

REPAIRING ROOFS & CEILINGS

Hurricane damage can result from wind-borne debris, flooding, fallen trees, sustained winds and strong gusts, driving rains and other water intrusion. This Technical Brief will guide homeowners and contractors when repairing damaged roofs and ceilings.

STEP 1: Assess the Extent of Damage

Do you need to patch a hole, or replace all the roofing? Remedy multiple leak-points, or replace the soaked, collapsing ceiling? Do a quick structural evaluation before expending time, effort, and money on a building that is not structurally sound. If damage compromises the structural integrity of the home, consult a professional engineer. When in doubt, call a professional.

FIVE SIGNS OF STRUCTURAL DAMAGE:

- ▶ The structure shifted on the foundation
- ▶ There are broken pilings, shifted stairs, or slanted walls
- ▶ The foundation shifted or floors are not level
- ▶ Crawlspace or foundation walls have cracked or caved in
- ▶ Erosion cut into the soil to the bottom of the foundation or has undermined the foundation

HOW WET IS TOO WET?

Some moisture is unavoidable, but too much causes mold, decay, and other problems. An electric moisture meter, which you can buy or rent at many building supply stores, can easily determine the moisture content of various building materials. Wood should have a moisture content below 20% before you cover it. Drywall and plaster should have a moisture content below 2%.

STEP 2: Remove Damaged Materials and Allow Structure to Dry

Prevent additional water damage with tarps or other water barriers. Some storm-damaged materials can be recovered, but many cannot. Always choose the safest option. Reusing unsound materials will come back to haunt you through structural problems, mold issues, and unpleasant appearances (buckling). If material will not have time to dry before being covered again in the repair process, do not reuse.

Move the materials that you want to reuse to a secure, dry place. Move unrecoverable materials away from the home, but save until an adjuster confirms your losses.

GUIDANCE ON WHAT TO KEEP AND WHAT TO DISCARD:

- ▶ Remove **roofing material** down to the sheathing in damaged areas.
- ▶ Keep **ceiling drywall** that has only been wet by clean rainwater, is not sagging, is not mildewing, and has not lost its smooth texture. Wet insulation must be removed for the ceiling to dry properly.
- ▶ Keep **plaster** if it appears undamaged, but note that it will take a long time to dry. Ceiling insulation must be removed for the plaster to dry. If the plaster separates from its wood laths, that entire interior portion of the ceiling should be removed and replaced.

HOW TO'S *for the* HANDY HOMEOWNER SERIES

- ▶ Your House is a System
- ▶ Selecting the Right Product
- ▶ Repairing Walls & Floors
- ▶ Repairing Roofs & Ceilings
- ▶ Repairing Windows & Doors

This Technical Brief is one of a series targeted to skilled do-it-yourself homeowners in the Gulf States region. It provides general guidelines for repairing storm-damaged homes.

NOTE: Contact a professional engineer if there is any evidence of structural damage to the home. If filing an insurance claim related to the damaged area, consult an agent before conducting any repair work. The local building agency can provide further guidance on applicable codes.

CAUTION

TURN OFF UTILITIES: Turn off electricity, gas, propane, and other utilities before assessing damage and starting repairs to avoid accident or injury.

BE AWARE OF LEAD-BASED PAINT HAZARDS: Many residences built before 1978 have paint that contains lead, which can pose a serious health hazard if paint, chips, and dust are not handled properly. See the U.S. Environmental Protection Agency's (EPA's) brief before disturbing painted surfaces in homes of this vintage: www.epa.gov/lead/pubs/leadinfo.htm#remodeling

BE AWARE OF ASBESTOS HAZARDS: Homes older than 1977 may have building products that contain asbestos such as insulation, high-temperature gaskets, roofing and siding shingles, and vinyl sheet flooring. See EPA's brief before disturbing such materials: www.epa.gov/iaq/asbestos.html



REPAIRING ROOFS & CEILINGS

7 STEPS FOR ROOF & CEILING REPAIR

STEP 1:

Assess the extent of damage

STEP 2:

Remove damaged materials
and allow structure to dry

STEP 3:

Wind-proof damaged roof

STEP 4:

Install weather-resistant barrier

STEP 5:

Install wind-resistant roofing in
high-wind zones

STEP 6:

Weatherize

STEP 7:

Repair drywall and plaster

► Remove and discard **fiberglass batt insulation** and **cellulose insulation** that has been soaked. **Rigid insulation** can be washed off and kept.

