

The Installation of a Frost-Protected Shallow Foundation

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ABSTRACT

The combination of frost-susceptible soil, moisture, and freezing temperatures produces the phenomenon of frost heave, which can result in the variable vertical displacement of the ground surface. In essence, frost heave is caused by the formation of "ice lenses" along the freezing front. Buildings constructed on ground with conditions favorable for frost heave are subject to damage if the frost zone penetrates beneath the footings. Traditionally, this problem has been overcome in the U.S. by placing the perimeter footings of the building beneath the maximum freezing depth occurring at a location. This usually results in the perimeter foundations extending three to six feet beneath the ground surface. An alternative "frost-protected shallow foundation" methodology has been pioneered in the Scandinavian countries over the past 20 years. An advantage of this method, with footings 12 to 24 inches below grade, is the lower cost, which results from the shallow excavations and the reduced amount of construction materials. The methodology uses thermal insulation located around the building foundation to maintain the temperature beneath the footings above freezing, which prevents the formation of ice lenses and the resulting occurrence of frost heave. The advanced frost-protected designs can rely on heat generated within the building to keep subfooting soil temperatures elevated above freezing or may not need a building heat source (this results in "passive" frost protection similar to traditional footing construction, which is protected even if the building's heating system fails). When correctly designed, the perimeter thermal insulation also reduces slab heat loss.

This presentation examines the design and field installation of an advanced frost-protected system with a house foundation, which is aimed at providing the passive frost heave protection afforded by conventional construction. The presentation will also examine techniques used with this project to address soil moisture and radon ingress protection, improved internal air movement management, passive thermal storage, energy conservation, and occupant comfort. Another concern with traditional foundation practice is the requirement for warm weather construction or some other means of ensuring that the footings are poured on warm ground. The project was, in fact, constructed on frozen ground

with no adverse consequences or structural damage yet observed.

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