

Safe and Healthy Recovery and Rebuilding: A Guide for Homes in the Territory of the U.S. Virgin Islands



This guide is a helpful introduction for stakeholders to restore and protect homes after a natural disaster

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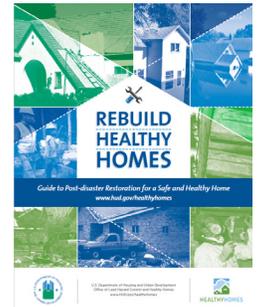
Introduction

This helpful guide is an introduction to keeping or restoring a home after a natural disaster for families located in the United States Virgin Islands. It includes methods, tips and ideas for safe recovery, restoration, and rebuilding that will result in **a healthier home** for the families you assist and serve. **This guide is intended for stakeholders: professionals, agencies, and those with expertise in working with families after a natural disaster.** After a disaster, there are many things to consider. Is the home safe to enter? How does a family save and clean up their possessions? How can families rebuild stronger and safer to protect them from future natural disasters?

This guide covers many types of natural disasters common to the U.S. Virgin Islands like Hurricanes, Floods, Earthquakes and others. The first part of the guide summarizes those disasters and gives you examples of possible damages to expect during the event. The second part of the guide looks at safe methods to re-enter the home or apartment right after the disaster and how to complete safe recovery of the home. The third part of this guide gives suggestions on how to restore and repair damages from the event, and how to rebuild for a safer and healthier home. At the end are additional resources for you and the families you work with in transforming their lives and their home.

Besides this guide, there are two other guides that are very helpful to you, assisting agencies, the families you work with, and those who might be helping you with recovery operations from a disaster:

1. **Rebuild Healthy Homes: Guide to Post-disaster Restoration for a Safe and Healthy Home.** This is a 74-page booklet published by the U.S. Department of Housing and Development that expands on the methods and procedures for post-disaster recovery of dwellings. The guide is a good resource for families, disaster agencies, organizations, and contractors that can assist them in cleanup, safety, repairing, and rebuilding their home. **You can get a copy of this guide from this weblink:** hud.gov/sites/documents/REBUILD_HEALTHY_HOME.PDF



There is also a smartphone app that can be used with the guide and might be easier to use after a disaster (assuming there is cellphone and/or internet still available). **You can download the app (iPhone only) at:**

<https://apps.apple.com/us/app/rebuild-healthy-homes/id980660616>

2. **Keep Safe: A Guide for Resilient Housing in Island Communities.** Published by Enterprise Community partners, this book is 490 pages and is an extensive resource for agencies and communities on disaster preparedness, recovery, and rebuilding. It has information on how to make homes and communities more resilient: stronger, healthier, and better after a disaster. It is most useful for disaster recovery agencies, repair and rebuilding contractors, and government officials. **You can get a copy of this guide from this weblink:**



<https://www.enterprisecommunity.org/solutions-and-innovation/disaster-recovery-and-rebuilding/keepsafe>

Types of Natural Disasters and Typical Damages to Homes

Floods

Floods are the most common natural disaster, affecting more homes than any other type of disaster. Floods can cause many kinds of damage, including:

- Mold is a common problem following a flood (after the water recedes), and gets worse over time. Mold is a significant hazard to people exposed to the spores. It grows on almost any material that stays wet more than about two to three days. The longer mold and wetness remain, the faster it spreads.
- Rising floodwater is usually contaminated with sewage (containing disease-causing bacteria), chemicals (pesticides, flammable liquids), and debris. Floods deposit these contaminants and they may be absorbed into building materials.
- Floods can shift or damage gas (and propane) tanks and lines, which may result in fire if exposed to a flame or spark. Chemicals or salt water can cause corrosion to wiring and other metals, and ruin equipment.
- Floods can cause foundations and walls to shift, settle or separate. This can cause serious structural damage to walls and floors. Rushing floodwater can cause wash-out of soil and expose foundations which can cause settlement of the structure.
- Wood swells when wet, so it may warp or split. Most processed wood products, such as oriented strand board (OSB) panels and particleboard, lose strength or disintegrate.
- In areas of unstable soil, floods can result in sinkholes.



Hurricanes and Tropical Storms

Hurricane season is from June 1 until November 30 although they can happen anytime.

Hurricanes are strong tropical cyclones that can produce extreme rainfall, storm surges, sustained very high winds, and may include tornadoes. Damage may be widespread across hundreds of miles, and affect thousands of buildings. Common types of damage include:

- Roof damage (most common) such as damage to or loss of roofing, underlayment, roof decking and vents. Wall or roof damage can cause collapse of the structure if the bracing and connections are broken. Wind can damage roofing and stagnant water on the roof can cause long term structural damage (corrosion of steel rods within concrete roofs) when leaks are not fixed promptly.
- Water damage from wind-driven rain such as roof leaks, loss of overhangs, leaks inside walls, and window and door leaks.
- Collapse or loss of add-on structures.
- Damage to or destruction of windows and doors, especially sliding glass doors and large areas of glass.

- Structural damage such as leaning or collapse of the entire home.
- Flying debris and glass shards becoming airborne missiles that puncture holes in buildings or break windows. In extreme events, such holes can lead to amplified air pressure loads and structural failures.

Earthquakes

Earthquakes are sudden and violent ground movement leaving moderate to major structural damages. They can also result in landslides, floods, fires and tsunamis. Damage from earthquakes include:

- Major structural damage or collapse of the home.
- Separated piping including dangerous gasses or flammable liquids, and water damage from broken pipes.
- Structure shifting off the foundation and foundations, walls, floors and roof pull apart or separate from swaying.
- Sliding of entire homes on steep hillsides.

Wildfires

Houses are susceptible to wildfires by exposure to burning embers, direct flame contact, intense heat, or firebrands (burning materials lifted by air currents). Damage depends on the fire intensity, its duration, and the type of materials used in a home. Damages range from destruction by fire, to smoke, ash and soot deposits and/or charring of materials. Firefighting efforts can result in water damage.

Smoke, soot and ash are serious health hazards. Ash can be a skin irritant and soot particles can float in the air and are an irritant to mouths, noses, and lungs. Oily soot can also contain toxins from chemicals carried by the fire from other areas. As the heat of a fire increases, soot becomes pressurized and forced into small cracks, crevices and into the surface of exterior and interior materials. Smoke, soot and ash can also become trapped in air conditioner equipment, vents, and ducts.

Combustible roof and wall coverings, including siding and roof membranes, are the greatest risk for fire on a house. The main risks to homes from wildfires include:

- Burning, charring, and destruction of flammable wall and roof materials and collection of burning debris.
- Pathways (windows, doors) allowing embers to enter the house.
- Destruction of plants and landscape material and fire using them to start a fire on the home exterior.

Although not the same as a close proximity wildfire, volcanos on other islands and smoke from distant continents (even Africa!) can create milder versions of the dust and soot problems listed above.

Tsunamis and Storm Surges

Tsunamis and storm surges are different coastal flood events from hurricanes and earthquakes, but they produce similar damages. A tsunami (high sea wave caused by earthquake or other underwater disturbance) takes place over a short time and produces quickly changing water levels and rushing currents. A storm surge (rising water due to a weather system) takes place over several hours with a repeated hammering of waves and winds. Both events can result in a dangerous rush of water that can damage or destroy homes. The main risks to homes from tsunamis and storm surges include:

- Structural damage from four main occurrences: force of the water, impact by water-borne debris, fires from debris and flammable liquids, and rapid erosion of soil. Even in tsunamis, concrete built homes could be lifted from their foundations causing permanent structural damage.
- Collapsed walls, broken windows and doors, and even total destruction, depending on construction methods and distance from the shoreline.

- Flood damage from sediments and debris, and water damage to materials and equipment.
- Water-borne debris impact is a major problem because rushing water carries debris very quickly and rams it into buildings. In addition, debris gathers against buildings supports, creating dams that produce even higher damaging forces on the structures.

Extreme Heat and Droughts

Drought can cause soil shrinkage, resulting in uneven settling and foundation cracks. This can lead to structural damage of walls, floors and roofs. In some areas, drought can cause sinkholes. Extreme heat poses a serious health threat to vulnerable residents, especially from dehydration.

Mudslides/Sinkholes/Debris Slides

Mudslides, debris slides and sinkholes usually happen after a long period of rain or an intense storm. They may coincide with floods. Home damages range from modest damage to foundations and roofs, to complete destruction.



