



BUILDINGS VIII Conference Thermal Mass Workshop ICF Presentation

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Presentation Objectives

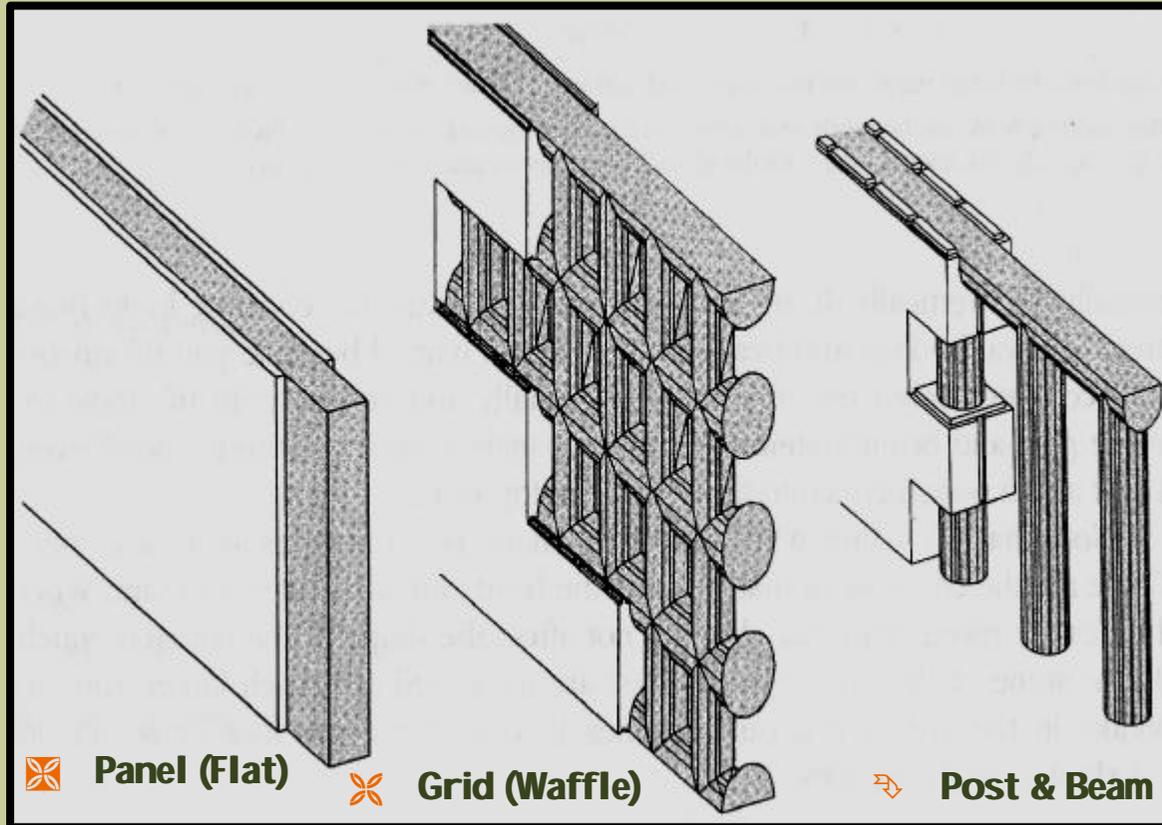
- ICF Technology
- Arxx wall system
- Living in ICF houses



An overview of Insulated Concrete Forms (ICF's)



