



A Guide to Eliminating Surface Voids in Concrete

Introduction

Surface voids (small holes, also known as bug holes or pitting) found on the surface of concrete castings have affected anyone who has ever cast concrete. Castings with a significant number of voids must be post finished or discarded, resulting in wasted product, time and labor. Understanding the causes of surface voids and what can be done to minimize them is the first step to a more efficient and productive casting operation.

The following information has been compiled through our experience with professionals who cast concrete for a living. Some of the tricks found here are results of many years of research and development. Although one may not find all the answers here, many of the common problems encountered when casting concrete will be addressed.

Question: *What are surface voids?*

Answer:

Surface voids are the cavities or little holes that appear on the surface of concrete castings. Surface voids (commonly known as pitting) are referred to as “bug holes” or “fish eyes”. These voids may produce an unacceptable appearance on the surface of the finished casting.

Question: *How are surface voids caused?*

Answer:

Surface voids are generally attributed to the following three factors: release agent, water or air (sometimes a combination of the three).

Question: *How does a release agent affect the surface of a concrete casting?*

Answer:

Release agents act as a “lubricant” between the mold and the concrete itself. The proper application of a release agent will yield castings

without surface voids. However, when a release agent is over applied, it may “pool” or “puddle” on the lower extremities of the mold. As the concrete is poured into the mold these pools prevent the concrete from filling in all the detail. When the casting is removed from the mold voids will be apparent in the areas where pooling occurred. Vibration magnifies this problem by forcing additional release agent into the lower extremities of the mold. Voids caused by too much release agent are recognizable as small spherical voids on the surface of the finished casting. These voids usually measure about 1/8” (.31 cm).

Question: *How does water cause surface voids?*

Answer:

Similar to release agents, water is also trapped against the mold’s working surface resulting in voids. As the concrete cures and the residual water evaporates, a cavity is left behind on the surface of the casting. Vibration also tends to force water from the cementitious material, however most voids caused by water are a result of a high water to cement ratio.

Question: *How does air cause surface voids on my finished concrete casting?*

Answer:

In most circumstances, air voids have an irregular shape and tend to be much larger (1/2” or 1.27 cm.) than those caused by water or release agents. The air voids are caused by air trapped between the mold surface and the concrete. They generally appear in low slump concrete and can be found underneath irregular (non-spherical) shaped pieces of crushed aggregate. This is a result of having too

little mortar to fill the spaces around the aggregate. Voids caused by air may also be found in castings that have severe undercuts.

How To Eliminate Voids In A Concrete Casting:

While many variables must be considered in the elimination of surface voids or bug holes in concrete castings, there are a number of precautions that can remedy this unsightly problem.

Careful preparation and methodical practices can eliminate even the worst of surface voids. The following section describes procedures and materials that will produce finished castings that even the most discerning eye will accept.

Question: *Will adding more mortar to the concrete assist in reducing surface voids?*

Answer:

Yes. Increasing the amount of mortar in the cementitious material will help make the material more fluid. A mixture that has a higher mortar content will assist in encapsulation of the aggregate. By encapsulating the aggregate, mortar also provides a chimney or venting system that will allow air and water bubbles to escape from the mixture. During vibration these bubbles will rise through the mortar and escape through the opening of your mold. A higher mortar content in your mixture also allows larger pieces of aggregate to easily move during vibration and thereby

release any air that may have been trapped.

Question: *What will happen to my casting if I use a larger aggregate?*

Answer:

Using a larger aggregate may cause more surface voids because air is entrapped under the irregular shapes of this material. There is also a larger volume of voids between larger aggregate pieces than smaller pieces. It is therefore recommended that a smaller aggregate be used or that a smaller aggregate be mixed with the larger particles. The smaller aggregate will act as a “roller system” to assist in turning the larger pieces of aggregate during vibration. It is recommended to use aggregate that passes through a number 50, 100 or 200 sieve.

Question: *Does the type of cement I use in my mixture make a difference?*

Answer:

Cement acts as a lubricant during vibration and allows larger pieces of aggregate to move around freely. Therefore it is recommended that a very fine cement be used to achieve a more fluid consistency. Fly ash, which is finer than cement particles, will increase the lubricity of the cement even further.

Question: *What precautions should I take if my concrete has a low water-cement ratio?*

Answer:

If the concrete you are casting has a low water-cement ratio, more mixing time will ensure that water and air bubbles are forced away from the aggregate and thereby eliminate the voids on the casting surface. Low water-cement ratio concrete also requires an increased vibration period.

Question: *I've heard that adding plasticizers to my concrete mixture will help eliminate surface voids. Is this true?*

Answer:

Yes. The addition of plasticizers are used effectively in creating large slump increases. The benefit of using a plasticizer is that these large increases can be attained without effecting the water-cement ratio. The result of increasing the slump will assist air, water and aggregate to move more freely throughout the mixture.

Although plasticizers will permit a large increase in slump, the concrete will begin to set much quicker. This means that there is a much smaller time period for the concrete to be vibrated. In order to eliminate surface voids from appearing we recommend using a release agent in tandem with plasticizers. The release agent will allow the concrete to move freely and force voids away from the surface of the casting.

Question: *What type of mold or form material should I use?*

Answer:

Form or mold surfaces be as smooth as possible to decrease the surface tension between the concrete and the mold.

Rubber molds are being used more and more for just this reason. The proper release used on a rubber mold will give the best possible surface.

Question: *I'm vibrating the concrete, but still have bug holes in the casting?*

Answer:

This occurs because air and water bubbles are the lightest elements of the concrete and will naturally flow to the most fluid portion of the mix. It just happens that this area is next to vibrator. So if you are using an external vibrator, the form or mold should be hammered. Hammering allows the mortar to flow toward the area being hit, consequently pushing air and water bubbles to the opening of your mold. This technique is recommended for molds with deep undercuts, where air and water bubbles tend to be predominate.

Question: *How beneficial are release agents?*

Answer:

Not only do release agents assist in eliminating surface voids, they also prolong the life of your mold. However, choosing the correct release agent and proper application are extremely critical. Various release agents will provide different surface finishes of your concrete casting. We recommend a chemically active release agent.

The amount of release that is applied to the mold or form will greatly effect the surface of your casting. Excess release agent tends to consolidate into spheres that cause bug holes. Too much release agent can be evidenced by voids on the

lower portions of your casting. Applying release agent in a thin coat will eliminate these voids.

Helpful Hints To Void Free Casting:

As any professional caster will tell you casting concrete is not an exact science. There are many variables and therefore no way to ensure void free castings. Voids can be minimized, however, and the following hints are offered to improve your chances for success.

Hint # 1

Extend the mix time to help break up any residual air or water bubbles. This will promote a more uniform and workable consistency.

Hint # 2

Make sure to that release agents are applied in thin films. This will eliminated any pooling or puddling in the lower portions of your mold.

Hint # 3

Lower the viscosity of cement by adding sand or fly ash. This allows large aggregate to move more freely and reduces the amount of air entrapment.

Hint # 4

Use aggregate that is more uniform in shape. Irregular shaped pieces of aggregate tend to make the concrete less fluid.

Hint # 5

Techniques used during vibration can eliminate most surface voids.

Vibrating both the outside and inside of your mold will draw most air and water bubbles away from the surface of the concrete. Hammering the mold can eliminate any residual voids.