R&T UPDATE
Concrete Pavement Research & Technology

INCORPORATING COLORED CROSSWALKS IN CONCRETE PAVEMENTS

The use of decorative concrete has increased dramatically in the last few years, especially for urban streetscape programs intended to revitalize downtown areas in small- and medium-sized towns and cities. A common location for decorative (stamped and/or colored) concrete in roadway pavements is at crosswalks. The colored concrete can help serve as a pavement marking if the standard white stripes identifying the crosswalk wear off. The colored crosswalk still alerts pedestrians and motorists of the crossing, making for safer pedestrian/vehicle intersections.

Decorative Concrete Basics

Many colors and textures are available to enhance the appearance of a concrete surface, often providing a cost-effective simulation of natural stone, brick, or other materials. Integrally colored concrete is made by adding mineral oxide pigments to concretes made with portland cement. The concrete aggregates, particularly fine aggregate, must be carefully selected to enhance the color effect.

The amount of coloring material added should not exceed 10% by weight of the cement, because larger amounts of pigment may excessively reduce the concrete strength. Strong color can usually be produced with less than 10% addition of pigment. Different color intensities are achieved by varying the amount of coloring material or by mixing two or more pigments. Red, tan, dark gray, and other hues are produced very satisfactorily using normal cement. However, avoid admixtures that contain calcium chloride since it can cause discoloration.

Variations in the components of the concrete mix make color formulas approximate. Experiment with trial mixes for best results. After a basic color is selected, the exact shade may be determined by preparing a number of small panels and varying the ratio of pigment to cement. Once the desired shade is selected, be sure to use the same materials and proportions in all of the actual work. To properly evaluate panels, store them for about five days under conditions similar to the jobsite. Panels will be darker when damp than when dry.

Coloring Materials

Finely ground iron oxides, either naturally or synthetic, are the most widely used pigments for coloring concrete. Chromium oxide and cobalt oxide usually cost significantly more than iron oxides. Do not use untreated carbon black and lampblack because they are unstable, fade, and reduce air content in the concrete. Pigments should meet quality standards of ASTM C 979.

- For BROWNS, use brown iron oxide
- For TANS, use yellow iron oxide
- For REDS, use red iron oxide
- For GREENS, use chromium oxide
- For BLUES, use cobalt oxide
- For GRAY or SLATE, use black iron oxide

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Some manufacturers supply pigments in pure oxide form, while others offer pigments combined with set-controlling and water-reducing admixtures. Pigments are also available in liquid form and can be added at the ready mix plant or at the job site when the specifications permit. It is important to follow the manufacturer's recommendations, especially when mixing various colors.

Powdered, dry shake colors have also been used to color concrete surfaces, particularly in combination with stamped textures to give the texture some definition and contrast. However, dry shake color alone is not recommended for vehicular pavements – to maintain consistent color, use integral color due to the potential for abrasion of the surface.

Crosswalks

Typically, the different colors and patterns of a stamped and colored crosswalk are placed in different stages to separate the colors and textures. Incorporating stamped and colored crosswalks into concrete pavements is not difficult, but in order to design and construct this area correctly, you need to follow a few simple steps.

First, identify the need to have each pattern placed separately. Consider placing the crosswalk integrally with the rest of the concrete pavement, with blockouts to define the colored areas. Within a stretch of approximately 10 feet (3 m) of pavement (typical crosswalk widths are 6-10 feet [2-3 m]), there could possibly be up to four construction joints.

If separate pours are required for the decorative design, decide in your jointing plan whether to tie or dowel the crosswalk to the surrounding pavement. If there is no separate border as in Figure 1, the jointing plan is made simpler. If a border section is required as in Figure 2, one successful method is to tie the border section to the crosswalk or to the pavement with tiebars, and then dowel the other side of the border into the adjacent pavement or crosswalk (Figures 3 through 5). Use the same dowel and tiebar sizing requirements as you would for standard pavement design. Do use tiebars on both sides of a border – this will restrain the movement of the joints and will likely cause cracking.

The width of the border should be at least 16 in. (400 mm), or wide enough to accommodate the tiebars and/or dowel bars. The borders should have more joints along their length than in the surrounding pavement; try to keep the aspect ratio (length to width) of the panels in the border portion around 2.0 if possible. For regions of the country that receive snowfall, a key point when using stamped patterns in an area subject to vehicular traffic is choosing a pattern that is minimally impacted by snowplows. Use a non-aggressive pattern, i.e. one that protrudes only slightly, to avoid breaking or chipping of the stamped concrete surface by snowplow blades.

Figure 1. Different color identifies the crosswalk

Figure 2. Colored crosswalk with stamped brick boundary

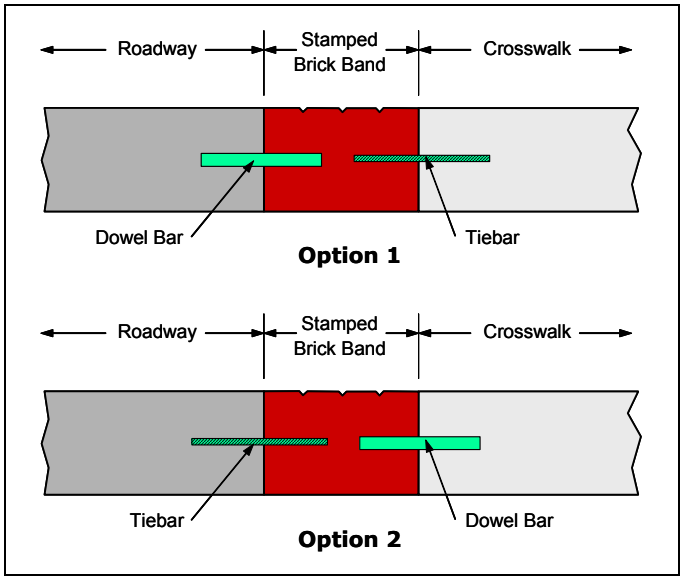

Figure 3. Typical joint details for colored crosswalk with stamped border
NOTE: Minimum border width = 16 in.; offset tiebars & dowel bars in plan

