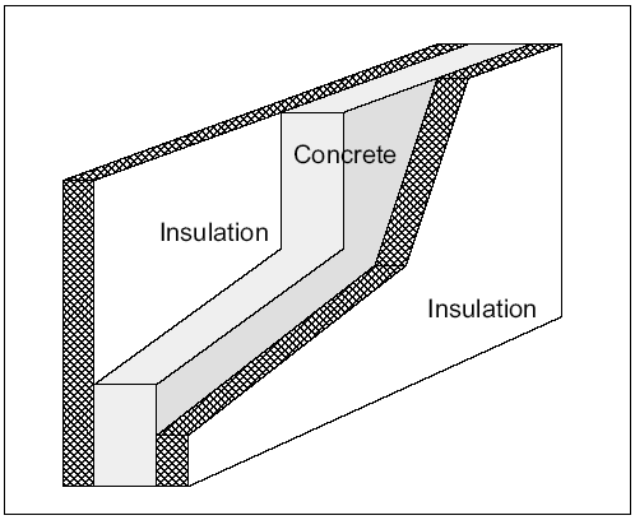
Insulated Concrete Form Systems

This pamphlet is one in a series that describes residential energy conservation requirements of the Oregon Residential Specialty Code and Structural Specialty Code. Other pamphlets in this series may be downloaded from Oregon Department of Energy web site at http://egov.oregon.gov/ENERGY/CONS/Codes/cdpub.shtml or local building departments or from Oregon Building Codes Division.

Insulated Concrete Form (ICF) systems use a prefabricated form made of foam insulation that is assembled into walls at the building site and filled with concrete. Proprietary systems vary, but generally they are composed of a layer of foam insulation on the outside, a concrete layer in the middle and a layer of foam on the inside. Conventional finishes are applied to suit the building.

ICF systems are differentiated by the type of insulation unit, shape of cavity and method of connecting insulation layers. The basic cavity shapes are flat, grid, and post-and-beam.

Figure 1.
Example cross section of flat-type ICF.



Wall Insulation

Many, but not all, ICF systems meet the requirement of the code's Standard Base Case, U-0.060 (R-21) requirement. Any wall with a U-value of 0.060 Btu/hr/ft^2/°F or less meets Standard Base Case requirements. Code requires a minimum of R-15 insulation for basement walls in one- and two-family detached dwellings.

Thermal Storage

Thermal storage improves overall building performance. Adding mass in ICF systems has been shown to improve annual performance of a building. A study by the Portland Cement Association and the Berkeley Solar Group indicated that effective thermal performance of an ICF wall is 14 percent to 18 percent better than a wood frame wall.

Maximum code U-factors are based on steady-state conditions and do not include the effect of thermal storage (mass). Building components must meet code requirements based on their steady-state U-factors. "Effective" R-values commonly provided by vendors may not be used to demonstrate compliance. These values attempt to quantify the improved thermal performance of a tighter air seal and thermal storage and are dependent on the building's operating conditions and local climate.

Infiltration

ICF construction can produce very tight building envelopes, with infiltration commonly less than 0.35 air changes per hour. Thus, they may reduce energy use. But extra care is needed to ensure that sufficient air is available for all combustion appliances (gas and oil furnaces and water heaters, wood stoves and fireplaces). A tight building envelope without proper ventilation can

result in indoor air quality problems, including back-drafting and build-up of hazardous combustion gases such as carbon monoxide.

Moisture Control

Energy code requires a one-perm vapor retarder in walls. ICF construction does not guarantee compliance with this requirement. Check vendor information or apply a one-perm moisture barrier on the warm side (in winter) of all interior walls and floors and a half-perm barrier on the warm side of all ceilings.

Heat Transfer

Using metal ties to connect the two layers of foam insulation greatly diminishes the thermal performance of the wall system, especially if the tie protrudes completely through the insulation. Heat transfer through the ICF system varies depending on conductivity. Most ICF systems that use metal ties do not meet Standard Base Case requirements without added insulation sheathing.

