Six Tips on Cold Weather Paving

Cold weather paving practices are appropriate when the average daily temperature falls below 40 degrees F for three successive days and daytime temperatures do not exceed 50 degree F.

Concrete must reach a minimum of 500 psi before freezing and develop approximately 4,000 psi compressive strength (580 psi flexural strength) before undergoing multiple freeze-thaw cycles. In severe conditions, an ultimate strength loss of 50% can occur if not properly protected. By following several key safeguards outlined below, paving can continue during cold winter months.

Heating concrete raw materials and mix water
Starting with sufficient concrete mix temperature at the time of batching is critical for early strength development. Once heated materials are mixed, the corresponding concrete temperature should be a minimum of 60 degrees F. Initial concrete temperatures should be maintained at or above 70 degrees F, this will aid faster cement hydration and strength development.

Heating the area in which concrete is placed
Using insulated blankets to warm the subgrade before paving will help during early strength development. Fresh concrete should never be placed directly on snow or ice. Remove the insulating blankets from the subgrade just prior to concrete placement and clean off any debris before placing on the fresh concrete surface for curing.

Use of additional cement or high early cement
Increasing the cement content by 100 pounds per cubic yard will speed the hydration process and increase early strengths. If locally available, using high-early cement (Type III) will increase early strength development and can be used as a direct replacement of the type I/II cement. It is best to reduce or eliminate mineral admixtures such as fly ash and slag cement -- they tend to slow the initial set times -- and replace with Type I, II, or III.

Addition of an accelerating admixture to the mix
There is no such thing as an anti-freeze for ready mix concrete. The use of concrete accelerating admixtures will help early strength develop and reduce the overall duration of winter protection. Some types of chemical admixtures (ASTM C 494 Types C & E) not only improve the early strength development but increase the long-term strength and durability as well. The use of calcium chloride is allowed if the pavement is a plain jointed concrete pavement and no steel reinforcement is used. Calcium chloride is one of the most widely used set accelerators but may cause a darkening of the concrete, increase in drying shrinkage, and increased scaling potential. Insulating blankets, when directly touching the pavement surface, may cause mottling. It is a surface discoloration that causes the pavement surface to hydrate differently. The dark and light blotching is due to a chemical reaction between the cement, calcium chloride, and varied levels of humidity where the blanket touches the pavement surface. Concrete discoloration does not affect concrete pavement performance but creates an esthetic problem. Use non-chloride type set accelerator if reinforcement is specified.

Insulating blankets for curing
Pavements need to be covered as soon as possible because concrete loses moisture and temperature rapidly in cold weather. However, working on the pavement too soon or overworking the surface, may result in surface scaling because of trapping bleed water into the finished surface. Fortunately, most

concrete pavements are placed at a lower water to cement ratio and reduces the amount of available water. Once the pavement reaches sufficient stiffness, as to not mar the surface, insulating blankets should cover the entire pavement.

This slows the pavements temperature loss and creates a good environment for curing. Internal concrete temperatures must be maintained above 55 degrees F from time of placement through the recommended strength development. Once concrete obtains the recommended strength, insulating blankets should be removed gradually, allowing the pavement to cool slowly, reducing the potential for thermal shock and cracking.

Monitor Concrete Temperatures

As a precaution, concrete temperatures can be monitored at critical locations such as the surface and edges. One of the best tools available is the maturity meter. By installing probes in the critical pavement locations, maturity meters measure and record concrete temperatures during curing.

As an additional benefit maturity meters can predict the in-place strength development, especially at early ages. If construction operations are anticipated to extend into the colder months, a laboratory maturity calibration curve can be developed and used throughout the concrete placement process. This calibration curve may also be used during the stages of construction for early opening to construction operations or traffic.