Creating a Plan for Safe Cleanup, Repair and Restoration of Homes

An important first step in the recovery process is to **plan ahead** before starting any cleanup and recovery operations. Your work sequence should progress in the following phases.

- 1. Protect yourself first and foremost** — Get and use personal protective equipment (PPE) and clothing. If you see pregnant women, children, elderly persons, or others at the location of the damage, advise them that they are especially vulnerable to hazards and should avoid being on site as much as possible.
- 2. Assess the damages and hazards** before you begin — including structural stability, safety risks and hidden health threats. Specialists may be needed (engineers, architects, building code officials) to conduct inspections and make the home safe to enter and restore.
- 3. Create a work plan.** Plan tasks, supplies, professional services, disposal methods, site layout, and power sources. Get supplies and tools in advance. They may be easier to find outside the disaster area.
- 4. Prepare the work site** and supplies for safe and productive work and disposal of debris.
 - When safe and feasible, get power, water and gas systems into operation.
 - Set up a health and safety station, debris layout, and work areas.
 - Cover damaged roofs, broken windows, and damaged exteriors with temporary protection.
 - Mark areas where people should not access because of present hazards.

5. Clean, remove damaged materials, and decontaminate using safe work practices that avoid releasing and spreading health hazards; protect you, your employees assisting you; and the home's residents and their property (Training or qualified professionals are important for lead, asbestos and mold hazards).

- If flooded, pump out water in stages (very slowly).
- Remove damaged contents. Shovel out mud and silt before it dries.
- Remove damaged, non-restorable building materials.
- Eliminate or mitigate home hazards and toxins from the disaster.

6. Restore and improve the home.

- Restore **ONLY** after steps 1 to 5 are thoroughly achieved. Restoration before materials are fully dry or safe can result in long-term problems and hazards.
- Include home improvements that create a safer, more durable and healthy home.

Safety and Personal Protection Equipment (PPE)

After a disaster, houses can be a very dangerous place to be near or in, even if they show no signs of damage or disrepair. It is possible that the damage is hidden, and can cause a partial or full collapse of roofs, walls, floors, and even the entire house. If you are unsure whether a house is safe to occupy, consult a professional (engineer, architect, builder) or the building code officials in your area.

A damaged structure and site can be very dangerous to children, pregnant women, seniors, and ill family members. In these cases, it is important to move these families to a safer place and to make sure that they are not present during the cleaning and restoration processes.

Most important of all, take care of yourself and your health and safety first, throughout the process of cleaning up and restoring a damaged home. Don't hesitate to seek medical attention for any signs of illness, infection or injury after a disaster and during clean-up.

If children are present in the area, there are specific recommendations for them that can be found at: https://www.pehsu.net/Hurricane_and_Flooding_Resources.html and <https://bit.ly/306podA>

Hazards you're most likely to encounter after a disaster can be very dangerous and possibly deadly. Some of the hazards you might be exposed to are:

- Sharp jagged debris (cuts and scrapes).
- Electrical hazards (shocks and burns).
- Slick and unstable surfaces (fall injuries).
- Exposure to floodwater, chemicals, lead dust and/or asbestos (poisoning, skin or lung damage).
- Splashes, particles and debris in the air (eye damage or blindness).
- Exposure to allergens and other air pollutants (asthma, allergic reactions, respiratory problems).
- Contact with infectious pathogens from sewage and other sources (illness and disease).

Because of the above hazards, it is extremely important that you and any others on the site wear appropriate personal protection equipment (sometimes called PPE). You should wear protective clothing and gear **every time** you set foot on the site, around, and inside a damaged home. To be most effective and provide you with safer exposure to the hazards, you should choose **personal protective equipment (PPE)** to protect each part of the body that might be exposed to hazards. Make sure you wear each of the below items and consult with professionals if you are unsure how to wear them. PPE items should be tight fitting without constraining your movement, sight, or hearing.

Be aware that some of the items may be unavailable or very hard to get after a disaster due to large amounts of damage and many people affected by the event and trying to buy these items afterwards. A good tip is to buy these items before the disaster and place in secure storage that can survive the disaster.

- For protection of your **eyes**, you should wear goggles or safety glasses with side shields, or a full-face shield.
- For protection of your **ears**, you should wear earplugs or earmuffs in high noise work areas.
- For protection of your **feet**, wear rubber boots (in wet areas) or disposable non-skid shoe covers over work boots that have a steel toe and thick, hard sole.
- For protection of your **head**, wear a cap with a brim or other protective head cover. Wear a hard hat if there is a chance of falling debris, bumping your head, and when working on the roof or tall ladders.
- For protection of your **hands**, wear strong, waterproof gloves designed to protect hands from cuts, chemicals, temperature extremes, and abrasions.
- For protection of your **body**, wear disposable coveralls preferably with elastic wrists and ankles. If you can't obtain disposable coveralls, bring a set of work clothes and shoes to the site. Change into them before entering the work area, and remove them before going home. Wash work clothes, including shoes separately from other clothes. If you are working at night and will be traveling in the street, you should wear a reflective vest.
- For protection of **nose** and **lungs** wear a respirator (not a dust mask!) rated for the types of hazards you may encounter, as described below.



For most clean-up work, a NIOSH-approved rubber half-face respirator with a High Efficiency Particulate Air (HEPA) filter rated N100 or P100 is highly recommended (see picture above). They are typically available from industrial and safety equipment suppliers, some home improvement stores, and online vendors. Do not enter contaminated areas without at least a mask respirator labeled N95 or higher, worn properly. Note that N95 mask respirators do not protect against asbestos and chemical vapors. P100 respirators are needed for chemical hazards and N100 or P100 are needed for minimize your exposure to asbestos, mold, and lead paint dust. All of the above respirators are labeled on the packaging.

Be aware that a dust mask is NOT the same as a respirator, and does not protect you from exposure to mold, lead dust, asbestos, or dust from debris.

Assess Damages and Hazards

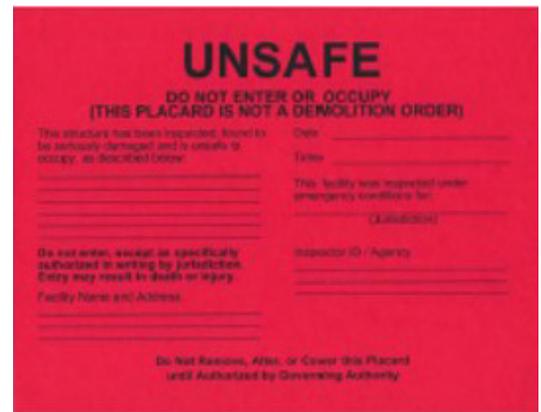
Right after the disaster is diminished enough to start recovery operations, personnel should begin assessing the damage to the region, town, and individual homes. Many communities have adopted a system where qualified volunteer professionals (engineers, architects, code officials, contractors) go from house to house and complete what is known as a Structural Assessment Visual Evaluation (SAVE). This is typically done between one and three days after a disaster and after the National Guard and emergency operations are complete. It is very important to note that this does not replace the necessity for full structural and hazard evaluations of homes, but serves as a stop-gap measure to inform the general public (and homeowners or renters) whether individual buildings are safe or are an immediate hazard.

During a rapid evaluation of homes, unqualified personnel should never enter a building that might have structural damage until it has been inspected by a local official, engineer, architect or professional home inspector. As part of a SAVE operation, placards are placed outside the home in a “visible from the street” location and uses three colors to quickly inform the public on the immediate dangers on site. If the area includes many totally destroyed homes, it is recommended to paint the colors on the street near the home. Each placard identifies the major concerns in the structure from the rapid evaluation as follows:

GREEN: Building is safe to enter and occupancy is permitted.

YELLOW: Building has potential structural damage and/or failing non-structural items or accessories (like a porch or deck). Building may or may not be habitable; partial occupancy is permitted per noted restrictions.

RED: Building is unsafe to enter and its occupancy is prohibited. The building is structurally unstable and may collapse





Many communities coordinate the assessments through smartphone apps, such as Collector for ArcGIS, which allows for aggregate evaluation of disaster zones. You can find more information at: <https://www.esri.com/en-us/arcgis/about-arcgis/overview>

Assess Structural Stability

Most buildings that suffered structural damage will show distinctive signs of what is broken or in disrepair. Never enter a building that might have structural damage. Review the information below about how to tell what is wrong and what to do.

