

INTEGRALLY COLORED CONCRETE MASONRY UNITS

The National Concrete Masonry Association (NCMA), Herndon, Virginia, publishes TEK treatises as an informational series addressing issues of concrete masonry technology.

It is the intent of the Wisconsin Masonry Alliance (WMA) to further the knowledge of concrete masonry by providing TECH papers as either supplements to the TEK notes or to address subject matter not currently covered. WMATECH papers will communicate pertinent subject matter and best practices, as well as disclose possible misuse of materials or improper applications relevant to concrete masonry design and construction in Wisconsin.

INTRODUCTION

Architectural Concrete Masonry Units (CMUs) may be manufactured with integral coloring to enhance the appearance and provide an enduring finish to masonry structures. A proper understanding of the color composition and the manufacturing process, as well as the benefits and limitations of integrally colored CMUs, can help provide familiarity and assist in meeting satisfactory expectations for the finished masonry assemblage. Recommendations for mortar selection and cleaning of integrally colored CMUs are also provided.

COLORED CONCRETE MASONRY

Predominantly synthetic iron oxides, and to a lesser extent natural inorganic oxides, are utilized for coloring CMUs. These inorganic, mineral oxide pigments are inert, water insoluble, and stable to all atmospheric conditions, ultraviolet rays, alkalis and normal acid conditions. Pulverized into fine particles, and then processed into powder, granular or liquid form, they are added into the cement batch mix. During a mechanical mixing phase,

the pigments are systematically dispersed throughout the cementitious mixture. This mixture is then placed into steel molds where it is formed to the desired CMU configuration. Immediately stripped from the molds, the formed CMUs are subsequently placed into kilns to cure. Upon the cement paste hardening, the impregnate pigments are permanently bonded throughout the CMU substrate. This uniform saturation of colored mineral pigments is what provides the visible chroma to colored CMUs. With a full spectrum of colors available, ranging from soft, earth tones to vivid hues, integrally colored CMUs provide a long lasting, low maintenance, attractive appearance and visual character to masonry structures.

REGULAR, SMOOTH FACED CMUS – UNEVEN COLOR

Regular *smooth* face CMUs have been successfully incorporated as design elements of patterned masonry walls. However, the WCMA does NOT recommend the utilization of *smooth*, integrally colored CMUs for building projects unless merely used for accents or band coursing. If it is determined to incorporate *smooth*, integrally colored CMUs for larger portions of masonry walls, there is a manufacturing peculiarity affecting the color of these units that should be understood by the designer and client-owner in order to avoid possible disappointment in the finished wall's appearance.

After viewing plan elevations or looking at an exemplary rendering illustrated in color, an owner may have expectations that the smooth block façades of his building will be similar in appearance to a homogeneous painted or stained wall. Instead, the end result will be wall surfaces possessing diversity of color resulting from the *smooth* CMUs having hue variations within the same color blend.

(Fig. 1)

Block manufacturers go through numerous quality control processes in an attempt to offer a consistent uniform product. However, there is one factor involved in the manufacturing process of *smooth* integrally colored CMU that cannot be precisely controlled. This is the effect of having moving steel in contact with a cement product while in its initial paste condition. This result can be seen when a steel trowel is used to finish cast-in-place concrete; when a steel jointer is utilized to finish mortar joints; and in this case, when the steel molds slide away from forming the CMU during the molding process. What occurs in each of these instances is that as steel moves over the concrete, it draws moisture of the mixture to the surface. This moisture movement draws additional coloring pigments, which impacts the colored surface appearance. While CMUs are manufactured relatively dry and are not in a true paste condition, enough water has to be added to the concrete mixture to cause a 'slick' to form on the surface of the CMUs. This troweling action of the steel mold and the formation of a slick will result in color variation within individual CMUs. When these units are laid in the wall, the finished wall's appearance will not convey uniformity of color, and may be disappointing or unacceptable to the client-owner.

If it is still desirable to design a project incorporating a major portion of integrally colored *smooth* faced CMUs, a provision should be provided in the original bid for painting these CMUs with a coordinated semi-transparent, masonry stain of the same color. This will blend the variations in color into a more homogeneous finished wall appearance. Prior to the actual staining, if the *smooth* block wall is acceptable to the client as installed, then moneys can be returned to a satisfied owner at the end of the project.

ARCHITECTURAL CMUS – SATISFACTORY COLOR

Split Faced Units

As previously discussed, a steel induced slick occurs on the outside smooth face of CMUs during the molding process resulting in a noticeable color variation within individual units. Despite this limitation, a uniform consistency of color may be obtained when utilizing a variety of split or exposed faced, architectural CMUs.

Many architectural CMUs are molded together in pairs, face-to-face. After the curing process is complete, these conjoined CMUs are mechanically split apart, forming one of several architectural face patterns. The newly exposed split face of the CMU – material untouched by steel – having uniform saturation of pigments, renders a



Figure 1 – Examples of SMOOTH Colored CMU Walls

suitably, consistent uniform color. It should be noted that in splitting the units open, the aggregate utilized in the cementitious mixture is also fractured and visible on the split face surface. The aggregate and the color pigments together combine to render the resulting finished color of the CMU. (Fig. 2a)

