

Energy Use in Houses with Concrete and Wood-Frame Walls

by

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Overview

- Testing of concrete walls
- Typical concrete walls
- Comparison of concrete and frame walls
- Mass walls in residential and commercial energy codes

1980's



Mass Effects

- ASHRAE paper in 1986 on 21 wall assemblies
- Concrete and masonry
 - Shift peak load
 - Moderate (reduce) peak load

Mass Effects

- Works best with mass on inside
- Works well with mass on outside
- Works best in commercial
- Works well in residential
- Testing got recognition in codes and computer models

Types of Mass Walls

- Masonry
- Concrete
- ICF
- AAC

Concrete Masonry – Split Face



Concrete Masonry - Scored



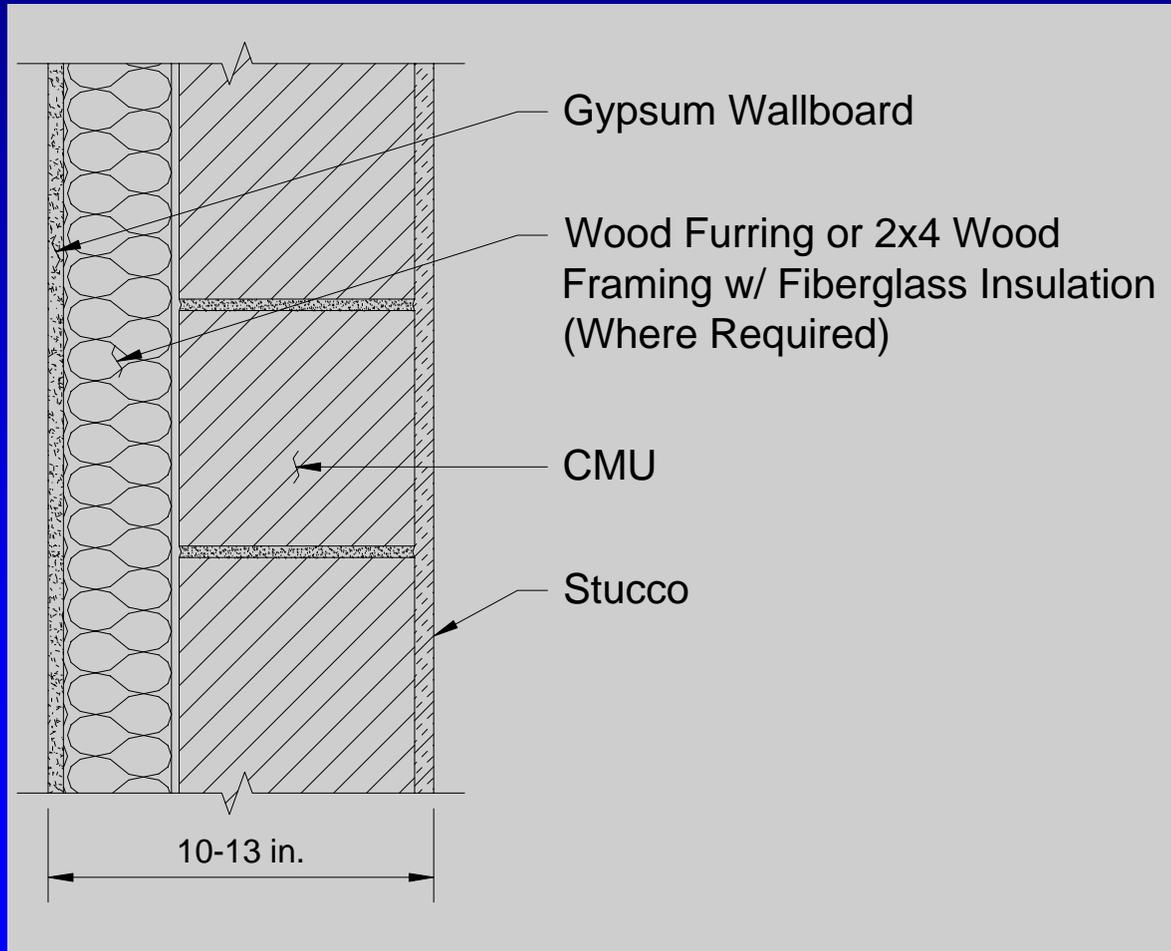
Concrete Masonry - Glazed



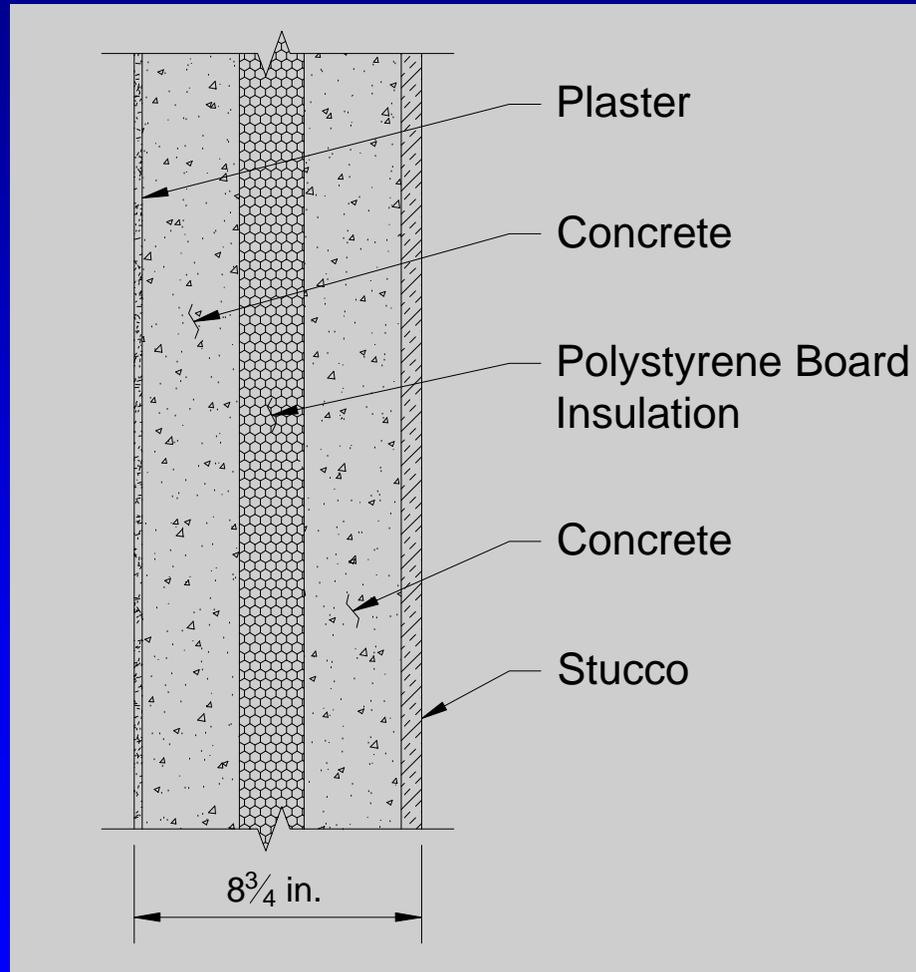
Concrete Colors



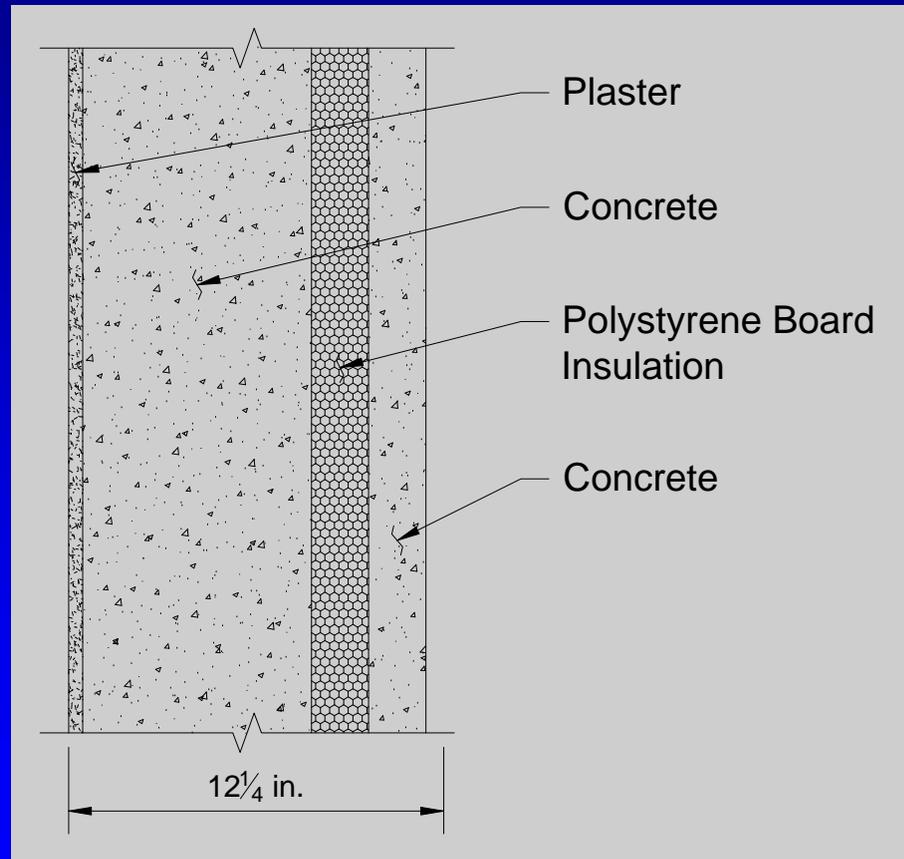