► Keep wet **framing members** and **trusses**, which will retain their shape if allowed to dry naturally, unless they are obviously damaged or warped. Though they may swell when soaked, they usually dry back to their original shape. **Sheathing** (plywood and oriented strand board [OSB]—OSB looks similar to fiberboard and particle board, but OSB has structural capability) might be kept if it is not soaked for too long. Pay careful attention to plywood and, especially, to OSB, because they may peel or fall apart as they dry.

► Use fans or heaters to speed the drying process after removing damaged materials.

STEP 3: Wind-Proof Damaged Roof

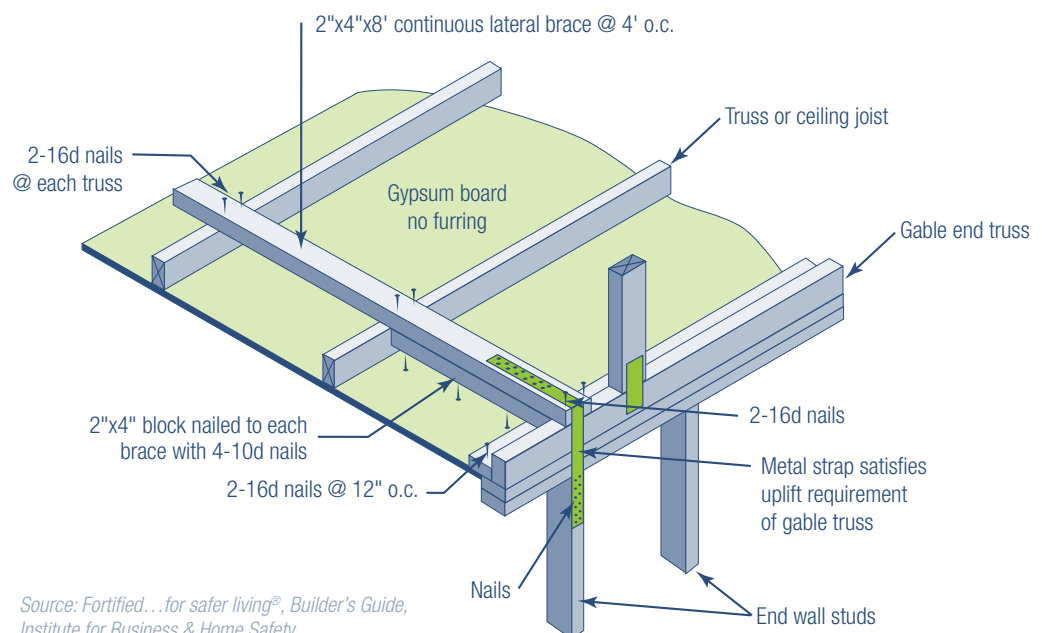
Add bracing to the attic structure to strengthen the home against future storms. Line up bracing and tie-downs at critical load points to maintain the integrity of the load path. (During Hurricane Andrew, hurricane ties had a 92% success rate.) Extend fascia board to terminate below

the underside of the soffit. This helps keep water out of the eaves. The Institute for Business and Home Safety (IBHS) suggests the following bracing plan for homes with gable ends:

► **Install lateral bracing of the bottom chord** (see Figure 1), running perpendicular to the bottom chords of the roof trusses, at 4 feet on center and extending back 8 feet from the gable end wall with 2x4's, fastened with two 16d (16 penny) nails at each truss chord or ceiling joist and four 16d nails into blocking in gable end truss or rafter end wall assembly. Make sure the bottom chord of the gable truss or end ceiling joist is anchored to the wall below. If you have a wood-frame house and the interior finish on the wall below is being removed, try to ensure that the lateral braces are aligned with studs in the end wall below so it is possible to connect the braces to wall studs using metal strapping. This metal strapping, when properly installed, helps to resist both lateral forces and uplift on the gable end wall.

► **Install bottom chord anchoring for uplift** to transfer the loads from the gable truss/frame wall to the end wall below. In order to ensure complete load paths at these points, install metal straps rated for a minimum tensile load of 770 pounds at each lateral

Figure 1. Lateral Bracing of Bottom Chord



Source: Fortified...for safer living®, Builder's Guide,
Institute for Business & Home Safety

brace. In addition, if the exterior sheathing has been damaged or removed, install new wall sheathing so that it overlaps the connection between the end wall and gable truss/frame by at least 12 inches.

