

# DOUBLE STUD WALL CONSTRUCTION

## DOUBLE STUD WALL CONSTRUCTION DETAILS (Wall 4)<sup>1</sup>

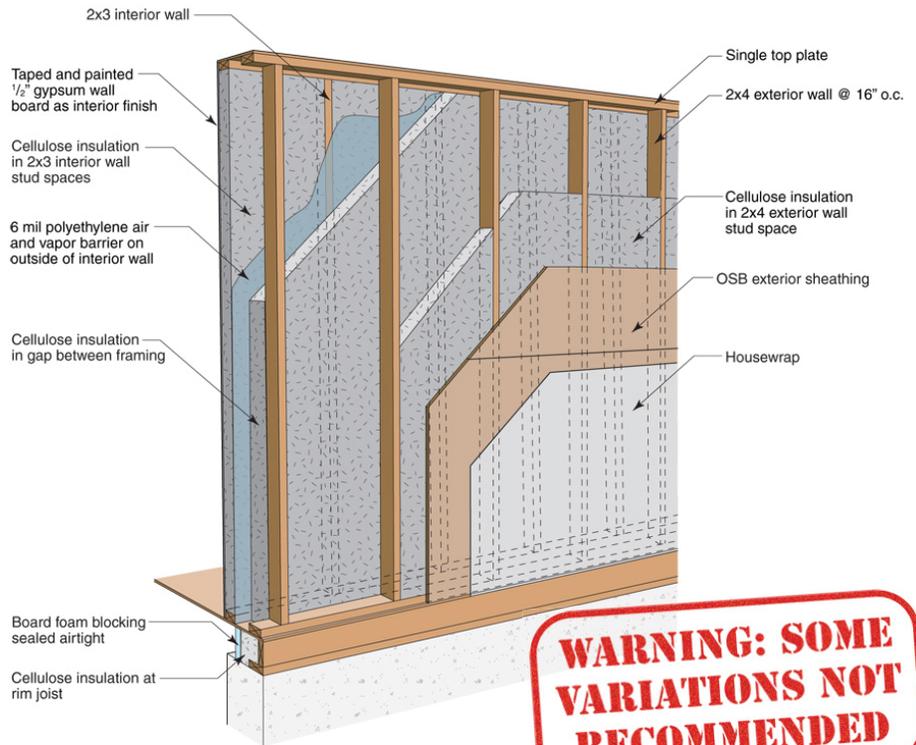
- 2x4 structural exterior wall with cellulose cavity insulation
- 2x3 interior wall with cellulose cavity insulation
- 6 mil polyethylene air and vapor barrier on outside of interior wall
- Cellulose insulation in gap
- OSB exterior sheathing
- Housewrap

## SCORING: HOW IT RATES

The scoring of each wall system is based on the following five categories. A score of 1 is the lowest score in each category and represents the worst possible technology for each category or highest possible relative cost. A score of 5 is the highest score available in each category, and is representative of the best available technology available on the market or lowest relative cost.

|                 |           |
|-----------------|-----------|
| Thermal Control | 4         |
| Durability      | 3         |
| Buildability    | 3         |
| Cost            | 3         |
| Material Use    | 2         |
| <b>Total</b>    | <b>15</b> |

This is a highly insulated wall system that will work in extreme climates, but still has significant risks to moisture related durability issues and premature enclosure failure. This wall system decreases the interior floor area of a fixed floorplan and may experience thermal and moisture issues at the rim joist unless it's detailed correctly.



## INTRODUCTION

This overview summarizes double stud wall construction including the advantages and disadvantages of this construction strategy. A more detailed analysis and direct comparison to several other walls can be found online.<sup>1</sup> The scoring system is subjective based on the relative performance and specifications between different wall systems. 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](http://www.buildingscience.com).

## THERMAL CONTROL

**Installed Insulation R-value:** The thickness of double stud walls varies, however, walls with overall insulation thickness of 9.5" appear to be most common. The insulation can be of either fiberglass batt (R-3.5/inch) or blown cellulose insulation (R-3.7/inch) resulting in overall installed insulation R-values of R-33 and 35 respectively.

**Whole-wall R-value:** Using two dimensional heat flow analysis with thermal bridging effects and average framing factors demonstrates that adding an interior framed wall with a insulation filled gap greatly reduces the thermal breaks through the stud wall and can increase the Clear wall R-value to R-34 depending on the thickness of insulation. However, because of the significant thermal losses at the rim joist, the whole-wall R-value is closer to R-30.<sup>1</sup>

**Air Leakage Control:** Fiberglass batt, and both blown and sprayed cellulose are air permeable materials allowing possible air paths between the interior and exterior as well as convective looping in the insulation. Although densepack cellulose has less air permeance it does not control air leakage.

**Typical Insulation Products:** Fiberglass batt, or blown cellulose; blown fiberglass is another option, but not too common.

## 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 drainage plane such as building paper or a synthetic WRB (i.e. homewrap). Intersections, windows, doors and other penetrations must be drained and/or detailed to prevent the penetration of rain water beyond the drainage plane.<sup>2</sup>

**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.<sup>3</sup>

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 studspace.<sup>4</sup>

**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.<sup>5</sup>

**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 vapor barrier and OSB sheathing. 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. Cellulose is often sprayed in damp, and manufacturers recommend drying before close in and moisture content limits. 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 because cellulose insulation is capable of storing and redistributing small amounts of moisture. Cellulose insulation is typically treated with borates that have been shown 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 very complicated, but does require custom frames around penetrations such as windows and doors. If polyethylene is used as the air barrier, it is critical to seal it perfectly to avoid wintertime air leakage condensation against the sheathing. This construction generally does not address the thermal losses or air leakage at the rim joist. Because the second framed wall is constructed on the interior of the structural wall, the interior floor space is decreased. This wall is quite susceptible to construction deficiencies in the air and vapor barrier.

## COST

The cost of this wall is higher than standard construction, but with a significant increase in thermal performance. This wall construction requires more time and materials for construction.

## MATERIAL USE

The wall framing material is increased significantly by building a secondary interior wall. This wall is often not structural, which means the stud spacing can be wider, and smaller framing lumber can be used provided an even surface is constructed to install the gypsum board. There is also an increase in insulation, but the embodied energy of cellulose is relatively small, and results in large increases in R-value.

## TOTAL SCORE

This is a highly insulated wall system that will work in extreme climates as part of a high-R enclosure, if the air barrier details are perfect, and the thermal losses at the rim joist are minimized. This construction technique does cost the occupant interior floor space with the thick insulated wall. There is significant risk to moisture related durability issues from wintertime condensation, however, the large amount of cellulose in this wall system will be able to buffer some moisture in the enclosure as long as the safe moisture capacity of the cellulose is not exceeded.

## REFERENCES

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