Building the Case for Open Space (Foundations)

Each year, Americans suffer millions of dollars in losses due to flooding. Elevating homes using local freeboard requirements provides significant protection from the risk of this hazard. By choosing more resilient construction methods in concert with increased freeboard, we can build a more resilient future and community. Such options are more cost-effective than ever before and provide co-benefits to property owners and the local community within the floodplain.

Introduction to Freeboard and Construction Foundation Comparison

FEMA defines freeboard as an additional amount of height above the base flood elevation (BFE) used as a factor of safety in determining the level at which a structure's lowest floor must be elevated or protected to follow state or local community floodplain management regulations.

The most common construction methods used to leverage freeboard to maximize life safety and risk reduction to personal property for housing within a Special Flood Hazard Area (SFHA) and other flood-prone areas are foundation systems that leverage the use of fill for slab-on-grade (SOG) or an open-space, elevated system such as a pier and beam foundation. These construction choices provide similar levels of protection to an individual property, differences in cost and impact to the surrounding community and floodplain are important considerations for homeowners as they look to buy or construct their home.

This guidance compares the two predominant construction foundation systems available in South Louisiana and provides greater detail regarding their costs, impacts, and advantages.

From a construction cost perspective and a community, floodplain management–based perspective, construction foundation systems are an important consideration to help reduce the impact of chronic flooding.

Foundation Systems Comparison

Design Standards and Assumptions

For the purposes of this comparison in Figure 1, a single-story, single-family residence (structurally rectangular in shape) based on a 2,000-square-foot living area (SFLA) building footprint is used as a uniform design standard. This design standard is considered representative of average new home construction in Louisiana and can be relied upon as a basis for the comparison of construction element costs. Costs were calculated utilizing similar heights of elevation, beginning at 2.2 feet and increasing in 1-foot increments up to 5.2 feet, which is representative of the

typical elevation requirement in Louisiana. The foundation requirements found in the International Residential Code (IRC) are used, including those requirements specific to flood hazard areas.

