EEBA High Performance Home Summit

Residential High Performance & the Three “R”s: Resistance, Resilience, and Recovery

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Disasters are an Opportunity for High Performance

Rebuild better

Resistance
- Withstanding the disaster

Resilience
- Surviving the aftermath

Recovery
- Rebuilding

Best Practices
- Resistant Designs
- Documentation

Research
- Renewables
- Micro Grid
If you are doing one, you are doing the other

Energy Efficiency

Disaster Resistance
In storms, it’s all about the Leaks

“All too often water leaks into the house through openings that are not adequately sealed during construction…"

Additionally, water intrusion through soffit vents, ridge vents, gable end vents, and doors and windows can be a major source of unwanted moisture in the house....”
Best Practices from FEMA and Building America

- Weatherstrip doors and windows.
- Use water-resistant flooring in entries.
- Slope exterior grade and paved surfaces away from house.
- Install pan flashing at windows and doors.
- Properly integrate, lap, and flash thermal, air, and moisture barrier layers around doors and windows.
- Install a continuous weather-resistant barrier over roof and walls (synthetic textured house wraps, liquid-applied flashing, taped rigid foam or coated sheathing).
Flood Resistance, Resilience, Recovery
Flood Hardy Homes

• **Elevate 2-3 ft. above BFE**
  (lowest flood insurance premium)
  – Pier and beam
  – Stemwall with flood vents
  – Slab cap on filled stemwall

• **Wet Floodproof to possible level**
  – elevate equipment, utilities
  – water-resistant materials
  – removable wainscoting on a drainable wall
Flood-hardy!

For homes in *levee-dependent* or *uncertain* flood level areas (potential to flood above BFE)
Flood Damage-Resistant Materials
FEMA Technical Bulletin 2

<table>
<thead>
<tr>
<th>Types of Building Materials</th>
<th>Uses of Building Materials</th>
<th>Classes of Building Materials</th>
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<tbody>
<tr>
<td></td>
<td>Floors</td>
<td>Walls/Ceilings</td>
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<td>Finish Materials (floor coverings, wall and ceiling finishes, insulation, cabinets, doors, partitions, and windows)</td>
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<td>Glass (sheets, colored tiles, panels)</td>
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<td>Glass blocks</td>
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<td>Insulation</td>
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<tr>
<td>Sprayed polyurethane foam (SPUF) or closed-cell plastic foams</td>
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<tr>
<td>Inorganic – fiberglass, mineral wool: batts, blankets, or blown</td>
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<tr>
<td>All other types (cellulose, cotton, open-cell plastic foams, etc.)</td>
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Building America Prototype
Post-Katrina *Green Dream* Homes 1 & 2
(Flood-hardy, strong, durable, energy-efficient, healthy, affordable)

- **Flood-hardy** materials and building systems
- **Elevated** on piers to BFE +2
- **Wind connections**, sheathing for 130 mph
- **Termite-resistant** borate-treated lumber, plywood
- **Rain, moisture, air** and **thermal controls**
- **HVAC** for low energy and healthy home
Flood-Resilient, Wood Frame Building System
(solid lumber, plywood & closed cell foam insulation)

Illustrations courtesy of Building Science Corporation
Flood-Hardy Materials
solid lumber & plywood – no OSB or LSL in floor and walls
Flood-Hardy Materials
Paperless drywall w/ moisture resistant core – no mold food
Tile flooring
Fiber-cement siding and trim
Flood-Hardy Materials
GD 1: Fire rated rigid foam under floor joists, sealed airtight
GD 2: Closed cell spray foam between floor joists, rim
Raised Floors
rot and cup
in the summer!

