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Learning Objectives

Upon completing this program, the participant should be able to:

1. Understand the four key factors affecting color in concrete and how to control them.
2. Understand the importance of pre pour planning and material selection
3. Identify the most common issues impacting decorative concrete flatwork
4. Identify and understand the importance of sealers and how they impact decorative concrete flatwork.

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Agenda

- Managing Expectations
- ACI Standards
- Pre-Placement Planning
- Subbase
- Mix Design
- Placement
- Finish
- Cure
- Sealer
- Maintenance



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It's OUR Responsibility to keep it Profitable!



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Handling Problems
in the Field

You are in the wrong business if
you think you are immune to
problems!

Consider all the variables you
deal with on a typical
decorative project

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Question ?

What is the first thing
you do when you have a
problem?

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Avoid Making it Worse



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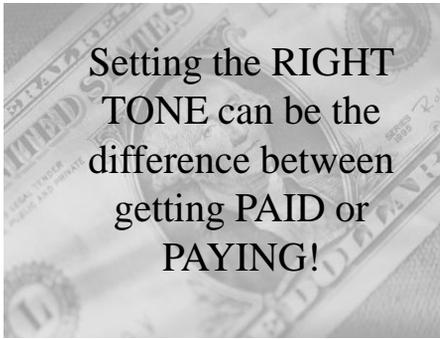
Problem Management

Poorly thought out solutions, can turn a small problem into a major issue.



Always test in an inconspicuous area.

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Customer Feedback Study
How Important is Price and Quality Work?

Satisfactory Work = Tell No One

Superior Work = Tell One Person

Poor Work = Tell Eight People

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Managing Expectations

- Communicating the Process
- Contracts
- On Site Samples
- Experience
- Brag Book and Testimonials



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Project Expectations



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ACI Decorative Flatwork Finisher and Associate Certification



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Reference and Study Materials



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Pre-Placement Planning

1. Safety
2. Layout
3. Soils and Subgrade
4. Forming, Reinforcement, and joint considerations
5. Materials and Systems
6. Team

Follow ACI Guidelines



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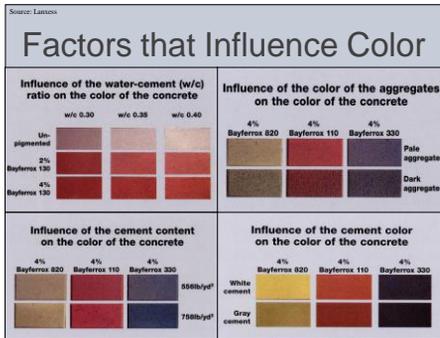
Mix Design

- The concrete mix depends on the decorative application
- Things to consider:
 - Maximum aggregate size needed
 - Type of portland cement (I to V), though many ready-mix companies offer limited types and type I-II cover most applications.
 - The addition of secondary cementitious materials (SCM) such as fly ash or slag
 - Percentage of air-entrainment needed
 - Concrete Slump and "placing slump"
 - The addition of admixtures such as superplasticizers, water reducers, or shrinkage reducing admixtures
 - The type and amount of fibers, if specified or needed.

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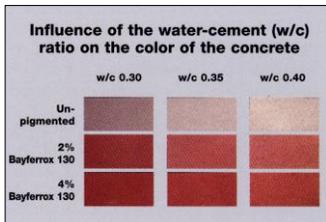


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Water to Cement Ratio (W/C)
More Water = Lighter Color



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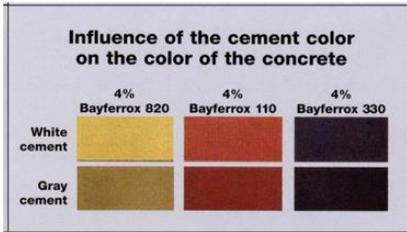
High Water Content in the Mix or On the Surface Dilutes Color



*W/C discoloration is permanent. Tinted sealer or stain is required.

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Cement has Color and Impacts the Overall Appearance.



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Cement Color Differences

Switched ready mix company's mid project. Same color supplier, identical pigment, identical loading, DIFFERENT COLORS!

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#1 Complaint Inconsistent Color



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Aggregate Color



- Dark vs Light stone
- Small vs Large stone
- Mix with high sand content have greater color effect

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Exposed Aggregate

Aggregate type and color impacts the final appearance.