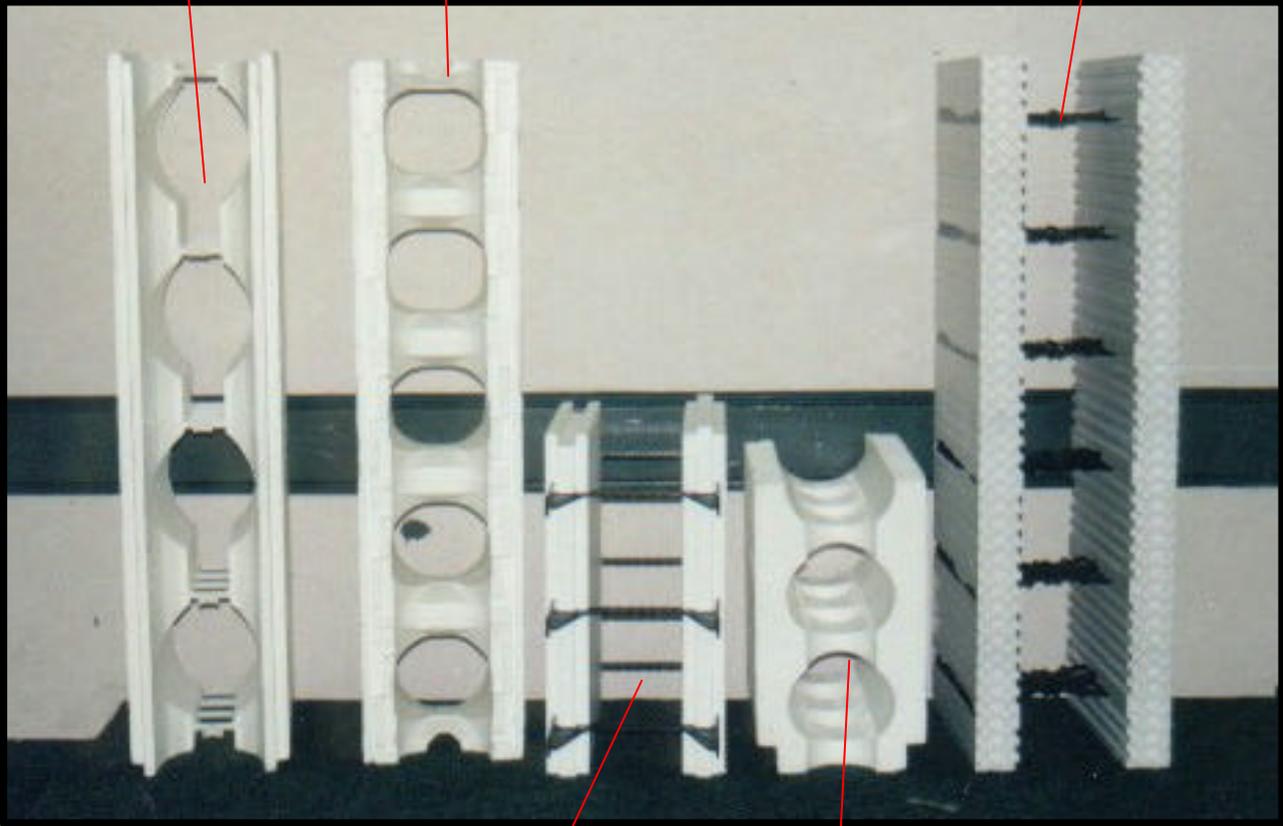
THREE TYPES OF ICF'S



waffle

post and beam

Panel (Arxx™)



panel

post and beam



The result...



...high performance wall systems

arxx





***Today, ICF's are used in all
types of residential
construction***



Residential

- > Silence
- > Energy savings
- > Safety



single family



Residential

- > Sound Transmission
- > Energy savings
- > Divided Occupancy



multi family – town homes



Residential

- > Sound Transmission
- > Energy savings
- > Fire resistance rating
- > Speed of construction



multi family - condominiums



Commercial

- > Energy efficiency
- > Sound Transmission
- > Fire Resistance ratings



hospitality (hotel/motel)



