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Guide to Hot Weather Concreting

Reported by ACI Committee 305

American Concrete Institute®
Guide to Hot Weather Concreting

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Environmental factors, such as high ambient temperature, low humidity, high wind, or both low humidity and high wind, affect concrete properties and the construction operations of mixing, transporting, and placing of the concrete materials. This guide provides measures that can be taken to minimize the undesirable effects of these environmental factors and reduce the potential for serious problems.

This guide defines hot weather, discusses potential problems, and presents practices intended to minimize them. These practices include selecting materials and proportions, precooling ingredients, and batching. Other topics discussed include length of haul, facilities for handling concrete at the site, and, during the early curing period, placing and curing techniques, and appropriate testing and inspection procedures in hot weather conditions.

The materials, processes, quality control measures, and inspections described in this document should be tested, monitored, or performed as applicable only by individuals holding the appropriate ACI certifications or equivalent.

Keywords: air entrainment; cooling; curing; evaporation; high temperature; hot weather construction; plastic shrinkage; production methods; retempering; slump tests; water content.

CONTENTS

Chapter 1—Introduction and scope, p. 2
1.1—Introduction
1.2—Scope

Chapter 2—Notation and definitions, p. 2
2.1—Notation
2.2—Definitions

Chapter 3—Potential problems and practices, p. 3
3.1—Potential problems in hot weather
3.2—Potential problems related to other factors
3.3—Practices for hot weather concreting

Chapter 4—Effects of hot weather on concrete properties, p. 3
4.1—General
4.2—Estimating evaporation rate
4.3—Temperature of concrete
4.4—Ambient conditions
4.5—Water
4.6—Cement
4.7—Supplementary cementitious materials
4.8—Chemical admixtures
4.9—Aggregates
4.10—Proportioning

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of hot weather concrete will not differ greatly from similar concrete placed at normal temperatures.

Where an acceptable record of field tests is not available, concrete proportions can be determined by trial batches (ACI 301 and 211.1). Trial batches should be made at temperatures anticipated in the work and mixed following one of the procedures described in Section 4.10, Proportioning. The concrete supplier is generally responsible for determining concrete proportions to produce the required quality of concrete unless specified otherwise.

If the initial 24-hour curing is at 100°F (38°C), the 28-day compressive strength of the test specimens may be 10 to 15% lower than if cured at the required ASTM C31/C31M curing temperature (Gaynor et al. 1985). If the cylinders are allowed to dry at early ages, strengths will be reduced even further (Cebeci 1987). Therefore, proper curing of the test specimens during hot weather is critical, and steps should be taken to ensure that the specified procedures are followed.

The effects of high air temperature and low relative humidity are more pronounced with increases in wind speed. The potential problems of hot weather concreting can occur at any time of the year, but generally occur during the summer season. Drying conditions can occur even at lower ambient temperatures, with slower set times, lower relative humidity, and wind, all of which are conducive to higher evaporation. Precautionary measures required on a windy, sunny day will be stricter than those required on a calm, humid day, even if air temperatures are identical.

1.2—Scope

This guide identifies problems associated with hot weather concreting and describes practices that alleviate these potential adverse effects. These practices include suggested preparations and procedures for use in general types of hot weather construction, such as pavements, bridges, and buildings. Temperature, volume changes, and cracking problems associated with mass concrete are treated more thoroughly in ACI 207.1R, 207.2R, and 224R.

CHAPTER 2—NOTATION AND DEFINITIONS

2.1—Notation

- $E = \text{evaporation rate, lb/ft}^2/\text{h (kg/m}^2/\text{h)}$
- $e_o = \text{water vapor pressure in mm/hg (psi) in the air surrounding the concrete obtained by multiplying the saturation vapor pressure at the temperature of the air surrounding the concrete by the relative humidity of the air. Air temperature and relative humidity are measured approximately 1.2 to 1.8 m (4 to 6 ft) above the concrete surface on the windward side and shielded from the sun’s rays}$
- $e_s = \text{saturation vapor pressure, kPa (psi)}$
- $r = \text{(relative humidity percent)/100}$
- $T = \text{temperature, °C (°F)}$
- $T_a = \text{air temperature, °F (°C)}$