Default U-Values

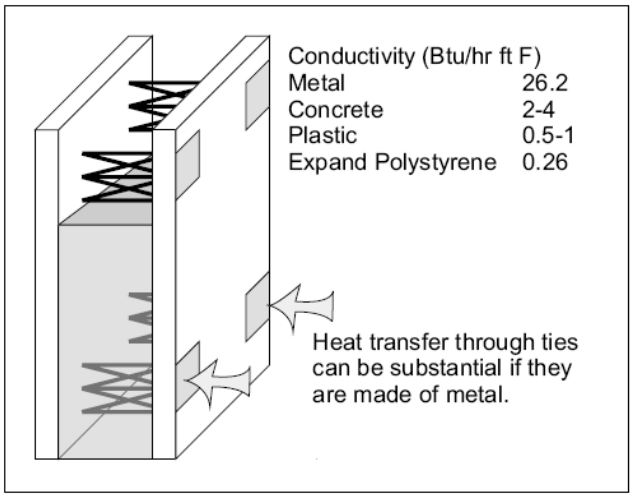
The table on page 3 lists tested U-factors for common ICF products. Use "Total U-factor" values when using the thermal performance calculations table. (See pamphlet no. 12.) Total U-factor values include the effect of air films, T1-11 exterior sheathing and half-inch drywall sheathing. "ICF U-Factor" values are based on the ICF system only.

How to Handle Non-Compliant Walls

A home that has ICF walls with U-factors greater than allowed by the Standard Base Case may comply with code using thermal performance calculation. (See pamphlet no. 12.) The calculation allows the use of components that exceed code requirements to compensate for those that do not meet them.

Another approach is increasing overall thermal performance of the wall so that it meets prescriptive path requirements. The simplest way to do this is to increase insulation on the interior or exterior of the wall assembly. All non-compliant wall types meet minimum code requirements with the addition of 3/4 inches or more of rigid insulation sheathing.

Figure 2.
Heat transfer and conductivity.



Example:

Polysteel - *prior to product update*

R-value of ICF only =	
1/U = 1/0.082 =	12.195 hr/ft^2/°F/Btu
Exterior air film	0.17
T1-11 siding	0.77
5/8" gypsum brd	0.50
Interior air film	0.68
3/4" polystyrene board	3.00
Total	17.315
Total wall assembly U-factor = 1/17.315 =	0.058

U-factors less than or equal to 0.060 comply with Standard Base Case requirements.

Table 1:
Default U-Factors

Brand Name	Manufacturer	Insulation Thickness	Total Wall Thickness	Insulation Type	ICF U-Factor	Total U-Factor
BLUE MAXX	AAB Building Systems	4.75	11.25		0.048	0.043
		4.75	12.75	EPS	0.047	0.043
Diamond Snap Form	AMF Corp.	4	8	EPS	0.054	0.048
		4	10	EPS	0.052	0.048
		4	12	EPS	0.052	0.048
		4	14	EPS	0.052	0.048
Feather Lite	Feather Lite, Inc.	Varies	8	Foam	0.046	0.042
Fold-Form	Lite Form, Inc.	4	8	EPS	0.054	0.048
		4	10	EPS	0.054	0.048
		4	12	EPS	0.053	0.048
GreenBlock	GREENBLOCK Worlwide	4.5	9.875	EPS	0.055	0.049
Ice Block	Foam Block	Varies	9.25	EPS	0.082	0.070
		Varies	11	EPS	0.080	0.068
Lite Form	Lite Form, Inc.	4	8	XPS	0.047	0.043
		4	10	XPS	0.047	0.043
		4	12	XPS	0.047	0.043
		4	14	XPS	0.047	0.042
		4	16	XPS	0.046	0.042
Polysteel Form	American Polysteel Forms	4.8” avg	9.25	EPS	0.082	0.070
		5.0” avg	11	EPS	0.080	0.068
Quad-Lock	Quad-Lock Building Systems	4.5	8.125	EPS	0.048	0.044
		4.5	10.125	EPS	0.048	0.044
		4.5	12.125	EPS	0.048	0.043
		4.5	14.125	EPS	0.048	0.043
R-FORMS	R-Forms	4	8	XPS	0.047	0.043
		4	10	XPS	0.047	0.043
		4	12	XPS	0.047	0.043
		4	14	XPS	0.047	0.042
Reddi-Form	Reddi-Form	Varies	9.625	EPS	0.052	0.047
Reward Wall	Reward Wall	Varies	9.25	EPS	0.054*	0.048*
ThermoFormed	Termoformed Block Corp.	Varies	8	EPS	0.063	0.055
Therm-O-Wall	Therm-O-Wall	Varies	9.125	EPS	0.066	0.058
		Varies	11	EPS	N.A.	–

Source: Portland Cement Association, 1998 (*1998 Ecotope study)
Note: Shaded values do not meet Standard Base Case requirements

Information presented in this publication supports the Oregon Residential Specialty Code. This publication does not include all code requirements. Refer to the code and check with your code official for additional requirements. If information in this publication conflicts with code or your local officials, follow requirements of code and your local officials.

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