PIMA Technical Bulletin #304

Energy Efficiency with the WarmWall[cm] System

About Polysio Insulation

Polyiso is a rigid foam insulation used in over 70% of commercial roof construction, in commercial sidewall construction and in residential construction.

The Benefits of using Polyiso include:

- *Quality Mark™ certified LTTR-values*
- *Highest R-value per inch of thickness*
- *Excellent fire test performance*
- *Moisture resistant*
- *Dimensional stability*
- *Superior compressive strength*
- *Extensive building code approvals*
- *Cost effective*
- *Recycled content*
- *Zero ozone depletion potential*
- *Virtually no global warming potential*
- *Preferred insurance ratings*
- *Nationwide availability*
- *Thinner walls and roofs with shorter fasteners*
- *Compatible with most roofing systems*

PIMA and polyiso products have received many environmental awards. These include an honorable mention in the Sustainable Buildings Industry Council's (SBIC) 2003 "Best Practice" Sustainability Awards Program and the U.S. EPA's Climate Protection Award for the association's leadership in promoting energy efficiency and climate protection. The EPA also awarded PIMA and its members the Stratospheric Ozone Protection Award for "leadership in CFC phase-out in polyiso insulation and in recognition of exceptional contributions to global environmental protection."

POLYISO
The top performer.

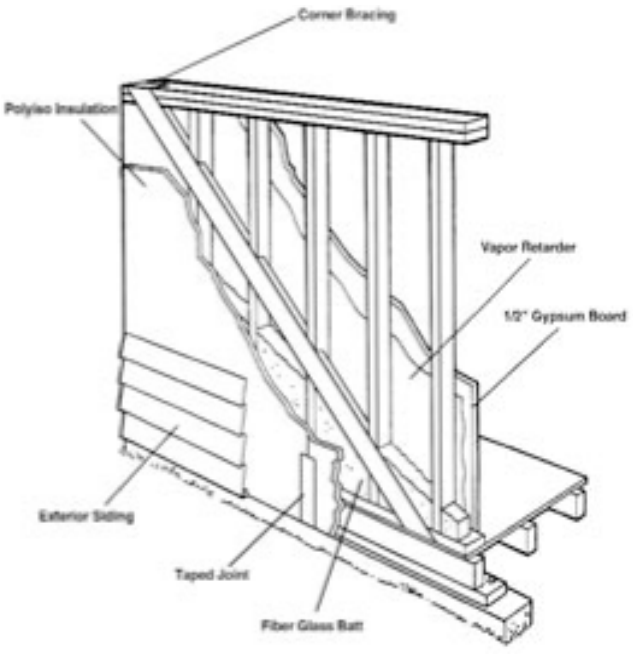
WarmWall[cm]
The Superior Sheathing System

The Superior Sheathing System.

The Polyisocyanurate Insulation Manufacturers Association (PIMA) features WarmWall[cm] - the Superior Sheathing System. WarmWall[cm] is an innovative building concept utilizing foil faced polyiso insulation sheathing to provide a complete envelope of insulation on the exterior of a home. The WarmWallcm concept is extremely beneficial to both wood and steel framed construction, providing insulation over 100% of the exterior walls and increasing the overall thermal performance of a home.

What is the WarmWall[cm] System?

- Proper corner bracing of framing;
- Insulates 100% of the exterior framed walls with foil faced polyiso insulation keeping energy loss to a minimum;[1]
- The exterior joints of the polyiso insulation sheathing are taped to prevent air infiltration;
- Conventional glass fiber batt insulation is placed between the wood or steel framing;
- In heating or mixed climates, a continuous vapor retarder is applied on the interior side of the studs;
- Gypsum board, minimum 1/2" thick, is applied to the interior; and
- Exterior finish is applied in accordance with the manufacturer's recommended application instructions, over the polyiso insulation sheathing.



