



## Cold Weather Concrete Placement

Construction projects needn't stop due to freezing temperatures and winter weather. To keep the project going over the winter, contractors and owners should plan and budget for the appropriate measures so that cold weather concrete placement is successful.

### How cold is too cold?

Concrete must be protected after placement and during initial curing to help achieve proper strength. Cold weather is defined as a period when average daily temperature falls below 40°F and ambient temperatures are no greater than 50°F for more than one-half day of any 24-hour period for more than three consecutive days.

The colder the air and ground temperatures, the longer concrete is susceptible to damage due to freezing temperatures. Concrete gains strength slowly at low temperatures and must be protected from freezing until it attains a sufficient strength either from the degree of saturation being significantly reduced by hydration, or achieving a minimum compressive strength of 500 psi. This period of protection can take from 2 to 7 days depending on weather conditions and type of structural element or flatwork.

### What happens when concrete freezes?

If concrete freezes while it is still fresh or before it has developed sufficient strength, water within the concrete mix freezes and develops ice formations resulting in the disruption of the cement paste matrix and causes an irreparable, initial loss of strength of up to 50 percent. The concrete's durability will also be adversely affected.

RECOMMENDED CONCRETE TEMPERATURES						
GEOTECHNICAL CONSULTANTS INC.		Adapted from ACI 306R				
		For Thin Sections		For Mass Sections		
Recommended Temperatures For Concrete Placed and Cured In Cold Weather	Section size	< 12 in.	12-36 in.	36-72 in.	>72 in.	
	Maximum size of aggregate	¾ in.	1 ½ in.	3 in.	6 in.	
	Minimum temperature of fresh concrete after placing and for first 72 hours	55°F	50°F	45°F	40°F	
	Minimum Temperature of fresh concrete as mixed for weather,	Above 30°F	60°F	55°F	50°F	45°F
		0°F to 30°F	65°F	60°F	55°F	50°F
		Below 0°F	70°F	65°F	60°F	55°F
	Maximum allowable gradual drop in temperature throughout first 24 hr. after end of protection	50°F	40°F	30°F	20°F	



*Additional time should be added to the construction schedule to accommodate the slower rate of concrete setting and strength gain due to cold weather.*

### **Schedule additional time for cold-weather setting**

The slower rate of concrete setting/curing and strength gain should be accounted for in the scheduling of finishing operations, form removal and building upon new concrete structural elements.

Depending on what type of cement used, degree of exposure to cold weather, and what type of initial loading the elements are subjected to, forms should not be stripped or thermal protection removed for 1 to 6 days after placement.

### **Budget considerations for cold weather concrete placement**

Project budgets should be prepared using adequate materials and in-place equipment to protect concrete from freezing both during and after placement and to retain the heat generated by cement hydration. Insulated blankets, tarps, straw covered with plastic sheeting, enclosures, insulated forms and heaters are common methods of protection.

GCI's engineers and technicians can work with project owners, contractors and suppliers to evaluate protection methods and mixture additives/alterations to help meet the project's budget and schedule parameters.

### **Test cylinders require special care**

Concrete test specimens used for acceptance of concrete should be stored in insulated boxes with adequate temperature controls.

### **Additional tips to prevent concrete damage due to freezing:**

1. Snow, ice and frost must be removed and the temperature of the base surfaces, forms and metallic embedments in contact with the concrete should be kept above freezing. This might require insulating or heating subgrades and contact surfaces prior to concrete placement.
  2. Water curing is not recommended when freezing temperatures are expected. Membrane-forming curing compounds or impervious paper and plastic sheeting are typically used for concrete slabs. Cure at recommended ACI temperatures.
  3. Chemical admixtures and other modifications to the concrete mixture can accelerate the rate of setting and strength gain but do not prevent concrete from freezing.
  4. Combustion heaters in enclosed spaces must be vented for safety reasons and to prevent carbonation damage of newly placed concrete surfaces.
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5. Monitor concrete temperatures throughout setting, as the temperature of the concrete determines the effectiveness of protection, regardless of air temperature.



Placing concrete in cold weather provides the opportunity for better quality, as cooler initial concrete temperatures will typically result in higher ultimate strength provided that the concrete is properly cured and protected from freezing.

Contact GCI's Jim Rosebrock or Bob Hiles at 614.895.1400 for technical details and specific strategies for your concrete work.

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*Base surfaces, forms and metallic embedments may need to be heated to make sure they are above freezing temperature prior to concrete placement.*

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