

# **HAHN**

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## **READY MIX**

### **Vibration and Consolidation**

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An important step in almost every concrete pour, proper consolidation is critical to ensure voids and entrapped air pockets in the concrete are removed and proper adhesion to any rebar is achieved. Consolidation can limit bleed water and improve workability.

### **Types of Concrete Vibrators**

#### **Internal Vibrator**



Internal vibrators, or immersion vibrators, are inserted into plastic concrete to consolidate from the inside.

## **External Vibrator**



External vibrators are placed on forms to vibrate the surface and alleviate honeycombing or other voids from the form-facing surfaces.

## Surface Vibrator



Surface vibrating screeds such a laser screed, truss screed, or vibra-screed utilize vibration to consolidate the concrete as it is screeded and bring up cream to aid in workability.

## Proper Consolidation

While vibration is an important tool, it can also go very, very wrong. Here's some tips to make sure consolidation is done properly.

- 1) Never place or lay immersion vibrator in horizontally, be sure to insert it vertically.
- 2) Use the lowest effective frequency on all types of vibrators. Ignore the instructions from the immersion vibrator manufacturers that claim concrete consolidates best at 9000-10,000 vpm. 6000-8000 vpm is much better for the concrete. In addition, there are theories that the 1L cement doesn't respond positively to high frequency vibration and could potentially segregate.
- 3) Over-vibration is worse than under-vibration. Don't leave an immersion vibrator inserted for more than a couple seconds, and don't leave surface or external vibrators running for too long in the same place. Over-vibration can result in bugholes, mix segregation, loss of paste through gaps in formwork, and it can knock out the entrained air matrix, reducing the concrete's freeze-thaw durability.
- 4) Use immersion vibrators in even patterns and keep the head at least 2" away from any formwork.
- 5) Never use a vibrator "like an electric shovel" to move the concrete from one place to another.

## **An Exercise in Consolidation**

We replicated an experiment that had been done elsewhere to show the benefits and pitfalls of vibration in concrete. We formed up three 1'x1' cubes and laid them on a bed of sand. A 6" slump concrete was placed in the cubes to a uniform elevation. We have an immersion vibrator in our yard for pouring lego blocks that was used to introduce vibration. We later looked up this common high-cycle vibrator has a stated vpm of 14,000. The first cube (left) was not consolidated with the vibrator, we simply tamped the concrete a bit with a shovel. The second cube (center), was consolidated with minimal vibration. The vibrator was smoothly and vertically inserted into the middle of the cube and immediately withdrawn. The concrete was under vibration for less than 2 seconds. The third cube was vibrated in a manner more consistent with what is common to see on jobsites. The vibrator was inserted and pulled up and down around the center of the cube for about 5-6 seconds before being withdrawn.





As you can see, the first cube does not have a clean corner and the higher elevation of the concrete suggests air voids present throughout the concrete. There is also quite a bit of rough surface near the bottom of the cube.





The second cube, while not perfect, had a relatively smooth finish and good shape to match the formwork.



The final cube exhibited a significant amount of bugholes and honeycombing. Additionally, a great deal of paste was lost through the corners of our admittedly-not-expertly-built forms, resulting in a lower mass of concrete still in the forms and edges of the cube that were not uniform. By over-vibrating, we actually

introduced the voids we were hoping to eliminate. It's scary to note that much of the literature from the vibrator manufacturers will recommend 5-15 seconds of vibration with a high frequency. At a 6" slump, this is far too much.

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## Hahn Ready Mix

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