Evidence of structural damage may include:

1. Roofs that sag in the middle or at the ends due to load-bearing walls that have shifted. Cracked or damaged rafters, ceiling joists or truss.
2. Walls that are not vertical or straight, and stuck doors.
3. Missing or broken support columns, studs or beams.
4. A shift or separation where the structure meets the foundation. Sunken, broken, or leaning foundation.
5. New cracks in the exterior of the building or foundation.
6. Continuous cracks or leaning of walls or piers.
7. Floors that sag, are buckled, have separated from the walls, or have holes. Rotten or displaced bottom plate, rim board, or sill beam. Cracked or broken floor joists.
8. Damaged roofing, roof decking and flashing.
9. Floor and ceilings not level.

Inspect for Creatures, Chemicals and Bio-Hazards

Just as people are displaced during disasters, so too are animals and insects. Snakes, rats, mice, cockroaches and other pests tend to hide in debris. Standing water breeds mosquitos and be cautious of fire ants — they can float and survive on floodwater. Disasters often result in toxic chemical and fuel spills. Industrial, agricultural and household chemicals can be released into the air or floodwater and leave a hazardous residue on materials. Contact local authorities or hazardous materials experts to inquire about potential sources of chemicals and inquire about spills or breaches.

You should assume that floodwater is contaminated. It's likely to contain sewage and infectious bacteria, in addition to chemicals. For example, diseases like tetanus can be acquired from contaminated soil and leptospirosis from contaminated water that gets on broken skin, like a cut or scrape.

- You should report major chemical and fuel spills to local authorities.
- If anyone shows signs of illness or infection, immediately seek a health professional and describe the exposure. If you suspect poisoning, call 911 or the National Poison Control Center at 1-800-222-1222. Note: People with hearing or speech disabilities may reach these phone numbers through the Federal Relay Service teletype service at 800-877-8339. Visit www.gsa.gov/fedrelay for additional ways to communicate with federal agencies.



Inspect Utilities: Electrical, Gas and Water Supply

You should always be aware of power lines, power junctions and downed electrical wires. They can cause electrocution and burns. Make sure that no live electric lines are on the property or in the house. You should also find out if there is a gas line or fuel tank leak, and check for damage. **If you smell gas, assume the area is unsafe.** Look for water streaming out of the home from a plumbing break. Finally, find out from officials if the water supply is safe to use and to drink. Use the checklist below to make sure you have examined all of the possible damage to utilities and the hazards that may be present:

- **Gas meter:** Check gas meter or fuel tank to be sure valve is off.
- **Power lines:** Report any down, loose or damaged power lines or wires.
- **Electric box or panel:** If an exterior disconnect is present, place handle in off position (usually down). Secure or label it to prevent accidental activation. If there is no exterior shut-off, turn off the main circuit breaker switch or remove fuse in the electrical panel. Do not touch electrical panel while standing in water or if it is damaged. You may need to use an electrician to shut off power.

- **Electric meter:** Before entering, make sure there is no dial movement on electric meter.
- **Water valves:** Turn off water valve (clockwise) of each sink, toilet, water heater, ice maker, etc.
- **Drains:** Pour buckets of water into sinks, toilets and tubs to check for leaks.
- **Gas appliances:** Turn off all valves to gas appliances. Valve handles should be perpendicular to pipe.
- **Water meter:** Find and turn off main water shut-off valve at meter (may be in the front yard). Call the water district office if you can't find or reach the valve. If the home uses well water on site, look for the shut-off valve between the wellhead and the house.
- Visually inspect equipment before use. Label or remove damaged items.
- When power is turned back on, make sure the circuits and electrical equipment are grounded. You may need an electrician to give you the okay to do this. Never use an electric tool or appliance while standing in water or a wet area.
- If there are plumbing leaks or the water supply might be contaminated, turn off the main shut-off valve with a wrench. Do not use contaminated water for clean-up.
- **Test or install carbon monoxide (CO) detectors and smoke alarms in the home.** When there's no power, get a battery-operated CO detector, if using any fuel-burning equipment.

There are important action steps that you should take before you enter a building that might have dangers due to compromised utilities from the disaster:

- Notify the electric company of damaged and downed power lines. Do not touch fallen wires.
- Shut off any gas supply to the building. Turn off the shut-off valve at the gas meter or propane tank.
- Open all windows when you enter a building to clear the air. If you smell gas or hear a noise that sounds like escaping gas, leave immediately. Also leave the door open and notify the gas company.
- Never create any ignition until you are 100% sure that there is no gas in the air. Do NOT smoke, light matches or lighters, operate electrical switches or flashlights, use telephones or mobile phones, or start a car.
- Turn off all electricity at the main electrical panel, but NOT while standing in water. Then, unplug appliances and lamps, remove light bulbs from fixtures, and remove the cover plates of any wall switches and outlets that got wet.

Assess and Reduce Health Hazards During Recovery, Repair, Rebuilding, and After

As the cleanup and recovery operations begin around and inside the homes, you will possibly encounter many toxins and unsafe conditions that you should avoid or work around. Some of these health hazards will still be in and around the home AFTER initial recovery operations are complete. Addressing these hazards during the recovery phase, and using best rebuilding standards and practices can eliminate or mitigate (reduce) exposure to these toxins during recovery, repair, and rebuilding.

The first lesson is to familiarize yourself and the clients you serve with the **Eight Principles of a Healthy Home**. These principles guide disaster recovery, repair, restoration and rebuilding.

The Eight Principles of a Healthy Home

HUD's Office of Lead Hazard Control and Healthy Homes defines **Eight Principles of a Healthy Home** as:

Keep it DRY

Damp homes provide an environment for dust mites, roaches, rodents and molds. All of these can cause or worsen asthma and allergies. In addition, moisture can damage the building materials in your home.

Keep it CONTAMINANT FREE

Levels of contaminants such as lead, carbon monoxide, asbestos, secondhand smoke, and other chemicals are often much higher indoors. Infants and children are more vulnerable than adults to the adverse effects of exposure to these and other contaminants.

Keep it PEST FREE

Exposure to pests such as roaches and rodents can trigger an asthma attack and allergies.

Keep it SAFE

Injuries such as falls, burns, and poisonings occur most often in the home, especially with children and seniors.

Keep it CLEAN

Clean homes reduce pest infestation and exposures to contaminants.

Keep it WELL MAINTAINED

Poorly maintained homes are at risk for moisture, pest problems, and injury hazards. Deteriorated lead-based paint is the primary cause of children being harmed by lead.

Keep it WELL VENTILATED

Having a good fresh air supply to your home is important to reduce exposure to indoor air pollutants and to increase respiratory health.

Keep it TEMPERATURE CONTROLLED

Homes that do not have balanced and consistent temperatures may place your family at increased risk from exposure to extreme heat, or humidity.

The next step is to learn about the common toxins and hazards that are often present during cleanup after disasters, repair and rebuilding operations, and sometimes after the home is occupied by the family. A good place to start is the disaster recovery resources from the U.S. Department of Housing and Urban Development at: hud.gov/program_offices/healthy_homes/Post-Disaster-Resources

Lead

Hazard: Lead poisoning is one of the biggest health risks for young children at home.

Health Effects: Lead can damage nervous systems, including the brain. It can cause permanent learning and behavior problems in children. It can also permanently affect hearing.

Source: Before 1978, lead was used in paint, water pipes, gasoline, pottery, consumer goods and objects. Lead is no longer used in house paint, but a lot of older homes still have lead paint and lead in water pipes, or in old materials that contain lead.

If the home being restored was built prior to 1978, it could contain lead-based paint. The older the home, the more likely it has lead-based paint. It was most commonly used on painted woodwork and trim, windows, kitchen and bathroom walls, and exterior surfaces like siding and trim. Soil, especially near major roads and in cities, can contain lead from leaded gasoline fumes of the past. It could also contain lead-based exterior house paint dust from past chalking and sanding. If the home or its painted or varnished furnishings were built prior to 1978 (or you don't know the age), and a certified lead inspector has not determined that it's lead-free, then assume there is lead-based paint. Look for damage to any painted materials. Any peeling, cracked, blistered or eroded paint creates lead-based dust that can float in the air and settle on any surface. If wind-driven dirt or silt from floodwater was deposited in the home, assume it contains lead.



Learn more about lead-safe work practices (**some are required by law!**) before you begin work. Free information is available at www.epa.gov/lead or hud.gov/program_offices/healthy_homes/healthyhomes/lead or by calling the National Lead Information Center at 1-800-424-LEAD (5323). There is also a guide specific to lead hazards during disaster recovery that you can download at: hud.gov/sites/documents/IEPWG_LEAD_FAMILY.PDF

Note: The Environmental Protection Agency's Renovation, Repair and Painting (RRP) Rule is designed to minimize exposure to lead-based paint hazards. Contractors performing renovation, repair and painting projects that disturb painted surfaces in homes built before 1978 must be RRP certified and follow lead-safe work practices, unless the paint has been found not to be lead-based paint.

