This testimony discusses (1) challenges associated with the nation's surface transportation, aviation, water, and dam infrastructure, and the principles GAO has identified to help guide efforts to address these challenges and (2) existing and proposed options to fund investments in the nation's infrastructure. This statement is primarily based on a body of work GAO has completed for the Congress over the last several years. To supplement this existing work, GAO also interviewed Department of Transportation officials to obtain up-to-date information on the status of the Highway Trust Fund and various funding and financing options and reviewed published literature to obtain information on dam infrastructure issues.

Download GAO Testimony (GAO-08-763T)

Return to Table of Contents

Submit your own items or suggestions for future topics to column editor Rebecca Quinn, CFM, at rcquinn@earthlink.net. Comments welcomed!

Here's Something You Might Find Interesting . . .

When was the last time you thought about how the NFIP defines the terms “development” and “structure”? We spend so much time focused on buildings that it wouldn’t surprise me if it’s been a while.

The NFIP definition of “development” is broad enough to capture just about any activity that can take place in special flood hazard areas: “Development means any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.”

The definition of “structure” is similarly broad: “Structure means, for floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home.” (note – the rest of the definition ‘for insurance purposes’ is not shown here).

Now I want to talk about tanks – underground tanks and above-ground tanks. I expect that we’ve all seen or heard about tanks that were dislodged by floodwaters, tipped over, ripped away, popped out of the ground, or even breaking through concrete floors. Not only is the tank itself damaged, but floating tanks become battering debris that can damage other buildings. Perhaps the more significant consequence is that tanks that aren’t adequately installed with respect to flooding can release their polluting contents. It doesn’t take a lot of petroleum-based material to create fire hazards, clean-up headaches – and also health concerns.

The NFIP regulations do not have provisions that explicitly apply to tanks, which might leave one guessing – which requirements apply? No guess work is necessary. The NFIP has a broad performance statement in Sec. 60.3(a)(3) that applies to all new construction and substantial improvement (the definition of “new construction” includes structures). All structures are to “(i) be designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy”.

That’s really all you need to apply your floodplain management ordinance or code to gas or liquid storage tanks that are to be installed in the SFHA. Above-ground tanks must either be elevated (and attached to their supporting structures) or anchored to resist the anticipated base flood conditions.
velocity, scour, and erosion). Underground tanks must be anchored to resist the buoyant forces imposed when the ground gets saturated. All you need to do is require applicants to provide evidence that tanks will be stable under flood conditions.

But let’s look at it a little more closely and point to some codes and guidance that will help you and applicants address tanks. Because tanks tend to float, the most important thing you can do is require that applicants and their engineers consider the buoyancy forces that will be imposed if tanks are empty. Empty tanks are the most buoyant; full tanks won’t float as easily, but you should not accept the argument that tanks rarely are empty. Indeed, some guidance documents specify that tanks should be designed, constructed, installed, and anchored to resist at least 1.5 times the potential buoyant and other flood forces acting on the tanks when empty.

Next, consider the openings through which tanks are filled with liquid contents and vent openings that allow air to flow in and out. In keeping with the overall objective of reducing flood damage, it is reasonable to require that any opening through which water can enter or contents can exit be elevated above the BFE or be fitted with covers that are designed to prevent loss of product.

And lastly, don’t forget to check that the engineers have considered soil settlement, scour, and erosion. These conditions can occur in both riverine and coastal floodplains and all can affect the stability of tank installations. Some soils tend to settle when they become saturated, especially soils that have been disturbed by excavation. Scour is localized loss of soil caused by water moving around an obstacle. Erosion refers to both a more generalized lowering of the ground surface and recession of a shoreline or streambank. No matter how well a tank is installed, it won’t be serviceable if the ground above it is eroded away – something that should be considered when new homes are proposed in erosion-prone areas. Many oceanfront communities have houses elevated above the BFE that can no longer be occupied because erosion has damaged their septic fields – whether sewage holding tanks can be installed to withstand anticipated flood conditions is a good question.

There are plenty of resources you can check to learn more, among them are the following requirements and guidance:

- The International Fire Code has requirements for tanks and vaults in areas subject to flooding
- The International Building Code references Flood Damage Resistant Design and Construction (ASCE 24), which has requirements for tanks
- The International Residential Code requires tanks to be elevated or anchored
- Standards issued by the National Fire Protection Association (cited by many state fire codes) include requirements that tanks be anchored to prevent flotation
- Protecting Building Utilities From Flood Damage: Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems (FEMA 348) contains several recommendations and methods to calculate buoyant forces, the volume of concrete necessary, and loads on anchor straps
- Download a 3-page handout at http://www.fema.gov/plan/prevent/howto/
- Order a new DVD from FEMA, Anchoring Home Fuel Tanks (FEMA 481)
- Check out Maryland’s homeowner handout about fuel, oil and propane tanks: http://www.mde.state.md.us/Programs/WaterPrograms/Flood_Hazard_Mitigation/fueltanks.asp

[RCQ]

Return to Table of Contents