



GUIDE FOR SPECIFYING WHITE AND COLORED CONCRETE

This Guide Recommendation is intended to supplement the material specifications available from publishers of references where white cement is being used for white and/or colored concrete. This Guide can aid in the development of a master specification and/or in the preparation of actual project specifications. In either case, this Guide must be edited to fit the conditions of use.

Particular attention should be given to the deletion of inapplicable provisions. Necessary items related to a particular project should be included. Also, appropriate requirements should be added where blank spaces have been provided. Coordinate the specifications with the information shown on the contract drawings to avoid duplication. A comprehensive discussion relative to white and colored concrete can be found in *White Cement Concrete* (EB217), the Portland Cement Association's technical handbook on this subject.

References available from:

ACI: American Concrete Institute

APA: Architectural Precast Association

ASCC/DCC: Decorative Concrete Council

Cast Stone: Cast Stone Institute

CSI: Construction Specifications Institute

DCN: Decorative Concrete Network

NCMA: National Concrete Masonry Association

NTMA: National Terrazzo and Mosaic Association

PCA: Portland Cement Association

PCI: Precast/Prestressed Concrete Institute

(See Notes to Specifiers, Part 1 on the next page for contact information.)



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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.

Guide Specification:

PART 1—GENERAL

Section Includes: This section shall apply to all architectural concrete finishes, decorative paving, and architectural precast indicated on the plans.

REFERENCES: The following may apply.

ACI 301-99	<i>Specifications for Structural Concrete</i>
ACI 302.1R-96	<i>Guide for Concrete Floor and Slab Construction</i>
ACI 303-91	<i>Guide to Cast-in-Place Architectural Concrete Practice</i>
ACI 304R-00	<i>Guide for Measuring, Mixing, Transporting, and Placing Concrete</i>
ACI 308-92	<i>Practice for Curing Concrete</i>
ACI 318-99	<i>Building Code Requirements for Structural Concrete and Commentary</i>
ACI 347R-94	<i>Guide to Formwork for Concrete</i>
ACI 533R-00	<i>Guide for Precast Concrete Wall Panels</i>

QUALITY ASSURANCE: A 'Design Reference Standard and Field' sample (mockup) shall be constructed to establish that proposed materials and construction techniques provide the visual effect desired. Construct a mockup at least 28 days in advance of the start of concrete work to allow sufficient curing time before final inspection. Use the same materials and placing and finishing techniques that will be used for the project. The approved panel shall constitute an example of minimum workmanship for all work specified under the section. If the mockup is not approved, additional mockups shall be made until approval is obtained. The approved sample shall be kept at the jobsite for comparison with the finished work. Make a test patch to establish patch proportions and installation methods.

PART 2—PRODUCTS

MATERIALS: Concrete shall comply with the appropriate ACI design and construction practices. For ready mixed concrete, ASTM C 94, *Specification for Ready Mixed Concrete*, shall be followed. Each material must be from a single source, and consistently proportioned per ACI mix design methods.

Cement: Cement shall comply with ASTM C 150 Type ___ (I, II, III, V) white portland cement.

Notes to Specifiers:

PART 1—GENERAL

Section Includes: The Web sites referenced on the cover list trade associations that have specifications and/or design recommendations that can be used directly with project specifications.

ACI:	www.aci-int.org/
APA:	www.archprecast.org
ASCC/DCC:	www.decorativeconcretecouncil.org/
Cast Stone:	www.caststone.org
CSI:	www.csi.org
DCN:	www.decorative-concrete.net/
NCMA:	www.ncma.org
NTMA:	www.ntma.com
PCA:	www.portcement.org
PCI:	www.pci.org

QUALITY ASSURANCE: As part of the mockup construction, it is necessary to submit materials and material specifications for color approval. These materials include: aggregates, pigments, mix designs (especially water and cement contents), chemical admixtures, and other materials that can affect concrete color, such as curing compounds, formwork material, or sealers.

Proportions for the patch should be chosen for the best color. It may be necessary to use part white cement and part gray cement to formulate the patch. Patches generally contain cement, fine aggregate, and water, but may have coarse aggregate pressed into the surface to match exposed aggregate textures. Pigments are optional.

PART 2—PRODUCTS

MATERIALS: Ingredients for making architectural concrete may be stockpiled at the ready mix plant. If there is adequate storage space, obtain enough of each material to complete the project. While this helps to minimize color variations during the project, it should be understood by all parties that concrete normally has color variations inherent in the material.

Cement: White cement, white cement with color pigment and/or a mixture of white and gray cements can be specified to provide a color of choice. White portland cement has less color variation than gray portland cement. Both are made from similar ingredients, but the white cement raw materials are closely monitored for minerals that impart the usual color to gray portland cement. Since there is no ASTM specification specifically for white cements, a limit on the iron oxide (Fe₂O₃) content may be appropriate. A maximum of 0.50 % has been used with good results. ASTM C 150 Types I and III white cements are commonly available.

Guide Specification:

PART 2—PRODUCTS (continued)

Aggregates: Aggregates shall comply with ASTM C 33, *Concrete Aggregates* or C 330, *Lightweight Aggregates for Structural Concrete*, and shall be free from staining impurities, dirt, other contaminants, and frost or ice.

Admixtures: Admixtures shall comply with:

ASTM C 260, *Specification for Air-Entraining Admixtures for Concrete*

ASTM C 494, *Specification for Chemical Admixtures for Concrete*

ASTM C 979, *Pigments for Integrally Colored Concrete*

ASTM C 1017, *Chemical Admixtures for Use in Producing Flowing Concrete*

Water: Water shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, metals and other potential staining impurities that may impact color.

