

**Determining Frost Depth in Pavement Systems
Using a Multi-Segment Time Domain Reflectometry Probe**

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ABSTRACT

In cold regions freeze-thaw cycling and spring thaw weakening contribute to loss of load bearing capacity and premature pavement failure. Determining frost depth below the pavement becomes important for timely implementation of winter and spring load limits. Recent pavement research indicates that Time Domain Reflectometry (TDR) methodologies are successful when used for determining base and subgrade moisture conditions. TDR technology has also been examined for use in frozen soils for determining the frozen-unfrozen interface. The dielectric constant of ice is less than that of liquid water therefore changes in dielectric constant due to ice formation results in an electrical discontinuity that can be easily detected in the TDR waveform. Research conducted by the Minnesota Department of Transportation involves the use of the Moisture Point TDR probe as an instrument for locating the depth to the freezing front. The Moisture Point probe combines TDR technology with remote diode switching to provide a profile of the base and subgrade dielectric properties, from this the frost depth can be estimated. The Moisture Point probe works well in locating the depth to the freezing front, and so improves the ability to successfully implement spring and winter load limits.

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