



U.S. Department of Energy
Energy Efficiency and Renewable Energy

THE BUILDING ENVELOPE

By

Insulated Component Structures, Inc.



The Building Envelope

- What is it?
- Why is it important?
- Construction considerations



The Building Envelope

- What is it?
 - Thermal Envelope
 - Structural Envelope



The Building Envelope

- Thermal Envelope
 - Controls the comfort level inside by maintaining temperature and relative humidity.
 - Prevents insect and vermin infestation and condensation inside the structure.
 - Not all envelopes function the same.
- Structural Envelope
 - Combination of the foundation, walls, and roof working together providing a safe environment.
 - The structural integrity of the building holds up the building protects the contents against rain, wind and groundwater.
 - Not all envelopes function the same.



The Building Envelope

- Importance of the Structural Thermal Envelope
 - Preserve the structural integrity of the building
 - Keep in heat during the winter
 - Keep out heat during the summer.
 - Keep out rain.
 - Keep out groundwater.
 - Keep out moisture vapor.
 - Remove moisture vapor from the inside.
 - Keep out wind.



The Building Envelope

- Envelope Considerations
 - Insulation
 - Structural



The Building Envelope

- Structural Material
 - Wood
 - Stud Framing, Log
 - Concrete
 - Block, Panel, Poured
 - Metal Framing
 - Structural Insulated Panels (SIPs)



The Building Envelope

- Structural Material
 - Wood - Stud Framing, Log





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The Building Envelope

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The Building Envelope

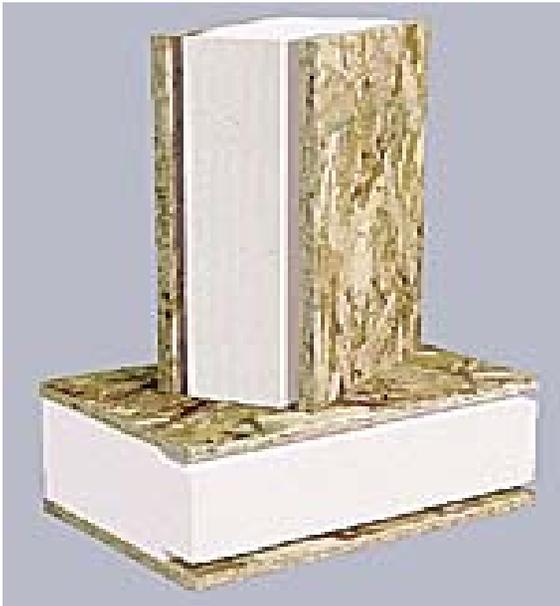
- Structural Material
 - Metal Framing





The Building Envelope

- Structural Material
 - Structural Insulated Panels (SIPs)





The Building Envelope

- Structural Material
 - Installation





The Building Envelope

- Structural Material
 - Installation





The Building Envelope

- Structural Material
 - Installation





The Building Envelope

- Structural Material
 - Installation





The Building Envelope

- Insulation Material
 - Wood - Battens or Blown in
 - Concrete – Battens, Blown in or Polystyrene
 - Metal Framing – Battens or Blown in
 - Structural Insulated Panels (SIPs)
 - Laminated Polystyrene
 - Injected Polyurethane



The Building Envelope

What is the Most Overlooked Item When Considering the Total Structural/Thermal Envelope?



The Building Envelope

- Thermal Wicking



The Building Envelope

- Thermal Wicking





The Building Envelope

- Heat Transfer
 - Primary Mechanisms
 - Conduction
 - Convection
 - Radiation
 - Secondary Mechanisms
 - Air Infiltration
 - Air Intrusion
 - Moisture Accumulation



The Building Envelope

- Moisture
 - Problems
 - Mold and mildew
 - Corrosion
 - Rot
 - Insects
 - Staining
 - Freeze-thaw damage
 - Delamination and adhesion loss
 - Loss of thermal resistance



The Building Envelope

- Moisture
 - Common Sources
 - Water leaks
 - Air leaks
 - Vapor diffusion (and condensation)



The Building Envelope

				R-value degradation	
Material	R-Value (Per In)	Water Perms	Absorption (% by wt.)	Water Absorption	Settling
Urethane	7.28	<2	N/A	No	No
EPS	3.25	<3	3%	Yes	No
Cellulose (Blown)	3.25	100	15%	Yes	Yes
Fiberglass Batts	3.15	100	2%	Yes	Yes



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Structural Insulated Panels (SIPs)

VS

Traditional Construction Methods



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- What is a SIP?
 - Panels that have self-supporting characteristics and provide insulating properties to the exterior envelope of a building.



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- Oak Ridge National Labs (ORNL) tests:
 - Sips perform at 97% of stated R-value. Losing 3% to nail holes seams, splines and the like. They provide a continuous layer of insulation and the interior free of drafts and cold spots.
 - 4 1/2" SIP wall outperforms 2" x 4" stick and batt construction in terms of thermal performance because SIPs are structural elements; no studs or braces



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- ORNL CONCLUSION:
 - “The end result is a more comfortable, energy efficient structure that performs up to spec in real-world conditions ... the nature of SIPs is such that the structural and insulative elements are joined as one. There are no hidden gaps, because a solid layer of foam insulation is integral to panel construction.”



The Building Envelope

- Structural Insulated Panels (SIPs)
 - Expanded Polystyrene (EPS) – Laminated
 - Polyurethane -- Injected



References

www.sipweb.com

www.sips.org

www.ics-sips.com

www.pathnet.org

www.rebuild.org



SIPs

- SIPs walls erected





SIPs

- SIPs walls erected





SIPs

- SIPs walls erected
 - Walls manufactured at 4/12 pitch
 - Panels delivered with doors installed
 - Preformed 90 degree Corner
 - Panels delivered with electrical outlets in place
 - Panels delivered with HVAC openings for ease of mounting
 - Beams set on walls supported roof panels





Complete – Ready for Use

- SIPs Classroom in 10 days





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