Increasing Insulating Value in Stud Frame Wall Construction
Michigan State University
Cooperative Extension Service
Energy Facts
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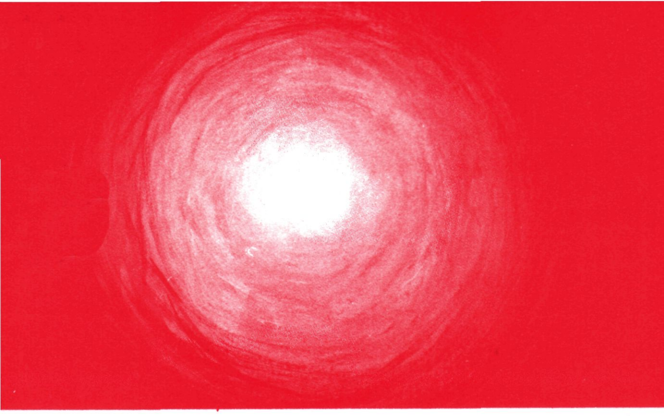

ENERGY FACTS

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INCREASING INSULATING VALUE

IN STUD FRAME WALL CONSTRUCTION

Energy efficient wall construction can increase R values* to 20, 30, or even 50 and more. New techniques for stud frame construction, beyond minimum insulation requirements, can reduce heating and cooling costs.

*R value refers to the resistance of a material to the transmission of heat. Increased insulation results in higher R value and reduced heat loss.

Three Framing Techniques

This publication looks at three framing techniques and some common methods of insulating wood frame walls.

The 2 × 4 stud wall, with studs 16 inches apart, is the most common wood framing method and can be insulated up to around R 20 with standard construction practices. The 2 × 6 stud wall, on

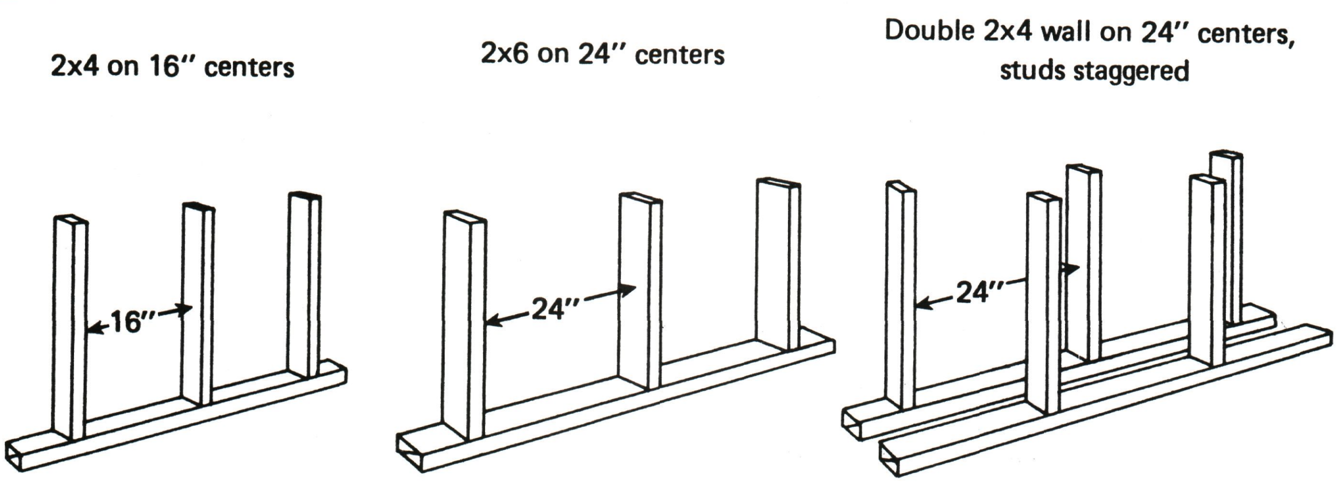

Figure 1. Illustration of Three Wall-Framing Sections.

16 in. or 24 in. centers is becoming more popular in an attempt to approach "superinsulation" while still using more or less standard framing techniques. Finally, double-wall framing is sometimes used, with potential R values of 40 and more (see Figure 1). Other, more exotic, superinsulation techniques have been successful, but generally result in high labor or material costs and questionable return on investment.