- ▶ **Cross Bracing** will transfer lateral loads from gable truss or gable framing to the ceiling and roof sheathing planes where loads can be effectively transferred to the walls. Cross-brace all gable ends with flat ceilings at the same spacing as the lateral bottom chord braces described in *Figure 1* (every 4 feet). Keep the orientation of the X in the vertical plane. Make sure the connection between the cross braces and trusses or rafters is made into the side of the top chord and bottom chord of the trusses or rafters.
- ▶ **Install top chord bracing** like the bottom chord bracing, with the exception that the metal strapping is not required. Install 2"x4"x8-foot blocking along the underside of the top chords of gable ends at all locations where cross bracing is installed (i.e., with a horizontal projection of not more than 48" on center).

STEP 4: Install Weather-Resistant Barrier

Repair localized damage to sheathing by replacing it with panels of the same thickness. Attach the new sheathing and re-nail

the existing sheathing with 8d ring shank (2.5"x0.120" diameter) nails at 6 inches on center to all framing members.

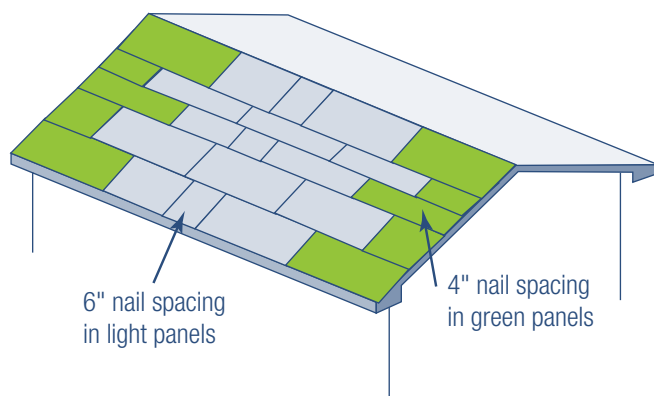
If you have to **replace all the sheathing**, consider using 32/16-rated roof deck sheathing (plywood or OSB) with a minimum thickness of 5/8" and a nailing pattern of 8d ring shank nails at 4" on center on any panel adjacent to a gable end. (*See Figure 2.*) The same nails are required at 6 inches on center everywhere else. If required due to roof geometry, piecework (panels ripped lengthwise to a width less than 4 feet) should be located in a strip at least 4 feet away from the ridge or eaves.

Use hurricane clips, which offer an extra connection between sheets of sheathing in the gap between trusses.

Use **baffled ridge vents and off-ridge vents** instead of unbaffled vents. Unbaffled vents tend to allow wind-driven moisture to enter attic spaces or the cavities of cathedral ceilings, causing moisture damage and mold growth.

Seal all roof-sheathing joints with a self-adhered asphalt/rubber tape (modified bitumen) at least 4" wide to provide a secondary moisture barrier. As an alternative, consider applying an ice and water shield type of product over the entire roof deck. These products are widely used in roof valleys and will provide an excellent backup protection from

Figure 2. Roof Sheathing



Source: *Rebuilding After a Hurricane, Recommendations from the Institute for Business & Home Safety*

water intrusion if the primary roof covering is damaged or blown off. If you use the ice and water shield, the felt paper underlayment is not required, but you must ensure the attic is vented.

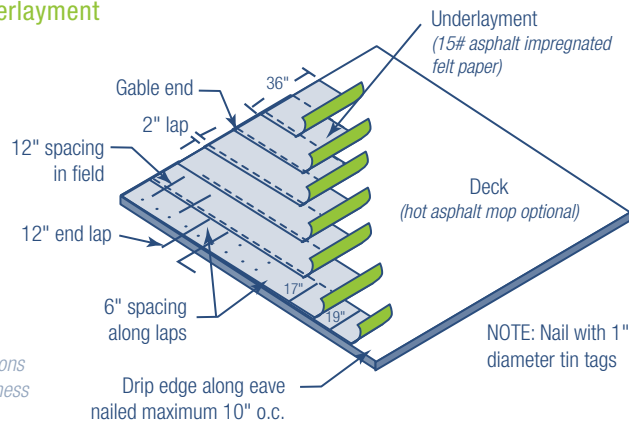
Roofing underlayment should be either a single layer of 30# felt with a minimum 2" overlap, or two layers of 15# felt. Install in accordance with manufacturer's instructions. (See Figure 3.) Underlayment requires a minimum 6" end lap (note that this can be omitted if you cover the entire deck with an ice and water shield type of product). **Peel-and-stick roof underlayment** reduces water intrusion if roof shingles are lost. These rubber or asphalt sheets cost \$700 to \$1,000 more than standard roofing felt for a 2,400-square-foot house.

