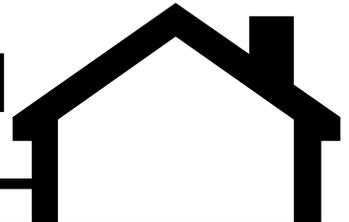


Restoring Storm-Damaged Buildings



Natural Hazards Series: Recovery

Part 3

Determining Structural Damage



Once calm has returned after a storm or flood, it's time to assess the damage and begin repairs. A number of factors should be considered, and the following information may be helpful.

Damage to Structures

Damage to structures in many cases is obvious, but damage that is not clearly seen may cause problems also.

Look for wood structural members that are cracked, and remember these can be hard to detect. Structural bracing may not be secured as tightly as originally. If doors or windows do not open as they did before the storm, this may indicate the structure has shifted. In case of severe shifting, water lines, gas lines and electrical circuits may have been damaged.

If wetness occurred because of leaking roofs, look for wet electrical circuits, wet insulation and other water damage to the interior of the structure. Once insulation becomes wet in a wall or attic, it must be replaced. Wall insulation that is sealed within the structure will not dry out.

Structures that use a roof truss system should be carefully inspected. In many cases, truss systems are constructed of 2 x 4s and metal fasteners. Any crack or break in the truss will greatly affect the strength of the truss system.

Repair or replace?

Damaged structures can be our homes, equipment storage buildings, barns and other outbuildings. Care and consideration should be given to their restoration. Appropriate measures vary with the type, age and condition of the structure. Often, the structure should be removed rather than rebuilt. The structural integrity of the building should be assessed, and if the decision is made to repair, additional bracing may be required before repairs begin.

In some communities, repair of damaged buildings may require a building permit. Even in communities without general permitting, permits may be required in special flood hazard areas. Check with your local building official or permit office before beginning or contracting for repairs.

There are a number of ways to repair homes so they will be less susceptible to flood and wind damage. These include elevation of utility systems and appliances, as well as the use of flood-resistant materials at levels in the structure which are likely to flood. There are flood-resistant materials for flooring, walls, wall covering and insulation. There are also materials for sealing the building itself, when flood waters do not exceed 30 inches. The American Red Cross publication "Against the Wind" details simple methods of adding extra bracing in key areas to strengthen buildings so they'll withstand high winds.



Louisiana State University

Agricultural Center

Louisiana Cooperative Extension Service

Checking outside for structural damage

- Make sure the building is not in danger of collapsing. Look for bulges, sways, leaning walls and sagging roof lines.
- Check the roof. The roof is a very good indicator of the presence of structural damage. Look at the ridge of the roof, and assess whether it is straight. This can be viewed from a distance better than close up. If the ridge sags either on the end or in the middle, the load-bearing walls have shifted.
- Check the walls to verify that they are vertical and straight. This normally can be done by eye or with a carpenter's level.
- Check where the structure meets its foundation. If the house is on piers, look at the individual piers and see that they remain in plane and level. Whether it is on a slab or on piers, check to see that the building has not shifted on its foundation. Flooded wooden floors, if they do not buckle, will sometimes push walls outward at the base.
- Check for cracks in masonry exteriors of the building. Look near the corners of the structures and under and around doors and windows.

If any of these indicators of structural damage are observed, it is advisable to call a building contractor, architect or engineer. A professional needs to further assess the building for its safety and determine the required repairs. These indicators also should be pointed out to the insurance adjusters.

Entering the building

Turn off any outside gas lines at the meter or tank, and let the house air for several minutes to remove foul odors or escaping gas.

Turn off the main electrical breaker until safe conditions are established. If the main disconnect is inside the house, it would be wise to call your utility company for assistance. Even if power is out in your neighborhood, disconnect the main switch, fuse or circuit breaker at your home, and disconnect all circuits. Unplug all appliances that have been flooded.

Enter cautiously. Do not smoke. Don't use a flame as a light source.

Check for sagging ceilings; wet insulation and pocketed water can cause ceilings to fall.

Turning off the Electricity



- Stand on a dry spot when working with electrical boxes and panels.
- If you have to step in water to get to the circuit or fuse box, call an electrician; do not try to turn off the power yourself.
- Use a dry stick to open panel doors and throw switches whenever possible. Use caution when removing fuses (can't be done with a stick).