How to Insulate

Forcing more insulation into the same size wall cavity does not increase its R value. Double-wall, or 2×6 framing results in thicker outside walls with more space for additional insulation.

Because wood is a poor insulator, there is very little insulating value where studs connect inside and outside wall surfaces. With 16 in. stud spacing this amounts to about 15% of the total wall surface. This problem can be eliminated with double-wall construction. Use of rigid foam insulation boards between siding and 2×4 or 2×6 framing will also reduce this thermal bridging.

In addition, the required air-vapor barrier can be installed one-third of the way into the winter-warm side of the insulation with a double-wall and need not be penetrated by electrical and plumbing runs (see Figure 5). An unbroken air-vapor barrier is an ideal way to minimize air infiltration which otherwise can result in 40% of heat loss in winter. Continuous air-vapor barriers are critical for best possible energy efficient construction.

Beyond the fiberglass, rock wool, cellulose or other insulation that fills the wall cavity, rigid insulation boards can be installed under the exterior siding and interior dry wall. The type and thickness of these panels determines the R value (see Figures 2-5).

When deciding on the desired amount of insulating value, consider construction costs as well as potential savings in heating dollars. Figures 2-5 are examples of four wood frame walls, their R values, and the cost of 100 sq. ft. of materials. Use these costs for comparison only. Actual costs will vary. The total cost of constructing a "super insulated" building can add 10 percent or more to the price of a house. On the other hand, a careful investment in a continuous air-vapor barrier and added insulation can cost little or no more than minimum insulation standards, especially if this allows use of a lower cost heating system.

Building codes, ingenuity, and budget are the only limits to designing insulation value into wall structures. Table 2 shows a cost comparison for the four examples (Figures 2-5). Costs for double walls may be 1½ times the cost of minimum insulation. (Local material and labor costs can make a significant difference from those shown in the tables.) Some builders have experience with highly insulated walls. Any construction method unfamiliar to framing contractors will take more time and therefore cost more than standard techniques. For example, double-wall construction requires more time when installing doors and windows since factory-built units are designed for 2×4 stud walls.

Table 2

Estimated Costs for Comparison of Four Wood Frame Wall Sections.*

	1200 square foot house (950 sq. ft. wall area)			2000 square foot house (1250 sq. ft. wall area)		
Example	**Materials**	**Labor**	**Total**	**Materials**	**Labor**	**Total**
Fig. 2	$ 972	$1430	$2402	$1279	$2290	$3569
Fig. 3	1047	1430	2477	1378	2290	3668
Fig. 4	1209	1440	2649	1591	2300	3891
Fig. 5	1540	1730	3270	2027	2770	4797

**Based on $15.00 per hour union carpenter labor costs for Lansing, Michigan.*

Some Other Considerations

It is important to keep in mind the whole house as a system when designing for energy efficiency. Attic, basement, and window insulation values are important in thermal performance. Structure siting, landscaping, placement of doors and windows are just as important. Carefully installed infiltration barriers, caulking and weatherstripping are highly cost-effective. A well insulated and tightly constructed house will also require a smaller space heating system. Installing too large a furnace reduces efficient operation of the system.

In addition, an air to air heat exchanger may be desirable in maintaining a healthy environment while keeping in the heat. Whatever wood frame wall insulation technique you choose for your home, use local estimates for the cost of building materials and labor and consider that most predictions are for ever higher costs for heating fuels.

References and Resources

Major Energy Conservation Retrofits: A Planning Guide for Northern Climates, U.S. Department of Energy DOE/CE/15095-11, March 1984.