Concrete Masonry Wall



Concrete Sandwich Panel Wall



Concrete Sandwich Panel Wall



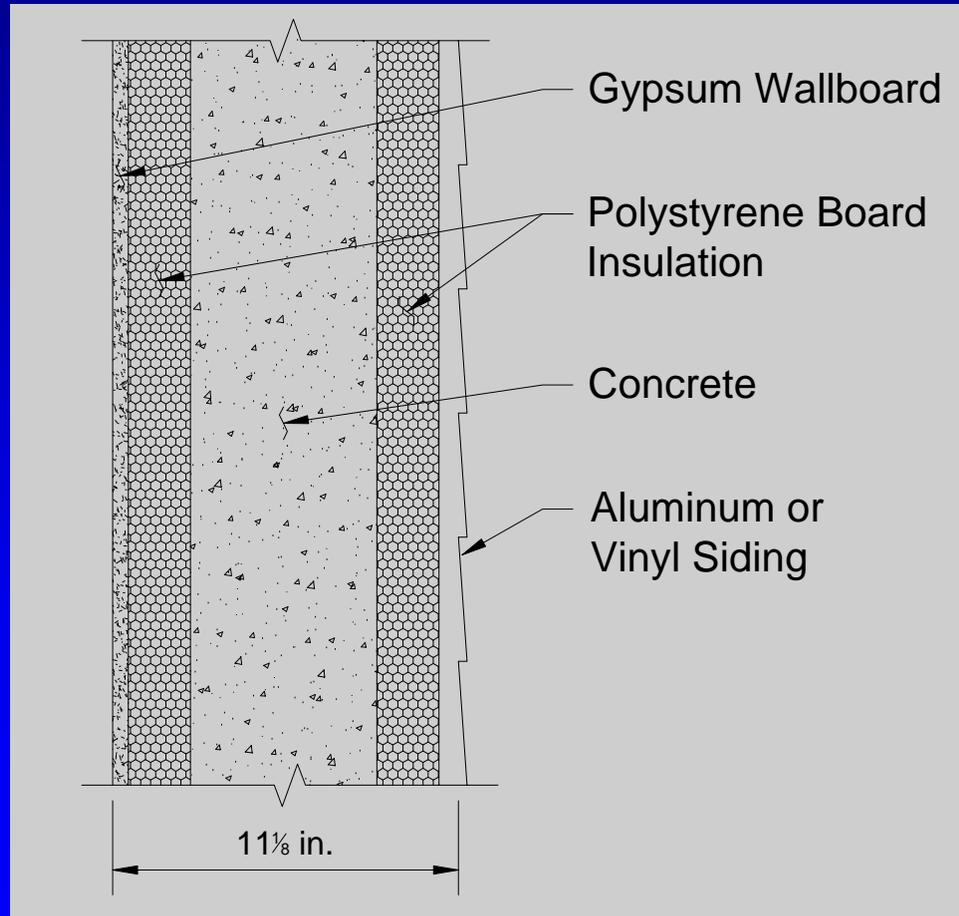
Sandwich Panel Construction



Concrete Sandwich Panel



Insulated Concrete Form - ICF



ICF Home



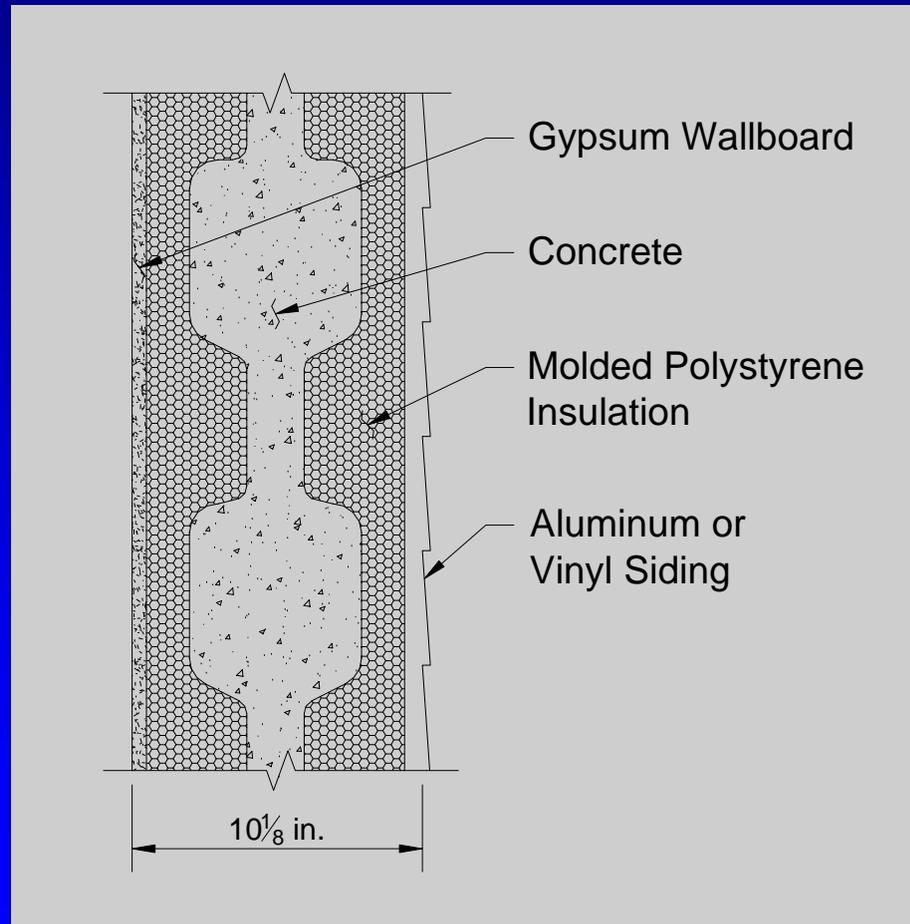