Preliminary repairs

Any temporary structural repairs that can be made will require some creativity since there's likely to be a shortage of materials. The most common repairs will involve nailing plywood or taping heavy plastic to broken windows, ceiling and walls.

If the building has shifted or the floors have settled badly, it may be necessary to install temporary bracing until extensive work can be done. To prevent flooded wooden floors from buckling and warping further, remove a board every few feet.

Cover damaged roof sections with heavy plastic or roofing felt anchored in place with wooden boards to help prevent leaks until permanent repairs can be made. Be especially cautious; damaged roofing can be loose or slippery.

Inside, remove any mud and debris while it is still moist.

Where freshwater flooding has occurred, remove covers from all outlets and fuses or multibreaker boxes after determining that power is not on. Flush with clean water to remove any buildup of

sediment. Let dry, and spray with contact cleaner/lubricant. Saltwater flooding will require replacement of outlets, breakers and controls. The wiring possibly can be reused after being checked by an electrician.

Dry Well to Prevent Decay

If your home was flooded, it must be disinfected and dried thoroughly to prevent mildew and future damage by wood rot. Areas wetted by clean rainwater, for instance from a leaking roof, do not need to be disinfected. All wet areas must be allowed to dry thoroughly.

Safety

For safety, wear a dust mask and protective clothing on legs, arms, feet and hands while cleaning up debris. When handling moldy or contaminated material, wear a respirator.

Wear rubber gloves while scrubbing flood-damaged interiors and furniture.

Buildings constructed in the '70s and earlier may have lead-based paint. Sanding or scraping this paint creates a serious health hazard. Read Extension Publication # 2564 before working with suspected lead-based paint.

Remove wet carpets, carpet pads and rugs within 24 hours. **Disinfect** the slab. You may be able to clean the carpets and rugs, but should replace carpet pads.

Remove vinyl flooring over wood subfloors if there appear to be water bubbles between the vinyl and subfloor immediately after the flood has receded. **Disinfect** the subfloor. Drying may take several weeks. A buckled subfloor may flatten out on drying; be patient.

- For wood floors, carefully remove a board every few feet to reduce buckling. Leave open until the flooring is dry.
- Check the attic; remove all wet insulation and **disinfect** the area. Saturated fiberglass insulation will not dry and eventually will cause wood rot and mildew problems.

Wet fiberglass insulation will not dry in a closed wall. The structure can be damaged by wood decay as a result. In addition, the moisture held in the wall cavity can create health problems with the growth of molds and mildew.

- Check inside exterior walls for wet insulation. Remove all wet insulation, even if it means cutting into walls. Fiberglass insulation should be replaced with new material - either more fiberglass or foam sheets. Using foam sheets will eliminate the need to replace insulation in the next flood. Wash the insides of walls with mild soap, and rinse with clean water. Spray on **disinfecting** solution. Allow wetted areas to dry thoroughly before installing the new insulation. This may take 4-6 weeks.
- Paneled walls may be repaired by prying the paneling loose at the bottom. Remove any wet insulation; wash and **disinfect** the wall cavity. Hold the bottom of the paneling away from the sill until the sill, studs and paneling have dried - about 4-6 weeks.
- Remove loose plaster wallboard and wet ceiling tiles. Badly damaged plaster walls can be resurfaced with sheetrock or plywood. Repair damaged walls and ceilings only after the house is completely dry.
- Remove vinyl wallpaper to allow supporting sheetrock or paneling to dry.
- Open closet and cabinet doors. Remove drawers for drying and to let air circulate. With care in drying, these may be reused, depending on the materials.

- An air conditioner is the best dehumidifier. If you don't have one, open as many doors and windows as possible and use fans to circulate the air.

Flooding and Damage-causing Pests



The severity of a pest problem following a storm or flood depends on the time of year and where, in the seasonal cycle of the pest, the disaster occurs.

Termites:

Current research indicates flooding will not leach termiticides from around a house unless the soil is eroded. If soil is deposited along the foundation of a house, it will provide a bridge for termites to go around the treated soil. Eliminate all sources of water and wood-to-soil contact. These conditions are conducive to termite infestations. Any damage to foundations or footing can result in termite infestations. Termites can enter buildings through cracks only 1/32-inch wide.