The WarmWall[cm] System

[1] Savings can vary. Find out why in the insulation sellers fact sheet on R-value. Higher R-values mean greater insulating power.

Energy Efficiency

Energy efficiency is one of the most important factors influencing the monthly operating cost of a home, and is affected by many variables. The building envelope, walls, attic or roof, windows, doors, and the foundation all play major roles. The builder must also be aware of the energy code for the area where the home is to be built. Most states have required energy codes affecting new home construction. The knowledgeable homeowner can have important input in creating an energy efficient home.

The Attic

In most homes today, attic or flat ceilings are insulated with batt or blown-in glass fiber insulation products. The increasing use of cathedral or vaulted ceilings makes polyiso insulation the preferred choice for this application. With either type of construction, the R-value required by the energy code for the geographic location of the home should be installed. Ventilation of the attic and ceiling spaces throughout the home according to the local building code is critical to the performance of the installed insulation.

Windows and Doors

The selection of windows and doors for the home is another critical variable. Products with good energy efficiency performance and air infiltration resistance should be selected to complement the total wall envelope. The knowledgeable homeowner, along with the help of the builder, can select products to enhance the design of the home and provide efficiency.

The Foundation

An important area to remember is the foundation and/or slab - the part of the home that is below-grade and out of sight. The walls of the basement and/or below the slab should be insulated as required by the local energy code for the climate zone of the area where the house is being constructed. Thin profile polyiso insulation is often used below the slab or on the interior of basement walls. When used on the interior of basement walls, the insulation should be covered by a thermal barrier, such as gypsum board, as required by the local building code.

The Walls

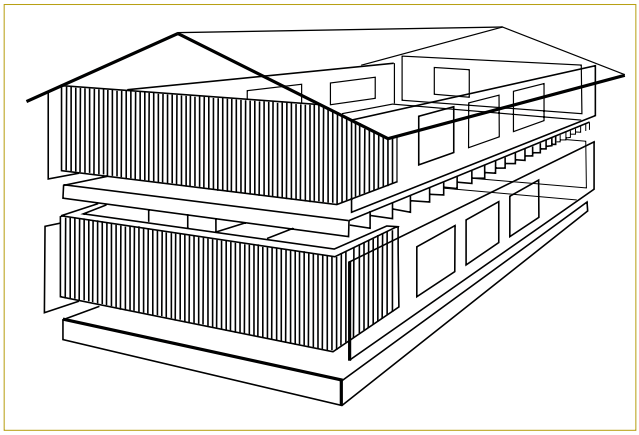
In the walls of the home, polyiso insulation is the main component of the WarmWallcm system, providing insulation over the entire solid building envelope and eliminating the low R-value areas caused by the framing.

Energy Efficiency and Framing

In homes constructed with wood or steel framing, a significant energy loss occurs at the framing where glass fiber batt insulation insulates only the cavity or open space between the framing. The wood framing, 2x4 or 2x6 studs, provides a low level R-value, while the steel framing essentially provides a thermal short circuit through the wall. If structural sheathing such as OSB or plywood is used over 100% of the opaque wall area, it is critical to consider the use of the WarmWallcm system. OSB or plywood has an R-value of approximately 0.5. The use of 1 inch of polyiso insulation with an R-value of 7.2 delivers almost 15 times the insulation value of the structural sheathing. This increased R-value insulates the framing, thereby greatly increasing the overall energy efficiency of the home.

Wood Framing

The wood framing on a house, represented by the studs, headers, plates and other structural components, can contribute to a 25% energy loss. The illustration demonstrates this concept. The effect of the framing factor can be shown in the calculations for a standard wall construction versus the WarmWallcm system.



