Truss Wall Construction

Truss Wall Construction Details

- 2x6 interior wood frame wall at 24" o.c.
- 2x3 exterior truss
- Cellulose cavity insulation
- OSB or plywood sheathing
- Housewrap
- Furring creating a minimum $^{3}/_{8}$" ventilation gap/drainage gap behind cladding

References

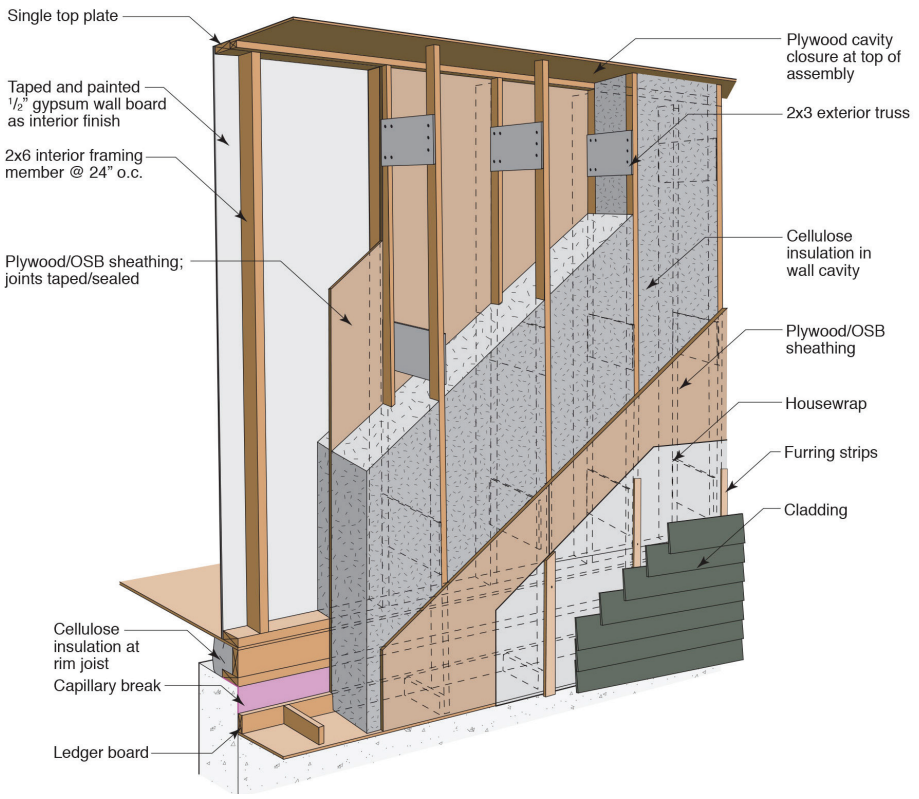
1 Lstiburek, J. W. (2006). *Water Management Guide*. Westford: Building Science Press Inc.

2 Lstiburek, J. (2008, 08 20). *BSD-104: Understanding Air Barriers.* www.buildingscience.com.

3 Straube, J. (2009, 04 22). *BSD-014 Air Flow Control in Buildings.* www.buildingscience.com.

4 Lstiburek, J. (2008, 10 17). *BSD-106 Understanding Vapor Barriers.* www.buildingscience.com.

Revised: November 2014



Introduction

This overview summarizes the truss wall construction including the advantages and disadvantages of this construction strategy. Complex two dimensional heat flow analysis and one dimensional hygrothermal modeling were used to determine moisture related durability risks for analysis.

For a more complete analysis of this and other wall constructions, go to www.buildingscience.com.

Thermal Control

Installed Insulation R-value: The thickness of truss walls varies greatly and because it is not a common wall construction, there does not appear to be a established standard construction insulation thickness. These walls are typically insulated with blown cellulose insulation (R-3.7/inch) or fiberglass batt insulation (R-3.5/inch), and overall installed insulation R-values in excess of 50 are possible.

Whole-wall R-value: Using two dimensional heat flow analysis with thermal bridging effects and average framing factors shows that adding the insulation to the exterior of the framing addresses the thermal bridging at the rim joist, studs and top plate. There is a large range of R-values possible with this type of construction, but 12" of cellulose provides a whole-wall R-value of approximately R-36.

