

STANDARD WALL CONSTRUCTION

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DETAILS (Walls 1A and 1B)¹

- 2x4 or 2x6 framing
- Fiberglass or cellulose cavity insulation in stud space
- Exterior sheathing
- Housewrap

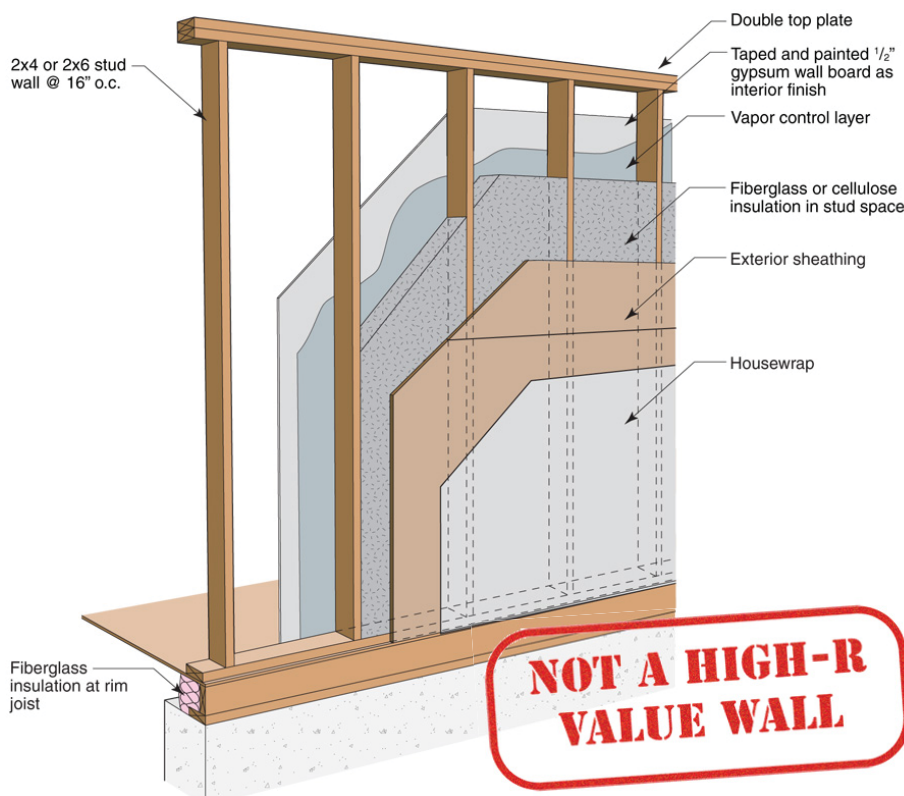


SCORING: HOW IT RATES

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	1
Durability	3
Buildability	5
Cost	5
Material Use	3
Total	17

This wall has been the standard of construction for many years in many places but no longer meets the energy code requirements for insulation in some climates. Many higher performance designs exist.



INTRODUCTION

This overview summarizes standard wall construction including the advantages and disadvantages of this construction strategy. A more detailed analysis and direct comparison to other walls can be found online.¹ 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.

THERMAL CONTROL

Installed Insulation R-value: There is a range of installed insulation R-values in commercially available fiberglass batts. The installed insulation R-value for 2x4 fiberglass batt ranges between R-11 and R-15 and for 2x6 the range is between R-19 and R-21. When blown or sprayed cellulose insulation is used, the R-values are typically R-13 for 2x4 and R-20 for 2x6 walls.

Whole wall R-value: Using two dimensional heat flow analysis with thermal bridging effects and average framing factors, a 2x4 wall with R-13 studspace insulation has a whole-wall R-value of R-10. Similarly a 2x6 wall with R-19 stud space insulation has a whole wall R-value of R-13.7.¹ The framing factor used for standard construction framing 16 inches on center is 25%.² These whole wall R-values could decrease even further if there is significant air leakage or convective looping, or increased framing factor.

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, blown fiberglass, blown cellulose, sprayed cellulose.

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.³

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.⁴

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 studspace is possible if this type of airflow occurs, depending on the weather conditions. Hence, wall designs should control airflow into the studspace.⁵

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.⁶

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 vapor control 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

Wood-framed walls with OSB exterior sheathing and fiberglass or cellulose insulation represent the most common wall assembly used in the construction of low-rise residential buildings in North America. Designers, trades and supply chains are well equipped to produce these walls and education is primarily needed to improve durability through better rainwater control and thermal performance through better air tightness and insulating practices.

COST

The cost to build this type of wall is well accepted, and is used as a baseline. Costs vary tremendously from region to region.

MATERIAL USE

This wall design contains redundant wood framing and wood sheathing. Framing lumber could be minimized further if advanced framing was used. In most of America, much of the sheathing could be removed. Cellulose has a significantly lower embodied energy than fiberglass or rockwool.

TOTAL SCORE

This wall has been the standard of construction for many years in many places. This wall no longer meets the energy code requirements for insulation in many climates, and thermal control requirements will only continue to increase. This wall system is difficult to air seal adequately and prone to air leakage related condensation and energy losses. Using advanced framing will reduce framing materials, and the cost of framing. Although this construction technique is usually allowed by code, many higher performance designs exist.

REFERENCES

- 1 Straube, J., & Smegal, J. (2009). *Building America Special Research Project - High-R Walls Case Study Analysis*. Retrieved from buildingscience.com.
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