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Evaluating Wind vs. Water

By Jeffery H. Warren, Ph.D., P.E., CSP

In hurricane situations, wind or water or both may cause damage. Determining the cause of the damage is critical in the claim settlement. Specific information about the storm will be very helpful in making this determination.

Knowing the power of wind compared to the power of water can help in assessing damages. Wind is less destructive than a storm surge. For example, wind at 40 mph produces 7 pounds of pressure per square foot (psf) compared to a wave at 7mph which produces 200 pounds of pressure per square foot (psf). There is zero wind velocity at the ground level therefore, wind forces increase exponentially with height above the ground. Winds passing over and around a building can develop negative or "pulling" pressure in addition to the "pushing" pressure. The average wooden roof is designed to sustain 30 psf, which means 80 mph winds are needed to cause considerable damage.

Storm surge is the combination of wind and low atmospheric pressure. It can range from 3-4 feet to 15 -20 feet. Keep in mind 1 inch of falling barometric pressure is going to raise the water level about 1 foot. Although it is hard to imagine how strong water can be, remember a cubic yard of water (3ft x 3ft x 3ft) weighs over $\frac{3}{4}$ ton. A breaking wave is so deadly because of this intense power. A modest 4-foot wave striking an 8-10 foot wall could destroy it. Obviously, this is the reason building codes require structures to be built above the wave height which is the best way to mitigate a loss.

Wind speeds and storm surge is not the only thing to be concerned about when it comes to hurricanes. In the last 30 years, more people have died from inland flooding than from tidal surges. Intense rainfall is not related to wind speed. The greatest rainfall amounts often occur from weaker storms that drift slowly or stall over an area. In 1999, Hurricane Floyd brought intense rains and record flooding. Of the 56 lives lost during this storm, 50 drowned due to inland flooding. Machinery, heavy equipment and vehicles often sustain significant damage from flooding. The attached Flood Damaged Machinery and Repair Guidelines #200 and #300 will assist you and your insured in assessing and mitigating flood damage.

Extensive investigation and documentation work must be done to determine the cause of the loss. Please refer to the Wind & Water Investigation Tips at the end of this article to assist you in analyzing hurricane losses. When a hurricane occurs, many issues must be addressed to understand the loss. Engineers at The Warren Group have experience with these losses and are happy to consult with you.



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Flood Damaged Machinery Analysis and Repair

Machinery and Equipment Damage Appraisal Guideline No. 200

By Roger E. Davis, P.E., CFEI

- Machinery subjected to flooding should not be operated until it has been cleaned and checked out.
- Try to clean machinery as soon as possible. Delay will make dirt and silt harder to remove and may cause considerable rusting and corrosion.
- Clean the exterior thoroughly with water spray. Scrub greasy deposits with solvent.
- Inspect the insides of machines and remove accumulated dirt, chaff, debris or water.
- Apply a rust inhibitor to all metal parts. Even though the machine may not have been submerged, rust can develop from dampness in the air.
- **Electric motors.** Electric motors may need to be reconditioned or replaced depending on size and cost to repair versus replace. Typically, 15 hp or larger motors should be repaired.
- **Wiring and fixtures.** Wiring and fixtures need to be checked and cleaned. They may also need replacement.
- **Centrifugal pumps.** Many centrifugal pumps contain two sets of oil-lubricated bearings along the drive shaft between the motor and the pumps. If the pump has been flooded, dismantle the housing and remove the bearings. Clean the bearings or install new bearings if the old ones are damaged or worn out.
- **Close-coupled centrifugal pumps.** Close-coupled centrifugal pumps contain no bearings. There is little chance of flood damage except to the seals and the electric motor.
- **Injector-type pumps.** These pumps usually contain watertight packing at the ground surface, with sealed impellers. Floodwaters probably will not damage this type of pump.
- **Gasoline Engines.** Do not try to rotate or start an engine that has been submerged until it has been cleaned and reconditioned, since dirt will damage bearings and precision parts.

- **Chains.** Soak chains in solvent for several hours, then remove chains and allow solvent to drain out of them. Soak chains for several hours in light oil, then drain off excess oil and replace chains on machine.
- **Gears and sprockets.** Clean exposed gears and sprockets with cleaning solvent. Coat gears with light oil.
- **Gear cases.** Inspect enclosed gear cases for water or grit. Water may be present below the oil. If you find water or grit, or if you are in doubt, drain the case, flush it with solvent and refill with clean oil.
- **Belts.** Examine all belts for tears or cracks. Repair or replace them as necessary.
- **Cutting parts.** Remove knives and cutter bars from machinery. Clean and dry them. Coat cutter parts with light oil and reassemble.
- **Molds (Injection Molding-for example).** Break open as soon as possible. Clean and coat with light oil. If pitting has begun, buff immediately and coat with light oil. Note: time is of the essence. If not cleaned and oiled early, pitting will be too deep for molds to be repaired.
- **Hand tools.** Clean dirt and rust from surfaces of hand tools. Coat these tools with light oil.





