

COLD WEATHER CONCRETE PRACTICES

When cold weather conditions exist, special precautions must be employed to protect concrete during production, placement and curing to ensure desired engineering properties are maintained throughout a construction project. These practices include the use of hot water, special admixtures, curing blankets and protection from the elements such as blankets and wind screens. Low concrete temperature has a major effect on the rate of cement hydration, which results in slower setting and rate of strength gain. A good rule of thumb is that a drop in concrete temperature by 20°F (10°C) will approximately double the setting time.

Some of the chemical admixtures that can and should be used during cold weather placement include the use of accelerators which have extended the construction season through the winter in North America by allowing the concrete to maintain desired internal temperatures to promote hydration and strength gain. Specific precautions and curing methods are recommended to ensure years of durability from your concrete and can be found in ACI 306.1, Guide to Cold Weather Concrete.

Concrete admixture companies offer the industry several chloride and non-chloride accelerators and a freeze-resistant accelerator that will keep your construction project on schedule even in 20°F (-6.7°C) temperatures. Concrete will gain very little strength in cold weather. If concrete freezes before reaching 500 psi (3.5 MPa) the hardened properties will be compromised. Concrete can lose up to 50% of its potential strength if precautions are not taken to ensure cement hydration continues. The use of Type III portland cement (high early strength) can reduce the time required for the concrete to reach initial set 500 psi (3.5 MPa). Using Type III cement with an accelerating admixture is a recommended but not necessary practice in cooler temperatures. Depending on the project requirements, choose a calcium chloride or non-chloride accelerator. Non-chloride accelerators are recommended for concrete that will come in contact with steel.

RECOMMENDED TIPS FOR COLD WEATHER CONCRETE PLACEMENT:

1. Always attend a pre-job conference and discuss the plan of action for cold weather concreting. Include a local concrete admixture and ready mixed concrete sales professional for technical expertise.
2. The relative percentage of fly ash or ground slag in the cementitious material component should be reduced or removed if the concrete design allows. Higher cement contents will be required to help generate the heat necessary for concrete to cure. If the concrete temperature drops to 40°F (4.4°C), hydration virtually stops.
3. Use warm water and heat your aggregates to get the concrete temperature as high as you can. This will help the concrete reach initial set and expedite the finishing process. Also, place the concrete at the lowest practical slump.
4. Protect the concrete from plastic shrinkage cracking with enclosures and polypropylene fibers. If there are extremely windy conditions, protect the surface from drying too quick and block the wind. Accelerators tend to "occupy" the water in concrete and reduce bleed. If the bleed water does not keep up with evaporation, tensile stresses on the surface of concrete will create plastic shrinkage cracking. Synthetic micro fibers can minimize the plastic shrinkage cracking by up to 88%.

5. Discuss curing requirements with your local concrete admixture or ready mixed concrete sales professional. The use of heating blankets is highly recommended. Fossil-fueled heaters in enclosed spaces should be vented for safety reasons and to prevent carbonation of newly placed concrete surfaces, which causes dusting.
6. It is not recommended to pour concrete if temperatures drop below 20°F (-6.7°C) for a significant period of time.

ACI 306.1 PLACEMENT TEMPERATURE GUIDELINES

Section size, minimum dimension, inch (mm)	Minimum concrete temperature as placed and maintained during the protection period	Maximum gradual decrease in surface temperature during any 24hr period after end of protection
Less than 12" (300)	55°F (13°C)	50°F (27°C)
12" - 36" (300 - 900)	50°F (10°C)	40°F (22°C)
36" - 72" (900 - 1800)	45°F (7°C)	30°F (17°C)
Greater than 72" (1800)	40°F (4°C)	20°F (11°C)

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[Technical Bulletin AD-02](#)

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