STEP 5: Install Wind-Resistant Roofing in High-Wind Zones

Install shingles or other roof covering per building requirements. If more than 10% of the old roof needs repair, the *Journal of Light Construction Field Guide* recommends a new roof.

Follow a proper nailing schedule. Size, type, and placement are all factors. Sheathing durability is sensitive to nails too close to the edge of the sheet; follow manufacturer's recommendations. Overdriving nails can significantly reduce uplift strength of the connection. Thicker sheathing can offset sensitivity to overdriving.

Figure 3: Roof Underlayment



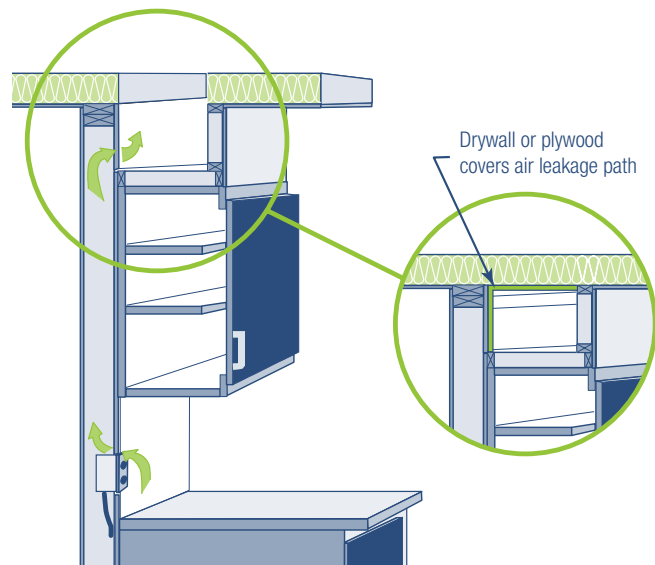
Source: *Rebuilding After a Hurricane, Recommendations from the Institute for Business & Home Safety*

RECESSED LIGHTS

If you have standard recessed fixtures, then you have gaps in your insulation (safety requirement) and air leaking between the attic and the rest of the house. Even IC-rated fixtures, which have a heat sensor switch and can be covered with insulation, allow air to leak.

Airtight, IC-rated fixtures are recommended for optimum energy efficiency, and required by the Residential Energy Code of Alabama. Alternatives to recessed lights include surface-mounted ceiling fixtures and track lighting.

Figure 4a. Soffits



Source: *Alabama Builder's Field Guide, Energy Efficient Building Envelope, prepared for the Alabama Department of Economic and Community Affairs by Southface Energy Institute, Inc., September 2004*

STEP 6: Weatherize

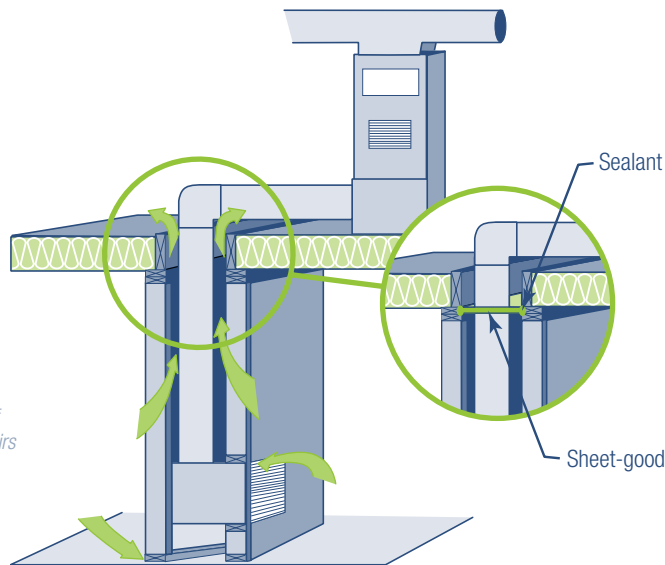
Air seal and insulate the home to maximize comfort, minimize energy bills, avoid moisture problems, and minimize fire hazards. Reducing air leakage is an inseparable part of insulating: you should not do one without doing the other.

