SBC ASSOCIATION

Research Report

Use of Cantilevered Sill Plates with Metal Plate Connected Wood Trusses to Align with Varying Thicknesses of Exterior Sheathing

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This research report is based on practical scientific research (literature review, testing, analysis, etc.). This research report complies with the following sections of the building code:

- *IBC* Section 104.11.1 and Section 1703.4.2 – "**Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved sources*."
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Introduction:

The prescriptive residential energy code requirements found in the *2009*, *2012* and *2015 International Residential Code* (*IRC*) include requirements for continuous insulation at foundations (Table N1102.1/R402.1) in several climate zones. This research report discusses the issue of cantilevered sill plates supporting metal plate connected wood trusses installed parallel and perpendicular to the foundation walls where there is a potential for discontinuous planes between the exterior wall above the sill plate and the foundation insulation planes. An example is shown in Figure 1. This report is based on the following assumptions:

- Exterior wall sheathing is any thickness to align the exterior face of the sheathing with the exterior face of the sheathing below.
- Basement continuous insulation is installed on the exterior of the foundation and does not exceed 2".
- Floor system is bottom chord bearing metal plate connected wood trusses.
- The sill plate does not overhang the foundation by more than $1^{9}/_{16}$".

It is important that all structural, energy, and durability requirements be taken into account.

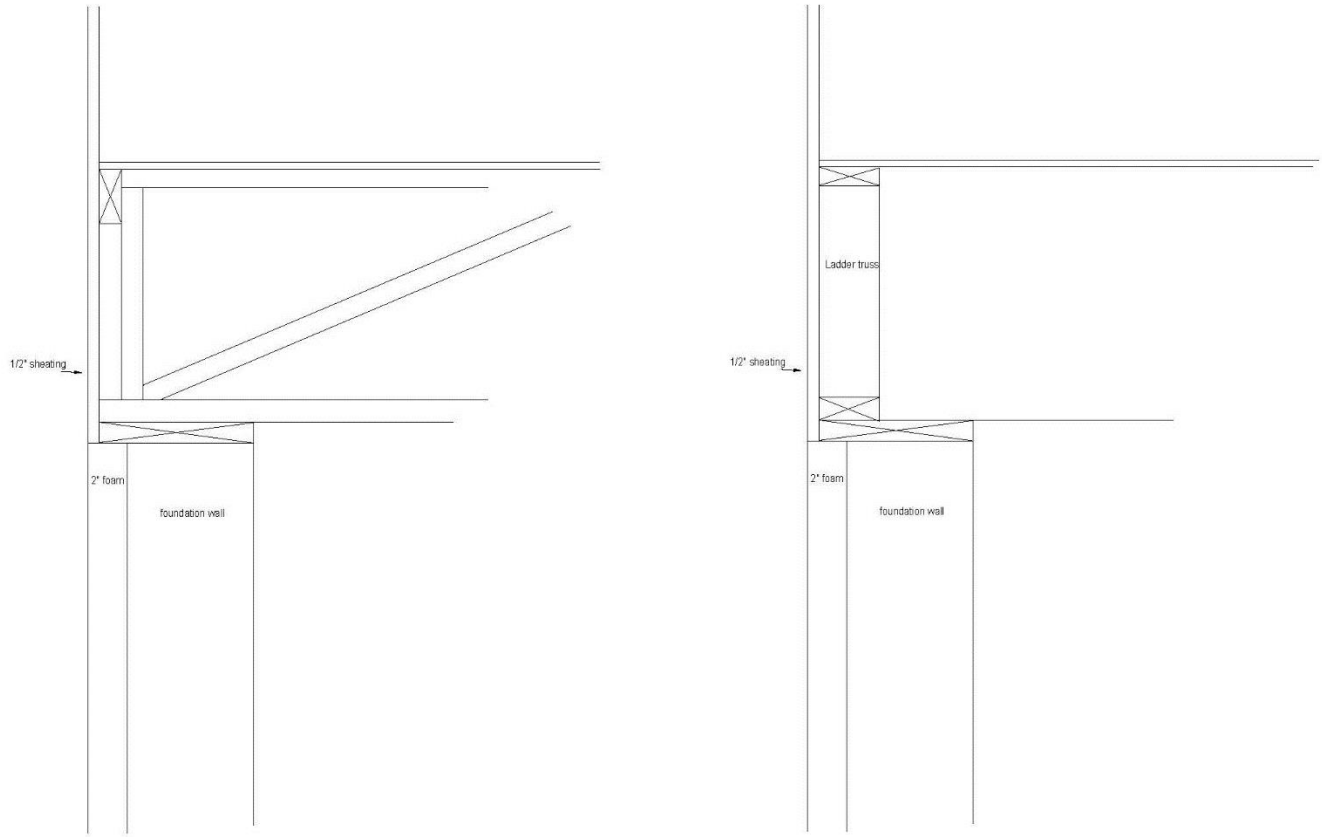

Figure 1: Truss Details

Key Definitions:

Band, Rim or Header Joist – Not defined, but shown on *IRC* Figure R502.2. In the case of sawn lumber and I-joists, it is a full depth framing member that provides lateral support for the ends of the joists perpendicular to the foundation.

