We are in the thick of another HOT summer. But even when pouring concrete, Mom’s advice is still the best: control hydration, stay out of direct sunlight if possible, and keep temperatures down. If all of these are accomplished, the magnitude of plastic concrete shrinkage and resultant cracking can be dramatically reduced.

Specific hot weather issues encountered in plastic concrete include: increased mix water demand, increased rate of slump loss, increased concrete temperature, shortened setting time, and the possible increase in plastic shrinkage and craze cracking. Issues encountered in hardened concrete include lower strengths, increased potential for uncontrolled cracking and decreased durability.

So...What’s Hot?

Not all hot weather is created equal. Hot weather as defined by ACI 305 ‘Hot Weather Concreting’ is “one or a combination of the following conditions (high ambient temperature; high concrete temperature; low relative humidity; high wind speed) 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.”

While informative, this criteria is not terribly helpful in determining if it is, indeed, HOT. An easier way to explain this is as follows: if the air temperature at the time of the concrete placement is higher than 77F to 80F, it is hot and a plan should be developed to combat the negative effects of these high temperatures.

What Is the Maximum Concrete Temperature Allowed by the Code?

This is another seemingly simple question without a clear-cut answer.

- ACI 318 (the Code) defers to ACI 305R-91 (Hot Weather Concreting) which states that “it is impractical to recommend a maximum limiting ambient or concrete temperature but advises that at some temperature between about 75F and 100F, there is a limit that will be found to be most favorable for best results…”
- Many project specifications list maximum concrete temperatures of 85F to 90F.
- ASTM C 94 notes that difficulty may be encountered when concrete temperatures approach 90F.
- ACI 305.1M-14, “Specification for Hot Weather Concreting” stipulates a maximum temperature of fresh concrete at the time of discharge of 95F.

The simple truth of the matter is that concrete placed and cured at a moderate temperature of 60F to 80F will outperform +90F concrete in strength and durability. If you are looking for superior concrete, control the temperature.
Controlling mix water temperature is typically the easiest way to lower concrete temperature. Mix water can be cooled to as low as 33°F but substituting ice for mix water is a good option. However, ice cannot be used for all of the mix water – specifications usually limit the amount of ice to 75% of the required mix water. Typically, the temperature of the concrete can be reduced by 1°F for every 4 degrees of Fahrenheit reduction in water temperature.

After placement, moisture loss can be prevented by immediately covering the concrete with moisture-retaining material such as burlap or curing compound. Moisture retention will optimize the cement hydration process (strength development).

Many concrete producers consider the use of supplementary cementitious materials to be essential in hot weather conditions. The materials of choice are fly ash, ground granulated blast-furnace slag, and other pozzolans. These materials tend to slow the rate of setting, slow the rate of slump loss, and reduce the temperatures caused by hydration. Portland cement content should be as low as possible but sufficient to meet strength and durability requirements. Keep in mind, however, that because the rate of bleeding can be slower than the rate of evaporation, plastic shrinkage cracking or crazing can result.

Water-reducing and set-retarding admixtures are used widely under hot weather conditions to lower water demand and control the setting times of the concrete. As an example, concrete without these admixtures that reaches final set in three hours at 60°F may reach final set in as little as 1 ½ hours at 80°F. The admixtures are designed to regulate this process so that setting occurs at roughly the same pace.

With all of this in mind, everyone involved in the placing of concrete in hot weather must be engaged in the design of a comprehensive plan to ensure the highest quality product possible. This plan should include the following:

- Schedule a preplacement conference to discuss the hot weather plan.
- Select concrete mixtures, materials, and proportion with satisfactory hot weather track record.
- Reduce and control the temperature of fresh concrete.
- Use a concrete consistency that permits rapid placement and effective consolidation.
- Minimize the time to transport, place, consolidate, and finish the concrete.
- Schedule placing operations at time or day (or night) when weather conditions are most favorable.
- Protect the concrete placement from direct sunlight and wind.
- Ensure the contractor has enough labor and equipment on hand to place concrete quickly and properly.
- Protect the concrete from moisture loss during placement and curing.
- Dampen subgrades and/or forms prior to placement (i.e., no free water).
- Minimize concrete truck drum revolutions (even at agitation speed).
- Cure concrete properly after placing.
- Do not compromise water-cement ratio of mixture with added water that exceeds the maximum water-cement ratio of the mix.
- Do not weaken concrete flat work surface by adding water (to surface) by hand.
- If compressive strength test specimens for concrete acceptance is made, then be certain to provide initial curing of 60°F to 80°F around the test specimens until they are transported to the testing laboratory. If this initial curing is not provided, then the strength results may be artificially low due to reduced strength development of the test specimens.

**Sweating the Details? Call the Experts at F&R!**

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