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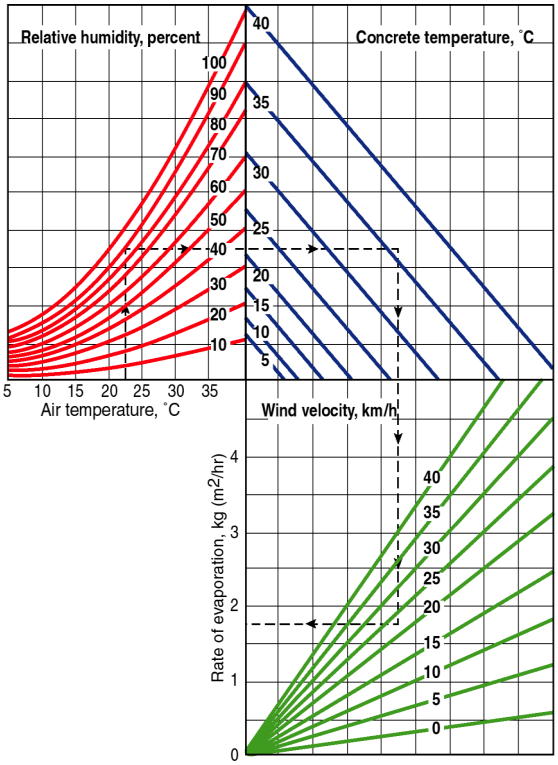
Hot Weather Concreting

1. WHAT is Hot Weather?

Hot weather, as defined by ACI 305R, is any combination of the following conditions that tends to impair the quality of freshly mixed or hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results:

- High ambient temperature
- High concrete temperature
- Low relative humidity
- High wind speed, and
- Solar radiation

Hot weather problems are most frequently encountered in the summer, but the associated climatic factors of high winds, low relative humidity and solar radiation can occur at any time, especially in arid and 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. Generally high relative humidity tends to reduce the effects of high temperature.



To use this chart::
1. Enter with air temperature; move up to relative humidity.
2. Move right to concrete temperature.
3. Move down to wind velocity.
4. Move left: read approximate rate of evaporation.

Effect of concrete and air temperatures, relative humidity, and wind velocity on rate of evaporation of surface moisture from concrete (Menzel, 1954).

Wind velocity is measured 500 mm above the evaporating surface. Air Temperature and Relative Humidity should be measured at a level approximately 1.2-1.8 m above the evaporating surface on its windward side shielded from the sun's rays (Menzel 1954).

2. WHY Consider Hot Weather?

Hot weather should be taken into consideration when planning concrete projects because of the potential effects on fresh and newly placed concrete. High concrete temperatures cause increased water demand, which in turn will increase the water-cementitious ratio and result in lower strength and reduced durability. Higher temperatures tend to accelerate the rate of slump loss and can cause loss of entrained air. Temperature also has a major effect on the setting time of concrete. At higher temperatures, concrete will set quicker and finishing operations will need to occur at a faster rate. Concrete that is cured at high temperatures at an early age will not be as strong at 28 days as the same concrete cured at more moderate (21 °C) temperatures.

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Reviewed and revised 2016.

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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 thicker concrete sections.

3. HOW To Use Concrete in Hot Weather.

The key to successful hot weather concreting is:

1. Recognition of the factors that affect concrete
2. Planning to minimize their effects.

Use proven, local recommendations for adjusting concrete proportions, such as use of water reducing, set retarding admixtures. The use of pozzolanic admixture (fly ash) can reduce the heat generated by cement hydration.

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. Consider pouring concrete at night when ambient temperatures and wind speeds tend to be lower.

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.

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

a. Concrete mixture designs may incorporate: set retarders or hydration stabilizers, water reducers. Use the lowest practical cement factor by replacing a portion of it with pozzolanic admixtures or other proven local solutions.
b. Have adequate manpower to quickly place, finish and cure the concrete. Schedule the rate of concrete delivery that can be managed by the available placing crew and equipment.
c. 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 10 - 15 l/m^3. Never add water to concrete that is more than 1 hour old. (CTT-24)
d. Slabs on grade placed directly on vapour retarders (CTT 29) will require special precautions when finishing and curing to avoid cracking and other surface defects.
e. 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 CTT-11) Using white pigmented membrane curing compounds will help to ensure proper coverage and will reflect heat from the concrete surface.
f. On dry and/or hot days, moisten the subgrade, forms and reinforcement prior to concrete placement. Avoid ponding of excess water.
g. Protect field test cylinders by shading and preventing evaporation. Field curing boxes with ice or refrigeration may be used to ensure a required 15 - 25°C curing environment is maintained for concrete test cylinders. (See CTT-9).

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