AMERICAN CONCRETE PUMPING ASSOCIATION

ACPA SAFETY BULLETIN

CONCRETE 101

The following information is for your knowledge and better understanding of concrete. It should not be used to instruct contractors or ready mixed concrete suppliers.

1. What is the importance of air and how can we minimize the loss of air?

Air improves the durability in: environments of freeze/thaw, deicer salts, sulfate (ground water) and alkali reactivity. It also improves the workability of the concrete. The DOT may have certain project specification requirements which require a specific amount of air content at the point of placement or at the discharge end of the pumping.

Air loss can be minimized when pumping by slowing down the "free-fall" of the concrete and minimizing the pumping pressure.

2. What is slump? (Why/what/how it effects concrete and us)

Slump is a measure of concrete consistency or fluidity. Consistency is the ability of freshly mixed concrete to flow. For given proportions of cement and aggregates (without admixtures), the higher the slump, the wetter the mix. Four-inch (4") slump is very common with normal weight concrete and is a good average slump for pumping. Above average slump - due to the addition of water – considerably reduces the strength, durability, and permeability of concrete and can cause segregation.

When possible, admixtures should be used instead of water to achieve higher slump. Slump loss through the pump can negatively affect pumping. Aggregate will absorb large amounts of water when under the pressure of the pump. This can cause a blockage and be completely unpumpable. Such aggregate should be soaked long

enough to achieve Saturated Surface Dry (SSD). SSD aggregate cannot absorb any more water.

3. **What aggregate size can we pump and size delivery system must be used?**

   ACI 304 suggests that the maximum size of angular (crushed stone) coarse aggregate be limited to one-third of the smallest inside diameter of the delivery system.

4. **What is "lightweight concrete"? How will it affect pumping?**

   Lightweight concrete is made using lightweight aggregates of expanded shale, clay and slag. These are used to produce structural lightweight concrete with a freshly mixed unit weight of 90 to 120 pounds per cubic foot. Normal weight concrete is typically 135 to 150 pounds per cubic foot.

   Lightweight aggregate is porous with absorption values of up to 20%. This quality requires the aggregate to be thoroughly soaked to minimize the aggregates' ability to absorb even more water under the pressure of the pump, causing severe slump loss.

5. **What is "flowable fill"? How will it affect pumping?**

   Flowable fill is a self-compacting low-strength material with a flowable consistency that is used as alternative to dry fill or backfill material. Some other terms used for this material are Controlled Low-Strength Material (CLSM), controlled density fill, or lean-mix backfill.

   Due to the low cement content of flowable fill, the material has a tendency to mechanically set (settle) quickly. When pumping flowable fill, it is important to keep the material moving.

6. **What is "block fill"? How will it affect pumping?**

   Block fill is used to fill the voids in masonry units. It is a grout – either fine or coarse.

   Block fill generally will pump easily. Sometimes, with leaner mixes it will tend to mechanically set (settle) quickly and you may need to keep the material moving periodically.

7. How does hot/cold weather affect concrete?

Concrete is temperature sensitive; it sets quickly in hot weather and slowly in cold weather. The addition of admixtures is often used to slow the set time (retarder) during hot weather and to speed up the set time (accelerators) in cold weather.

Hot weather can create difficulties in fresh concrete such as:

- Increased water demand
- Accelerated slump loss
- Increased rate of set
- Difficulties in controlling entrained air

Adding water to the concrete at the jobsite can adversely affect the properties of concrete, resulting in:

- Decreased strength
- Decreased durability
- Non-uniform surface appearance
- Increased tendency for cracking

8. How does high cement content effect pumping (i.e. 3000 PSI versus 4000 PSI)?

Higher cement content mixes are generally easier to pump. The difference between a typical 3000 PSI mix and a typical 4000 PSI mix is that there is approximately 100 pounds more of cementious material and approximately 85 pounds less sand in the 4000 pound mix. Cement is the sliding agent in concrete; while sand is abrasive which therefore, makes the 4000 pound mix pump easier.

5000 PSI mixes and higher can start to be more difficult to pump do the "sticky" effect of very high cement contents. The addition of silica flume makes it even worse. Always remember – the higher the PSI, the faster the set time of the concrete.

9. How do admixtures affect pumping?

Water reducers are used to achieve desired levels of slump without the addition of extra water to the mix. Water reducers typically:

- Increase workability
- Increase pumpability
- Decrease segregation
- Improve finishability

There are basically three types (levels) of water reducers:

- Normal – reduces water by 5-10%
- Mid-range – reduces water by 10-15%
- High-range – recued water by 15-40%

Accelerators (calcium, polar set) are used to reduce the setting time concrete and increase the early strength of hardened concrete. Calcium chloride is widely used in non-structural concrete. It can contribute to the corrosion of reinforcing steel and is prohibited or very limited in most structural concrete applications. Non-chloride accelerators are used in structural concrete because they do not contribute to corrosion. Brand names do not necessarily indicate if the accelerating admixture contains calcium chloride or not. Either way, these accelerators are used to decrease the set time. Most often, the indicator of how much accelerator is in the mix isexpressed as a percentage. The higher the percentage, the faster the set.

Retarders (Daratar 17, Pozzolith 100XR) are used to delay the set of the concrete and are usually used in hot weather. A retarder can delay set times for a few minutes to several hours; the time is dependent upon the dosage rate and is usually expressed as ounces of retarder per 100 pounds of cement (oz/cwt). This typically ranges from two to five oz/cwt. Retarding admixtures are made from lignosulfonates and/or carbohydrates such as molasses or corn sugar. Most retarding admixtures also act as water reducers.

10. Fly ash – how does it affect pumping?

Fly ash increases the pumpability of concrete by making it more slippery without adding more water. It's small, spherical shape is the physical characteristic of fly ash that makes it useful. Fly ash particles range from the same size as cement particles to 20 times smaller. The smaller size and shape improve pumpability. Higher contents of fly ash can start to be more difficult to pump do to the "sticky" effect.