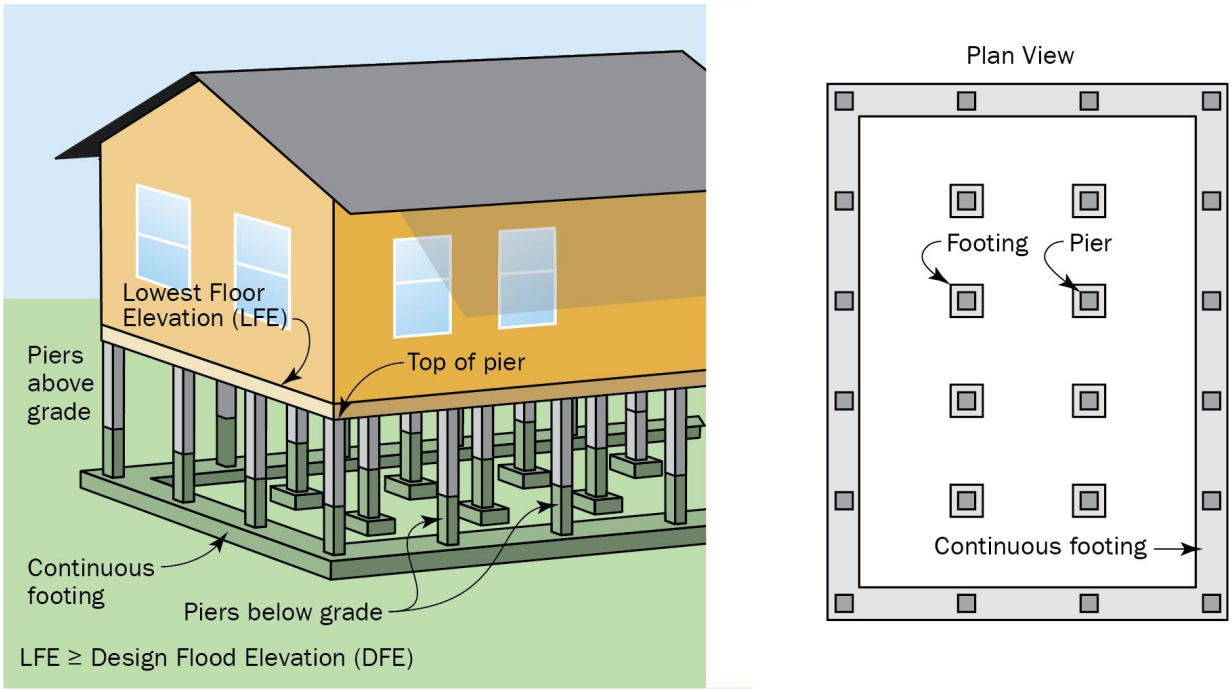

Figure 1. Single-story, single-family residence elevated using pier and beam foundation (side and plan view)

Slab-on-Grade Foundation Construction Considerations

When an SOG foundation system is used in construction, freeboard is achieved by determining the ground height (grade) and then using fill material in conjunction with the height of a concrete slab. The foundation system is built directly on the soil with under-floor building systems embedded within the soil. Additional structural fill modifies the finished floor elevation (FFE), reaching a height above the BFE known as freeboard, which provides protection from flooding.

For the purposes of this comparison, costs for this construction foundation type include compacted structural fill, grading, reinforced slab, and labor costs. Pricing was developed using industry-standard cost estimation guides and methods, along with locally sourced information from and by industry contractors.

Open-Space Foundation (Pier and Beam) Construction Considerations

Like SOG and fill foundation systems, open-space foundation construction types, or methods such as pier and beam foundations (Figure 1), provide protection from flooding by leveraging elevated heights above the natural grade and BFE using freeboard. This method differs from SOG in that the foundation system under the home is constructed using a combination of columns, piers, and piles to support the structure and achieve the desired height above the BFE using freeboard. In addition to the inherent benefits of freeboard, when vented properly or completely open, these foundation systems allow the free flow of floodwater under and through the home's foundation system during a flooding event.

For the purposes of this comparison, costs for this construction foundation type include concrete masonry units (CMUs), raised wood floor and footings, uplift/sheer anchors, termite shields, localized use of fill for stabilization, rebar, and labor. Pricing was developed using industry-standard cost estimation guides and methods, along with locally sourced information from and by industry contractors.

Cost Comparison

Because of construction materials and methods, the lowest height of pier and beam foundation construction is a slightly higher level of protection (1.2 feet in comparison to 1 foot). Each pier and beam foundation also assumes a 12-inch flooring system. The pier-and-beam foundation systems were adjusted to the same relative lowest floor elevation (LFE) or design flood elevation (DFE) height increments to that of SOG (fill) foundation systems to provide a more accurate cost comparison at approximately the same level of flood protection.

Table 1: Foundation System Cost Comparison by Relative Lowest Floor Elevation

Pier and Beam Foundation		Slab-On-Grade (Fill) Foundation		Cost Difference (Savings)
Relative LFE	Total	Fill Height / Relative LFE	TOTAL	Total
2.2 Feet	$27,506	2.2 Feet	$31,749	$4,244
3.2 Feet	$28,393	3.2 Feet	$37,431	$9,038
4.2 Feet	$29,952	4.2 Feet	$43,982	$14,030
5.2 Feet	$30,874	5.2 Feet	$51,468	$20,594

LFE = lowest floor elevation

Cost Comparison Summary

Many prospective homeowners or citizens in local communities may think SOG with fill as a foundation construction type is a more economical solution. However, based on this comparison of costs using uniform design standards and assumptions, construction considerations for both foundation system types and their respective pricing, pier and beam foundations consistently provide a similar if not more cost-effective solution. When considering leveraging freeboard to achieve reduced risk from flooding hazards in Louisiana, prospective homebuyers or builders who are motivated by cost should consider open-space foundation systems such as pier and beam. The higher the elevation desired or necessary to meet local floodplain management requirements or minimum National Flood Insurance Program (NFIP) standards, or the more protection desired via additional freeboard, the more cost-effective open space (pier and beam) foundation system types become when compared to SOG with fill (Figure 2).

