

## Cold Weather Concreting Best Practices

### Cold Weather Best Practices

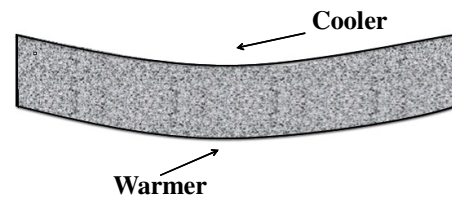
- 3 consecutive days in which the average daily temperature drops below 40°F is considered cold weather (ACI)
- Any 24 hour duration in which the temperature is above 50°F for 12 hours is no longer considered cold weather (ACI)
- When cold weather is expected while concreting, preparations must be made to ensure quality concrete



### Effects of Cold Weather Concreting

- 50% reduction of ultimate strength of the concrete if it freezes within the first 24 hours (Can't be repaired)
- Thermal cracking caused by a rapid change in concrete temperature (Thermal shock)
- Delayed set time
- Temperature curling of concrete pavement

### Temperature Curling



Large temperature difference in the top and bottom of the slab can cause concrete to curl.

Watch out for this in concrete pavement!

### Best Pre-Pour Practices

- Plan and be prepared!
- Look at the upcoming weather forecast to determine if low temperatures are expected
- Hold a pre-pour conference
  - TDOT, the contractor, and the concrete producer should participate
  - Discuss actions that should be taken by all parties to ensure quality concrete.

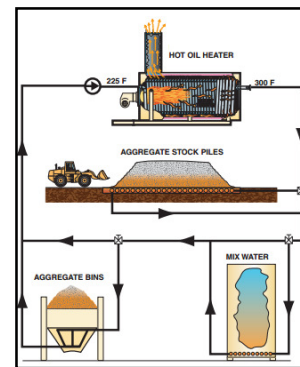


## Cold Weather Concreting Best Practices

### Best Pre-Pour Practices

- **Concrete Producer:**
  - Submit a cold weather mix design for approval
    - Use Type III cement or use an extra 100-200 lb/C.Y. of Type I cement (high-early strength concrete)
    - Avoid use of fly-ash and slag
    - Use a Type C (Accelerator) chemical admixture
    - Use a Type E (Water reducer & Accelerator) chemical admixture
  - Heat materials
    - Uniformly heat aggregates and water before mixing.

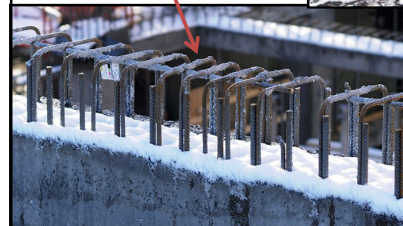
### Heating Concrete Materials



### Best Pre-Pour Practices

- **Contractor:**
  - Schedule pour for the warmest part of the day
  - Surfaces to be cast against should be free from ice and snow
  - Insulate the subgrade prior to pouring
  - Have materials available on-site to protect the concrete from cold weather

Clean off snow/ice  
from  
reinforcement  
bars

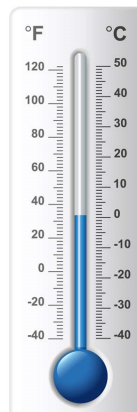


Heating the  
ground with  
hydronic heat  
pipes

### Best Pre-Pour Practices

- **Inspector:**
  - Check the air temperature (**501.11 & 604.12**)
    - Temperature must be **35°F and rising** to begin mixing and concreting operations
    - Mixing and concreting operations shall discontinue when temperatures reach **40°F and falling**.
  - Concrete may be poured at temperatures below 35°F, if authorized by the engineer in writing.
    - Water and aggregates at time of mixing must be between 70°F and 150°F. (Plant inspector can check)

Ensure  
thermometer is  
calibrated and  
working properly!



35°F and rising



40°F and falling



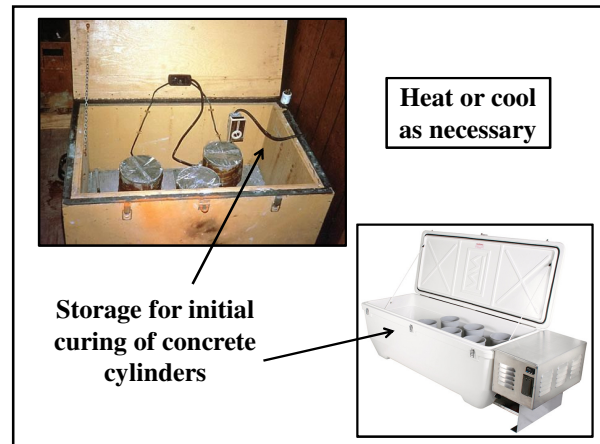
10 AM Tue, Dec 22	32°	23°
11 AM Tue, Dec 22	33°	24°
12 PM Tue, Dec 22	34°	25°
1 PM Tue, Dec 22	35°	26°
2 PM Tue, Dec 22	36°	27°