Seal Leaks

If you stop conditioned air from leaking out of the top of the house, you stop outside air from leaking into the house through the basement or crawl space. It pays to spend time sealing air leaks in the attic. (See Figures 4 a,b,c,d.)

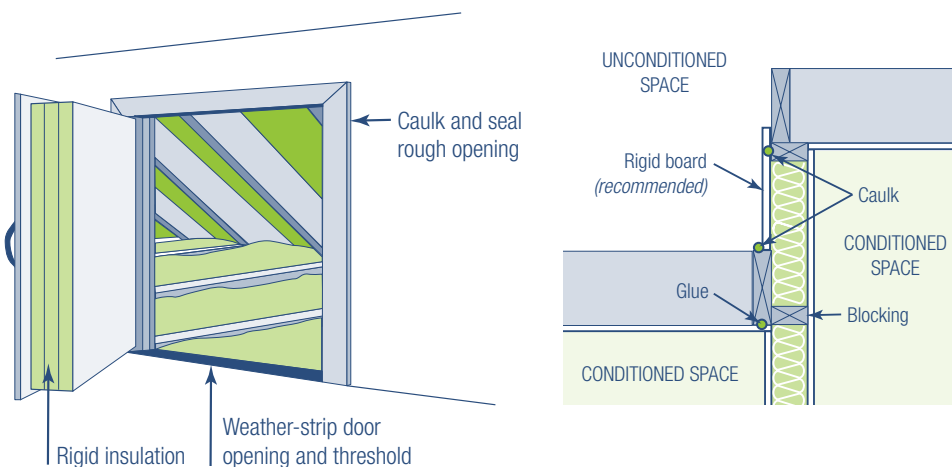
Spray foam insulation can seal many of the smaller leaks. For larger holes, cut a patch from rigid insulation board and seal the edges with caulk or spray foam. Recessed lighting fixtures require special handling and careful compliance with applicable codes because they generate so much heat. (See Figure 5 for recommended clearances around lighting and other penetrations.) Sealing a chase around a furnace exhaust vent requires sheet metal and high-temperature caulk. (See Figure 6.)

Figure 4b. Chases



Source: Alabama Builder's Field Guide, Energy Efficient Building Envelope, prepared for the Alabama Department of Economic and Community Affairs by Southface Energy Institute, Inc., September 2004

