

# Hot Weather Concreting

With the onset of summer in India and many parts of the globe construction personnel will need to take extra care or additional measures when it comes to concreting. In fact, some parts of the world remain hot throughout the year. These are situations when paying attention to a few simple yet very necessary points on hot weather concreting would certainly help in completing any concreting without compromising its quality. That's what this article is about.

But, before proceeding with soothing the trouble let's throw a bit of sunlight in the trouble itself in order to understand what it is all about. Well, simply put, sunlight itself is the root of the whole issue. Sunlight leads to hot weather which compels us to adopt special measures while concreting which is known as hot weather concreting.

But then, what exactly is hot weather? The definition may vary from country to country. For Indian weather condition, Indian codes prescribe 40°C as the threshold for hot weather concreting. That means, any concreting done at an ambient temperature of more than 40°C can be regarded as hot weather concreting inviting special measures to be adopted.

Apparently, that's not the case in many other parts of the globe due to different weather condition. For example, according to ACI 305, any combination of high ambient temperature, high wind, low relative humidity and solar radiation (sunlight) is a good enough pre-condition to label concreting as hot weather concreting. Some other views say that any temperature above a comfortable room temperature, say 25°C or so, begins to make concrete bit uncomfortable i.e., concrete starts reacting differently and hence calls for special care befitting hot weather concreting, if strict quality is to be maintained.

How is hot weather concreting different from concreting in normal temperature? We studied such things in great details in our engineering courses. To put it very simply & briefly, concrete sets and gains strength due to hydration of cement within it. Hydration of cement occurs faster in hot weather. Hydration of cement also releases heat. Hence, faster the hydration of cement faster the heat generation. This makes the concrete hotter, further speeding up the process of cement hydration or setting. Fast setting cement does not allow concrete enough time to gain strength sufficiently. While the initial strength may not suffer, the long term strength (28-day strength) is adversely affected. This is the key reason why hot weather concreting needs special care. Otherwise, you would be playing with the designed strength of the concrete.

But, that is not the only issue associated with hot weather concreting. Water demand of a concrete mix is higher in hot weather due to rapid evaporation. Unless suitable measures are adopted, extra water would have to be added to the concrete mix in order to maintain the workability of the mix. This would increase the water cement ratio which

in turn would decrease the strength of the concrete. If additional cement is added to keep the w/c ratio unchanged then cost would increase as cement is the costliest ingredient of a concrete mix.

There are other problems too. Rapid drying of freshly poured concrete surfaces occurs in hot weather due to quicker evaporation or loss of water from the mix. If proper care is not taken this can lead to cracks known as plastic shrinkage cracks which are quite difficult to repair later on. Concrete surface tends to shrink quickly due to fast moisture loss while the mix is yet to develop sufficient strength to counter these shrinkage stresses resulting in the cracks.

In hot weather, the concrete bed, forms, steel reinforcement, mixing or concreting equipments etc. too get hot transferring the heat to the mix contributing further to the problem.

Based on my understanding on the subject which is based on some studies about the topic in books, the web as well as my practical experience on hot weather concreting in projects in India and the Gulf region, few important precautionary measures to be adopted while concreting in hot weather have been briefly discussed in the next post for the benefit of construction personnel and readers seeking a bit more info on the subject.

In Part-I, definitions of hot weather concreting and a few typical problems associated with such concreting were discussed. In this post some useful measures that need to be taken in order to perform concreting in hot weather condition without compromising important quality parameters such as workability, strength, smooth crack-free surface etc. are mentioned below:

In hot weather condition timing of concreting becomes important. It is always better to schedule the concreting for early morning & late evening hours when the sun is milder. In fact, in moderately hot and humid climates this alone may mitigate the issue to a large extent. For hot climates it is best to schedule it for night hours when the ambient temperature gets substantially lower.