Commercial

- > energy savings
- > fire resistance ratings
- > speed of construction



resort facility



Commercial

- > wind resistance
- > energy savings
- > fewer sub-trades



curtain wall construction

Institutional

- > improved indoor air quality
- > comfort
- > safe
- > quiet



senior's care residence



The ICF Building Experience



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FOOTINGS/SLAB ON GRADE

 **Straight / Level**

 **Dowels or Keyway**

 **Steps to Match
Course Height**







COURSES PLACED

2000sf Foundation
3 Men

One Hour



Four Hours



Eight Hours Ready to Pour



WINDOWS AND DOORS



Wood Bucks



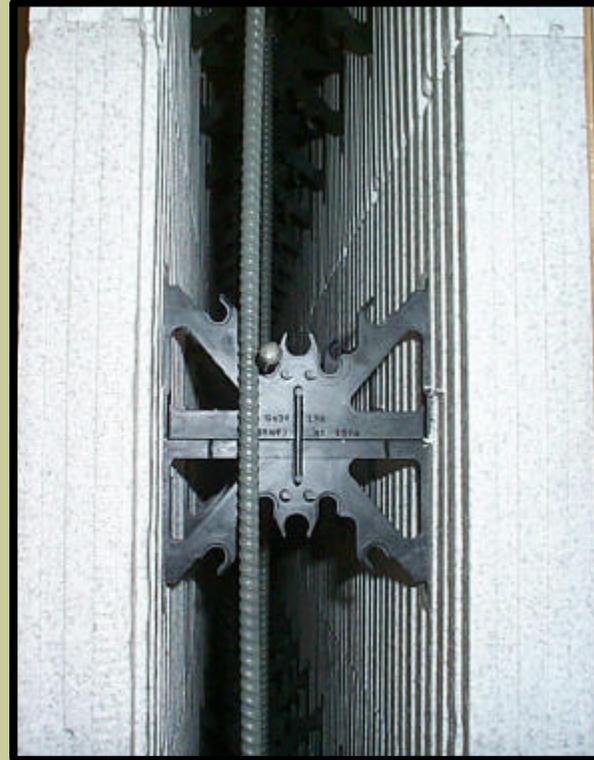
WINDOWS AND DOORS



**Vinyl Bucks
(Buck Saver™)**



Reinforcement



**simple placement of
horizontal and vertical rebar**



Wall Alignment



Arxx™ Alignment System



