NRMCA

What, Why & How?

Loss of Air Content in Pumped Concrete

CONCRETE IN PRACTICE **CIP 21**

WHAT is Air Loss in Pumping?

Increasingly, specifiers are testing concrete at the discharge end of concrete pumps and, in some cases, finding air contents much lower than that in samples tested at the truck chute. It is normal to find 0.5 to 1.0 percent less air at the pump discharge. However, when the new 5" line, long boom pumps have the boom in an orientation with a long, near vertical downward section of pipe, the air content at discharge may be less than half of that of the concrete going into the pump hopper. When the boom is upward or horizontal, except for a 12 ft. section of rubber hose, there generally is no significant loss of air. There is some controversy over how frequently air loss is a problem in pumped concrete. Certainly, it doesn't occur every time, or even most times. However, it does occur often enough to be considered seriously until better solutions are developed.

WHAT is Air Loss?

There are several mechanisms involved, but air loss will occur if the weight of concrete in a vertical or near vertical downward pipe is sufficient to overcome frictional resistance and let a slug of concrete slide down the pipe. One part of the theory is that when the concrete slides down the pipe, it develops a vacuum which greatly expands the air bubbles; and when they hit an elbow in the boom or a horizontal surface, the bubbles collapse. You can demonstrate the effect of the impact by dropping concrete 15 or 20 ft. into a tray. Naturally, the transition from several hundred psi of pressure in the line to a near vacuum condition may make matters worse. Most field experience suggests that air loss is greatest with high cement content, flowable concrete mixes which slide down easier; however, air loss has also been experienced with $5^1/_2$ sack concrete of moderate slump.

HOW to Prevent Air Loss

Keep concrete from sliding down the line under its own weight. Where possible, avoid vertical or steep downward boom sections. Be cautious with high slumps, particularly with high cement content mixes and mixes containing silica fume. Steady, moderately rapid pumping may help somewhat to minimize air loss, but will not solve most problems.

a) Try inserting four 90 degree elbows just before the rubber hose. *(Do not* do this unless pipe clamps are designed to comply with *all safety requirements.)* This helps, but won't be a perfect solution.

b) Use a slide gate at the end of the rubber hose to restrict discharge and provide resistance.

c) Use of a 6 ft. diameter loop in the rubber hose with an extra section of rubber hose is reported to be a better solution than (a) or (b).

d) Lay 10 or 20 ft. of hose horizontally on deck pours. This doesn't work in columns or walls and requires labor to handle the extra hose.

e) Reduce the rubber hose size from 5 to 4 in. A transition pipe may be needed to avoid blockages.

PRECAUTIONS

a) Before the pour, plan alternative pump locations and decide what will be done if air loss occurs. Be prepared to test for air content frequently.

b) Sampling from the end of a pump line can be very difficult. Wear proper personal protective equipment. Never sample the initial concrete through the pump line.

c) Sample the first load on the job after pumping 3 or 4 cu. yds. Temper it to the maximum permissible slump. Swing the boom over near the pump to get the maximum length of vertical downward pipe and drop the sample in a wheel barrow. If air is lost, take precautions and sample at the point of placement.

d) If air loss occurs, do not try to solve the problem by increasing the air content delivered to the pump beyond the upper specification limit. High air content concrete with low strength could, or almost surely will, be placed in the structure if boom angles are reduced or somewhat lower slump concrete is pumped.

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