length is only from wall to ridge. The rafter size selection should more correctly be based on a span from wall to wall.

This brings us back to the basis for the traditional timber framed roof covered by framing tables. The traditional approach assumed involves rafters used in conjunction with ceiling joists that act as a tie between wall supports.

This structural system shown in Figure 3 is termed a "closed coupled roof".

Each rafter is supported at one end by the wall (vertically) and ceiling joist (horizontally) and at the other end by the opposing rafter.

The ridge board merely acts as a longitudinal tie and to maintain a level ridgeline. It does not have the ability to support the rafters.

Another common traditional approach that does not have a ceiling joist utilises a ridge beam to support the rafters.

In this situation shown in Figure 4, the sarked or sloping ceiling is attached to the underside of the rafters. The rafters span from wall to ridge beam.

As the ridge beam supports the roof, they are naturally much larger than ridge boards in size.

Furthermore, unlike ridge boards, the ends of the beam should also be properly supported.

The advantage of the overhang supported truss system is that only external walls are required for support. It is also more effective than framed roofs under high wind uplift as the joints are more reliably connected.

The trusses are fabricated identically to ensure a consistent profile and roof shape. Trusses are certainly cheaper, easier and quicker to install than framing timbers.