Introduction to Exposed Aggregate Concrete

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What is Concrete:

- Prepared from Aggregate + cement + water
- Easy to use
- Available
- Structural
- Durable
- Iow cost

Decorative concrete:

- What?
- an aesthetic enhancement to a structure, while keeping Structural properties.
- How?
- decorative concrete is achieved through the use of a variety of materials that may be applied during the pouring process or after the concrete is cured

History:

• between 1890 to 1920 The L.M. Scofield Company was the first evercompany to make a mark by manufacturing colors for concrete.

Renowned people like Mary Pickford, Groucho Marx, Charlie Chaplin and many others used the products of Scofield to build their homes

Types of decorative concrete

- Stamped concrete
- Stained concrete
- Concrete countertops
- Polished concrete
- Exposed aggregate concrete

Exposed Aggregate

It is exposing aggregate that in concrete.

Properties:

- Natural
- Elegant
- Strong; even more than plain concrete
- Long lasting
- Natural appearance

1-High pressure water jet:

- Combination of water and air to expose aggregate.
- Application time should properly be determined.
- Minimum compressive strength 10.3MPa
- Could be used with out surface retard

2-Acid wash:

- Washing face with Acid solution.
- Using aggregate acid resistance like Quartz and granite, not Dolomite, Marble, or Limestone.
- paste removal, color and appearance depend on concrete age
- Concrete age should be 14 days and 20.1 MPa of strength
- Not used for vertical cast-in-place

3-Abrasive Blasting or Sand blasting:

- Make the color uniform.
- Form-joint tightness is important in abrasion treatment

Sandblasting Degrees:

- Brush
- Light
- Medium
- Heavy

Surface retarders for Abrasive blasting

- Can be used in conjunction with medium and heavy texture to reduce Blasting time and lessen the abrasion on softer aggregate.
- Blasting is usually during first 24 72 hrs.
- Minimum strength 13.8MPa.
- Materials used for abrasive blasting include silica sand, aluminum carbide,
- Black slag particles, and walnut shells.

4- Tooling or other mechanical treatment:

can be performed in several methods:

- Bush Hammering
- Grinding
- Manual treatment

Application:

An exposed aggregate finish is ideal for most flatwork including:

- Sidewalks
- Driveways
- Patios
- Pool deck
- Plazas

Application

An exposed-aggregate finish is also possible on concrete walls or tilt-up panels. Vertical applications include:

- Decorative retaining walls
- Architectural building facades
- Sound barrier walls

Advantages:

- Highly decorative effects at a reasonable cost
- Very few additional materials are needed. Some decorative aggregates, a
- Surface retardant and sprayer, and a garden hose
- Easy to master quickly
- Surface is strong, , nonskid, and resistant to heavy traffic and weather extremes and handles all kinds of extreme weather.
- Aggregates are available, large and small, colored, round, plus many more.
- Highly versatile
- Require very little maintenance other than occasional cleaning with water and re-sealing every few years

Disadvantages:

- Movement of heavy objects and water damages can
- dislodge or loosen the stones close to the surface to create small pits therein.
- Repairing a part of such floor is more difficult, compared to repairing cracks in concrete floors.
- Cleaning exposed aggregate is certainly more difficult than cleaning of concrete slab that can be hosed off.
- Whether you have exposed aggregate surface on the walkway, driveway or patio, it needs sealing once in two years to enhance its life andstrength.

Exposed aggregate concrete maintenance is difficult

Surface retarder

- Used to retard setting in the top of the concrete.
- Minimum concrete strength before placing retarder is (6.9 to 10.3)MPa
- In vertical surfaces you have to ensure the uniformity of vertical strength result

Joints will enhance durability of the pavement.

1-Construction joints:

- Placed vertically or horizontally.
- They have to be designed adequately to allow displacement between the sides in the slabs and to transfer flexural stresses in the slab by external loads.

2- Expansion joint:

- Expansion joints are allowing expansion and contraction movement due to
- concrete volume change without damaging the concrete slab.
- It is a function of time.
- Slabs longer than 45m needed one or more expansion joints.

3-Contraction Joints

- Contraction joint also known as "shrinkage joints".
- Sawed, formed, or tooled groove in a concrete slab that creates a weakened vertical plane.
- Placed generally between 1/4 1/3 the depth of the slab and typically spaced every 3.1 15m

4- Isolation joint:

- Isolation joint formation is to isolate concrete slab from any other element like walls, columns and drainpipe.
- Expansion joints are defined as full- depth, full-width joints placed at regular intervals of 50 to 500 ft (15 to150m) (with contraction joints in between).

Old methodology.

 Expansion joints not necessary to be done if contraction and construction joints well designed.

Pavement expansion joints are only needed when:

- The pavement is divided into long panels (60 ft (18m) or more) without contraction joints in-between.
- The pavement is constructed while ambient temperatures are below 40°F (4°C).
- The contraction joints are allowed to be infiltrated by large incompressible materials.
- The pavement is constructed of materials that in the past have shown high expansion characteristics. In most situations, these criteria do not apply. Therefore, expansion joints should not normally be used.

Joint fillers and sealant:

- Prevent moisture passing through construction and contraction joints.
- When joint is available it will enhance durability of the pavement.
- Any concrete structure that is going to require numerous movement joints is best designed by a civil or structural engineer

Curing at joints:

- Joints need curing to gain maximum strength of concrete in the edges and reduce possibility of curling.
- Joints can be cured adequately by wet curing or moisture retaining covering.