Figure 4c. Kneewalls

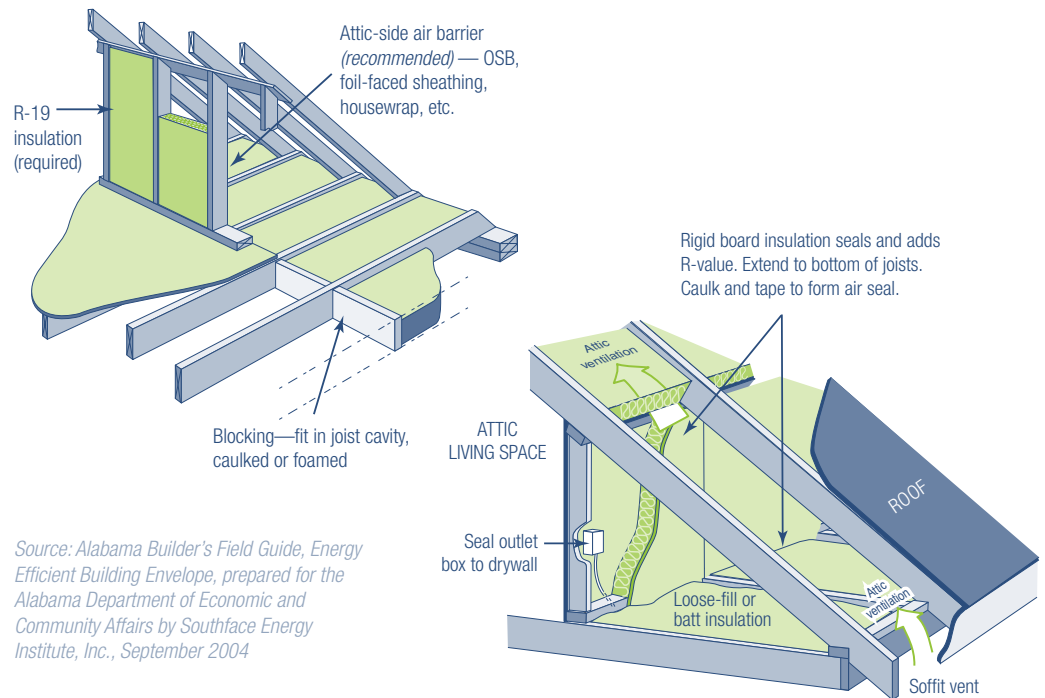


Source: Alabama Builder's Field Guide, Energy Efficient Building Envelope, prepared for the Alabama Department of Economic and Community Affairs by Southface Energy Institute, Inc., September 2004

WIRING IN OLDER HOMES

Older homes may have "knob-and-tube" wiring, where two separate wires run through ceramic posts (knobs) attached to the top of ceiling joists or through ceramic tubes inserted into holes drilled in the roof framing. Since this type of wiring was designed to dissipate heat to the attic air, insulating over knob-and-tube wiring can cause dangerous overheating. Consider having an electrician modernize your wiring so that the entire attic can be insulated.

Figure 4d. Finished Attic Details



Source: Alabama Builder's Field Guide, Energy Efficient Building Envelope, prepared for the Alabama Department of Economic and Community Affairs by Southface Energy Institute, Inc., September 2004

Insulation

If you have not air sealed the ceiling, don't insulate it – yet. Air sealing the attic is essential for the insulation to perform. Penetrations into the attic provide pathways for air to move between conditioned and unconditioned spaces.

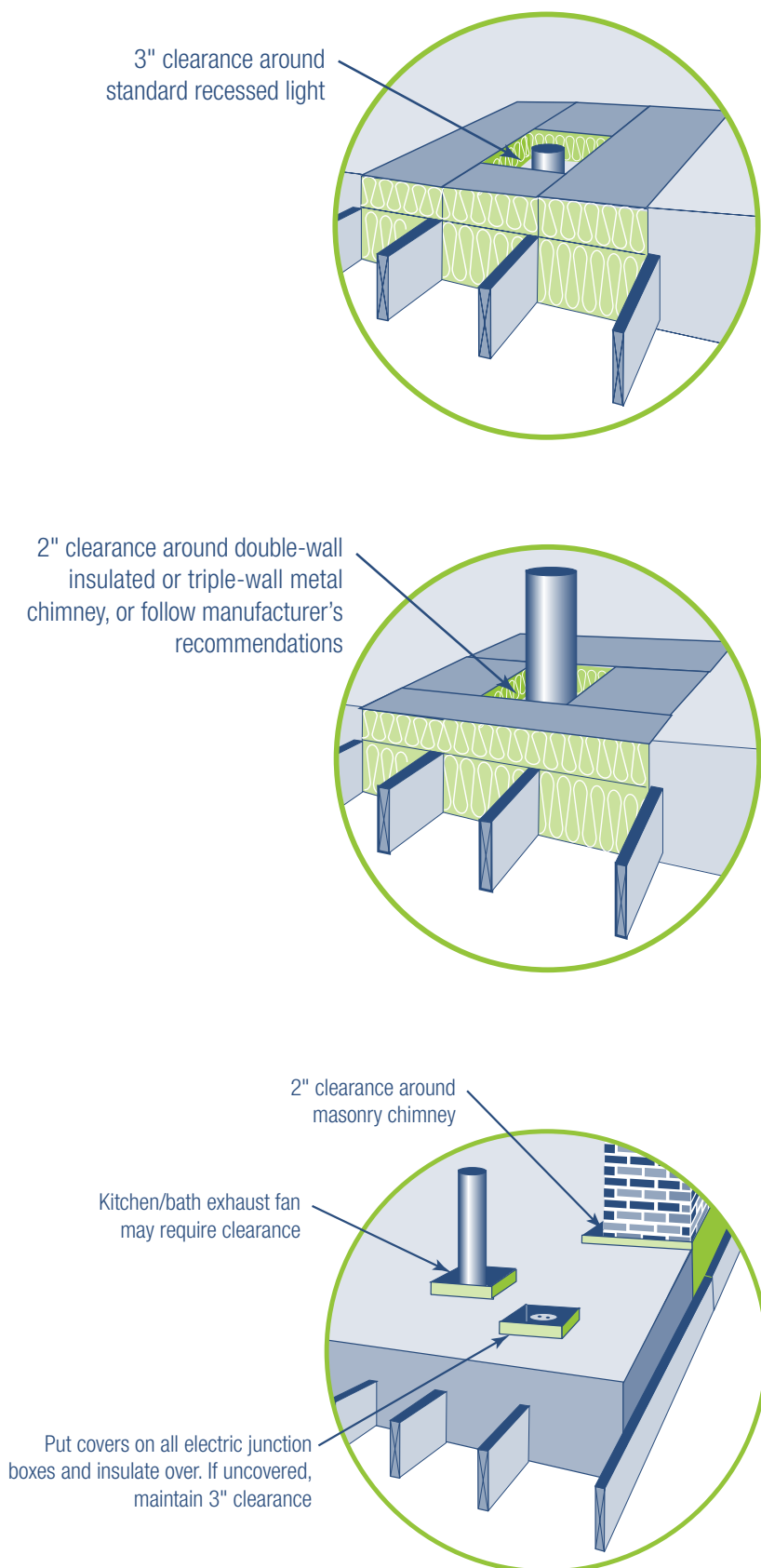
Insulation must cover the entire ceiling, including any kneewalls or cathedral ceiling portions. It must be evenly distributed and in contact with the air barrier (drywall), but the insulation should not be compressed or fluffed.