Wood debris of any kind will eventually attract termites. Termites are extremely important in recycling wood. Wood is composed of cellulose, and few organisms can break it down. We want termites to recycle wood, but we **don't** want them recycling our homes.

Get the house inspected within six months after a major flood. Contact your pest control company before disturbing the soil around the foundation or installing a drainage system around a home. Your actions may void your termite contract.

Don't be pressured into getting ANY pest control treatments done quickly if you are unsure of what you are being told. When in doubt, contact the Louisiana Department of Agriculture and Forestry - Structural Pest Control Commission.

Boring insects and fungi:

Moisture problems in the crawlspace can lead to other problems, such as wood-boring beetles and wood-decaying fungi in floor joists. Wood-decaying

fungi will not grow below 20% wood moisture content, however, and the likelihood of problems with powderpost beetles and old house borers decreases as the wood moisture decreases to 14% or less.

Therefore, applying a pesticide while moisture is high is NOT the solution to the problem. As soon as possible, complete temporary or permanent repairs and reduce moisture in the crawlspace. It may take some time to get the wood moisture down. Make sure foundation vents are opened properly and are clear of debris. Get standing water out of the crawlspace as soon as possible. If necessary, increase ventilation to the crawlspace. This can be a simple matter of opening the crawlspace door or using a fan to pull air out of the crawlspace. Rapid ventilation and drying are very important.

Before getting on the roof to do repairs, inspect the

Repairing the Roof After a Storm

Under the multiple pressures of shortages of time and finding skilled or reputable workers, materials, etc., it may be tempting to take short cuts on roof repairs, but remember that a depreciated home and future expensive trouble can come with such a decision. Repairs now, while the damage is clearly linked to the storm, may be covered by insurance or other assistance. Later, when problems reappear, you may bear those repair costs alone.

When considering roof repair, assess the condition of the roofing materials. If your shingles are nearing the end of the warranty period, you may want to replace the roof rather than patch it.

A word of caution:

Before getting on the roof to do repairs, inspect the rafters for breaks and sags.

Remember that electrical wiring is run through the attic; be sure the power is off before entering the attic space for the first time.

- Even without a disaster, the attic can be a dangerous place. Nail tips are left exposed and there can be numerous rough edges which could cause injury.
- When you do get on the roof, be very careful. The slope of the roof presents a hazard; in addition, a damaged roof may have loose shingles, exposed nails or other features which could lead to injury. When working on steep inclines, use a safety harness.

A common roof consists of three layers of materials: sheathing, roofing felt and an outer layer of shingles, metal panels or non-metallic panels. Sheathing is nailed to rafters before the felt and shingles or panels are applied. The felt is the layer which waterproofs the roof; it is important to overlap the layers properly so water runs over a lower course, not under it. Shingles or panels protect the felt from physical damage but don't really seal the structure against rain.

Rafters

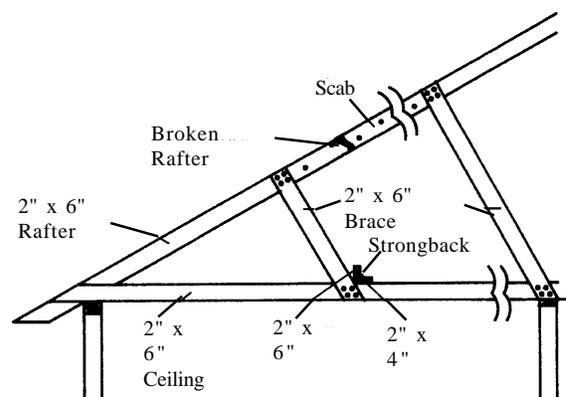
If you have broken rafters and ridge beams, they must be repaired first. The size of the area damaged dictates proper procedures. One or two broken rafters can be repaired by using a scab-and-prop method. If three or more adjacent rafters are broken, it may be advisable to replace them. Replacing rafters may require removal of undamaged shingles, felt and sheathing along the length of the rafter to be replaced.

Check with the local permit office to see if inspection or permitting requirements or building codes must be met.

