

## ***How to Identify, Minimize, and Eliminate Frost Action***

Frost action is best described as the expansion and eventual consolidation of fine-grained soils due to freezing. A number of factors must be present for frost action to occur. They include:

- A "frost susceptible" soil, generally a silt or silty clay.
- An adequate supply of moisture, occurring from infiltration, ground water movement, capillary rise, etc.
- *Sustained* temperatures below freezing. (Note that for this to happen, the soil must actually freeze. Ambient air temperature and historic climatic data can be used to predict the likelihood of this happening.)

Frost heave occurs when adequate moisture is present in a frost susceptible soil that is then frozen. These conditions lead to the formation of "ice lenses" in the soil. Because ice occupies a greater volume than water, a wedging action or expansion of the soil results.

As the ice lenses form, additional water is drawn in, leading to further expansion. When the soil thaws, the ice lenses melt and consolidation of the soil occurs. Frost action affects all pavement types, although concrete pavements are less susceptible to it than asphalt pavements. It is most detrimental during the formation of the ice lenses, which result in expansion of the soil.

Pavement distress typically involves longitudinal cracking and differential vertical movement of the slabs. The consolidation phase during thawing is not as critical because concrete pavements distribute stresses over a wide area. The most problematic areas are transition zones between materials of different frost susceptibility.

Methods to minimize or eliminate frost action include:

- Removing the frost-susceptible soil and replacing it with a more suitable material.
- Cross hauling to eliminate differential frost susceptibility.
- Adding soil modifiers to reduce frost susceptibility.
- Minimizing the level of moisture present through proper drainage, pavement maintenance, and design features.

For more information on frost action, see ACPA publication TB011P which covers subgrades and subbases for concrete pavements. To order TB011P, log-in to the ACPA members only section at [www.pavement.com](http://www.pavement.com); call toll-free 1-800-868-6733; or fax requests to 847-966-9666.

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