

Cold Weather and Concrete

Cold weather is slow in coming this year, but you know it is coming. Effective concreting in cold weather means knowing what to expect and reacting to changes in conditions.

Air entrained concrete:

Reduced air temperatures mean the air entraining admixtures are more effective, meaning a lower amount is needed to achieve the necessary air content. Normally, as temperatures drop from September on, the concrete producers start making minor adjustments in air admixture dosage rates to maintain the required content. An extreme drop in temperature from day to day or even during the day can result in higher air contents than specified that can cause lower compressive strength and other problems. Cold weather also means that hot water or set accelerators come into the mix and with them added monitoring of their effect on air content is doubly important.

The primary negative result of too much air is a reduction in the compressive strength of the concrete. A general "Concrete Rule of Thumb" provides that a one percent increase in air content over the design content equates to about a five percent reduction in compressive strength. As an example; a 4000 PSI mix designed with 5% entrained air with a normal 28-day compressive strength of 4550 PSI could result in 3650 PSI if the air content increased to 9% due to a cold weather. Increased air can also cause poor abrasion resistance, delamination and increased permeability of the concrete.

Concrete Temperature Effect:

A 20 degree drop in concrete temperature will almost double the set time of normal concrete. The use of supplemental cementitious materials like fly ash or slag will extend set even further. The concrete supplier can provide means to counter the effects of cold temperatures on set time and compressive strength gain by making

changes to the mix like those in the following list.

- Addition of "Set Accelerators" to offset slower set time and increase strength gain
- Changing from a normal water reducer to a Mid-Range Water Reducer (MRWR) to decrease the total water in the mix – An extra 1 to 2 gallons of water per cubic yard will delay set by as much as 2 hours
- Minimize the amount of fly ash or slag in mix, in extreme conditions – eliminate totally
- Increase the Portland Cement content by 20-30%
- Place concrete at a lower slump to minimize the total amount of water in mix

Cold Weather Concreting:

Considerations –

- Concrete will freeze at about 25°F
- The compressive strength of frozen concrete is reduced by 50% or more
- New concrete is saturated with water and should be protected

from cycles of freezing and thawing until it reaches 3500PSI

- Large temperature fluctuations (>35°) between the surface and interior of the concrete can result in cracking , so use insulation and remove gradually to avoid thermal shock

Lower temperatures of the air or concrete itself affect the way the materials place, finish, set, gain strength and its long term durability. The keys to effective cold weather concreting are planning and good communications with the concrete supplier. Having in place the equipment and procedures to counter the effects of cold weather on concrete can reduce the risks of cold weather placements.

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