Materials for Concrete Joints:

1- Flexible board:

- Fibrous
- Compressible
- Flexible board
- Cheap
- Readily available from Builders & merchants in pre-cut strips of the required depth
- It is typically 12mm, 20mm or 25mm Thick and the right thickness for the joint should be chosen.
- No joint should be wider than 30mm.

Materials for Concrete Joints:

2- Dowels:

 400-600mm long, 20-32mm in diameter and manufactured from Grade 250 steel.

Joint sealant materials

Table-1: Joint sealant for water retaining structures and water tight structures

Structure for retaining / excluding	Type of joint	Type of joint sealant
Sewage	All joints	Polyurethane based
Other than sewage	Expansion joint	Polyurethane based or Polysulphide based
	Horizontal joints other than expansion joints	Hot applied bitumen rubber, Polysulphide based or polyurethane based
	Vertical and inclined joints other than expansion joints	Polysulphide based, polyurethane based or cold-applied bitumen rubber

Selection of Aggregate

Aggregates used in Exposed aggregate:

- River Rock
- Quartz
- Granite
- Trap rock
- Limestone
- Marble

Main factors to be considered in aggregate selection

Color

- Hardness
- Size and gradation.
- Shape
- Method of exposure
- Durability
- Cost and availability (Generally, local products are more economical)

Sealer usages

- Minimize effect of industrial chemical matters in the air and the Effects of carbonation.
- Improves appearance and reduce darkening when wetted.
- Blocks U.V. rays that cause fading
- Reduces mold/mildew infiltration
- Increases service life of the surface and facilitate cleaning.
- Stabilizes the foundation
- Minimizes damages from water and freezing

1- Penetrating sealers:

- Use on exterior concrete provide good chemical resistance.
- Natural matte finish does not leave sheen.
- Non -yellowing and most are breathable.

2- Film forming sealer:

. ACRYLICS:

- Can be used on both interior and exterior concrete
- Enhance the beauty of colored, stained, stamped or exposed aggregate concrete
- Fast drying will usually dry to the touch within an hour
- Come in different sheen levels, solvent based usually enhance color better than water based

2- Film forming sealer:

- II- POLYURETHANES :
- Use on both interior and exterior concrete
- Very good on floors with high traffic areas
- Provide resistant to scuffs and staining
- Enhances the beauty of all decorative concrete
- Use on concrete countertops
- Finish is transparent and non-yellowing with a range of sheen levels

2- Film forming sealer:

III- EPOXIES :

- Use on floors with high traffic areas
- Use on cement overlays
- Use on concrete countertops
- Most are two component products mixed before application

2- Film forming sealer:

- IV- DENSIFIERS & amp; HARDENERS -
- Dust proofs concrete surfaces
- Repels water, oil, and many other chemicals
- Use on new or existing concrete floors
- D. Reduces tire marking

Selecting right sealer

Before selecting any sealer, you have to answer these questions to select the best sealer for your decorative concrete:

- What type of concrete you have?
- In which weather your concrete place?
- Is color important to you?
- The appearance of your demanded concrete? Sheen, glossy, or dark....
- And any other questions asked by the supplier.

Reasons for curing:

- To sum up the advantages of careful control of moisture and temperature in curing:
- The strength of concrete increases with age if curing conditions are favorable. Compressive strength of properly cured concrete is 80 to
- 100 per cent greater than the strength of concrete which has not been cured at all.
- Properly cured concrete surfaces wear well.
- Drying, shrinkage, cracking is reduced.
- Greater water tightness of constructions is assured.

Important points in curing:

- Start curing operations as soon as possible after concrete has been placed.
- For proper curing concrete needs moisture.
- Continuity in curing is a must; alterations of wetting and drying promote the development of cracking.
- If during curing the concrete is allowed to dry out as may happen in hot weather
- The chemical stops right at the point where the concrete loses its moisture.

Important points in curing:

- The ideal curing temperature is 23°C.
- Cure concrete for at least 7 days.
- The vicious cycle in inadequate curing must be obvious. If enough water evaporates from the concrete before it has attained its maximum strength, there will not be sufficient water remaining in the concrete to fully hydrate the cement and so achieve that maximum strength.

1- In-Form- curing:

- Form-curing is a good method for concrete curing, when wood forms are used.
- Keep wood forms moist by sprinkling, especially during hot, dry weather.
- The form surfaces should be sealed with non-vapor transmitting coating to prevent staining. One of the shortcomings of this method increases the possibilities of color variations, and this occurs may be due to: water absorption by the form, wood staining, new versus old forms, from leakage, or temperature variations.

2- Moist curing:

- Ensure the used material is not making stains and blotches on its surface or changing texture.
- If w/c <0.4 use water temp. not vary by ±20F (±11 o c) from the surface temp.</p>
- Avoid conveying water from iron or steel pipe to avoid staining and blotching.
- For irregular and complex shapes you can use plastic sheet.

3- Membrane curing:

- In this method wet concrete covered by water proof compounds for 7 seven days, which prevent evaporation of water.
- No need for constant supervision.
- Colorless material should be used

4- Hot weather curing:

 Special curing compounds have to be used in hot, windy and desert-type environment, with taking care about the type of the curing compound not making stains.

Air:

- Entrained air is introduced as part of the mix design by the quality assured concrete supplier.
- Air contributes approximately 4-6% by volume of a concrete mix
- A further percentage can be entrapped as a result of the mixing process.

Acid etching

- Etching is the process where diluted acid is applied to the concrete to remove excess cement paste from the aggregate.
- Gives a more uniform appearance over the surface.
- This can be undertaken as early as three days after the concrete has been poured and up to three weeks later.