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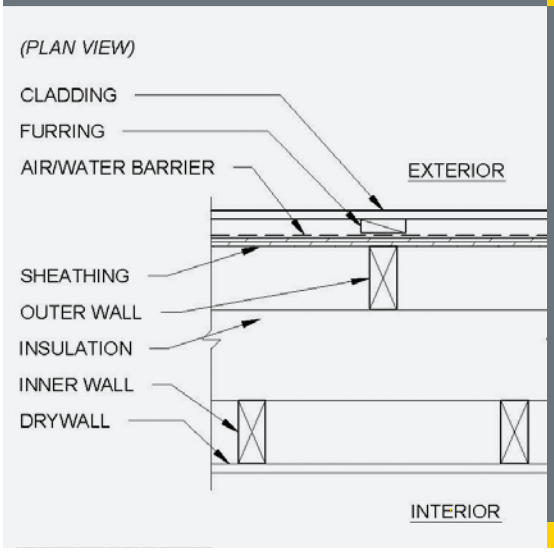


Building America Case Study
Technology Solutions for New and Existing Homes

Construction Guidelines for High R-Value Walls without Exterior Rigid Insulation

Cold Climate Region

PROJECT INFORMATION

Project Name: High R-Value Walls

Location: Northeast United States

Partner: CARB, *carb-swa.com*

Building Component: Double-stud cellulose walls

Application: New and retrofit; single- and multifamily

Years Tested: 2012–2014

Applicable Climate Zones: 5 and colder

ASSEMBLY CONSTRUCTION

Interior Vapor Retarder: Vapor retarder paint—0.5 perm per manufacturer

Framing: Double-stud 2 × 4 walls, 16″ on center (o.c.)

Insulation: Dense-pack cellulose, R3.6/in.

Sheathing: Oriented strand board with integrated water-resistant barrier (0.3 perm at 0% RH/13 perm at 100% RH)

Siding: Vinyl; assumed 10 air changes per hour ventilation behind siding

Building America® U.S. Department of Energy

High R-value wall assemblies that are R-40 and greater are gaining popularity in the market due to programs such as the U.S. Department of Energy (DOE) Zero Energy Ready Home program, Passive House, Net Zero Energy Home challenges in several states, and deep energy retrofit programs that are highly incentivized at the federal and state levels. In response to the demand, several builders have successfully used double-wall systems to achieve higher R values in thicker framed walls. To builders of conventional stick-framed homes, one of the most appealing features of double-wall systems is that there are very few new exterior details. Exterior sheathing, structural bracing, house wrap or building paper, window and door flashing, and siding attachment are usually identical to good details in conventional framed-wall systems.

Even though the details are very similar to conventional stick framing, there is sometimes less room for error in double-wall systems. Several studies have confirmed the occurrence of colder temperatures of exterior sheathing in high R-value wall assemblies that do not have exterior rigid foam insulation. These colder temperatures can lead to increased chances for condensation from air exfiltration, so they present potential for moisture-related problems.

The Consortium for Advanced Residential Buildings (CARB), a DOE Building America team, conducted a study to learn more about this issue. The resulting information presented here is intended to reduce the risk of failure in these types of assemblies, increase durability, and reduce material brought to landfills because of failures and resulting decay. Although this document focuses on double-wall framing techniques, the majority of the information on how to properly construct and finish high R-value assemblies is applicable to all wall assemblies that do not have foam insulation installed on the exterior of the structural sheathing. Through field studies, the techniques presented here have been shown to reduce the likelihood of mold growth and moisture-related damage; they are intended for builders, framing contractors, architects, and consultants involved in designing and building superinsulated homes. The information is applicable to both new construction and gut rehab projects in Climate Zones 5 and colder.

DESCRIPTION

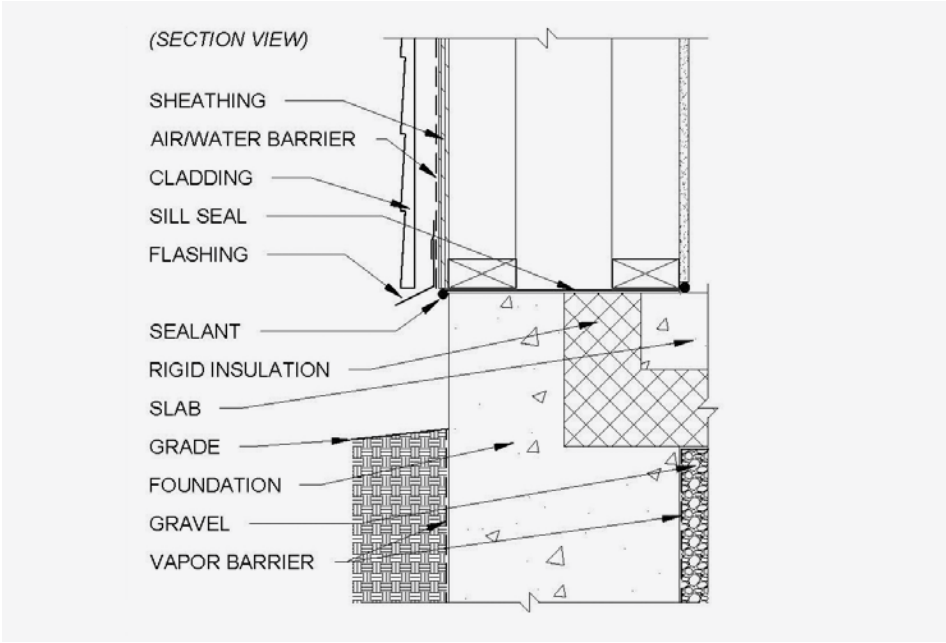
Once the proper moisture control strategies are installed at the foundation level, wall framing can begin. The exterior load-bearing wall will be constructed first. The builder has the flexibility to decide if the second wall is installed next or if it is installed after the building is dried in.

Inner and outer wall framing is typically framed with 2×4s at 16″ o.c. Inner and outer wall studs do NOT need to be offset. The distance between inner and outer wall framing varies depending on desired R-value. Overall depth typically does not exceed 16″ (refer to insulation manufacturer's installation guidelines.)

Dense-blown cellulose, blown fiberglass, or open-cell spray foam can be installed to full depth. If using a combination of products, proper attention must be paid to the ratio of air-impermeable insulation (closed-cell foam) to air-permeable insulation (fiberglass, cellulose) or condensation problems could occur.

For more information, see the Building America report *Guidelines for High R-Value Walls without Exterior Rigid Insulation* at *buildingamerica.gov*.

Image credit: All images were created by the CARB team.



One option for double-wall/slab-on-grade connection.

Lessons Learned

Both modeling and field studies have shown that temperatures of the exterior sheathing of walls without exterior rigid insulation are more prone to experience condensation from air exfiltration. The key steps to ensuring long-term durability of these types of wall structures include:

- Ensuring that the moisture content of building materials remains < 12% during construction
- Implementing meticulous air sealing
- Installing adequate mechanical ventilation to manage indoor relative humidity (RH) levels
- Installing a robust water-resistant barrier
- Providing a vented cladding system.

Looking Ahead

These recommendations have been created to help reduce the risk of moisture-related damage with a particular focus on high R-value assemblies that have no exterior rigid insulation installed over the exterior structural sheathing—such as double walls, Larson truss assemblies, and structural insulated panels. The recommendations are based on research conducted to date and on current best practices.

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