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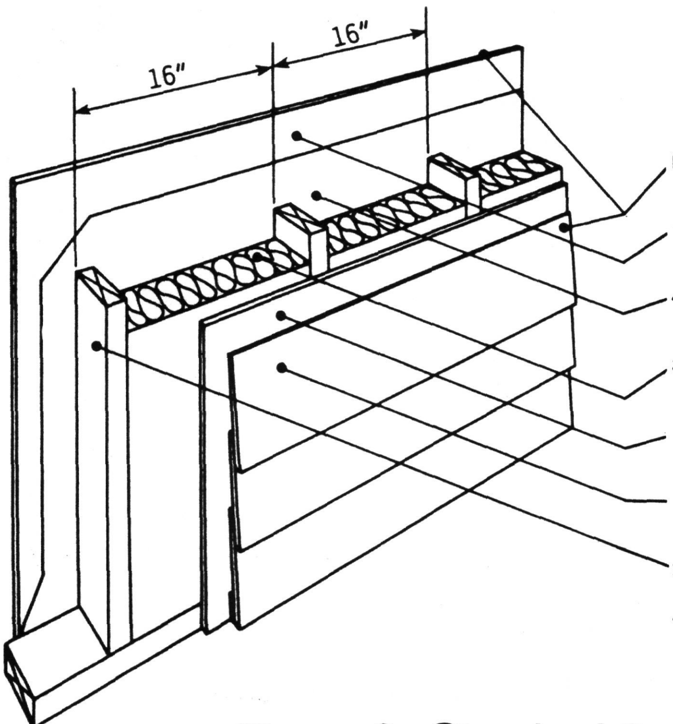
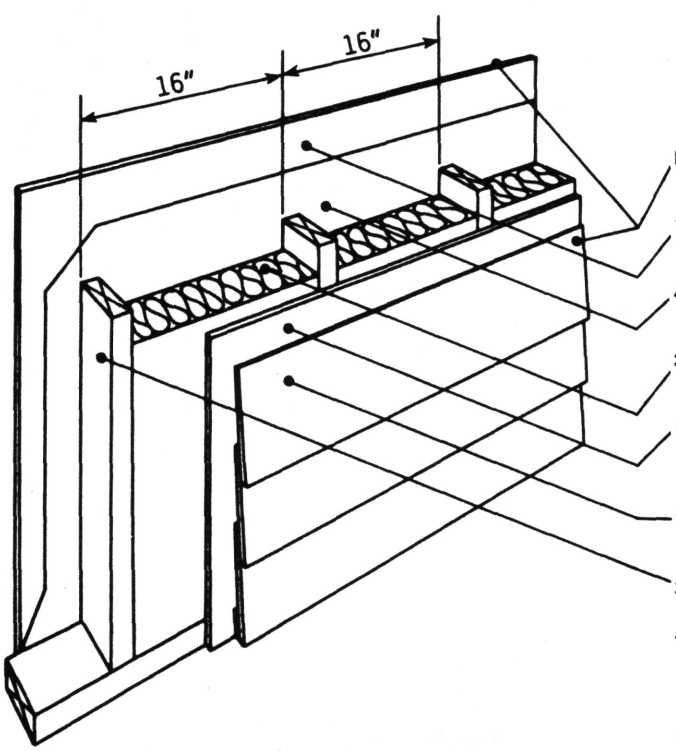


	R Value		Cost/100 sq. ft. of Materials
Both Surfaces	0.9		—
½" Gypsum Board	0.5		12.85
4 mil Vapor Barrier	0.0		2.20
3½" Fiberglass Batt	11.0		15.48
½" Fiber Board	1.2		15.19
½" Wood Siding	1.0		46.90
2" x 4" Studs	--		9.60
TOTAL RESISTANCE	**14.6**	**TOTAL COST**	**$102.32**