Mold and Moisture

Hazard: Molds are part of nature, but inside a home mold growth should be avoided. Mold spreads in tiny spores and the spores are invisible. The spores float through the indoor air of a home. Mold may begin growing indoors, and be seen when these mold spores land on surfaces that are wet or in rooms that are humid. Damp and humid areas of a home can also be a hazard, even without mold.

Health Effects: Many people are allergic or sensitive to mold. If a family member has allergy problems or asthma at home, but not when they are away, they may have mold growing in their home. If a family has mold in their home, they may have trouble breathing, or have wheezing, runny nose, headaches, itching, or watery eyes. Damp or humid areas of a home can also cause these symptoms in people with asthma.

Source: Mold is usually found in areas of high humidity (kitchen, bathroom) or moisture (roof and pipe leaks) and especially all over a house after natural disasters like floods and hurricanes. Mold can grow on walls, clothes or appliances. It also grows in hidden places like behind walls, in attics, and under carpet. Mold can smell musty. A musty odor sometimes means mold is alive and growing.

The solution to mold control is moisture control. Mold growth begins on materials that stay wet for about two to three days and can multiply rapidly. After a wetting event, rapid drying can prevent a mold population explosion. When that's not possible and mold growth has occurred, it's still important to deal with it as soon as possible using safe and effective methods.

Some good resources and guidelines for cleaning up and reducing mold after a disaster (including downloadable and printed booklets) can be found at this weblink: www.epa.gov/mold and at this website: <https://www.cdc.gov/disasters/mold/index.html> and this website: hud.gov/sites/documents/IEPWG_MOLD_CONS.PDF. In general,



these guiding principles and procedures are an important part of a post-disaster mold removal strategy:

- Signs of significant mold growth in a home include discoloration and fuzzy growth on surfaces, or a musty odor (which indicates active growth). High humidity conditions (above 50% relative humidity) and temperatures above 70 degrees F (21 degrees C) are ideal conditions for mold growth.
- Use a moisture meter with a probe or scanner to check for hidden dampness. Moisture meters are available at many home improvement stores and online.
- Look for hidden areas with musty odors and seek out hidden mold growth behind, above or underneath materials such as wallpaper, drywall, paneling, flooring, ceiling tiles, cabinets, etc. Ensure proper ventilation of the house all the time. Stagnant air favors the growth of mold.
- As much as possible, discard wet porous materials such as drywall, wood trim, fabrics, wallcovering, and carpet. Removing or reducing mold in these items is difficult and mold can quickly appear in the home if they remain.
- On non-porous surfaces, mold can be removed using stiff brushes and non-phosphate laundry detergent or dish soap. If the surfaces contain biological hazards (very common in flood disasters), use one part bleach to sixteen parts water but remember to not mix bleach with ammonia!



Pests

Hazard: Pests are unwanted living things in or around a home and include bugs or rodents that get inside. Pests may also include bed bugs which are tiny insects that feed on the blood of humans and animals. Chemical pest treatments must be used carefully or they can also pose a risk to health.

Health Effects: Inside a home, mice, rats and cockroaches may trigger asthma attacks. Insects and rodents can also get into food. Mice and rats can chew on electrical wires and cause fires. Bites of rat, fleas, ticks, centipedes, and certain spiders can make family members ill. Many pests and bugs spread diseases. Some common pesticides are also known to trigger breathing problems or cause neurological damage in children.

Source: Pests travel into a home from outdoors or other places and they are looking for places with food, water and shelter. Pests often enter a home through gaps or openings in walls, doors or windows, but can also be carried inside by pets.

During and after recovery efforts on the home, identifying pests and fixing the causes of pest problems is the first step. Next, recovery and rebuilding should try pest prevention and mechanical tools like traps that do not use toxic substances. After restoration of the home is complete, families should try to remove the conditions that allow the pest(s) to enter and live.

This system of removing pests is called **Integrated Pest Management** or **IPM**. IPM is an effective and environmentally sensitive approach to pest management that relies on a combination of commonsense practices. IPM programs use information on pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment. Correct implementation of IPM also reduces the need for hazardous insecticides.

Asbestos

Hazard: Asbestos fibers are dangerous if they get into the air and you breathe them in. The fibers get into the air when materials containing asbestos are damaged or disturbed.

Health Effects: Asbestos can cause serious long-term health problems including lung disease and cancer. Smokers have a higher risk from asbestos exposure. Other health hazards may include mesothelioma and asbestosis. These health hazards can take many years to develop.

Source Asbestos: was commonly used in homes in the past to insulate pipes and attics. Asbestos was also used for roofing, siding, floor tiles, fireproofing, and spray-on textures for walls and ceilings.

If you are unsure if a home was built before 1980, assume these materials might contain asbestos. **Only certified asbestos inspection**





professionals can determine whether a material contains hazardous asbestos and remove or replace it. If an asbestos material is in good condition with no damage, leave it alone. It's better to not disturb it but take precautions to avoid further damage during restoration activities. If asbestos materials are damaged, there are two types of correction — repair or removal. Repair involves either sealing or covering asbestos material to keep it in place and prevent fibers from being released into the air. It is usually safer and lower cost than removal.

Some good resources and guidelines for repairing and removing asbestos after a disaster (including downloadable and printed booklets) can be found at this weblink: <https://www.epa.gov/asbestos> and at this website: <https://www.cdc.gov/niosh/topics/asbestos/default.html>.

Carbon Monoxide

Hazard: Carbon monoxide (CO) is a dangerous gas and it is not safe to breathe. You can't see, taste, or smell it. Every home should always have a CO alarm (with battery backup power) and one should be installed (preferably combined with a smoke detector) during cleanup and recovery operations.

Health Effects: If you are exposed to CO, you might get headaches, upset stomach, vomiting, dizziness, weakness, or confusion. Severe cases can cause brain damage, blindness, deafness, heart problems, or death. Exposure to CO can be a major threat to you and a family's health.

Source: Fuel burning appliances and automobiles are the main source of carbon monoxide in a home. They use natural gas, gasoline, kerosene, coal, propane, oil, or wood. CO can be produced if fuel burning appliances aren't vented to the outside or are not working correctly.

When power outages occur during natural disasters and other emergencies, the use of alternative sources of fuel or electricity for heating or cooking can cause CO to build up in a home, garage, or camper and to poison the people and animals inside. Some good resources and guidelines for eliminating sources of CO after a disaster can be found at this weblink:

<https://www.cdc.gov/disasters/carbonmonoxide.html>.

In addition to the resources above, workers repairing a home and the occupants should remember these important points:

- Never use a gas range or oven to heat a home.
- Never leave the motor running in a vehicle parked in an enclosed or partially enclosed space, such as a garage or carport.
- **Never use a generator, pressure washer, or any gasoline-powered engine inside a home or less than 20 feet from any window, door, or vent.** Use an extension cord that is more than 20 feet long to keep the generator at a safe distance.
- When using a generator, use a battery-powered or battery backup CO detector in the home.
- Never use a charcoal grill, hibachi, lantern, or portable camping stove inside a home, tent, or camper.
- If CO poisoning is suspected, **LEAVE THE HOUSE IMMEDIATELY** and then call 911 or the Poison Control Center at 1-800-222-1222 or consult a health care professional right away

Special Concern: Mosquito-Borne Viruses

Mosquito-borne diseases are those spread by the bite of an infected mosquito. Diseases that are spread to people by mosquitoes include Zika virus, West Nile virus, Chikungunya virus, dengue, and malaria.

Recovery agency personnel and all other workers on site (including the families occupying the home) should protect themselves from diseases spread by mosquitoes. Although people may not become sick after a bite from an infected mosquito, some people have a mild, short-term illness or (rarely) severe or long-term illness. Severe cases of mosquito-borne diseases can cause death. The Centers for Disease Control (CDC) has the following recommendations to reduce exposure to mosquitos and related illnesses:

- Use EPA-registered insect repellents (<https://www.epa.gov/insect-repellents>) with one of these active ingredients: DEET, picaridin (known as KBR 3023 and icaridin outside the US), IR3535, oil of lemon eucalyptus (OLE), para-menthane-diol (PMD), or 2-undecanone. Find the right insect repellent by using EPA's search tool (<https://www.epa.gov/insect-repellents/find-repellent-right-you>). When used as directed, EPA-registered insect repellents are considered acceptable even for pregnant and breastfeeding women.
- If also using sunscreen, apply sunscreen first and insect repellent second.
- Permethrin can be applied to clothing and gear.
- Wear clothing that covers hands, arms, legs, and other exposed skin.
- Remove standing water to reduce places where mosquitoes lay eggs.
- Workers who develop symptoms of a mosquito-borne disease should report this promptly to their supervisor and get medical attention.

