# Supplement D

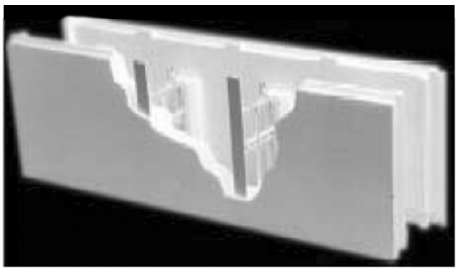
# Insulated Concrete Form Systems

## Thermal Characteristics

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. Systems vary, but generally they are composed of a layer of foam insulation, either expanded polystyrene (EPS) or extruded polystyrene (XPS), on the outside, a concrete layer in the middle and a layer of EPS or XPS foam on the inside.

*Figure D-1*

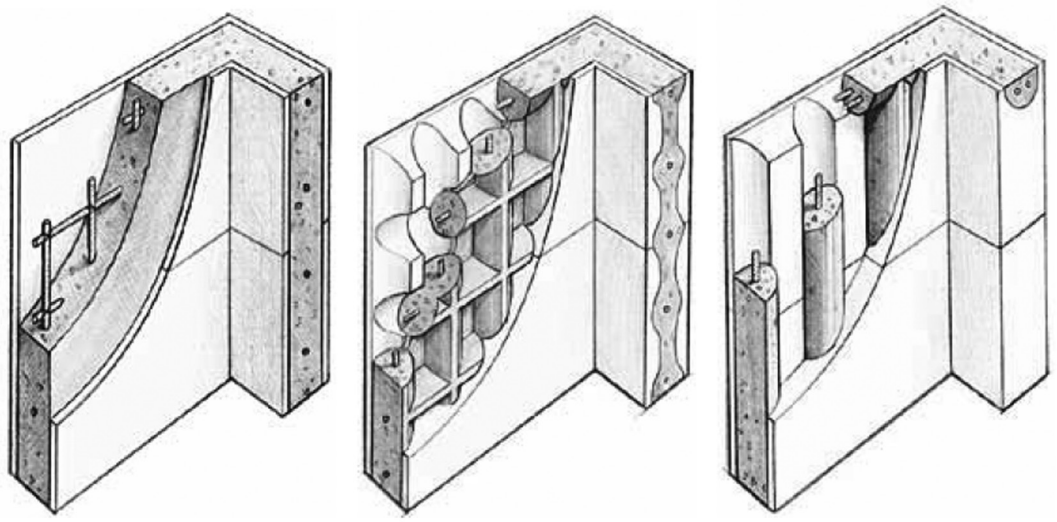
**Examples of Foam Forms**



Conventional finishes are applied to suit the building. ICF systems are differentiated by the type of insulation, the shape of the cavity and the method of connecting the insulation layers. The basic cavity shapes of the concrete blocks are flat, grid and post-and-beam. Many, but not all, ICF systems meet the thermal requirements of the *Washington State Energy Code* (WSEC), see WSEC Tables 6-1 and 6-2.

*Figure D-2*

**Examples of Various Conventional Finishes**



*Flat Wall* *Grid Wall* *Post & Beam Wall*

## Why Do Some ICF Perform Better Than Others?

Not all ICF systems are constructed the same. The primary variables are the type of material used for the form, the ratio of concrete to form materials, and the type of ties. For example, an ICF with steel cross ties will have greater heat loss than one with plastic ties. Forms with more insulation and less concrete will have less heat loss than forms with high ratios of concrete to insulation.

## Prescriptive Application of U-Factors

Strictly speaking, the prescriptive requirements in the WSEC do not allow the use of wall U-factors. But the use of U-factors as a demonstration of compliance with prescriptive values is an acceptable alternative method. For above grade and below grade walls, the following prescriptive U-factors may be utilized (see Tables 6-1 and 6-2).

