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COLD WEATHERCONCRETING

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Abstract:- *Weather conditions can have a dramatic effect on both the setting time and concrete placing, finishing and protection systems that must be followed for proper concrete placement. Because the hydration process is a chemical reaction it is strongly affected by ambient air and subgrade/formwork temperatures. At low temperatures concrete gains strength and sets very slowly and must be adequately protected from freezing and thawing. Concrete that is allowed to freeze while in its plastic state can have its potential strength reduced by more than 50% and its durability properties will be dramatically reduced. Hence necessary precautions/arrangements should be taken so that concreting work can be carried out in cold temperatures without compromising with the strength of concrete. This Study explains various aspects of cold weather concreting.*

Keywords: *Cold weather concreting; Temperature; Curing; Hydration.*

Introduction

The conditions of cold weather concreting exist when the air temperature has fallen to, or is expected to fall below, 40°F (4°C) during the protection period. The protection period is defined as the amount of time recommended to prevent concrete from being adversely affected by exposure to cold weather during construction. Concrete placed during cold weather will develop sufficient strength and durability to satisfy the intended service recommendations when it is properly proportioned, produced, placed, and protected. The necessary degree of protection increases as the ambient temperature decreases. Take advantage of the opportunity provided by cold weather to place low-temperature concrete. Concrete placed during cold weather, protected against freezing, and properly cured for a sufficient length of time, has the potential to develop higher ultimate strength and greater durability than concrete placed at higher temperatures. It is susceptible to less thermal cracking than similar concrete placed at higher temperatures.

Principles of cold weather concreting

The objectives of cold weather concreting practices are to: (a) Prevent damage to concrete due to early-age freezing. When no external water is available, the degree of saturation of newly placed concrete decreases as the concrete matures and the mixing water combines with cement during hydration. Additionally, mixing water is lost to evaporation even at cold temperatures. Under such conditions, the degree of saturation falls below the critical saturation. Critical saturation is the level at which a single cycle of freezing can cause damage. The degree of saturation falls below critical saturation at the approximate time the concrete attains a compressive strength of 3.5 MPa. At 50°F (10°C), most well-proportioned concrete mixtures reach this strength within 48 hours. (b) Ensure that the concrete develops the required strength for safe removal of forms, shores, and re-shores, and for safe loading of the structure during and after construction. (c) Maintain curing conditions that promote strength development without exceeding the recommended concrete temperatures in Table 5.1 by more than 20°F (–7°C) and without using water curing, which may cause critical saturation at the end of the protection period, thus reducing resistance to freezing and thawing when protection is removed . (d) Limit rapid temperature changes, particularly before the concrete has developed sufficient strength to withstand induced thermal stresses. Rapid cooling of concrete surfaces or large temperature differences between the exterior and interior region of structural members can cause cracking and can be detrimental to strength and durability. At the end of the required period, gradually remove insulation or other protection so the surface temperature decreases gradually during the subsequent 24-hour period (e) Provide protection consistent with the durability of the structure during its design life. Satisfactory strength for 28-day, standard-cured cylinders is of no consequence if the structure has surfaces and corners damaged by freezing, dehydrated areas, and cracking from overheating because of inadequate protection, improper curing, or careless workmanship. Similarly, early concrete strength achieved by the use of calcium chloride ($CaCl_2$) is not serviceable if the concrete cracks excessively in later years because of disruptive internal expansion due to corrosion of reinforcement. Short-term gains in construction economy on concrete protection should not be obtained at the expense of long-term durability.

Economy

Although cold weather concreting results in extra costs because of potentially lower worker productivity and additional needed products such as insulating blankets, tarping, and heaters, it most likely will also allow a project to stay on schedule. Neglecting protection against early freezing could result in immediate destruction or permanently weakened concrete, making it essential that adequate planning, protection from low temperatures, and proper curing are performed with cold weather concreting.

General procedures for cold weather concreting include:

- Removing all ice and snow from the sub grade or formwork.
- Supplying the necessary supplemental heat required to ensure that forms, sub grades, and reinforcing steel is maintained a minimum temperature of 5°C well prior to the concrete placement.
- Maintaining concrete with a temperature between 10°C – 25°C.
- Concrete should have lowest practical water slump since this will reduce bleeding and setting times. Chemical admixture can still be used to improve the workability of the concrete.
- Chemical admixtures and mix design modifications can be used to offset the slower setting times and strength gain of concrete during cold weather conditions. Considerations should be given to ordering concrete that will obtain higher early strengths.
- Concrete temperature must be maintained at a minimum of 10°C for the full curing period.
- The surface of the concrete should not be allowed to dry out while it is still plastic since this may cause plastic shrinkage cracking. The longer set times encountered during cold weather combined with the effects of hot dry air from heaters being blown along the top surface of the concrete significantly increase this risk.
- Wet curing methods are typically not recommended during cold weather conditions since the concrete will not have a sufficient time period to air dry before the first freeze/thaw cycle.
- The possibility of thermal cracking must be considered when the heating supplied during the curing period is going to be suspended.

References:

1. ACI Committee 306, *Cold-Weather Concreting,* ACI 306R-88, reapproved 1997, American Concrete Institute, Farmington Hills, Michigan, 1997, 23 pages.
2. ACI Committee 347, *Guide to Formwork for Concrete,* ACI347R-94, reapproved 1999, American Concrete Institute, Farmington Hills, Michigan, 1999, 34 pages.
3. Burg, Ronald G., *The Influence of Casting and Curing Temperature on the Properties of Fresh and Hardened Concrete,* Research and Development Bulletin RD113, Portland Cement Association, 1996, 20 pages.
4. CSA A23.1-04 – Concrete Materials and Methods of Concrete Construction, Canadian Standards Association International
5. Concrete in Practice 27 – Cold Weather Concreting, National Ready Mixed Concrete Association