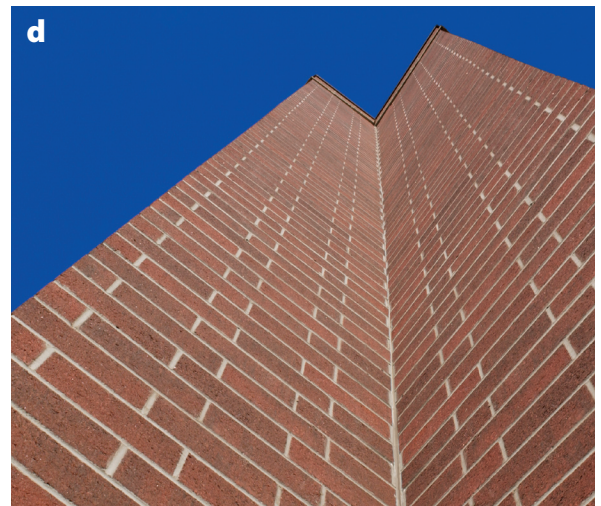
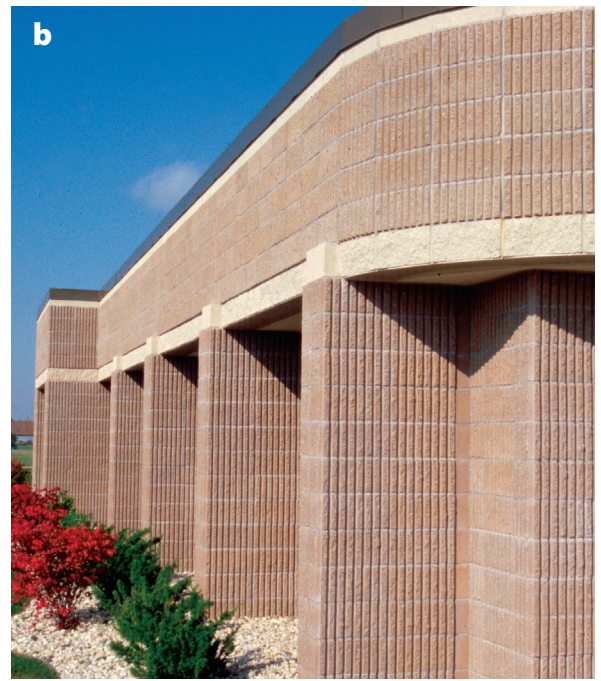
Various split face patterns are available by the addition of scores, offsetting the splitting planes and creating flutes and ribs. Each of these integrally colored, architectural CMUs has been utilized on a multitude of projects with successful aesthetic results. (Fig. 2b)

Exposed or Ground Faced Units

Another means of rendering architectural units with consistent color is to grind or sandblast the face of the individually cast units. By removing the surface color inconsistency resulting from the steel induced slick, the interior of the CMU is exposed, revealing uniform color. (Fig. 2c)

SMOOTH & STRIATED FACED – BLENDED COLORS

Yet another means of rendering architectural units with consistent color is to purposefully provide smooth units with varying color. Blending two or more colors together in the mix or impregnating the surface of the CMU with a random application of color renders purposely-variegated color. Great success has been accomplished using this process in manufacturing smooth and striated faced concrete brick, half-high and full high CMUs. (Fig. 2d)



- (a) Split Face
- (b) Scored Split Face
- (c) Ground Faced
- (d) Blended Smooth Face

Figure 2 – Examples of ARCHITECTURAL Colored CMUs

MATCHING MORTAR COLOR – RECOMMENDED

Inherent with all types of masonry construction is the problem of mortar soiling. During the placement of the masonry units, i.e. brick, stone, block etc. the walls will unavoidably become grimed with the occasional mortar droppings, splatters, or smears. **(Fig. 3a)**

To lessen the impact of incidental mortar soiling on colored CMUs, the same or closely matching color pigments should also be incorporated into the mortar mix. As opposed to the use of natural gray or a contrasting color, a matching mortar color will render minor mortar soiling nearly imperceptible and provide a much cleaner appearing wall. **(Fig. 3b)**



Figure 3 – Mortar Coloring

- (a) Contrasting Mortar Color
- (b) Matching Mortar Color

CLEANING COLORED CONCRETE MASONRY

With certain types of masonry, construction dirt, efflorescence and mortar soiling may effectively be removed with a harsh acid washing or a vigorous high-pressure water cleaning. Either of these processes is particularly detrimental to integrally colored CMUs. Both processes, one involving chemical etching and the other power blasting to remove the grime, will also forcibly remove the impregnate color from the CMU substrate. This loss of coloring pigment will result in altering the color appearance, typically to a lighter hue.

Considerable care should be used when attempting to clean integrally colored CMUs. First and foremost, every attempt should be made to keep the wall as clean as possible during construction. Mortar soiling should be removed at the end of each day. As construction progresses, once the mortar joints have set, a synthetic wire brush and water may be used to clean smears. Steel scrapers or a piece of scrap block the same color may be utilized to remove hardened globules and chunks.

If a colored CMU wall requires cleaning, strong acids, acid washes or chemicals with a strong acid reaction should be strictly prohibited. Detergent masonry solutions such as brand names, “Sure Klean® Vanatrol®”, Custom Masonry

Cleaner® or “EaCo Chem NMD 80” may be employed, but the manufacturer’s directions of use must be explicitly followed. When utilizing any detergent masonry cleaner, a thorough pre-wetting and continued water irrigation is critical, as the walls should never dry out during the cleaning process.

High pressure washing may also be applied to clean dirt and soiling, but parameters should be set limiting the pressure to no more than 800-1,000 pound per square inch to prevent potential detrimental effects. Higher pressures may alter the color and impregnate excessive water into the masonry wall, which could result in the occurrence of efflorescence.

Typically, if only a small area of wall requires cleaning, the entire adjoining wall plane must also be cleaned for uniformity of appearance. Always utilize a test patch prior to a full-scale cleaning operation. Clean a portion of the sample wall panel if one was constructed for the project. If not, test an obscured area of the wall. Allow the test panel to thoroughly dry before evaluating the results.

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