Figure 4. Note dowels in brick edging – edges of crosswalk will function as typical transverse joints

Figure 5. Stamped brick edging cast with tiebars – edges of crosswalk will function as longitudinal joints

Joint Layout

Regardless of which joint detail you select, follow the same steps regarding joint layout as normal. The key steps in joint layout include:

- Calculating maximum slab sizes
  - max. slab length = 24 x T (thickness) on granular subbases; 21 x T on stabilized subbases
  - max. slab width = 14 feet (4.3 m); lane width is typically the slab width
- Doglegging joints near the pavement edge
  - all joints should intersect the edge of pavement at a 90° angle
  - if needed, dogleg the joints within 2-3 feet (0.5-1.0 m) of the pavement edge
- Adjusting joint locations to meet in-pavement structures such as drainage inlets and manholes
  - immovable structures in the pavement will cause cracks to form if joints are not provided
- Avoiding “L-shaped” slabs (interior corners)

A typical joint layout with integral colored crosswalks is shown in Figure 6 on the next page.

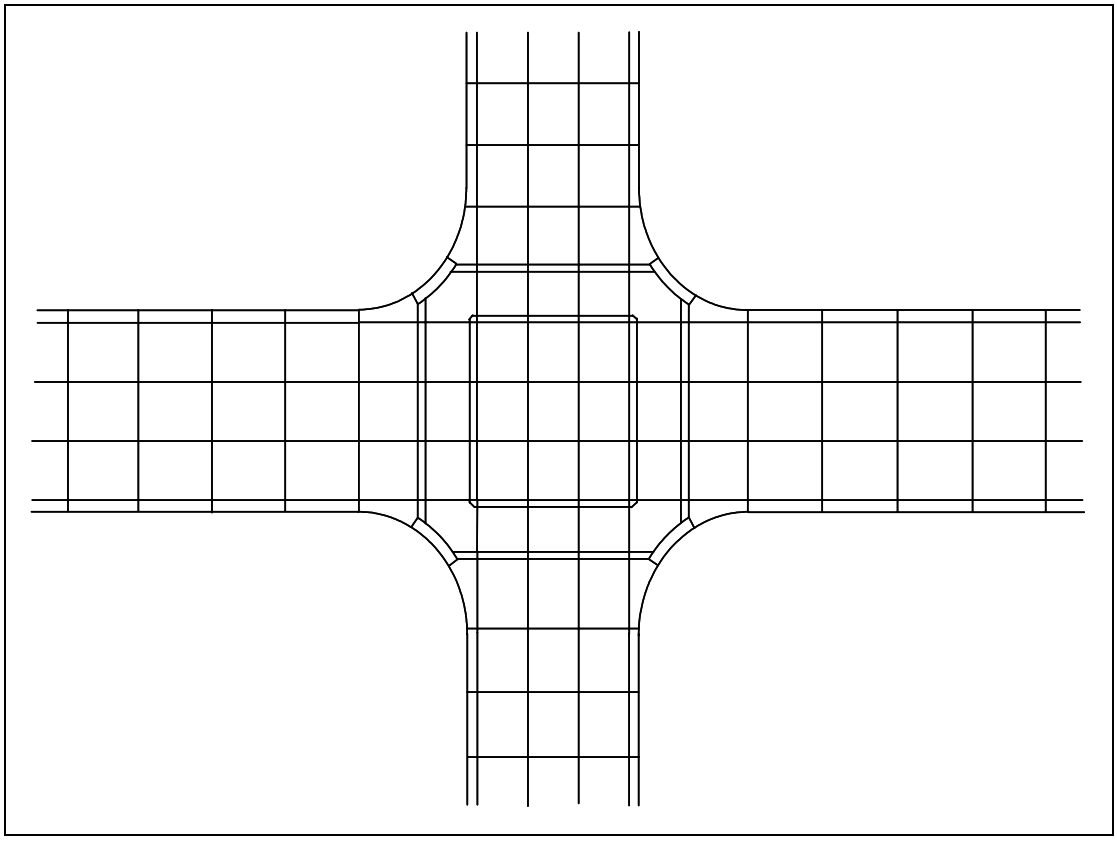

Figure 6. Typical joint layout for colored crosswalk with stamped brick boundary

Construction

The normal precautions for constructing concrete pavements are important for success with colored concrete. Not only must batching, mixing, and placing practices be uniform, but manufacturers and sources of materials must remain constant throughout the project. To maintain color and texture consistency, try to keep the number of construction phases as low as possible.

Many communities require a sample be cast before the work begins as a comparison to the ensuing placements. Areas of shade and sun should be watched carefully, as this can affect the timing of stamping dramatically. The speed of the stamping crew is usually the restraining factor on production.

Clean forms as well as non-staining release agents are vital when using fixed forms in lieu of a slipform paver. Check the pigment manufacturers' recommendations for release agents, and test the curing procedures on a mock-up before construction. Wet curing can affect color adversely, and in most cases membrane-forming curing compounds are more suitable. Plastic sheeting can also be used if there are concerns about white-pigmented curing compound.

References

"Color and Texture in Architectural Concrete," Portland Cement Association, SP012.02A, 1995.

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