

Definitions and Criteria

Definitions

- **Daily Freezing Index (FI_i)**

- Daily Freezing Index = $\left(T_{reference} - \frac{T_{maximum} + T_{minimum}}{2} \right)$

Where: FI_i = daily degree days below the freezing point (°F-day),
 $T_{reference}$ = reference freezing point air temperature (°F),
 $T_{maximum}$ = maximum daily air temperature (°F), and
 $T_{minimum}$ = minimum daily air temperature (°F).

- **Cumulative Freezing Index (CFI)**

- Summation of the Daily Freezing Indices

$$\text{Cumulative Freezing Index (CFI)} = \sum_{i=1}^n FI_i$$

- **Daily Thawing Index (TI_i)**

- Daily Thawing Index = $\left(\frac{T_{maximum} + T_{minimum}}{2} - T_{reference} \right)$

Where: TI_i = daily degree days above the freezing point (°F-day),
 $T_{reference}$ = reference freezing point air temperature (°F),
 $T_{maximum}$ = maximum daily air temperature (°F), and
 $T_{minimum}$ = minimum daily air temperature (°F).

- $T_{reference}$ varies from 29 degrees Fahrenheit on February 1 to 24 degrees Fahrenheit on March 15

- **Cumulative Thawing Index (CTI)**

- Summation of the Daily Thawing Indices

$$\text{Cumulative Thawing Index (CTI)} = \sum_{i=1}^n TI_i$$

Criteria

- Pavement structures achieve adequate strength to carry increased loads at a cumulative freezing index of about 280 F degree-days. (This value is based on observations of pavement deflections, frost depth and air temperature at the Mn/ROAD Site and Layered Elastic Modeling of typical, Minnesota pavement sections). Therefore, the criteria used to begin winter load increases is a cumulative freezing index (CFI) greater than 280 F degree-days based on the 3-day weather forecast, with predicted increases well in excess of this value.

Why is it necessary to include a three-day forecast as part of the placement criteria? The intent is to use the 3-day advance forecast temperatures to ensure that a thawing event is not likely and that future freezing will ensure the pavement structures will maintain adequate strength, through increasing frost depth, to carry the larger loads.

- The end of the winter load increase period is not tied to the starting date of spring load restrictions. Winter load increases are not removed during temporary thaw events that are followed by extended freezing period during the months of December and January, and therefore, are not typically removed prior to February 1. After which time, winter load increases are removed when the extended forecast predicts daily thawing, as indicated by the cumulative thawing index, and the impending placement of spring load restrictions.