The WarmWall[cm] System

Framing:	2x4,	16" o.c.
Cavity Insulation:	R-13	glass fiber
Sheathing:	1"	polyiso sheathing
Siding:	Vinyl	

Component	**R-value at cavity**	**R-Value at frame**
Inside air film	0.68	0.68
Gypsum board	0.45	0.45
Vapor retarder	-	-
Cavity insulation	13.0	-
Wood studs	-	4.38
1" polyiso sheathing	7.20	7.20
Vinyl siding	0.61	0.61
Outside air film	0.17	0.17
Total R-value	**22.11**	**13.49**

$$U \text{ value} = \frac{0.75}{22.11} + \frac{0.25}{13.49} = 0.0525$$

$$\text{Wall R-value} = \frac{1}{U} = \frac{1}{0.0525} = \mathbf{19.05}$$

Standard Wood Stud Wall Construction

Framing:	2x4,	16" o.c.
Cavity Insulation:	R-13	glass fiber
Sheathing:	7/16"	OSB
Siding:	Vinyl	

Component	**R-value at cavity**	**R-Value at frame**
Inside air film	0.68	0.68
Gypsum board	0.45	0.45
Vapor retarder	-	-
Cavity insulation	13.0	-
Wood studs	-	4.38
7/16" OSB sheathing	0.60	0.60
Vinyl siding	0.61	0.61
Outside air film	0.17	0.17
Total R-value	**15.51**	**6.89**

$$U \text{ value} = \frac{0.75}{15.51} + \frac{0.25}{6.89} = 0.0846$$

$$\text{Wall R-value} = \frac{1}{U} = \frac{1}{0.0846} = \mathbf{11.82}$$

The WarmWall[cm] System Benefits for Wood-Framed Walls

The WarmWallcm system, along with the normal good construction practices of the builder, provides an energy efficient wall system that improves the overall wall R-value by 60% compared to conventional wood frame construction. In addition it controls water penetration from the exterior, condensation from the interior, and air infiltration.

- The WarmWallcm system, using standard 2x4 wood stud construction can provide an additional total wall R-value of 7.23, compared to a wall with wood sheathing such as plywood and OSB.
- The WarmWallcm system with 2x4 wood framing, even out-performs a wood frame wall using 2x6 wood framing, R-19 batt insulation, and wood sheathing. The 2x4 WarmWallcm system has a wall R-value of 19.05 versus the 16.26 for the 2x6 construction.

Steel Framing

With steel framing, a significant thermal short circuit or thermal bridge occurs at the studs, conducting heat rapidly through the wall system. While the steel web thickness is small, heat flows quite readily through steel. This thermal short circuit can result in a major reduction in the overall wall R-value. An effective way to minimize this effect is through the use of the WarmWallcm system, incorporating polyiso insulation sheathing on the exterior of the wall.

The reduction in overall wall R-value occurs as the thermal short circuit of the steel studs causes the cavity insulation to perform at approximately 50% of the listed or rated R-value. From

Component	**Standard**	**WarmWall**
Inside air film	0.68	0.68
Gypsum board	0.45	0.45
Vapor retarder	-	-
Cavity insulation (R13 x 0.5)	6.5	6.5
Steel studs (2x4)	-	-
1" polyiso sheathing	-	7.20
7/16" OSB sheathing	0.60	-
Vinyl siding	0.61	0.61
Outside air film	0.17	0.17
Total R-value	**9.01**	**15.61**

2x6 Wood Stud Wall Construction

Framing:	2x6,	16" o.c.
Cavity Insulation:	R-19	glass fiber
Sheathing:	7/16"	OSB
Siding:	Vinyl	

Component	**R-value at cavity**	**R-Value at frame**
Inside air film	0.68	0.68
Gypsum board	0.45	0.45
Vapor retarder	-	-
Cavity insulation	19.0	-
Wood studs	-	6.88
7/16" OSB sheathing	0.60	0.60
Vinyl siding	0.61	0.61
Outside air film	0.17	0.17
Total R-value	**21.51**	**9.39**

$$U \text{ value} = \frac{0.75}{21.51} + \frac{0.25}{9.39} = 0.0615$$

$$\text{Wall R-value} = \frac{1}{U} = \frac{1}{0.0615} = \mathbf{16.26}$$

ASHRAE 90.2, Energy Efficient Design of New Low-Rise Residential Buildings, a correction factor of 0.50 and 0.40 is applied to 2x4 and 2x6 steel studs at 16" o.c. respectively. The use of 1.0" of polyiso sheathing adds a R-value of 7.2 to the wall. This is shown in the calculations.