ICF Forms – Flat Panel



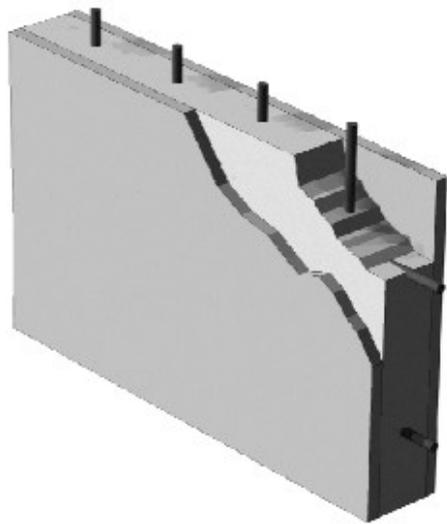
ICF Forms – Screen grid



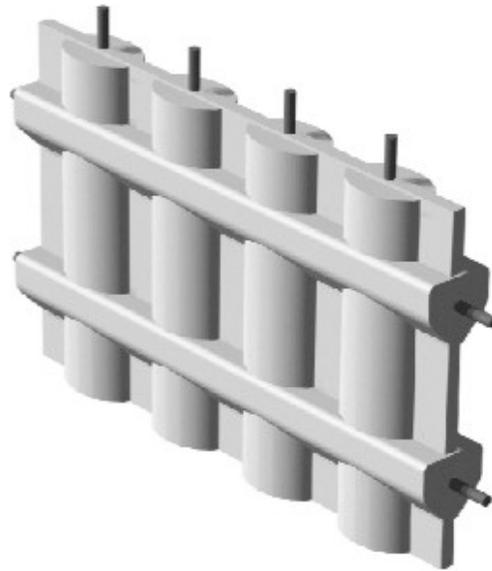
ICF Form – Waffle grid



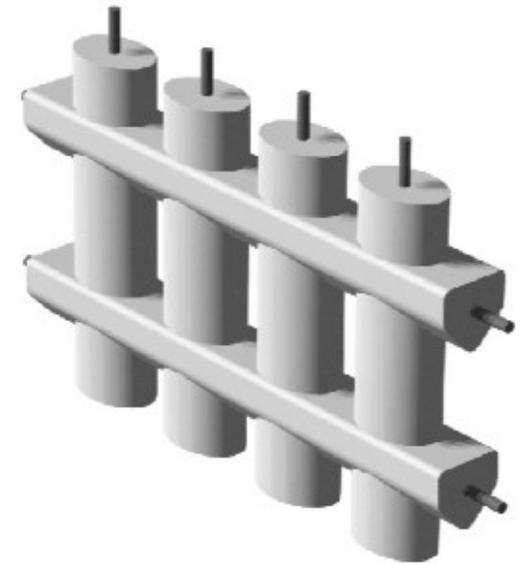
Types of ICF forms



Flat wall core with
foam in place



Waffle grid core with
