



## Reducing / Eliminating Bug Holes in Vertical Concrete Surfaces

Bug holes or blow holes found on the vertical surfaces of concrete when forms are removed are caused by entrapped air or water pockets sticking to the form face. There are many contributing factors that can be controlled to minimize or eliminate bug holes, but the most critical are proper concrete placement and vibration/ consolidation procedures. The most common cause of bugs holes and other surface defects is under-vibration.

### **Concrete Placement, Vibration/ Consolidation:**

DO: Place and vibrate concrete as soon as possible especially in warm weather, as delays will increase the likelihood of concrete beginning to set and becoming more difficult to consolidate

DO NOT: Fill the form to the top, and then try to vibrate the entrapped air out.

DO: Place concrete in such a manner to minimize the introduction of air and minimize segregation of aggregate, such as with an elephant trunk, or tremie. Minimize the free-fall of concrete. Avoid cascading concrete over rebar.

DO: Place concrete in shallow lifts, as little as 6-12" at a time. Insert vibrator into concrete vertically and rapidly to bottom of the lift. Penetrate the prior lift approximately 6" to ensure good mixing of the lifts and removal of entrapped air from the interface between lifts. Don't push vibrator down, let it sink. Hold at bottom (of lift) for 5-15 seconds and listen for the tone to change. Withdraw gradually with an up and down motion. At the surface, remove the vibrator head quickly.

DO: Vibrate each lift thoroughly to move entrapped air out to the form face and then up to the surface. Look for leveling and embedment of large aggregates, for the formation of a thin film of mortar on the surface and for the air bubbles to stop escaping. Listen for the pitch of the vibrator to change; the frequency will drop off then become constant when the concrete is free of entrapped air.

DO: Use a high frequency 12,000-17,000 vpm (vibrations per minute), low amplitude vibrator to move entrapped air and mortar paste rather than aggregate.

DO: Use a vibrator head with a radius of influence at least 1.5x the tube radius. For example, for a 24" diameter column, use a vibrator with at least an 18" radius of influence. Otherwise, multiple insertions will be needed.

DO: Avoid contacting the form face with the vibrator head. Try to maintain a minimum 2" distance from the form face.

DO NOT: Strike the form externally, as this can cause unsightly blemishes in concrete shade/ appearance.

## **Concrete Mix:**

DO: Use a concrete mix with good workability that will flow smoothly yet avoid segregation of the ingredients.

DO NOT: Use too stiff or too sticky concrete mix as this will make it more difficult to liquefy the concrete and remove the entrapped air. A sticky mix (high cement, fine dust or fine sand content) requires more water for workability and therefore may be more susceptible to shrinkage cracking.

DO NOT: Use harsh mixes from too much or too little water, a deficiency of cement (lean) or a deficiency of fine aggregate as these will have poor workability and the ingredients may tend to separate.

DO: Use properly graded, uniformly shaped aggregate, with a minimum of fine aggregate

DO NOT: Use high slump, high water content concrete. Use admixtures, plasticizers or entrained air to improve workability instead of increasing water content.

## **Form Release Agents:**

DO: Ensure the form face is clean.

DO: Use a chemically reactive form release agent according to the release agent manufacturer's instructions.

DO: Apply a thin coat without excess or dripping. Excess release agent can trap air pockets to the form face.