The WarmWall^{cm} System Benefits for Steel Framed Walls

The WarmWallcm system, along with the normal good construction practices of the builder, provides an energy efficient wall system with improved overall wall R-value of 73%, compared to standard construction. Other benefits include controlling water penetration from the exterior, condensation from the interior, and air infiltration.

- A standard steel wall with wood sheathing has an overall wall R-value of 9.01, which is well below the R-value of the cavity insulation.

- The WarmWallcm system improved the R-value to 15.61, a 72% increase over the steel framing construction without polyiso sheathing – a significant improvement in energy efficiency, resulting in lower energy costs.

Meeting Energy Efficiency Requirements

The amount of insulation required for the building envelope of a home will depend on the area of the country where the home is located, type of heating and/or cooling (gas, oil, or electricity) equipment installed, and other components such as windows and doors. In all cases, the area where the home is to be constructed will be covered by an energy code. The local building officials in your area will have the information available and the builder should be aware of the requirements. To learn more about energy efficiency for the home the following sources are available:

Building Codes Assistance Project
www.crest.org/efficiency/bcap
202-530-2221

Department of Energy
www.energycodes.org
800-270-CODE

Oak Ridge National Laboratory
www.ornl.gov/%7Eroofs/Zip/ZipHome.html

Energy Star Program
www.energystar.gov
888-STAR-YES

Energy Efficiency and Renewable Energy Clearinghouse
www.eren.doe.gov/erec/factsheets
800-DOE-3732

The WarmWall[cm] System Provides:

- **A wall system with a high R-value -** increasing the energy efficiency of the home and significantly reducing heat loss;
- **A reduction in air infiltration and exfiltration -** increasing the overall performance of the wall and reducing heat loss;
- **A reduction in the risk of water condensation/intrusion -** increasing thermal and structural performance and reducing builder call backs;
- **Insulation over the entire framing members -** reducing the loss of energy from the home;
- **Increased home builder confidence -** assurance that the builder is providing a quality product;
- **Increased home buyer/owner confidence -** assurance of a quality home with state-of-the-art energy efficient construction techniques.

Remember, normal good construction practices are essential in any building system. Always follow the manufacturers recommended application instructions.

PIMA

For over 20 years, PIMA (Polyisocyanurate Insulation Manufacturers Association) has served as the unified voice of the rigid polyiso industry proactively advocating for safe, cost-effective, sustainable and energy efficient construction.

PIMA produces technical bulletins in an effort to address frequently asked questions about polyiso insulation. PIMA's technical bulletins are published to help expand the knowledge of specifiers and contractors and to build consensus on the performance characteristics of polyiso. Individual companies should be consulted for specifics about their respective products.

PIMA's membership consists of manufacturers of polyiso insulation and suppliers to the industry. Our members account for a majority of all of the polyiso produced in North America.

SAFETY

Polyiso insulation, like wood and other organic building materials is combustible. Therefore, it should not be exposed to an ignition source of sufficient heat and intensity (e.g., flames, fire, sparks, etc.) during transit, storage or product application. Consult the product label and/or the PIMA members' Material Safety Data Sheets (MSDS) for specific safety instructions. In the United States, follow all regulations from OSHA, NFPA and local fire authorities; in Canada, follow all regulations from Health Canada Occupational Health and Safety Act (WMHIS) and local fire authorities.

For more information on polyisocyanurate insulation, visit www.polyiso.org

PIMA
Polyisocyanurate Insulation Manufacturers Association

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