Special Concern: Food and Drinking Water

Recommendations after a Disaster:

Food: Throw away food that may have come in contact with flood or storm water; perishable foods that have not been refrigerated properly due to power outages; and those with an unusual odor, color, or texture. Unsafe food can make a person sick even if it looks, smells, and tastes normal. When in doubt, throw it out.

Water: Do not use or let a family use water that you suspect or have been told is contaminated to wash dishes, brush teeth, wash and prepare food, wash your hands, make ice, or make baby formula. Before handling water or food, family members should wash hands and face or take a bath. Safe water for drinking, cooking, and personal hygiene includes bottled, boiled, or treated water. The local or island territorial health department can make specific recommendations for boiling or treating water in your area.

Clean and sanitize food-contact surfaces that have been flooded:

- Throw out wooden cutting boards, baby bottle nipples, and pacifiers if they have come in contact with flood waters because they cannot be properly sanitized. Clean and sanitize food-contact surfaces in a four-step process:
- Wash with soap and hot, clean water.
- Rinse with clean water.
- Sanitize by immersing for 1 minute in a solution of 1 cup (8 oz/240 mL) of unscented household chlorine bleach in 5 gallons of clean water.
- Allow to air dry.

Create a Work Plan

The next step is to develop a comprehensive work plan for the site, yard, and home. Making a plan before you start any repair or restoration saves time and helps protect the health and wellbeing of all involved – workers, family members, and volunteers.

- Be sure to obtain all required permits and approvals - including from building code offices, local, territory, and federal agencies – before construction begins!
- Ensure that deliveries and workers will be able to find your address. If street signs or address markers are missing, paint your home's address on the pavement or erect a sign.
- If exterior materials are damaged or missing, temporary weather barriers should be installed as soon as possible to prevent water intrusion that could cause further damage. Plan what temporary protections are needed and arrange for installation. If there was a disaster declaration, find out if you are eligible to have a tarp or other weather barriers installed through FEMA disaster assistance programs. Contact your local emergency management office to find out.

A good plan includes the following information:

Supplies and Materials

Make a list of all the supplies and materials you will need and buy as much of them ahead of time as you can (as many of the items might be scarce immediately after the disaster). After the disaster, it may be easiest to find supplies outside the area. Use the list on the following page as a checklist for materials and supplies needed.

Electricity

When electricity is not available soon enough, you may want to arrange for a portable generator. Get specialized gasoline cans designed for safely storing gasoline to refuel the generators. **Never use gasoline-powered generators indoors!** They will make a major carbon monoxide hazard that can be deadly. They can also pose a fire risk. Plan to place them outside as far from the building as possible, and at least 10 feet away from all building openings.

Storage Areas

Determine where and how much clean storage space is needed for the family's belongings that you are saving. Items that have been contaminated must be cleaned before being placed into storage. Set up a secure storage area to keep tools and supplies safe. Store supplies in an organized manner for convenience and safety. Store moisture-sensitive materials on pallets or above the ground.

Disposal

Find out about your community's disaster debris disposal guidelines. Monitor the local media or check with your area's Department of Health, Sanitation or Waste Management. Waste should normally be sorted for special disposal or pick-up.

Hazardous waste needs special disposal and should be separated from other waste. Make sure that debris that has lead, asbestos or mold is wrapped or bagged (heavy-duty or double-bagged), sealed, labeled and disposed of in accordance with local, state and federal requirements. Construction waste, furniture, large appliances, and electronics may also have specialized disposal rules, especially after a disaster.

Ensure that the debris is properly sorted and discarded. If the home does not receive collection service for large debris, make plans to rent a large waste container or have a contractor haul the waste to proper disposal sites.

Site Planning

Plan and layout and mark on the yard (signs or paint on grass) of how to arrange work stations and sorted debris piles. Follow your community's guidance in sorting waste for disposal, since various types of items may be handled differently. As a general rule, place the debris piles curbside, within 10 feet of the street. Debris should not block pathways or roadways. Don't place debris near trees, poles or other structures that could make it difficult to remove.

Clean-Up, Health and Safety Station Supplies

- List of emergency phone numbers
- Well-stocked first aid kit
- Eye wash station
- 3 to 5 clean-up buckets
- Pump sprayer (for clean water)
- Hand soap, detergent, hand sanitizer
- Scrub brushes
- Paper towels, tissues
- Trash bin or bags
- Table (weather resistant)
- Rack for hanging work clothes, respirators
- Bottled water
- Personal Protective Equipment (PPE)
- Lungs: N100 respirators (min. N95 if home built after 1980)
- Eyes: Goggles or safety glasses
- Ears: Ear plugs or earmuffs
- Feet: Non-skid shoe covers, work boots, rubber boots
- Head: Cap with brim or hard hat
- Hands: Waterproof, cut-resistant gloves; chemical resistant gloves
- Body: Disposable coveralls with elastic wrists and ankles or removable work clothes
- Other safety gear: Tethers, back support belt, etc. as needed

Tools and Equipment

- Fire extinguishers (10ABC type)
- Work lights (break-resistant), portable lanterns, flashlights
- Generator (gasoline or solar kit), gas cans (if needed)
- Extension cords (three-wire heavy duty, outdoor)
- Wet/dry shop vacuum cleaner
- HEPA vacuum cleaner, spare filter bags and filters
- Dehumidifier, drain hose
- Fans (box fan for containment negative pressure; fans for comfort)
- Ladders
- Shovels
- Chain saw
- Wheelbarrow, handcart, high-capacity dolly
- Pliers with end-cut
- Crowbar
- Wrench
- Hammers and assorted nails
- Staple gun, staples
- Saws: reciprocating, drywall, circular, handsaw
- Power tools (drill, saw, screwdriver)
- Current tester (for electrical work)
- Moisture meter
- Pocket knife
- Carpet cutter
- Measuring tape, retractable
- Straight edge
- Pump sprayer
- Hand sanders and planers, paint scrapers
- Tool box, tool pouch or belt

Supplies

- Cell phone and charger, solar charger
- Batteries (for lights, meters, testers)
- Camera
- Reading glasses
- Notebook (protect it with a plastic bag or cover), pen or pencil for taking notes.
- Cooler for food and drinks
- Door mats
- Water hose, water jugs
- Mops, brooms and dust pans
- Scoops, disposable containers
- Abrasive sponges, soft sponges, rags, scrub brushes, stiff brush
- Buckets
- All-purpose cleaner – low suds, phosphate free
- Disinfectant solutions (appropriate to surface)
- Spray mister (hand-held), wet/dry abrasive paper, wet sanding sponges (for wet-methods)
- Heavy duty, contractor trash bags
- Bungee cords, rope
- Plastic sheeting, 6 mil roll
- Roof tarp, roofing nails, roofing cement
- Weather barrier materials (housewrap, cap nails, etc.)
- Masking tape, duct tape
- Construction adhesive, epoxy, caulks
- Pieces of lumber: 2x4's, furring strips
- Plywood
- Lead dust test kits (EPA-recognized, see www.epa.gov/lead)
- Fungicide, mildewstat coatings (water vapor permeable, only)
- Borate treatment solution
- Plaster repair, drywall spackle, joint compounds
- Gypsum drywall, paperless, water-resistant drywall
- Latex paints, primers, finishes (water vapor permeable)
- Weather stripping, foam sealant, etc.
- Hurricane hardware, ring shank nails
- Other needs

Prepare the Work Site

A planned work site will help you and other workers be productive and stay safe. This includes: protecting a damaged home with temporary weather barriers, providing for basic needs of workers, taking some key precautions, setting up a clean-up station, and installing containment barriers to isolate the work area from clean areas.