*Table 6-1*

## Zone 1 Presecriptive Requirements

| | R-Value Required | Acceptable U-Factor |
|---|---|---|
| Above Grade Wall, all options | 21 Int. | 0.054 |
| Below Grade, exterior, continuous | 10 | 0.056 |
| Below Grade, interior, in stud cavity | 21 | 0.037 |

*Table 6-2*

## Zone 2 Presecriptive Requirements

| | R-Value Required | Acceptable U-Factor |
|---|---|---|
| Above Grade Wall, option I | 21 Int. | 0.054 |
| Above Grade Wall, options II, III | 19 + 5 | 0.044 |
| Below Grade, exterior, continuous | 12 | 0.050 |
| Below Grade, interior, in stud cavity | 21 | 0.037 |

## Thermal Storage (Mass Value)

Thermal storage may improve overall building performance. Adding mass in ICF systems has been shown to improve annual performance of a building in certain conditions. Although thermal mass may have a benefit in its ability to store heat, prescriptive path R-values do not take thermal mass into account. R-values used to demonstrate code compliance is the tested "steady state" R-value without any increases for the potential benefit from thermal mass. "Effective" R-values commonly provided by manufacturers or vendors may not be used to demonstrate code compliance.

## Moisture Control

The WSEC requires a one-perm or less vapor retarder in all walls. Although extruded polystyrene products typically meet this requirement, ICF construction does not guarantee compliance. Check manufacturer or vendor information to see if applying a one-perm vapor retarder, on the warm side (in winter), is needed.

## How to Handle Non-Compliant Walls

If a building cannot meet the prescriptive requirements of the WSEC, the Component Performance approach may allow one element of the structure to be less efficient than what the code requires if the deficiency is compensated for in another area of the building. A home that has ICF walls with U-factors greater than allowed by the Prescriptive Path may comply with code using the Component Performance Approach worksheets. This web site link lets the user download the worksheets:

**www.energy.wsu.edu/code/**

## Default U-Values

The following table (see Figure B-3) lists tested U-factors for common ICF products. Use "Total U-factor" values when using the Component Performance Approach for qualifying an ICF house. Total U-factor values include the effect of air films, wood exterior siding and half inch drywall sheathing.

*Figure D-3*

## Common ICF Products*

| Brand Name | Manufacturer | Wall Thickness | Insulation Type[1] | R-Value[2] | U-Factor[3] |
|---|---|---|---|---|---|
| Blue Maxx | AFM Building Corp. | 11.25″ | EPS | R-21 | .043 |
| Diamond SnapForm | AFM Corp. | 8″ | EPS | R-19 | .048 |
| Durisol | Durisol Bldg Systems | 12″ | No foam inserts | R-9.13 | .109 |
| Durisol | Durisol Bldg Systems | 12″ | 3.5″ foam inserts | R-21 | .048 |
| Feather Lite | Feather Lite, Inc. | Varies | -- | R-22 | .042 |
| Fold-Form | Lite Form, Inc. | 8″ | EPS | R-19 | .048 |
| GreenBlock | Greenblock Worldwide | 9.87″ | EPS | R-18 | .049 |
| Ice Block | Foam Block | 9.25″ | EPS | R-12 | .070 |
| Lite Form | Lite Form, Inc. | 8″ | XPS | R-21 | .043 |
| Polysteel Form | American Polysteel Forms | 9.25″ | EPS | R-12 | .070 |
| Quad-Lock | Quad Lock Bldg Systems | 8.125″ | EPS | R-21 | .044 |
| R-Forms | R-Forms | 8″ | XPS | R-21 | .043 |
| Rastra | Rastra | 8″ | EXP | R-8 | .1134 |
| Rastra | Rastra | 12″ | EPS | R-15 | .0654 |
| Rastra | Rastra | 14″ | EXP | R-18 | .0524 |
| Reddi-Form | Reddi-Form | 9.625″ | EPS | R-21 | .047 |
| Reward Wall | Reward Wall | 9.25″ | EPS | R-19 | .048 |
| ThermoFormed | ThermoFormed Block Corp. | 8″ | EPS | R-16 | .055 |
| Therm-O-Wall | Therm-O-Wall | 9.125″ | EPS | R-15 | .058 |

**This list may not include all ICF products available. Refer to manufacturers tested R-values and U-factors for compliance with code requirements. Information courtesy Oregon Department of Energy Pamphlet #20.*

*[1] EPS Expanded Polystyrene; XPS Extruded Polystyrene.*

*[2] R-values are for ICF only – not total wall assembly.*

*[3] U-factors are for total wall assembly.*

*[4] Assumes stucco finish exterior and interior.*