foam removed for clarity



Screen grid core with
foam removed for clarity

Courtesy of the Portland Cement Association, 2001

Forming Radius



Constructing Radius



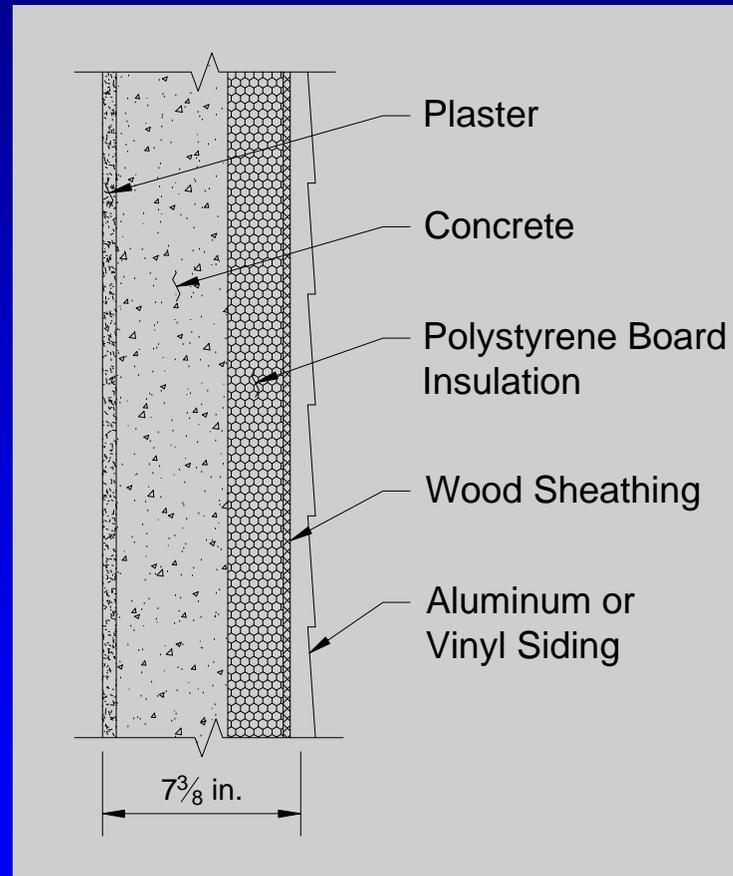
Applying Drywall



ICF Home



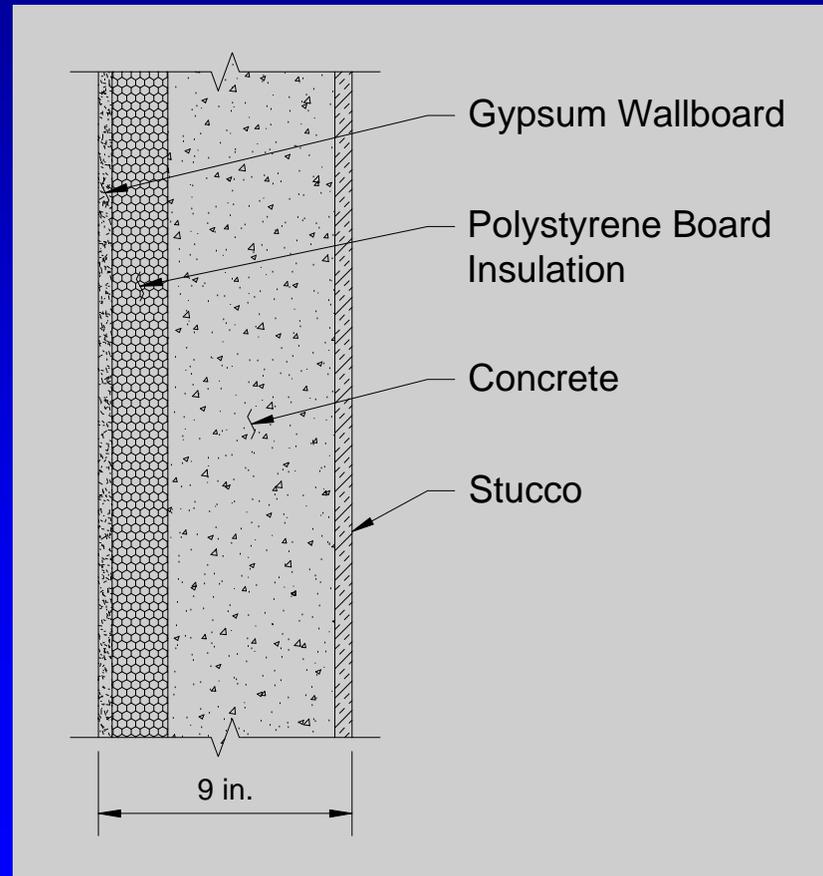
Exterior Insulation



