

- Set time for concrete slows down by approximately 1/3 for each 10° decrease in temperature down to about 40°.
- When concrete freezes, the hydration process is stopped.
- The hydration process can resume when concrete thaws but up to 50% of the potential concrete strength can be lost.
- The volume of water increases approximately 9% when frozen.
- The strength loss in frozen concrete is caused by the increase in void space left after water freezes and thaws.
- Air entrained concrete can typically withstand one freeze/thaw cycle without damage if it has gained 500 PSI prior to freezing and no water has been supplied from an external source.

COLD WEATHER CONCRETE FACTS

- Concrete typically reaches 500 PSI during the second day at 50°.
- If concrete is exposed to multiple freeze/thaw cycles or is frozen while saturated, it needs 3500 PSI for protection.
- The recommended method of curing concrete during cold weather is with a curing compound or impervious covers and not with water.
- Properly protected concrete placed at low temperatures will ultimately reach higher strengths than concrete placed at high temperatures.
- For concrete 50° is a recommended placing temperature. There is no benefit in placing higher temperature concrete in cold weather.
- There are several methods used to improve set time and early strength:

1. use additional Type I cement (100 - 200 lbs)
 2. use Type III cement (where applicable)
 3. use hot water
 4. place lower slumps
 5. use chemical accelerator
- Typical chemical accelerators are non-chloride non-corrosive accelerators or calcium chloride.
 - Accelerators are helpful because they speed up the hydration process which uses water, so there is less water available in the paste to freeze and expand.
 - Non-chloride non-corrosive admixtures are typically used when there is concern for corrosion of any steel or reinforcement in the structure.
 - Non-chloride non-corrosive admixtures

[more facts on back]