

LESSONS LEARNED:

GEOTECHNICAL ENGINEERING

OBSERVATIONS AND LESSONS FROM THE SCHOOL OF EXPERIENCE

SPREAD FOOTING FOUNDATIONS

This “**Lessons Learned**” deals with shallow spread footing foundations, the most common foundation system used to support structures. Spread footing foundations, like any foundation system, are intended to extend the building load into the underlying soil or rock strata in a manner that does not exceed the load carrying capacity of the underlying materials, and does not result in excessive settlement.

What is a spread footing? Very simply, a spread footing is usually a concrete pad, most commonly square or rectangular in shape that is placed on the soil or rock bearing strata. The column or wall is then placed on top of this concrete pad. A spread footing is larger to significantly larger than the column or wall it supports. Most spread footings are constructed of reinforced concrete, although unreinforced spread footings are occasionally feasible. Historically spread footings were constructed of stone, brick or even wood prior to the use of concrete.

When are spread footings used? If spread footings are feasible for a project, they are usually the most economical foundation system available. There are occasional exceptions, which are discussed later.

What governs spread footing design? Although geotechnical engineers usually speak in terms of allowable bearing pressure, such as 3,000 pounds per square foot, what usually governs the capacity of spread footings is the compression of the underlying soil or rock. Spread footings achieve their load carrying capacity through a combination of factors including the strength of the soil or rock, the depth of embedment, and the size of the footing. When all these factors are taken into consideration, the majority of the time what limits the allowable bearing pressure is the settlement characteristics of the soil or rock. In other words, footings seldom “tip over” under a load, but rather fail by causing excessive settlement of the building.

Is there a “rule of thumb” that would tell me if my spread footings are too large to be economical? Yes, typically, if more than about 50 to 60 percent of the floor area is covered by the spread footing foundation, then a mat foundation (one large footing over the entire building footprint that supports all columns and walls), deep foundation, or ground improvement techniques to improve the settlement characteristics of the soils in combination with support spread footings, may be more economical. For example, a building that has a 30 feet square bay, which is 900 square feet, the maximum footing size for the spread footing foundation to be economical is somewhere between 21.2 feet square (450 square feet) to 23.2 feet square (540 square feet). Like any rule of thumb, it ultimately depends upon local costs and other factors. However, if the spread footings start to get so large that the footings themselves cover most of the slab area, then other foundation systems may be more economical.

If a spread footing is less than 50% of the floor area, are there circumstances where different foundations will be more economical? Yes, but only under unusual circumstances. For example, if there is a uniform and high quality bearing strata located at a shallow depth below the slab elevation, then deep foundations may be a more economical alternative. Also, some deep foundations are almost “weather proof” in their installation methodology. For example, drilled piers or piles can be installed under almost any weather condition. Spread footings, however, are susceptible to weather disturbance as the bearing strata must be exposed prior to the placement of the concrete, which can increase cost and cause delays. Therefore, there are rare occasions when spread footing foundations are not as economical as deep foundation alternatives.

What is the “frost embedment depth” that governs the minimum depth that a footing should be installed below exterior grade? The frost embedment depth is based on historical frost penetration information. If a spread footing foundation is placed too shallow and the ground below it freezes, then frost heave of the footing can occur (due to expansion of the water in the soil as it turns to ice), resulting in damage to the structure.

Are there other conditions that may require an embedment depth deeper than the frost depth? Yes, there are some soils that have expansion potential. In most parts of the country, the biggest concern is bearing capacity and settlement. However, where expansive soils exist, the design may require either removal of potential expansive materials, or the extension of the footing, sometimes with deep foundation, below the zone of the swelling soil. In most instances, local practitioners are well aware of the locations where expansive soils exist.

Spread footing foundations are the most common foundations used to support structures because of their low cost, ease of installation, and simplicity. If you have the opportunity to use a shallow foundation, that is generally the foundation that you are going to use. We hope this “**Lessons Learned**” has increased your understanding of spread footing foundations.

Respectfully,

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