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September 2019

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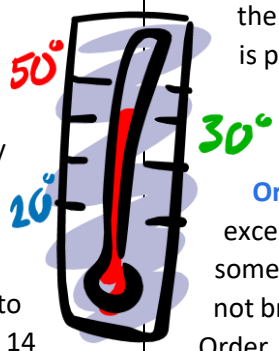
(After many requests, CalPortland has brought back our quarterly newsletter. This is our third issue. Each issue will contain information that will be useful for everyone involved with ready mix concrete. Consider saving the issues for future reference.)

COLD WEATHER CONCRETING

Concrete can be successfully placed, finished and cured in colder weather, but it requires an understanding of the impact of cold weather on the process of creating a long lasting product. Aside from rain, impacts of winter weather effects on concrete revolve mostly around setting times and the need to protect the concrete while it gains strength. While adverse conditions rarely bring a halt to a construction project, cold weather does require builders and contractors to make additional decisions based on the working environment. The slower rate of strength gain may impact other phases of the construction project.



Concrete Temperature: One area frequently overlooked is the relationship between ambient air temperature and concrete set times. At 70 degrees F, the approximate set time is six hours. If the concrete temperature drops to 40 degrees F., the set time jumps to just over 14 hours. Freezing temperatures can freeze the mix water within the concrete. Once ice has formed, cement hydration stops, and strength development is seriously impaired. Fresh concrete frozen during the first 24 hours can lose 50 percent of its potential 28-day strength. This can result in severe surface spalling and low durability.

Keeping the concrete warm and maintained at a temperature above 55 degrees F for three to seven days after placing is the key to winter strength gain. This can be accomplished by using enclosures and moist heat, applying insulating blankets, polystyrene sheets or hay as well as leaving the forms in place. Start with warm concrete and keep it warm. The internal temperature of the concrete mix may be raised by heating the materials, using extra or special cements or by the addition of accelerators.

Guides for Winter Concreting in the Field: PLANNING! All equipment and materials necessary should be at the job site before the first frosts are likely to occur, not after the concrete has been placed and its temperature begins to approach the freezing point. Be prepared with heaters, insulating blankets and enclosures. Check the temperature of the subbase and any other surfaces that come in contact with the fresh concrete to ensure they are not below 32 degrees F. Don't ever place concrete on a frozen subbase. Curing blankets can be used to keep the subgrade from freezing. On the day the concrete is placed, the blankets can be removed, the concrete placed and then the blankets used to recover the slab (providing the blankets are clean).

Ordering Concrete: Ordering hot water is an excellent option for winter concrete. Bear in mind that some mixes have low water contents so hot water may not bring the mix temperature up a significant amount. Order a lower slump mix for flatwork in cold weather. That will cut the set time and reduce bleed water. Cold air retards the evaporation rate of bleed water and retards the setting time. Use air entrainment if concrete is exposed to freezing during construction and for all exterior flatwork.

- Curing and protecting all concrete in cold weather is critical. As higher percentages of fly ash and slag become more prevalent, extended

curing and protection periods should be considered for these mixes.

- Order concrete mixes that contain accelerating admixes to keep setting times reasonable.
- Request a mix with additional cement to help develop early strength. A mix that gains strength sooner will require a shorter protection period from freezing. This may be the least expensive option to consider.

In the Field – Concrete Placement: Try to ensure that the minimum concrete temperature as placed and finished is 55 degrees F. or higher. Do not begin final finishing operations while bleed water is present. Don't overwork cool slabs that exhibit delayed setting characteristics. Blisters can result. Curing of the concrete surface in very cold conditions should not be done with water – a membrane system will provide the best cold weather curing.

Concrete Temperature	Approximate Set Time
100° F	1 -2/3 hours
90° F	2-2/3 hours
80° F	4 hours
70° F	6 hours
60° F	8 hours
50° F	11 hours
40° F	14 hours
30° F	19 hours
20° F	Set will not occur

In the Field – Protection: In moderately cold weather, all freshly placed concrete should be protected from freezing for a minimum of 72 hours. One popular myth is that concrete does not need additional protection the first night because it will produce enough internal heat through cement hydration. This is not correct. Insulated curing blankets should be placed as soon as possible to hold this internal heat generated by the concrete. Be sure the blankets are anchored properly in windy conditions. Protection from freezing for the first 24 hours does not assure the development of the required strength at a specific age, particularly when considerably colder temperatures are forecast. Additional cement and the use of an accelerating admixture can reduce protection periods by up to 33%.

In the Field – Additional Heating: If heated enclosures are used, they must be strong, windproof and weatherproof. Be sure to properly vent enclosures both for the safety of workers and the benefit of the concrete. In the first 24 hours, fresh concrete exposed to excess carbon dioxide from a polluted atmosphere resulting from the use of salamanders or other heating devises can result in surface carbonation and soft, dusting surfaces. Cure concrete to prevent the loss of moisture. When heated enclosures are used, provide extra moisture by fogging or using steam heat. When removing a heated enclosure, the concrete should be allowed to cool slowly to prevent thermal cracking.

Summary: If sufficient planning and care are taken, concrete can be placed, finished and cured in cold conditions. The neglect of early freezing protection may result in the immediate destruction or permanent weakening of concrete. Consider what is required and the resulting benefits. The costs of adequate protection for cold weather concrete are not excessive.

Tips: The use of calcium chloride or admixtures containing soluble chlorides is not recommended for certain situations:

- In concrete containing aluminum or prestressing strand because of corrosion
- Where discoloration of troweled surfaces cannot be tolerated
- Where galvanized steel will remain in permanent contact with the concrete
- In concrete subjected to alkali-aggregate reaction or exposed to soils or water containing sulfates

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