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Flood Damaged Machinery Analysis and Repair (Part 2)

Machinery and Equipment Damage Appraisal Guideline No. 300

By Roger E. Davis, P.E., CFEI

CLEANING AND REPAIR OF VEHICLES POWERED BY GASOLINE AND DIESEL ENGINES SUBJECTED TO FLOODING

If you must use a vehicle with a gasoline or diesel engine immediately, use the following procedure and be aware that this procedure isn't thorough enough to prevent possible damage or need for overhaul in the future. Complete disassembly of the engine and drive train may be required.

- Clean exterior thoroughly with a hose. Scrub greasy deposits with solvent.
- Remove spark plugs or fuel injectors, air cleaner, intake manifold and carburetor. Clean these parts thoroughly with solvent.
- Drain the crankcase. Flush the crankcase with oil and refill with clean oil. Also disconnect fuel lines, blowing them out with compressed air.
- Crank the engine slowly with spark plugs or fuel injectors removed to force water out of cylinders. Squirt light lubricating oil into each cylinder and let it stand for about five minutes. Then crank the engine slowly to lubricate cylinder walls and rings.
- Replace all filters: engine, fuel, hydraulic.
- Completely flush out the fuel system tank and pump the fuel lines with No.1 diesel fuel. Be extremely careful to avoid fire danger.
- Remove the starter and generator and have an expert service them.
- Drain and flush the transmission and final drive with solvent. Refill with new, clean oil.
- Remove and clean unsealed wheel and track bearings with solvent. Lubricate and replace the bearings. Factory-sealed bearings should not need cleaning if the seal is unbroken.
- Flush the cooling systems with fresh water, and clean the radiator fins.
- Replace the battery, if necessary. If it was submerged, it will probably need to be replaced.

- Examine the machine and turn it over by hand after you have cleaned and replaced all parts. If it turns freely, it is probably ready for operation. Turn on the engine and operate the machine at low speed until you are sure all parts are working smoothly.
- If there is a substantial amount of dirt in the crankcase, transmission or gear train, change the oil and oil filter after operating the machine for a few hours. Using fresh lubricant is cheaper than paying for additional repairs.
- Remove inside door panels. Clean and lubricate latches and window raising mechanisms.
- Remove seats and floor mats. Brush and vacuum thoroughly. Clean washable surfaces with soap and water. Use rug or upholstery shampoo on non-washable areas. Dry thoroughly.
- Disassemble leaf springs. Clean or replace spring pads if necessary.
- Have brakes and steering mechanism checked before you drive the vehicle.





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Wind & Water Investigation Tips

By Jeffery H. Warren, Ph.D., P.E., CSP

Research local newspapers and/or check with the local weather service, the U.S. Weather Bureau or other agencies to determine the specific data relative to the storm. Information may also be obtained from the Federal Emergency Management Agency meteorologist at telephone (202) 566-1600.

(When damage was caused by a hurricane)

Record:

- Highest wind speed
- Barometric pressure and storm surge
- Amount of rainfall
- Tidal heights
- Wave heights
- Check and record the timing and duration for each

Record the distance and direction of the insured risk relative to the eye of the storm. Remember that the waves are higher to the right of the storm's path.

Research and record site conditions:

- Original ground elevation
- Distance from body of water
- After-storm ground elevation or other indications of scour
- Amount and type of storm debris

Canvas the neighborhood for eyewitnesses and take their recorded or signed statements.

Measure and record how many feet the debris line is from the shoreline. Describe the topography in detail.

Determine and record a complete description of the damaged or demolished building, including the type of construction, whether elevated (if elevated with an enclosure, be sure to indicate the type of enclosure - breakaway wall, open lattice work, etc.), number of floors (including basement), roof covering and pitch, windows, carports, etc., and the building's relative position to the wind. Also include a description of the foundation type (i.e., piles, piers, etc.) and damage.

Photograph (close-up) the remains of connectors or tie downs. Describe the size, type, and method of installation.

Document where evidence suggests the insured risk was not built as securely as neighboring buildings. Check local building codes to determine if a building violation has occurred. Document the age of the building and the effective dates of the building codes.

Check for and photograph:

- Debris line.
- Houses and objects adjacent to the insured risk. If damage appears to be different from that of the insured risk, determine why and record it in the claim files.
- Wind-caused openings in the building.
- Missing roof shingles.
- Watermarks on both the exterior and interior walls and ceilings of the building, and on nearby trees or fence posts.
- Uprooted trees or trees snapped off at a high level.
- Severe erosion (water) such as leaning pilings or houses "nosed down" in the ground. Remember (wind) leaning or bent pilings can also occur when a building is pushed over by the wind forces or blown off the pilings.