Concrete Placement



← Direct from truck

↓ By crane and bucket



Concrete Placement



← With trailer pump



→ With boom pump



Concrete Placement



ADDITIONAL STORIES



FLOOR CONNECTIONS



Joists hanger

Wood 'I's on ledger board



FLOOR CONNECTIONS



Hollow core

**Hambro™ Composite
Floor Joists**



ROOF CONNECTIONS



Pitched roof



ARCHITECTURAL DETAILS



Footings

Curved walls



Basement

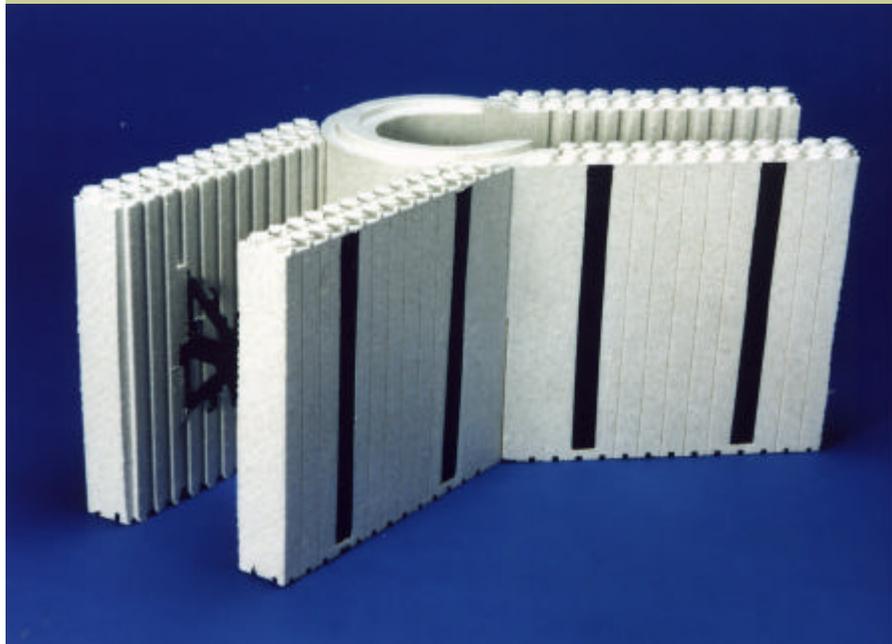


Main Floor



ARCHITECTURAL DETAILS

turrets



arxx



ARCHITECTURAL DETAILS

cantilevered walls



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Exterior finishes

Brick veneer



Featured in the Knoxville, TN 1998 Parade of Homes

Exterior finishes

stone



Exterior finishes

Vinyl siding



Exterior finishes

wood siding



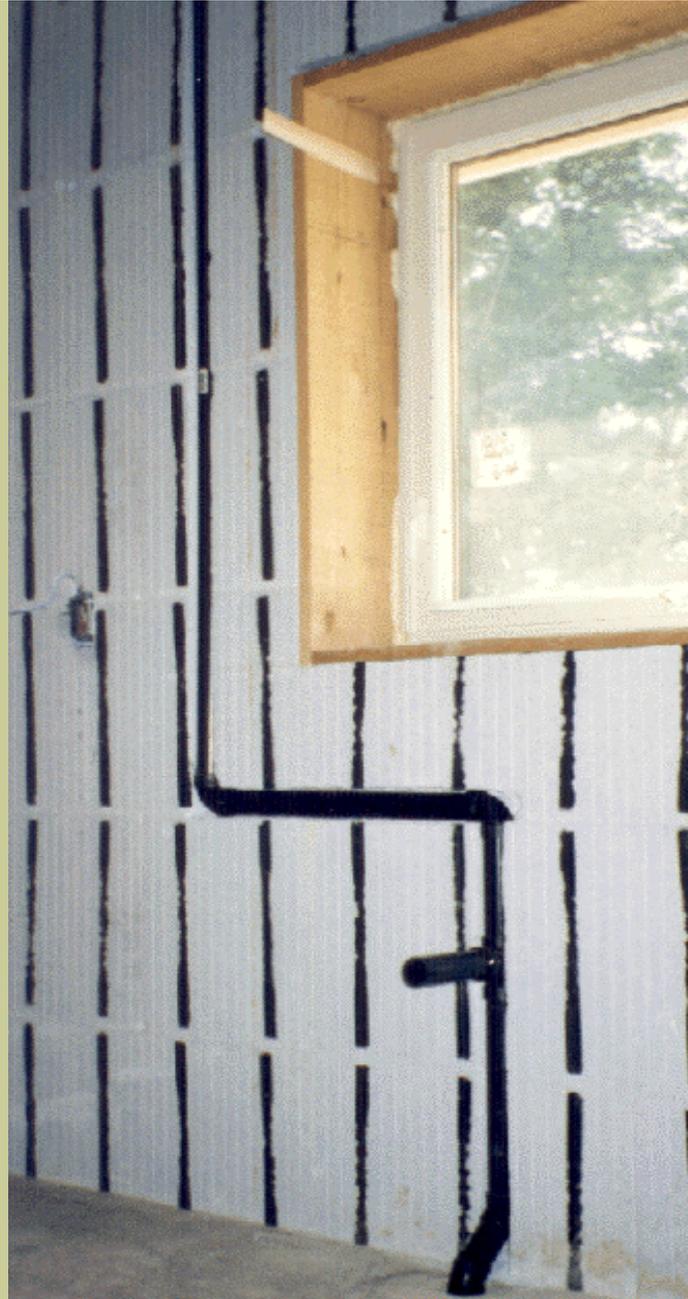
Electrical

