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Building America U.S. Department of Energy
Research Toward Zero Energy Homes

CARBNews
Consortium for Advanced Residential Buildings

Residential wall systems: R-30 and beyond

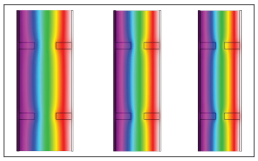
Hello readers, After a short hiatus, CARBNews is back with a new look and exciting line up of projects and research to share.

Based on experience with builders across the country, CARB researchers have written a paper describing three builder-friendly wall systems with R-values of 30 or higher. The paper is being presented at the BEST2 conference (Building Energy Science and Technology) which takes place in Portland, OR in April 2010.

DOUBLE WALLS

The double walls described here consist of an exterior, load bearing 2x4 frame wall and a separate 2x4 frame wall built 2-5" inside the outer wall. When finished, this wall cavity (9-12" deep) is usually filled with blown cellulose insulation. ***Whole wall R values of R-26 to R-42 can be achieved with 1-5" gap between the walls.*** One major appeal of this system to builders is the construction and details are almost identical to those in conventional frame construction: flashing, siding, drywall, electrical, etc. are usually quite routine.

Click on the image to view a case study report of a recent CARB project featuring double walls



Click on the image to view an article on thermal bridging in staggered and in-line studs in double walls

The big cost in the double wall system is framing time and labor. Framing the inner wall can sometimes take longer than framing the outer wall, as it takes time to carefully align window and door openings. Complicated plans and inefficient framing practices can further increase the amount of wood and time required.

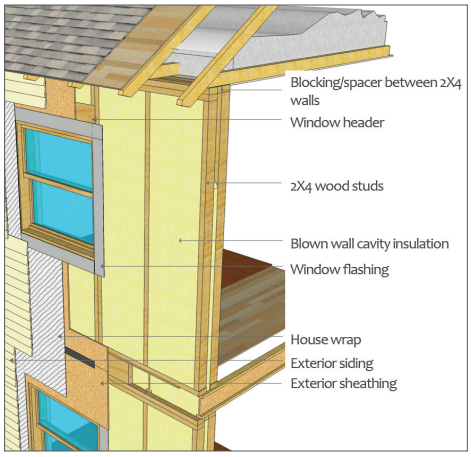


Fig 1: Simple cut-away details of double wall construction

FRAMED WALLS WITH FOAM SHEATHING

Applying exterior foam sheathing to framed walls is becoming more widespread. To achieve R-30 performance, 3-5" of exterior rigid foam is usually required (though 2x4 interior wall framing can sometimes be used instead of 2x6 to reduce costs). As with double walls, builders are familiar with the frame portion of construction, and there are few changes required by electricians or drywallers.

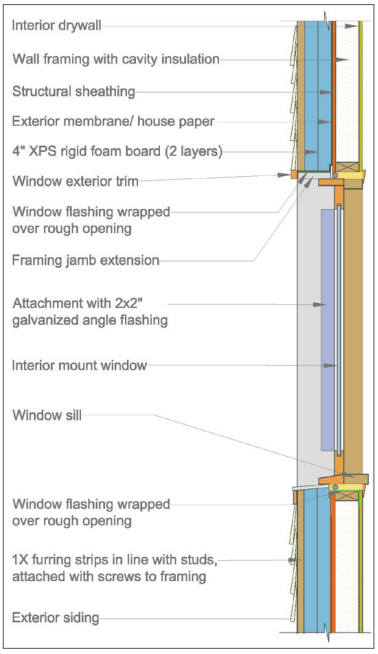


Fig 2a: Interior Mount window: Installed at the plane of exterior structural sheathing. Requires extension jambs to the exterior which are attached to the house using angle flashing

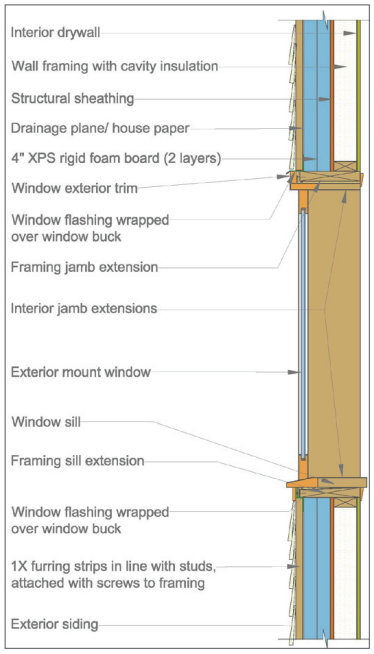


Fig 2b: Exterior Mount Window: Installed at the outer-most plane of rigid insulation. Windows are attached to a window buck spanning the entire depth of the opening

Wall studs	Dim. (in)	R values (ft²hr°F/Btu)				
		XPS	Cavity	Whole-Wall		
				15% FF	20% FF	25% FF*
2x4	3.5	20	13	34	33	33
2x6	5.5	20	20	40	39	38

Table 1: Nominal and whole-wall R values for framed walls+sheathing and cavity insulation of R 3.7 per inch.
** Framing Factor*

On the outside, however, window installation and weatherproofing require builders to learn a few new details. (See figure 2 for details of window installation and location of drainage plane). Siding is usually attached to furring strips; these furring strips, in turn, are typically attached to the framing with long (5-6") fasteners. These fasteners can be expensive, and attaching furring and siding takes more time than in standard frame construction.

