

2x6 ADVANCED FRAME WALL CONSTRUCTION

2x6 ADVANCED FRAME WALL CONSTRUCTION DETAILS

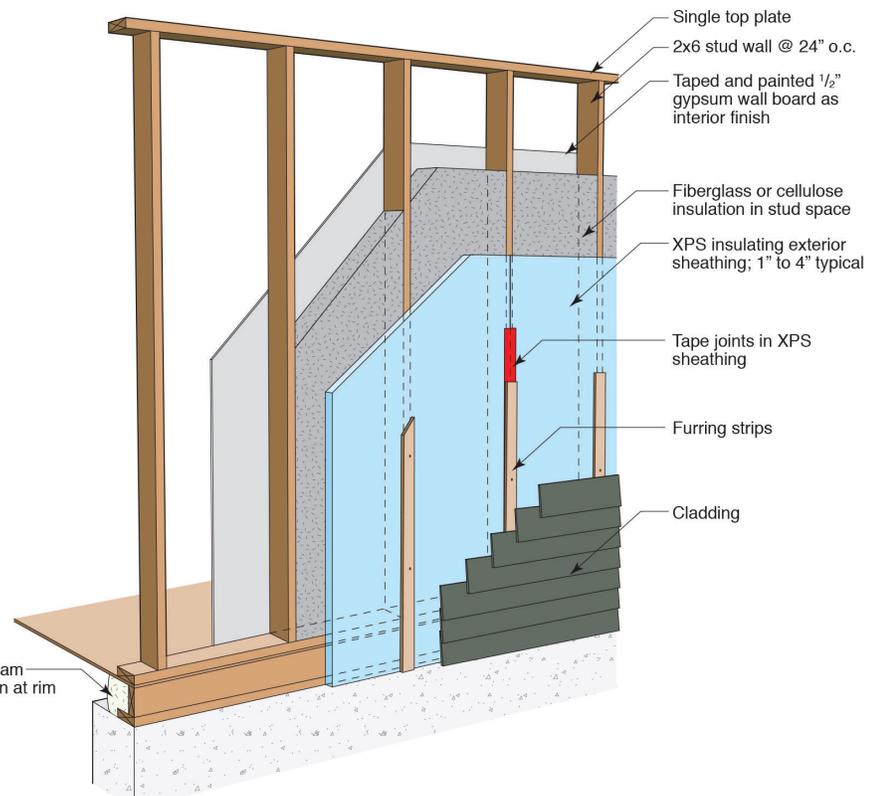
- 2x6 wood frame wall at 24" o.c.
- Fiberglass or cellulose cavity insulation
- XPS insulating sheathing
- Furring creating a minimum $\frac{3}{8}$ " ventilation gap/drainage gap behind cladding



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.

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INTRODUCTION

This overview summarizes 2x6 advanced frame 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: There is a range of installed insulation R-values in commercially available fiberglass batts for the stud space insulation in this wall system. The installed insulation R-value for 2x6 fiberglass batt ranges between R-19 and R-21. When blown or sprayed cellulose insulation is used, the R-value is typically R-20 for 2x6 walls.

Exterior insulating sheathing is typically added as expanded polystyrene (EPS) at R-4/inch, extruded polystyrene (XPS) at R-5/inch or foil-faced polyisocyanurate at R-6.5/inch.

Whole-wall R-value: Two-dimensional heat flow analysis with thermal bridging effects and average framing factors (16%) shows increases to the R-value of the assembly and improvements to the efficiency of the fiberglass batt in the stud space by decreasing the thermal bridging effects. Advanced framed walls with 1" and 4" of XPS insulating sheathing have whole wall R-values of R-23 and R-38 respectively.

Air Leakage Control: Fiberglass, blown and sprayed cellulose are air permeable materials used in the stud space of the wall allowing possible air paths between the interior and exterior as well as convective looping in the insulation. Dense pack cellulose has less air permeance but does not control air leakage. Insulating sheathing (EPS, XPS and foil-faced polyisocyanurate board foam) products are air impermeable. When joints between panels of insulation and the insulation and framing are properly sealed with tape, mastic, caulk, etc., an effective air barrier is created.

er system can be created at the exterior sheathing.

Typical Insulation Products: Fiberglass batt, blown cellulose, sprayed cellulose, and sprayed fiberglass are typically used to insulate the stud space. Expanded polystyrene (EPS), extruded polystyrene (XPS) and foil-faced polyisocyanurate (PIR) board foam are used as the exterior insulating sheathing. Spray foam is used at the rim joist to control air leaks.

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). It is possible to use insulating sheathing as the water control layer if all the intersections, windows, doors and other penetrations are connected to the surface of the insulating sheathing in a watertight manner, and the seams of the insulation are taped or flashed to avoid water penetration.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. Using insulating sheathing decreases the risk of air leakage condensation by increasing the temperature of the condensation plane, but condensation is still possible with insulating sheathing in cold climates. An air barrier is required in this wall system to ensure that through-wall air leakage is eliminated (ideally) or at least minimized.² An air barrier should be stiff and strong enough to resist wind forces, continuous, durable, and air impermeable.³

Vapor Control: Fiberglass or cellulose in the stud cavity are vapor permeable, while EPS, XPS and PIR are moderately permeable, moderately impermeable and completely impermeable respectively.

Insulating sheathing reduces the risk of wintertime condensation by increasing the temperature of the condensation plane, and reduces the risk of summer time inward vapor drives by slowing the vapor movement into the enclosure from storage claddings such as masonry or stucco. The level of vapor control in insulating sheathing walls is determined in the IRC and should be consulted as installing the incorrect vapor control layer or installing the vapor control layer in the incorrect location can lead to building enclosure failure.⁴

Drying: Insulating sheathing limits the drying to the exterior, and the wall must be able to dry to the

interior. Poly vapor barriers are typically avoided so that this drying can occur. The minimum level of vapor control on the interior surface is determined by the IRC. Installing a vapor barrier on both sides of the enclosure 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. Cellulose is often sprayed in damp, and manufacturers recommend drying before close in and moisture content limits.

Durability Summary: The primary durability risks associated with these wall assemblies involve moisture damage related to rain water penetration. Condensation (most likely the result of air leakage, but also potentially the result of vapor diffusion) is decreased with insulating sheathing but may still occur, although the insulating sheathing is less susceptible to moisture related risks than structural OSB sheathing.

BUILDABILITY

Exterior insulation up to 1 1/2" requires minimal changes to standard enclosure construction practices. Exterior insulation in excess of 1 1/2" requires changes to window and wall construction and detailing which requires training and monitoring during the initial implementation.

Cladding can be easily attached to the studs directly through 1" of insulating sheathing. Thicker levels of insulation (>2") require strapping or furring strips anchored to the framing with long fasteners. Some cladding manufacturers allow their cladding to be fastened to the strapping directly.

COST

Advanced framing wall construction decreases the cost required for framing. There is a slight increase in cost for the insulating sheathing to replace most of the structural wood sheathing, but there are measureable cost benefits of saving energy, as well as improvements to comfort, which is difficult to quantify.

MATERIAL USE

If advanced framing is applied correctly (single top plates, correctly sized headers, two stud corners, etc.) the redundant wood framing from standard construction is removed, and the amount of framing will decrease. Using insulating sheathing instead of structural wood sheathing may require using structural panels or bracing in some locations.

SUMMARY

This is highly insulated wall system that will work in extreme climates as part of a high-R enclosure.