The prescriptive requirements for ceiling insulation in the International Energy Conservation Code indicate a minimum thermal resistance of R-30. A do-it-yourself homeowner is likely to use rolls of fiberglass insulation (also called fiberglass batts) because of its availability and ease of installation. Manufacturers mark the product's R-value on the package. Use unfaced batts.

Steps for installing batt insulation in the attic:

1. Seal attic air leaks.
2. Follow manufacturers clearance requirements for heat-producing equipment found in an attic, such as flues or exhaust fans. Other blocking requirements may be mandated by local building codes. Use metal flashing, plastic or cardboard baffles, or pieces of batt insulation for blocking.
3. Choose batts that are tapered (cut wider on top) so that they cover the top of the ceiling joists.
4. Completely fill the joist cavities. Shake batts to ensure proper loft. If the joist spacing is uneven, patch gaps in the insulation with scrap pieces. Try not to compress the insulation with wiring, plumbing, or ductwork.
5. Attic storage areas can pose a problem. If the ceiling joists are shallower than the depth of the insulation (generally less than 2x10s), raise the finished floor using 2x4s or other spacing lumber. (See Figure 7.) Install the batts before nailing the storage floor in place.
6. Insulate the attic hatch or attic stair.

Figure 5. Insulation Clearances



OBJECT	RECOMMENDED ACTION*
Recessed light	3" clearance on all sides, unless rated as Insulated Coverage (IC)
Doorbell transformer	Do not cover, no clearance on sides required
Masonry chimney	2" clearance
Metal chimney	2" clearance or follow manufacturer's recommendations
Vent pipes from fuel-burning equipment	Follow manufacturer's recommendations
Kitchen/bath exhaust	Duct to the outside; leave 3" clearance for all kitchen exhausts and for bathroom exhausts with attached lighting
Heat/light/ventilation	3" clearance on all sides
Uncovered electric	Cover the box and insulate junction boxes over it; if it is left uncovered, leave a 3" clearance
Whole house fan	Install blocking up to the fan housing; leave 3" clearance around the fan motor
Attic access door	Block around the door if blowing in loose-fill insulation

*These are general guidelines. Follow specific manufacturer's recommendations.

Source: Alabama Builder's Field Guide, Energy Efficient Building Envelope, prepared for the Alabama Department of Economic and Community Affairs by Southface Energy Institute, Inc., September 2004

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Figure 6: Flues and Exhaust Vents