For SOG foundations, the main cost driver is the amount of fill material required to meet the height requirements. The NFIP prohibits the use of fill in a regulatory floodway. Many communities limit the use of fill in floodplains or flood-prone areas to help protect storage capacity and promote the natural, beneficial function of a floodplain.

Additional Considerations

Foundation System Types

While pier and beam foundation systems are used in the Cost Comparison Section, several foundation system types (Figure 3) may be used to reduce the risk of structural flooding.

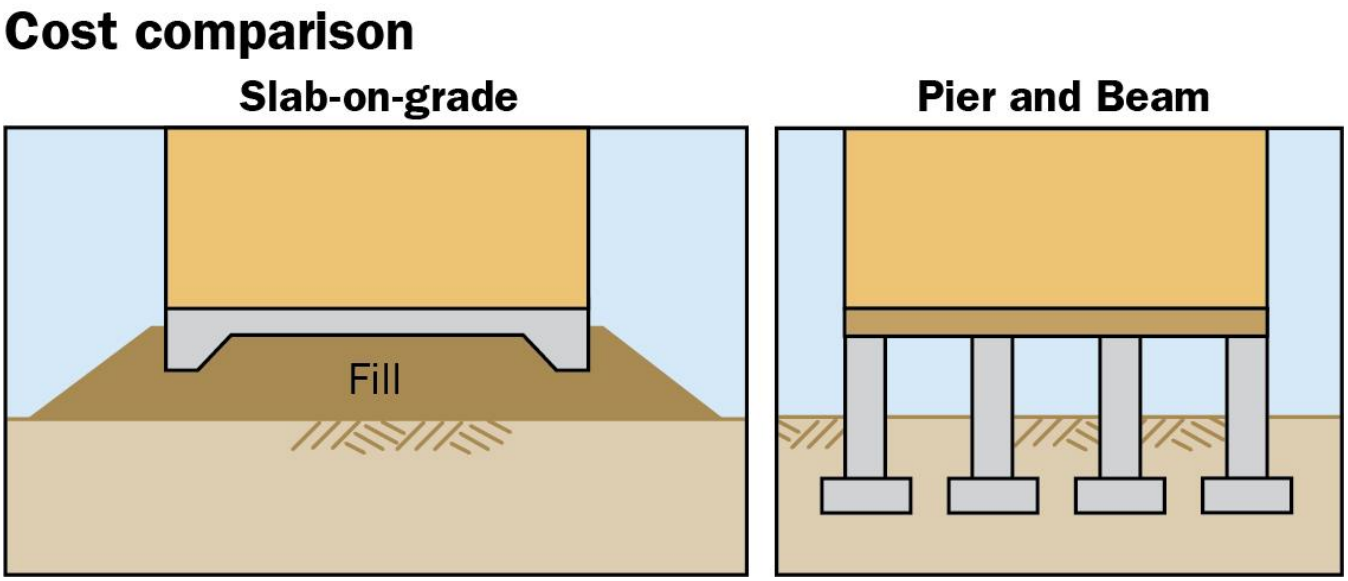

Figure 2. Foundation system designs intended to reduce flood risk

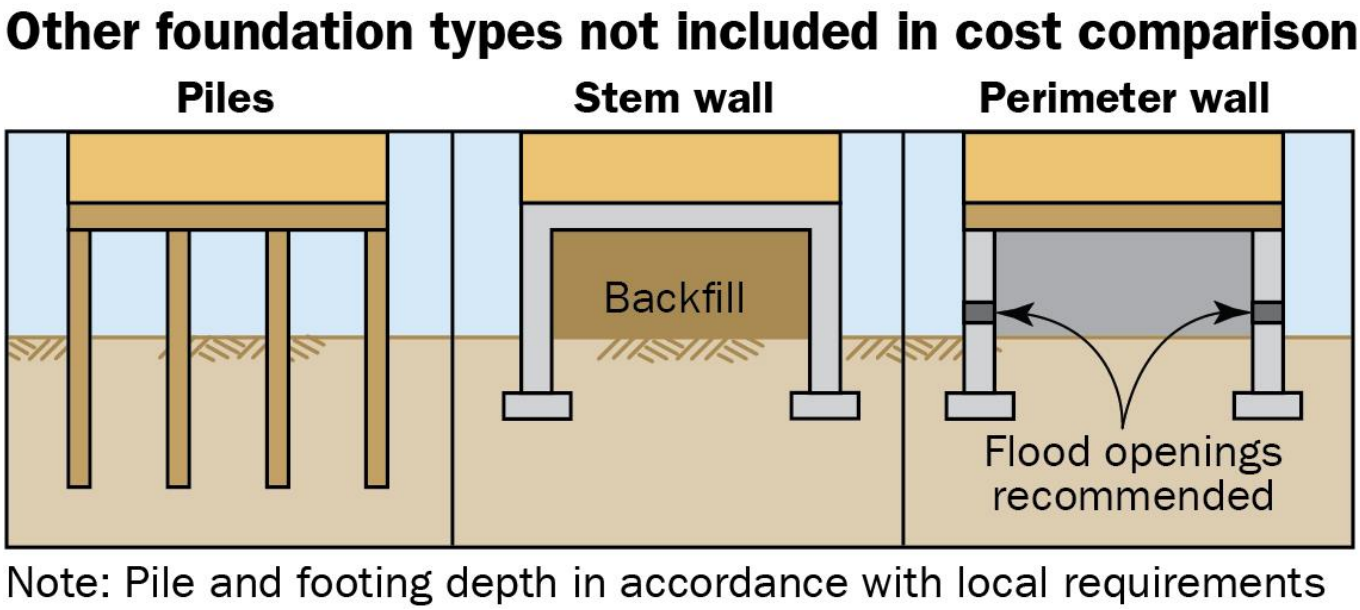

Figure 3. Additional foundation system designs intended to reduce flood loss

Advantages of Open Space Foundation Systems

For structures within a SFHA or any area at risk of flooding hazards within a community, both fill with SOG and open-space foundation systems such as pier and beam provide similar levels of life safety in reducing the risk of flooding.

However, the use of open-space foundation system types during the construction process provides additional benefits to property owners and communities in comparison to other foundation system construction types.

Additional Benefits of Open-Space Foundation Systems

- Reduced flooding for neighboring structures when less fill is used
- Reduced stress on community drainage systems (water travels more slowly with low or no grade)
- Water flows more naturally through an area with fewer impediments during a flood