1 PM Tue, Dec 22	41°	35°
2 PM Tue, Dec 22	40°	35°
3 PM Tue, Dec 22	40°	34°
4 PM Tue, Dec 22	39°	33°
5 PM Tue, Dec 22	39°	33°

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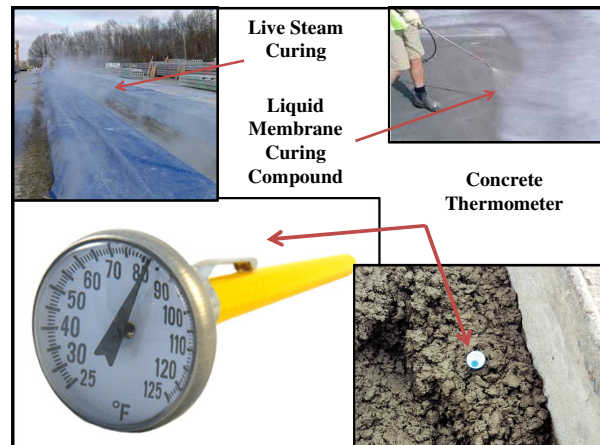
### Best Practices During the Pour

- **Contractor:**
  - Provide a cure box for initial curing of concrete cylinders for up to 48 hours.
  - Temperature in the cure box shall be maintained by heating and cooling as necessary and shall range between:
    - 60°F-80°F for mixes with design strength below 6000 psi
    - 68°F-78°F for high early strength mixes (≥6000 psi)



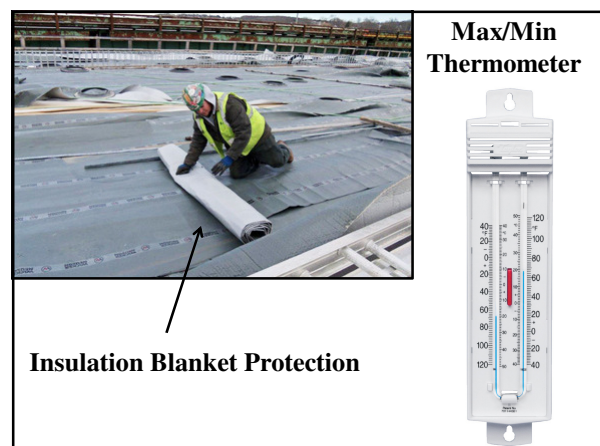
### Best Practices During the Pour

- **Contractor:**
  - **Curing**
    - Avoid using conventional water curing methods within 24 hours of freezing temperatures
    - Use liquid membrane curing compound
    - Use live steam
- **Inspector:**
  - Monitor concrete temperature (501.11 & 604.12)
    - 50°F-90°F at time of placement
    - 60°F-100°F if authorized to pour below 35°F



### Best Post-Pour Practices

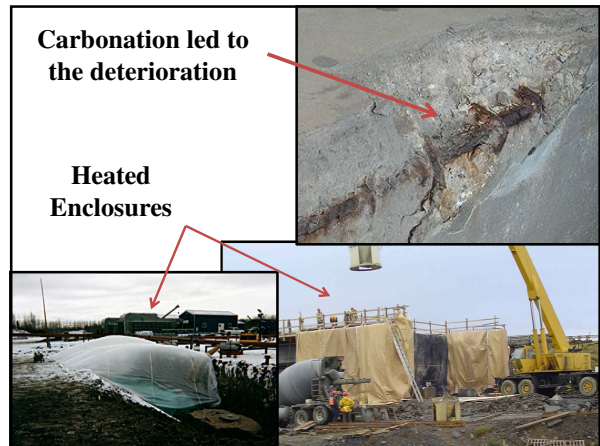
- **Inspector:**
  - Record the maximum and minimum temperature surrounding the fresh concrete daily
- **Contractor:**
  - Provide cold weather protection of fresh concrete if ambient temperature is expected to drop below 35°F (604.24)
    - Air surrounding the fresh concrete must be maintained at a temperature between 45°F-80°F for 120 hours (5 days)
    - Furnish a maximum-minimum thermometer for temperature documentation



## Cold Weather Concreting Best Practices

### Best Post-Pour Practices

- **Contractor:**
  - Acceptable cold weather protection:
    - Insulation blankets
    - Heated enclosures
  - Caution with heated enclosures
    - When using combustion heaters, there must be sufficient ventilation for safety as well as to protect concrete from carbonation
    - Place heaters in a manner to prevent overheating or over drying select areas of the fresh concrete



### Best Post-Pour Practices

- **Contractor:**
  - Removal of forms and falsework (501.19 & 604.19)
    - In cold weather, vertical forms shall remain in place until concrete has set sufficiently to withstand damage when forms are removed.
    - Falsework may be removed from concrete structures after 21 calendar days or 7 days in which the temperature has not fell below 40°F.
  - Avoid thermal shock! (rapid temperature change)

