Rebuilding a Flood Damaged Home
Purpose of this training course

• Give builders and homeowners best available information on home reconstruction to reduce potential future flood damage while improving comfort and reducing energy use.
Introduction — The Gulf Coast and New Orleans have suffered unprecedented flood damage
All kinds of residential areas have been flooded by the hurricanes
Response to Floods - FEMA

- Substantial damage (repairs cost ≥50% of preflood market value)
  - Elevate
  - Relocate
  - Buy-out
- Not substantially damaged (repairs cost <50% of preflood market value)
  - Wet floodproofing (focus of this Workshop)

See: http://www.fema.gov
Post-flood New Orleans homes

- Previous condition or flood related damage will preclude some homes from restoration
Post-flood New Orleans homes

• Many well maintained older homes and newer homes can be candidates for restoration
Elevate—Examples
Let’s get started on recovery
Post-Flood Activities
Refer to the American Red Cross’s, *Repairing Your Flooded Home*

http://www.redcross.org/static/file_cont333_lang0_150.pdf
Post-Flood Activities

• **Drying**
• **Cleaning**
• **Draining Walls**

Post-Flood Activities

• Sanitizing
• Mold Removal

It’s time to rebuild.

• What have we learned to improve future flood damage resistance?
  – From ORNL/Tuskegee University testing
  – From inspection of New Orleans homes
ORNL & Tuskegee University have been doing flood damage research since 2000.

Reports at http://www.ornl.gov/sci/res_buildings/NaturalDisaster.htm
Field Test Modules at Tuskegee
Reconstruction Principle

*Exclude Water* — this is at best difficult to accomplish

Multiple tries at Dry Floodproofing failed in Tuskegee Tests
Reconstruction Principles

*Encourage Drying* — acknowledges the probability that water will get into a system like the wall

**GOOD – Wall System**
- INSIDE
  - Latex Paint
  - Gypsum Wallboard
  - SPUF Insulation
  - Plywood sheathing
  - House Wrap
  - Fiber Cement Lap Siding
  - Latex Paint
- OUTSIDE

**POOR – Wall System**
- INSIDE
  - Oil Based Paint or Vinyl Wall Covering
  - Gypsum Wallboard
  - SPUF Insulation
  - Plywood sheathing
  - House Wrap
- OUTSIDE
  - Plywood Panel Siding (e.g. T-111)
  - Oil Based Stain
Flood damage resistant reconstruction

Numerous things can be done throughout the home – let’s focus on the envelope first
Site drainage, foundation, crawl space
Site drainage, foundation, crawl space

- Completely dry crawl space
- Slope site away from house
- Install flood vents
- Regrade crawl space to drain to perimeter
- Cover dirt with vapor barrier
- Seal connections to house
Floors—subflooring, framing, finish flooring
Subflooring, framing

• Promote drying by removing
  – Wet carpeting
  – Flooring that traps moisture
  – Wet insulation
• Concrete floors usually OK
• Wood sub-floor and joists OK if able to dry

POOR - Floor System
INSIDE
Vinyl Floor Covering or Wet Carpet
Plywood Sub-flooring
Wood Joists
SPUF or Wet Fiberglass Insulation
CRAWL SPACE
Finish Flooring

Which flooring materials could be reused?

• Carpet and pad (no)
• Wood (?)
• Wood composite (?)
• Sheet vinyl (?)
• Ceramic/quarry tile (yes)
Walls—framing, sheathing, siding, gypsum wallboard, finishes, insulation
Wall Framing, Sheathing

Tuskegee and New Orleans Experience—No damage
Siding

Plywood

Vinyl

Fiber cement
Gypsum Wallboard
Tuskegee and New Orleans Experience—Fibrous insulation remained moist and encouraged mold growth on walls
Gypsum Wallboard

Which gypsum wallboard materials could be reused?

• Common paper faced wallboard—drywall (?)
• WR Greenboard (no)
• Fiber-reinforced gypsum interior wall panels—ASTM C-1278 (?)
• WR Fiber-reinforced gypsum interior wall panels (yes)
• Other WR gypsum wall board products (?)
Wall finishes

- Flaking paint
- Typical mold
- Vinyl Wallpaper
- Restored Post flood
Wall and floor insulation
Spray polyurethane foam (SPUF)
Windows and Doors
If the roof has been damaged

Replacement roofs stop flooding “from above” and provide safe haven for equipment
Not All Roofs Performed Equally

See: www.fema.gov/pdf/hazards/nhp_fema55.pdf
What can be done to improve roof performance on existing homes?