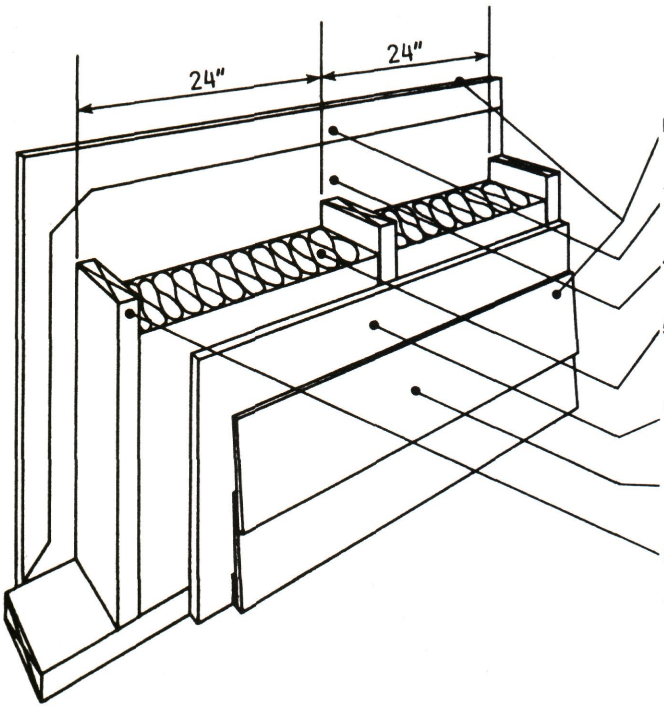
Figure 2. Standard Construction Practice.



	R Value		Cost/100 sq. ft. of Materials
Both Surfaces	0.9		—
½" Gypsum Board	0.5		12.85
4 mil Vapor Barrier	0.0		2.20
3½" Fiberglass Batt	11.0		15.48
¾" Extruded Polystyrene (EPS)	3.75		23.19
½" Wood Siding	1.0		46.90
2" x 4" Studs	—		9.60
TOTAL RESISTANCE	**17.15**	**TOTAL COST**	**$110.22**

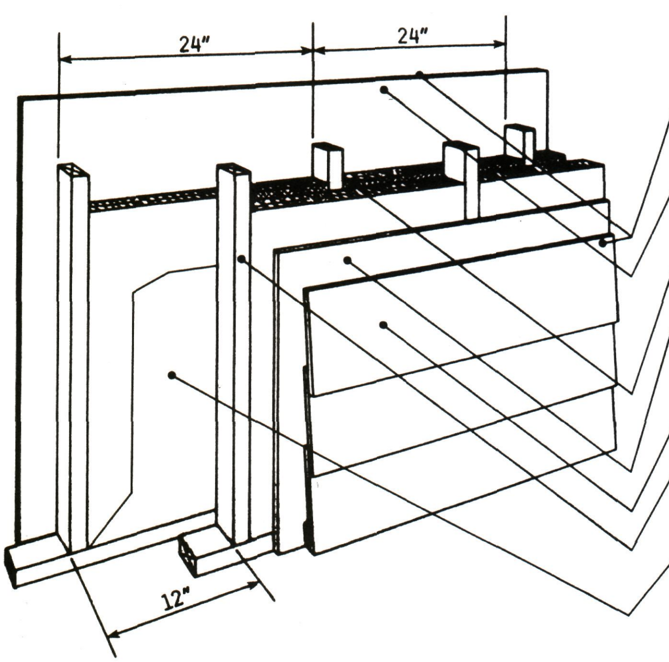
Figure 3. Fiberboard Replaced with Extruded Polystyrene (EPS).

Drawings in this bulletin supplied by Thomas Greiner, Extension Horticulture Engineer, Iowa State University.



	R Value		Cost/100 sq. ft. of Materials
Both Surfaces	0.9		—
½" Gypsum Board	0.5		12.85
4 mil Vapor Barrier	0.0		2.20
5½" to 6" Fiberglass Batt	19.0		26.55
¾" Extruded Polystyrene (EPS)	3.75		23.19
½" Wood Siding	1.0		46.90
2" x 4" Studs	—		15.58
TOTAL RESISTANCE	**25.15**	**TOTAL COST**	**$127.27**

Figure 4. A 2 x 6 Framing Technique with EPS.



	R Value		Cost/100 sq. ft. of Materials
Both Surfaces	0.9		—
½" Gypsum Board	0.5		12.85
12" Fiberglass Batt	38.0		53.10
1" Extruded Polystyrene (EPS)	5.0		30.76
½" Wood Siding	1.0		46.90
2" x 4" Studs (two stud frame walls with 5" between walls)	--		16.32
4 mil Vapor Barrier	0.0		2.20
TOTAL RESISTANCE	**45.4**	**TOTAL COST**	**$162.13**

Labor costs will be greater for this framing technique.

Figure 5. Double 2 x 4 Staggered Framing.

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