Hot-humid Climate

Cool A/C
+ impermeable flooring
+ permeable insulation

- wet subfloors
- cupped wood flooring
- mold and decay fungi
- termite attraction
Flood-Hardy Materials & Drainable Assemblies
GD 1: 2.5” closed cell spray foam in wall cavities – partial fill
GD 2: 2” rigid Iso foam board outside sheathing & wrap
GD2: WRB AND Drainage Gap

1. Housewrap over plywood
2. Insect screen draped over bottom flashing
3. Foil-faced 2” rigid foam board over housewrap
4. Furring strips over foam board, screen wrap insect excluder
5. Trim out window wells
6. Fiber-cement siding, trim
New Flood-hardy wood-frame building system
(Source: Building Science Insights 101 – Rebuilding Houston)

- XPS sheathing + CC foam
  - No wood sheathing
- CC foam provides racking resistance
- Washable, drainable, dryable
- Added R-value

Illustration courtesy of Building Science Corporation
Now what about restoring flooded homes?
www.LSUAgCenter.com/LaHouse

Flood Recovery Resources

- Storm Damage Cleanup Highlights
- Wet Floodproofing
- Disaster Information
- FAQ's – After Gutting Your Flooded Home

Innovate. Educate. Improve Lives

The LSU AgCenter and the LSU College of Agriculture
15. When damaged sheathing is removed (since it’s rotten, soft, won’t dry, mold infested fiberboard, etc.), how can it be replaced?
16. I can’t afford to replace the brick veneer, so now what?

**Restoration Method Options:**

1. CC spray foam with rainscreen
   - *Rainscreen* strips on brick for drainage
   - 2.5” closed cell spray foam behind & between studs

2. CC spray foam with thin XPS sheets
   - Thin XPS sheets with shims for drainage
   - 2 “ closed cell spray foam between studs

3. Rigid XPS foamboard inserts
3 Flood Restoration Methods
Hurricane Resistance, Resilience, Recovery

External Pressures

Internal Pressures

*Turn it upside down and shake it.*
Hurricane Damages

The major building envelope issues:

1. Loss of roof cover
2. Loss of roof sheathing
3. Debris impact – large holes via broken windows and doors
4. Window and door anchorage, connections, and pressure ratings
5. Garage doors & sliding glass doors
6. Water leakage
7. Ridge vents, gable vents and soffits
Hurricane-Hardy Roof
Plywood decking, ring shank nails, 6 in. spacing
Adhesive underlayment (*secondary moisture barrier*)
Class H (150-mph) wind-rated, Class 4 hail-rated shingles
Attic Vents and Soffits

**Risky**
- Gable vents
- Turbine vents
- Power vents
- Standard ridge vents
- Vinyl, aluminum soffit vents, esp. in J-channel

**Safer**
- TSA 100 wind-tested ridge vents with water barrier
- Structural soffits
  - Perforated fiber cement
  - Plywood w/ fastened soffit vent
  - Baffle at top plate
- Unvented attic system
  - No vents, so no wind driven rain
  - CC foam adds deck adhesion plus shear load capacity

![Diagram](image)
Hip Roof with moderate slope  
Aerodynamic + sheds water away + shades all sides  
Continuous Sheathing to resist racking  
Blocking at seams so all edges nailed to framing
Continuous Load Path
from roof to foundation
Advanced Framing
(2x6, 24 o.c.)
More insulation
Less lumber
Stack Framing
Easier Connections
Low cost

Modified for high wind:
- **Double** top plates
- **3**-stud corners

Reproduced with permission from Building Science Corporation
Impact Rated, High Design Pressure, Energy Star Windows and Doors
Why do you got an abandoned mobile home in the middle of your cornfield?

KEEPS THE TORNADOES AWAY FROM THE HOUSE.
Tornados

Tornado Risk Map

Wind Zones
- Zone I (130 mph)
- Zone II (160 mph)
- Zone III (200 mph)
- Zone IV (250 mph)

Other Considerations
- Special Wind Region
- Hurricane-Susceptible Region

Design Wind Speeds (3-second gust) consistent with ASCE 7-98
High Wind Designs Cover Most Tornados

Wind designs for building code in hurricane areas will protect from nearly all tornados EF3 and lower.
Spray Foam Insulation in New Construction

- Seals and Insulates unvented attics.
- Seals and Insulates wall cavities and rim joists.
- Foam must be thick enough to avoid condensation.
Spray Foam Insulation in Retrofits

- Seal roof framing to underside of roof deck with two-part, cc polyurethane spray foam or AFG-01-rated adhesive.*
- Increases wind-uplift resistance of pre-1994 code-minimum wood roof panels by 250%–300%.**
- Air seals and increases integrity of ceiling deck.