Air Leakage Control: Cellulose insulation is an air permeable material allowing possible air paths between the interior and exterior as well as convective looping in the insulation. Although dense pack cellulose has less air permeance than some other air permeable insulations, it does not control air leakage. Accordingly, the primary air control layer is the plywood or OSB sheathing on the exterior of the 2x6 frame wall.

Typical Insulation Products: Blown cellulose.

Building Science Corporation
3 Lan Drive Suite 102
Westford, MA 01886
www.buildingscience.com

Durability

Rain Control: Rain leakage into the enclosure is the leading cause of premature building enclosure failure. Rain control is typically addressed using a shingle lapped and/or taped water control layer such as building paper or a synthetic WRB (i.e. housewrap). Intersections, windows, doors and other penetrations must be drained and/or detailed to prevent the penetration of rainwater beyond the water control layer.[1]

Air Leakage Control: Air leakage condensation is the second largest cause of premature building enclosure failure with this type of wall construction. It is very important to control air leakage to minimize air leakage condensation durability issues. An air barrier is required in this wall system to ensure that through-wall air leakage is eliminated (ideally) or at least minimized. An air barrier should be stiff and strong enough to resist wind forces, continuous, durable, and air impermeable.[2]

Air need not leak straight through an assembly to cause moisture problems; it can also leak from the inside, through the wall, and back to the inside; or it can leak from the outside, through the wall, and back to the outside. Condensation within the stud space is possible if this type of airflow occurs, depending on the weather conditions. Hence, wall designs should control airflow into the stud space.[3]

Vapor Control: Fiberglass and cellulose are highly vapor permeable materials, so a separate vapor control strategy must be employed to ensure that vapor diffusion does not result in condensation on, or damaging moisture accumulation in, moisture sensitive materials. The permeance and location of vapor control is dependent on the climate zone. Installing the vapor control layer in the incorrect location can lead to building enclosure failure.[4] In this assembly, the vapor control layer is the plywood or OSB sheathing on the exterior of the frame wall.

There is a higher risk of vapor diffusion condensation if the vapor barrier is not detailed correctly due to the lower wintertime temperature of the sheathing in the truss wall relative to standard construction.

Drying: Cellulose and fiberglass insulation allow drying to occur relatively easily, so drying is controlled by other more vapor impermeable enclosure components such as the plywood or OSB sheathing on the exterior of the 2x6 frame wall. Installing a vapor barrier on both sides will seal any moisture into the stud space, resulting in low drying potential, and possibly resulting in moisture-related durability risks. Ventilation behind vapor impermeable claddings and interior components (e.g. kitchen cabinets) can encourage drying.

Built- in Moisture: Care should always be taken to build with dry materials where possible, and allow drying of wet materials before close in. If a polyethylene vapor barrier is installed with relatively vapor impermeable OSB sheathing, drying could be slow if built-in moisture is present.

Durability Summary: The primary durability risks associated with these wall assemblies involve moisture damage related to rain water penetration or condensation (most likely the result of air leakage, but also potentially the result of vapor diffusion).

Cellulose insulated walls are slightly more durable than fiberglass insulated walls because cellulose insulation is capable of storing and redistributing small amounts of moisture. Cellulose insulation is typically treated with borates to protect itself and neighboring wood material from mold growth and decay. Cellulose insulation also has decreased flame spread potential relative to other insulation materials.

Buildability

This wall construction is not a standard construction practice. The trusses used to space the exterior framed wall off the structure are time consuming to construct, and require tight tolerances to ensure smooth sheathing and cladding.

Cost

This construction requires increases in both time and materials for the enclosure. The wall framing material is essentially doubled, and constructing the exterior wall with gussets is time consuming. The increased thermal performance and decreased thermal bridges may be worth the extra time and money in specific cases.

Material Use

There is a significant increase to framing since every framing member in the structural wall has a corresponding exterior framing member attached with wood gussets.

Summary

The truss wall system can achieve a very high whole wall R-value with minimal thermal bridging and would perform well in extreme climates provided the air barrier was detailed perfectly minimizing air leakage condensation durability risks. It is possible to reduce the risk of condensation by using a combination of the truss wall in combination with an air impermeable insulation. One advantage of the truss wall is that it is used in both new construction and retrofit situations to decrease energy consumption, and improve occupant comfort. The truss wall allows the extra insulation to be placed on the exterior of the structural wall that does not affect the interior space, unlike the double stud wall.