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Exposed Aggregate Post Cleaning Creates a White Haze



Power washing to remove surface paste



White haze once surface dries



Acidic cleaner to remove the white haze before sealing

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Sealing Exposed Aggregate

- Penetrating Sealer
- Film Forming Sealer

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Under-exposed Aggregate Finish Acid or Mechanical Repair



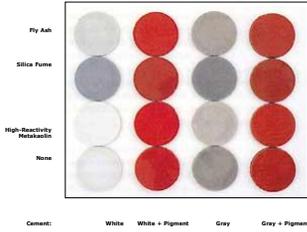
Under exposed aggregate repairs. Sandblasting concrete away to expose the aggregate beneath it converts a mess into a masterpiece!



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Effect of Pozzolans on Color

Suggested 10% - 20% max loading



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Mix Design

Best Practice

- Generally speaking, it's best to order concrete by the desired compressive strength.
- ACI recommends minimum strengths of 4500 psi with w/c ratios of 0.45 for freeze-thaw climates, 3000 psi strength concrete for warmer climates (sulfate conditions may require lower w/c ratios), or structural engineer ordered higher strengths due to loading requirements.
- Calcium chloride can effect the color of concrete and shouldn't be used for decorative work.
- Most modern mix designs contain some type of admixture. Shrinkage reducer, water reducer, plasticizer are most common.

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Admixtures by Classification			
Type of Admixture	Material	Desired Effect	Effect on Color
Air Entraining (ASTM C260)	Salts of wood resins Some synthetic detergents Salts of sulfonated lignin Salts of petroleum acids Salts of proteinaceous material Fatty and resinous acids and their salts Alkybenzene sulfonates	Improved durability	Normally makes color lighter
Plasticizer (ASTM C494, Type A)	Lignosulfonates Hydroxylated carboxylic acids (also tend to retard set, so accelerator is added)	Reduce water required for given consistency	Initially darker; reduced color effect in later stages
Accelerator (ASTM C494, Type C)	Calcium Chloride (ASTM D59) Triethanolamine	Accelerate setting & early strength development	Darker color
Pozzolan (ASTM C618)	Natural Pozzolans (Class N) Fly Ash (Class F and G) Other materials (Class S)	Reduce costs; improved workability and plasticity	Typically lightens but may darken due to plasticizing effect; inherent color affects final color also.
Water Repellent	Stearate of calcium, aluminum, zinc, or lead Petroleum greases or oils Silicate chlorides	Decrease permeability	Possibly darkens color

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Mix Design

Integrally Colored Concrete

- Natural or synthetic iron oxide pigments
- They can be granular, powdered or liquid products
- They are all added during mixing operations
- Carbon black pigments aren't color-fast and reduce the effect of air-entraining admixtures.
- Carbon black is the highest in tint strength and the cheapest. But it fades if not sealed against water penetration.
- Chrome Green and Cobalt Blue are available, but very expensive.

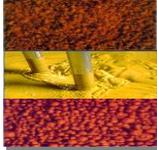
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Pigments for Concrete

Synthetic or Natural

- Iron Oxide, Carbon Black, Chrome Green, Cobalt Blue

- Powder
- Liquid
- Granular



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Automated Color Dosing System

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Pigment Loading

- Dosed as a % of cement content. (includes cement and SCM)
- Percent and pounds are interchangeable
- Multiply dosage rate X cement content



2 lb. loading x 5 sack per yard
= 10 lb. per yard

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Integrally Colored Concrete

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Mix Design

Surface Dry Shake Color (Color Hardener)

- Best products are made with pigments, gray or white cement, graded fine aggregates, and water reducing admixture wetting agents.
- They are bagged products that are broadcast onto the surface of fresh concrete and floated in.
- The color layer is usually 1/8 to 3/16 inches thick
- The color is more intense than integral finishes
- They offer a much wider range of colors
- They densify the surface and make it much harder
- Surfaces are less permeable and more abrasion resistant.
- The added paste on the surface helps produce sharper more defined imprints
- They cost less than integral, especially for slabs thicker than 4 inches

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Shake On Color Hardener

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Placement



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Placement

ACI Guidelines and Key Considerations

- Timing and Environment
- Proper Tools
- Screed
- Float
- Edge
- Trowel



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Finish

The decorative technique will dictate the type and level of finishing needed.