• Convert to hip roof or reinforce gable ends
• Remove or reinforce overhangs
• Consider making attic unvented conditioned space to house equipment
• Do not overlay existing shingles with a new membrane
• Use infra-red reflective, hurricane resistant roof membranes (metal, shingle, tile)
Don’t Overlay Existing Roofing
Use Infrared Reflective Roofing

IR reflective roofing (magenta) lowers the solar heat flux through the roof by 15 to 30% when compared with a standard (black symbols) roof of the same material. IR reflective roofs are currently available in painted metal, shingle, and tile.
Strategies for flood damage resistant equipment and appliances
Raise HVAC equipment above potential flood level
Associated Attic Modifications
Raise water heater & laundry above potential flood level
Kitchen and Bath Cabinets
Kitchen cabinets and appliances
Restoring the electrical system
Electrical system
Sanitary Sewer
Katrina – Floodwater contamination a potential issue in New Orleans
If flood damage resistant construction isn’t required by code why would a homeowner want to use it?

• Reduced vulnerability to future floods
  – Less disruption (faster return)
  – Lower recovery cost
• Reduced heating and cooling energy costs
  – Improved comfort
Cost and benefits - typical 1800 S.F. home, Gulfport, MS restored in-kind versus restored with flood damage resistance

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (in-kind)</th>
<th>Cost (flood-resistant)</th>
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</thead>
<tbody>
<tr>
<td>Wall Insulation</td>
<td>$775</td>
<td>$2380</td>
</tr>
<tr>
<td>Floor Insulation</td>
<td>$1620</td>
<td>$4860</td>
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<tr>
<td>Attic Insulation</td>
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<tr>
<td>Front Door</td>
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<td>$250</td>
</tr>
<tr>
<td>Windows</td>
<td>$2200</td>
<td>$1700</td>
</tr>
<tr>
<td>Heat Pump</td>
<td>$1160</td>
<td>$790</td>
</tr>
<tr>
<td>Totals</td>
<td>$6355</td>
<td>$12410</td>
</tr>
</tbody>
</table>

(the costs cover only that portion of the restoration where the costs differ among the options and not the total cost of restoration)
The reasons for the cost differences are as follows:

• Wall and floor insulation changes from fiberglass batt (in-kind) to SPUF (flood resistant)
• Under roof deck insulation is added to flood resistant to enable HVAC and ducts to be relocated above flood level
• Front door is solid wood (in-kind) and steel foam filled (flood resistant)
• Windows are wood (in-kind) and solid vinyl (flood resistant)
• Heat pump is 4 tons (in-kind) and 2 tons (flood resistant) due to the improved envelope
Energy Savings - based on design simulations of heating and cooling cost

• In-kind restoration $1175/year.
• Flood resistant restoration $588/year.
• The savings for flood resistant restoration $587/yr.
• The $6055 added cost is offset by energy saving in about 10 years.
DOE’s Fact Sheet—Reconstructing Flood Damaged Homes

Energy-Efficient, Flood-Damage-Resistant Home Reconstruction

RECONSTRUCTION PROCEDURES

1. Start by removing all damaged materials and contents from the flooded areas.
2. Disconnect all utilities such as gas, electricity, and water to prevent further damage.
3. Assess the extent of damage to decide on the necessary repairs or replacements.
4. Use proper ventilation to dry out areas affected by floodwater.
5. Install new insulation and ensure it is properly installed to maintain energy efficiency.
6. Replace damaged roofing and flashing to prevent further water penetration.
7. Reinforce the foundation to prevent future flooding and structural issues.
8. Install new windows and doors to improve energy efficiency and security.
9. Consider using flood-resistant building materials and techniques.
10. Ensure proper drainage systems are in place to prevent future flooding.

NEIGHBORHOOD PROTECTIONS

- Elevate or strengthen existing structures to protect against future flooding.
- Install floodproof barriers around the property to restrict floodwater entry.
- Consider adding levees or dikes for increased flood protection.
- Regularly check and maintain your drainage system to prevent blockages.

RECONSTRUCTION KEYS

- Plan ahead and consult with local authorities for guidance on reconstruction.
-优先使用环保材料，减少对环境的影响。
-咨询专业人士，确保施工符合最新的建筑标准。
-之后，对你的家进行保险，确保财产得到充分的保护。

The “bottom line” for homeowners

Using flood damage resistant restoration will:

• Reduced vulnerability to future flood damage and disruption
• Potentially lower home flood insurance rates
• Reduced energy costs and increased home comfort
Your Questions

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