Inside...

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STRUCTURAL INSULATED PANELS (SIPS)

SIP construction is very different from the previous two systems, as it is not based on platform frame construction. SIPs usually consist of rigid foam "sandwiched" between OSB sheets. Panels are typically sent from the factory pre-cut and numbered, and they're quickly put in place on site, often with the help of cranes or lifts.

Because there are no wall cavities, some trades – especially electricians – must make adjustments to panel construction. Because it is quite different from frame construction, there is a larger learning curve for builders when moving to SIPs. But many SIP builders find a dramatic increase in the speed of construction with less time needed to enclose a building - offering net cost savings.

Whole-wall R values for SIPs with EPS foam core range from R-14 to R-36 based on thickness of 4.5" to 10.25" EPS SIP respectively.

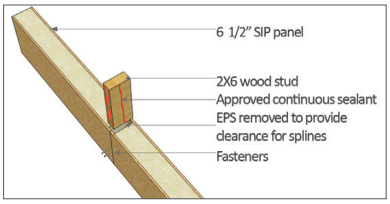


Fig 3a: 2x6 stud panel spline

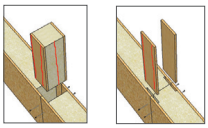


Fig 3b & 3c: Insulated block spline & OSB panel splines

Fig 3: Panel splines: Structural attachments are required at the vertical seams between panels. These attachments, or splines, are most often one of the three configurations shown above.

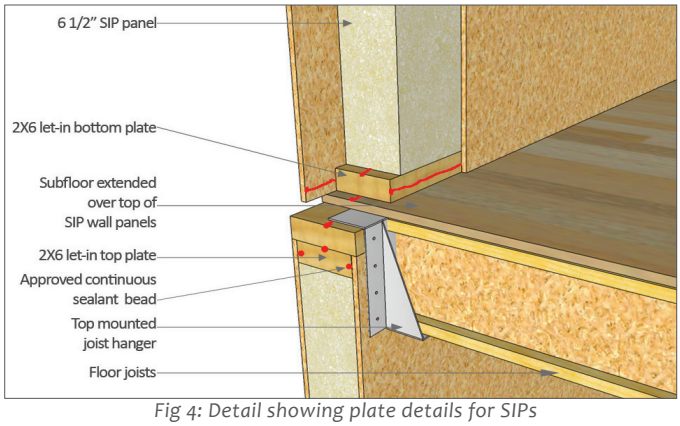


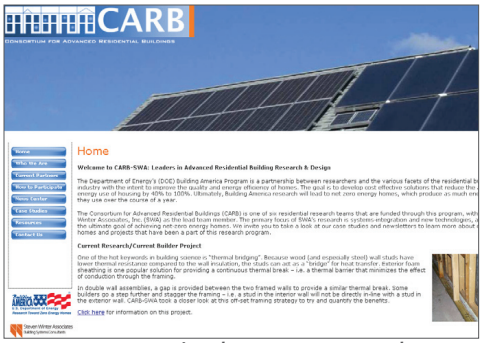
Fig 4: Detail showing plate details for SIPs

COSTS

Obviously, it costs more to build an R-30 wall than a conventional 2x6 framed wall. Costs vary regionally, over time, and from contractor to contractor. CARB's best estimate, however, is that incremental cost for these systems is $1,500 - $3,500 for 100 linear feet of 8' wall. With all of these wall systems, there are substantial cost savings when the building plan is relatively simple (fewer angles, very few non-right angles, standard dimensions, etc.).

Fig 5: SIP walls being set on a small home

New website launched!



We are excited to announce the launch of the new and improved CARB-SWA website. The new site has a fresh look and an easy to use site navigation featuring important information for interested builders and homeowners.

It offers general participation information for interested builders, case studies on past projects, building design guide white papers, and published articles (including CARBNews).

Upcoming features in the pipeline for the website include more design white papers, research papers, and 3D models of high performance building details with interactive filters and search facilities.

Click on the image above or here to visit the site.

CARB is the Consortium for Advanced Residential Buildings, a "Building America Energy Efficient Housing Partnership" Industry team within the Building America Program, part of the Department of Energy, Efficiency and Renewable Energy, Building Technologies Program.

For further information, comments and suggestions for inclusion in CARB News, please contact

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More CARB information and an archive of past issues are available on the CARB website.