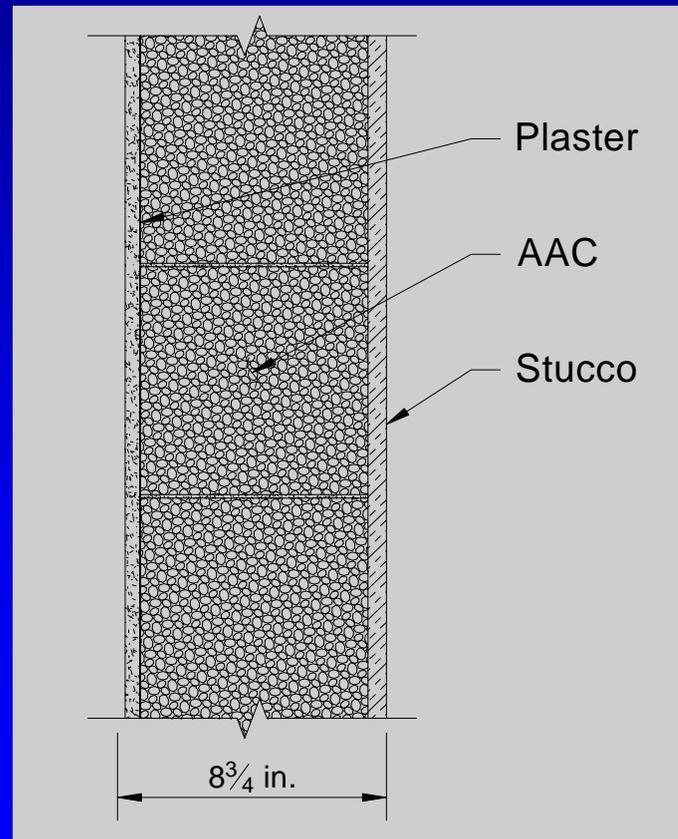
Exterior Insulation



Interior Insulation



Aerated Autoclaved - AAC



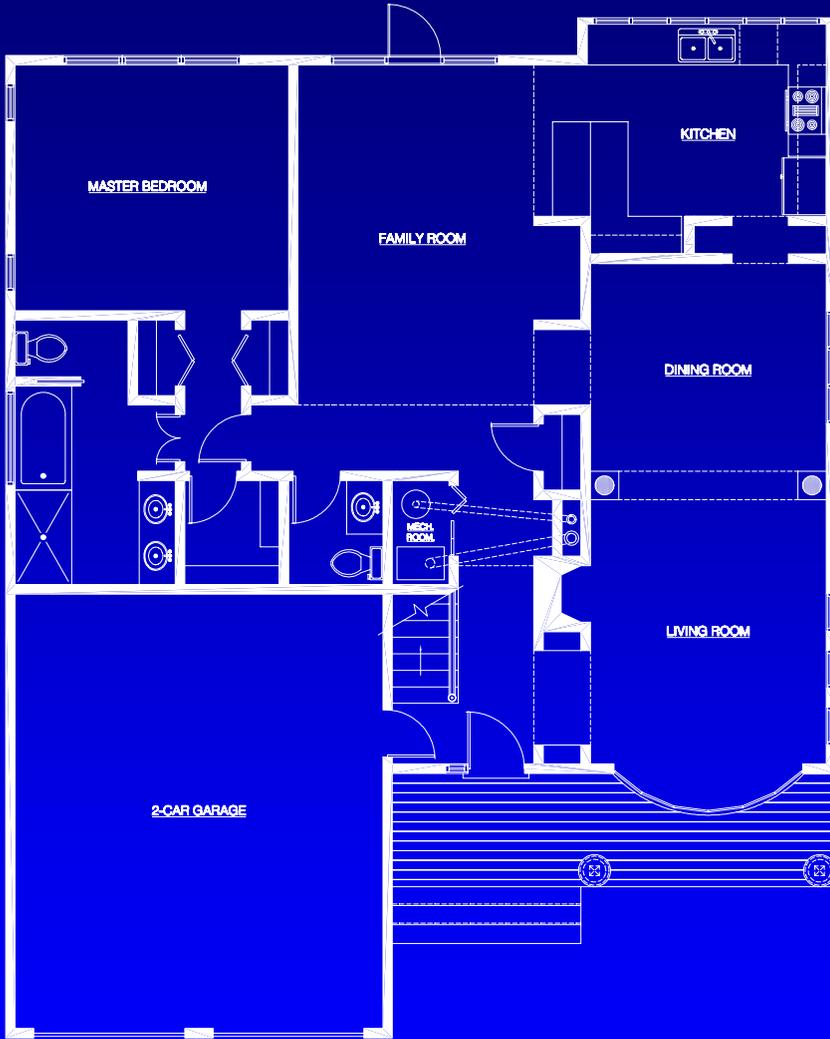
Energy Study

- Concrete walls
- Metal frame walls
- Wood frame walls
- 25 U.S. and Canadian climates
- 2000 IECC
- 1997 Canadian code

