

ACI 310R-19

# Guide to Decorative Concrete

Reported by Joint ACI-ASCC Committee 310



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## Guide to Decorative Concrete

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# Guide to Decorative Concrete

Reported by ACI Joint ACI-ASCC Committee 310

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*This guide describes techniques for imparting aesthetic finishes to concrete flatwork, of which many can be combined for unique effects. The owner and architect/engineer will acquire detailed, practical guidance for achieving aesthetic effects using proven techniques. Recommendations are made for the production of cast-in-place decorative concrete flatwork, decorative stains, and overlays. In addition to attention to the specified materials, mixture designs, concrete placement, curing, protection, sealing, and other treatments, this guide also considers the effects of these treatments on the overall aesthetics of the project.*

Keywords: cementitious overlays; dry-shake hardeners and release agents; embossing; engraving; etching; inlays; polishing; stains; stamping; tooling.

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## CHAPTER 1—INTRODUCTION AND SCOPE

### 1.1—Introduction

Decorative concrete has been in existence since approximately 70 A.D., when concrete was used for defining affluent or important areas of living space in communal cultures (ConcreteNetwork.com 2019). Early examples of this type of adornment are the streets and paving throughout the city of Pompeii near Naples, Italy. Early decorative concrete used colored aggregates and varying shapes or natural materials embedded in concrete paving.

Traditionally, concrete has been specified more for its functional characteristics than as an enhancement to the aesthetics. Landscape architects were leaders in using concrete flatwork to enhance the visual appeal of hardscapes. Using color and texture introduced concrete as a landscape feature in addition to its functionality. An example is flatwork textured and colored to replicate the look of slate, brick, or natural stone, as shown in Fig. 1.1a and 1.1b.

The use of decorative concrete has been well received and considered as an alternative to other building materials for durable, versatile, and economical finishes. Designers are creating greater aesthetic appeal in projects by using one or more combinations of special concrete placement techniques, including integral concrete colors, color hard-



Fig. 1.1a—Stamped, colored concrete with slate and brick patterns in landscape setting (courtesy of Decorative Concrete Resources).



Fig. 1.1b—Concrete slab enhances design aesthetic with mimic of stone slab (courtesy of L. M. Scofield Company).

eners, chemical stains, pigments and dyes, surface texturing, jointing, exposed aggregate, surface embossing, polishing, and the use of sealants and coatings. The combinations of techniques and mediums described in this guide are exclusive; they cannot be replicated by any other durable medium.

### 1.2—Scope

This guide describes several techniques for imparting aesthetic finishes to concrete, many of which can be combined for unique effects (Fig. 1.2a and 1.2b). The guide provides detailed practical guidance for achieving aesthetic effects

using proven techniques, both within and beyond the context of **ACI 302.1R**, which also governs these concrete elements.

Recommendations for the production of cast-in-place decorative concrete, stains, and overlays are presented. In addition to attention to specified materials, mixture proportions, concrete placement, curing, protection, sealing, and other treatments, consideration of the effects of these treatments on the overall aesthetics of the structure is also addressed.

## CHAPTER 2—DEFINITIONS

Please refer to the latest version of “ACI Concrete Terminology” for a comprehensive list of definitions. Definitions provided herein complement that resource.

**color hardener**—similar to traditional one-component hardeners, having additional constituent materials formulated to color the concrete surface.

**concrete dye**—colorant for concrete that is applied to the concrete while it is in solution and results in a stained appearance; concrete dyes do not produce color via chemical reaction.



Fig. 1.2a—Cast-in-place decorative concrete combining treatments during and post placement to achieve aesthetic effects (courtesy of Concrete Mystique Engraving).

**crack chaser**—rotary tool using a v-shaped diamond blade to enlarge cracks in concrete to facilitate repair.

**decorative aggregate**—specially selected aggregates chosen for their artistic contribution to the project; examples of materials used as decorative aggregate include colored stone, intrinsically valuable gathered stone, semiprecious stone, or colored glass.

**decorative overlay**—mixture of cementitious materials installed over an existing concrete substrate.

**densifier**—combination of silicate and water-based compounds that react in the surface of the concrete to produce additional calcium silicate hydrate (C-S-H).

**embossing**—creating a raised print or reverse replication of an object in the concrete surface.

**engraving**—cutting with a mechanical rotary or impact tool to texture a concrete surface.

**etch**—textured surface produced by cutting with a mechanical impact tool or by chemical etching by use of acid.

**grinding**—intentional removal of a visually apparent amount of the surface paste to create a profile on the surface.

**integral color**—iron oxide pigments that are added to the concrete during the mixing process to change the color of the paste.