Rough-in for electrical work is accomplished in many ways



Plumbing

Rough-in same
as for electrical

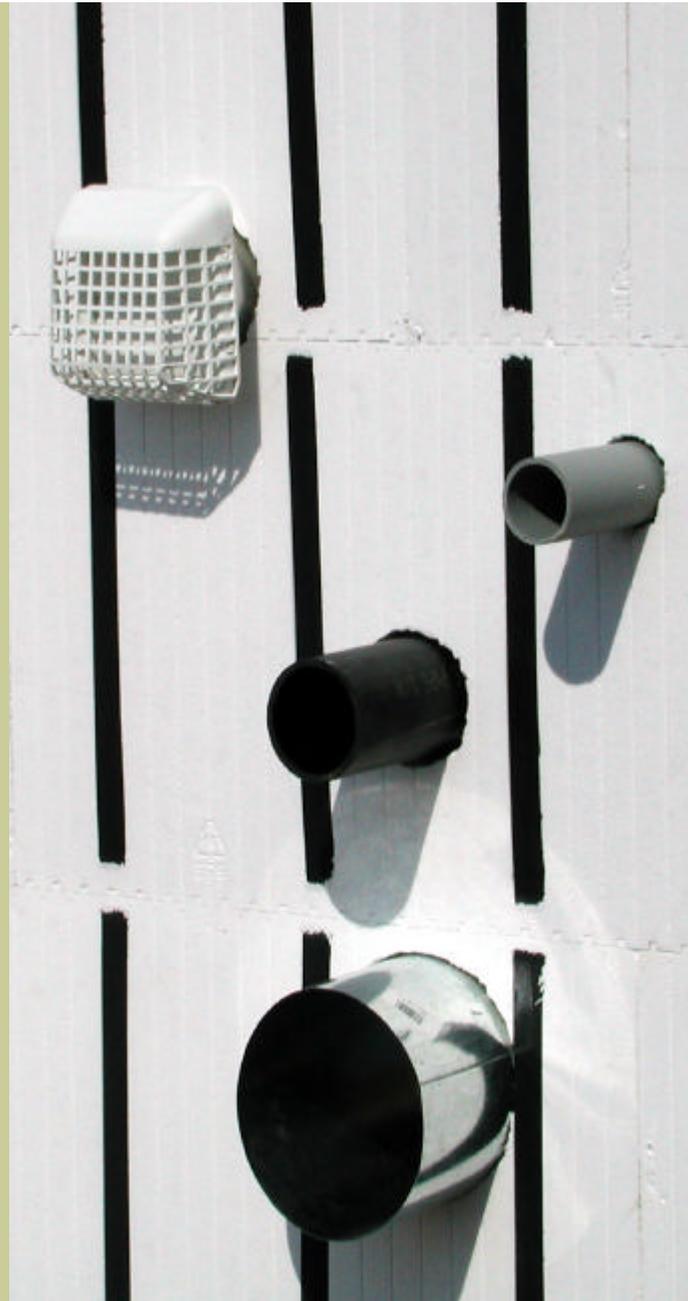


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Service penetrations

**Water
Sewer
Gas
Electrical
HRV
Bath / Kitchen Fans
Cable tv
Phone lines**

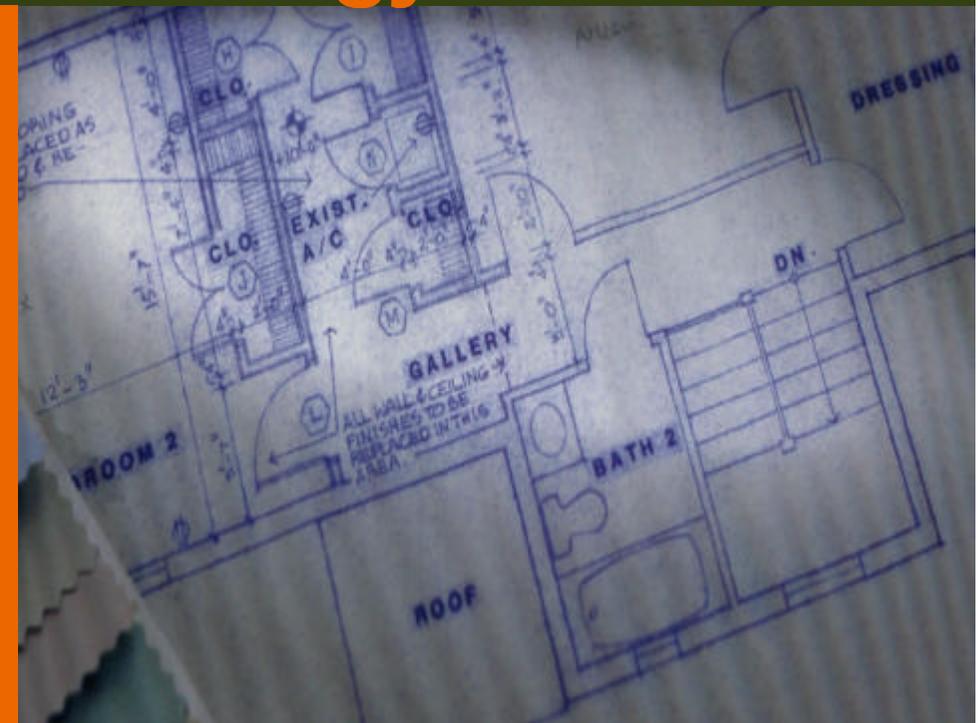


arxx





ARXX high performance wall system technology





Clear Wall R-value (typical walls) Compared to R-22 for Arxx walls

| Framing Member and Spacing | Nominal Cavity Insulation | Effective Clear Wall R-Value | |
|----------------------------|---------------------------|------------------------------|-------------|
| | | Wood Frame | Steel Frame |
| 2x4@16"o.c. | R-13 | R-10.1 | R-6 |
| 2x4@24"o.c. | R-13 | R-10.7 | R-7.2 |
| 2x6@16"o.c. | R-19 | R-16.2 | R-7.4 |
| 2x6@24"o.c. | R-19 | R-17.2 | R-9.0 |



