Flood Resistant Design

Any proposed development in the regulated floodplain must be consistent with the need to minimize flood damage. This can be accomplished, in part, by using materials, equipment, and construction techniques that are resistant to flood damage in locations that would be wet during a 100-year flood.

- New construction and substantially improved structures (including accessory structures): It is required that materials and equipment located below the flood protection level (and outside of dry floodproofed areas) be resistant to flood damage. This may apply to foundations, floor beams, joists, enclosures, and equipment servicing the building (electrical, plumbing, mechanical, ducts, etc.).
- Non-substantial improvements to existing (pre-FIRM) buildings and non-building development: New and replacement electrical, plumbing, and mechanical equipment must be located or designed to resist flood damage. The entire project should utilize flood resistant design, materials, and practices to the greatest extent practical.

What Does "Flood Resistant" Mean?

Floodplain areas can be subjected to hydrostatic (standing water) and hydrodynamic (flowing water) pressures during floods. These pressures can result in displaced foundation walls, collapsed structures, floating fuel tanks, scouring, and other damage. Flood resistance thus requires that structural and non-structural components be durable, resistant to flood forces (including buoyancy), and resistant to deterioration caused by inundation with floodwater. Options that require emergency operation (such as shutting off electricity or removing vulnerable components) should be avoided if possible, particularly in areas subject to flash flooding. "Flood resistant" is not "dry floodproofing" of non-residential structures.

Flood Damage-Resistant Building Materials

It is important that all parts of a building or other project that are susceptible to flooding (including fasteners and connectors) be made of materials that are resistant to flood damage. "Flood-resistant materials" include any building product capable of withstanding direct and prolonged contact with floodwaters without sustaining significant damage. "Prolonged contact" means at least 72 hours, and "significant damage" is any damage requiring more than cleaning or low-cost cosmetic repair (such as painting). The need to replace flood damaged drywall or other material is considered "significant damage" and is thus not acceptable. Components that are not inundated should be resistant to excessive humidity.

Flood damage-resistant materials include:

- Glazed brick, concrete, concrete block, glass block or stone (with waterproof mortar or grout);
- Steel trusses, headers, beams, panels, or hardware;
- Naturally decay resistant lumber, recycled plastic lumber, or marine grade plywood;
- Clay, concrete, rubber, or steel tiles (with chemical-set or waterproof adhesives);
- Cement board;
- Metal doors, cabinets, and window frames;
- Mastic, silicone, or polyurethane formed-in-place flooring;
- Sprayed polyurethane foam or closed-cell plastic foam insulation;
- Water-resistant glue; and
- Polyester epoxy paint (mildew-resistant paint contains toxic ingredients and should not be used indoors).

Anchoring

Foundations, equipment, accessory structures, and other components located below the flood protection level must be firmly anchored to resist flotation, collapse, and lateral movement.

Mechanical, Plumbing, and Electrical Systems
Location above the flood protection level is generally the best way to protect service equipment, such as heating, ventilating, air conditioning, plumbing appliances, plumbing fixtures, duct systems, and electrical equipment (service panels, meters, switches, and outlets). If these components are at a lower level, they must be designed to prevent damage from flooding. This may involve waterproof enclosures, barriers, protective coatings, or other techniques to protect vulnerable components. The municipality may require certification from a licensed professional that the standards for resistance to flood damage are met.

Backflow and Automatic Shut-Off Valves
Flooding can cause sewage from sanitary sewer lines to back up into buildings through drain pipes, causing both damage and health hazards. Backflow valves are designed to temporarily block pipes and prevent flow into the building and should be installed on any pipes that leave the building or are connected to equipment located below the flood protection level. In addition to sanitary sewer and septic connections, this may include water lines, washing machine drain lines, laundry sinks, downspouts, and sump pumps. Fuel supply lines must be equipped with float operated automatic shut-off valves.

Storage Tanks
Unanchored fuel tanks can be easily moved by flood waters, posing a serious threat of contamination and other damage. Even a buried tank can be pushed to the surface by buoyant effects. A tank can be anchored by attaching it to a concrete slab that is heavy enough to resist the force of flood waters or by running straps over it and attaching them to ground anchors. Tanks and other containers should have watertight fill caps, vents that extend above the flood protection level, and accurate labeling of contents (so that emergency personnel know what it contains if the tank breaks loose and floats away).

Certification of Flood Resistant Design
If the local building official is unable to confirm that a proposed design is resistant to flood damage, the municipality may require certification from a licensed professional engineer or architect prior to issuing a floodplain development permit. Situations in which certification may be necessary include: wet floodproofed utilities or equipment, anchoring, septic systems, gas well equipment, or flood-resistant materials not listed in FEMA's Technical Bulletin 2.

Additional Resources
- *Wet Floodproofing Requirements for Structures Located in Special Flood Hazard Areas*, FEMA Technical Bulletin 7-93 (1993), https://www.fema.gov/sites/default/files/2020-07/tb_7_wet_floodproofing_requirements-1993.pdf, includes planning, safety, and engineering considerations.
- *Flood Damage-Resistant Materials Requirements for Buildings Located in Special Flood Hazard Areas*, FEMA Technical Bulletin 2 (2008), https://www.fema.gov/sites/default/files/2020-07/fema_tb_2_rev1.pdf, includes lists of acceptable materials for flood-resistant construction.
- *Protecting Building Utility Systems from Flood Damage*, FEMA P-348 (2017), https://www.fema.gov/media-library-data/1489005878535-dcc4b360f5c7eb7285acb2e206792312/FEMA_P-348_508.pdf, technical guidance for the design and construction of flood-resistant utility systems, including HVAC systems, fuel systems, electrical systems, sewage management systems, and potable water systems.
- *Elevator Installation for Buildings Located in Special Flood Hazard Areas*, NFIP Technical Bulletin 4 (2019), https://www.fema.gov/sites/default/files/2020-07/fema_tb4_070219.pdf, guidance concerning the installation of elevators below the Base Flood Elevation.
- *Flood-Resistant Design and Construction*, American Society of Civil Engineers (ASCE) 24-14, purchase at www.asce.org, highlights available at https://www.fema.gov/sites/default/files/2020-07/asce24-14_highlights_jan2015.pdf. ASCE 24 is a referenced standard in the NYS Building and Residential Codes. Buildings designed according to ASCE 24 are better able to resist flood loads and flood damage.
- *Recommended Practice for Home Heating Oil Tank Flood Resistance*, National Oil Heat Research Alliance, https://noraweb.org/storage-tanks.