Bottom Chord Bearing – (*BCSI*) Bearing condition of a truss that is supported on its bottom chord (Figure 2).

Continuous Insulation – (*IRC* Chapter 2) Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.

Ribbon (Band) – (*BCSI*) Framing member installed on the edge of the exterior perimeter, usually tying the ends of the floor trusses together. Note: structural sheathing, blocking panels, or a rim board may be required, in addition to the ribbon, to transfer all the lateral loads (see *BCSI–B7*).

Sill Plate – Not defined, but shown in *IRC* Figure R502.2. It is attached to the foundation using anchor bolts and the floor system is, in turn, attached to the sill plate.

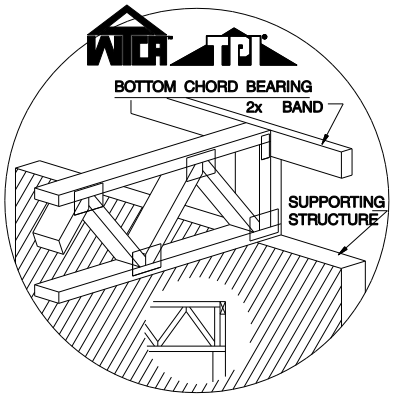

Figure 2: Bottom Chord Bearing Truss

Background:

The *IRC* includes prescriptive information regarding floor cantilevers for sawn lumber (R502.3.3). The *IRC* also provides prescriptive information on lateral restraint at supports for sawn lumber (R502.7) but defers to the manufacturer's recommendations for engineered products in Exception 1.

> Trusses, structural composite lumber, structural glued-laminated members and I-joists shall be supported laterally as required by the manufacturer's recommendations.

The *IRC* provides prescriptive information on bridging (R502.7.1) but defers to the manufacturer's recommendations for engineered products in the Exception.

> Trusses, structural composite lumber, structural glued-laminated members and I-joists shall be supported laterally as required by the manufacturer's recommendations.

This research report functions as the "manufacturer's recommendation" for metal plate connected wood trusses for situations where there is a sill plate cantilever of $1^{9}/_{16}$" or less.

Discussion:

As illustrated in Figure 1, the cantilever of the sill plate and floor truss (perpendicular) or ladder truss (parallel), is $1^{9}/_{16}$" or less, given the stated limitations.

Where the floor truss runs perpendicular to the foundation, it carries the load of the roof, walls, and any upper floors and transmits the load to the sill plate through the two vertical members that form the end of the floor truss (notched to accommodate the ribbon). With a maximum $1^{9}/_{16}$" cantilever, one of the two verticals bears on the bottom chord and sill plate over the foundation (3" total). The truss plate connecting the end verticals to the truss bottom chord will assist in transferring load into the truss bottom chord. Two general engineering principles apply to this situation. First, loads flow to the stiffest members. Since the foundation is the stiffest location, it will attract the load. Second, loads follow a load path through solid materials at up to a 45° angle from the point of loading. In addition, a general "rule-of-thumb" formula allows a sill overhang of ½ the plate thickness. In this case, the bottom chord of the truss and the sill plate equals 3", allowing up to a $1^{1}/_{2}$" cantilever using this rule of thumb.

Where the floor truss runs parallel to the foundation (typically on a gable end), it is typically more lightly loaded. With a maximum $1^{9}/_{16}$" cantilever of the sill plate in this condition, the ladder truss is $3^{1}/_{2}$" wide, so 2" bears on the sill plate over the foundation. Again, the stiffness of the foundation attracts the load, and the load is also distributed through the bottom chord and sill plate at a 45° angle. The rule-of-thumb formula stated above would return the same result.

The difference between $1^{1}/_{2}$" and $1^{9}/_{16}$" in the cantilever is negligible. This situation also does not require any special truss design as do longer cantilever conditions.

Connection of the trusses to the sill plate and the sill plate to the foundation are required per the applicable building code. One of the primary purposes of this connection is to resist uplift forces imposed on the trusses from the walls above. Care should be taken to make the connection of the trusses to the sill plate as close to the line of anchor bolts in the sill plate as practical. This will avoid any potential for parallel to grain bending in the sill plate when the connection is loaded in uplift. No additional consideration is required for the design of the trusses in uplift due to the cantilever. In all cases, consult the locally adopted building code for sill plate to foundation and floor system to sill plate connection requirements.

Findings:

Sill plates supporting metal plate connected wood truss floor systems as described in this report may be cantilevered up to $1^{9}/_{16}$" without requiring design of the trusses for a cantilevered condition. Truss to sill plate uplift connections, where required, are made per the applicable building code for the non-cantilevered condition. No addition design for the connection is required.

References and Substantiating Data:

1. *International Residential Code* (*IRC*), International Code Council.

2. *Building Component Safety Information* (*BCSI*), Structural Building Components Association (SBCA) and the Truss Plate Institute (TPI).