*FEMA. 2010. FEMA P-804/December 2010
**Datin et al. 2011. Journal of Architectural Engineering

Photo courtesy of FEMA 2010.
Earthquake Resistance, Resilience, Recovery via SIPS

6 SIPS homes withstood the "Great Hanshine" earthquake in Kobe, Japan, in 1995.

Are you building in an area at high risk for earthquakes?

Structural Insulated Panel Systems achieved Class 6 Seismic Designation, the highest designation for building materials in the State of California.
Earthquake Resistance, Resilience, Recovery via SIPS

Structural Insulated Panel System (SIPS)
Airtight seams, truly continuous insulation (no studs),
High racking resistance via 2 sheathing panels
Earthquake Resistance, Resilience, Recovery via **ICF**

**Insulating Concrete Forms (ICF)**

Steel reinforced concrete core
High R, continuous insulation
Wildfire Resistance, Resilience, Recovery
Wildfire Protections
to resist wind-blown embers

1. Roof:
   - Class A rated roofing system
   - ¼” wire mesh on vents
   - Birdstops, gutter leaf guards

2. Design does not hold debris

3. Walls:
   - Non-combustible finishes
   - Steel doors
   - Tempered, dual-glaze, low-e glass

4. Decks, porches, fencing
   - UBC fire-retardant material
   - Cement plaster undersides

5. Landscape buffer zone > 5 ft.
   - Non-combustible mulch, etc.
IBHS Study: Ember Intrusion through Gable and Eave Vents
Vulnerability of Roof Vents to Wind-Blown Embers

Limit Ember Entry

• >2 million homes in CA have high-to-extreme risk for wildfire damage.
• Embers can enter thru soffit and gable vents.
• Avoid gable-end vents if possible.
• Use wildfire-resistant gable, soffit, and ridge vents plus mesh screen that is less than ¼-in.
• Keep vents clean.
• Better yet, design homes with unvented attics.

IBHS Research Center. Ref. Stephen I. Quarles, 2017 IBHS
Unvented Attics improve resilience and save energy

Multi-Hazard Resilience
- Keep out burning embers.
- Keep out wind-blown rain.
- Reduce wind uplift pressures.
- Keep out bugs, birds, bats, and other varmints.

Energy Benefits
- Provide conditioned space for HVAC (and storage).
- Move thermal boundary above ceiling penetrations for electrical, HVAC, can lights, exhaust fans...
- Reduce the stack effect.
- Simplify air sealing and insulating of attic kneewalls.

Both
- Keep out humid air.
- Minimize ice dam formation.

“Unvented attics make a lot of sense.”
Joe Lstiburek, Building Science Corporation.
Disaster Recovery Reform Act of 2018

Every $1 invested in mitigation activities.

$1 = $6

saved in future disaster costs, nationally
Ride out the Storm in a High-Performance Home

ICF “Igloo” in Upstate New York
Winter 2017 - Severe cold, Four-day power outage
Outside: -8 to +16°F
Inside: + 56°F - with no heat source in house
Ride out the Storm in a High-Performance Home

1.89 kW of PV plus a 10-kW battery covers nearly all of the homes energy needs.
Ride out the Storm in a High-Performance Home
Ride out the Storm in a High-Performance Home

Mountain Home
7,600 feet elev.
Durango, CO
World-Class
Best Practices...

Building America
Solution Center
BASC.energy.gov

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...At Your
Fingertips
Thank you!

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