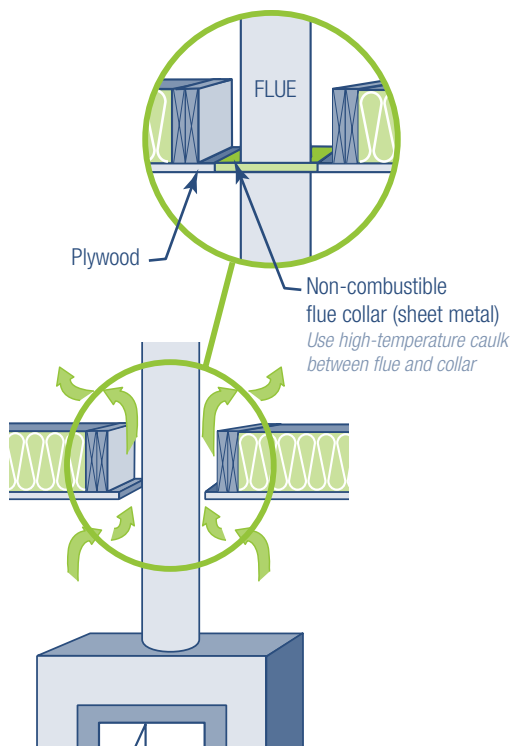
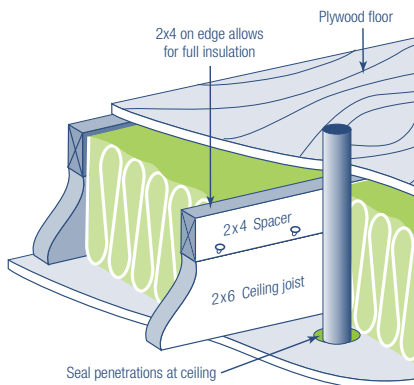


Figure 7: Raised Ceiling Floor



Source for Figures 6 and 7: Alabama Builder's Field Guide, *Energy Efficient Building Envelope*, prepared for the Alabama Department of Economic and Community Affairs by Southface Energy Institute, Inc., September 2004

STEP 7: Repair Drywall and Plaster

Repair large holes or water-damaged areas of ceiling drywall with a US Gypsum repair kit or equal. To replace large sections of ceiling, nail or screw drywall to existing or newly replaced joists. Mold-resistant drywall is now available, though it is more expensive than standard drywall. Scrape excess glue, if any, from the existing joists or studs so that the new drywall is flat and plumb.

If joists do not adequately back the drywall throughout the entire area, frame the opening with blocking to support new drywall. Cut new drywall panel section to fit damaged area, leaving approximately $\frac{1}{8}$ " gap all around. Use quick-setting joint compound and fiberglass tape, which perform much better under flood conditions than standard drywall compound and paper joint tape.

The least expensive and most desirable way to repair old plaster ceilings after they dry is to carefully patch and then paint them. Covering cracked or deteriorated ceilings with an additional layer of gypsum board is the next most cost-effective option. The most expensive option is to tear out old plaster in its entirety and replace it with new drywall and trim. Generally, it is less expensive to repair up to 50% of walls and ceilings that have otherwise sound plaster, than to remove all the existing plaster and replace it with drywall.

The material in this Tech Brief was adapted from the following sources:

Alabama Builder's Field Guide:
Energy Efficient Building Envelope
prepared for the Alabama Department of Economic and Community Affairs by Southface Energy Institute, Inc., September 2004

Durability by Design: *A Guide for Residential Builders and Designers*
Partnership for Advancing Technology in Housing, U.S. Department of Housing and Urban Development, May 2002

Field Guide
Journal of Light Construction, 2003

Field Testing of Energy-Efficient Flood-Damage-Resistant Residential Envelope Systems, Summary Report
Oak Ridge National Laboratory, 2004

Rebuilding After a Hurricane
Institute for Business & Home Safety (undated)

Repairing Your Flooded Home
American Red Cross, 1992

The Rehab Guide Volume 3: Roofs
prepared for the U.S. Department of Housing and Urban Development, August 1999

The Rehab Guide Volume 5: Partitions, Ceilings, Floors, and Stairs
prepared for the U.S. Department of Housing and Urban Development, August 1999

FOR MORE INFORMATION SEE:

Building America Best Practices Series:
Volume 1: *Builders and Buyers Handbook for Improving New Home Efficiency, Comfort, and Durability in the Hot and Humid Climate*
www.buildingamerica.gov

Energy Efficient Rehab Advisor
www.rehabadvisor.com

Practices for Improving Hurricane Resistance
www.pathnet.org/hurricane

ENERGY STAR
www.energystar.gov

For comprehensive information from the Center for Disease Control on how to limit exposure to mold and how to identify and prevent mold-related health effects, visit:
www.bt.cdc.gov/disasters/mold/report/pdf/2005_moldreport.pdf