**microtopping**—bonded decorative overlay usually 1/8 to 3/16 in. (3 to 5 mm) in thickness.

**needle scaler**—reciprocal impact tool that uses single or multiple thin rods to strike a surface.

**polished concrete**—post-placement architectural finish or texturing technique where concrete undergoes sequential mechanical abrasion resulting in full surface refinement.

**polished overlay**—bonded decorative overlay 3/8 to 1 in. (10 to 25 mm) in depth cast over an existing concrete substrate designed to accept diamond abrading for a polished concrete appearance.

**reactive stain**—reactive solution of one or more metal salts stabilized by acid that produce coloration in a concrete substrate by neutralization of acid followed by precipitation of metal hydroxides or oxides.



Fig. 1.2b—Decorative concrete applications such as post placement colorants can complement the overall aesthetic of a project (courtesy of PROSOLO).

**stain (v)**—use of a chemical stain or a concrete dye to change the color of the concrete surface that can be a penetrant or a low-build coating that does not appreciably change the concrete's texture.

**stamping**—process of applying a surface pattern to decorative concrete by using impact pressure to emboss texture, patterns, or faux joints into the surface of plastic concrete.

**stencil patterned concrete**—texture created by use of preprinted pattern stencils or freeform using alternate texturing materials.

**surface release agent**—temporary powder or liquid, usually pigmented, that is applied to plastic concrete surface immediately prior to imprinting or texturing that performs as a bond breaker between texturing tools and the concrete surface.

**surface split**—separation in the paste usually 0.005 to 0.060 in. (0.13 to 1.52 mm) wide and less than 1 in. (25 mm) in length appearing on top surface, which is normally near a joint or corner of imprinted surface.

**weeding**—process of removing portions of a stencil to allow decorative treatment or protection of specific areas to produce a desired pattern of contrasting color and or texture.

## CHAPTER 3—GENERAL AND DESIGN CONSIDERATIONS

### 3.1—General

Decorative concrete is a durable building media providing artistic choices and flexibility for the designer. Combinations of techniques (Fig. 3.1) offer variations for adaptability and sustainability unmatched by other building materials.

### 3.2—Process development

Although concrete is one of the most popular and versatile construction materials, it has not always been known for its beauty. Creative and technical improvements in the concrete industry have resulted in better-quality concrete and led to techniques that allow the contractor to manipulate concrete to resemble other building materials such as brick, slate, marble, granite, or other decorative stone. These techniques have been used to produce unique visual effects not possible with other materials. Aesthetic effects can be added to concrete so that it combines with the structural landscape to create a landscape that meets the aesthetic requirements of the owners and architects. As more color palettes, texturing systems, and post-placement processes become available, more owners are considering the addition of decorative concrete elements to their projects (Fig. 3.1).

Decorative concrete is subject to cracking and scaling common to all concrete construction when proper construction and maintenance procedures are not followed. Properly designed concrete mixtures and joints and proper installation procedures will mitigate many unwanted imperfections. Feature strips incorporated into a design can help avoid mismatched patterns and break up pattern fields into easily managed areas. Contractors installing decorative concrete should be experienced and possess the expert knowledge and skills necessary to work with it. Requiring contractors to use



*Fig. 3.1—Decorative concrete used to create visual effects not possible with other materials (courtesy of L. M. Scofield Company).*

ACI-certified flatwork finishers and or decorative flatwork finishers should ensure that the quality is consistently high.

**3.2.1 Communication**—A critical element among all participants of a project is to ensure the design intent of the owner, architect/engineer, or both, is achieved. Job-site meetings and mockups are helpful and allow those involved to share information and discuss their expectations, limitations, questions, and concerns (Fig. 3.2.1).

Some designers/engineers incorporate decorative designs and coloration into the structure; care should be taken to ensure tolerance requirements for the structural installation are consistent with those of the final decorative finishes. Where multiple contractors are responsible for end results of two distinctly different building mediums, tolerance incompatibility between phases of the work will dictate additional work or preparation by one of the contractors. Although similar materials and trades are needed to install the concrete, different levels of knowledge, care, and planning are required. Issues that arise that can compromise achieving the intended design should be addressed with the owner and architect/engineer and those involved, and an alternate solution or plan formulated.

**3.2.2 Sample panels**—Just as historical data and trial batches demonstrate a material supplier's ability to produce concrete suitable for a given project, sample panels demonstrate a contractor's ability to produce the required decorative effects. Sample panels are typically small enough to be portable and are often used as a tangible exhibit of a contractor's work.