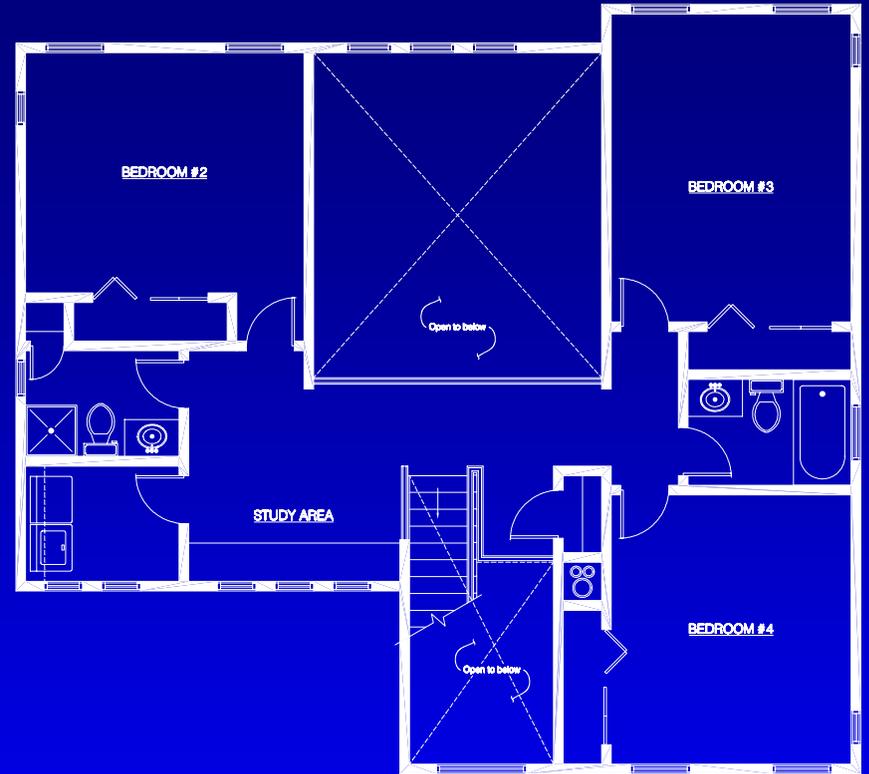
House Description

- Current design
- Typical
- 2 story
- 2,450 sq ft
- Attached garage
- 9 ft ceilings
- Large window area





Lower Level



Upper Level

House Components and Walls

- All assemblies met energy codes
- All components for any climate *identical* except for walls

Annual Energy Cost - Houston

Wall	Cost, \$
Flat panel ICF (R22)	790
Sandwich panel 1 (R11)	800
2 x 12 (R38 added) wood (R34)	800
Sandwich panel 2 (R11)	820
2 x 10 (R30 added) wood (R29)	820
Waffle grid ICF (R13)	830

Annual Energy Cost - Chicago

Wall	Cost, \$
2 x 12 (R38 added) wood (R34)	1300
Flat panel ICF (R22)	1310
2 x 10 (R30 added) wood (R29)	1330
2 x 8 (R25 added) wood (R24)	1360
Sandwich panel 1 (R11)	1390
Waffle grid ICF (R13)	1405

Annual Energy Cost - Boulder

Wall	Cost, \$
Flat panel ICF (R22)	1090
2 x 12 (R38 added) wood (R34)	1105
Sandwich panel 1 (R11)	1120
2 x 10 (R30 added) wood (R29)	1130
Sandwich panel 2 (R11)	1140
2 x 8 (R25 added) wood (R24)	1160

Energy Codes

- Reduced wall R-value allowed for mass walls
- Residential (IECC) – based on HDD
- Commercial (ASHRAE) – provided in prescriptive tables
- Performance paths will provide better mass effects

2000 IECC – Ext. Ins. Criteria

Wood Frame R-value	Mass R-value 0-2000 HDD	Mass R-value 4000-5500 HDD
R11	R6	R7
R15	R7	R8
R23	R9	R11

ASHRAE 90.1 – Non Res. Crit.

Wall	HDD 0-1800	HDD 4000-5500
Mass	NR	R5.7 or perlite
Steel Frame	R13	R13
Wood Frame	R13	R13

Summary

- Walls tested in 1980s
- Types of concrete walls
 - Masonry
 - ICF
 - Sandwich panel
 - Interior and exterior insulation
 - AAC

Summary

- Energy study shows R11 and R22 mass walls equivalent to R29 and R24 frame walls
- Energy codes allow less R-value for mass walls
- **MASS + INSULATION SAVES ENERGY**

