Homes near rivers and coastal areas are very desirable, yet they may be prone to flooding. The devastation of the Gulf Coast region in 2005, several areas of Florida in 2004, and other Gulf and Atlantic states in years past, dramatically illustrate this vulnerability. Communities that participate in the National Flood Insurance Program (NFIP) require homes in mapped floodplains to have the lowest floor at least as high as the base flood elevation (BFE). The BFE is the predicted high water mark of the 1%-annual-chance flood, also called the 100-year flood. In parts of Mississippi and Louisiana, new advisory BFEs, issued after assessments from Hurricanes Katrina and Rita were taken into account, may govern how high homes must be raised.

The requirement to elevate homes can be met by using raised foundations, driving pilings, or hauling in fill to create a raised pad on which a concrete slab foundation is poured. Raised foundations include solid perimeter walls (crawlspace) and low piers. Basements are not allowed under new homes in floodplains.

In 2003, 53% of all new homes in the U.S. were built as slab-on-grade and in the South, an even higher percentage of the homes are built on slabs. The trend seems to be increasing, despite the fact that raised foundations are easier on the environment, more attractive, and easier and less expensive to build. Raised foundations are the best choice for infill and redevelopment, to accommodate future additions easier, and they perform well during floods.

Learn more about the advantages of raised foundations at www.RaisedFloorLiving.com, sponsored by the Southern Pine Council.

**ENVIRONMENTAL CONSIDERATIONS**

Elevating on raised foundations maintains the natural ground contours. Lawns are easy to mow, more mature trees can be saved, landscaping is more attractive, and it is easier to site pools and makes for nicer play areas.

Fill used to elevate a home in the floodplain can cause adverse environmental impacts. Most communities specify a maximum 2:1 slope for fill, in part to make lawn maintenance safer. That slope requirement can lead to significant areas of ground disturbance, loss of mature trees, and possible wetlands encroachment. Changes in drainage patterns can increase flooding of neighboring properties, creating liability for damage.
ARCHITECTURAL CONSIDERATIONS

Raised foundations have aesthetic benefits. The wood floor system is warmer and softer under foot than a concrete slab. Attractive front porches welcome visitors and offer better views and cooler breezes than at-grade patios. And more landscaping options are available, with plants nestled beneath the home instead of engulfing it.

CONSTRUCTION CONSIDERATIONS

Construction of a raised foundation is easier to schedule because the concrete and masonry work do not have to wait on plumbing installation and inspection, as is the case with slab foundations. In areas with poor soils, the contractor does not have to find a source of good fill.

Homes on raised foundations are less likely to experience differential settlement, which is common in many floodplains where expansive clays and soft organic soils often are found. Leveling work, common in many parts of the country even for relatively new homes, is easy to accomplish and less expensive when homes are on raised foundations.

Fill that is used to elevate homes on slab foundations may slump when saturated or be eroded by moving floodwaters, leading to structural damage when the slab is unsupported.

In floodplains where the water is predicted to be more than 3-4 feet deep, many owners elect to raise their homes even higher. Not only does this better protect the home from flooding, it reduces the cost of flood insurance and allows the area underneath to be enclosed. Enclosed areas must not be livable, but can be used only for parking, limited storage and building access. See page 4 for code requirements for the enclosure walls.

COST CONSIDERATIONS

The Southern Pine Council found that raised foundations compare favorably to the cost of monolithic slabs on grade. But adding the costs of trucking in quantities of clean fill and performing the required compaction to elevate the slab above the flood elevation makes slab-on-fill homes more expensive. The cost differential increases as height above grade increases. It is less expensive to build a raised foundation higher above the flood level to achieve better flood protection.

Added height above the flood level is a selling point. Families and their possessions are less vulnerable to flooding and the emotional stress and financial impacts of flood damage. A two-story home that has a $250,000 flood insurance policy from the NFIP will save nearly $300 each year if it is raised 3 feet above the BFE. Lower cost insurance and safer homes are becoming prime selling points in many coastal communities.
CONSIDERATIONS FOR IN-FILL DEVELOPMENT AND OLDER HOMES

Raised foundations are easier to construct on in-fill lots or when an older home is demolished to make way for new home, especially when the new home has to be elevated to meet floodplain requirements.

Many owners of flood-prone homes and communities are pursuing federal grant funds to physically lift up older homes and attach them to new foundations so the buildings are less vulnerable to flooding. Called “elevation-in-place”, this process is easiest when the home is replaced on a raised foundation. It is less expensive than bringing in fill and it requires less work area for the contractor. See page 4 for code requirements for raised foundations with solid perimeter walls.

MAINTENANCE CONSIDERATIONS

Original installation and future maintenance and modification of utilities (water, sewer, electrical, plumbing) are comparatively simple and less expensive in raised foundation homes because of easy access. No need to jackhammer the slab to access original installations or to upgrade and remodel.

Concrete slabs have a tendency to be cold and hold moisture. A raised floor foundation separates the home from the biggest source of moisture — the ground itself. With proper design, construction, and maintenance practices, a raised foundation home can remain dry and minimize moisture-related problems. Building codes require that crawlspaces have positive drainage, a vapor retarder on the ground, air vents, and under-floor insulation. Owners should regularly inspect crawlspaces to ensure these measures are intact. Also, if built in a floodplain, flood openings are required.

