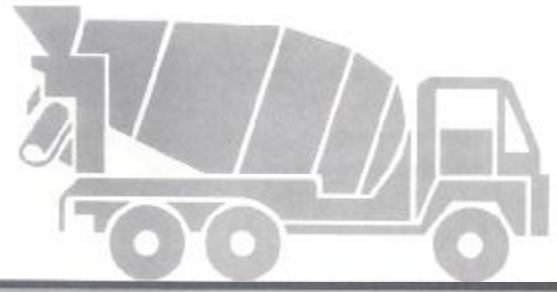


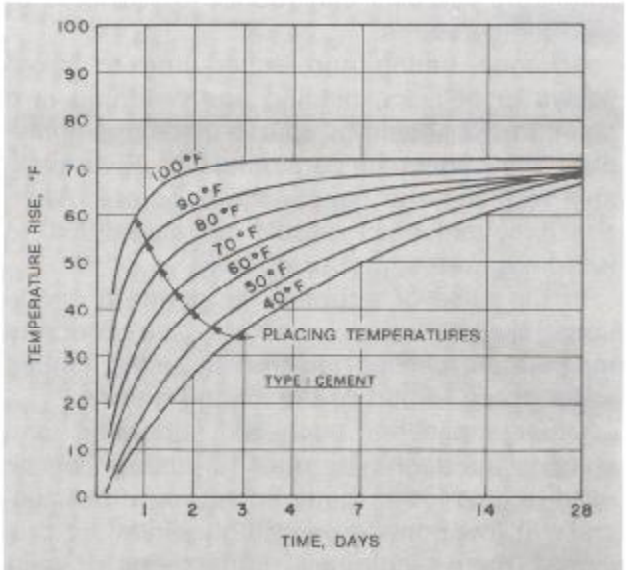
CONCRETE IN PRACTICE

CIP 12

What, Why & How? Hot Weather Concreting

WHAT is Hot Weather?

Hot weather may be defined as any period of high temperature in which special precautions need to be taken to ensure proper handling, placing, finishing and curing of concrete. Hot weather problems are most frequently encountered in the summer, but the associated climatic factors of high winds and dry air can occur at any time, especially in arid or tropical climates. Hot weather conditions can produce a rapid rate of evaporation of moisture from the surface of the concrete, and accelerated setting time, among other problems.[1] Generally high relative humidity tends to reduce the effects of high temperature.



Temperature Rise of Mass Concrete

ACI 207.2R-73, Figure 3.3

WHY Consider Hot Weather?

It is important that hot weather be taken into account when planning concrete projects because of the potential effects on fresh and recently placed concrete. High temperatures alone cause increased water demand, which in turn will raise the water-cement ratio and yield lower potential strength. Higher temperatures tend to accelerate slump loss and can cause loss of entrained air. Temperature also has a major effect on the setting time of concrete; concrete placed under high temperatures will set quicker and can therefore require more rapid finishing. Concrete that is cured at high

temperatures early will not be as strong at 28 days as the same concrete cured at more moderate (70F) temperatures.

High temperatures, high wind velocity, and low relative humidity can affect fresh concrete in two important ways; the high rate of evaporation may induce early plastic shrinkage or drying shrinkage cracking, and the evaporation rate can remove surface water necessary for hydration unless proper curing methods are employed. Thermal cracking may result from rapid drops in the temperature of the concrete, such as when concrete slabs or walls are placed on a hot day followed by a cool night. High temperature also accelerates cement hydration and contributes to the potential for cracking in massive concrete structures.

HOW to Concrete in Hot Weather

The key to successful hot weather concreting is (1) recognition of the factors that affect concrete and (2) planning to minimize their effects. Use proven, local recommendations for adjusting concrete proportions, such as use of water reducing, set retarding admixtures. Perhaps a moderate heat of hydration cement (ASTM Type II—moderate heat)[2] or pozzolanic admixture (fly ash) can reduce the effects of high temperatures.

Advance timing and scheduling to avoid delays in delivery, placing and finishing is a must; trucks should be able to discharge immediately and adequate personnel should be available to place and handle the concrete. When possible, deliveries should be scheduled to avoid the hottest part of the day.

In the case of extreme temperature conditions or with mass concrete, the concrete temperature can be lowered by using chilled water or ice as part of the mixing water.[3]

Other measures such as sprinkling and shading the aggregate prior to mixing, can be used to help lower the temperature of the concrete. If low humidity and high winds are predicted, then windbreaks, sunscreens or mist fogging may be needed to avoid plastic shrinkage cracking in slabs.

Follow These Rules for Hot Weather Concrete

1. Concrete mixture designs may include: set retarders and water reducers,[4] the lowest practical cement factor. Modify mixtures as appropriate—retarders, moderate heat of hydration cement,[2] pozzolanic admixtures or other proven local solutions.[5]
2. Adequate manpower to quickly place, finish and cure the concrete.
3. Limit the addition of water at the job site—add water only on arrival at the job site to adjust the slump. Later additions should be avoided; in no instance should they exceed 2 or 2½ gallons per cubic yard. Never add water to concrete that is more than 1½ hours old.
4. Slabs on grade should not be placed on polyethylene sheeting—if a vapor barrier is required, then a bed of damp sand should be placed over it.
5. Finish as soon as the sheen has left the surface; start curing as soon as finishing is completed. Continue curing for at least 3 days: cover to prevent evaporation or use a liquid membrane curing compound, or cure slabs with water. (See CIP 11) The addition of white pigment to membrane curing compounds will help by reflecting heat away from the concrete surface.
6. Moisten the subgrade, forms and reinforcement prior to placement. However, avoid standing water.
7. Protect field test cylinders by shading and preventing evaporation. Field curing boxes with ice or refrigation may be used to ensure required 60-80F for cylinders.[6] (See CIP 9)
8. Do not use accelerators!

References

1. ACI 305, "Hot Weather Concreting," ACI Manual of Concrete Practice, Part 2. American Concrete Institute, P. O. Box 19150, Detroit, Michigan 48219.
2. ASTM C 150, "Standard Specification for Portland Cement," American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
3. "Cooling Ready Mixed Concrete," NRMCA Publication No. 106.
4. ASTM C 494, "Chemical Admixtures for Concrete."
5. ASTM C 618, "Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete."
6. ASTM C 31, "Making and Curing Concrete Test Specimens in the Field."

NATIONAL READY MIXED CONCRETE ASSOCIATION

Technical Information prepared by:

National Ready Mixed Concrete Association

900 Spring Street, Silver Spring, Maryland 20910