To repair a broken rafter using a scab method, place a new rafter alongside the broken one and nail them together at several points. A scab should run approximately 4 ft. on each side of the break. A scab can be used to repair a truss rafter. In a truss, the scab must cover the broken rafter element and the points where that element is attached to other elements. The size of wood used for repairs should be the same size as the wood broken or larger (but never smaller).

Broken, severely damaged rafters are seldom as strong after repairs. Further strengthening may be

achieved by adding support braces between the rafter(s) and the ceiling joist(s) below. Run two braces from each repaired rafter: one from the rafter scab to the point on the joist where it crosses a load-bearing wall and one to the joist below (see diagram). If the attachment point for a brace is not over a load-bearing wall, the joist should be reinforced with a "strongback." The strongback is constructed of one 2x4 and one 2x6 plank nailed together at right angles; it is nailed to the ceiling joist and extends across several joists on both sides of the damaged area.



Sheathing

Best results come from replacing damaged sheathing with the same material as the undamaged section of the roof. Thickness may not be built up satisfactorily with felt, shingles or furring on rafters or trusses. Roof strength and appearance usually depend on the sheathing being a uniform thickness over the entire roof.

The face grain of the plywood must run perpendicular to the roof rafters. Joints must be placed over the rafters. When repairing large areas of the roof, a single sheet of sheathing must continue over two or more spans. If the flashing is damaged or removed, it must be replaced.



Roofing felt and outer layer (Shingles or panels)

A clean, dry, solidly sheathed and adequately flashed roof surface provides the stage for the last two roofing layers - the building felt and shingles (or other covering material).

First, apply the #15 or #30 building felt underlayment, fastening it down with 12-gauge felt nails spaced a maximum of 12 inches on center. The single ply of underlayment is placed parallel to roof eaves, so it runs from side to side, not up and down. The felt should have a 2-inch top lap and 4-inch end lap minimum; 6 inches all around is preferred.

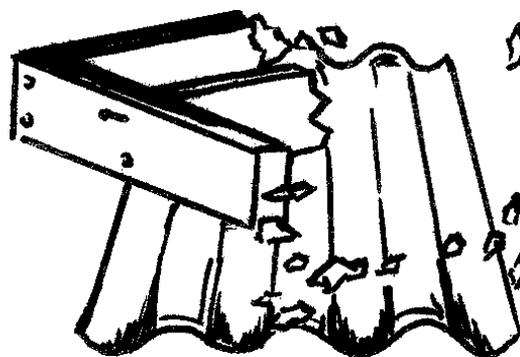
Since the piece higher on the roof needs to lap over the piece lower on the roof, you should start laying the felt at the bottom edge of the section being repaired. If the area you are repairing does not go all the way to the top of the roof section, be sure to slip the new felt under the bottom edge of old felt which is not being replaced.

Next, apply the shingles or panels. Usually instructions supplied by the manufacturer are the best to follow. Match the color and style of the existing material as closely as possible. Begin the starter course along the bottom and work to the top, following markings you have applied on the underlayment for squaring. Staying square and straight is a challenge.

Fasteners for asphalt shingles need to be 12-ga. nails, spaced four per 36- to 40-inch section of shingle. For panel roofing, follow the manufacturer's instructions.

If you have experienced structural damage, it is likely you'll need to engage one or more contractors to make repairs. Information on selecting a contractor, what should be in a contract and consumer protection is given in Part 6 of this series, "Financial Recovery and Risk Management."

For more information, contact your local Cooperative Extension Service office listed under local government in the telephone directory.



"This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under special project numbers 92-ESNP-1-5184 and 96-ESNP-1-5219."

Contributors:

Fred E. (Gene) Baker, Ph.D., Associate Vice Chancellor for Information Technology

Claudette Reichel, Ed.D., Specialist, Housing

Pat Skinner, Extension Associate, Environmental Programs

Dennis Ring, Ph.D., Associate Specialist, Entomology

Visit our website: <http://www.agctr.lsu.edu>

Louisiana State University Agricultural Center, William B. Richardson, Chancellor
Louisiana Cooperative Extension Service, Jack L. Bagent, Vice Chancellor and Director

Pub. 2668-C

7/99 Rev.

Issued in furtherance of Cooperative Extension Service work, Acts of Congress of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. The Louisiana Cooperative Extension Service provides equal opportunities in programs and employment.