Homes on insulated raised foundations are more energy efficient than those built slab-on-grade. Houses on slabs require 12% more energy for heating and cooling, and those with both concrete slabs and masonry walls require 25% more energy. [Energy costs were reported by Evangelos Biblis of Auburn University in the Forest Products Journal, March 2005.]

Landscaping and flower beds next to slab foundations may invite termites. Raised foundations allow the home to rise above plantings, reducing the opportunity for termite invasions.

This historic floodplain house is being lifted and will be anchored to a new raised floor foundation on the same site.

Utility repairs and remodeling are difficult and expensive in slab homes.

Access to utilities is easy in raised foundation homes, making future remodeling and repairs easier.

(TOP PHOTO CREDIT: MGMEDIA) (OTHER PHOTOS: SOUTHERN PINE COUNCIL)
CODE REQUIREMENTS FOR ENCLOSURES UNDER ELEVATED FLOODPLAIN BUILDINGS

When constructed in mapped floodplains, certain code requirements apply to elevated homes on crawlspaces or that have enclosures with non-load bearing walls. The requirements are found in the International Building Code, the International Residential Code, and local floodplain management ordinances that are adopted to participate in the National Flood Insurance Program.

The code requirements vary depending on whether the home is in an “A Zone” or a “V Zone” as shown on the NFIP’s Flood Insurance Rate Maps. V Zones are found along open coasts where breaking waves higher than 3 feet are predicted. A Zones are found along rivers and streams and inland of V Zones and shorelines in coastal communities. The requirements described here apply only in A Zones (in V Zones, walls around enclosures under elevated buildings must be designed and certified to “breakaway” under flood loads).

The following requirements for enclosures under elevated floodplain buildings govern use of the space, utilities, flood-resistant materials, and flood vents:

**Use of Space:** Enclosed spaces below buildings elevated on raised foundations must be used only for crawlspaces, parking (garage), building access, and limited storage. These spaces are designed to get wet during floods—conversion to living space is not allowed. Flood insurance does not cover contents or damage to non-compliant conversions.

**Utilities:** Mechanical equipment may be located in enclosed spaces, but must be mounted on platforms that raise the equipment above the base flood elevation. Duct work must be installed so that it is above the base flood elevation, which often requires the floor to be higher (thus qualifying the home for lower flood insurance rates).

**Flood-Resistant Materials:** Materials located below the base flood elevation will get wet. Materials should be capable of withstanding direct and prolonged contact with floodwaters without sustaining any damage that requires more than cosmetic repair and cleanup.

**Flood Openings:** Walls surrounding enclosed spaces must be equipped with openings called flood openings or flood vents. Openings are to allow for the automatic entry and exit of floodwaters to minimize differential hydrostatic pressure that can cause structural damage. Standard air ventilation units (which typically offer only 45 to 65 square inches of open area each) do not meet the requirement unless disabled in the open position.

The code offers two methods to meet the flood opening requirement:

- **Prescriptive:** Requires 1 sq. in. of opening for every square foot of enclosed area. A 2,000 sq. ft. crawlspace requires a total of 2,000 sq. in. of opening.

  **At-grade garages are allowed under or beside raised foundation homes in flood-prone areas (note two flood vents).**

- **Heat pumps raised above the base flood elevation will be functional after a flood, speeding homeowner recovery.**
Flood Vents come in standard stainless steel finish, with the exception of the Overhead Garage Door Models which come in standard white finish. Optional colors are available on all models. Choose from White, Wheat, Earth, Gray, Black, or Stainless.

Performance: Requires engineered openings to be certified as meeting the specified performance (see NFIP Technical Bulletin #1). The only engineered opening that is certified by the ICC Evaluation Service and accepted by FEMA is manufactured by Smart Vent, Inc. (www.smartvent.com). A 2,000 sq. ft. crawlspace requires only 10 certified Smart Vent units. These units are closed until floodwaters rise and activate the patented float mechanism. Smart Vent options include vents that open automatically in hot weather or that are fully insulated to allow for conditioned spaces below the BFE.

ELEVATION CERTIFICATE REQUIREMENTS

The building codes and local floodplain management ordinances require submission of surveyed elevation information to demonstrate compliance. The information must be signed and sealed by a registered licensed surveyor or professional engineer. Most communities require use of the NFIP’s Elevation Certificate.

The Elevation Certificate requires information on flood openings, in addition to surveyed ground elevation and the elevation of the elevated floor. The certificate must confirm that a sufficient number and size of flood openings are provided. For prescriptive openings this is done by measuring the total net open area of the vents, which must add up to 1 sq. in. per square foot of enclosed area.

Don't be fooled by flood vent devices that haven't met rigorous quality standards. When engineered openings are used, a copy of the engineering certificate prepared by a registered professional engineer should be attached to the Elevation Certificate to take the guesswork out of measuring the openings. Smart Vent units are the only flood vents that are certified by the ICC Evaluation Service (Legacy Report NER-624) and meet the requirements of ICC Acceptance Criteria AC364 (available online at www.iccsafe.org).

CONCLUSION

As Gulf Coast rebuilding continues and more people seek to build in desirable coastal and riverine areas that are prone to flooding, it is important that design and construction practices adhere to code and incorporate best practices. Raised foundations and proper flood venting of enclosed areas below the BFE are two important approaches that can reduce construction costs, reduce the cost of flood insurance premiums and, most importantly, reduce the risk of damage and help homeowners avoid the stress caused when a home is flooded.