- Reduced risk of **undermining** (when water washes out the compacted fill on a SOG foundation during a flood)
- With small lot size constraints, fill and slope requirements are impractical in many cases
- Cost-effective utility repair and maintenance costs compared to closed foundation/SOG systems
- Cost-effective to retrofit in case of future mitigation due to chronic flooding issues
- Superior response to soil conditions where expansion and contraction occur
- Additional airflow in open-space foundations may help with seasonal energy costs in warm climates

Additional Information

Detailed technical information on foundation systems, considerations, and general design practices can be found in the following links, resources, and publications.

2018 International Residential Code (2018 IRC). Chapter 5, Floors, R502.2, Design and construction, Figure R502.2 at: https://codes.iccsafe.org/content/IRC2018/chapter-5-floors

Southern Forest Products Association, Header Beam Size Selection, Southern Pine Span Tables, Header Beam Size Selection Tables can be found at: https://www.southernpine.com/span-tables/headers-beams-size-selection-tables/

Southern Forest Products Association, Size Selection Tables for Floor Girder Beams can be found at: http://www.southernpine.com/app/uploads/SS_13-14L.pdf

Construction Costs and Pricing Guidance for Slab-on-Grade (with Fill) and Pier & Beam Foundation providing by RS Means (Gordian)

International Residential Code (IRC) Chapter 4 – Foundations can be found at: https://codes.iccsafe.org/content/IRC2021P2/chapter-4-foundations

Contact Us

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