A good resource for specific detailed planning and preparing the worksite can be found on pages 35–39 of the *Rebuild: Healthy Homes — Guide to Post-disaster Restoration for a Safe and Healthy Home*. You can download a copy of this guide at: hud.gov/sites/documents/REBUILD_HEALTHY_HOME.PDF

Consider the following strategies when setting up the worksite:

Install Temporary Weather Barriers

If the roof, exterior walls, windows or doors are damaged or missing, cover with temporary weather barriers or tarps as soon as possible to prevent further damage from water entry. If any siding, masonry, or panels are missing, cover the damaged section with a tear-resistant weather barrier (housewrap). Wrap it across the damaged wall in layers from the bottom to the top of the wall so the layers overlap shingle-fashion. Secure the weather barrier with nails and seal seams and edges with a compatible construction tape or caulking.

Provide Basic Necessities

Provide nearby access to:

- Non-contaminated water supply for washing and drinking (bottled water may be necessary if the usual water source is contaminated).
- Wet wipes for cleaning hands and face.
- Toilet.
- A fire extinguisher rated ABC minimum.
- Cleanup station (see **pages 37–38** of the *Rebuild: Healthy Homes* guide).
- Soap and hand sanitizer (at least 60% alcohol or other appropriate disinfectant).
- A place to take breaks away from the work area.
- Secured location for power for tools, lights and equipment away from water and moisture.
- A generator (placed outside because of the carbon monoxide hazard) unless electricity is safe to use in the home.
- Work lights.

Set Up a Containment Area

Containment refers to sealing off work areas to isolate them from other areas. It's important to keep clean areas separate from the work areas to minimize

the risk of spreading contaminants and hazardous materials. Set up barriers, such as plastic sheeting, in doorways, over vents and other openings to create a containment area between the current work area and all adjacent clean areas. If possible, the containment area should have a window or other opening to the outdoors. Seal off air vents and any other openings into clean rooms with plastic sheeting or other disposable material and tape. See **page 39** of the *Rebuild: Healthy Homes* guide for how to properly seal off the containment area.

Demolition, Decontamination, and Cleaning

Depending on the types and level of damage, the full process may need to be completed in phases. The first task is to clean-out by removing mud, water or ash. The next phase is removal of damaged materials. This involves gutting and tear-out (demolition). Both phases should be completed before full and final cleaning and decontamination.

Before you begin this process, you should HIGHLY consider engaging or hiring a professional contractor or expert volunteer agency. Choose a company or agency licensed, qualified, and certified for demolition, removal, and repair of damaged building materials, equipment, and structure. If the home is covered by homeowner's insurance, it is important to contact the company and seek advice on proceeding to demolition and repair of the home.

Also be aware that some of the building materials (particularly asbestos or lead paint and piping are required to be demolished, removed, or repaired by certified workers according to strict federal laws!

For more information on the federal laws governing hazardous building materials (asbestos and lead) refer to these HUD guides:

U.S. Dept. of Housing and Urban Development Disaster Resources – Worker and Employer Guides (also contains links to Spanish versions):

Asbestos: hud.gov/sites/documents/IEPWG_ASBESTOS_WORKER.PDF

Lead: hud.gov/sites/documents/IEPWG_LEAD_WORKER.PDF

If you are unable to hire a contractor or engage a qualified and certified restoration agency, you should strictly follow the recommendations on **pages 39–49** of the *Rebuild: Healthy Homes* guide.



Special Concern: Mold Removal

If you, your employees, or the family is unable to hire a trained professional to remove mold in your water-damaged home, use these 10 steps to complete the job as safely and successfully as possible:

1. Wear protective gear.
2. Isolate work area and ventilate to outdoors.
3. Remove moldy porous materials.
4. Clean and disinfect.
5. Apply borate treatment to undamaged wood structural members (columns, beams, studs, joists).
6. Ventilate after cleaning.
7. Speed dry wet materials especially wood structural members (columns, beams, studs, joists).
8. Continue to look for signs of dampness and new mold growth.
9. Do not continue with restoration and repair until all materials have dried completely.
10. Restore with flood-resistant materials.

*A more detailed procedure for mold removal using the above 10 steps can be found on pages 51–52 of the **Rebuild: Healthy Homes** guide.*

Young children, older adults, people with asthma or chemical sensitivities, or people who have colds or the flu should never attempt to remove mold, even with proper personal protection equipment (PPE).

Special Concern: Fire and Smoke Damage

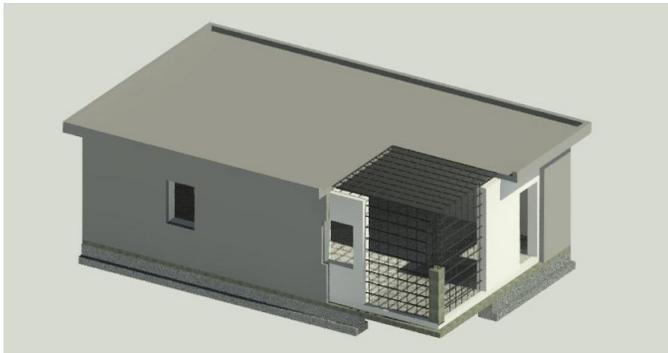
Soot from fires can be oily and easily stain textiles and porous materials. If possible, hire a professional fire damage restoration professional. If that is not possible, use these methods:

- Clean soot from smooth surfaces, skim items with the suction-only nozzle (no beater brush) of a vacuum cleaner with a HEPA (high efficiency particulate air) filter to let suction pull off the soot.
- To clean dry soil and soot in carpeting, use a HEPA vacuum with a beater brush.
- Use a dry chemical sponge, rubbing alcohol, or other non-water based cleaner to wipe light soot from drywall, bare wood and other porous surfaces.
- For light to heavy soot on gypsum board (drywall), avoid a water-based cleaner since it can cause stains to bleed into the wall. Wash then seal with a stain blocker before repainting.
- Use a household cleaning detergent in water for hard materials like tile, countertops, sealed wood, glass, metal and appliances.
- Clean plastics with a mild alkali detergent to remove and neutralize possible acidic soot. Acidic soot can be activated by humidity to cause permanent staining.
- Do not use scented deodorizers that mask smoke odor and add chemicals to the air (especially if family members have chemical sensitivities or asthma).
- Clean or replace materials, repeatedly launder fabrics, and ventilate to reduce odor. If odor lingers, try wiping with vinegar or baking soda, set out activated carbon or use odor absorbing products.

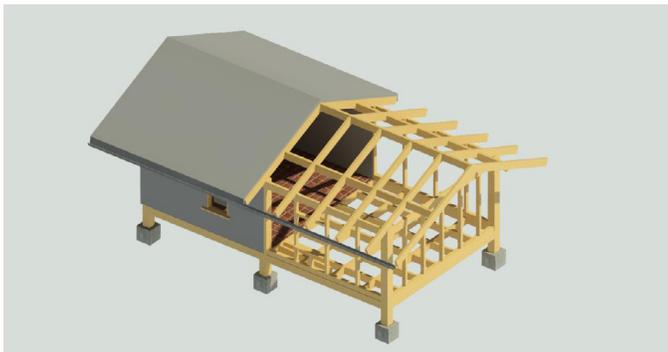
Repairing and Rebuilding for Resilience

Resilient homes are buildings that are intentionally built, repaired, and restored to be safer and stronger than conventional construction methods. Resilient buildings resist the forces of natural disasters, so that the home is much less likely to be damaged or destroyed by earthquakes, hurricanes, floods, or fire. Resilient construction is also durable to not only disasters, but the toll that normal rain, sun, heat, cold, and insects take on a home and a family's expenses for repair. Resilient homes are longer lasting than conventional homes and most are more energy-efficient and sometimes more environmentally sustainable.

For restoration and rebuilding of a home, as well as new construction, applying resilient design and construction ideas before the next natural disaster can protect lives, reduce costs on repair and rebuilding, and reduce homelessness due to an event.



Type 2: Masonry (cinder blocks) or concrete on a Continuous Footing



Type 1: Framing on Pier Footings

Every house has weaknesses due to the construction materials, assemblies, equipment, and connections used when the home was built. The older a building is, the greater the chance that it will fail during a disaster. Some homes were built with very low costs and with construction methods that would not meet current building codes. Understanding what makes the foundation, walls, and roof of a home strong, and how to anchor openings and evaluate resilient construction methods can help develop an overall approach to protect a home while addressing multiple possible disasters at once.

Each method of home construction has some strengths and weaknesses. In the Caribbean, two particular types of older structures are common. Each has predictable vulnerabilities over time (from deterioration and deferred maintenance) and after a significant disaster, especially earthquakes, hurricanes, and floods.

