

## **Cold Weather Concrete – Important Guidelines & Tips**

Cold weather presents many problems for the concrete industry. The most common problem is with having the concrete freeze and/or go through freeze/thaw cycles before acquiring adequate strength. This and other problems can be avoided with precautionary steps. Protecting exposed concrete in these conditions can prevent costly issues down the road.

### **What is cold weather?**

ACI 306 defines cold weather when the following conditions exist for three consecutive days:

- The average daily temperature falls below 40°F, and
- Air temperature does not rise above 50°F for more than half a day in any 24-hour period.

### **What's the problem?**

- ❄ Water begins to freeze in capillaries of concrete at 28°F
- ❄ Water expands up to 9% of its volume when it freezes, causing cracks in the concrete matrix
- ❄ Up to 50% strength reduction can occur if concrete freezes before reaching 500-psi.



### **What's the solution?**

The following facts and guidelines should be followed to assure quality of the concrete in cold weather:

- Concrete should be protected from freezing at an early age – for the first 24-48 hours- until it achieves a compressive strength of at least 500-psi
- Concrete that is saturated with water should not be exposed to cycles of freezing and thawing until it achieves a compressive strength of at least 4000-psi
- Concrete that will be exposed to freezing and thawing even during construction should be air entrained. Exceptions may be interior floors with hard-troweled finishes
- For every 10°F difference in concrete temperature, set time will increase by 1/3<sup>rd</sup> of value (example: a 6 hour set at 70°F equals an 8 hour set with the same concrete at 60°F)
- Methods used to accelerate strength gain can include:
  - Use of Type III (ASTM C 150) cement
  - Additional Portland cement, 100 – 200 lb/yd<sup>3</sup>
  - Use of Type C & E (ASTM C 494) chemical admixtures

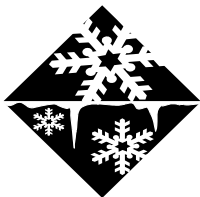
- When heating materials, using hot water is likely the easiest and most efficient way of raising concrete temperature.
- Use caution if water temperature exceeds 140°F
- Surfaces in contact with the concrete should be above freezing and free from snow, ice, and frost prior to placement
- Cover the subgrade with insulated blankets a few days prior to concrete placement
- When making and testing concrete cylinders, maintain an initial curing environment temperature of 60° - 80°F.



Protection of concrete using insulating blanket

### ***Important Tips to Remember:***

- ★ Monitor the weather forecast
- ★ Monitor the temperature of the concrete
- ★ Have all materials available and protected before placing concrete
- ★ Anticipate the worst case and be prepared for it
- ★ Schedule the placement during the warmest part of the day
- ★ If it is cold enough outside for you to wear a jacket; you probably need to put one on your concrete too!



### ***References:***

*ACI Committee 306, "Cold Weather Concreting" (ACI 306R-88), American Concrete Institute, Farmington Hills, MI*

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