- Float Finish
- Trowel Finish



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Curing

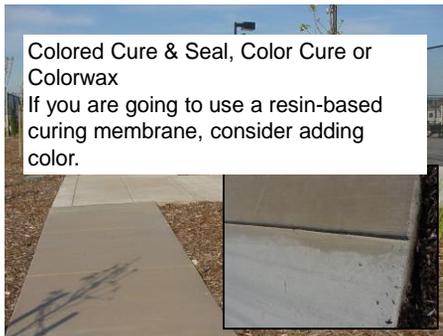
Curing Concrete not only promotes better strength and durability but provides the best color intensity and longevity

Types of Curing for Decorative Flatwork

- Colored Curing Compound
- Cure and Seal - clear or colored
- Fabric or Mat
- Wet Cure



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Curing Mats are best used on smooth surfaces. Overlay all edges and avoid any air bubbles or wrinkles.



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Salt Residue from Plastic Sheet Cure

Mechanical Surface Removal

Diamond grinding to remove surface contamination

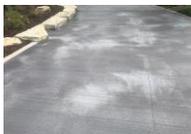


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Common Colored Concrete Curing Issues



Non Breathable Membrane placed over fresh concrete trapped moisture creating spotting or "leopard" pattern.



Inconsistent Application of curing compound or cure and seal



Over application of curing compound or cure and seal

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Sealing

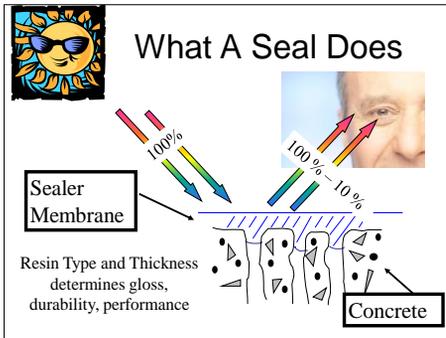
Sealing Decorative Flatwork is arguably the most important factor impacting color longevity.

Key Factors:

- Sealer Selection
- Application
- Maintenance



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Clear Sealer

Clear film forming sealers can change and enhance the color dramatically



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Less is More When it Comes to Exterior Sealer Solids
Higher Solids Increases Potential for Problems

1. High Build = Weakness
2. Less Breath Ability
3. Traps Moisture
4. Rigid and Brittle

The perception and desire for a "WET LOOK" by applying thick coats of acrylic sealer is contrary to what these sealers are designed to do! Two thin coats, and let the sealer resin provide the level of gloss.

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Spray and Back Roll



Solvent Based Sealer Application Methods



Roller

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Spray and Back Roll



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Maintenance

Sealer maintenance is not well understood and is important to long term color and concrete performance with decorative applications.



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Reseal when needed, not by the calendar



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Aged Colored Concrete
Before



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Colored Sealer
After



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Repair with Tinted Sealers



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Applying more sealer is not always the best option.



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Stripping Sealers – Chemical and Mechanical

Chemical Stripper Methods
 (Methylene Chloride is NO longer available)

- Caustic
- Solvent
- Bio Chemical



Keys to Sealer Removal

1. Time
2. Active
3. Residue removal

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Final Rule on Regulation of Methylene Chloride in Paint and Coating Removal for Consumer Use

After November 22, 2019, all persons are prohibited from manufacturing (including importing), processing, and distributing in commerce, including distribution to and by retailers, methylene chloride for consumer paint and coating removal. After this date, methylene chloride for paint and coating removal cannot be available for purchase by consumers.



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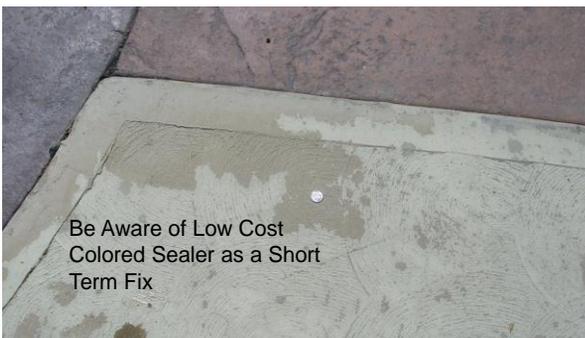
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When Installed Properly, Concrete for a Lifetime

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Thank You!

Any Questions?

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