Reinforcement: Reinforcement supports, other embedded items, and form ties shall be made of plastic or other non-corroding materials to prevent rust stains.

Curing compound: Curing compound shall be of the type specifically recommended for white or colored concrete as manufactured by _____.

Sealer: Sealer shall be a clear or color-matched, non-yellowing, color stable sealer as manufactured by _____.

ACCESSORIES

Form Materials: Forms shall be clean and free from all extraneous substances. Use non-porous form material unless otherwise specified or permitted. Joints shall be watertight to prevent discoloration resulting from leakage from forms.

Release Agent: Use a non-staining, chemically active release agent.

Notes to Specifiers:

PART 2—PRODUCTS (continued)

Aggregates: Aggregates that have been shown by actual service or special test (non-staining) to produce concrete of adequate properties and appearance should be allowed. Specify if aggregates should be natural or manufactured. Aggregate color: coarse aggregate might exhibit aggregate transparency or ghosting, which is a shadowing effect of a darker colored aggregate to the concrete surface. Choose white or light colored coarse aggregates to avoid aggregate transparency. Fine aggregate has an effect on the color of the mix, somewhat like a pigment. Anything that wears away cement paste at the concrete surface (sandblasting, acid rain, etc.) will expose more fine aggregate and will bring out its color.

Admixtures: Concrete shall be air-entrained if freeze/thaw durability is a potential concern. ACI 301 Section 4 and ACI 318 Chapter 4 provide guidance on air contents for various intended exposures.

Chemical admixtures should be evaluated for their effect on color control of the concrete as some chemical admixtures have agents that can cause surface discolorations. It is recommended to check with the admixture supplier regarding use. Do not use calcium chloride (CaCl₂) as it can affect color and set consistency.

Pigments should be limited to a maximum dosage of 10% by mass of cement, as recommended by ASTM C 979 Section 1.4.

Water: Almost any potable water is satisfactory for concrete; however, there are metal and other impurities that can affect the color of architectural concretes. These water sources should not be allowed. ACI 301 Section 4 and ACI 318 Chapter 3 have guidelines covering water.

Reinforcement: If form ties or reinforcement supports will be exposed at the concrete surface, they should be color-matched to the cement matrix to conceal their appearance. Plastic ties are available in many colors. Non-metallic ties can be cut off flush with the concrete surface, require no patching, and are nearly imperceptible in an exposed aggregate surface.

Curing compound: Some curing compounds will impart a temporary color to the concrete surface but will fade with time and exposure to sunlight and air. Check with the manufacturer.

Sealer: Sealers are recommended to preserve the concrete surface. Penetrating formulations allow the concrete to breathe. Some will make the surface appear glossy and others will not. Choose sealers with the desired sheen.

ACCESSORIES

Form Materials: ACI 303 Section 4, ACI 304 Chapter 6 and ACI 347 Chapter 4 discuss the selection and use of forming materials. The use of steel, high density overlaid plywood, or approved form liners are recommended per ACI 347 Chapter 5.

Release Agent: Heavy coatings of release agents are not required or recommended. A light, even coating will produce a surface with the best overall appearance.

Guide Specification:

PART 3—EXECUTION

ERECTION

Placement of Concrete: Throughout the job, all mixing and placing equipment shall be kept free from oil, grease, rust, and dirt to prevent color contamination of the concrete. Use a consistent water-cement ratio (w/c). If greater workability (slump) is required, use only pre-approved water-reducing and/or plasticizing admixtures that comply with ASTM C 494 or ASTM C 1017. Do not overvibrate.

CONSTRUCTION

Finishing: The use of metal tools on white or light-colored concrete should be avoided. Do not fog this concrete with water and/or add water with tools or brooms.

Curing: Do not cure with water or with plastic sheets unless otherwise specified or permitted.

Formwork Removal: Remove formwork at consistent concrete age to minimize color differences. Remove forms in accordance with ACI 347.

Finishing Formed Surfaces: Specify the method of finishing; off the form, sandblasting, high-pressure water jet, or other. For exposed aggregate, specify the depth of reveal of the coarse aggregate.

Patching: Install patches having the same proportions as the approved test patch. Cure the patches thoroughly.

PROTECTION

Sealer (Optional): After the concrete is allowed to dry, curing compound shall be applied to the surface according to manufacturer's directions.

Notes to Specifiers:

PART 3—EXECUTION

ERECTION

Placement of Concrete: ACI 303 and ACI 304 review mixing, transporting, and placement of architectural concretes. Control of the w/c during placement is very important for color consistency. Vibration needs to be properly performed so as to not affect surface texture and consistency.

CONSTRUCTION

Finishing: Concrete finishing is as much an art as a science, therefore a skilled, experienced installer should be used. There are wood and plastic finishing tools that can be used to minimize the effect of metal trowels on the concrete surface. Chapter 8 of ACI 302 on floors and slabs and ACI 304 Section 6.3 should be referenced for general finishing requirements and procedures.

Curing: ACI 308 has additional notes to the Architect/Engineer.

Formwork Removal: Remove formwork carefully to prevent damage to edges and corners, which are vulnerable to chipping at early ages.

Finishing Formed Surfaces: Tool and finish concrete surfaces at a consistent concrete age to minimize color differences and to allow similar tooling efforts.

Patching: Patches should have low water-cement ratios and a stiff, dry consistency to minimize shrinkage. Curing is especially important for dry concrete mixtures.

PROTECTION

Sealer (Optional): Prepare and condition the concrete surface per sealer manufacturer's instructions. Protect adjacent area (windows, landscaping, etc.) from overspray.

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.

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