

# DECORATIVE CONCRETE

## Tech Brief

### Mixing and Handling White Cement Concrete

#### Proportioning

For uniform color, white cement concrete mixes should be rich in cement, with a high fine-sand content and continuously graded coarse aggregate to promote a more uniform appearance. A high proportion of fine aggregate is recommended to reduce color variation. Because the sand acts like a pigment in the mix, its color is important. White or light-colored sands give the best results for bright white concrete or pastel finishes. If natural sands are not available or are not the right color, manufactured sands are a good alternative.

A fresh mixture having a slump of about 100 mm (4 in.) works well for many projects. Admixtures, including water reducers and air-entraining chemicals, can provide added workability. Regardless of temperature fluctuations or other changing weather conditions, proportions for white and colored concrete should be held constant. Modifying the concrete mixture by changing materials, proportions, or construction procedures could lead to color differences.



**Figure 1. Proportioning white cement concrete mixtures involves making sample batches. If highly sanded mixes are utilized, a slight increase in mixing time will help ensure adequate dispersion of fine materials. (70146)**

#### Batching

Measuring ingredients accurately and consistently is essential in order to produce white or colored concrete of uniform quality and color from batch to batch. White cement should be stored separately from gray cement. If layout of the mixing facility permits, a dedicated silo prevents contamination from other materials. Soft-sided bulk bags may be available for the handling of bulk white cement. For smaller operations or for intermittent projects, standard-sized bags of 42 kg or 94 lb (40 kg in Canada) can be added directly to a ready-mix truck.

No foreign materials should contaminate the concrete. Batching all ingredients into clean trucks permits mixing white concrete directly in a transit mixer.

For truck mixing to be effective, all sources of water must be strictly controlled and batch-to-batch variations in water content should be avoided. To start with, the aggregates should have a reasonably uniform moisture content throughout the stockpile. In addition, the water-dispensing device must be accurate. It should be calibrated periodically.



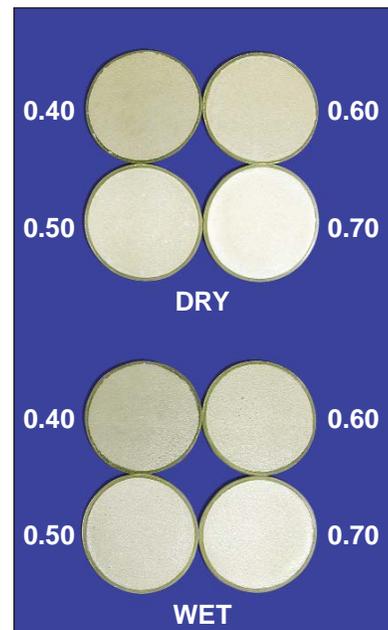
**Figure 2. Bagged materials like white cement or dry pigment can be added directly into the drum of a mixing truck. (67963)**

The importance of controlling water content cannot be overstated. Variations in water (or cement) content can affect the color of concrete (see Figure 3). A low water-cement ratio paste is almost always darker than a high water-cement ratio paste made with the same cement.

#### Mixing

Clean equipment in good condition should be used to mix white cement concrete. All contaminants must be prevented, including oil, grease, and dirt, and unless a truck mixer will be used exclusively for white or colored concrete, extra care should be taken to remove all loose gray cement concrete that may be in the mixer drum. For small projects, mobile batchers can be used.

Overall, mixing white concrete is like mixing any other concrete. Generally, the coarse aggregate is added first, along with part of the mix water. This is followed by cement, sand, pigment (if any), and more water. Some of the water can be held back to adjust the batch toward the end of



**Figure 3. Mortar color is largely determined by the color of cement and sand, but different water-cement ratios and surface conditions (wet/dry) cause variations in the shade. (70102)**

mixing. Admixtures can be added along with the mixing water. If more than one admixture is used, check with the supplier to make certain they are compatible.

To achieve uniform blending, slightly longer mixing times may be required, especially if using water-resistant white cement. The mixing time must be sufficient to obtain a uniform dispersion of the cement throughout the mixture. There are several reasons why this is important. Dispersion affects color. Higher-than-normal cement contents require longer-than-typical mixing times. Furthermore, white cements are ground slightly finer than common gray portland cements. The finer size of the particles means that rigorous mixing—by slightly extending the mixing time—is needed to blend the cement with the other ingredients. Mixing time from batch to batch should be constant. Variable mixing might cause different degrees of dispersion, especially if pigments are being used, and could lead to different shades of color. Thorough mixing is particularly important when the colors of the sand and cement are different. If streaking is a problem, dry cement and pigment should be thoroughly blended before adding them to the mix.