From ASHRAE's 90.1 Committee

ICF EFFECTIVE THERMAL PERFORMANCE



 **R-Value of EPS Foam**

 **Thermal Mass of Concrete
Moderating Mass**

 **Controlled Air Infiltration / Exfiltration
Solid barrier significantly reduces air
movement through wall assembly**



SILENCE (Sound Transmission Class)

Arxx walls provide STC 50

| STC | Audibility of Loud Speech on Other side of Wall |
|-----|---|
| 25 | easily understood |
| 30 | fairly understandable |
| 35 | audible but generally not intelligible |
| 42 | audible as a murmur |
| 45 | must strain to hear |
| 48 | barely audible |
| 50 | inaudible |

source: Huntsman Chemical (1995)



From concept





To completion



High performance wall systems (ICF's) provide the solutions





Living in ICF Houses



Objectives

- Features of ICF houses
- Energy Performance



Features & Benefits

- Thermal Performance
 - Comfort
 - Lower energy costs
- Sound attenuation
 - Comfort
 - Quiet enjoyment
- Resistance to high wind events
 - Sense of security
 - Protection against wind blown debris



Features & Benefits

- Structural
 - Easy to meet requirements
- Fire Resistant Construction
 - Reduced insurance premiums



Fire Resistant Construction

- Reduced insurance premiums



Structural

- Exceeds structural requirements across most of USA
- Easily designed to meet structural requirements in
 - High seismic areas
 - High wind areas

No loss of insulation to meet higher structural requirements of high seismic and high wind areas



High Wind Events

- Building occupants sheltered from wind blown debris
 - Miami Dade County approvals
 - Texas Tech Wind Institute testing



Sound Attenuation

- Arxx walls offer superior STC performance compared to typical frame walls (STC 50 versus STC 32 to 38)
- Arxx walls meet code requirements for demising walls



Thermal Performance

- ICF walls offer significant improvements in thermal performance to typical frame walls



Thermal Performance

- Many ICF companies make claims of up to 70% energy saving for heating,
- ICF customers give anecdotal reports of 25 to 75% savings



Opinion

- Large space heating and cooling savings reflect both
 - the performance of ICF walls and
 - the poor thermal performance of housing lived in prior to moving into an ICF house



Testing and Studies

- CTL ICF Study 1996
 - R 18 ICF wall to Equivalent R-values from 20.5 to > 50
- PCA – Comparison study of ICF houses to frame houses
 - Energy savings of 44% for space heating & 32% for space cooling
- NAHB-RC comparative testing
 - Savings of approximately 20%
- PCA / CFA Energy Use Study 2001
 - Comparison with code, ICF walls projected savings of –1% to 47%
- ORNL 2000 Test of Reward ICF wall
 - Clear wall R-value 18.0
 - Dynamic R-value equivalents 24. (30%) to 27. (50 %)
- ORNL 2001 Comparison Testing
 - Savings of 9%



What we know

- R-value
- Benefit of thermal mass confirmed by dynamic guarded hot box test
- ORNL Comparison study with frame construction (with caveat that frame construction in this study was better than typical)

However several areas remain unclear



Possible areas to investigate

- Reduced air infiltration
- Interior wall surface temperature closer to temperature of conditioned space (radiant heat balance)
- Because of items 1 & 2 is there a tendency of occupants to set thermostat lower in ICF houses
- Impact of wind
- Potential ground coupling



Ground-coupling study - Texas A&M





Other factors

- Lifestyle choices of occupants
- Differences in specs for fenestration, doors and ceiling/roof assemblies between ICF houses and frame houses ?
- Differences in quality of construction between typical ICF and typical frame?



Summary

- ICFs provide real benefits to homeowners and occupants
- One of these benefits is thermal performance
 - Increased comfort, reduced energy costs
- The understanding of the thermal performance of ICF houses is incomplete
- Further research is needed



Thank you!

For your time and attention.



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