Providing sunsheds is another effective way tackling the heat issue. Whenever possible, sheds are to be provided not only in the pour locations but also over the equipments to be used in concreting such as batching or mixing plants, concrete pumps and pipes etc. This would cut off direct sunlight reducing heat transfer to the concrete mix to some extent. Sheds over the concrete should be continued for few days if possible.

The base or the bed on which concrete is to be poured gets hot and dry in hot weather condition and so do the reinforcing steel bars and the forms. These need to be cooled by wetting with cold water taking care that no water pools are formed in the bed. If not cooled, these elements would transfer their heat to the poured concrete and also the dry bed would suck moisture from the mix.

In really hot climates the above steps merely are not good enough and additional measures are required. One of them is lowering the temperature of the concrete mix itself.

In order to lower the temperature of the mix primarily two of its major constituents, aggregates & water, are targeted. If these two are cooled adequately the resulting concrete mix too becomes substantially cooler.

Aggregates may be kept cooler by storing them away from direct sunlight or by providing sheds, if possible. Coarse aggregates are also sometimes cooled by wetting them with cold water.

Water to be added to the mix may be cooled by refrigerating or by adding ice. Introducing ice directly can be avoided in this way. If at all ice is added to the mixing plant directly, it is added in the crushed state only and complete melting is ensured before mixing is complete.

In hot weather condition the mix sets quicker and loses workability or slump swiftly due to rapid hydration & evaporation of moisture from the mix. This can make placing, compaction, finishing quite difficult leading to deterioration of quality. Adding additional water would reduce the strength of the concrete substantially. Use of retarding admixtures to delay the setting is a viable option. Many water reducing admixtures are also effective retarders. Superplasticizers can not only reduce water content of a concrete mix but also can delay its setting up to several hours. They are good options and I remember extensive use of superplasticizers in reinforced concrete in projects both in India as well as in the Gulf region for these very same purposes. However, use of these admixtures need to be carefully considered while designing the mix itself.

As soon as finishing of freshly poured concrete is over it should be covered with burlap or curing compound to prevent loss of moisture by evaporation. Curing compound should preferably be white pigmented so as to reflect sunlight.

Evaporation retarders, monomolecular films etc. can be used to get rid of the rapid evaporation problem in hot, dry or windy climate ensuring prevention of shrinkage cracks. I have not seen these products being used in any of hot weather concreting work I was involved in, but I read that these are effective means of dealing with shrinkage cracks.

There could be some differences in opinions as to when curing should commence after a hot weather concrete pour. My perception is that immediately after surface finishing of fresh concrete steps need to be taken to stop rapid evaporation. This can be in the form of covering the surface with a wet burlap, providing evaporation retarders or curing compounds or other suitable film-barriers and so on. I would prefer not to use plenty of water right after surface finishing. That can wait until the concrete hardens to a reasonable extent.

There should be no delay during the entire process of mixing, transporting, placing and compacting concrete. Careful plan can achieve that with ease.

Containers, truck mixers etc. used for hauling fresh mix should be appropriate to hot and dry weather condition, especially if long-distance transportation is involved. These should not be shallow and their outer surface should have reflective coatings.

The purpose of the special care taken for hot weather concreting is to maintain the designed or expected quality of the concrete. While it is certain that unless special measures are adopted the quality of the finished concrete may suffer substantially, apparently, there are no hard and fast rules as to which measures are to be adopted for a particular weather condition. This may vary from case to case and all of the abovementioned measures may not be necessary for many situation. Requirements are to be assessed on case to case basis and implemented accordingly.

Based on my perception I would rather summarise the story as follows:

If the weather is only moderately hot and highly humid, as is the case in many parts of India, fewer precautions like providing sheds, a pour plan to avoid undue delays, timely curing and so on should be good enough. Admixtures, especially meant for hot weathers, may or may not be necessary. Crack prevention measures may not be too important.

If the weather is moderately hot but is very dry with plenty of sunlight throughout the day or is accompanied with dry wind, most of the measures, including crack prevention care, may be necessary.

If the weather is too hot most or all of the abovementioned measures may be necessary for best outcome, immaterial of the other conditions.

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