The two common home construction types are 1: framing on pier footings and 2: masonry (cinder blocks) or concrete on a continuous footing. The type 2 home is more resilient to earthquakes, hurricanes, and fire if the masonry and/or concrete is reinforced with steel rebar according to the building code. A continuous footing is considered more resilient than pier footings, due to the strength of the connections (if adequately constructed and reinforced according to applicable building codes). Foundations can fail due to weak structural connections to the walls or floors above them; improper concrete mixture; inadequate and/or exposed rebar in concrete foundations (Inadequate design of concrete foundations can lead to cracking and fragments dangerously breaking off during a storm or seismic event); decay and incorrect footing connections in timber foundations; and inadequate soil compaction or conditions.

A building's foundation is one of the most important structural elements. A foundation must support the building above it and all the loads that are exerted on it. It

must adequately transfer loads acting on the structure to the supporting soils and must resist weathering, decay, and corrosion (with little or no maintenance) in order to remain viable for the entire life of the building. The foundation must perform all of these functions while being exposed to the damaging effects and conditions present in a Caribbean island environment. These effects include erosion and scour, high winds from hurricanes, breaking waves and moving floodwaters, and the potentially disastrous effects of flood-borne debris. Foundations on homes in the Caribbean must be stronger, better planned and designed, and more solidly constructed.

In Caribbean locations, resilient foundations must be designed and constructed to elevate the building high enough to avoid flooding and strong enough to resist the water pressure from floods. These foundations must also be strong enough to resist all loads expected to act on the building and its foundation during a disaster (especially earthquakes, floods, and hurricanes); to prevent flotation, collapse, and lateral movement of the building; and to accommodate expected scour and erosion throughout the life of the structure. Without these design features, the building is less resilient and will most likely fail in a significant disaster.

Another feature of resilient homes is the concept of continuous load paths. Maintaining a continuous load path, from roof structure to wall structure to foundations/footings is important and helps the house resist earthquake, flood, and hurricane forces against the structure in all directions.

The following are common strategies to make a home more resilient to failure from a future disaster:

Foundations: Before making any changes to a foundation, it is wise to hire a qualified professional to evaluate, and make suggestions on ways to repair and reinforce foundation walls to withstand the pressures of flooding, and the

seismic forces of earthquakes. Cracked or settled foundations may require anchors, shoring, or underpinning. Best foundation improvements are systems that increase the stability of the footings from floods and settlement and are well connected to the building, have lateral bracing, and some flex and adjustability. In flood hazard zones, flood vents are required by the National Flood Insurance Program in foundation walls within one foot of the ground to prevent failure from the pressure of rising floodwater. Paint the exterior of above-ground foundation walls and slabs with latex paint to resist water absorption, but allow water vapor diffusion to help them dry. If possible, upgrade waterproofing of exterior of walls to withstand high water pressure.

Wood treatment (borate): Borate treatments are a safer, eco-friendly alternative to toxic pesticides and wood preservatives. They can provide long-term protection from decay and destructive insects, including termites. Borate compounds can also deter mold growth while waiting for wood to dry after cleaning. Walls that have to be opened up due to removal of damaged drywall or siding presents a good opportunity to treat structural wood not normally accessible.

Backflow Prevention: Install a sewage backflow valve in the sewer line to protect your home and health. Even minor flash floods in the vicinity can cause sewage back-up.

Damage-resistant materials: Restore with flood-resistant replacement materials, which also tend to be less vulnerable to mold. Examples include:

- **Floorings:** Ceramic tile, solid vinyl tile or inlaid sheet vinyl with no paper backing; waterproof adhesives and mortars; decorative concrete, solid hardwood planks (not coated with an impermeable finish); and exterior grade plywood subflooring.
- **Interior walls:** If interior walls are not concrete or masonry, use paperless (fiberglass mat-faced) gypsum drywall

with a moisture resistant core; removable wainscoting made of solid wood, plywood or fiber-cement panels; removable or composite trim. (Note: avoid using vinyl wallpaper since it can trap moisture in walls and lead to hidden mold.

- **Exterior wall cladding:** Masonry; fiber-cement, vinyl, aluminum, or high-tech moisture-resistant composite sidings and trim with long warranties.
- **Openings (doors and windows):** Metal or fiberglass-skin doors with closed cell insulation cores and composite framing; metal, fiberglass or vinyl frame windows.

Plumbing, Appliances and Equipment:

Elevate appliances, equipment, wiring and outlets above the potential flood level. Place water heaters and exterior cooling and ventilation equipment on sturdy platforms. Wall ovens and front-loading laundry equipment should be placed high enough off the floor to protect them from shallow floods. Install flexible connections and piping for gas and water lines.

Walls: Create a “drainable, dryable wall” assembly: Use flood-resistant exterior materials, such as masonry (cinder block) or cement siding.

Roofs: If reroofing, remove all of the existing roof covering (above structure) and use a high-wind resistant metal (for sloped roofs) or waterproofing membrane (fluid or stick-on adhesive).

Structure (Continuous Load Path): If walls and roofs are open from rebuilding, add metal straps, anchors, and clips to strengthen connections of the wall to the foundation, to the roof or trusses, and between levels. When building or repairing damage, make sure the foundation and structural materials and connectors comply with local seismic building codes. Have a building code official, a licensed engineer or architect evaluate and design repairs and reinforcements of the foundation, wall and

roof framing, structure and connections that hold them together. Unreinforced masonry walls are especially vulnerable to earthquakes.

Windows: Install wind-borne debris protections such as impact-rated shutters, removable panels or impact-rated window and door systems. If replacing windows, choose units with at least one pane of tempered glass.

Weather Barriers: When replacing windows, doors, siding or any wall penetration, upgrade the flashing system. Make sure everything is layered shingle-fashion with no gaps or tears. Use high performance caulks and sealants to reduce wind-driven water leaks.

As noted at the beginning of this guide, there are two related resources that have additional and more detailed information on rebuilding homes for resiliency:

- **Keep Safe: A Guide for Resilient Housing in Island Communities:**

This book is published by Enterprise Community Partners. You can get a copy of this guide from this weblink:

<https://www.enterprisecommunity.org/solutions-and-innovation/disaster-recovery-and-rebuilding/keepsafe> See pages 134–209:

This guide also has very good information on how to help entire communities become more disaster resilient with strategies on water and energy-efficiency, alternative energy for homes, and resilient landscaping.

- **Rebuild Healthy Homes: Guide to Post-disaster Restoration for a Safe and Healthy Home:**

You can get a copy of this guide from this weblink: hud.gov/sites/documents/REBUILD_HEALTHY_HOME.PDF See pages 54–60.

There are two additional resources that have more detailed information on healthy and safe homes:

- **Everyone Deserves a Safe and Healthy Home – Stakeholder Guide.**

It can be downloaded at: hud.gov/sites/documents/STAKEHOLDER_EDSHH.PDF

- **Everyone Deserves a Safe and Healthy Home – Consumer Guide.**

It can be downloaded at: hud.gov/sites/documents/SAFEANDHEALTHYHOME.PDF

Additional Concerns: Financial Resiliency Before and After a Disaster

Homeowner’s insurance and flood insurance are the primary financial resources for most homeowners. Families should frequently review insurance policies and their limits before a disaster and before beginning recovery efforts. When there is a disaster, families should immediately contact their insurance company to report the damages and condition of the home (especially whether it can be still occupied safely or not). After a disaster, a family should safely take photos of all damages, interior and exterior to show the insurance claims agent before the agent is able to visit the site.

Homeowner’s insurance rarely covers flood damage, may have a higher deductible for wind damage than other perils, and may exclude mold or other types of damage. Flood insurance is made available by and claims are paid by the National Flood Insurance Program (learn more at www.FloodSmart.gov). Typically, there is a 30-day waiting period from date of purchase before a flood policy goes into effect. That’s why it’s so important for a flood insurance policy to be obtained long before a hazard warning, and that it be maintained. Check for availability of other types of insurance covering earthquakes or other disasters. This may be of special interest in cases of homes where there is no active mortgage.

Following a Presidential Disaster Declaration, the Federal Emergency Management Agency

(FEMA) helps state and local governments with recovery operations. Funding and other types of assistance are made available to residents whose property has been damaged and whose losses are not covered by insurance. Declared counties/territories and disaster assistance information are available on the FEMA website at www.fema.gov and www.DisasterAssistance.gov.