## Placing

White and colored concrete should be placed with care. Fresh concrete should be deposited into forms as close as possible to its final position. In addition to making the most efficient use of mechanical equipment, this approach to handling fresh concrete minimizes segregation and leads to the most uniform surface appearance.

Moderate slump concretes promote uniform aggregate distribution. Overly wet mixtures with high slumps are not suggested for most concrete projects, especially architectural jobs where appearance is an important aspect. Wet mixtures will delay, rather than speed up, placing procedures. For vertical applications, pressure on the forms will be higher; for horizontal applications, finishing operations must be delayed until the concrete is able to support equipment and workers.

In general, concrete should be placed in uniform horizontal layers, each lift being about 150 mm to 500 mm (6 in. to 20 in.) in depth for reinforced members. Both the width between forms and the amount of reinforcement influence the layer depth. One layer should be thoroughly consolidated before the next layer is placed. Progressing this way prevents segregation and sloping lift lines. With care, it is possible to prevent concrete splatter. If fresh concrete is dropped from a great height, or if it is too wet, mortar may splash the forms or reinforcement. Dried mortar that adheres to bars may lead to a poorer bond, and dried mortar that sticks to forms can create uneven or blemished surfaces. A moderate slump mixture decreases the possibility of splashing mortar. A hopper with an elephant trunk (a canvas or plastic chute) can be used to guide the concrete into place without splatter or segregation. Internal vibrators must not come in contact with the face of the forms. Vibrators should be kept at least 75 mm (3 in.) away from the face, especially if the concrete is to have an exposed aggregate finish.

## Special Considerations Regarding Surface Appearance

Gap-graded aggregate helps increase the uniformity of exposed-aggregate surfaces leading to an improved appearance. Bugholes are small rounded cavities that result from air trapped at the form surface during placement. If they are prominent, one way to inhibit them is to reduce the proportion of sand. Lower sand contents can, however, reduce the uniformity of the surface color and texture. It is therefore necessary to decide which potential blemish is of less concern. Gap-graded aggregates that don't contain coarser particles of sand and finer particles of coarse aggregate can produce a surface free from bugholes, but may also allow greater color variation and some aggregate transparency (dark shadows reflected through to the surface). Experimenting with different proportions will help determine the optimum blend of materials. The selection of cement and fine sand contents also must take into account mixture economy and the tendency for crazing.

Combining proper placing techniques with suitable form materials and release agents also makes bugholes less noticeable in size and in number.

Curing has an effect on the relative lightness or darkness of the surface. Adequate moist curing promotes good durability and even color, and should be given proper attention.

Go to [www.portcement.org/white](http://www.portcement.org/white) for additional resources related to white cement concrete.

**WARNING:** Contact with wet (unhardened) concrete, mortar, cement, or cement mixtures can cause SKIN IRRITATION, SEVERE CHEMICAL BURNS (THIRD DEGREE), or SERIOUS EYE DAMAGE. Frequent exposure may be associated with irritant and/or allergic contact dermatitis. Wear waterproof gloves, a long-sleeved shirt, full-length trousers, and proper eye protection when working with these materials. If you have to stand in wet concrete, use waterproof boots that are high enough to keep concrete from flowing into them. Wash wet concrete, mortar, cement, or cement mixtures from your skin immediately. Flush eyes with clean water immediately after contact. Indirect contact through clothing can be as serious as direct contact, so promptly rinse out wet concrete, mortar, cement, or cement mixtures from clothing. Seek immediate medical attention if you have persistent or severe discomfort.

### PORTLAND CEMENT ASSOCIATION

5420 Old Orchard Road  
Skokie, Illinois 60077-1083 USA

Voice: 847.966.6200

Fax: 847.966.9781

Internet: [www.portcement.org](http://www.portcement.org)

**An organization of cement companies to improve and extend the uses of portland cement and concrete through market development, engineering, research, education, and public affairs work.**

This publication is intended SOLELY for use by PROFESSIONAL PERSONNEL who are competent to evaluate the significance and limitations of the information provided herein, and who will accept total responsibility for the application of this information. The Portland Cement Association DISCLAIMS any and all RESPONSIBILITY and LIABILITY for the accuracy of and the application of the information contained in this publication to the full extent permitted by law.