Temporary Disaster Recovery Centers may be set up to assist applicants in person with information about FEMA or other disaster assistance programs and questions. Some faith-based and charitable organizations provide financial assistance also. Such assistance does not require a Presidential declaration of disaster, so it may be available in counties and territories that were not declared. A family should contact the emergency management office in their area to find out what assistance will and is being offered.

Whether a homeowner is filing for insurance, seeking assistance or claiming a casualty tax deduction, they will need to provide proof of the damage and losses. After a disaster and before cleanup begins, a family should document in writing and photographs the extent of the damages. If a homeowner cannot safely take pictures, they should describe the situation accurately, listing the specific items that have been lost or damaged. This documentation should include losses in the landscape and garden as well as the amount of debris to be removed, and whether it came from the same property or elsewhere. Some homeowner’s insurance policies will cover debris removal.

The homeowner should keep damaged materials for proof of loss until their insurance adjuster authorizes their disposal. It is ok to remove the damaged articles from their original location to prevent further damage to the building, but the homeowner should not throw the items away without insurance company approval.

Additional documentation for losses should include (whether covered or not):

- receipts for temporary lodging and food if the home is not livable. Some policies pay the difference between normal living expenses and the cost of living elsewhere.
- receipts for temporary repairs made to protect the property from further damage.
- receipts for any materials purchased and for other items needed to protect the home or its contents from further damage. The homeowner may be able to claim these on their homeowner's insurance policy.
- copy of all letters and receipts that are sent to insurance companies or relief agencies.
- record of all phone calls made to get reimbursement or aid.

Casualty losses are sometimes tax deductible if the following conditions are met:

- Losses must have occurred in a federally-declared disaster area.
- Losses were not fully reimbursed by insurance.
- Losses exceeded 10% of taxpayer's Adjusted Gross Income.
- Taxpayer itemizes rather than taking a Standard Deduction.

Many people are surprised about the extent of protection a homeowner's insurance policy offers. Although a homeowner's policy does not cover damage caused by rising floodwaters and many other wide scale disasters, it does offer some protection from loss caused by wind, rain

and lightning. If a homeowner has experienced a loss or damage to property, they should review the policy's provisions (policy provisions are parts of an insurance contract that explain what coverage is provided and for what amounts, along with any other restrictions) and contact the insurance agent to file a claim and to update a policy, if necessary, to include coverage needed for the future.

A homeowner should try to obtain a policy that has a coverage amount at least 80% of the current replacement cost of the home. Otherwise, they may not be paid the full cost of replacing a partial loss. Also, many homeowner's policies pay for losses to the contents of the home, such as furniture, appliances and clothes, on an actual cash value basis (replacement cost minus depreciation for age or wear and tear). A better option, if affordable, is to buy replacement cost coverage that pays the full cost to replace personal property at today's prices. Although the premium costs are a little higher, the protection is usually worth it.



Additional Resources

The following are additional resources, including guides, weblinks, and phone numbers to assist you in finding out more information about topics in this manual, as well as information not covered in it.

Territorial Information

Virgin Islands Territorial Emergency Management Agencies

VITEMA Headquarters

www.vitema.vi.gov

8221 Estate Nisky
St. Thomas, VI 00803
phone: (340) 774-2244
fax: (304) 715-6847

St. Croix Office

www.vitema.vi.gov

Department of Planning and Natural Resources
45 Estate Mars Hill
Frederiksted, VI 00840
phone: (340) 773-1082

St. John Office

www.vitema.vi.gov

6 Susannaberg
St. John, VI 00830
phone: (340) 776-6444
fax: (304) 714-4470

Virgin Islands Housing Authority

3202 Demarara Plaza Suite 200
St. Thomas, VI 00802-6447
phone: (340) 777-4432
fax: (304) 775-7913

USVI Department of Planning & Natural Resources

www.dpnr.vi.gov

Director, Division of Building Permits
8100 Lindberg Bay
Cyril E King Airport

Pediatric Environmental Health Specialty Unit (PEHSU) Region 2

American Academy of Pediatrics

<http://icahn.mssm.edu/research/pehsu>

Terminal Building, 2nd floor
St Thomas, VI 000802

email: PEHSU@mssm.edu
phone: (866) 265-6201

General Disaster Recovery Information

- HUD — U.S. Dept. of Housing and Urban Development Disaster Resources hud.gov/info/disasterresources
- Disaster Assistance Improvement Program www.DisasterAssistance.gov
- IBHS — Insurance Institute for Building & Home Safety www.DisasterSafety.org
- NFIP — National Flood Insurance Program www.FloodSmart.gov
- FLASH — Federal Alliance for Safe Homes www.flash.org
- FEMA — Federal Emergency Management Agency www.fema.gov
- FEMA information on Safe Rooms www.fema.gov/safe-rooms
- For all of the above you can also access federal agency telecommunication services for people with speech and hearing disabilities: www.gsa.gov/fedrelay
- FEMA — Federal Emergency Management Agency website for households www.ready.gov
- American Red Cross www.RedCross.org
- National Association of Home Builders — Disaster Recovery <https://www.nahb.org/Advocacy/Industry-Issues/Emergency-Preparedness-and-Response/Disaster-Recovery>

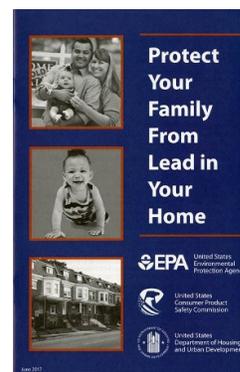
- Citizen Corps www.ready.gov/citizen-corps
- Pediatric Environmental Health Specialty Units website for children in disasters
https://www.pehsu.net/Hurricane_and_Flooding_Resources.html

Specific Disaster Hazard Resources (HUD)

- HUD — U.S. Dept. of Housing and Urban Development Disaster Resources — Office of Lead Hazard Control and Healthy Homes:
hud.gov/program_offices/healthy_homes/disasterrecovery
(also contains links to Spanish versions of these guides below):
- Asbestos: [hud https://dpr.vi.gov/.gov/sites/documents/IEPWG_ASBESTOS_FAMILY.PDF](https://dpr.vi.gov/.gov/sites/documents/IEPWG_ASBESTOS_FAMILY.PDF)
- Lead: hud.gov/sites/documents/IEPWG_LEAD_FAMILY.PDF
- Mold: hud.gov/sites/documents/IEPWG_MOLD_CONS.PDF
- Radon: hud.gov/sites/documents/IEPWG_RADON_FAMILY.PDF

The **Protect Yourself from Lead in Your Home**

pamphlet was created specifically to educate homebuyers and renters about lead-based paint and the protections provided by federal law. It is available in several languages, and it provides key instructions a homebuyer or renter must know about lead-based paint, the rules that protect consumers from lead-based paint, and the measures people can take to protect themselves from lead poisoning. You can visit a website for this guide at: <https://www.epa.gov/lead/protect-your-family-lead-your-home>



- HUD — U.S. Dept. of Housing and Urban Development Disaster Resources — Worker and Employer Guides (also contains links to Spanish versions of these guides below):
- Asbestos: hud.gov/sites/documents/IEPWG_ASBESTOS_WORKER.PDF
- Lead: hud.gov/sites/documents/IEPWG_LEAD_WORKER.PDF
- Mold: hud.gov/sites/documents/IEPWG_MOLD_WORKER.PDF
- Radon: hud.gov/sites/documents/IEPWG_RADONWORKER_FINAL.PDF

Key Hotlines

All the phone numbers below may also be reached by people who are deaf or hard of hearing, or who have speech disabilities, by teletype at 711.

- **FEMA Helpline** (800) 621-3362
- **Poison Control Centers** (800) 222-1222
- **HUD and EPA National Lead Information Center** (800) 424-LEAD, (800) 424-5323
- **EPA Safe Drinking Water Hotline** (800) 426-4791
- **National Pesticide Information Center** (800) 858-7378
- **FDA, Food Safety Information Service Hotline** (888) SAFE-FOOD, (888) 723-3663

General Safe and Healthy Homes Guides

HUD's Office of Lead Hazard Control and Healthy Homes has two guides on general safe and healthy homes principles:

- **Everyone Deserves a Safe and Healthy Home – Stakeholder Guide.**
It can be downloaded at: hud.gov/sites/documents/STAKEHOLDER_EDSHH.PDF
- **Everyone Deserves a Safe and Healthy Home – Consumer Guide.**
It can be downloaded at: hud.gov/sites/documents/SAFEANDHEALTHYHOME.PDF

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Healthy Homes Partnership
healthyhomespartnership.net

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